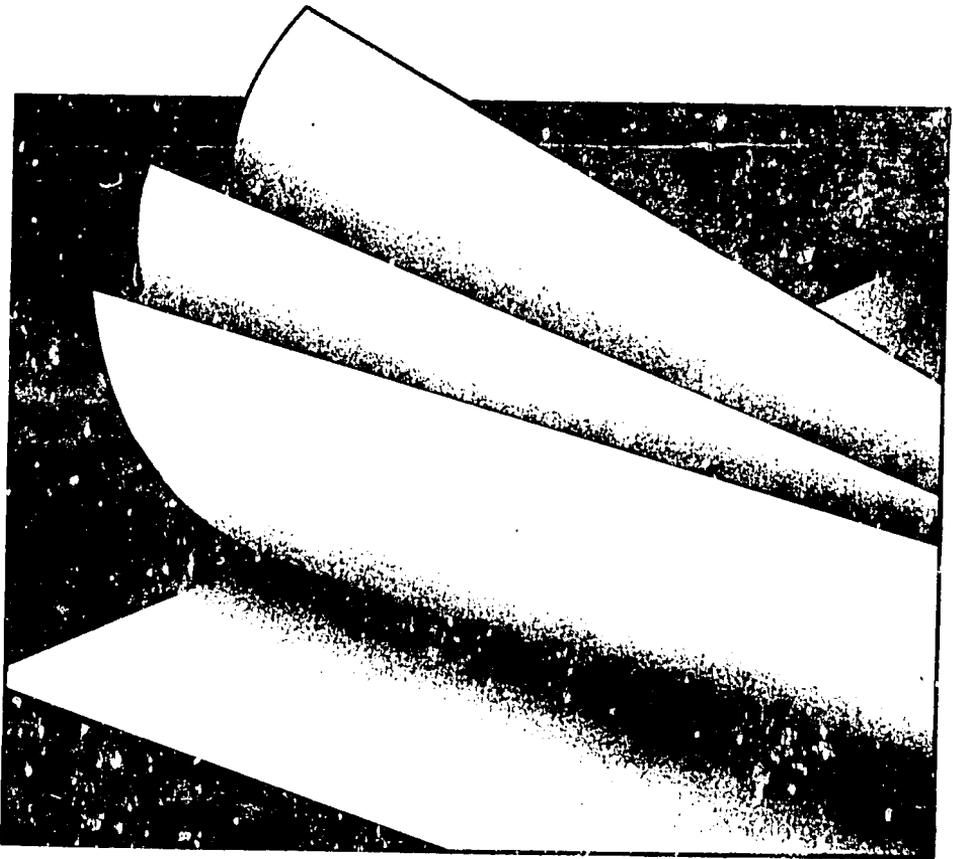


Acceptability and nutritional quality of common beans (*Phaseolus vulgaris* L.)

A bibliography



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**Acceptability and nutritional quality of
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A bibliography

**Leonardo René Lareo
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Comps.**



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INTRODUCTION

The importance of common beans as a dietary protein source in the tropics is well known. Several factors, however, restrict nutritional quality or consumer acceptability of beans, and important research efforts are presently trying to understand and overcome these constraints.

In October 1988, food technologists and nutritionists from the whole world gathered at CIAT to discuss "Bean Quality and Nutritional Aspects." Among their conclusions, they expressed the need of bringing together the scattered information on the subject, to help focus research on it and to facilitate a more efficient use of the resources involved. The present bibliography and the short literature review which leads into it are intended to contribute to meeting such a need.

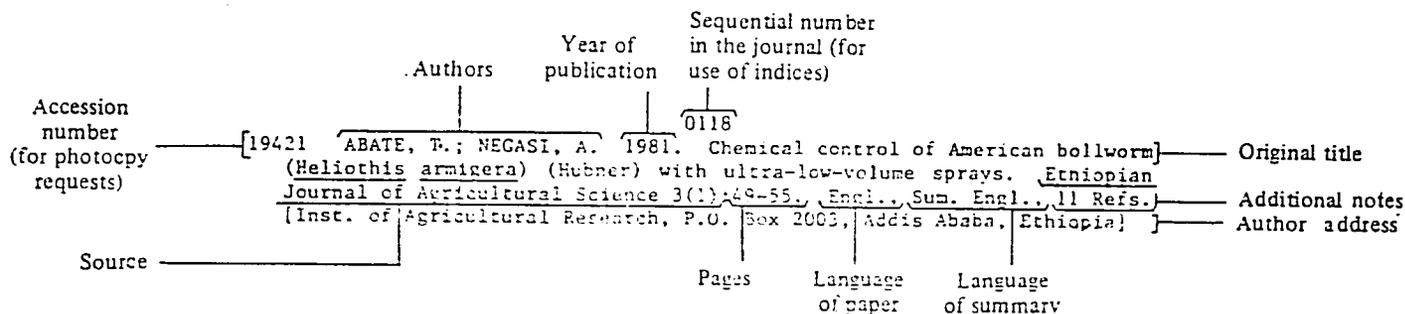
This bibliography will be expanded and up-dated in the future. For this, the help of readers in pointing out missing entries and in providing articles and documents to be included in the collection and database of the Bean Information Center will be greatly appreciated.

ORGANIZATION

The bibliography compiles 614 references organized by discipline, by year (in ascending chronological order), and alphabetically by author within the same year. Abstracts of the corresponding documents are also provided.

For easier consultation, author and subject indexes are provided. Authors and co-authors are listed in the author index, in alphabetical order. Numbers below each author's name refer to the consecutive number of the corresponding reference in the bibliography. The subject index presents an alphabetical list of descriptors, which are accompanied by the consecutive numbers of the relevant references; many descriptors are combined with others to allow for the identification of more specific topics. A list of the abbreviations and acronyms used in the abstracts and bibliographic references is also included.

COMPONENTS OF AN ABSTRACT



Phaseolus vulgaris. Injurious insects. Lepidoptera. Heliothis armigera.
Insect control. Chemical control. Ethiopia. } Descriptors

Expt. consisting of ultralow vol. formulations of endosulfan (500 and 750 g a.i./ha), cypermethrin (150 g a.i./ha), fenitrothion (960 g a.i./ha), profenofos (750 g a.i./ha), and an untreated check were conducted for 2 consecutive yr against Heliothis armigera on haricot beans at the Awassa and Nazareth Expt. Stations of the Institute of Agricultural Research (IAR), Ethiopia. The treatments were replicated 5 times in a randomized complete block design on 20 x 20 m plots. Of the insecticides used, single application of cypermethrin gave a more consistent and significant control than the check in both seasons at both stations. A new product, cypermethrin/profenofos 166^R, substituted for fenitrothion at Nazareth in the 1980 season, gave promising results to warrant further testing. Endosulfan, a recommended insecticide against the American bollworm in the past, was not as satisfactory as cypermethrin in its control of H. armigera on haricot beans. [AS] } Abstract

|
Abstractor
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AVAILABILITY OF DOCUMENTS

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ACCEPTABILITY PARAMETERS AND NUTRITIONAL QUALITY OF COMMON BEANS (*Phaseolus vulgaris* L.)

L. R. Larco*

Introduction

Common beans (*Phaseolus vulgaris* L.), one of the 13,000 leguminosae species, have been selected as a natural protein source from the beginning of time. The exact place of origin of common cultivated beans has not been determined, but it is evident that it belongs to the American continent. In Mexico, beans were found to have been cultivated between 4300 and 7000 before present and between 1000 and 2300 in the southwestern United States (Gentry, 1969). Some studies report that early beans were cultivated in the intermountain Peruvian valley of Callejón de Huaylas between 7700 and 10,000 before present (Kaplan et al., 1973). In the Old World, *Phaseolus vulgaris* was not known with certainty until post-Columbian times. The Freijhoff study, one of the oldest in Europe, reports beans in the diets of boarding schools during the academic year 1770/71. In Molsheim, France, the daily menu included at least 17 grams of white beans (Freijhoff and Julia, 1975). Currently, beans constitute the main source of supplementary protein in the diets of large segments of Latin American and African populations. To increase consumption and obtain varieties that are nutritionally more adequate and better accepted by consumers, more knowledge is required about the positive (high protein content) and limiting factors of beans. Antiphysiological parameters (low digestibility and flatulence factors) and physical characteristics of beans should also be studied because of their importance in determining acceptability by consumers.

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This paper attempts to summarize the increasing volume of literature on nutritional and acceptability aspects. For the purpose of this document, these have been divided into nutritional quality and acceptability parameters, noting that this is only an academic division, since they are closely interrelated.

Nutritional Aspects

Proteins

The great majority of samples reported in the literature have given crude protein ($N \times 6.25$) values ranging from 16%-30% (dry base matter, DBM) (0170, 0173, 0174, 0176, 0178, 0186**). This same range has been found at CIAT, in the Bean Nutrition and Quality Laboratory, for the 2000 samples studied (1983-1988). This value is strongly affected by environmental conditions. The same genotypes give statistically different values in different agroclimatic conditions. Concepts on heritability of this character are still controversial, mainly because of its apparently multigenic character (0223). Some variability has been found for protein content as related to seed position in the pod and pod position in the plant, but these are minor variabilities when compared with intervarietal differences or with interplant variabilities for the same material (0179).

Seed proteins of common beans have five main fractions: phaseolin (36%-46% by weight), globulin-2 (5%-12%), albumin (12%-16%), prolamine (2%-4%), and an alkali-soluble fraction (20%-30%) (0173, 0178). The main storage protein of bean seeds is phaseolin, also called glycoprotein II, vicilin, and globulin-1. The amino acid pattern of dry bean proteins is generally characterized by their deficiency in sulfur amino acids and tryptophan (0143, 0147). Table 1 summarizes data collected from more than 100 reports where comparable methodologies were used. This summary permits a comparison with samples analyzed in different laboratories and includes very comprehensive data on the composition of amino acids, making the data statistically representative and reliable.

More collaborative research in this field is still needed. Amino acid content is affected by the environment (0159, 0164). Knowledge is lacking on the heritability of amino acid composition; only some reports are available on sulfur amino acids, specifically on inheritance and heritability of methionine levels (0147). The effects of bean storage and processing on

(**) Numbers in parentheses refer to entries in the bibliography which follows this work.

this composition also require more research; existing studies are scarce and differences in methodologies used do not provide for comparisons or generalizations. Studies have paid particular attention to bean phaseolin. It contains 37.6% acidic residues and amides, 13.7% basic residues, about 1% sulfur-containing residues, 1% glucosamine, 0.35% xylose, and 3.2% mannose (0238, 0239, 0242).

Other proteins

Other bean proteins which have been isolated and characterized include protease inhibitors and phytohaemagglutinins (PHA or lectins) (0270, 0380). Protease inhibitors have attracted the attention of nutritional scientists because of their functions in inhibiting proteolytic enzymes during protein digestion (0321). Trypsin inhibitors isolated from dry beans are chemically quite similar to one another. Most are able to inhibit both trypsin and chymotrypsin simultaneously (0324, 0332). Some inhibitors isolated were found to be a glycoprotein. Since some bean varieties are not greatly improved in quality by heating, which usually destroys trypsin inhibitors, concentration of inhibitors and their activities are apparently variable (0330, 0331). Lectins or PHA are glycoproteins consisting of a number of subunits (0354). Lectin proteins contribute greatly to the poor nutritional value of raw beans (0345). Purified bean lectins were toxic when fed to quail, and caused severe intestinal damage to rats (0346, 0357). Cooking legume seeds removes the toxic effects of the lectin proteins and some other inhibitory factors (0374, 0398). Some studies revealed that several common bean lines lacked the agglutination property (0392).

Protein digestibility and quality

Despite the preponderance of globulins, other seed protein fractions are also important determinants of the nutritional value of beans (0255, 0259). Metabolic proteins (albumins) are richer in methionine per unit of nitrogen than storage proteins; seeds containing different proportions of these fractions may vary in the amount of available methionine (0265). The low digestibility of bean proteins is a large barrier to their nutritional quality, in addition to low sulfur-containing amino acids and heat-labile antiphenological factors. Another factor involved in this low digestibility is the normal narrow range for in vitro values (between 76 and 82) (0199, 0200, 0207). The most common factor of those mentioned is tannins or polyphenols (0411, 0414). Some relationships between tannins and low digestibility have been reported, but results largely depend on the methodology used. Polyphenol content is measured as catechin equivalents by some modifica-

tion of the Burns method or by using the Lindt reactive (0410). The relationships are more or less significant, but variabilities are very broad (0412). These methods are well known for their low degree of specificity (0421). When true tannins are evaluated, for example, by removal with polyvinylpolypyrrolidone (PVP), the regression coefficient between the true tannin content and the in vitro digestibility loses significance (0058, 0059). Similar results were obtained when the tannins were reported as procyanidins. If the tannin effect exists, it is not the main factor affecting protein digestibility.

Another factor that has recently gained interest is the protein structure itself. Globulins show very low in vivo and in vitro digestibilities (0195, 0196, 0204, 0210). A factor that has been studied is the structural relationship of proteins with other cell components, such as digestible and undigestible carbohydrates (0117, 0135). No definite reports are known about environmental effects on digestibility. Genetic variance in raw beans is very narrow (0218). At this point, the importance of results obtained with wild *P. vulgaris* accessions is evident. These accessions were found to have greatly reduced amounts of phaseolin (15%-20% of total protein compared to 40%-45% in most cultivated varieties). In addition, preliminary analyses of segregating populations suggest that the reduced phaseolin levels are heritable and that total protein content is not greatly affected (0221, 0223, 0228, 0229, 0230, 0232, 0239). The response of varieties to processing, especially cooking, is different and is related to an increase in digestibility, which varies from 5% to 10% over the digestibility of raw beans.

Lipids

There are few reports on the lipid content of beans, but the values for lipids, expressed as crude fat, are never greater than 5% (DBM) and range from 1% to 5% (0128). However, part of this difference is due to the method used to analyze the lipids, because some pigments are removed together with the lipids. This apparently increases the lipid value, but the degree of contamination is very difficult to evaluate.

Sterols have been reported to increase in concentration during development, but to decrease during maturation (0129). Similar behavior, with peaks during different periods, was found for polar lipids (mono- and diglycerides). Free fatty acids decrease as development and maturation advance and triglycerides increase five days after germination and up to the maturation period. Germinated seeds contained high levels of C20-C22 fatty acids, which decrease after germination, with a concomitant increase

in C16-C18 unsaturated fatty acids. It appears that even the low levels of fat present are sufficient to cause off-flavors in bean extracts.

Carbohydrates

Total carbohydrate content of dry bean ranges from 55% to 65% (DBM). These carbohydrates include mono- and oligosaccharides, starch, and other polysaccharides (0114, 0115). Starch is the most abundant bean carbohydrate and varies from 30% to 58%. Amylose ranges from 10% to 40%, and total soluble sugars from 5% to 10%. Among sugars, oligosaccharides of the raffinose family (raffinose, stachyose, verbascose, and ajugose) predominate and account for a significant percentage (30%-80%) of total sugars. Among these, stachyose accounts for more than 50% of total oligosaccharides (0134).

Only recently has bean starch been studied seriously. One of the inherent difficulties in its study is its heterogeneity (0115). Granule length varies from 10-50 micrometers and width from 10-20 micrometers. Most bean starch granules have greater length than width, but spherical, ovoid, and irregular granules are also found. This variation could be due to genetic control, environmental effect, and stage of maturation (0135). Most bean starches (about 70%) have a very high molecular weight (2×10^6), and the remaining 30% are between this value and 4×10^4 . This clearly implies a high degree of polymerization (1300 monomers) and a limiting viscosity number of 180 ml/g on the average (0130). Water absorption has been found to range from 150% to 290%, but the method used for measuring it is responsible for this variability. Gelatinization studies indicated that bean starches could yield stable gels at concentrations as low as 5% to 7% (weight/volume); gelatinization temperatures range from 65 °C to 75 °C (0135). Results of the hydrolysis of bean starches by porcine pancreatic α -amylase show values from 26% to 35% (compared with 74% for corn starch). Some varietal differences were found in this range; the best substrate was obtained from black bean starch and the worst from pinto bean starch. This suggests that the enzyme may preferentially hydrolyze certain granules or that differences in enzyme susceptibility may exist among granules. It is interesting to point out here the close relationship of the values of the low molecular-weight starches (30%) with the maximum percentage of starches hydrolyzed by amylase (35%). The above results indicate that the factors that control the mode of α -amylase activity are granule size, amylose/amylopectin ratio, degree of crystallinity, and degree of polymerization of the granular components. Some studies in humans suggest that the high temperatures used in processing beans may alter the digestibility of starches.

It was recently demonstrated that tannins apparently have the capacity to bind starch; this would be a factor explaining reduced digestibility (0137).

Flatulence factors

Another important group of carbohydrates are the oligosaccharides of the raffinose family of sugars. They have been identified as one of the important contributors to flatus in humans and experimental animals (0492, 0498). The raffinose family of sugars is not digested by man because the intestinal mucosa lacks the specific galactosidase enzyme, and these sugars are unable to pass through the intestinal wall (0493). The microflora in the lower intestinal tract metabolize these sugars, and large amounts of carbon dioxide and hydrogen, and small amounts of methane, are generated in the process (0495). The varying amounts of the raffinose family of oligosaccharides in different beans may cause different degrees of flatulence, as can be deduced from the variation in micromoles (from 105 to 160) resulting from feeding 3 grams of a diet containing 66.7% beans in a rat bioassay. Flatus formation was affected by the percentage of beans in the diet (0496). Physiological variability in humans is very great. In some studies, flatus produced by navy bean meal ranged from 5 to 465 ml/h, in comparison with 0-28 ml/h for the basal diet. However, removal of these oligosaccharides does not completely eliminate the flatus-producing effect. The active compounds in the bean residue and/or extract that cause flatulence have not yet been identified, but are presumably distinct from the raffinose family of sugars (0498).

Fiber

Fiber is one of the main undigestible components in bean residues and may be involved in the process of fermentation by microorganisms and subsequent flatulence production. Crude fiber is made up of cellulose, hemicellulose, lignin, and pectic and cutin substances. Beans contain between 3% and 8% (DBM) crude fiber. Cellulose is the major component, ranging from 1% to 6%, followed by hemicellulose (0.5% to 5%) and lignin (1% to 3%) (0116). Most crude fiber is present in the testa and accounts for at least 50% of the testa's weight. No significant changes in crude fiber content were found during a six-day germination period. Dietary fiber, polysaccharides, and lignin (all resistant to hydrolysis by the digestive enzymes of man) have been reported to constitute 22.5% of dry matter in cooked beans, expressed as monosaccharides; cellulose by itself contributes 4.2% to this value. The pectin value in raw beans is 2.8% (DBM) (0118, 0122, 0126).

Ash and minerals

Ash content ranges from 3% to 5% (DBM). This component is strongly related to environmental conditions, particularly edaphic factors and fertilization levels (0306). Besides ash, the major mineral components are potassium (close to 1%) and phosphorus (about 0.4%), primarily present in the form of phytic acid, which is associated with one of the most important acceptability parameters, cooking time. Each day there is more evidence supporting the hypothesis that the ratio of monovalent ions (Na + K) to bivalent ions (Ca + Mg) is closely related to cooking time, especially the Ca:Na ratio levels; but again, the enormous variability in the data does not yet permit conclusions. Normally, reports agree that the levels of some minerals are reduced during cooking. Special consideration must be given to iron, because its level (70 mg/kg) does not vary considerably, but its bioavailability is very low. This is due to two factors: ionic form and tannin content (which was recently reported to have a marked effect on iron bioavailability). Perhaps the availability of other minerals may also be reduced by the same chelating mechanisms (0309, 0311).

Vitamins

Only three water-soluble vitamins are relevant in beans, and there is no evidence to claim that beans are a significant source of fat-soluble vitamins. Thiamine, riboflavin, and nicotinic acid contents are 6.7, 1.6, and 21 mg/kg, respectively. Relative stability of these averages was found because data from different laboratories with different varieties showed low variability. No clear data exist for the effects of processing on bean vitamins or environmental effects on this same component (0305).

Overall nutritional quality

Studies with rats on the overall nutritional quality of beans as a sole source of protein showed that biological value ranged from 0.44 to 0.68, with 0.64 as the average (0064). Net protein utilization (NPU) ranged from 0.38 to 0.56, with 0.46 as the average. When the diet was supplemented with different amino acids at different levels, the range changed from 0.47 to 0.74 and the average increased to 0.61. Similar data were obtained for the protein efficiency ratio; the 1.0 average for a nonsupplemented diet increased to 3.0 for a diet supplemented with different amino acids at different levels. However, the most marked effect resulted from supplementation with methionine, in which case the protein efficiency ratio increased from 170%

to 310% (0094, 0097).

All these data on beans as the sole source of protein are more of academic importance because obviously the human diet includes many other components. In fact, cereal-bean or cassava-bean based diets are much more important. The percentage of utilizable protein in cereals is known to increase by substituting 10% of the cereal weight with 10% beans (e.g., rice increases from 4.01% to 4.96%, maize from 2.41% to 4.10%, and sorghum from 2.23% to 3.93%) (0085). Instituto de Nutrición de Centroamérica y Panamá studies have shown that the cereal-bean ratio has an important role in increasing protein utilization (0060, 0061, 0062). A 100% maize protein diet has 2.93% protein utilization, while in a 71% maize and 29% bean protein diet, utilization increases to 4.54%, and to 6.26% when the ratio is 51% maize and 49% bean protein. Some varietal differences were found among bean cultivars, but this was due to the amino acid balance for each specific material (0063).

At this point, it is interesting to look back at the history of beans. The close relationship between beans and maize in the indigenous diet of the Mesoamerican and Andean regions is well known. The summary of Moctezuma's annual tribute reports maize and beans to constitute 60% of the tribute. In the Codex Matricula of Tributes and the Codes Mendocinus, reference is made to 7000 tons of maize and 5000 of beans paid by the Aztecs as annual tribute.

Acceptability Aspects

This section discusses the parameters determining consumer acceptance of varieties existing in different bean-consuming regions. These are usually visual parameters, such as grain color, shape, and brilliance. Other criteria are also important, such as percentage of water absorption (associated with the hard-seed or hard-shell phenomenon, since hard seeds take a long time to absorb water) and cooking time (significant from a nutritional point of view and because it affects the cost of energy for cooking). These two parameters are normally associated with grain freshness. Consumers have developed empirical but obvious methods to determine freshness in raw seed. In Central America, the sound of a grain when dropped on a solid surface is considered indicative of its freshness. In addition, the resistance of the grain to penetration by a fingernail or breaking between the teeth is another indication. The primary aspects of cooked beans considered by consumers in accepting a variety include soluble solids in the broth (measured as the percentage of solid matter in the broth), color and flavor

of broth and grains, and grain texture.

The relative importance of each of these parameters depends on the consumer's habits and is associated with ecogeographical locations. These differences make the study of acceptability parameters very difficult and become even more complex when considering the landscape of bean-growing areas and the effect of varietal and environmental differences on freshness and performance during storage.

Color

Voysset (1983) conducted a most comprehensive study on consumer color preferences in Latin America. A very simplified overview shows that small red and black materials are preferred in Central America, big reds in the Antilles, and medium-sized blacks, yellows, and creams in Mexico. Preferences are more complex in South America mainly because of the multiple ecological regions existing in each country (0485, 0486).

Size

The simplest size stratification is by weight; the smallest seeds weigh less than 25 grams per 100 seeds, the medium-sized ones are between 25 and 40 grams, and the large are those over 40 grams. Size preferences are also multiple in Latin America and are usually independent of shape (0457).

Shape

No clear regional preference in relation to shape was determined. The basic shape classification includes round, oblong, and kidney-shaped seeds. In some special cases, there is color-shape association.

Brilliance

This parameter includes brilliant, semibrilliant, and opaque materials and is a rather subjective classification, especially with the semibrilliant category. Brilliance is considered to be indicative of seed freshness (0466).

Water absorption

This parameter, related to freshness, is measured as the capacity of seed to imbibe water overnight. In some countries, this is not considered important, while in other regions the increase in volume after soaking is a

major acceptance parameter. Water absorption has been thought to be related to the hard-to-cook phenomenon, but recent findings indicate that these are independent variables. Varietal differences in bean freshness imply the possibility of genetic control. Recently, similar varietal behavior has been determined for developing impermeability during storage (0452, 0454, 0459).

Cooking time

Several methods exist for measuring this parameter, but one of the most reliable and sensitive is the Mattson Bean Cooker (0534, 0536). With any of the methods, the effect of varietal differences, grain freshness, or storage time is clearly demonstrated (0537, 0547, 0548). Environmental conditions also affect this parameter. In developing countries having pressure cookers, this parameter has become meaningless, but in other parts of the world, such as Africa, where traditional cooking systems are used and energy shortages are common, cooking time is an important parameter. In any case, long cooking times are undesirable from the nutritional point of view (0538, 0544, 0549, 0550, 0551).

In a few regions, acceptability parameters such as seed-coat thickness and percentage of seed coat are occasionally mentioned. There are also other acceptability parameters that have not yet been understood or studied.

All of this clearly shows that beans are a potential source of major nutrients, but difficult-to-solve constraints related to protein and starch digestibilities reduce their full nutritional potential. It is also evident that the existence of such an enormous number of acceptability characteristics reduces the possibility for a specific variety to become popular in the market in spite of its possible highly desirable nutritional qualities. Finding an equilibrium between acceptability parameters and nutritional aspects is a goal for all bean researchers, and it needs to be associated with varietal resistances to limiting factors, high yield potential, and other favorable agronomic characteristics. It is a delicate job for this delicate and delicious dish, beans.

Table 1. Amino acid composition of common bean (*Phaseolus vulgaris*) proteins.

Amino acid	Number of samples	Average in mg/g of N	Standard deviation	Skewness
Alanine	129	246	32	-0.500
Arginine	137	393	52	3.241
Asparagine	129	716	106	-0.294
Cystine	186	53	26	0.681
Glutamine	129	943	150	-0.344
Glycine	129	223	26	-0.843
Histidine	134	178	35	1.720
Isoleucine	152	473	101	-0.121
Leucine	152	274	80	0.944
Lysine	187	432	63	0.263
Methionine	295	65	16	0.594
Phenylalanine	152	327	62	0.350
Proline	129	265	133	3.921
Serine	129	329	58	1.004
Theorine	155	258	33	0.037
Tryptophan	68	74	27	0.172
Tyrosine	147	173	45	0.428
Valine	155	302	71	-0.576

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GENERAL ASPECTS (Consumption, Research Origin)

0001

3526 TANDON, O.B. et al. Nutrients in Central American beans. *Agricultural and Food Chemistry* 5(2):137-142. 1957. En., Sum. En. 21 Ref.

Phaseolus vulgaris. Protein content. Methionine. Lysine. Tryptophane, Thiamin. Nicotinic acid. Riboflavin. Amino acids. N. Cultivars. Analysis. Nutritive value. Guatemala. Central America.

The content of nitrogen, met., lysine, tryptophan, niacin, thiamine, and riboflavin was determined in 25 bean varieties grown in two different locations in Guatemala. Yield data on these varieties in the two locations were obtained for two different plantings. Yield ranged from 9.66 to 20.19 bushels per acre (average 24.1 percent) from 0.17 to 0.33 percent (average 0.25 percent), lysine from 1.69 to 2.42 percent (average 1.98 percent), and cryptophan from 0.14 to 0.22 percent (average 0.17 percent). This variation was due to both varietal and location factors, except in the case of met. where varietal differences were not significant. Niacin varied from 1.68 to 2.95 mg per 100 g (average 2.22 mg per 100 g), thiamine from 0.77 to 1.34 mg per 100 g (average 1.01 mg per 100 g), and riboflavin from 0.16 to 0.23 mg per 100 g (average 0.18 mg per 100 g). The differences in niacin and thiamine were due largely to varietal factors. The riboflavin values did not differ significantly among varieties or between locations. All intervariety coefficients of correlation between yield and the different nutrients were negative in sign, except that between yield and riboflavin which was negligibly small. Since the intervariety coefficients of correlations between pairs of the nutrients were all positive, selection among varieties for any one of these nutrients will not result in losses in others. (Author's summary).

0002

10173 WAGH, P.V. et al. Nutritive value of red kidney beans (*Phaseolus vulgaris*) for chicks. *Journal of Nutrition* 80(2):191-195. 1963. En., Sum. En., 14 Ref.

Phaseolus vulgaris. Nutritive value. Diets. Chicks. Animal physiology. Amino acids. Phytohaemagglutinins. USA.

Inclusion of raw red kidney beans at a level equal to or greater than 30 percent in the diet of chicks produced growth retardation and pancreatic hypertrophy. Autoclaving the kidney beans at 121 degrees Celsius for 30 min considerably improved wt gains and eliminated the pancreatic enlargement. A diet containing 1 percent hemagglutinin (devoid of trypsin inhibitor) significantly lowered the growth rate of chicks without pancreatic enlargement. Supplementing the diet containing 50 percent red kidney beans with deficient essential amino acids did not result in growth performance equivalent to that with the maize-soybean, meal control diet. (Author's summary)

0003

21546 DRIED BEANS are nutritious, tasty, and cheap. *Farming in South Africa* 39(11):55-56. 1964. En.

Phaseolus vulgaris. Nutritive value. Palatability. Proteins. Cooking. South Africa.

The nutritive value, tastiness, and low cost of dried beans and other legumes, as basic ingredients of many dishes, are highlighted. Dried beans contain approx. 10 percent water and 20 percent protein compared with 65-90 percent water and 2.5 protein in green beans. Although the quality of dried legume protein is not as high as that of animal

foods, they compare favorably with meat, fish, egg, and cheese. Beans are also a source of vitamin B, Ca, and Fe and, when they are allowed to germinate, of vitamin C. Hints are given for cooking beans. (Summary by I.B.)

0004

7086 KAKADE, M.L. and EVANS, J. Nutritive value of different varieties of navy beans. *Michigan Quarterly Bulletin* 48(1):89-93. 1965. En., Sum. En., 12 Ref.

Phaseolus vulgaris. Nutritive value. Methionine. N. Protein content. Amino acids. Inhibitors. Diets. Laboratory animals. Composition.

Nutritive values of different varieties of navy beans were evaluated by chemical composition, amino acid content and growth promotion in a rat feeding experiment. Gratiot beans had the highest protein content; Seaway beans were richest in most of the essential amino acids, except met.. All of the beans studied contained the 2 heat-labile antinutritional factors, trypsin inhibitor and hemagglutinin. Rats fed the raw beans died, Michelite being most toxic. Rats fed the diets containing autoclaved beans gained weight and appeared to be normal. (Author's summary)

0005

22537 KAPLAN, I. 1965. Archeology and domestication in American *Phaseolus* (beans). *Economic Botany* 19(4):358-368. En., Sum. En., 26 Ref., II.

Phaseolus vulgaris. Plant geography. History. *Phaseolus coccineus*. *Phaseolus acutifolius*. *Phaseolus lunatus*.

The systematic and economic botany of 4 species of American beans (*Phaseolus vulgaris*, *P. coccineus*, *P. acutifolius*, and *P. lunatus*) is discussed. Beans were prominent among agricultural products cited in tribute lists in pre-Hispanic times. Some important morphological features distinguishing the domesticated from the wild species are: increase in seed size; decrease in impermeability of seeds to water intake; reduction in fleshiness of the root system and loss of perennialism; reduction in shattering of the pods and violent seed dissemination. For the most part, the archeological materials now available do not document these changes. Excavations in the Pacific highlands and coastal areas of Mexico may be expected to yield transitional bean materials. Archeological bean distributions do show that, unlike maize, var. characteristics of beans have remained remarkably stable from their earliest records to their most recent. *P. vulgaris* was domesticated in Mexico by 7000 yr ago. The tepary has been largely replaced by common beans. This process of replacement continues at the present time. In the Tehuacan Valley, some kinds of beans and maize may have been domesticated in association with one another. Elsewhere, early records of maize and beans do not coincide. Although beans are preceramic in the Southwest, Tamaulipas, Tehuacan, and Coastal Peru, they did not become abundant in the Southwest and Middle America until agriculture was well established for some time. (Author's summary)

0006

3839 GENTRY, H.S. The ancestor of the common bean and its potential as a breeding source. In *Dry Bean Research Conference, 9th., Fort Collins, Colorado, 1968. Report.* Washington, D.C., U.S. Department of Agriculture, Agriculture Research Service, 1969. pp.73-78. En., 6 Ref.

Phaseolus vulgaris. Plant geography. Plant anatomy. Plant breeding. Cultivars, Genetics. Mycoses. Host-plant resistance.

The antecedents and genetic possibilities of wild beans are examined for their use as breeding resource for bean crops. Morphological and climatic characteristics are described as well as genetic evidence (no. of chromosomes) linking wild forms with cultivated var., and their agricultural and historical evolution. (Summary by I.B. Trans. by L.M.F.)

0007

12661 MIRANDA C., S. Origen de *Phaseolus vulgaris* L. (Frijol común). (Origin of the common bean). *Agronomía Tropical* 18(2):191-205. 1969. Es., Sum. Es., En., 23 Ref., Il.

Phaseolus vulgaris. Cultivars. Centre of origin. Plant geography. Seed color. Plant anatomy. Disease and pathogens. Injurious insects. Mexico.

Botanical explorations in Mexico have shown that wild var. of *Phaseolus vulgaris* are growing along the Sierra Madre Occidental; these var. have also been found in Guatemala. In both areas they are growing in an ecological transition belt ranging from 500-1800 m above sea level. The highest frequency of wild var. occurs at about 1200 m. In the 1st area cited it is possible to observe several species of the genus *Phaseolus* and a great genetic diversity in *P. vulgaris*. Besides, the oldest archeological remains of *P. vulgaris* have been found in the same area and wild var. are still growing at the sites of archeological ruins. These facts suggest that *P. vulgaris* has its center of origin at some place located in the W. Mexico-Guatemala area with an elevation of about 1200 m. (Author's summary)

0008

2708 GENTRY, H.S. Origin of the common bean, *Phaseolus vulgaris*. *Economic Botany* 23(1):55-69. 1969. En., Sum. En., 15 Ref., Il.

Phaseolus vulgaris. History. Ecology. Plant geography. Plant anatomy. Maps. Genetics. Plant breeding.

A wild leguminous vine growing in Mexico and Central America is identified as conspecific with the cultivated *Phaseolus vulgaris*. The exact origin of the common cultivated bean has not certainly been known. Evidence from comparative morphology, geographic distribution, ecology, genetic relationship, and archaeological history all indicate the wild vine are progenitors of the common American bean. Collections of both wild and cultivated seeds graphically illustrate the evolution of the cultivated beans and display evidence for multiple origins in Mesoamerica. The recognition of the wild beans and their acquisition provides agriculture with a renewed genetic resource for the protein deficient world. (Author's summary).

0009

1333 OROZCO S., S.H. El cultivo del frijol en Colombia. (Bean cultivation in Colombia). Palmira, Instituto Colombiano Agropecuario. Boletín de Divulgación no.02. 1971. 22p. Es., 13 Ref.

Phaseolus vulgaris. Taxonomy. History. Plant anatomy. Plant habit. Nutritive value. Climatic requirements. Plant breeding. Agronomic characters. Cultivation. Injurious insects. Diseases and pathogens. Irrigation. Colombia.

The following aspects of growing beans are discussed: taxonomic relationship, origin and areas of production, morphology, nutritive value, uses, climate and soil requirements, fertilization, varietal improvement, inoculation, plant breeding, weed control, pests, diseases, irrigation, rotation, harvesting, and storage. The characteristics are given of improved var. developed by the National Program for the following ecosystems:

Moderately hot, alt 800-1200 m. Diacol Calima, Diacol Nima, Algarrobo, ICA Huasano, ICA Tui, ICA Bunsí. Temperate, alt 1200-1800 m. Diacol Nutibara, Diacol Catio, ICA Cuna, alt 1800-2600 m. Diacol Ano.no. (Summary by T.B.) G00 D00

0010

5990 LIMA, Z.B. DE. Estudo bromatológico de feijões (*Phaseolus vulgaris*, L. e *vigna sinensis*, Endl.) nas condições em que são vulgarmente consumidos. (Bromatological study of cooked beans and cowpeas). Revista de Farmacia e Bioquímica da Universidade de São Paulo 10(1):37-62. 1972. Pt., Sum. Pt., En., 18 Ref.

Phaseolus vulgaris. *Vigna sinensis*. Animal nutrition. Protein content. Carbohydrate content. N. Mineral Content. Amino acids. Methionine. Cultivars. Laboratory animals. Brazil.

Beans and cowpeas (*Vigna sinensis*) constitute the staple food of most of the population in NE Brazil. Analytical results are usually based on the raw material, and the real contribution of cooked beans for nutritional purposes is unknown. Results of studies on raw and cooked bean var. Nanus and cowpeas are given. When cooked, these legumes present a total solid fraction of ca. 33.0 and 35.5 percent, resp. The most outstanding components in the solid fraction are carbohydrates and protein. The protein content in 100 g of solid material is 27.20 and 26.62 for cowpeas and beans, resp. Both legumes had 19 amino acids in their composition, 8 of which are essential: isoleucine, leucine, lysine, phenylalanine, met., treonine, tryptophan, and valin. In both products the limiting amino acid was met.. The seeds of the cooked legumes contain the majority of nutrients, but 10 percent of the protein, 10 percent of the carbohydrates and 10 percent of ether-soluble components, and 50 percent of the mineral components are transferred to the broth, upon cooking. The use of these legumes as the only source of protein, at the level of 10 percent, is insufficient to promote the normal growth of exptl animals (rats), though cowpeas are strongly superior to beans, because the loss of wt of the exptl animals was less. (Author's summary) H00 C03

0011

4499 BRESSANI, R.; FLORES, M.; ELIAS, I.G. Aceptabilidad y valor de leguminosas de grano en la dieta humana. (Acceptability and value of grain legumes in human diets). Guatemala, Instituto de Nutrición de Centro América y Panamá, 1973. 86p. Es., 43 Ref., II. Paper presented at Seminario sobre Potenciales de Frijol y otras Leguminosas de Grano, Cali, Colombia, 1973.

Phaseolus vulgaris. Consumption. Nutritive value. Cooking. Inhibitors. Protein content. Methionine. Lysine. Guatemala.

A study is presented on grain legumes as a source of proteins for populations of tropical regions and several aspects related to their consumption or acceptability are considered: consumption rates, preferred species, relation of consumption to age and economic income, method of preparation or cooking, important factors for the acceptability of the grain including: (1) antiphysiological factors (trypsin inhibitors, hemagglutinins, goitrogenic and flatulence factors), the hypocholesterolemic property and problems with protein digestibility. Protein content and the quality of grain legumes were also studied, varying according to the species, locality and form of handling. Met. deficiency and the nutritive value of the legumes are taken into account for mixed diets based on cereals and cassava. Legume proteins are deficient in met. but rich in lysine, while cereals contain a sufficient amount of sulfur-containing amino acids but are deficient in lysine. The former information includes tabulated data, tables and the results of the expt. conducted in relation to the most important aspects. The need for var. improvement to obtain a higher level and better quality protein is indicated. (Summary by C.P.G. Trans. by L.M.F.)

0012

8867 CONTRERAS L., G. Situación actual de las leguminosas comestibles en Colombia. (The present state of edible legumes in Colombia). Bogotá, Instituto Colombiano de Bienestar Familiar. Dirección de Nutrición. T.I. no. 197. 1973. 16p. Es., Sum. Es., 8 Ref., II.

Phaseolus vulgaris. Legume crops. Nutritive value. Protein content. Human nutrition. Food energy. Amino acids. Protein deficiencies. Analysis. Colombia.

The most important aspects of the Colombian nutritional problem are discussed, emphasizing the importance of legumes--among them beans--in contributing toward a solution for this problem. The annual quantifiable gross requirements needed for balancing deficits in 1980 are determined. The chemical composition of the main Colombian legumes is given, with the purpose of finding low-cost food combinations of max nutritional value. The need for conducting a mass campaign to educate the consumer is pointed out. (Author's summary. Trans. by T.M.) H01 C03

0013

5163 KAPLAN, L.; LYNCH, T.F.; SMITH, C.E. Early cultivated beans (*Phaseolus vulgaris*) from an intermontane Peruvian valley. *Science* 1979:76-77. 1973. En., Sum. En., 6 Ref.

Phaseolus vulgaris. *Phaseolus lunatus*. Light. Pods. Analysis. Plant geography.

Remains of *Phaseolus vulgaris* and *P. lunatus* were recovered from deposits in Guitarrero Cave in the Callejon de Huaylas, Peru. The beans of *P. vulgaris* had thin testas, were dark and were within the size range and form of contemporary cv. The pod fragments found did not have the heavy inner fibrous layer characteristic of wild bean pods. This fibrous layer has been selected against in cultivation to prevent loss of beans before or during harvest. The *P. lunatus* seeds were similar in size and shape to those recovered in more recent strata in the Guitarrero deposits. ¹⁴C dating indicated that the remains of *P. vulgaris* and *P. lunatus* found are between 7,680 plus or minus 280 to 10,000 plus or minus 300 yr old. (Summary by Plant Breeding Abstracts)

0014

8519 PROTEIN ADVISORY GROUP OF THE UNITED NATIONS SYSTEM. Upgrading human nutrition through the improvement of food legumes. New York, N.Y. Legume improvement. PAG Statement no.22. 1973. 38p. En., Sum. En., 98 Ref.

Phaseolus vulgaris. Human nutrition. Legume crops. Proteins. Seed. Amino acids. Growth. Genetics. Plant breeding. Digestibility. Vitamin content.

Food legumes are major sources of protein and other nutrients in the diets of many developing countries and often play a significant role in desirable crop rotations. These important food species have been neglected in terms of research necessary to increase yield and to correct certain defects in nutritional and food use qualities. The PAG recommends urgent research attention to 6 major food legume species, dry beans, pigeon peas, cowpeas, chickpeas, broad beans and peas; and the 2 leguminous oilseeds, peanuts and soybeans. While increased yield and improved consumer-acceptance qualities are primary objectives, priorities are also proposed for genetic improvement of various nutritional factors including increased protein concentration, higher met. and cystine levels, augmented lysine where feasible (legumes are primary sources of lysine in cereal-based diets) and protein digestibility. The importance of specific nutrients is indicated, and the need for careful nutritional evaluation is emphasized. Techniques for evaluating nutritional properties in breeding programs are compared. These include total protein, met., cystine, total sulfur and other amino acids. Also evaluated are methods for digestibility

and for toxic constituents, which are classified under heat-labile and heat-stable types. These include trypsin inhibitor (whose effect on humans may not be significant), the hemagglutinins, antivitamin, goiterogens, cyanogens, alkaloids, lathyrogens, and factors leading to favism and flatulence. The applicability and interpretation of feeding tests for various factors, including protein efficiency ratio and digestibility, are discussed. Bioassays for growth-depressing factors are also listed. Recommendations are presented for needed nutritional and biochemical research. (Author's summary)

0015

13186 SRIKANTIA, S.G. use of legumes and green leafy vegetables in the feeding of children: a review of experience. *PAG Bulletin* 3(2):30-40. 1973. En., 26 Ref.

Phaseolus vulgaris. Human nutrition. Inhibitors. Consumption. Cooking. Composition. Nutritive value.

The possibility of utilizing different legumes and green leafy vegetables in feeding children and the amount that can be used according to the age (infants below 6 mo., infants from 6-12 mo., and children from 1-3 yr) are reviewed. Toxic factors (endogenous and exogenous toxins), flatulence, cooking time, and good beliefs and taboos are mentioned among the problems related to the inclusion of legumes in the diets of infants. Methods of preparation of legumes are included. Among the risks of consuming green leafy vegetables by children are infections and infestations when they are consumed raw, low acceptability, and nitrite poisoning. The nutritive value of legume and green leafy vegetables is emphasized. The use of legumes is recommended for normal children and even for sick or mal-nourished ones. There is no limit to the amount that can be given to children provided they are suitably processed. (Summary by I.B. Trans. by L.M.F.)

0016

7924 ELIAS, L.G.; BRESSANI, R. Nutritional factors affecting the consumption of leguminous seeds. *Archivos Latinoamericanos de nutrición* 24(3):365-378. 1974. En., Sum. En., Es., 16 Ref.

Phaseolus vulgaris. Nutritive value. Seed. Proteins. Protein content. Laboratory animals. Amino acids. Legume crops. Zea mays. Digestibility. Guatemala.

For the purpose of stimulating consumption of leguminous seeds, several nutritional factors affecting their intake were studied. Biological trials were carried out with rats, giving them a choice between maize and beans. Consumption of both maize and beans was recorded separately in order to obtain the maize:beans ratio. Without the addition of nutrients, this ratio was 3:6:1, which is significantly better than that normally consumed by people in the rural areas of Guatemala (7:3:1). The optimum ratio for the higher protein complementation found previously by the "mixed feeding" technique was 2.6. The addition of other nutrients enhanced the relative consumption of beans, improving the ratio and significantly increasing the utilizable protein. Consumption of beans per se is stimulated by the addition of vitamins, minerals, and calories; response to the addition of met. needs the presence of the other nutrients. The dietary treatment applied to maize also affects favorably the consumption of beans. The use of cowpeas instead of black beans followed the same tendency, except that the protein quality of the diets was higher. It was also found that protein digestibility or lysine availability could not account for all of the improvements observed. It is therefore concluded that availability of leguminous seeds is an important factor that possibly impairs a higher consumption of this food commodity. (Author's summary)

0017

6781 MONCADA R., F. Aprovechamiento de frijol caraota partido en alimentación humana. (The use of dehulled black beans in human nutrition). IIT Tecnología no.87:21-33. 1974. Es., 8 Ref., II.

Phaseolus vulgaris. Seed. Flowers. Seed coat. Protein content. Cotyledons. Production. Industrialization. Nutritive value. Nutrition. Colombia.

Research was conducted to determine the technical feasibility, characteristics and uses of a white flour made from dehulled black beans. Several steps were introduced into the process to guarantee the high quality of the by-products; i.e., cleaning and selection of seeds to eliminate foreign material and immature or damaged seeds. The alternative of obtaining reconstituted seeds was also studied. The black bean seeds are dehulled, ground and extruded in bean form; these reconstituted seeds may have greater commercial acceptance than the black bean flour. The separated hulls and immature or damaged seeds form nearly 13 percent of the dehulled bean fraction and can be used in animal concentrates if the antinutritional compounds of these products are eliminated by special thermic treatment. It was also found that the most functional process for obtaining the white flour, as well as the other by-products, from the dehulled beans was the "moist" process (soaking of beans), together with a careful biological control. (Summary by T.M.)

0018

5656 BRESSANI, R. A new assessment of needed research. In: Milner, M. ed. Nutritional improvement of food legumes by breeding. New York, John Wiley and Sons, 1975. pp.381-389. En., Sum. En., 5 Ref.

Phaseolus vulgaris. Legume crops. Research. Consumption. Analysis. Protein content. Nutritive value. N. Seed. Amino acids. Uses.

The overall objective of the research proposed in this chapter is to find ways to increase consumption of beans and other food legumes of better nutritive quality through increased production. When the information currently available on production, preservation, processing, chemical composition, nutritive value, consumption and uses of legume foods is compared to data on cereal grains, it becomes clear that food legumes have been neglected. It also becomes clear that research on these foods and their development is urgently needed. Research and development activities on their nutritive value and use should be related to the production programs. Efforts should be concentrated on (1) chemical and biological methods to help agronomists and breeders to select for better nutritive quality, (2) improved methods of storage and processing, (3) diversified uses of legume foods, (4) possible uses of legume foods as nutritional supplements. (Author's summary)

0019

19880 MARECHAL, R. 1975. Studies in Phaseolinae. In Luse, R.A.; Rachic, K.O., eds. IITA Collaborators' Meeting of Grain Legume Improvement. Ibadan, Nigeria, 1975. Proceedings. Ibadan, International Institute of Tropical Agriculture. pp.35-37. En.

Phaseolus vulgaris. Nutritive value. Crossbreeding. *Phaseolus coccineus*. Amino acids. Hybrids. *Phaseolus lunatus*.

The possibility of improving the nutritional quality of the Phaseolinae subtribe was studied at the Faculty of Gembloux (Belgium); this depends upon the widening of the genetical variability of the cultivated species. The relationship between the genus *Phaseolus* (of American origin) and *Vigna* (Asiatic) is analyzed and an attempt in numerical taxonomy in view of the large quantity of data accumulated to date and based on

a live collection of species is reported. Phaseolinae presents incompatibility barriers between species; cytological analyses of different hybrids, however, show acceptable chromosome affinity. It is almost certain that only intra-genomic hybrids have been made. Best chances of interspecific crossing are within *Phaseolus* or *Vigna*. Several hybrids related to *P. coccineus* and *P. vulgaris* show the possibility of introgressing 2 incompatible species by using an intermediate species. Attempts are being made to cross *P. lunatus* with other *Phaseolus* spp., mainly *P. ritensis*. Relatively small intrinsic variations between the different forms of a same species and between different species in a same genus have been observed. The variation due to growing conditions appears to be more important than that observed between different botanical forms grown in identical conditions; for example, they influence amino acid and protein balance, especially that of free amino acid peptides, and half-cystine which in turn is bound to antitryptic factors. (Summary by EDFTEC. Trans. by L.M.F.)

0020

3709 MEINERS, J.P.; LITZENBERGER, S.C. Breeding for nutritional improvement. In Milner, M., ed. Nutritional improvement of food legumes by breeding. New York, John Wiley & Sons, 1975. pp.131-141. En., 19 Ref.

Phaseolus vulgaris. Human nutrition. Plant breeding. Nutritive value. Protein content. Amino acids. Selection. Production.

Research on genetic improvement of several food legumes, including beans, for nutritional quality is reviewed. The necessity of locating genetic variability for a given attribute is emphasized as the 1st step in a breeding program. Breeding for higher protein content, better amino acid balance, and other nutritionally related characters is included. The current state of germplasm collections for food legumes is examined. Among priorities, the obtaining of higher yields, improved adaptation, resistance to diseases and pests, responsiveness to fertilizers, and other management input factors are mentioned. The genetic base should be kept as broad as possible. (Summary by I.B. Trans. by L.M.F.)

0021

24687 BLISS, F.A. 1976. Annual report on improving yield and quality of bean seed protein and the development of superior populations for cooperative utilization in breeding programs; January 1-December 31, 1976. Washington, D.C., Agency for International Development. Department of State. 49p. En., Sum. En., 2 Ref., Il.

Colombia. Genotypes. Germplasm. *Phaseolus vulgaris*. Plant breeding. Protein content. Puerto Rico. Seed.

The research carried out in Wisconsin (USA), Colombia, and Puerto Rico on developing and evaluating high protein bean genotypes with wide adaptability and multiple trait superiority is discussed. The results of the studies are presented and illustrated with tables. There is great variability among bean genotypes to accumulate protein in seed. There is now a sound basis for developing strains with improved met. content, and research is well underway in determining the effects of tannin. [AS (Extract)]

0022

7577 ELIAS, L.G. et al. Composición química y valor nutritivo de algunas leguminosas de grano. (Chemical composition and nutritive value of some grain legumes). Turrialba 26(4):375-380. 1976. Es., Sum. En., Es., 16 Ref.

Phaseolus vulgaris. Nutritive value. Composition. Legume crops. Lysine. Methionine. Inhibitors. Protein content. N. Fibre content. Ash content. Fat content.

A total of 15 cultivars of grain legumes (*Phaseolus vulgaris*, *Vigna sinensis*, *Cajanus cajan*, and *Glycine max*) were studied chemically and nutritionally. Chemical analyses showed that except for soybeans (41.5 percent), the protein content of all samples fluctuated between 20.6-27.9 percent. Regarding ether extract, soybeans had a 4- to 5-fold content as compared with the other species. Independent of species, lysine content was relatively high whereas that of met. was low. Lysine content, however, varied more within species such as beans and cowpeas. Trypsin inhibitor content also varied among var. and species, with beans having the highest content, followed by pigeon peas, and soybeans. The protein efficiency ratio (PER) was lowest for *Phaseolus* (0.11-0.46), followed by *Cajanus* and *vigna* (0.89 and 1.40, respectively); the highest values were obtained with soybeans (2.15). Pancreatic growth index values were parallel to those of PER. When samples were evaluated with their cooking water, results were lower, irrespective of species, than when the cooking water was eliminated. Likewise, protein digestibility of the cooking water was very low. It is concluded that the differences encountered in nutritive value cannot be explained in terms of chemical or amino acid composition or content of trypsin inhibitors. The adverse effect of the cooking water on the nutritive value of seeds can be partially attributed to the low digestibility of the N-containing fraction, which in turn may be due to other substances present in the seeds that could form nondigestible complexes with the protein. (Author's summary)

0023

9984 SMARTT, J. Comparative evolution of pulse crops. *Euphytica* 25:139-143. 1976. En., Sum. En., 6 Ref.

Phaseolus vulgaris. Legume crops. Plant anatomy. Pods.

Patterns of apparently homologous variation are to be seen over the whole range of pulse crops. These are most apparent in those pulses that originated from climbing, twining, or trailing ancestors and have produced domesticates of erect growth form. The most remarkable homologous series can be seen in the genera *Phaseolus* (American) and *Vigna* (sens lat. i.e., including Asiatic *Phaseolus* spp.). The changes under domestication are typically loss of seed dormancy and pod dehiscence mechanisms, a change from perennial to the annual life form and a great change in seed size correlated with modified shoot architecture. Stems tend to be thicker, leaves larger, branches fewer, the no. of nodes may be reduced and internode length is shortened. This process culminates in the evolution of self-supporting plants well adapted to monocrop husbandry systems. (Author's summary)

0024

19759 BRUSSANI, R.; ELIAS, L.G. 1977. Tentative nutritional objectives in the major food crops for plant breeders. In Hulse, J.H.; Rachie, K.O.; Billingsley, L.W., eds. Nutritional standards and methods of evaluation for food legume breeders. Ottawa, Canada, International Development Research Centre. IDRC-TS73. pp.51-61. En., 21 Ref., II.

Phaseolus vulgaris. Nutritive value. Protein content. Amino acids. Diets. Methionine. Cystine. Tryptophan. Lysine.

Considerations that could serve as a basis for plant breeders in the nutritional improvement of basic food crops are given. Variability in nutrient content and cereal and legume consumption patterns are explained, on the basis of representative diets consumed by preschool children in rural Guatemala. Cereals amount to around 80 percent of the total diet and legumes to about 10 percent; these diets are consequently low in protein and deficient in amino acids, especially lysine. The characteristics of both types of food are analyzed and nutritional goals should be established for a mixed diet (maize and bean). Nutritional goals should be established for a mixed diet (maize and bean). Nutritional benefits were obtained when maize with higher levels of lysine and tryptophan were used and when twice the level of beans was used in the diet (relative nutritive values of 66.7

and 56.8 percent, resp.; normal size, 44.7 percent). Results were similar with high protein maize. Results are clearly related to the amino acid values of these 2 foods. Nutritional benefits were also obtained by the isonitrogenous replacement of common maize by black bean nitrogen up to 50:50 protein ratio distribution level. Although the mixture of rice and beans has a protein quality higher than each component alone, improvement is possible if the amount of deficient amino acids is increased. The better performance of soybean and cowpea compared with common beans is due to their higher sulfur amino acid and tryptophan contents. In cereal grain-legume diets, there is little advantage in increasing met. content of beans; however, efforts to increase lysine and tryptophan content in common maize or lysine content in other cereal grains in mixed diets are clearly justified. Protein and amino acid levels in some basic foods are proposed. It is hoped that further research will be stimulated to obtain more precise values of limiting nutrients. (Summary by EDITEC. Trans. by L.M.F.)

0025

19758 HAWTIN, G.C.; RACHIE, K.O.; GREEN, J.M. 1977. Breeding strategy for the nutritional improvement of pulses. In Hulse, J.H.; Rachie, K.O.; Billingsley, L.W., eds. Nutritional standards and methods of evaluation for food legume breeders. Ottawa, Canada, International Development Research Centre. IDRC-TS7e. pp.43-51. En., 22 Ref., II.

Phaseolus vulgaris. Nutritive value. Backcrossing. Crossbreeding. Selection. Genetics. Genotypes. Inheritance.

Background information on a breeding strategy for the nutritional improvement of pulses is given. The most important objective in pulse improvement is the increase and stabilization of seed yields and the improvement of nutritional quality. Nutritional factors included in a breeding program will depend on their relative importance as determined by nutritionists, the availability of suitable screening methods, and genetic considerations. The importance of handling large populations, at least 2 generations/yr, to advance as quickly as possible is recognized. Several more important genetic considerations are outlined: genetic variation, environmentally induced variation, genotype x environment interaction, heritability, major and minor genes, genetic linkages, transgressive segregation, correlations, breeding methods, and germplasm. Although the objective of breeding is not to improve nutritional quality, the nutritional level should not be allowed to fall below an acceptable standard. The scheme followed in a conventional breeding program is outlined. Breeding methods to increase nutritional quality are indicated: pedigree breeding, backcrossing, and population improvement. Future trends in nutritional improvement in pulses are included; these will enable greater quantities of material to be handled with greater accuracy. (Summary by EDITEC. Trans. by L.M.F.)

0026

9688 RHEENEN, H.A. VAN. Diversity of food beans in Kenya. Thika, Kenya, National Horticultural Research Station. Grain Legume Project, 1979. 9p. En., Sum. En., 10 Ref.

Phaseolus vulgaris. Seed characters. Seed color. Consumption. Seed coat. Human nutrition. Kenya.

In order to determine consumer preferences for beans in Kenya and to survey the variation existing in local bean material, 997 seed samples from plants selected in farmers' fields and from agricultural fairs were investigated and classified on the basis of color, size, and shape among the 10 most common types identified, the Rose Haricot with 9.2 percent, Mwendzimoja with 9.0 percent, and Mwitermania with 2.4 percent. The types differed considerably, indicating that consumer preferences are very flexible. Therefore, a breeding and selection program can rank characters such as disease and drought resistance higher in importance than seed type. (Author's summary)

0027

10365 SILVA, E.F. DA. Aspectos conjunturais do feijão. (Bean production constraints). *Lavoura Arrozeira* no.301:12-15. 1977. Pt., II.

Phaseolus vulgaris. Nutritive value. Protein content. Carbohydrate content. Yields. Cultivars. Economics. Brazil.

Because of their nutritional value, beans are being recommended instead of meat for consumption by families with limited income. However, area under cultivation in the state of Rio Grande do Sul is decreasing (272,292 ha in 1970 vs. 185,500 in 1976). At present beans are cultivated mainly at the subsistence level. The Empresa Brasileira de Pesquisa Agropecuária has developed cultivation systems for small (less than 10 ha) and large (more than 20 ha) operations in the state, where mainly black beans are grown; var. recommended by the Instituto de Pesquisas Agronômicas are Tambô Mauiné Rico 23, Cubano, and Rio Tibagi. (Summary by T.B.)

0028

10654 BELL, J.L. Comments on present production and usage of edible dried beans in Australia. Brisbane, Queensland, Department of Primary Industries, 1978. 13p. En. Paper presented at Bean Improvement Workshop, Sydney, Australia, 1978.

Phaseolus vulgaris. Production. Consumption. Cooking. Marketing. Processing. Australia.

An estimate of edible dry bean (*Phaseolus* and *Vigna*) production in Australia from 1972-77 showed an increase from 3280 t to 9936 t, mainly due to increased plantings of mung beans. The major canning bean is the navy bean, a record 10,500 ha being planted in Queensland for the 1977-78 season. Under present legislation growers will not plant beans unless they have a contract; thus it is necessary to import to meet domestic demands (45 percent of the imports are from the USA). (Summary by T.B.)

0029

22571 EVANS, A.M.; DAVIS, J.H.C. 1978. Breeding *Phaseolus* beans as grain legumes for Britain. *Applied Biology* 3:1-42. En., 158 Ref., II.

Phaseolus vulgaris. *Phaseolus coccineus*. Adaptation. Plant habit. Harvesting. Maturation. Resistance. Disease and pathogens. Yields. Seed characters. Plant breeding. Selection. Protein content. Seed. Nodulation. United Kingdom. Europe.

The objectives and methods that are important in possible breeding programs of *Phaseolus vulgaris* and *P. coccineus* in Great Britain are discussed. These would include: breeding for adaptation (suitable growth habit, earlier flowering, and maturity), for pest and disease resistance (fungi, bacteria, viruses, insects, nematodes), and for seed yield and quality (protein content and quality, improved nodulation). An indeterminate bush type which produces a taller plant for mechanical harvest is considered to be the appropriate bean type. *P. vulgaris* yields in Great Britain are comparable with those obtained in North America, probably due to the favorable moisture distribution in this country. A stable yield in most seasons and a stable supply of seed are essential. (Summary by I.B. Trans. by L.M.F.)

0030

10378 KABA, H.; SANABUJA, J.C. Evaluación nutricional de concentrados proteicos de porotos (*Phaseolus vulgaris*) y de lentejas (*Lens esculenta*). (Nutritional value of pro-

tein concentrates from beans and lentils). Archivos Latinoamericanos de Nutrición 28(2):169-183. 1978. Es., Sum. Es., En., 17 Ref.

Phaseolus vulgaris. Nutritive value. Legume crop. Protein content. Analysis. Laboratory experiments. Amino acids. Laboratory animals. Digestibility. N. Diets. Argentina.

The composition and nutritive value of any bean and lentil meals were determined and their respective protein concentrates obtained through extraction followed by isoelectric precipitation. Sulfur amino acids g of N were lower in the concentrates than in the meals, while there was no difference for lysine and threonine. The white bean protein concentrate had a lower BV than the meal but, better digestibility, although trypsin inhibitor concentration was unchanged. Digestibility greatly improved with heating but did not increase beyond 81 percent even after autoclaving. Autoclaved samples supplemented with met. reached a BV of 83. The lentil protein concentrate also had a lower BV than the meal but digestibility was high for both samples (91 percent) and remained unchanged after heating. Trypsin inhibitors were absent. After supplementing with met., a BV of only 63 was obtained, due to the low level of tryptophan, the 2nd limiting amino acid. In spite of the lower BV of the concentrate, they equaled the potential of the meal for complementing cereals, as their content in lysine and threonine is high. The concentrates have the additional advantage of allowing effective supplementation without increasing the legume/cereal ratio. (Author's summary)

0031

18569 LEVEHLE, G.A.; MORLEY, S.S.; HARPSHEAD, D.D. 1978. Beans—a food resource. In Robertson, L.S.; Frazier, R.D., eds. Dry bean production—principles and practices. East Lansing, Michigan State University. Cooperative Extension Service. Agricultural Experiment Station. Extension Bulletin E-1251. pp.31-44. En., 18 Ref., ll.

Phaseolus vulgaris. Nutritive value. Analysis. Digestibility. Protein content. Vitamin content. Fat content. Mineral content. Carbohydrate content. USA.

The nutritional value of bean is analyzed and the methods of nutritional evaluation used to determine protein, lipid, carbohydrate, vitamin, and mineral contents are discussed. Antinutritional factors in bean are also discussed as well as the characteristics that affect consumer acceptance of the grain. Nutritional considerations that should be taken into account in bean breeding programs are given. These include a wider range of met. levels, lower levels of antinutritional factors, and greater digestibility and utilization of the product by the human body (Summary by EDITEC. Trans. by I.M.F.)

0032

10187 VIEIRA, C. Cultura de feijão. (Bean cultivation in Brazil). Viçosa, MG, Brasil, Universidade Federal de Viçosa, 1978. 146p. 184 Ref., ll.

Phaseolus vulgaris. Production. Yields. Nutritive value. Amino acids. History. Plant anatomy. Plant habit. Agronomic characters. Soil requirements. Climatic requirements. Mineral and nutrients. Mineral deficiencies. Manures. Green manures. Nodulation. Nitrogen fixing bacteria. pH. Cultivation. Cultivars. Planting. Spacing. Irrigation. Weeds. Weeding. Storage. Stored grain pests. Intercropping. Brazil.

Emphasis is placed on botanical and cultural aspects of dry bean cultivation in Brazil in this book for agronomy students, agricultural engineers working in rural extension and farmers. The following topics are dealt with: Brazilian and world production, nutritive value, origin, the plant, the seed, soils, climate, other legumes, preparation of the soil, crop rotation, control of erosion, visual symptoms of mineral deficiencies, mineral and organic fertilization, soil sampling for chemical analysis, nodulation and N fixation, varieties, sowing, irrigation, weed control, intercropping (beans + maize, sugar cane or coffee), support systems for climbing beans, mulching with dry plant debris, harvesting and

threshing, crop productivity, storage production costs, growing of French beans, seed production. (Summary by T.B.)

0033

16080 GRAHAM, G.C.; MORALES, E.; PLACKO, R.P.; MACLEAN, W.C. 1979. Nutritive value of brown and black beans for infants and small children. *American Journal of Clinical Nutrition* 32(11):2362-2366. En., Sum. En., 9 Ref.

Phaseolus vulgaris. Nutritive value. Human nutrition. Diets. Methionine. Digestibility. Proteins.

A precooked, instant mixture of brown and black beans, without DL-met. or with 0.3 percent added was the only source of protein in the diets of 10 recovered malnourished infants and children 10-42 mo. old. At 6.4-6.7 percent dietary protein energy stool wet wt. were twice as high, apparent N absorption significantly lower, 65.6 against 87.5 percent of intake, and apparent N retention much lower, 9.8 against 34.5 percent of intake, than during, before, and after isonitrogenous casein-based diets of equal energy and N value. The addition of met. improved N retention slightly and increased free met. in plasma. Prolonged feeding on the met. enriched beans at 5.0-10 percent protein energy supported satisfactory growth and serum albumin in 2 of 3 children but not in the smallest one, in whom repeated balance studies showed no decrease with time in stool wet wt. and only marginal improvement in N absorption and retention. The poor digestibility of the protein in these beans is the 1st-limiting factor in its utilization by infants and small children. (Author's summary)

0034

11621 KEMPF S., F.N., comp. Algunas recetas a base de frejol. (Some bean recipes). Santa Cruz, Universidad Boliviana "Gabriel René Moreno". Instituto de Investigaciones Agrícolas y de Recursos Naturales Renovables, 1979. 4p. Es.

Phaseolus vulgaris. Human nutrition. Dietary value. Cooking. Diets. Bolivia.

A compilation is presented of Bolivian bean recipes as an effective alternative to substitute animal protein in daily diets. (Summary by F.G. Trans. by L.M.F.)

0035

15890 LUSE, R.A.; RACHIE, K.O. Seed protein improvement in tropical food legumes. Vienna, International Atomic Energy Agency. Series SM-230/53. 1979. En., Sum. En., 22 Ref.

Phaseolus vulgaris. *Phaseolus lunatus*. *Vigna unguiculata*. Seed. Protein content. Digestibility. Inhibitors.

Food legumes are an important source of low-cost protein in all tropical areas. An excellent strategy to combat protein malnutrition is to raise legume productivity (kg of edible material/ha) by plant introduction and breeding and by better management. An important alternative, however, is to increase the production of nutritionally available protein (kg of quality protein/ha) actually utilized by the population. This approach involves factors of amino acid balance, protein digestibility, consumer acceptance, and adaptation to food processing. The quality characteristics that need to be improved in a no. of widely used tropical food legumes are discussed with examples based on work in Africa and in L.A. These quality factors include content of the S amino acids in cowpea, household processing in soybeans, digestibility in field beans, and consumer acceptance in newly introduced food legumes such as lima and winged beans (*Phaseolus lunatus* and *Psophocarpus tetragonolobus*). Concerted multidisciplinary efforts are needed to im-

prove the yield potential and yield stability of tropical egumes. Farming systems should be designed that utilize trellised good legumes, low capital input, and relatively high labor input. Intermediate level technology should be developed for the processing of legumes into high-protein foods that are attractive yet inexpensive. Supporting all these activities will be the continued screening of large collections of plant germplasm--with both natural and induced variation--for the characteristics of productivity, adaptability, and product quality that are needed. (Author's summary)

0036

12630 SGARBIERI, V.C.; ANTUNES, P.L.; ALMEIDA, L.D. Nutritional evaluation of four varieties of dry beans. *Journal of Food Science* 44(5):1306-1308. 1979. En., Sum. En., 16 Ref.

Phaseolus vulgaris. Cultivars. Nutritive value. N. Amino acids. Mineral content. Analysis. Fe. Laboratory animals. Enzymes.

Data on proximate composition, distribution of nitrogenous compounds, amino acid composition, nutritional values, and available Fe content are tabulated for the dry bean cv. Rico 23, Rosinha-G2, Carioca, and Pirata-1. The nutritional quality of the protein was generally highest in Rico 23. (Summary by Field Crop Abstracts)

0037

14721 AYAD, G.; ANISHETTY, N.M. Directory of germplasm collection. 1. Food legumes. Rome. International Board for Plant Genetic Resources, 1980. 22p. En.

Phaseolus vulgaris. Germplasm. Plant geography. Storage. Research.

A directory is presented of food legume germplasm collections, including beans, that exist in the following countries: Afghanistan, Algeria, Argentina, Australia, Bangladesh, Belgium, Bolivia, Bulgaria, Canada, China, Colombia, Costa Rica, Cuba, Czechoslovakia, Democratic Republic, Ethiopia, Federal Republic, Germany, Greece, Guadeloupe, Hungary, India, Indonesia, Iran, Italy, Japan, Kenya, Malawi, Malaysia, Mexico, Netherlands, Nigeria, Pakistan, Papua New Guinea, Philippines, Poland Romania, Rwanda, Spain, Sweden, Syria, Thailand, Turkey, United Kingdom, USA, USSR, and Venezuela. The institution, person in charge, details of samples, geographical representation of the collection, forms of evaluation, documentation, and storage are given. (Summary by C.P.G. Trans. by L.M.F.)

0038

7986 HOSFIELD, G.L.; UEBERSAX, M.A.; ADAMS, M.W.; GHADERI, A.; TAYLOR, J.L. 1980. U.S.D.A., Dry Bean Food, Processing Quality and Yield Potential Improvement Program. In Michigan State University. Agricultural Experiment Station. Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1980 Research Report. pp.107-113. En.

Canned beans. Cooking. Nutritive value. *Phaseolus vulgaris*. Plant breeding. Planting. Processing. Soil compaction. Tannin content. Timing. USA. Yields. CIAT-2.

The objectives of the bean improvement program of the U.S. Department of Agriculture are given. These consist in (1) developing new breeding lines and cv. that combine improved yield potentials with favored food quality factors, pest resistance, tolerance to environmental stresses, and adaptation to mechanized culture; (2) developing new and improved cultural and management practices. Preliminary results are included. (CIAT)

0039

18539 MATTJIK, A.A. 1980. Construction of selection indices on dry beans (*Phaseolus vulgaris* L.). Ph.D. Thesis. Fort Collins, Colorado State University. 107p. En., Sum. En., 67 Ref., II.

Phaseolus vulgaris. Selection. Plant breeding. Yield. Seed. Protein content. Methionine. Inheritance.

Two selection indices (termed estimated and base indices) were constructed for the F₈, F₉, and F₁₁ generations of a bulk breeding population grown in 1979. A total of 126 estimated indices were constructed for each generation using 18 combinations of 6 traits (4 yield component traits and 2 quality traits) and 7 combinations of economic wt. of zero or one, for seed yield, protein percentage, and available met./unit of protein (AMP). Seven base indices using the 7 sets of economic wt. were also constructed. Genetic differences among the 3 generations were observed. A comparison of the total expected genetic gain for 7 estimated indices based on 6 traits with the 7 base indices showed similarity in all 3 generations. An advantage of the estimated index is the possibility of calculating expected gain for subset combinations having zero economic values. Broad-sense heritabilities ranged from 0.88 for seed wt. to 0.16 for AMP and narrow-sense heritabilities from 0.61 for seed yield to 0.00 for AMP. (Summary by Plant Breeding Abstracts)

0040

26964 MICHIGAN STATE UNIVERSITY. Agricultural Experiment Station. 1980. Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1980 Research Report. 151p. En.

Nutritive value. *Phaseolus vulgaris*. Plant breeding. Processing. Puerto Rico. Rotational crops. Soil compaction. Soil fertility. USA. Water stress. Yields.

The advances of research carried out in 1980 on navy beans, sugar beets, maize, soybeans, and alfalfa at the Agricultural Expt. Station of Michigan State U., USA, are presented. These cover soil fertility, crop management, plant breeding, food value, processing quality, yield potential, crop rotation, compaction, and water stress. (CIAT)

0041

27232 OCHETIM, S.; BOGERE, C.; KATONGOLE, J.B.D. 1980. Nutrient content and feeding value of common bean types grown and consumed in Kenya. East African Agricultural and Forestry Journal 45(4):284-289. En., Sum., En., 26 Ref.

Phaseolus vulgaris. Cultivars. Nutritive value. Dietary value. Protein content. Fiber content. Amino acids. Kenya.

Nutrient content and feeding value of 4 bean var. grown and consumed in Kenya (Rose Coco, Mwenzi Moja, Canadian Wonder, and Mexican 142) were determined. The protein content of the 4 var. was 20 percent; that of Mwenzi Moja was slightly greater than in the rest. Mexican 142 had the most fiber, 9.08 percent, and Canadian Wonder the least, 6.76 percent. GE value was 4.33-4.47 Kcal/g. Beans were high in P, Mg, and Ca but low in Fe. first limiting amino acids were met. and cystine, with valine next. Essential amino acid index was from 88.7 in Canadian Wonder to 94.4 in Mexican 142. chemical scores for Canadian Wonder, Mwenzi Moja, Mexican 142, and Rose Coco were 87.1, 84.8, 81.7, and 77.9, resp. Rats given autoclaved beans lost wt. but when met. was present they gained wt. but not as much as did controls given casein. (Nutrition Abstracts and Reviews)

14308 PECK, N.H. et al. Nutritional quality of vegetable crops as affected by phosphorous and zinc fertilizers. Agronomy Journal 72(3):528-534. 1980. En., Sum. En., 40 Ref., 11.

Phaseolus vulgaris. Nutritive value. Composition. Fertilizers. P. Zn. pH. Yield. Harvesting. Analysis. Micronutrients. Plant toxins.

The nutritional quality as well as the yield of the portions of vegetable plants used for human consumption should be considered in fertilization programs. The effects of rates of concd. superphosphate and Zn sources on some nutritionally important factors were studied including the concn. of P, Zn, phytic acid, and oxalic acid in the edible portions of 4 vegetables. The plants, pea, snap bean, cabbage, and table beet were grown on a Honeoye fine sandy loam derived from calcareous glacial till. These crops were fertilized with concd. superphosphate (CSP) at rates of 0, 30, 60, and 120 kg P/ha, and ZnSO₄ or ZnCl₂ at rates of 0, 5, 20, and 80 kg Zn/ha applied in a band at planting time in a factorially designed expt. The plants were sampled at processing stage except that pea and snap bean seeds were also sampled at full maturity. Increasing fertilizer CSP rates increased yields and P concn. in all crops. Fertilizer CSP increased phytic acid concn. in immature and mature pea seeds and in mature snap bean seeds. Oxalic acid concn. in table beet plants decreased with increasing rates of CSP fertilizer. Fertilizer CSP without Zn fertilizer decreased Zn concn. in plants, but CSP with Zn fertilizer generally increased Zn concn. Fertilizer Zn did not affect yields nor cause visible plant toxicities. However, Zn fertilizer increased Zn concn. in the plants, especially when applied with high rates of CSP fertilizer. Thus, CSP fertilization without Zn fertilization of vegetable crops can reduce their nutritional quality by lowering their Zn concn. However, the concomitant use of Zn fertilizer, with high rates of CSP fertilization, can improve the nutritional quality of vegetable crops with respect to Zn. (Author's summary)

0043

17388 CARPENTER, K.J. 1981. The nutritional contribution of dry beans (*Phaseolus vulgaris*) in perspective. Food Technology 35(3):77-78. En., 16 Ref.

Phaseolus vulgaris. Human nutrition. Nutritive value. Digestibility. Proteins.

The capacity of bean (30 and 15 g) to meet recommended dietary allowances for adults and children regarding vitamins and minerals, proteins and energy, is analyzed. Findings of an extensive literature review on the amino acid composition of beans and protein quality studies with rats are summarized. The only limiting amino acid is met. and protein digestibility is low (77 percent). Results of studies on the value of bean as the sole source of protein for children are analyzed. The following priorities for plant breeding are recommended: (1) increase bean yield potential; (2) increase protein content and improved digestibility; (3) reduce carbohydrate content (or that of other factors) responsible for flatulence and fecal bulk; (4) improve cooking qualities. (Summary by EDITEC. Trans. by L.M.F.)

0044

22279 BEAN/COWPEA COLLABORATIVE RESEARCH SUPPORT PROGRAM. U.S.A. 1983. 1983 Annual Report Technical Summary. East Lansing, Michigan State University. 141p. En. Also in Es.

Agricultural projects. Plant breeding. Pest control. Nitrogen fixation. Human nutrition. Dominican Republic. Ecuador. Guatemala. Honduras. Kenya. Malawi. Tanzania. Brazil. Technology. South America. Central America. Africa.

A technical summary is presented of the 1983 Annual Report of the Bean/Cowpea Collaborative Research Support Program (CRSP) of Michigan State U. After describing the organization of this program, a research report of each country is presented. Program strategy is to bring together the scientific resources of the identified countries to address universal constraints to the production, availability, and consumption of beans and cowpeas and to address the constraints through research in settings where they have local importance. The program support: research in var. improvement, insect and disease control, productive and stable farming systems management, efficient N fixation and soil P utilization, drought and heat tolerance, improved seed and its availability, improved storage and methods of preparation, improved nutrition and digestibility, reduced cooking requirements and digestibility, and understanding of the socioeconomic implications of agronomic intervention. All the projects shared the following goals: training professional and technical personnel, strengthening research capability in collaborating institutions, developing long-term collaborative relationships, and recognizing the social and environmental constraints to small farmer production and the central role that women play in agriculture in host countries. Collaborative relationships exist with institutions and/or universities in 13 countries: Botswana, Brazil, Cameroon, Dominican Republic, Ecuador, Guatemala, Honduras, Kenya, Malawi, Mexico, Nigeria, Senegal, and Tanzania. (CIAT)

0045

22287 BEAN/COWPEA COLLABORATIVE RESEARCH SUPPORT PROGRAM. U.S.A. 1983. Improved biological utilization and availability of dry beans; in _____, 1983 Annual Report. Technical summary. East Lansing, Michigan State University, pp.77-85. En. Also in Fs.

Storage. Seed characters. Cooking. Protein content. Phenol content. Seed. Composition. Guatemala. Central America.

A technical summary is presented of the 1983 Annual Report of the Bean/Cowpea Collaborative Research Support Program (CRSP) of Michigan State U. on the improved biological utilization and availability of dry beans at the Instituto de Nutrición Centroamericana y Panamá (INCAP) of Guatemala. The investigators, objectives and their modifications, research and training outputs, professional and organizational linkages established, institutional resources contributed to the project, progress toward project objectives and constraints, baseline data, and future plans are indicated. Drying beans for 10 min at atmospheric pressure, soaking beans in 15 percent NaCl solution for 5 h, and drying beans in the sun prevented the development of the hard-to-cook phenomenon in storage and reduced cooking time after storage. Steam-heating and soaking in salt water significantly reduced the concn. of proteins and polyphenols in beans. A methodology for the reliable and reproducible estimation of in vivo digestibility of common beans, a sophisticated method to accurately and objectively determine optimum cooking time for beans, and a method for sensitive estimation of biological activity of lectin of kidney beans were developed. Two methods were identified: one for the determination of procyandins in testa and cotyledons of dry beans, and the other for preparation of fermented dry bean "tempeh". Met. supplementation was shown to enhance protein quality. (CIAT)

0046

21772 BRESSANI, R. 1983. Research needs to up-grade the nutritional quality of common beans (*Phaseolus vulgaris*). *Qualitas Plantarum Plant Foods for Human Nutrition* 32(2):101-110. En., Sum. En., 27 Ref., Il. [Division of Food & Agricultural Sciences, Inst. of Nutrition of Central America and Panama, Guatemala, Guatemala]

Phaseolus vulgaris. Nutritive value. Protein content. Lysine. Cooking. Digestibility. Timing. Guatemala.

Some of the nutritionally important factors in common beans which are relatively well defined and may serve as a basis for recommendations for further study and for establishing nutritional objectives for breeding are briefly reviewed. (Author's summary)

0047

20846 BRESSANI, R. 1983. World needs for improved nutrition and the role of vegetables and legumes. Shanhua, Taiwan, Asian Vegetable Research and Development Center. 10th Anniversary Monograph Series. AVRDC Publication 83-185. 22p. En., 37 Ref., Il. (Inst. de Nutrición de Centro América y Panamá, Carretera Roosevelt, Zona II, Guatemala)

Phaseolus vulgaris. Intercropping. *Zea mays*. Nutritive value. Diets.

Due to the relatively high intake of cereal grains in most parts of the world, they provide a significant amount of the nutrients in the human diet; in some regions, however, these are replaced by tubers such as cassava and yams. Their quality, particularly their protein content, decreases their net dietary value unless they are complemented by food legumes in particular, and by animal food products. Considering these facts the best solution to the problem of malnutrition are offered by an intake of cereal grains or tubers and food legumes in such a proportion as to maximize their individual qualities. This can be achieved by following cereal or starchy crops/food legume consumption patterns, which provide a useful system for production programs and for selection and recommendation of supplementary foods. Maize, bean, rice, bean, and cassava, bean systems are discussed. These, if practiced, would present a good beginning for improved nutrition as far as calories and protein quantity and quality are concerned, and could further be improved by the consumption of small amounts of animal products and vegetables. The latter, particularly the leaves, are sources of vitamins and minerals and, if concentrated in dehydrated food products or leaf juices, can supply significant amounts of protein. (Summary by J.R.)

0048

22663 WILLIAMS, W.A.; BLUESTEIN, C.; TUCKER, C.L.; LYONS, J.M. 1983. Fossil energy requirement of protein produced by dry beans. *Crop Science* 23(5):1007-1008. En., Sum. En., 13 Ref.

Phaseolus vulgaris. Proteins. Food energy. Fertilizers. N. Mechanization. Cultivation. USA.

Fossil energy cost of the cultural inputs for production of dry beans were highest for fertilization followed in declining order by crop establishment, machinery, irrigation, harvesting, weed control, insect control, transportation, and disease control. The av. energy requirement was 20.6 GJ/ha and 10.4 MJ/kg of beans produced, and protein energy output/energy input equalled 0.38. Dry beans grown in California, USA, compared favorably in protein produced/ha and fossil-energy use efficiency with other crops (wheat, rice, maize, and potatoes) widely grown in the USA. (Author's summary)

0049

26009 BEAN/COWPEA COLLABORATIVE RESEARCH SUPPORT PROGRAM. U.S.A. 1984. Improved biological utilization and availability of dry beans. In -----, 1984. Annual Report. 1. Technical Summary. East Lansing, Michigan State University. pp.135-153. En.

Agricultural projects. Amino acids. Cooking. Guatemala. Mineral content. Nutritive value. *Phaseolus vulgaris*. Storage. S. Timing. Transfer of technology.

The results of project activities in 1984 to improve the availability, utilization, and nutritional quality of beans for human consumption in developing countries are presented. General aspects of the project are discussed. Research outputs in 1984 indicated that culinary and nutritional traits of beans are inherited qualitatively and can be improved through plant breeding. Total S assays may be an accurate indication of S amino acid concn. A method was developed for determination of soluble and bound procyanidins in beans. Soaking beans in 15 percent NaCl for 5 h and sun drying prior to storage inhibited the hard-to-cook phenomenon. A modified Morris-Matson penetrometer is available to assess cooking time of beans as well as a method to assess hemagglutinin concn. and activity. Extrusion of hard-to-cook black beans is a good alternative process to produce animal feed. Training objectives and outputs and expected short-term research outcomes are summarized. Research plans for 1985 are included. (CIAT)

0050

25291 PACHICO, D.H. 1984. Nutritional objectives in agricultural research. The case of CIAT. In Pinstrup-Andersen, P.; Berg, A.; Forman, M., eds. *International Agricultural Research and Human Nutrition*. Washington, D.C., International Food Policy Research Institute. pp.25-40. En., Sum. En., 62 Ref.

Colombia. Development. Human nutrition. *Phaseolus vulgaris*. Technology. CIAT-1.

Nutritional factors have been important considerations both in the setting of commodity priorities at CIAT and in the determination of research strategies for individual programs. Just as collaboration with national research and extension organizations is critical to the development of new technology for CIAT commodities, so is the collaboration with other institutes necessary in nutrition research. The CIAT Bean Program might benefit from advances in biochemical studies of protein digestibility that have led to estimate price and income elasticities of demand is essential for sound analysis of the nutritional effects of new technology. [AS (EXTRACT)]

0051

28084 UBERSAX, M.A.; HOSHIED, G.L. 1984. Nutritional perspective of dry beans. *Michigan Dry Bean Digest* 8(4):12-13,23. En. II.

Phaseolus vulgaris. Nutritive value. Amino acids. Mineral content. Diets. USA.

The nutritional properties of beans, such as protein and mineral content, are analyzed in detail. A series of comparisons are made with other foodstuffs consumed in the USA as to satisfying the recommended daily allowance. (CIAT)

0052

24115 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1985. Evaluation of quality characteristics in -----, Bean Program. Annual Report 1984. Cali, Colombia. Working document No. 7. pp.117-120. En. Also in Es.

Cultivars. Selection. Seeds. Protein content. Stored grain pests. Resistance. Colombia. Plant anatomy. Composition. South America. America. CIAT-1.

In 1984 the nutrition and quality lab. evaluated 390 advanced lines from the EP 84 for seed quality, percentage of water absorbance from dry wt., presence of hard and broken seeds, av. cooking time, soup quality, and protein content. Results suggest that shiny grains tend to resist absorbing water during soaking and the opaque colors present less seed hardness. The influence of location, harvest time, and var. on cooking time, seed hardness, and CP content was also studied to determine if genetic or environmental variability, or interaction of the 2, can influence some cooking and nutritive seed character-

istics. Cooking time and hardness of wild lines of the common bean and resistance to storage insects were assessed by measuring the cooking time in 9 resistant and 5 susceptible lines and the percentage hardness in 18 resistant and 5 susceptible lines. There were no significant differences among the lines for either variable.

0053

26901 NABHIAN, G.P.; WEBER, C.W.; BERRY, J.W. 1985. Variation in composition of Hopi Indian beans ecology of food and nutrition 16(2):135-152. En., Sum. En., 26 Ref., II. (Office of Arid Lands Studies, Univ. of Arizona, Tucson, AZ. 85721, USA)

Phaseolus vulgaris. Proteins. Dietary value. Amino acids. Nutritive value. *Phaseolus coccineus*. USA.

Dry *Phaseolus* beans grown on the Hopi Indian Reservation were collected and compared with beans utilized by the Hopis but grown off the reservation. species included *P. vulgaris*, *P. acutifolius* var. *latifolius*, *P. coccineus*, and *P. lunatus*. Ethnobotanical information, morphological, and chemical data were obtained. Beans grown on the reservation were generally, but not always, found to be superior in protein content, but no clear differences in protein quality could be attributed to bean types or field environments. Legumes are consumed at the same level (30 g/day/person) but native beans contribute less protein to the Hopi diet than during the 1930's, as a consequence of reduced diversity in var. locally produced and consumed. Much variation occurs in mineral levels in Hopi beans, but the wide range in soil composition found in Hopi fields gave no clear correlation with bean composition. (AS)

0054

29157 SCHWARCZ, H.P.; MELBYE, J.; KATZENBERG, M.A.; KNYF, M. 1985. Stable isotopes in human skeletons of Southern Ontario: Reconstructing Palaeodiet Journal of Archaeological Science 12(3):187-206. En., Sum. En., 62 Ref., II. (Dept. of Geology, McMaster Univ., Hamilton, Ontario, Canada)

Phaseolus vulgaris. Diets. Protein content. History. Canada.

The introduction of beans into the native diet about AD 1100, should have caused a decrease in the (15N) content of human bone collagen because legumes are deficient in this isotope, with respect to meat and fish; however, no significant change was observed in the (15N)/(14N) ratio of human bone collagen over the period from 2300 BC to 1640. It is concluded that meat and fish remained the main sources of protein even after the advent of agriculture into southern Ontario, Canada. [AS (Extract)]

0055

27012 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1986. Scientific Training and Network Activities. Africa in -----, Bean Program. Annual Report 1985. Cali, Colombia. Working document no.14. pp.282-318. Also in Es., En.

Phaseolus vulgaris. Plant breeding. Development. Transfer of technology. Plant introductions. Pest control. Germplasm. Cooking. Timing. Protein content. Africa. CIAT-1.

Detailed information on the activities of the CIAT breeding program and African Regional and National Programs is presented, with special emphasis on the Great Lakes Regional Project in Central Africa. The main activities carried out in 1985 in the areas of training, var. development and introduction, cultural and chemical control of diseases and pests, nutritional studies (cooking time and protein content), on-farm research, bean consumption preference surveys, and on-farm var. trials are summarized and major results are given. Future plans for 1986 are included. (CIAT)

0056

27003 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1986. Genetic improvement. Character improvement. Nutritional quality in -----, Bean Program. Annual Report 1985. Cali, Colombia. Working document no.14. pp.123-130. Also in Es., En.

Phaseolus vulgaris. Cultivars. Seed characters. Cooking. Timing. Protein content. Colombia. CIAT-1.

Several groups of EP (Preliminary Trials) var. were evaluated in the nutrition and quality lab. for grain quality, percentage water absorption from dry wt., presence of hard and broken grains, av. cooking time, broth quality, and protein content. Significant differences were found in the av. values of all the characteristics measured in the EP/82, 84, and 85 with the exception of protein content of the EP/82 and 84 and for solids in the broth. In addition, harvest period, and var. on cooking time, hardness and protein content to determine whether genetic variability or environmental variability or their interaction exists. The results of the various trials are presented in table form. (CIAT)

0057

29776 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1987. Genetic improvement and related activities. Regional activities. Africa. Great Lakes region in -----, Bean Program. Annual Report 1986. Cali, Colombia. Working document no.21. pp.235-277. En., Il.

Phaseolus vulgaris. Germplasm. Cultivars. Resistance. Plant introductions. *Isariopsis griseola*. *Colletotrichum lindemuthianum*. *Ascochyta*. *Pseudomonas syringae* pv. *Phaseolicola*. *Xanthomonas campestris* pv. *Phaseoli*. *Uromyces phaseoli*. Bean common mosaic virus. *Ophiomyia phaseoli*. Cooking. Timing. Seed hardening. Water absorption. Varietal mixtures. Yields. Transfer of technology. Technology evaluation. Seed production. Rwanda. Zaire. Burundi. CIAT-1.

The Great Lakes Regional Bean Program works with the Agricultural Research Institutions of Burundi, Rwanda, and Zaire. Advanced breeding lines were introduced as potential new var. for the region and/or as sources of resistance to angular leaf spot, anthracnose, *ascochyta* leaf spot, halo and common blight, rust, BCMV, and the bean fly. Together with locally collected germplasm, the introduced germplasm forms an excellent basis for the var. development programs. Advanced lines from all 3 national programs in the region were evaluated for cooking time, water absorption, and hard seed character. A collaborative project between the U. of Munchen and CIAT investigated the significance of var. mixtures in terms of yield gains to obtain information to develop a strategy for improving var. mixtures. The genotypes which gained most from being planted in mixtures were BAT 1297 and PVMX 1531. On-farm var. trials were carried out in Rwanda and Burundi. diagnostic surveys and exploratory trials were also conducted in several regions of all 3 countries in the Great Lakes region to establish on-station and on-farm research priorities. Cultural methods (seed selection and removal of diseased leaves and seedlings) in combination show promise as an effective way to control diseases in var. mixtures. The program in 1986 initiated the following technology development and testing trials: (a) chemical seed treatments for areas with root rot, bean fly, and soil acidity problems; (b) a detailed study on the acceptability of climbing beans in the Central Plateau region; (c) on-station trials testing the integration of soil improvement components such as legume-trees and green manure crops in bean production systems; and (d) techniques to improve farmers' self-seed production.

29767 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1987. Genetic improvement and related activities. Improvement of individual characters. Nutritional quality in -----. Bean Program. Annual Report 1986. Cali, Colombia. Working document no.21. pp.163-168. En.

Phaseolus vulgaris. Germplasm. Protein content. Cooking. Timing. Statistical analysis. Water absorption. Planting. Cultivars. digestibility. Colombia. CIAT-1.

The principal activities carried out in 1986 in the nutrition and quality lab. are reported. A statistical analysis of all the parameters of acceptability on all bean materials evaluated in the lab. from 1981 to 1985 was executed. A joint project was carried out between CIAT and Instituto de Nutrición de Centroamérica y Panamá (Costa Rica) on methods to measure cooking time. Studies also aimed at identifying the important parameters for water absorption and at determining the influence of site, planting time, and var. of the cv. on acceptable nutritional characteristics. A joint project with Italy's National Institute of Nutrition was initiated to study tannins, fiber content, and other factors responsible for the low digestibility of beans; likewise, a prototype model of a modified Mattson's automatic cooker was assessed. No significant differences were found for the protein content among the majority of the tested var., but some differences were observed for seed color. Planting time has a marked effect on protein content. Results from planting of Rojo 70 and Rojo de Seda in Palmira, Restrepo, and Quilichao (Colombia) indicate that site is strongly correlated to grain hardness, water absorption, and cooking time. (CIAT)

29753 CENTRO INTERNACIONAL DE AGRICULTURA TROPICAL. 1987. Bean Program. Annual Report 1986. Cali, Colombia. Working document no.21. 318p. En., II.

Phaseolus vulgaris. Snap beans. Germplasm. Database. Propagation. Plant breeding. Hybridizing. Resistance. Mycoses. Viroses. Bacterioses. Injurious insects. Adaptation. Yields. Photoperiod. Temperature. Drought. Nitrogen fixation. Nutritive value. Transfer of technology. Central America. Caribbean. Brazil. Peru. Mexico. Argentina. Asia. Africa. Netherlands. CIAT-1.

The activities carried out by the CIAT Bean Program in 1986 are reported. Bean germplasm activities covered collection, multiplication and distribution, data management, genetic variability from biotechnological techniques, and variability from interspecific hybridization. Individual character improvement studies were conducted on resistance to fungal, bacterial, and viral diseases and invertebrate pests, yield potential, photoperiod and temp. adaptation, drought and acid soils tolerance, N fixation, nutritional quality, and snap beans. Genetic improvement also aimed at evaluation in uniform nurseries (bean evaluation nursery, VEP; preliminary trials, EP; and IBYAN). Agronomic practices were evaluated in on-farm trials. Regional activities were carried out in Central America, the Caribbean, Brazil, Peru, Mexican highlands, Argentina, West Asia, Andean zone, Africa (Great Lakes region, East and Southern Africa), and the Netherlands, in the latter with the Institute for Horticultural Plant Breeding, (CIAT)

NUTRITIONAL ASPECTS

NUTRITIVE VALUE

9009 MURILLO, B.; CABEZAS, M.T.; BRESSANI, R. Influencia de la densidad calórica sobre la utilización de la proteína en dietas elaboradas a base de maíz y frijol.

(Influence of calorie density on protein utilization in diets based on maize and beans). *Archivos Latinoamericanos de Nutrición* 24(2):223-241. 1974. Es., Sum. Es., 22 Ref., II.

Phaseolus vulgaris. Protein content. Amino acids. Food energy. Laboratory animals. Nutritive value. N. Diets. *Zea mays*. Central America.

The effect of individual and combined additions of calories, protein and/or amino acids on the balance of 3- to 4-mo.-old dogs fed a diet of maize and beans in a 6.24 to 1 ratio was studied. In the 1st expt., the animals were fed 3, 4, 5 g of protein/kg/day of the maize-bean diet supplemented at each level of protein intake with 0, 25, and 50 percent calorie increments over the basal level. Results showed that the addition of calories (as oil) increased N retention significantly, particularly when protein intake was 3 g/kg/day. As a result of the calorie supplement, the animals gained more wt. In a 2nd study, the protein of the same diet, with 25 percent additional calories, was replaced by 10, 20, 30, and 40 percent milk or egg protein, or lysine, tryptophan, and met. in equivalent amounts. N balance increased as animal protein replaced more of the basal dietary protein. The same was also true when amino acids were used; however, the responses obtained were not as high as when whole protein was utilized, and when higher amino acid additions were used, a plateau in N balance was reached. The 3rd expt. was designed to measure the individual effect of calories and amino acids, as well as their combined effect on the protein quality of the maize-bean diet. The individual addition of both types of supplements improved N balance, the calorie addition showing slightly superior effects. The simultaneous addition of both types of supplements gave slightly higher N retention values than did individual additions. In conclusion, the data indicate that when diets are to be improved nutritionally, it is important to consider all limiting nutrients. Furthermore, recommendations to increase nutrient intake through increased food intake are not sound because the bulk of diets based on maize and beans does not permit such an approach. (Author's summary) H10

0061

7264 ARAUJO, T.M.V.C. DE et al. Valor nutritivo das misturas: feijão Macá ar integral + farinha de mandioca e feijão Mulatinho integral + farinha de mandioca, suplementadas com diferentes níveis de metionina. (Nutritional values of diets containing beans (Macá ar and Mulatinho) and cassava flour supplemented with methionine at different levels). *Revista Brasileira de Pesquisas Médicas e Biológicas* 8(2):143-147. 1975. Pt., Sum. Pt., En. 5 Ref., II.

Phaseolus vulgaris. Cassava. Nutritive value. Methionine. Diets. Laboratory animals. Analysis. Dietary value.

A study was made of the effect of met in diets prepared with beans and cassava flour. The biological value of the diet was determined by the protein efficiency ratio in white rats, using diets with protein levels of 10 percent supplemented with 0.3 and 0.4 percent met. The results showed a significant increase in the biological value of the diet with 0.3 percent met., as compared with the control diet (no met.); there was no significant increase at the 0.4 percent level. (Author's summary)

0062

11679 ELIAS, I.G. Algunos aspectos bioquímicos y nutricionales del maíz y del frijol. (Biochemical and nutritional aspects of maize and beans). In Miranda M., II., comp. *Cursos de Producción de Maíz y Frijol*, Santa Tecla, El Salvador, 1976. Notas. Santa Tecla, Centro Nacional de Tecnología Agropecuaria, 1976. pp.1-44. Es., 44 Ref., II.

Phaseolus vulgaris. *Zea mays*. Protein content. Amino acids. Lysine. Methionine. Nutritive value. Diets. Storage.

The nutritional condition of populations in developing countries is described along with the chemical, biochemical and nutritional characteristics of maize and beans and ways to improve diets on the basis of cereals and legumes. In Guatemala the principal sources of nutrients are cereals and legumes. The PER is 2.5 for casein and 0.58-1.72 for rural diets in Guatemala. In L.A., *Phaseolus vulgaris* is the bean that is most consumed in all its var., forms and colors. Legumes are good sources of lysine while cereals contain met. Maize, deficient in lysine and tryptophane, has been improved by increasing the amino acid content in grains of Opaco-2 maize; however, the softness of the grain endosperm and the consequent damage during storage has reduced its commercial production. White-seeded beans present a higher PER than black-seeded beans since they do not contain pigments in their seed coat. Tannins reduce protein digestibility forming tannin-protein complexes. The MC in seeds, room temp., RH, and the length of storage affect the conservation of stored beans. Storage should be effected with a MC between 10-11 percent and temp. equal to or less than 25 degrees Celsius. Tables and figures, summarizing the information, are given. (Summary by C.P.G. Trans. by L.M.F.)

0063

23382 MORALES G., V.M. 1976. Evaluación biológica de cinco variedades de frijol (*Phaseolus vulgaris* sp.) producidas en México. (Biological evaluation of five bean varieties grown in Mexico). Tesis Ing. Agr. Chapingo, México, Escuela Nacional de Agricultura 41p. Es., Sum. Es., 23 Ref.

Animal nutrition. Diets. Nutritive value. Cultivars. Mexico. North America. America.

Three expt. were conducted using 3 different biological methods to determine the nutritive value of 5 bean var. (Meccentral, Jamapa, Canario, Villa Guerrero, and Cacahuate) grown in Mexico. during the initiation phase, 195 fryers were used and accommodated in electric battery brooders. The PER method was used in the 1st expt., which had a duration of 13 days; the NPR method was used in the 2nd expt. with a duration of 7 days; and the gross protein value method was used in the 3rd expt. with a duration of 20 days. In the 1st expt., it was observed that chickens fed a casein-based diet had wt. gains statistically superior to chickens fed beans. Wt. gain of poultry receiving bean-based diets was variable, best results being obtained with var. Meccentral and Jamapa. Casein again showed higher PER values than beans. The lowest PER value was obtained with var. Meccentral. No statistical wt. gain differences were found between poultry fed with casein and those fed beans. NPR values obtained with Villa Guerrero and casein were similar between each other and superior to those observed with the rest of the bean var. In the 3rd expt., chickens fed Meccentral beans showed higher protein consumption than those fed var. Jamapa, Villa Guerrero, or Cacahuate, and less consumption than those fed Canario beans and casein. No significant differences were observed for the PER and gross protein values.

0064

12320 BOLOORFOTOOSHAN, M. Bean protein evaluation and supplementation. Ph.D. Thesis. East Lansing, Michigan State University, 1977. 148p. En., Sum. En., 192 Ref., 11.

Phaseolus vulgaris. Laboratory animals. Proteins. Amino acids. Nutritive value. Analysis. Methionine. Zn. Tryptophane. Fibre content. Ash content. Moisture content. USA.

Feeding expt conducted with weanling rats showed that the protein quality of navy beans (a poor source of sulfur-containing amino acids) can be largely improved by mixing the beans with sesame flour (a rich source of met.). The protein quality of navy beans, sesame meal, and mixtures of navy beans:sesame flours (BS) were evaluated using PER, NPR, and slope-ratio techniques. Protein scores and modified essential amino acid indices (MEAA) were also computed. Compared to a PER of 100 for casein, the PER for

B:S 87.5:12.5, B:S 75:25, and B:S 50:50 were 62, 49, 72, 90, and 92 percent, resp. The Relative Protein Value (RPV) and Relative Nutritive Value (RNV) were obtained from slope-ratio comparisons in which the corresponding lactalbumin values were set equal to 100. The RPV were 57, 52, 67, 71, and 74 percent, resp. The RNV were 54, 66, 68, and 74 percent, resp. The protein scores for the tested samples were 48, 50, 60, 72, and 78, resp. The MEAA indices were 88, 78, and 88, resp. Linear regression equations and correlation coefficients were derived, relating the protein values obtained by the different assays for the 5 diets. All the bioassays correlated very well with the av. correlation coefficient of 0.96. The correlation between the chemical assay was poor ($r = 0.50$); and of the 2 methods tested, only protein scores gave a high correlation coefficient with the biological methods ($r = 0.94$). The supplementary effect of whole egg powder on navy beans was also studied; protein quality of the navy beans was improved by the presence of egg protein in the diet. The protein quality of navy beans subjected to different processing methods (canning with or without sugar, home cooking, and autoclaving) was estimated. PER, met. availability (growth assay with weaning rats), and lysine availability (reaction with 1-fluor-2,4-dinitrophenol benzene) were used to estimate protein quality. For the canned beans with 1.5 percent sugar in brine, home-cooked beans, and autoclaved beans, the PER values were 58, 56, 56, and 60 percent, resp.; the met. availability values (compared to 100 for crystalline met.) were 49, 42, 48, and 50 percent, resp.; the lysine availability values were 93.3, 93.9, 97.5, and 97.4 percent, resp. It was concluded that the processing methods did not seriously impair the protein quality of navy beans. Zn supplementation of a 10 percent protein diet for the rat in which the sole source of protein was autoclaved navy beans was carried out. Graded levels of zinc sulfate were added to bean diets so that the final concn. of Zn in the diet varied from 16.6-37.8 ppm. A very modest increase in growth, 6 percent in PER, over the unsupplemented diet, was observed when the Zn content of the bean diet was raised to 20 ppm. It was calculated that only 0.002 percent of the phytic acid of the beans could be involved in the binding of Zn. Supplementation of the same diet with 0.5 percent D,L-met. resulted in a much greater increase in growth rate, 110 percent in PER. Furthermore, the very modest additional growth obtained by supplementing the bean diet with Zn disappeared when bean protein quality was upgraded by adding met. (Summary by Dissertation Abstracts)

0065

9248 BRESSANI, E. et al. Estudios sobre la producción de harinas precocidas de frijol y caupí, solos y combinados mediante cocción-deshidratación. (The nutritive value of precooked flours of beans and cowpeas). Archivos Latinoamericanos de Nutrición 28(2):247-260, 1977. Es., Sum. Es., En., 14 Ref.

Phaseolus vulgaris, *Vigna sinensis*. Processing. Nutritive value. Seed. Diets. Protein content. Laboratory animal. Cooking. Guatemala.

The effect of processing on the nutritive value of beans and cowpeas mixed in proportions of 100:0, 50:50, 25:75, and 0:100 were studied. The precooked flours obtained by processing the raw materials by 3 methods: (1) soaking whole grains for 1 h-cooking autoclave-dehydration in tray drier; (2) soaking for 24 h-grinding-drum drying; (3) grinding-soaking for 30 min drum drying in which the velocity of rotation of the drums was varied (2, 4, and 6 rpm). The 50:50 bean-cowpea blend and 100 percent cowpea was processed by means of extrusion-cooking with a Wenger X 25 extruder. All flours were analyzed for trypsin inhibitor activity and for their protein quality by PER assays. Results from Process I were used as reference for Process II. Process I did not cause major changes in the quality of the products although PER increased as cowpeas replaced common beans. These observations were more marked in the samples of Process II although animal performance at equivalent combinations of beans and cowpeas was lower. Trypsin inhibitor activity was lower in samples from Process I, in both cases, activity decreased as cowpeas replaced common beans. Better wt gain and PER were obtained when the velocity of the dryer drums was 4 rpm. Higher trypsin inhibitor activity was measured in samples produced when drums rotated at higher rpms. Protein quality decreased as soaking time increased in ground raw samples while values for trypsin

inhibitors changed in the opposite direction. Legume food precooked flours from extrusion cooking were the highest in PER. The nutritional and technological implications of the processes are discussed. (Author's summary)

0066

14220 FRANCA, M.H. DE C.; ZUCAS, S.M. Misturas de arroz e feijao suplementadas com retinol, metionina e cálcio e os níveis hepáticos de retinol e caroteno. (Mixtures of rice and beans supplemented with retinol, methionine and calcium and values for retinol and carotene in liver). Revista de Farmacia e Bioquímica da Universidade de Sao Paulo 15(1/2):131-147. 1977. Pt., Sum. En., Pt., 48 Ref.

Phaseolus vulgaris. Dietary value. Diets. Methionine. Ca. Brazil.

For 43 days 108 Wistar rats, initially 30 days old and weighing 45-46 g, were given diets in which protein was supplied by rice and beans in the ratio 3:1 without or with supplements of retinol, Ca, or met. singly or in different combinations. The diets were given freely or were restricted to 60 percent of free intake. Values for retinol and carotene in liver were nearest to those in rats given casein as protein source when all 3 supplements were added to the rice and bean diets. Ca and met. singly or together gave values for carotene in liver about double those for controls given casein but only Ca and retinol together increased retinol in liver to values approaching those in controls. (Summary by Nutrition Abstracts and Reviews)

0067

15889 YADAV, N.R.; TIENER, J.E. Optimizing the nutritive value of the protein of navy beans (*Phaseolus vulgaris*) by complementation with cereal proteins. Haryana, India, Agricultural Research Communication Centre, 1977. 10p. En., Sum. En., 28 Ref., II. Reprint from: Legume Research 1(1):17-26. 1977.

Phaseolus vulgaris. Proteins. Nutritive value. Digestibility. Food technology. Amino acids. Diets. Inhibitors.

A navy bean flour prepared by dry roasting in a salt bed as a medium of heat exchange was found to have a higher PER than beans which had been autoclaved in the conventional manner. This difference was attributed to a small but significant improvement in the digestibility of the protein. The PER of the roasted beans was higher than the autoclaved beans even in the presence of supplemental met. When various proportions of roasted beans and maize were fed at a level of 8.3 percent protein in the diet, a mixture in which 40-60 percent of the protein was provided by either beans or maize had a PER essentially the same as casein. Diets containing roasted beans and various cereal grains (oats, barley, buckwheat, wheat germ, and rice) were formulated in proportions calculated to give the highest chemical scores. In most cases the PERs were not significantly different from that of casein, and, in the case of rice, the PER was higher than that of casein. Supplementation of such diets with their 1st limiting amino acid failed to produce a further enhancement of the PER. (Author's summary)

0068

12631 BOOLORFOROOSHAN, M.; MARKAKIS, P. Protein supplementation of navy beans with sesame. Journal of Food Science 44(2):390-391. 1979. En., Sum. En., 11 Ref.

Phaseolus vulgaris. Proteins. Protein content. Diets. Laboratory animals. Analysis. Fat content. Ash content. Carbohydrate content. Amino acids.

Feeding expt. with weanling rats showed that the proteins of navy beans and sesame (*Sesamum indicum*) are mutually supplementary. Standard diets containing as the sole

source of protein: beans (B); sesame (S); and mixtures of 87.5 percent B protein + 12.5 percent S protein and 75% B protein + 25% S protein, and 50% B protein + 50 percent S protein resulted in the following PERs: 1.56, 1.19, 1.79, 2.26, and 2.30, resp., compared to 2.50 for casein. The NPR correlated almost perfectly ($r = 0.99$) with PER. The amino acid scores by the method A/E correlated highly with both PER and NPR ($r = 0.82$ and 0.81 , resp.). The amino acid scores by the method A/F correlated even better with PER and NPR ($r = 0.96$ and 0.97 , resp.). (Summary by Food Science and Technology Abstracts)

0069

14706 KON, S.; WAGNER, J.R. Simplified process makes legume-based foods. *Food Product Development* 13(7):47-49. 1979. En., 3 Ref., II.

Phaseolus vulgaris. Food production. Food technology. Food energy. Nutritive value. Dietary value. Protein content. Fat content. Storage. Deterioration.

Bean chips were prepared by soaking California small white beans for about 75 min at 90 degrees Celsius, passing them through a meat grinder; oat flour and hot water were added in a proportion of 1 g oat flour: 2 g soaked beans: 0.6 ml hot water, and the entire mass was mixed until dough developed. The dough was sheeted (1.3 mm), cut into round discs of 2.65 cm in diameter, dried in an oven equipped with air circulation for 10 min at 135 degrees Celsius, deep fried in a high oleic acid safflower oil, containing no preservatives, at about 200 degrees Celsius for 15 s. Analyses showed the bean chips to have 2.5 x the protein content of either maize or potato chips and only half the oil content of either. Because legumes are somewhat deficient in S containing amino acids they must be supplemented to obtain a nutritionally complete protein. California small white beans and oats complemented each other and have an acceptable amino acid pattern. The chips were packed in pouches, and stored at room temp. No off-flavour could be detected until the end of the seventh month. (Summary by Food Science and Technology Abstracts)

0070

13533 OBIZOBA, I.C.; EZIKWE, M.O.; AKAIKWE, B.N. Utilization of sorghum, wheat, and navy beans by human adults: protein metabolism. *Nutrition Reports International* 20(3):291-301. 1979. En., Sum. En., 18 Ref.

Phaseolus vulgaris. Diets. Human nutrition. N. Proteins.

In a preliminary study, 5 healthy college women, 19 to 25 yr old, were given 4 diets with mixed plant protein similar in N content in which whole wheat flour (WF), 3 var. of sorghum [Purdue normal (PN), high lysine (HLY), and Nigeria normal (NN)] and navy bean flour (B), in different combinations, provided 6.7 g N with 0.8 g N from foods low in N daily for 24 days. Mean daily balances were 0.52, 0.90, 1.00, and 2.14 g, resp., when WF:NN:HLY, WF:PN:B, WF:HLY, and WF:HLY:PN diets supplied the N. The mixtures induced different N balances sufficiently positive to cover integumental losses. Mean N balance of women given diet WF:HLY:PN (1:1:2) was significantly different from that of women given WF:NN:HLY (1:3:3) diet. Replacement of 15 percent HLY with NN decreased N balance. Excretion of 3-methylhistidine in urine was not affected by treatment. (Summary by Nutrition Abstracts and Reviews)

0071

14369 OBIZOBA, I.C. utilization of sorghum, wheat, and navy beans by human adults: mineral and vitamin metabolism. *Nutrition Reports International* 20(6):777-786. 1979. En., Sum. En., 34 Ref.

Phaseolus vulgaris. Human nutrition. diets. Protein content. Amino Acids. Ca. P. Mg. Fe. Vitamin content. Mineral content. Metabolism.

Five healthy college women, 19-25 yr old, were fed 4 isonitrogenous mixed plant protein diets in which whole wheat flour (WF); 3 var. of sorghum, Purdue normal (PN), high lysine (HLY), and Nigeria normal (NN), and navy bean flour (B), in various blends, provided 6.7 g N + 0.8 g N from low N foods daily for 24 days. Mean daily Ca balances were +147, +158, +250, and +188 mg/day, resp. Ca balances of subjects fed diets containing navy beans (WF:PN:B, 50:30:20) were higher than for those fed the other diets. However, this may be due to higher lysine intake provided by the mixture. diet WF:HLY (50:50) produced the lowest P balance due to high fecal excretion of the mineral. The mixture containing 70 percent WF had higher Mg content and induced more positive Mg balance during the exptl. period. The diet containing 50 percent sorghum and 50 percent wheat produced the lowest Fe balance, however, this might be attributed to higher phytate content of the diet. The mixture containing 70 percent WF induced higher niacin levels in the subjects, this may be due to higher dietary intake. The mean balances produced by the diets are higher than the normal range reported for this compound. The subjects fed WF:HLY:PN (25:25:50) diet had negative riboflavin balance. On the other hand, the same diet had higher folic acid content and induced higher balances of the nutrient in subjects fed the diet. (Author's summary)

0072

15479 ROCKLAND, L.B.; ZARAGOSA, E.M. 1979. Process for preparing mixed bean salads. United States Patent 4,159,351. 2p. Sum. En.

Phaseolus vulgaris. Cultivars. Food technology. Cooking. Human nutrition. USA.

Mixed bean salad is prepared by a process wherein different var. of beans are independently rendered quick-cooking and then independently precooked for a period of time sufficient to remove extractable pigments therefrom. The precooked beans, again independently, are cooled rapidly and then mixed together in a marinating liquid. Finally, the beans are finish-cooked in the marinating liquid. (Author's summary)

0073

18081 CONTRERAS, G.; ELIAS, L.G.; BRESSANI, R. 1981. Efecto de la suplementación con vitaminas y minerales sobre la utilización de la proteína de mezclas de maíz:frijol. (Effects of supplements of vitamins and minerals on protein utilization of maize and bean mixtures). Archivos Latinoamericanos de Nutrición 31(4):808-826. Es., Sum. Es., Eng., 11 Ref., II.

Phaseolus vulgaris. Laboratory animals. Proteins. Vitamin deficiencies. Human nutrition. Minerals and nutrients. Lysine. Methionine. Tryptophane.

For 4 wk., groups of 8 Wistar rats initially 21 days old had freely water and feed based on ground white maize and black beans at 87:13 or 70:30 with mineral mixture, vitamin solution, soybean oil, and cod liver oil. Diets contained protein 8.5 and 10.6 percent and the control had 10 percent casein. Thiamin, niacin, vitamin B₆, riboflavin, or vitamin A, or none or all of them were excluded. Omission of Fe, Zn, I, or Mg or of none or all of them was tested similarly. Effect of adding L-lysine, DL-met., and DL-tryptophan was tested in conjunction with the other treatments. Wt. gain and feed intake were monitored and utilizable protein was calculated. Utilization of protein was greater for 70:30 than for 87:13 with or without supplementary amino acids. Omission of the one nutrient such as Mg seemed as crucial as combined deficiency of all vitamins or all minerals; utilization of protein was consistently greatest when no vitamin or mineral was omitted. Addition of amino acids was effective only with complete supplies of vitamins, minerals, and energy. Carcass, but not liver, contained significantly more fat with 70:30 than with 87:13 mixture. (Summary by Nutrition Abstracts and Reviews)

0074

18535 DHAWARI, J.B.; KAMATH, P.S.; BATTI, R.P.; MUKHERJEE, S.; RAGHAVAN, S. 1981. Reduction of postprandial plasma glucose by bengal gram dal

(Cicer arietinum) and rajmah (Phaseolus vulgaris). *American Journal of Clinical Nutrition* 34(11):2450-2453. En., Sum. En., 15 Ref., Il.

Phaseolus vulgaris. Glucose. Human nutrition. Diets. Uses.

Postprandial plasma glucose levels were measured in 6 healthy (human) subjects at 0, 15, 30, 45, 60, 90, and 120 min after taking 50 g of carbohydrate in the form of wheat, rice, *Cicer arietinum*, and red kidney beans. The results were compared with the plasma glucose values obtained after taking 50 g dextrose. *C. arietinum* and red kidney beans, when compared with dextrose, were more effective in reducing postprandial plasma glucose levels than wheat and rice. The mean peak rise in plasma glucose was decreased by 82. percent with *C. arietinum* and 67 percent with red kidney beans, while wheat and rice showed reduction only by 25 and 16 percent, resp., when compared with dextrose. This study suggests a reappraisal of the diet for diabetics. (Author's summary)

0075

19087 NAVARRETE, D.A.; BRESSANI, R. 1981. Protein digestibility and protein quality of common beans (*Phaseolus vulgaris*) fed alone and with maize, in adult humans using a short-term nitrogen balance assay. *American Journal of Clinical Nutrition* 34(9):1893-1898. En., Sum. En., 11 Ref. (Inst. de Nutrición de Centroamérica y Panamá, Apartado Postal 1188, Carretera Roosevelt, Zona 11, Guatemala, Guatemala)

Phaseolus vulgaris. Human nutrition. Digestibility. Proteins. N. Diets. Composition.

In different studies 36 men, 23-35 yr old, were given common beans alone and in different forms and with maize as tortillas to measure N digestibility and to evaluate protein quality using a short term N balance assay. Digestibility of common bean protein was significantly lower than that of meat, and similar to that of a textured soybean protein. Forms of intake affected bean protein digestibility. Estimation of protein quality by the method of short term multiple intake showed that with feeding on beans alone, N equilibrium was reached with a daily N intake of 114 mg/kg body wt., whereas on a diet with beans and maize (87:13), equilibrium was reached with N intake of 98 mg/kg. The difference was attributed to a complementary protein effect and an increase in protein digestibility of the mixture. (Author's summary)

0076

17439 SATHE, S.K.; PONTE JUNIOR, J.G.; RANGNEKAR, P.D.; SALUNKHE, D.K. 1981. Effects of addition of Great Northern bean flour and protein concentrates on rheological properties of dough and baking quality of bread. *Cereal Chemistry* 58(2):97-100. En., Sum. En., 17 Ref., Il.

Phaseolus vulgaris. Protein. Bean flour. Uses. Bread making. Diets. Human nutrition.

Proteins from Great Northern beans were concentrated. The rheological and baking properties of a blend of wheat flour and protein concentrates were compared with those of a blend of wheat flour and bean flour. Addition of the bean flour or protein concentrates to wheat flours caused an increase in water absorption and a decrease in mixing time, dough stability, and mixograph peak height. Load extension curves for wheat flour-bean flour blends indicated a decreased resistance to extension with increased concn. of the bean flour. For a fixed bean flour level in the blend, however, resistance to extension increased with an increasing resting time. Addition of the bean flour at levels above 10 percent was detrimental to the dough and bread quality. However, breads prepared with added protein concentrates (equal to or less than 10 percent) were more acceptable than those prepared with added bean flour (equal to or less than 10 percent). (Author's summary)

0077

20093 VANNUCCHI, H.; DUARTE, R.M.F.; OLIVEIRA, J.E.D. DE 1981. Nutritive value of rice and beans based diet for agricultural migrant workers in southern Brazil. Nutrition Reports International 24(1):129-134. En., Sum. En., 6 Ref. (Univ. of Sao Paulo, School of Medicine of Ribeirao Preto, 14.100 Ribeirao Preto-SP, Brasil)

Phaseolus vulgaris. Diets. Nutritive value. Proteins. Digestibility. Brazil

Brazilian agriculture migrant workers were fed traditional rice and bean based diets, found to supply an av. 1.15 plus or minus 0.15 g of protein and 41.0 plus or minus 6.1 calories/kg of body wt. Metabolic studies carried out when they received this diet showed a mean true protein digestibility of 77.6 plus or minus 5.1 percent and a N balance of 6.47 plus or minus 15.25 mg/kg day. Mean and standard deviation of NPU were 35.0 plus or minus 6.4 percent. These results show a good nutritive value of this local diet. Its protein and energy utilization seems to cover the workers' need for these elements. (Author's summary)

0078

17485 ANGELIS, R.C. DE; ELIAS, L.G.; BRESSANI, R. 1982. Mezclas de arroz y frijol (55:45 y 77:23). 1. Valor nutricional de las proteínas de las mezclas. (Rice/bean mixtures (55:45 and 77:23). 1. Nutritive value of proteins in mixtures). Archivos Latinoamericanos de Nutrición 32(1):47-63. Es., Sum. Es., 18 Ref.

Phaseolus vulgaris. Uses. Diets. Nutritive value. Composition. Proteins. Laboratory experiments.

The nutritive value of rice/bean mixtures in proportions of 55:45 (B1) and 77:23 (B2) parts, resp. was studied using conventional methods (NPR, PER, NPU, utilization of protein calories, and protein utilization). Rats were fed diets containing 10 percent protein with or without supplements of powdered milk, cassava (75:25), starch (75 percent), sugar (25 percent), and oil (26 percent). Studies on the value of the cassava/milk supplement indicated that it improved the quality of both mixtures (B1 and B2) and a greater efficiency was observed at 28 days with the B2 mixture. However, the other supplements of B1 and B2 diets were not significantly different. There were no differences among the groups regarding biochemical parameters (plasmatic protein and albumin, and the ratio nonessential/essential amino acids). (Author's summary. Trans. by L.M.F.)

0079

17486 ANGELIS, R.C. DE; ELIAS, L.G.; BRESSANI, R. 1982. Mezclas de arroz y frijol (55:45 y 77:23). 2. Limitación de vitaminas liposolubles y minerales. (Rice/bean mixtures (55:45 and 77:23). 2. Limitation of minerals and liposoluble vitamins). Archivos Latinoamericanos de Nutrición 32(1):64-78. Es., Sum. Es., 6 Ref.

Phaseolus vulgaris. Uses. Diets. Vitamin content. Mineral content. Amino acids. Nutritive value.

The nutritive value of rice/bean mixtures in proportions of 55:45 parts was studied using the method of NPR, PER, NPU, protein utilization, and calorie intake. Supplementation with cassava and milk (CM) as well as with vitamins and minerals improved all indexes but the addition of only minerals or cod-liver oil gave better results but not to the same extent as with CM. No effect was observed with casein, met., or hydrosoluble vitamin supplementation. Ca and P were efficient in partially improving the indexes, especially by inducing an increase in appetite. It is suggested that the rice/bean mixture is limiting regarding its mineral (Ca and P) and liposolubles vitamin content. (Author's summary. Trans. by L.M.F.)

0080

17865 DEFOUW, C.; ZABIK, M.E.; UEBERSAX, M.A.; AGUILERA, J.M.; LUSAS, E. 1982. Effects of heat treatment and level of navy bean hulls in sugar-snap cookies. *Cereal Chemistry* 59(4):245-248. En., Sum. En., 11 Ref.

Phaseolus vulgaris. Seed coat. Heat treatment. Uses. Fibre content. Bean flour.

The effects of levels of navy bean hull incorporation and of navy bean heat treatment on the physical and sensory qualities of sugar-snap cookies were investigated. Levels of 0-30 percent substitution of navy bean hulls were substituted for flour. The hulls were either not roasted or subjected to 1 of 2 roasting temp.: 160 or 240 degrees Celsius. The major differences attributed to roasting were cookie color, moisture, and flavor. Flavor and physical characteristics, including top grain and spread, were adversely affected as the level of substitution increased. Approx. 0.2, 0.7, 1.2, and 1.7 g of dietary fiber was available per cookie with 0, 10, 20, and 30 percent navy bean hull substitution, resp. (Author's summary)

0081

18782 DeFOW, C.; ZABIK, M.E.; UEBERSAX, M.A.; AGUILERA, J.M.; LUSAS, E. 1982. Use of unheated and heat-treated navy bean hulls as a source of dietary fiber in spice-flavored layer cakes. *Cereal Chemistry* 59(3):229-230. En., 12 Ref. (Dept. of Food Science and Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Bean flour. Heat treatment. Uses. Dietary value. Nutritive value.

The use of navy bean hulls as an alternative source of dietary fiber in spice-flavored layer cakes was evaluated and hull flour from beans with no heat treatment was compared with that from beans roasted for 2 min at 240 degrees Celsius. Unheated and roasted bean hulls were substituted for flour in the cake formula at a level of 15 percent. Characteristics such as color, tenderness, texture, flavor, and general acceptability were evaluated. The addition of 15 percent navy bean hulls resulted in a thicker batter due to the high water absorbancy of the hulls. Cakes prepared with the roasted navy bean hulls tended to be slightly more moist and tender than the control, although these results were not significant. Consequently, navy bean hulls are an acceptable source of dietary fiber in flavored cakes. (Summary by EDHEC. Trans. by L.M.F.)

0082

19724 GARCIA-LOPEZ, S.; WYATT, C.J. 1982. Effect of fiber in corn tortillas and cooked beans on iron availability. *Journal of Agricultural and Food Chemistry* 30(4):724-727. En., Sum. En., 30 Ref. (Dept. of Food Science, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Fibre content. Fe. Animal nutrition.

Availability of Fe from a diet of corn tortillas and cooked beans with different levels of fiber was determined by hemoglobin repletion. Neutral detergent fiber (NDF) in corn tortillas and cooked beans and soluble, ionizable, and total Fe in the test foods were determined. Weanling male rats were fed an Fe-free diet until anemic and then divided into groups. The rats were fed diets with 0.5, 10, and 15 percent NDF and 25, 30, and 35 ppm of total Fe. Fe availability was significantly reduced by 15 percent NDF. The amount of Fe in the same diet affected Fe repletion. A significant correlation between soluble Fe and pH 1.35 in vitro and percentage efficiency of hemoglobin repletion was obtained. Fe from corn tortillas and cooked beans is approx. 50 percent less available than FeSO₄. (Author's summary)

29959 MYER, R.O.; FROSTH, J.A. 1983. Extruded mixtures of beans (*Phaseolus vulgaris*) and soybeans as protein sources in barley-based swine diets. *Journal of Animal Science* 57(2):296-306. En., Sum. En., 20 Ref. (Univ. of Florida, Agricultural Research Center, Marianna, FL 32446, USA)

Phaseolus vulgaris. Diets. Animal nutrition. Nutritive value. USA.

Two expt. were conducted to evaluate extruded mixtures of beans and soybeans as the sole source of supplemental protein in barley-based diets for starting and growing-finishing pigs. The substitution of extruded mixtures of beans and soybeans for SBM in the diet of young starting pigs (av. initial wt. of 7 kg) decreased av. daily gains slightly, with the decreases being significant (P less than 0.05) with 2 of the 6 mixtures; however, feed efficiency was improved significantly (P less than 0.05) with 1 mixture. Method of extrusion (separate vs. together), moisture treatment during extrusion (dry vs. wet extrusion), and proportion of beans and soybeans in the mixtures (1/3-2/3 vs. 2/3-1/3) did not affect (P greater than 0.05) performance of starting pigs. In growing pigs (from 22 to 54 kg), rate of gain was similar to or greater (P less than 0.05) for pigs fed various dry extruded bean-soybean mixtures ranging from 1/8 to 3/4 beans than that of pigs given SBM as the protein supplement; feed efficiency was not different (P greater than 0.05). There were no differences in performance (P greater than 0.05) of finishing pigs (from 54 to 90 kg) fed any of the dry extruded bean-soybean mixtures or SBM. Concurrent extrusion of beans and soybeans is an effective method of heat processing cull beans for use as protein supplements in growing-finishing swine diets. (Extracted from author's summary)

22673 MYER, R.O.; COON, C.N.; FROSTH, J.A. 1982. The nutritional value of extruded beans (*Phaseolus vulgaris*) and extruded mixtures of beans and soybeans in chick diets. *Poultry Science* 61(10):2117-2125. En., Sum. En., 27 Ref. (Univ. of Florida, Inst. of Food & Agricultural Sciences, Agricultural Research Center, Marianna, FL 32446, USA)

Phaseolus vulgaris. Nutritive value. Diets. Protein content. Amino acids. USA.

Two expt. were conducted to evaluate extruded small beans (recleaned culls) and extruded mixtures of beans and soybeans as protein sources in chick diets. In expt. 1, PERs were determined for 1-wk-old chicks fed diets for 2 wk containing all the protein (13 percent) from either SBM, extruded soybeans, autoclaved beans (121 degrees Celsius for 15 min), and 135 or 150 degrees Celsius extruded beans. All of the bean treatments, with or without supplemental met., resulted in lower (P less than 0.05) PER than the soybean treatments similarly supplemented. No differences (P greater than 0.10) in Per were noted between autoclaved or 150 degrees Celsius extruded bean treatments; however, 135 degrees Celsius extruded bean treatments resulted in lower (P less than 0.05) PER. In expt. 2, 1-day-old chicks fed diets containing 1/2 of the total dietary protein from extruded beans had lower (P less than 0.01) 2-wk gains and gain:feed ratios than chicks fed SBM. Chicks fed diets containing an extruded mixture of 1/3 beans + 2/3 soybeans with supplemental met. had similar 2-wk gains and higher (P less than 0.05) gain:feed ratios compared with chicks fed the SBM diet with supplemental met. Chicks fed diets containing an extruded mixture of 2/3 beans + 1/3 soybeans with supplemental met. had decreased (P less than 0.05) 2-wk gains but similar (P greater than 0.10) gain:feed ratios. The method of extrusion (separate or together) or moisture pretreatment during extrusion (dry or wet extrusion) of the bean and soybean mixtures had not effect (P greater than 0.10) on chick performance. In both expt., supplementation of diets with met. resulted in greater increases in wt. gain and gain:feed ratios for chicks fed the bean containing diets compared with chicks fed the soybean diets. Dry extrusion of beans and soybeans together, especially if the proportion of beans in the mixture is 1/3 or less, offers a practical and easy method for heat processing cull beans for use in poultry diets. (Author's summary)

19053 VARGAS, E.; BRESSANI, R.; ELIAS, L.G.; BRAHAM, J.E. 1982. Complementación y suplementación de mezclas vegetales a base de arroz y frijol. (Complementation and supplementation of rice- and bean-based vegetable mixtures). Archivos Latinoamericanos de Nutrición 32(3):579-600. Es., Sum. Es., 20 Ref., II.

Phaseolus vulgaris. Laboratory animals. Proteins. Nutritive value.

A series of expt. with lab. animals was carried out to determine the best complementation of rice and bean proteins; to measure possible protein differences of some bean var., both in terms of quality and quantity; and to quantify the effect of animal protein (meat or milk) and caloric (oil) supplementation on the nutritive value of rice- and bean-based mixtures. Three black bean var. (Suchitán, Turrialba, and S-19 N) and on cof white polished rice were evaluated by partially substituting, by stages, the proteins of one grain for that of the other. Diets for young rats were prepared with these mixtures, evaluating the complementary effect of each bean var. combined with rice by the NPR. Results indicated that rice and bean proteins were complementary when rice supplied 90:40 percent of the protein in the diet and beans, 10:60 percent. It was also found that bean var. S-19-N contains more good quality protein than the other 2 var. studied. The relative protein value of the 60:40 rice:bean mixture, on a protein basis (optimum mixture), was 87 percent that of casein when var. S-19-N was used. The 60:40 mixture and a 35:65 rice:bean mixture, on a protein basis, were supplemented with milk or meat protein, replacing the vegetable protein as levels of 0, 5, 10, and 15 percent. The caloric density of the mixture was also increased 0, 7, 14, and 21 percent over a basal value of 360 kcal/100 g. The NPR was used as a measure of protein quality of diets for 21 to 23-day-old rats. Results revealed that meat and bean constitute supplements of equal quality for mixtures prepared on a rice and bean basis. For the 60:40 mixture there was no positive effect of protein supplementation. The 35:65 equivalent to that of the 60:40 mixture with the 15 percent supplementation level. Both mixtures were slightly favored by the 7 percent energy supplementation. Even though feed consumption, and protein and energy contents in animals receiving the 60:40 mixture were higher than 100 percent compared with those fed casein, the NPR, wt. gain, and feed conversion were only 88, 87, and 82 percent those of casein. Consumption, cost, and cultivated area required to maintain N equilibrium of an adult population fed beans and rice, with or without the milk supplement, were calculated.

23618 MERINO, G.; LAREO, L.; BRESSANI, R. 1983. Evaluación del potencial nutricional del pescado en dietas a base de frijol (*Phaseolus vulgaris*) y un cereal [maíz (*Zea mays*)] y/o arroz (*Oriza sativa*). (Nutritional potencial of fish in diets based on beans and a cereal [maize and/or rice]). Nutritional potential of fish in diets based on beans and a cereal (maize and/or rice). Archivos Latinoamericanos de Nutrición 33(3):588-605. Es., Sum. Es., En., 15 Ref., II.

Central America. Diets. Human nutrition. Nutritive value. *Phaseolus vulgaris*.

The complementation between maize and fish and between rice and fish was evaluated to establish the required level of each in order to obtain an optimum biological response. The optimum levels of fish were around 2 and 8 percent for the maize and rice diets, resp. Complementary levels of fish in the bean:maize and bean:rice diets, basic staples of Central American diets, were evaluated in the same manner; levels as low as 2 percent fish were sufficient to obtain a significantly high biological response. The cost analysis of these expt. mixtures revealed that the nutritional value of the Central American rural diets can be increased with the introduction of fish in small quantities, without increasing the family food expenses. (AS)

23984 NIELSEN, B.; HEVIA, P.; BRITO, O. 1983. Study on the complementation of two proteins of low quality: black bean (*Phaseolus vulgaris*) and sesame (*Sesamum indicum* L.). *Journal of Food Science* 48(6):1804-1806. En., Sum. En., 26 Ref. (Univ. Simón Bolívar, Depto. de Tecnología de Procesos Biológicos y Bioquímicos, Apartado 80.659, Caracas 1080-A, Venezuela)

Proteins. Laboratory animals. Diets. Venezuela. Human nutrition. South America. America.

To determine the complementary potential of black bean and sesame proteins, female rats were fed diets with 10 percent protein from black bean, sesame, or combinations of these. Data showed that diets with these proteins combined had better quality than either protein alone. Max. protein quality was observed when the 2 protein sources were mixed in a 1:1 (wt./wt.) ratio. This mixture had PER and NPR values 2 and 5 times higher, resp., than those of the black bean protein alone and 61 and 71 percent of the values of PER and NPR, resp., obtained with a casein diet. Also, there was no alteration of serum or liver lipids. (AS)

20808 MYER, R.O.; FROSETH, J.A. 1983. Heat-processed small red beans (*Phaseolus vulgaris*) in diets of young pigs. *Journal of Animal Science* 56(5):1088-1096. En., Sum. En., 33 Ref. (Univ. of Florida, Agricultural Research Center, Marianna, FL 32446, USA)

Phaseolus vulgaris. Diets. Animal nutrition. Proteins. Amino acids. enzymes. Digestibility. Processing. USA.

For 4 wt. 64 pigs weighing 9.9 kg initially were given a diet based on maize and soybean oil meal with 15 percent raw red beans, autoclaved (121 degrees Celsius for 15 min) or extruded (150 degrees Celsius for 16 s). Pigs given raw beans showed creased pancreatic trypsin, chymotrypsin and amylase activities, serum alkaline phosphatase activity, and serum albumin concn. as well as increased liver wt. as a percentage of body wt. and serum urea concn. Autoclaving or extruding the beans overcame those effects. Inclusion of 40 percent autoclaved or extruded beans in the basal diet decreased daily gain. Met. supplementation of autoclaved beans gave a feed:gain ratio similar to that for pigs given the basal diet. When all protein was supplied by extruded or autoclaved beans, apparent digestibilities of CP, and total S and most individual amino acids decreased, N in urine and sulphate excretion increased, and N retention decreased. Extrusion gave higher values for apparent digestibilities of protein and most amino acids than did autoclaving. (Summary by Nutrition Abstracts and Reviews)

24235 SANCHEZ, W.K.; CHEERE, P.R.; PATTON, N.M. 1983. utilization of raw and heat-treated Pinto beans by weanling rabbits. *Journal of Applied Rabbit Research* 6(4):139-141. En., Sum. En., 15 Ref., II. (Oregon State Univ., Rabbit Research Center, Corvallis, OR 97331, USA)

Animal nutrition. Diets. USA. North America. America.

Raw and autoclaved Pinto beans were evaluated as protein sources in diets for weanling New Zealand white rabbits. These feedstuffs were unpelleted in trial 1 and pelleted in trial 2. Rabbits given control, raw bean, or autoclaved bean diets (unpelleted) took 139.3, 87.2, and 93.8 g daily, gained an av. 35.7, 14.4, and 21.9 g body wt./day, and used feed 3.9, 6.1, and 4.3 g/g gain. Of the same diets pelleted they took 122.9, 68.7, and 72.8 g, gained 38.6, 10.1, and 20.2 g, and used feed 3.2, 6.8, and 3.6 g/g gain. Feed efficiency (feed/gain) was poorer (P 0.05) for raw Pinto beans than for the other groups. Results indicated severe growth depression with raw Pinto beans, which was partially overcome by autoclaving. Pelleting the diets did not increase their feeding value. (AS)

0090

22235 VOHRA, P. 1983. Nutritional evaluation of some varieties of *Phaseolus vulgaris*. In Farrell, D.J.; Vohra, P., eds. Recent advances in animal nutrition in Australia, 1983. Armidale, University of New England Publishing Unit. pp.274-285. En., Sum. En., 34 Ref. (Dept. of Avian Sciences, Univ. of California, Davis, CA 95616, USA)

Phaseolus vulgaris. Cultivars. Nutritive value. Composition. Amino acids. Ash content. Protein content. Seed color. USA.

Studies were carried out at the U. of California-Davis (USA), to screen the nutritional value of white and colored bean var. and their fractions by using the larvae of the insect *Tribolium castaneum*. Var. differences were observed in their amino acid profiles. Beans, in general, were deficient in met. Even after met. supplementation, var. differences in nutritive value of beans were observed that were not correlated to bean color. For screening nutritional value, the growth of the tribolium larvae can be used for bioassay. (Extracted from author's summary)

0091

23972 VANNUCCHI, H.; DUARTE, R.M.F.; OLIVERIA, J.E.D. DE. 1983. Studies on the protein requirement of Brazilian rural workers ("hoias Irias") given a rice and bean diet. *International Journal for Vitamin and Nutrition Research* 53(3):338-344. En., Sum. En., 12 Ref., II. (Univ. of Sao Paulo, Division of Clinical Nutrition, Medical School of Ribeirao Preto, 14.100 Ribeirao Preto-SP, Brasil)

Nutritive value. Dietary value. Food energy. Brazil. Human nutrition. South America. America.

The nutritive value of a multiple level rice and bean diet fed to Brazilian migrant workers was evaluated. Nine healthy males, 18-28 yr old were admitted to the metabolic unit for a 3-period metabolic balance study. The rice and bean based diet was fed at levels to provide 0.4, 0.6, or 0.8 g of protein/kg body wt. Mean energy intake for the 3 levels of intake and for all subjects was 46.9 ± 2.9 kcal/kg body wt./day. Each N balance period consisted of 1 day on a N-free diet, 5 days on an adaptation period and 5 days on the balance period. True digestibility, true N balance, BV, and NPU were calculated. Mean protein requirements were estimated by regression analysis of pooled data of balances at different levels of intake. Values of 103.8 N/kg body wt./day were shown. Mean and standard deviation for protein digestibility at each level of intake were 59.2 ± 17.0 , 75.5 ± 5.3 , and 74.9 ± 10.6 percent, resp. Mean and standard deviation for NPU were 49.9 ± 26.3 , 55.6 ± 10.6 , and 57.8 ± 14.4 , resp. A rice and bean diet is a well balanced food combination and can serve as a fairly good source of protein for the adult human. (AS)

0092

23933 WYCKOFF, S.; VOHRA, P.; KRATZER, F.H.; CALVERT, C.C. 1983. Nutritional evaluation of four varieties of colored and one of white beans (*Phaseolus vulgaris*) for Japanese quail. *Poultry Science* 62(8): 1576-1586. En., Sum. En., 33 Ref. (Dept. of Avian Sciences, Univ. of California, Davis, CA 95616, USA)

Seed color. Nutritive value. Animal nutrition. Water content. Ash content. Fat content. Protein content. Amino acids. Diets. USA. Seed characters. Composition. North America. America.

The nutritional values of 1 white bean and 4 colored bean var. were determined using a quail growth assay. The beans contained 7.2-7.5 percent MC, 3.7-6.0 percent ash, 2.1-2.7 percent lipid, and 21.9-25.3 percent protein. The amino acid profile of the beans was also determined. Lys was highest in bean var. Small White and Black Turtle Soup (89.8 and 90.7/mg, resp.). The nutritional value of small White in a test diet containing 24 percent protein, without additional met., was superior to colored beans. When 0.4 percent met.

was supplemented, this nutritional difference disappeared. Small white bean elicited the poorest growth response when incorporated at a level of 70 percent in test diets containing 24 percent protein and 0.4 percent met. air-dried residues of the Small White bean, extracted with either water or 80 percent methanol, were lethal to growing quail, adult quail, and growing rats. (AS)

0093

24705 BRESSANI, R.; NAVARRETE, D.A.; ELIAS, J.G. 1984. The nutritional value of diets based on starchy foods and common beans. *Qualitas Plantarum Plant Foods for Human Nutrition* 34(2):109-115. En., Sum. En., 18 Ref. (Inst. of Nutrition of Central America & Panama, P.O. Box 118, Guatemala City, Guatemala)

Nutritive value. Laboratory animals. Diets. Proteins. Guatemala. Human nutrition. Animal nutrition. Central America. America.

Feeding trials were carried out to determine the min. amount of common beans, with and without met. supplementation, needed to obtain positive wt. gains or rats fed cassava, sweet potato, plantain, and potato flour. The protein content of these materials was 1.4, 3.8, 3.1, and 9.5 percent on a dry wt. basis compared with 22.8 percent in common beans. The amount of beans added varied from 0 to 40.0 percent, without and with 0.3 percent met. Without met. addition, the amount of beans required to maintain body wt. was 24.8, 19.3, 20.0, and 40.1 percent for plantain, cornstarch, cassava, and sweet potatoes, resp. With just potato flour in the diet, the animals gained wt. With met. addition, the amount of beans required for body wt. maintenance was 20.1, 10.1, 14.5, 14.6, and 29.3 percent for plantain, cornstarch, cassava, potato, and sweet potatoes, resp. Mixtures of potatoes with as little as 10 percent beans with met. gave excellent protein quality values. The results confirm previous findings on S amino acid contents of beans. It is of interest to point out that factors other than a low level of protein in the starchy food tested are influencing the level of beans needed in the presence or absence of met. supplementation. (AS)

0094

26251 BRESSANI, R.; HERNANDEZ, E.; NAVARRETE, D.; BRAHAM, J.E. 1984. Protein digestibility of methionine supplemented common beans (*Phaseolus vulgaris*) in adult human subjects. *Archivos Latinoamericanos de Nutrición* 34(4):640-653. En., Sum. En., Es., 17 Ref. (Inst. of Nutrition of Central America & Panama, Guatemala, Guatemala)

Cultivars. Digestibility. Guatemala. Human nutrition. Methionine. *Phaseolus vulgaris*. Proteins.

Protein digestibility of 5 common bean cv. of different color was tested in young adults, as the only dietary protein source. Cheese protein was used as reference protein. The cooked beans provided 0.65 g protein/kg daily, and energy intake was adjusted to 45 kcal/kg daily. Met. was added at 0.5 percent of ingested protein. Results indicated apparent protein digestibility to vary from 49.6 to 62.1 percent. White-colored beans had the highest value; black beans gave the lowest. Cheese protein showed an apparent protein digestibility of 76.2 percent. The true protein digestibility was calculated using the endogenous N excretion values obtained in the study, as well as literature values. Digestibility increased as expected, but was still low compared with other protein sources. A high correlation was found between digestibility of DM and protein digestibility. Fecal N was fractionated between soluble and insoluble N in a 0.02 N NaOH solution. The soluble N fraction was highly correlated with protein digestibility, with a correlation coefficient of -0.94. This fraction, still to be identified, could very well be responsible for the low digestibility values found for common beans in man. (Nutrition Abstracts and Reviews)

24406 HOOJJAT, P.; ZABIK, M.E. 1984. Sugar-snap cookies prepared with wheat-navy bean-sesame seed flour blends. *Cereal Chemistry* 61(1):41-44. En., Sum. En., 17 Ref. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Processed products. Palatability. Dietary value. USA. North America. America.

Sugar snap cookies were prepared with 20 and 30 percent navy bean-sesame seed flours substituted for wheat flour. Navy bean-sesame combinations were 20:0, 15:5, 10:10, 5:15, and 0:20 for 20 percent substitutions, and 30:0, 20:10, 15:15, 10:20, and 0:20 (wt./wt.) for 30 percent substitutions. Cookie spread and top grain scores were reduced as the percentage of navy bean and/or sesame flour alone were tough, and more force was needed to compress and break them. The force required to break and shear the cookies decreased with increasing levels of navy bean flour. Cookies containing up to and including 20 percent navy bean flour were scored above 4 on a 7-point scale by most sensory panelists. Panelists gave low scores to the flavor of cookies containing more than 10 percent sesame flour. Cookies with 20 percent substitution had better baking properties and organoleptic characteristics than did those with 30 percent substitution. (AS)

26370 NAVARRETE, D.A.; GUTIERREZ, O.M.; BRESSANI, R. 1984. Digestibilidad, valor proteínico y necesidades de proteína de dietas a base de plátano/ frijol en jóvenes adultos. (Digestibility, protein value, and protein requirements of plantain-bean and cassava bean diets in young men). *Archivos Latinoamericanos de Nutrición* 34(4):654-665. Es., Sum. Es., 17 Ref. (Inst. de Nutrición de Centro América y Panamá, Guatemala, Guatemala)

Diets. Digestibility. Guatemala. Human nutrition. Nutritive value. *Phaseolus vulgaris*. Proteins.

The short-term N balance method with multiple intakes was used with groups of 10 men on av. 24.8 yr old given a diet based on cassava or plantain without or with beans so that protein intake was 0, 0.2, 0.4, and 0.6 g/kg daily. Even with intakes of N of 105.7 and 117.4 mg/kg daily, the men did not reach positive balance. Protein digestibility was 55.7 percent for the cassava-bean diet and 50.4 percent for the plantain-bean diet. Mean N intake required to reach N equilibrium for the cassava-bean diet was 114.3 mg/kg daily, varying from 81.3 to 172.4 mg/kg, and for the plantain-bean diet 111.9 mg/kg daily, varying from 83.6 to 219.3 mg/kg. In 4 of 5 men who took part in both studies, the N intake required to reach N equilibrium was greater with the plantain-bean than with the cassava-bean diet. [AS (extract)]

26561 VARGAS, J.E.; BRESSANI, R.; NAVARRETE, D.A.; BRAHAM, J.E.; ELIAS, L.G. 1984. Efecto de la suplementación de proteína animal y energía en la calidad proteínica de dietas a base de arroz y frijol en hombres adultos. (Effect of animal protein and energy supplementation on protein quality of diets based on rice and beans in adult men). *Archivos Latinoamericanos de Nutrición* 34(1):46-68. Es., Sum. Es., En., 23 Ref. (Inst. Costarricense de Investigación y Enseñanza en Nutrición y Salud, Apartado 4, Tres Ríos, Costa Rica)

Diets. Guatemala. Human nutrition. *Phaseolus vulgaris*. Protein content.

For 10 days men were given a diet in which rice and beans supplied 60 and 40 percent of protein, resp., and 46 kcal Me/kg daily. Regression coefficient between ingested N and N balance was 0.76 plus or minus 0.11, and N for maintenance was 96.2 plus or minus 13.7 mg/kg daily. When the same diet was given at 51.2 kcal Me/kg daily, the regression coefficient was 0.80 plus or minus 0.13 and N for maintenance 90.1 plus or minus 8.7

mg/kg daily. Differences between the 2 expt. were not significant. When 10 percent of the protein in the diet was replaced by milk protein and given at 45.2 kcal Me/kg daily, the regression coefficient was 0.96 plus or minus 0.08 and N for maintenance 78.6 plus or minus 10.2 mg/kg daily. These values were significantly different from the previous ones. When the same was given at 48.9 kcal Me/kg daily, regression coefficient was 0.86 plus or minus 0.7 and N for maintenance 82.4 plus or minus 10.2 mg/kg daily. (Nutrition Abstracts and Reviews)

0098

26571 VARGAS, E.; BRESSANI, R.; NAVARRETE, D.; BRAHAM, J.E.; ELIAS, L.G. 1984. Digestibilidad de la proteína y energía de dietas elaboradas a base de arroz y frijoles en humanos adultos. (Digestibility of protein and energy in diets based on rice and beans for adult persons). Archivos Latinoamericanos de Nutrición 34(1):109-129. Es., Sum. Es., En., 15 Ref., Il. (Inst. Costarricense de Investigación y Enseñanza en Nutrición y Salud, Apartado 4, Tres Ríos, Costa Rica)

Diets. Digestibility. Guatemala. Phaseolus vulgaris. Proteins.

For periods of 10 days 10 men were given diets based on rice and beans to supply 46, 72, or 103 mg N/kg daily. When the basal diet (rice provided 60 and beans 40 percent of the protein) was given at 103 mg N/kg and gross energy 50 kcal/kg daily, apparent and true digestibility of N was 59.1 and 70.8 percent, resp., digestibility of energy was 93.8 and of Me 92.5 percent. when 10 percent of the plant protein was replaced by milk protein, corresponding values were 65.3, 76.8, 93.5, and 92.1 percent. When gross energy of the diet was increased from 45 to 70 kcal/kg daily there was no effect on N or energy absorption. Apparent digestibility of N increased significantly when the amount of N in the diet was increased and stabilized when N intake exceeded 100 mg/kg daily. (Nutrition Abstracts and Reviews)

0099

23631 WILLIAMS, K.C.; NEILL, A.R.; MAGEE, M.H. 1984. The nutritional value of navy bean (*Phaseolus vulgaris*) following autoclaving or dry extrusion as a mixture with soya beans for growing pigs. Proceedings of the Australian Society of Animal Production 15:635-638. En., Sum. En., 6 Ref. (Dept. of Primary Industries, Animal Research Inst., Yeerongpilly, Qld. 4105, Australia)

Nutritive value. Digestibility. Animal nutrition. Diets. processing. Australia. Dietary value. Oceania.

The apparent digestibilities of DM, OM, CP, and energy estimated by substitution were 83.9, 85.9, 87.6, and 84.9 percent for a blend (55:45) of navy bean and soybean (NB-SOY) extruded at 146 degrees Celsius; 93.5, 93.9, 97.6, and 94.8 percent for full-fat soybean (FF-SOY) extruded at 140 degrees Celsius; and 93.9, 94.7, 94.0, and 93.3 percent for navy bean (NB) autoclaved at 126 degrees Celsius for 15 min, resp. The nutritive value of isoenergetic levels of these processed beans, raw NB-SOY and NB-SOY extruded at 121, 135, or 157 degrees Celsius was assessed in a pig growth test. The raw NB-SOY diet caused severe scouring and was given only for 2 wk. Growth rate and feed conversion of pigs fed on extruded NB-SOY improved as the extrusion temp. increased to 135 degrees Celsius but declined with higher temp. The nutritive value of isoenergetic levels of autoclaved NB and extruded FF-SOY was similar and significantly better than all extruded NB-SOY supplements apart from that extruded at 135 degrees Celsius. (AS)

0100

23916 WILLIAMS, P.E.V.; PUSZTAI, A.J.; MACDEARMID, A.; INNES, G.W. 1984. The use of kidney beans (*Phaseolus vulgaris*) as protein supplements in diets for young rapidly growing beef steers. Animal Feed Science and Technology 12(1):1-10. En., Sum. En., 11 Ref., Il. (Rowett Research Inst., Bucksburn, Aberdeen, AB2 9SB, England)

Diets. Nutritive value. Proteins. Dietary value. United Kingdom. Animal nutrition.

Rolled barley was pelleted with supplementary minerals and vitamins (diet 1), with supplements for SBM (diet 2), or with 50 or 75 percent of the supplementary protein supplied by soybean being replaced by protein from kidney bean cv. Processor (diets 3 and 4, resp.). CP content of diet 1 was 11.5 percent of the DM, and in diets 2, 3, and 4, it was approx. 15 percent. In trial 1, groups of 4 steers with a mean live wt. of 203 ± 4.8 kg were allocated to each of the dietary treatments. Blood samples were obtained from these steers before they received the exptl. diets, and 10 and 13 days after they were introduced to the diets. Four days after the steers were offered the diets, 6 out of the 8 steers given diets containing kidney beans were excreting loose watery feces. All steers given diets containing kidney beans developed antilectin antibodies to a varying extent by day 13 of the trial. In trial 2, the pelleted diets used in trial 1 were offered with 2 kg hay/day to groups of 8 steers of similar type and wt. over a 60-day period; the live wt. gains of steers offered diets 1, 2, 3, and 4 were 1.06, 1.28, 1.05, and 0.86 ± 0.11 kg/day, resp. Steers consumed significantly less pellets containing kidney beans, diets 3 and 4 giving intakes of 6.5 and 6.2 kg/day, resp., compared with 6.8 and 7.1 kg/day for diets 1 and 2, resp., compared with 6.8 and 7.1 kg/day for diets 1 and 2, resp. Food conversion efficiency of steers on diets 1, 2, 3, and 4 was 6.5, 5.6, 6.3, and 8.5, resp. Incorporating kidney bean in the diets of yearling cattle was detrimental to the health of the cattle and depressed daily live wt. gains. (AS)

0101

27076 WULF M., H.; CAFATI K., C.; YANEZ, F. 1984. Mejoramiento del valor nutritivo del pan con harina de frejol. (Improvement of the nutritive value of bread with bean flour). *Semente* 54(1-2):3-5. En., Sum. En., Es., 5 Ref. (Inst. de Investigaciones Agropecuarias, Estación Experimental La Platina, Casilla 5427, Santiago, Chile)

Phaseolus vulgaris. Cultivars. Starch content. Bean starch. Processing. Chile.

To improve the nutritive value of bread 2, 4, 6, 8, and 10 percent bean flour was substituted for wheat flour. The influence of the bean flour on the farmological characteristics of the dough and on the different parameters of bread quality were analyzed. Increases in bread yield and in protein percentage were obtained with the addition of bean flour. when bean flour substituted wheat flour up to 6 percent, no important alterations of the organoleptic and physical-mechanical properties of the dough or of bread quality were observed. Future studies should examine the chemical changes in bread composition, its nutritive value in rat assays, its sensorial characteristics, and consumer acceptability. (AS)

0102

30643 ANGELIS, R.C. DE; FIORE, P.A.; BESSON, R.; VODOZ, G.; ROGANO, R.N.; GIULI, G.G.; VECCHIA, M.G. 1985. Bioavailability of mineral elements in the Brazilian basic food system of rice and beans. *Nutrition Research* 5(9):969-981. En., Sum. En., 30 Ref. (Centro de Nutricao, Depto. de Fisiologia e Biofisica, Inst. de Ciencias Biomedicas da Universidade de Sao Paulo, Caixa Postal 04365, 01.000 Sao Paulo-SP, Brasil)

Phaseolus vulgaris. Laboratory animals. Diets. Nutritive value. Zn. Ca. Brazil.

A mineral balance sheet and a fortification test were used to detect the limiting minerals and trace elements in 10-day diets of rice and red beans (RB) or RB supplemented with milk (RBM), fed to 20 male Wistar weanling rats. Body wt. gain, food intake, and food conversion efficiency were significantly higher in RBM groups than in Rn ones. The balance sheet indicated negative retention of Mn, Fe, Zn, Ca, Co., Cu, Cr., Mo, and P in the RB group, with a significant improvement only for Ca in the RBM group. Fortification of the RB diet with Ca and P, or with Zn enhanced the growth rate; this is attributed to the low level of Ca in the RB diet and to the low bioavailability of Ca and Zn in the presence of phytic acid and fiber. (AS)

28245 RULISANI, E.A. 1985. O cultivar de feijao Carioca 80 (bean cultivar Carioca 80). *O Agronomico* 37(3):165-166. Pt., 2 Ref. (Secao de Leguminosas, Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brasil)

Phaseolus vulgaris. Seed. Amino acids. Proteins. Digestibility. Nutritive value. Brazil.

Bean cv. Carioca 80 resulted from the cross between cv. Carioca and an American line, Cornell 49242. It was selected for its resistance to anthracnose, rust, and BCMV. Carioca 80 plants have a more erect architecture than Carioca plants. The evaluation of the nutritional value of Carioca 80 seeds revealed a BV of above 80, and a protein digestibility of 72 percent. Large-scale cultivation of this cv. is recommended for the State of Sao Paulo, Brazil. (CIAT)

26091 FLEMING, S.E.; O'DONNELL, A.U.; PERMAN, J.A. 1985. Influence of frequent and long-term bean consumption on colonic function and fermentation. *American Journal of Clinical Nutrition* 41(5):909-918. En., Sum. En., 31 Ref., II. (Dept. of Nutritional Sciences, Univ. of California, Berkeley, Ca, USA)

Dietary value. Diets. Fatty acids. *Phaseolus vulgaris*. USA.

The influence of frequent and long term consumption of legume seeds on colonic function was investigated. Two groups of subjects were studied: 1 group habitually consumed legume seeds as part of their normal diet and the 2nd group seldom consumed legumes. No differences between these groups could be detected for fecal output and frequency, intestinal transit time, VFA excretion, or fecal pH during 23 day study periods in which subjects consumed either their usual diet or 100 g red kidney beans, daily. The addition of beans to the diets of both groups provided significantly more dietary fiber and produced greater fecal output and a higher concn of VFA in feces. Fecal output was determined by 2 independent parameters, dietary fiber intake and VFA excretion. Beans provided a physiologically useful source of dietary fiber and favorably influenced colonic function. (AS)

27266 VARGAS, E.; BRESSANI, R.; NAVARRETE, D.A.; BRAHAMI, J.E.; ELIAS, L.G. 1985. Nueva alternativa para el cálculo de recomendaciones de ingesta de proteína en humanos. Necesidades de proteína de una población adulta alimentada con dietas a base de arroz y frijol. (A new approach to estimate recommended dietary protein intake in man. Protein requirements of an adult population given diets based on rice and beans). *Archivos Latinoamericanos de Nutrición* 35(3):394-405. Es., Sum. Es., En., 12 Ref. (Inst. Costarricense de Investigación y Enseñanza en Nutrición y Salud, Tres Ríos, Costa Rica)

Phaseolus vulgaris. Diets. Human nutrition. Proteins. Costa Rica.

A new approach to estimate the protein needs of a population is proposed; recommendations are made on the protein intake of adults given diets based on rice and beans. N balance data previously reported for 40 adults who had participated in 160 N balance periods given diets based on rice and beans, with and without animal protein and/or energy supplementation, were used. The method is based on the curvilinear response between N intake and N balance. The 2nd-degree equation describing the relation between N balance and intake is calculated. When values obtained by means of the quadratic equation were compared with those obtained by the traditional linear equation, they were similar (P less than 0.05) for the 2 calculation methods. The recommended protein intake of an adult population given a diet based on rice and beans was 0.80 and 0.77 g/kg daily for the quadratic approach and the conventional method, resp. When this diet was supplemented with 10 milk protein and with the same energy value, the calculated protein values were 0.65 and 0.71 g/kg daily for the 2 methods. Intakes of each and all essential

amino acids met values, with the exception of isoleucine and the S-containing amino acids. [AS (Extract)]

0106

28936 BAHNASSEY, Y.; KHAN, K. 1986. Fortification of spaghetti with edible legumes. 2. Rheological, processing, and quality evaluation studies. *Cereal Chemistry* 63(3):216-219. En., Sum. En., 20 Ref. (Dept. of Cereal Science & Food Technology, North Dakota State Univ., Fargo, ND 58105, USA)

Phaseolus vulgaris. Laboratory animals. Diets. Nutritive value. Zn. Ca. Brazil.

Spaghetti was prepared from durum wheat semolina, blended with 3 percent vital wheat gluten, and fortified with 0, 5, 10, 15, 20, and 25 percent of nonroasted or roasted navy, Pinto, or lentil flours or their protein concentrates, to increase protein quantity. Supplementing semolina with legume flours or protein concentrates caused an increase in farinograph water absorption except for blends containing 25 percent of nonroasted and roasted Pinto bean flour, in which a slight decrease was noticed. Dough development time and stability were higher for blends containing navy or Pinto bean flour or protein concentrates. Fortified spaghetti shattered earlier than control spaghetti. Cooking loss of fortified spaghetti was higher as the level of substitution increased and higher for spaghetti containing protein concentrates than for spaghetti containing legume flours. Firmness scores of fortified spaghetti increased with level of fortification. Taste panel evaluation showed that spaghetti supplemented with up to 10 percent of legume flours or protein concentrates was acceptable for all parameters tested. All panel members showed preference for spaghetti containing legume flours over spaghetti containing protein concentrates; however, spaghetti containing 10 percent protein concentrates was also acceptable. Spaghetti made from roasted samples was preferred. A beany taste was reported for spaghetti containing 25 percent of nonroasted legume flours or protein concentrates. (AS)

0107

28935 BAHNASSEY, Y.; KHAN, F.; HARROLD, R. 1986. Fortification of spaghetti with edible legumes. 1. Physicochemical, antinutritional, amino acid, and mineral composition. *Cereal Chemistry* 63(3):210-215. En., Sum. En., 24 Ref. (Dept. of Cereal Science & Food Technology, Fargo, ND 58105, USA)

Phaseolus vulgaris. Bean flour. Protein content. Ash content. Fiber content. Fat content. Mineral content. USA.

Legume flour was obtained by dry milling nonroasted and roasted seeds of navy bean, Pinto bean, and lentil. Protein concentrates were extracted from the legume flours by acid precipitation from dilute alkali solution. Comparison of the chemical composition of the legume flours and their protein concentrates with durum wheat semolina showed that all legume flour contained significantly higher protein, ash, fiber, and fat contents than durum semolina. Fortified spaghetti was prepared from blends of legume flour or protein concentrates with a strong gluten durum semolina. Protein, ash, and fiber contents of the fortified spaghetti exceeded the levels for the control spaghetti. Navy bean contained the highest amount of trypsin inhibitor and hemagglutinin activity, followed by Pinto bean and lentil. Legume flours also contained higher levels of both activities than protein concentrates. Legume flours and their protein concentrates had a relatively higher level of most amino acids than durum semolina. Mineral content of legume flour, protein concentrates, and fortified spaghetti was considerably higher than that of the semolina or control spaghetti. [AS (Extract)]

0108

29689 BLANCO, A.; NAVARRETE, D.A.; BRESSANI, R.; BRAHAM, J.E.; GOMEZ-BRENES, R.; ELIAS, L.G. 1986. Composición química y evaluación de la calidad de la proteína del frijol en humanos adultos por el método de balance nitrogenado

de corto tiempo. (Evaluation of the chemical composition and quality of bean protein in human adult by the short-term nitrogen balance method). Archivos Latinoamericanos de Nutrición 36(1):79-97. Es., Sum. Es., En., 25 Ref. II. (Inst. de Nutrición de Centro América y Panamá, Guatemala, Guatemala)

Phaseolus vulgaris. Cultivars. Proteins. Analysis. Water content. Mineral content. N. Inhibitors. Tannin content. Phytohemagglutinins. Fiber content. Antinutritional factors. Diets. Nutritive value. Guatemala.

Three common bean var. were chemically analyzed and their protein quality was evaluated in 12 human male adult subjects by the short-term N balance method. chemical analyses were performed for both raw and cooked grains. Cooking reduced the trypsin inhibitors by 28-73 percent, hemagglutinins 100 percent, tannins as acid tannic equivalents 9-72 percent, and as catechin equivalents 55-75 percent, and alkali-soluble N 65 percent. Red and black beans contained more residual trypsin inhibitors and tannins than white beans, while the latter contained more alkali-soluble N. Although cooked colored beans had more antinutritional factors that affect protein digestibility, their protein quality was similar to that of white beans. This could be explained by the fact that the amino acid composition and/or balance of absorbed N in red and black beans is better than that of white beans, so that the final nutritional value will be determined by the sum of interactions between all factors. Each of the 3 var. studied presented at least 1 protein quality depressor in higher concn. than the other 2 var. therefore, the overall differences found between treatments (bean var.) and residual effect (days to adaptation) were small or nonexistent, while significant differences (P greater than 0.05) were found between subjects and N balance periods. A level of 0.65 g bean protein/kg/day was not enough to maintain N balance in subjects fed a diet with beans as the only protein source. According to calculations, 0.9-1.6 g bean protein/kg/day are necessary for N balance in male adults, and 1.2-1.3 g bean protein are recommended. (AS)

0109

27299 CHANG, K.C.; FTHEN, S.; HARROLD, R.; BROWN, G. 1986. Effect of feeding dry beans on rat plasma cholesterol. Nutrition Reports International 33(4):659-664. En., Sum. En., 15 Ref. (Dept. of Food & Nutrition, North Dakota State Univ., Fargo, ND 58105, USA)

Phaseolus vulgaris. Animal nutrition. Diets. Bean flour. USA.

The ability of various dry beans to lower plasma total cholesterol in outbred rats fed a high lipid, high cholesterol diet was investigated. Male rats 90 days old were fed casein or wet-outclaved dry bean flour for 4 wk. Plasma total cholesterol was determined by an enzymatic procedure. Results show that the replacement of casein by the wet-autoclaved bean flours did not cause any significant reduction in plasma cholesterol in rats fed the high lipid, high cholesterol diet. (AS)

0110

28042 DONANGELO, C.M.; PEDERSEN, B.; EGGUM, B.O. 1986. Proteins, energy, and mineral utilization in rats fed rice-legume diets qualitas. Plantarum Plant Foods for Human Nutrition 36(2):119-137. En., Sum. En., 40 Ref. (Natnl Inst. of Animal Science., Dept. of Animal Physiology & Biochemistry, 25 Rolighedsvej, DK-1958 Frederiksberg C, Denmark)

Phaseolus vulgaris. Animal nutrition. Diets. Digestibility. Proteins. Fe. Cu. Zn. Nutritive value. Denmark.

Protein, energy, and mineral utilization was examined in growing rats fed cooked, dry legume seeds in combination with polished rice. The legumes tested included 3 var. of common beans (black, white, and brown), lentils, and peas. The rice:legume mixtures (1:1 N ratio) were the only dietary sources of protein, Zn, Fe, and Zu. The rice:black bean mixture was also tested at a 4:1 N ration. Nutrient utilization was studied by bal-

ance trials and mineral utilization was further assessed by tissue analyses. True protein digestibility and energy digestibility of the rice:legume (1:1) mixture were high. The BV varied little but was lowest in the rice:lentil mixture. The rice:brown bean mixture had the lowest amount of utilizable protein. The rice:legume (1:1) mixtures did not adversely affect Fe status, as measured by liver Fe content and blood hemoglobin and hematocrit, or Cu status, as measured by liver Cu content and plasma ceruloplasmin. Femur Zn content, however, indicated a suboptimal Zn status. Increasing the dietary N from rice in combination with black beans resulted in a substantial improvement of BV, NPU, and Zn status of the animals but had a negative effect on utilizable protein and Fe status of the rats. (AS)

0111

29701 OLIVERIA, A.C. DE; SGARBIERI, V.C. 1986. Effect of diets containing dry beans (*Phaseolus vulgaris* L.) on the rat excretion of endogenous nitrogen. *Journal of Nutrition* 116(12):2387-2392. En., Sum. En., 32 Ref. (Depto. de Planejamento Alimentar e Nutricao, Faculdade de Engenharia de Alimentos e Agricola, Univ. Estadual de Campinas, 13.100 Campinas-Sp, Brasil)

Phaseolus vulgaris. Laboratory animals. Diets. Proteins. Digestibility. Glycine. N. Nutritive value. Brazil.

Wistar rats of 60.5 plus or minus 5.0 g fasted for 24 h were injected intraperitoneally with 10 μ moles of (14C)glycine. From 1 to 2 h after injection the rats were fed a diet containing 10.53 plus or minus 0.75 percent protein provided by dry beans or casein, or a protein-free diet and submitted to a 4-day N balance. Radioactivity in the feces of rats fed casein, cooked beans, and raw beans was roughly 2, 5, and 10 times greater, resp., than in the feces of those fed the protein free diet. Apparent protein digestibility showed a strong negative linear correlation ($R = -0.9805$, P equal to or less than 0.01) with radioactivity in the feces. Positive correlation (P equal to or less than 0.01) was demonstrated between radioactivity and either total C or total N in the feces of rats injected with (14C)glycine. Mean value for the radioactivity in the urine of rats fed the different diets did not differ significantly (P equal to or less than 0.05). Endogenous N excretion of rats on bean diets was estimated by the ratio of total endogenous N:marker N, based on the protein free diet. The results indicated that rats fed bean containing diets excreted significantly more endogenous N than those fed the casein diet, even though the casein diet had stimulated twice as much endogenous excretion than the protein free diet. As a consequence, apparent digestibility and BV of bean protein are generally underestimated, although the real BV was not affected by the endogenous N excretion of the rat. (AS)

CARBOHYDRATES

0112

9678 LIAO, T. Studies of L-fucose metabolism in higher plants. Ph.D. Thesis. Columbus, Ohio State University, 1972. 129p. En., Sum. En., 96 Ref., II.

Phaseolus vulgaris. Carbohydrate content. Cell walls. Glycoproteins. Analysis. Phytohaemagglutinins. Tissues. Enzymes. Metabolism.

The presence of L-fucose was demonstrated in the cell-wall polysaccharide, phytohemagglutinin and the microsomal fraction of french beans (*Phaseolus vulgaris*). An enzyme preparation from the bean leaves catalyzed the reduction and epimerization of GDP-D mannose to GDP-L-fucose. Similar enzyme preparations were obtained from flax leaves, pea seeds, wheat germ, and etiolated seedlings of *Vigna radiata* (= *P. aureus*) and *P. vulgaris*. (Summary by Field Crop Abstracts) C03

16777 ORTEGA D., M.I.; RODRIGUEZ C., c. 1979. Estudio de azúcares solubles en semillas de frijol (*Phaseolus vulgaris* L.). (Research on soluble sugars in bean seeds). *Agrociencia* 37:17-24. Es., Sum. En., Es., 15 Ref. II.

Phaseolus vulgaris. Seed. Composition. Carbohydrate content. Sugars. Analysis. Biochemistry. Mexico.

The composition of soluble sugars in 24 common bean var. belonging to 4 groups of the infraspecific classification, was studied. Sugars were eluted from paper chromatograms and quantitatively determined by the phenol-sulfuric acid colorimetric method. Stachyose, raffinose, melibiose, maltose, sucrose, glucose, fructose, and xylose were identified. The distribution of each sugar among the genotypes was variable, but in all the cases, the quantity of oligosaccharides was greater than the monosaccharides. The most constant sugar in all genotypes was stachyose. A classification of beans on the basis of stachyose content was made. (Author's summary)

16776 ORTEGA D., M.I.; RODRIGUEZ C., C. 1979. Estudio de carbohidratos en variedades mexicanas de frijol (*Phaseolus vulgaris* L. y *Phaseolus coccineus* L.). [Research on carbohydrates in Mexican bean varieties (*Phaseolus vulgaris* and *Phaseolus coccineus*)]. *Agrociencia* 37:33-49. Es., Sum. En., Es., 17 Ref., II.

Phaseolus vulgaris *Phaseolus coccineus*. Cultivars. Seed characters. Composition. Starch content. Carbohydrate content. Protein content. Biochemistry. Analysis. Mexico.

A total of 68 genotypes, classified in 7 groups, 6 belonging to *Phaseolus vulgaris* and one to *P. coccineus* (Ayocote group) were analyzed. In raw seeds, determinations of starch, direct, indirect, and total reducing sugars were made. *P. vulgaris* has less soluble sugars and starch than *P. coccineus*. Starch represents more than half of the N-free extract and correlates with seed size. The Bayo and Ayocote groups present the highest soluble sugar content. The characteristics of each group are discussed. (Author's summary)

26979 LESTER, G.; HOSFIELD, G.L.; IZQUIERDO, J.A.; UBERSAX, M.A. 1980. An HPLC method for the quantitative determination of nonstructural carbohydrates in tissues of common bean. In Michigan State University. Agricultural Experiment Station. Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1980 Research Report. pp.80-84. En.

Analysis. Carbohydrate content. Dry matter. Leaves. Petioles. *Phaseolus vulgaris*. Pods. Roots. Seed. Stems. Sugar content. USA.

An accurate analytic procedure for rapid separation and quantitative determination of free sugars and water-soluble starch in tissues of common bean was developed, using high performance liquid chromatography. The data obtained are presented in table form. (CIAT)

17746 MONTE, W.C.; MAGA, J.A. 1980. Extraction and isolation of soluble and insoluble fiber fractions from the pinto bean (*Phaseolus vulgaris*). *Journal of Agricultural and Food Chemistry* 28(6):1169-1174. En., Sum. En., 11 Ref., II.

Phaseolus vulgaris. Cooking. Fibre content. Protein content. Carbohydrate content. Cellulose. Fat content. Analysis. USA.

A method was tested to separate the fiber portion of the pinto bean into 13 fractions. The method overcame many problems which make extraction of fiber from high-starch and/or high-protein products difficult. The lipid, fatty acid, and protein content associated with each fraction was investigated in both raw and cooked beans. Cooked beans contained more than twice the amount of soluble fiber than the raw pinto beans, while the cooking process reduced by one-third the extractable hemicellulose A and completely depleted the hemicellulose B. Extraction by this technique revealed a 50 percent decrease in the levels of lignocellulose and crude cellulose after the cooking process. Some protein contamination was found in all fiber fractions except the bound pectin. Lipids, as phospholipids, monoglycerides, diglycerides, triglycerides, and free fatty acids were found in all fiber fractions tested except at the lignocellulose level of the cooked beans. (Author's summary)

0117

16729 TELES, F.F.F.; BATISTA, C.M.; GIUDICE, M. DE L.P. DEL.; SANTANA, B.F.; LEAL, T.L. 1980. Carbohidratos ácido-digeríveis e medidas físicas de sete feijões (*Phaseolus vulgaris* L.) consumidos em Viçosa, Minas Gerais. (Acid-digestible carbohydrates and physical measurements in seven types of bean consumed in Viçosa, Minas Gerais). *Revista Ceres* 27(151):320-324. Pt., Sum. En., 7 Ref.

Phaseolus vulgaris. Composition. Carbohydrate content. Seed. Cultivars. Human nutrition. Analysis. Brazil.

Seven types of beans grown in the state of Minas Gerais, Brazil, were analyzed for acid-digestible carbohydrates (ADC). Statistical analysis (F test and Tukey's test at 0.05) showed significant differences among types. ADC values were found to vary from 36.72-51.30 percent green material. Physical measurements and a general description of the types were made, but not apparent correlation was found among types. (Author's summary) H101

0118

17438 LABANEJAH, M.E.O.; LUIH, B.S. 1981. Changes of starch, crude fiber, and oligosaccharides in germinating dry beans. *Cereal Chemistry* 58(2):135-138. En., Sum. En., 16 Ref.

Phaseolus vulgaris. Cultivars. Seeds. Germination. Carbohydrate content. Analysis. Biochemistry.

The effect of germination at 22 degrees Celsius on changes in carbohydrate components of red kidney, Gloria pink (*Phaseolus vulgaris* cv. Gloria), and black eye (*Vigna sinensis*) dry beans was investigated. Starch, amylose, and amylopectin decreased gradually during the 6-day sprouting period. The ratio of amylose to amylopectin also decreased during germination. Acid detergent fiber, cellulose, and lignin in the sprouts did not change appreciably during germination. The red kidney and Gloria pink var. were higher in acid detergent fiber and cellulose contents than were the black eye beans. High pressure liquid chromatography was used to determine quantitative changes of oligosaccharides in the germinating beans. During the preliminary soaking period of 14 h, an appreciable loss of sucrose, raffinose, and stachyose took place as a result of diffusion. The levels of raffinose and stachyose continued to decrease during germination. They disappeared after 6 days of germination in the Gloria pink and black eye beans. sucrose increased in the 4-day sprouts. (Author's summary)

0119

17770 SATHE, S.K.; SALUNKHE, D.K. 1981. Isolation, partial characterization and modification of the Great Northern bean (*Phaseolus vulgaris* L.) starch. *Journal of Food Sciences* 46(2):617-621. En., Sum. En., 28 Ref., II.

Phaseolus vulgaris. Seed characters. Starch content. Composition. analysis. Bean starch.

The yield of *Phaseolus vulgaris* seed starch was 18.23 percent. Starch granule size ranged from 12 x 12 micrometers-58 x 40 micrometers (length x width). The shape of starch granules was round to oval to elliptical, and in some cases, concave as well. Lamellae were present on all the starch granules observed. Amylose content of the starch was 10.2 percent (starch basis). The starch had good water and oil absorption capacities at 21 degrees Celsius and formed a stable gel at concn. greater than 7 percent. The viscoamylographic studies of the isolated starch indicated its restricted swelling characteristics. (Extracted from author's summary)

0120

21033 BRIARTY, L.G.; PEARCE, N.M. 1982. Starch granule production during germination in legumes. *Journal of Experimental Botany* 33(134):506-510. En., Sum. En., 12 Ref., Il. (Dept. of Botany, Univ. of Nottingham, Nottingham, NG7 2RD, England)

Phaseolus vulgaris. Cotyledons. Germination. Seed. Starch content.

The development of new, small starch granules in germinating cotyledons of *Phaseolus vulgaris* and *Vicia faba* is described; axis removal inhibits their synthesis in *P. vulgaris*. (Author's summary)

0121

21321 MARTIN-VILLA, C.; VIDAL-VALVERDE, C.; ROJAS-HIDALGO, E. 1982. High performance liquid chromatographic determination of carbohydrates in raw and cooked vegetables. *Journal of Food Science* 47(6):2086-2088. En., Sum. En., 25 Ref. (Servicio de Nutrición, Clínica Puerta de Hierro, Centro Nacional de Investigaciones Médico-quirúrgicas de la Seguridad Social, Univ. Autónoma, S. Martín de Porres 4, Madrid-35, España)

Carbohydrate content. Snap beans. Sucrose. Glucose. Fructose. Maltose. Cooking. Soluble carbohydrates. Composition.

The soluble sugar contents of 17 raw and cooked vegetables, including green bean, were determined by TLC and high performance liquid chromatography. In general, the soluble carbohydrate content of vegetables is low. For raw materials the highest content was found in carrot, red cabbage, eggplant, green bean, and leek. Upon cooking, the glucose, fructose, and total sugar contents decrease and this diminution is more drastic in the case of frying. The amount of sucrose, except in the case of carrot, eggplant, and green bean, increases with cooking. The maltose content of the broad bean increases in the culinary process. (AS)

0122

26908 MENDEZ, M.H.M.; POURCHET, C., M.A. 1984. Estudo analítico dos integrantes da fração fibra de alimentos vegetais. (Constituents of dietary fiber of vegetables. Studies on pulses). *Ciência e Tecnologia de Alimentos* 4(1):95-103. Pt., Sum. Pt., En., 35 Ref. (Depto. de Farmácia da Univ. Federal Fluminense Rua Dr. Mario Viana, 523, 24.000 Niterói-RJ, Brasil)

Brazil. Fiber content. Nutritive value. *Phaseolus vulgaris*.

Studies were conducted on composition of dietary fiber, isolated from 4 kidney bean cv. (Sanilac, 51051, Costa Rica, and Carioca), and grow cowpeas or chickpeas. Data are given for moisture, ether extract, protein, soluble and insoluble ash, cellulose, lignin, hemicelluloses, total and reducing sugars, soluble pectin, and protopectin in dietary fiber isolated from raw or cooked samples. (Food Science and Technology Abstracts)

29614 GARCIA-OLMEDO, R.; DIAZ, A.; VILLANUEVA, M.J. 1985. Estudio de la fibra alimentaria en legumbres cocinadas según recetas típicas de la cocina española. (Dietary fiber in legumes cooked according to typical Spanish recipes). *Anales de Bromatología* 37(1):79-80. En., Sum. Es., En., 14 Ref., II. (Depto. de Bromatología, Toxicología & Análisis Químico Aplicado de la Facultad de Farmacia, Univ. Complutense, Madrid, España)

Phaseolus vulgaris. Cooking. Dietary value. Composition. Human nutrition. Spain.

Studies were carried out to determine the dietary fiber content and composition of several Spanish dishes: stewed lentils, fabada asturiana (navy bean/meat dish), and chickpea soup. Southgate's scheme was used to analyze composition: non-cellulose polysaccharides, cellulose, lignin, and dietary fiber. Resp. values for the navy bean/meat dishes were 2.55, 1.43, 0.26, and 4.24 percent fresh wt. basis. Results obtained before and after the cooking process were compared to determine its possible influence on these values. (CIAT)

29648 YASUI, T. 1985. Variation in low molecular weight carbohydrate composition of *Phaseolus vulgaris* seeds. *Phytochemistry* 24(4):1241-1244. En., Sum. En., 6 Ref., II. (National Food Research Inst., Ministry of Agriculture, Forestry & Fisheries, 1-2, Kan-Nondai 2-Chome, Yatabe-Machi, Tsukuba-Gun, Ibaraki 305, Japan)

Phaseolus vulgaris. Seeds. Carbohydrate content. Analysis. Wild phaseolus. Japan.

Variations in the low MR carbohydrate composition were observed in wild forms of common bean seed. In 4 of 23 samples, verbascose content in the seeds was quite high and the ratio verbascose:stachyose was more than 1.0. This type of carbohydrate composition was named type A, and has a much higher verbascose content and lower galactinol and stachyose content than the rest of the wild forms, named type B. Although the total and individual carbohydrate content, with the exception of the verbascose content, of the cultivated forms of the common bean were higher than those of wild forms, the carbohydrate composition of the cultivated forms was essentially similar to type B of the wild forms. This carbohydrate composition was considered to be basic to the species. (AS)

28966 CHAMP, M.; BRILLOUET, J.M.; ROUÏO, X. 1986. Nonstarchy polysaccharides of *Phaseolus vulgaris*, *Lens esculenta*, and *Cicer arietinum* seeds. *Journal of Agricultural and Food Chemistry* 34(2):326-329. En., Sum. En., 19 Ref., II. (Laboratoire de Technol. Des Aliments des Animaux, 44072 Nantes Cedex, France)

Phaseolus vulgaris. Seeds. Sugar content. Cotyledons. Seed coat. France.

Nonstarchy polysaccharides of 3 legume seeds (kidney bean, lentil, chickpea) have been isolated and analyzed. Trichloroacetic acid-soluble materials represent, resp., 7.1, 0.8, and 2.1 percent of kidney bean, lentil, and chickpea whole dry seeds. Arabinose is the major sugar of the 3 extracts. Their arabinose:galactose ratios are, resp., 1:0.35, 1:0.77, and 1:0.57. Cotyledon cell walls were defatted and then treated with pronase and α -amylase. DM percentages were 7.5, 10.7, and 13.7 for lentil, kidney bean, and chickpea, resp. Cell walls from kidney bean, lentil, and chickpea contained, resp., 67, 73, and 42 percent pectic polysaccharides associated with 16, 12, and 10 percent cellulose. Arabinose was the major pectic sugar of the 3 walls. Hulls were mainly composed of cellulose (29-41 percent) associated with hemicellulosic and pectic polymers. They had low lignin contents (1.2-1.7 percent). Kidney bean hulls contained the greatest percentage of the (xylose + glucose) pair. (AS)

28246 KNUDSEN, I.M. 1986. High-performance liquid chromatographic determination of oligosaccharides in leguminous seeds. *Journal of the Science of Food and Agriculture* 37(6):560-566. En., Sum. En., 21 Ref., II. (Novo Industri A/S, Novo Alle, 2880 Bagsvaerd, Denmark)

Phaseolus vulgaris. Seeds. Analysis. Sucrose. Denmark.

A simple and reliable high-performance liquid chromatographic method was developed to determine sucrose, raffinose, and stachyose in leguminous seeds (among them red kidney beans). A lichrosorb NH2 column (Merck) and an acetonitrile + water solvent (65:35, by vol.) at a flow rate of 1 ml/min were used for the separation. An interference type refractive index detector (tecor) was used for the detection. With this detector the smallest amount of oligosaccharide detectable was 10 ng. With a traditional deflection type refractive index detector the smallest amount of oligosaccharide detectable was 240 micrograms. The oligosaccharides were extracted by placing the whole, dry seeds in boiling water for 30 min, blending the seeds and water, placing the whole suspension in a shaking bath at 60 degrees Celsius for 60 min, and removing the solid material by centrifuging. The extract was deproteinated by adding 65 parts of acetonitrile to 35 parts of extract (by vol.), placing the mixture at 5 degrees Celsius for 60 min, and filtering off the resulting proteinaceous precipitate before injection into the chromatograph. The entire procedure has been successfully applied to soybeans, chick peas, garden peas, and red kidney beans with recoveries of added raffinose in the range 97-102 percent. (AS)

28023 PENA V., C.B.; ORTEGA D., M.L. 1986. Chemical composition, free soluble sugars and unavailable carbohydrates in the embryonic axis and seed coat of *Phaseolus vulgaris* L. (Canario group). *Qualitas Plantarum Plant Foods for Human Nutrition* 36(1):27-34. En., Sum. En., 32 Ref. (Laboratorio de Bioquímica, Centro de botánica, Colegio de Postgraduados, Chapingo, México 56230, México)

Phaseolus vulgaris. Cultivars. Protein content. Seed coat. Ash content. Fiber content. Starch content. Cellulose. Sugar content. Enzymes. Bean flour. Mexico.

Four common bean var. (Gto. 113-A, Zac. 40, Chis. 34, and Chis 141-A, all belonging to the Canario group) were examined, but there were no significant differences among them. CP content (46.7 and 49.0 percent) was the main constituent in embryonic axes. The av. values of ash, crude fiber, and ether extract were 4.2, 3.7, and 3.0 percent, resp. Starch was approx. 3 times more abundant (7.5 percent) than cellulose (2.7 percent). Hemicellulose B values were lower (5.5 percent) than those of hemicellulose A (9.2 percent). The mean value of the pectic substances in embryonic axes was 12.3 percent. The free ethanol-soluble sugars ranged from 2.9 to 4.9 percent. Verbascose, stachyose, raffinose, sucrose, and galactose were identified and quantified in embryonic axes. Seed coat flour contained cellulose (30.6 percent), ether extract (0.4 percent), ash (2.8 percent), and protein (5.4 percent). Free ribose, mannose, arabinose, and galactose were present in seed coats in amounts ranging from 0.009 to 0.031 percent. (AS)

LIPIDS

5457 TAKAYAMA, K.K.; MUNETA, P.; WIESE, A.C. Liquid composition of dry beans and its correlation with cooking time. *Journal of Agricultural and Food chemistry* 13(3):269-272. 1965. En., Sum. En., 22 Ref.

Phaseolus vulgaris. P. Analysis. Lipids. Cooking. Seeds. Cotyledons. Fatty acids. Composition.

The triglyceride and phosphatide contents of 7 var. or types of dry beans and the Alaska pea were determined. The triglyceride content ranged from 0.89 percent for Alaska peas to 1.54 percent for Michelite beans. The phosphatide content averaged near 1 percent, except for lima beans which averaged 0.88 percent. Gas-liquid chromatography was used to study the component fatty acids of the triglycerides and phosphatides. The main fatty acids of the triglycerides were palmitic, oleic, linoleic, and linolenic. Small amounts of myristic acid were found in all var. except Great Northern beans. Lauric acid was found in Alaska peas. The list of component fatty acids of the phosphatides was similar to the triglycerides, except for the omission of linolenic acid in the phosphatides of the Great Northern, Michelite, Pinto, and lima beans. Palmitic acid constituted about 50% of the fatty acids in the phosphatides of the 8 types studied. No significant simple correlation coefficients were obtained between triglyceride, phosphatide, or crude lipid content and the cooking time for dry beans. (Author's summary)

0129

27071 KERMASHA, S.; VAN DE VOORT, F.R.; METCHE, M. 1986. Changes in lipid components during the development of the french bean seed (*Phaseolus vulgaris*). *Journal of the Science of Food and Agriculture* 37(7):652-658. En., Sum. En., 34 Ref., II. (Dept. of Food Science & Agricultural chemistry, MacD. Campus, McGill Univ., 2111 Lakeshore Road, Ste Anne de Bellevue, Quebec, Canada H9X 1C0)

Phaseolus vulgaris. Snap beans. Fatty acids. Seeds. Seed. Proteins. Plant development. Canada.

Changes in lipid classes and fatty acid composition and distribution have been monitored during the germination, development, and maturation of french bean seed. A lipase activity profile over time was also determined. Ungerminated seeds contained high levels of triglycerides and free fatty acids, but low levels of polar lipids, monoglycerides, and diglycerides. Five days after germination there was a decrease in the quantity of triglycerides and free fatty acids and a concomitant increase in the levels of monoglycerides, diglycerides, and polar lipids. As development and maturation progressed, triglycerides increased substantially at the expense of mono- and diglycerides. Ungerminated seeds contained high levels of C20-C22 fatty acids which decreased after germination with a concomitant increase in C16-C18 unsaturated fatty acids. A study of the fatty acid distribution among the different classes of lipids demonstrated that 55 percent of the unsaturated fatty acids in the ungerminated seeds were present in the triglycerides, whereas the remainder were distributed among the mono- and diglycerides as well as the other lipid classes (free fatty acids, polar lipid, and sterols). Five days after germination, the majority of these unsaturated fatty acids were found in the glyceride form. Overall, the lipid classes and fatty acid composition and distribution changes during development and maturation of the french bean seed indicated that it shares many of the characteristics of soybean development. (AS)

STARCH

0130

14211 BILLADERIS, C.G.; GRANT, D.R.; VOSE, J.R. Molecular weight distribution of legume starches by gel chromatography. *Cereal Chemistry* 56(5):475-480. 1979. En., Sum. En., 22 Ref., II.

Phaseolus vulgaris. Enzymes. Starch content. Analysis. Composition. Laboratory experiments.

The distribution of the mol. wt. of the components of 9 purified legume starches (smooth and wrinkled field peas; adzuki, garbanzo, mung, red kidney, navy, and faba beans; and green lentil) was investigated by gel chromatography. The Sepharose 2B columns were

calibrated with dextrans of known mol. wt. Evidence was provided (percentage beta-amylolysis and lambda max of I-polysaccharide complexes) that the amylopectin fraction was excluded from the gel in all the starches. It was concluded therefore that the av. mol. wt. of this component was greater than 20×10^6 . The distribution of components differed at different mol. wt. ranges. The elution patterns of their components fractionated within the range of 0.2-0.9 Kav (primarily amyloses) were quite similar for all the legume starches except those of smooth and wrinkled seeded peas. The amount of polysaccharide material of both smooth and wrinkled pea starches was greater in the intermediate mol. wt. range, 2×10^6 less than mol. wt. less than 20×10^6 , as compared with those of the other legume starches. Correlation analysis between set-back viscosities (obtained from viscoamylograms) and percentage components fractionated between 0.2-0.9 Kav showed significant correlation ($P = 0.05$). (Author's summary)

0131

2759 LAI, C.C.; VARRIANO-MARTSON, E. Studies on the characteristics of black bean starch. *Journal of Food Science* 44(2):528-530. 1979. En., Sum. En., 8 Ref., Il.

Phaseolus vulgaris. Starch content. Analysis. Water content. Ash content. Mineral content. N. Yields. Cooking. USA.

The physicochemical properties of black bean starch were studied. Isolated bean starch had a high amylose content (38 percent), a high gelatinization temp. range (63.8-76 degrees Celsius) and relatively low swelling (11 units at 95 degrees Celsius) and solubility (18 percent at 95 degrees Celsius) patterns. These data suggest that inherent structural characteristics of the starch contributed to limited in situ starch gelatinization and swelling during cooking. (Author's summary) C03

0132

26983 GARCIA, S.; REICOSKY, D.; ADAMS, M.W. 1980. Differential starch storage in two bean varieties in relation to their ability to withstand a shading stress. In Michigan State University. Agricultural Experiment Station. Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1980 Research Report. pp.100-102. En.

Cultivars. Petioles. Phaseolus vulgaris. Pods. Roots. Seeds. Shading. Starch content. Stems. USA. Yield. Components.

An expt. was conducted to obtain information on the value of starch storage in beans, and to determine whether breeding should be focussed on their characteristic. Navy bean var. Sanilac (Nonstarch storer) and Nep-2 (starch storer) were grown with 2 treatments, with and without shade. The rates of seed fill in all plots were measured and sampled plants in each plot were analyzed for starch and soluble solid contents using the starch iodide staining test and the refractometer, resp. Samples of roots, stems, petioles, pods, and seeds were also taken, and frozen for later lab. analysis. the rate of seed fill of Sanilac was significantly reduced by shading, while that of Nep-2 was not. Sanilac yielded 6 percent less than Nep-2 without shade, but 23 percent less under shade. Nep-2, the high-level starch storer, was less adversely affected by the reduced availability of light. (CIAT)

0133

23689 ZABIK, M.E.; UEBERSAX, M.A.; BENZINGER, J.; AGRO, G. 1983. Edible bean flour research progress report: Bean starch extrusion potential. *Michigan Dry Bean Digest* 8(1):12-13. En., Il. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Processed products. Processing. Human nutrition. USA. North America. America.

The possibility of using various bean starches in food products was investigated. High starch bean flours (navy, Pinto, and black) were fed into an extruder with various levels (0 to 20 percent total dry wt.) of ground and unground hulls. After the extrusion process, vegetable oil, salt, and flavor powder (either onion, hickory, barbecue, or cheese) were added. All bean starches yielded good expansion (3.1- to 3.8-fold increase in diameter). The presence of hulls up to 20 percent did not adversely affect expansion. The puffs themselves were bland and flavorless, thus making them compatible with any flavored product. Properly balanced levels of bean starch, bean hulls, and high protein bean flours could yield an acceptable nutritious food product. (CIAT)

0134

27079 FIGUEROA R., F.; ESTEVEZ A., A.M.; SEPULVEDA E., E.; VILLARROEL S., P. 1984. Almidón de tres cultivares de frejol (*Phaseolus vulgaris* L.). I. Extracción y análisis de pureza. (Starch from three bean cultivars. I. Extraction and purity analysis). *Alimentos* 9(4):5-9. Es., Sum. Es., En., 19 Ref. (Depto de Agroindustria, Facultad de Ciencias Agrarias, Veterinarias y Forestales, Univ. de Chile, Casilla 1004, Santiago, Chile)

Phaseolus vulgaris. Cultivars. Starch content. Bean starch. Processing. Chile.

The feasibility of obtaining bean starch was studied and the efficiency of 2 extraction methods, centrifugation, and sedimentation, was determined. In addition, the yield and purity of starch obtained from bean cv. Tortola, Arroz, and Red Kidney were evaluated. The yield obtained through sedimentation (23.7-26.4 percent) was higher than that obtained by centrifugation (20.4-21.8 percent). N content of starch did not show significant differences between extraction methods or cv. ash content was significantly lower in sedimentation (0.11-0.23 percent) than in centrifugation (0.22-0.26 percent). Fiber content was also lower in sedimentation (0.60-0.70 percent) compared with centrifugation (0.71-0.89 percent). Cv. Arroz had the highest starch yield and purity. (CIAT)

0135

26910 HOOVER, R.; SOSULSKI, F. 1985. Studies on the functional characteristics and digestibility of starches from *Phaseolus vulgaris* biotypes. *Starch Staerke* 37(6):181-191. En., Sum. En., De., 43 Ref., II. (Dept. of Crop Science & Plant Ecology, Univ. of Saskatchewan, Saskatoon, Saskatchewan S7N 0W0, Canada)

Canada. Cultivars. Digestibility. *Phaseolus vulgaris*. Starch content.

The functional properties of starches from black, kidney, navy, Northern, and Pinto beans, all biotypes of *Phaseolus vulgaris*, were examined. Starch granule sizes ranged from 22-39 microns (length) to 19-28 microns (width) and shapes varied from elliptical to oval. Amylose content ranged from 30.2 to 37.3 percent. A highly ordered crystalline structure of granules (CA) was suggested by restricted swelling power and solubility, resistance to alpha-amylase attack, high gelatinization temp, and stable amylographic viscosities. The existence of a crystalline structure of the highest and lowest order to stability among the *Phaseolus* starches was indicated for Pinto and black beans, resp., which were substantially different than those of kidney, Northern, and navy bean. The higher degree of associative bonding forces, namely, hydrogen and covalent, between oxygen and hydrogen atoms of closely packed parallel amylose chains. The wide range in amylographic viscosities was a reflection of crystalline stability, amylose exudation, granule swelling, and pH of slurry. Gels exhibited a higher degree of retrogradation at +4 degrees Celsius than at -15 degrees Celsius. Scanning electron microscopy showed that alpha-amylase-treated maize starch granules were degraded from the inside out by the formation of large circular holes; those of kidney bean were less extensively degraded and showed only scaling and roughening of the surface as evidence of granule deterioration. (AS)

27761 KDALDY, M.S. 1985. Starch structure and mating of the small white (navy) bean. Bean Improvement Cooperative. Annual Report 28:118-119. En. (Agriculture Canada Research Station, Lethbridge, Alberta T1J 4B1, Canada)

Phaseolus vulgaris. Bean starch. Cultivars. Laboratory experiments. Canada.

An electron microscope investigation of beans grown in Alberta and Ontario (Canada) showed a net-like formation of the starch fractions around the starch granules of Alberta-grown beans. In contrast, little or no starch fractions were present on the starch granules of the Ontario-grown beans. Other studies showed that Alberta-grown small white beans have less alcohol-insoluble solids (starch, protein, cellulose, and hemicellulose) compared with those grown in Ontario. (CIAT)

29159 WONG, S.; TRAIANEDES, K.; O'DEA, K. 1985. Factors affecting the rate of hydrolysis of starch in legumes. *American Journal of Clinical Nutrition* 42(1):38-43. En., Sum. En., 11 Ref., 11.

Phaseolus vulgaris. Digestibility. Canned beans. Starch content. Processing. Human nutrition. USA.

To understand the mechanism for the extremely slow rate of digestion and absorption of carbohydrate from legumes, among them Red Kidney beans, a No. of factors which could potentially affect the process in vitro were examined. The rate of hydrolysis of legume starch in vitro was not affected by the presence of fat (as either butter or an emulsion); however, it was significantly increased in commercially available canned bean preparations, suggesting that the high temp. used in the canning process may alter the availability of starch in legumes. In vitro starch hydrolysis rate was also significantly increased by grinding legumes finely prior to cooking. The slow rate of digestion and absorption of legume carbohydrate does not appear to be due to viscosity since increasing the shaking rate of viscous mixture of either Red Kidney beans or lentils from 0 to 120 oscillations/mm did not affect the hydrolysis rate, and a thick viscous mixture of either of these legumes did not retard the diffusion of free glucose from a dialysis sac into the dialysate. (AS)

WATER CONTENT

13149 GUEVARA G., M.; PFOST, H.B. Equilibrium moisture content of beans. Manhattan, Kansas. Food & Feed Grain Institute. Grain Storage, Processing and Marketing. Research Report no. 5. 1973. 54p. En., 27 Ref., 11.

Phaseolus vulgaris. Seed. Water content. Storage. Temperature. Physiology. Laboratory experiments. USA.

The objectives of this investigation were to: (1) find the adsorption and desorption isotherms of various types of beans at different temp. and over a range of RH (10-90 percent); (2) study the rate of desorption in beans; (3) evaluate the results in Chung and Pfost equation, and (4) determine the heats of desorption and adsorption of water by various types of beans. A literature review is included on isotherm theories and hysteresis. the types of beans used were *Phaseolus vulgaris* (small red and pint) and *P. lunatus*, obtained commercially and wetted to 25 percent MC and oven dried at 120 degrees Fahrenheit to obtain 5-10 percent initial MC, on a dry basis. RH of the samples was controlled by sulfuric acid and the RH at different solution concn. was determined (range 10-90 percent). The sample was suspended inside a sealed flask, placed in a temp.

control chamber for 3 wk. The equilibrium MC were determined by an oven method (72 h at 103 degrees Celsius). Results indicate that the equilibrium MC of the types of beans investigated decreases with an increase in temp. and increases with an increase in RH. Type II or sigmoid isotherms for beans are consistent with those for other grains. It was concluded that hysteresis, for beans, decreases with an increase in temp.; the rate of desorption is a function of the RH and temp.; and that these rates were higher in the 1st 2 days of storage. The equation by Chung and Pfost predicts the equilibrium moisture of beans for a wide range of RH at a given temp. Isoteric heats of desorption and adsorption continually decreases with increasing MC and values of ΔH_{st} for desorption are greater than those of adsorption. The heat of desorption for beans was greater than that of the latent heat of vaporization of pure water. (Summary by I.B. Trans. by L.M.F.)

0139

17827 ALVARENGA, L.C. DE; FORTES, M.; PINHEIRO FILHO, J.B.; HARA, T. 1980. Transporte de umidade no interior de graos de feijao-preto sob condicoes de secagem. (Internal moisture movement of black bean grains under drying). *Revista Brasileira de Armazenamento* 5(1):5-18. Pt., Sum. Pt., En., 22 Ref., II.

Phaseolus vulgaris. Drying. Statistical analysis. Brazil.

Internal moisture distribution of black bean grains was simulated for several drying conditions, simulation studies being based on the liquid diffusion and capillary theories (Fortes and Okos). Model validation and analysis was based on exptl. data. The diffusion coefficient was found to follow an Arrhenius-type equation. The liquid diffusion theory can explain drying phenomena in the initial 60 mm with a temp. range of 30-50 degrees Celsius. Vapor diffusion is important for longer drying periods (lower MC). (Author's summary)

0140

17826 ALVARENGA, L.C. DE; FORTES, M.; PINHEIRO FILHO, J.B.; HARA, T. 1980. Distribucao de umidade no interior de graos de feijao-preto apos secagem. (Moisture distribution within black bean grains after drying). *Revista Brasileira de Armazenamento* 5(1):19-29. Pt., Sum. Pt., En., 9 Ref. II.

Phaseolus vulgaris. Seed characters. Water content. Brazil.

The period of tempering of black beans after drying was simulated. Internal moisture distribution curves of the grains are given for this period. These can be used to analyze and optimize drying processes such as air drying and intermittent drying. Regression curves were fit to exptl. data on conductance variance of grain layer with tempering time. A relationship between surface MC and electrical conductance was established. It is suggested that electrical conductance-based moisture meters are influenced by the grain surface MC and therefore should only be used when grain thermodynamic equilibrium is assured. (Author's summary)

0141

20606 McCURDY, A.R.; LEUNG, H.K.; SWANSON, B.G. 1980. Moisture equilibration and measurement in dry pinto beans (*Phaseolus vulgaris*). *Journal of Food Science* 45(3):506. En., Sum. en., 15 Ref., II.

Phaseolus vulgaris. Seed. Water content. Seed characters. Storage. USA.

Investigations of postharvest spoilage of dry beans have been inconclusive about the moisture level at which loss of quality will occur. Different moisture equilibration and moisture determination methods used with dry beans in previous investigations were evaluated and compared. Results indicated that significant variation among individual dry beans existed for all methods of moisture equilibration especially with direct addition of

water. No significant differences were found among methods of moisture analysis. Storage of pinto beans with MC of 14.1 percent or less is recommended for microbial stability. Because of bean to bean variation, a mean and CV for MC of a representative sample of beans described the condition of the beans better than a mean alone. (Author's summary)

0142

24447 HUTCHINSON, D.H.; OTTEN, L. 1984. Equilibrium moisture content of white beans. *Cereal Chemistry* 61(2):155-158. En., Sum. En., 18 Ref., Il. (School of Engineering, Univ. of Guelph, Ontario N1G 2W1, Canada)

Seed. Water content. Canada. Composition. North America. America.

Moisture desorption isotherms were determined for Seafarer white beans. Saturated salt solutions were used to maintain constant humidity environments in which samples were allowed to equilibrate. Data were obtained at 16, 32, 38, and 49 degrees Celsius. RH were varied from approx. 20 to 80 percent at each temp. Several variations of the Henderson and Chung-Pfost equations were chosen from the large no. of available expressions for predicting equilibrium MC. Good fits of the exptl. data were obtained when both the Henderson and the Chung-Pfost equations with temp.-dependent parameters were used. (AS)

AMINO ACIDS

0143

7272 BRESSANI, R.; MENDEZ, J.; SCRIMSHAW, N.W. Valor nutritivo de los frijoles centroamericanos. III. Variaciones en el contenido de proteínas, metionina, triptófano, tiamina, riboflavina y niacina de muestras de *Phaseolus vulgaris* cultivadas en Costa Rica, El Salvador y Honduras. (Nutritive value of Central American beans. III. Variations in protein, methionine, tryptophan, thiamine, riboflavin, and niacin content of bean samples from Costa Rica, El Salvador, and Honduras). *Archivos Venezolanos de Nutrición* 10:71-84. 1960. Es., Sum. En., Es., 22 Ref.

Phaseolus vulgaris. Nutritive value. Protein content. Methionine. Tryptophane. Amino acids. Analysis. N.

The nutritive value of 20 bean selections from Honduras, 11 var. from El Salvador and 7 from Costa Rica was determined. The samples from Honduras had 23.6 percent protein, 2.22 percent lysine, 0.23 percent met., 0.16 percent tryptophan, 0.71 mg/100 g thiamine, 0.15 mg/100 g riboflavin, and 2.06 mg/100 g niacin. The nutrient content (in the same order) for the samples from El Salvador was as follows: 21.2, 1.95, 0.15, 0.16 percent, 0.60, 0.14, and 1.85 mg/100 g. The Costa Rican var. averaged 19.3 percent protein, 1.84 percent lysine, 0.17 percent cystine, 0.12 percent tryptophan, and 2.97 percent niacin; they were not analyzed for thiamine or riboflavin. A significant correlation was found between N and lysine, as well as between N and met. The amino acid results are compared to the amino acid standards of the FAO Reference Protein. (Author's summary)

0144

7082 BRESSANI, R.; ELIAS, L.G.; NAVARRETE, D.A. Nutritive value of Central American beans. IV. The essential amino acid content of samples of black beans, red beans, rice beans, and cowpeas of Guatemala. *Journal of Food Science* 26(5):525-528. 1961. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Nutritive value. Amino acids. Protein content. N. Arginine. Histidine. Tryptophane, Valine. Ash content. Carbohydrate content. Seed. Guatemala.

The rice bean (*Phaseolus calcaratus*), cowpea (*Vigna sinensis*), red and 3 black bean (*Phaseolus vulgaris*) samples grown in Guatemala were found to be fairly similar in chemical composition. Av. percentage values were moisture 14.5, protein 22.3, ether extract 1.3, ash 3.5, crude fiber 6.0, and carbohydrate 52.4. The range in amino acid content (expressed as mg of amino acid/g of N) was arginine 356-528, histidine 159-232, isoleucine 143-339, leucine 189-260, lysine 322-544, total sulfur-containing amino acids 80-94, phenylalanine plus tyrosine 362-171, tryptophan 52-73, threonine 215-348, and valine 191-383. The cowpea sample was higher in lysine; the rice bean and red bean samples were higher in tryptophan. The isoleucine and valine contents were lower and the leucine higher in the red beans than in the other samples. When compared with the amino acid pattern of the FAO Reference Protein, met. plus cystine was the most limiting amino acid, and leucine and tryptophan the 2nd and 3rd most limiting, resp. All the samples contained high amounts of lysine, making beans a good source of this amino acid. (Author's summary)

0145

7090 JONES, V.M.; BOULTER, D. Arginine metabolism in germinating seeds of some members of the Leguminosae. *New Phytologist* 67(4):925-934. 1968. En., Sum. En., 38 Ref. II.

Phaseolus vulgaris. Seed. Metabolism. Arginine. Germination. Cotyledons. N. Proteins. Analysis. enzymes. CO(2). Urea.

Estimation of the arginine content of germinating seeds of *Vicia faba*, *Canavalia ensiformis*, *Phaseolus vulgaris*, and *Psidium sativum* showed a lowering in concn. during the 1st wk. of germination. When (14)C arginine was fed to cotyledon discs of *Vicia faba*, ornithine, proline, urea, and carbon dioxide quickly became labeled and other amino acids became labeled after a longer period of incubation. Arginase was extracted from *V. faba* and shown to be present in the roots, shoots, and cotyledons during the 1st 6 days of germination. Urease was also extracted from *V. faba* and shown to have a pH optimum of 8 for extraction. The possible presence of an ornithine cycle is discussed. (Author's summary)

0146

9614 OTOUI, F. Repartition des principaux acides aminés dans les différentes parties de la graine d'un cultivar de *Phaseolus vulgaris* L. (Distribution of the major amino acids in various parts of the seeds of a *Phaseolus vulgaris* cultivar). *Bulletin des Recherches Agronomiques de Gembloux* 4(2):287-301. 1969. Fr., Sum. Fr., 9 Ref. II.

Phaseolus vulgaris. Seed. cultivars. Amino acids. Analysis. Protein content. Cotyledons. Embryo.

Qualitative and quantitative chromatographic studies revealed important differences in the distribution of the major amino acids in various parts of the seeds of *Phaseolus vulgaris* cv. S.G.44. The integuments (about 9 percent of seed wt.) are low in total protein, rich in glycine and alanine, and low in glutamic and aspartic acids. The cotyledons (90 percent of seed wt.) contain more than 96 percent of the total protein. The remainder of the embryo (1 percent by wt.) was rich in total protein, high in arginine, and met. Pimelic acid was noted but not in amounts comparable to usual values reported in literature. Other small peaks of undetermined nature were found. (Summary by Chemical Abstracts)

0147

4637 KELLY, J.F. Genetic variation in the methionine levels of mature seeds of common bean (*Phaseolus vulgaris* L.). *Journal of the American Society for Horticultural Science* 96(5):561-563. En., Sum. En., 9 Ref.

Phaseolus vulgaris. Methionine. Human nutrition. Cultivars. Seeds. Seed. Genetics. Hybridizing.

From 3600 bean cv., lines and single plant selections grown at Rancocas, New Jersey in 1968, 82 were selected as having more than 33 percent higher microbiologically available met. in the mature seed than the Sanilac standard. Of these, 63 again assayed more than 33 percent higher in 1969. Met. levels varied more within lines or mixed lots than pure lines. A highly significant correlation existed between met. levels in seed from 2 or 3 crop years. Commercial cv., regardless of the seed source, tended to have relatively uniform levels of available met. The level of met. in mature seeds of the common beans is determined genetically, and sufficient variation exists within the species to permit improvement through hybridization and selection. (Author's summary)

0148

LELEJI, O.I.; DICKSON, M.H.; HACKLER, L.R. Effect of genotype on microbiologically available methionine content of bean seeds. *HortScience* 7(3):277-278. 1972. En., Sum. En., 12 Ref.

Phaseolus vulgaris. Seeds. Methionine. Genetics. Plan breeding. Hybridizing.

Comparison among F1 hybrid bean seeds (*Phaseolus vulgaris* L.) indicated highly significant reciprocal difference in met. There was not significant difference in available met. between hybrid and selfed seeds in a low-met. line, whereas a highly significant difference was found between hybrid and selfed seeds in a high-met. line. (Author's summary)

0149

7884 BALDI, G.; SALAMINI, F. Variability of essential amino acid content in seeds of 22 *Phaseolus* species. *Theoretical and Applied Genetics* 43:75-78. 1973. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Amino acids. Seed. Legume crop. S. Cystine. Methionine. Protein content. Analysis.

The reserve protein composition of 22 *Phaseolus* species was studied. The nonsulfur-containing amino acids were present at values higher than those suggested for animal (and human) nutrition; but the sulfur-containing amino acids, with some exceptions, were under the minimum accepted requirement. However, taking into account the variability in the percentages of met. and cystine, as well as their cystine/met. ratio, it is concluded that the genus *Phaseolus* has a theoretical possibility of synthesizing a reserve protein with a balanced sulfur-containing amino acid content. An accession from Mexico of the species *P. phyllanthus* possesses a protein characterized by a high sulfur-containing amino acid content (3.84 percent). The possible utilization of this species in breeding for legume protein quality is suggested. Some observations about the percentage of arginine in wild and cultivated forms of *P. vulgaris* are also presented. (Author's summary)

0150

1285 HACKLET, L.R.; DICKSON, M.H. A comparison of the amino acid and nitrogen content of pods and seeds of beans (*Phaseolus vulgaris* L.). *Search Agriculture* 3(5):1-6. 1973. En., 8 Ref.

Phaseolus vulgaris. Amino acids. N. Seed. Pods. Seed production. Composition. Analysis.

The results of pod and seed analysis of 62 var. and lines are tabulated, showing the proportions of the 16 amino acids and the total amino acid and N contents. PI 180758 had the highest amino acid content in the pods, PI 281954 in the seeds. Nitrogen content was negatively correlated with almost all the amino acids in the pods, but this was less no-

ticeably the case in the seeds. Most of the essential amino acids were significantly correlated. (Summary by Plant Breedings Abstracts)

0151

5099 JAFFE, W.G.; BRUCHER, O. El contenido de nitrógeno total y aminoácidos azufrados en diferentes líneas de frijoles. (*Phaseolus vulgaris*). (Total nitrogen and sulphur amino acids in different lines of beans (*Phaseolus vulgaris*). Archivos Latinoamericanos de Nutrición 24(1):105-113. 1974. Es., Sum. Es., En., 6 Ref.

Phaseolus vulgaris. N. Cystine. Methionine. Protein content. Analysis. Cultivars. Human nutrition.

Analytical results are presented of the protein levels and of the met. and cystine contents in the protein of 100 pure lines of beans, divided into 10 groups according to the different filetic lines to which they belong. There were significant differences between the groups in the amount of protein they contained and its content in sulfur amino acids. A negative correlation was observed between protein content and the level of cystine and met. (Author's summary)

0152

21792 MTEGA, L.A.; SUGIYAMA, T. 1974. A note of the amino acid composition and some legume seeds grown in Tanzania. East African Agricultural and Forestry Journal 39(3):307-310. En., Sum. En., 19 Ref.

Phaseolus vulgaris. Amino acids. Composition. Seed. Tanzania.

The amino acid content of seed of 5 legume crops (cowpea, groundnut, kidney bean, pigeon pea, and soybean) grown in Tanzania are presented and compared with data from other sources regarding essential amino acid content and protein score which is based on the FAO reference protein (equal to 100) calculated as a chemical index to compare the protein quality. Soybean had the highest protein score (69) followed by pigeon pea (61), kidney bean (56), cowpea (52), and groundnuts (43). Kidney beans and pigeon peas were relatively low in CP content as compared with other Tanzanian crops. Lysine content was highest in kidney beans and lowest in groundnuts. Results suggest that the amino acid composition of legume seeds grown in Tanzania is very close to that of the same seeds in other parts of the world, although Tanzanian cowpeas showed a high tryptophan content. (Author's summary)

0153

5279 OTOUL, E.; LE MARCHAND, G. Contribution a l'etude de l'influence d l'équilibre mineral sur la composition en aminoacides des *Phaseolus vulgaris* L. resultats d'ensemble. (The influence of mineral balance on the amino acid composition of beans). Bulletin des Recherches Agronomiques de Gembloux 9(1):73-93. 1974. Fr., Sum. Fr., En., 11 Ref.

Phaseolus vulgaris. Amino acids. N. P. K. S. Ca. Mg. pH. Seed. Plant development. Flowering. Production.

Beans were grown under different nutrient conditions (i.e., high in N, S, P, K, Ca, or Mg). The mineral composition of plants and seeds varied considerably, the differences being almost always higher in plants than in seeds. An analysis of the seeds showed that the content of 8 out of 16 amino acids were significantly different according to the nutrient treatment; however, their proportions were not upset. As it is generally recognized in literature that the amino acid balance of proteins is highly stable, it could be assumed that the differences observed were due to variations in free amino acids and peptides. This was, however, not proved. (Author's summary)

6260 SODEK, L.; VECCHIA, P.T.D.; LIMA, M.L.G.P. Rapid determination of tryptophan in beans (*Phaseolus vulgaris*) by the acid ninhydrin method. *Journal of Agricultural and Food Chemistry* 23(6):1147-1150. 1975. En., Sum. En., 13 Ref., II.

Phaseolus vulgaris. Tryptophane. Proteins. Analysis. Seed coat. Seed color. Nitrogen content. Protein content.

The rapid and simple acid ninhydrin method was adapted for the colorimetric determination of tryptophan in protein extracts of beans. Total extraction of the seed N is possible by a simple extraction procedure using 0.2 percent sodium hydroxide. A sample blank is necessary to compensate for nonspecific absorption due mainly to pigments, but the extracts are otherwise free of interfering factors. Tryptophan values obtained compare favorably with literature values, provided a simple correction for tyrosine is made. The method was shown to be applicable to protein extracts of maize and wheat. The rapidity, simplicity, and accuracy of the method make it useful for both routine analysis and screening purposes. (Author's summary)

7616 MOREIRA, M.A.; BRUNE, W.; BATISTA, C.M. Avaliacao do teor de metionina em sementes de feijao (*Phaseolus vulgaris* L.). (Methionine content of bean seeds). *Turrialha* 26(3):225-231. 1976. Pt., Sum. Pt., 23 Ref., II.

Phaseolus vulgaris. Seed. Methionine. Protein content. Germplasm. N. Histidine. Triptofano. N. Cultivars. Hydrolysis.

Forty-seven cv. from the germplasm bank at the Universidade Federal de Vicosa (Minas Gerais, Brazil) were analyzed for their protein and met. content. The level of met. was measured after enzymatic hydrolysis with papain and reaction with nitrosoferricyanide. Unidentified components in the seeds contributed substantially to the met. values observed. This interference was revealed when using solutions containing all the components of the reaction mixture (except papain), as well as vegetative material. The same interference, though to a lesser degree, was observed in sorghum and soybeans. No interference was found in casein and maize samples. Corrections were made to get reliable met. values. There was not correlation between met. content on a dry matter basis and protein level. A significant negative correlation (P less than 1 percent) was found between the percentage of met. in protein and the protein level. These data are of importance in bean breeding programs. (Author's summary)

11924 EVANS, R.J. et al. Methionine and cystine contents of bean (*Phaseolus*) seed. *Journal of Agricultural and Food Chemistry* 26(5):1234-1237. 1978. En., Sum. En., 24 Ref.

Phaseolus vulgaris. Methionine. Cystine. Seed. Proteins. N. Protein content. Analysis.

An improved method for determining met. and cystine in *Phaseolus* spp. seeds is described in an analysis of 544 samples of *Phaseolus* seeds, met. contents of air-dried seeds ranged from 0.16-0.33 percent, met. + cystine from 0.29-0.56 percent, and crude protein (CP) 16.1-33.9 percent. Met. in seed proteins ranged between 0.51-1.24 percent and met. + cystine between 1.17-2.49 percent. Using 198 samples of *P. vulgaris* seeds collected worldwide, a significant correlation coefficient of -0.531 between protein and met. + cystine. (Summary by Plant Breeding Abstracts) C03

4040 EVANS, R.J.; BAUER, D.H. Studies of the utilization by the rat of methionine and cystine in heated dry bean seed (*Phaseolus vulgaris*). *Journal of Agricultural and Food Chemistry* 26(4):779-784. 1978. En., Sum. En., 13 Ref.

Phaseolus vulgaris. Methionine. Cystine. Seed. Laboratory animals. Cooking. Diets. Proteins. Toxicity.

Growing rats fed autoclaved bean flour did not absorb 50 percent of the bean met. and 41 percent of the bean cystine. When the bean flour was supplemented with synthetic met., the supplemental met. was completely absorbed. Met. + cystine availability in bean flour and bean flour fractions was determined by wt. gains of rats fed diets containing them and by PER diets. Potassium hydroxide (0.2 percent) extracts of autoclaved bean flour depressed rat growth. Met. and cystine of water extracts of raw bean flour were poorly utilized. An undialyzed water extract of autoclaved bean flour depressed growth of rats fed casein as principal protein, but a dialyzed extract did not. Bean flour prepared from beans boiled in water or in 0.1 percent sodium bicarbonate solution supported similar growth of casein-fed rats, but the 0.1 percent sodium bicarbonate did not. (Author's summary) C03

0158

16961 ANTUNES, P.L.; SGARBIERI, V.C.; GARRUTI, R.S. 1979. Nutrifcation of dry bean (*Phaseolus vulgaris* L.) by methionine infusion. *Journal of Food Science* 44(5):1302-1305. En., Sum. En., 23 Ref., II.

Phaseolus vulgaris. Seeds. Nutritive value. Amino acids. Methionine. Seed treatment. Diets. analysis.

Soaking for 1 h at 50 degrees Celsius with 5 percent met. increased the met. content of dry beans from 1.2 to 24 percent of protein and absorbed water was 40 percent of wt. Such beans, dried and mixed with original beans (1:7), and cooked with the soaking water contained 3 percent met. in protein. Soaking with 1 percent met. increased the PER of beans from 0.9 to 2.6 and the efficiency of a 10 percent bean diet from 9.4 to 26.6 percent. (Summary by Nutrition Abstracts and Reviews)

0159

20643 BADIALLI, E. 1979. Variacao de metionina em feijoes (*Phaseolus vulgaris* L.) armazenados. (Variation in methionine content in stored beans). Tese Mag. Sc. Campinas-Sp, Brasil, Universidade Estadual de Campinas. Faculdade de engenharia de Alimentos e Agricola. 113p. Pt., Sum. Pt., En., 72 Ref., II.

Phaseolus vulgaris. Seed. Storage. Amino acids. Composition. Methionine. Brazil

The ferricyanide method determining the level of met. in *Phaseolus vulgaris* seed was modified and applied to seed of 12 cv. In cv. Goiano Precoce, SP 7052, and SC 7010 amounts of 44.4, 39.8, and 38.8 percent of the met. was able to form ferricyanide complexes at the beginning of the storage period. During storage for 8 mo. at 20-26 degrees Celsius and 80 percent RH the amount of met. forming complexes decreased in all cv. The cv. showing the least effects of storage were Pirata I and Cara suja. (Summary by Field Crops Abstracts)

0160

14210 HANG, Y.D.; STEINKRAUS, K.H.; HACKLER, L.R. Amino acid composition of high protein fractions prepared from mung beans, pea beans, and red kidney beans. *Journal of Food Sciences* 45:388-389. 1980. En., Sum. En., 5 Ref.

Phaseolus vulgaris. Composition. Amino acids. Protein content. Analysis.

Bean fractions containing 4-83 percent protein were prepared from mung beans, pea beans, and red kidney beans by aqueous extraction followed by acid precipitation. The yields of bean fractions containing the highest concn. of protein ranged from 64-76 percent depending on the beans used. Amino acid scores of the bean fractions compared

favorably with those of the FAO reference pattern of amino acids. The sulfur amino acids, met., and cystine were 1st limiting in the bean fractions. In addition, the fractions prepared from mung beans were also deficient in threonine. (Author's summary) H01

0161

14330 PATEL, K.M.; BEDFORD, C.L.; YOUNGS, C.W. Amino acid and mineral profile of air-classified navy bean flour fractions. *Cereal Chemistry* 57(2):123-125. 1980. En., Sum. En., 19 Ref.

Phaseolus vulgaris. Food products. Food technology. Protein content. Amino acids. Mineral content. Ash content. Water content. Methionine. S. Nutritive value.

Navy bean flour (NBF) was fractionated into protein concentrate (PC) and starch residue (SR), using an Alpine Microplex air classifier. NBF and the resulting fractions were analyzed for amino acids and minerals. The overall yields of the PC and the SR were 34.7 and 61.9 percent, resp. The NBF and its fractions had a relatively high lysine content and the low sulfur amino acid content characteristic of legume proteins. Compared to the flour, the PC was lower in cystine, met. and tryptophan but higher in valine. Compared with the FAO reference amino acid pattern, the total sulfur amino acids were the 1st limiting factors whereas all other essential amino acids considerably exceeded the reference pattern in the NBF and in both fractions. The NBF and the two fractions contained from 2-17 times more minerals than did wheat flour. Pronounced shifting of all minerals except Ca into the PC fraction was noted. (Author's summary)

0162

21774 ADDO, R.A.; HILL, M.A. 1982. An investigation into a dye-binding procedure for measuring available lysine in raw and cooked beans. *Journal of Plant Food* 4(4):183-189. En., Sum. En., 21 Ref. (Dept. of Food Science & Nutrition, Queen Elizabeth College, Campden Hill Road, London W8 7AH, England)

Phaseolus vulgaris. Cooking. Protein content. Lysine. Water content. Heat treatment. Processing. England.

CP and available lysine were estimated in raw and cooked blackeye (*Vigna unguiculata*) and red kidney beans. Open cooking in water for 3 h under mild heat showed a slight increase in CP and available lysine content, whereas dehulling, grinding, and steaming for 1 h showed a slight loss of CP and available lysine. Available lysine was estimated by dye-binding with acid orange 12 dye, before and after treatment with propionic anhydride. (Author's summary)

0163

19727 PENZ JUNIOR, A.M.; EARL, L.; KRATZER, F.H. TUCKER, C. 1983. Availability for chicks of tryptophan from autoclaved beans. *Nutrition Reports International* 27(1):161-169. En., Sum. En., 10 Ref. (Dept. of Avian Sciences and Agronomy and Range Sciences, Univ. of California, Davis, CA 95616, USA)

Phaseolus vulgaris. Cultivars, Tryptophane. Chicks. Animal nutrition. Diets.

Samples of 4 bean cv. (small white-seeded cv. Chief and No. 7653, California Dark Red Kidney, Red, Kidney) varied in tryptophan content from 0.211 to 0.335 percent or 1.01 to 1.29 percent of the protein. With chief and No. 7653 fed at 39 percent of a diet for 1-day-old male Foster Farms chickens, with supplementary protein provided by maize, SBM, and meat and bone meal, growth was good and there was no response to the addition of tryptophan. With the basal diet made more deficient in tryptophan and Chief fed at 36 percent of the diet there was a response to the addition of 0.04 percent tryptophan, but when fed at 71 percent of the diet more total tryptophan was required. The 2 red kidney var. also responded to 0.04 percent tryptophan when they were fed at 36 percent of the diet. Results indicate that autoclaved beans are a good source of

tryptophan and can be useful in supplementing a cereal such as maize when used to 39 percent of chick diets. Tables are included on the effect of tryptophan on body wt. gain and feed efficiency of chickens 8-19, 8-15, and 8-16 days old. (Author's summary)

0164

26069 ABD EL-SAMEI, M.H.; LASZTITY, R. 1984. Comparative study on the amino acids composition in three local *Phaseolus vulgaris* seed varieties. *Zeitschrift Fuer Lebensmittel-Untersuchung Und-Forschung* 178(1):24-26. En., Sum. De., En. 22 Ref. (Agricultural Chemistry Dept., Faculty of Agriculture, El-Minia Univ., El-Minia, Egypt)

Phaseolus vulgaris. Cultivars. Seed. Amino acids. Composition. Egypt.

The overall amino acid compositions of 3 *Phaseolus vulgaris* seed var. (Contender, Swissblan, and Giza) were similar. All had a relative deficiency in S-containing amino acids. Moreover, there was a negative correlation between S-amino acid content and the percentage of seed proteins. The lysine content of the *Phaseolus* seeds was relatively high; the amount ranged from 8.05 to 8.63 g/16 g N. Tryptophan was slightly higher for var. Giza than for the others. The highest levels of free amino acids were recorded for var. Contender and Swissblan. Cystine, phenylalanine, and tyrosine were absent from the extracts of the 3 var. (AS)

0165

28920 BRADBPEAR, N.; BOULTER, D. 1984. The use of enzymic hydrolysis in vitro to study the digestibility of some *Phaseolus* seed proteins. *Qualitas Plantarum Plant Foods for Human Nutrition* 34(1):3-13. en., Sum. En., 27 Ref., II. (Univ. of Durham, Dept. of Botany, Science Laboratories, South Road, Durham DH1 3 LE, England)

Phaseolus vulgaris. Phaseollin. Proteins. Digestibility. Laboratory experiments. Seeds. England.

In vitro proteolysis was used to study the digestibility of the major seed protein, phaseolin, and the trypsin inhibitor, purified from *Phaseolus vulgaris* seeds. Whereas denatured phaseolin was fully digested in the in vitro enzymic method used, its native form was only partially digested. Trypsin inhibitor, both native and after heat treatment, was poorly digested. It was also found that native trypsin had some resistance to digestion conferred upon it by the presence of the inhibitor.

0166

27405 ORTEGA D., M.L.; MORALES H., C.L. 1985. Comparison of tryptophan content in recently harvested and stored common bean seeds (*Phaseolus vulgaris* L.). *Bean Improvement Cooperative. Annual Report* 28:131-132. En., 3 Ref. (Colegio de Postgraduados, Chapingo 56230, Mexico)

Phaseolus vulgaris. Seeds. Tryptophane. Composition. Storage. Cultivars. Mexico.

Tryptophan content of seeds of 8 bean genotypes belonging to the Canario and Negro Arribeno groups was analyzed, and it was compared with that obtained previously from seeds of the same genotypes stored for more than 10 yr. In both groups there were consistently higher values for the recently harvested seeds than the stored ones. In the Canario group the tryptophan increases fluctuated between 9-33 percent, with an av. of 23 percent. In the Negro Arribeno genotypes av. increments of 34 percent were obtained with values between 26-55 percent. (CIAT)

PROTEINS

General

8689 KLOZ, J. An investigation of the protein characters of four *Phaseolus* species with special reference to the question of their phylogenesis. *Biologia Plantarum* 4(2):85-90. 1962. En., Sum. En., Ru., 13 Ref., II.

Phaseolus vulgaris. Seed. Proteins. Cotyledons. Hypocotyls. Phaseollin. Legume crops. Seedlings.

The results are discussed of quantitative and qualitative analyses of the protein characters of seed-enclosed cotyledons and of hypocotyls + roots (of the primary root) of germinated seeds of the following species: *Phaseolus vulgaris* L., *P. coccineus* L., *P. lunatus* L., and *P. aureus* Roxb. A practically identical phaseolin was found in the cotyledons of *P. vulgaris* and *P. coccineus* being absent in *P. lunatus* and *P. aureus*. A protein component described as Phaseolus protein H1 was found in the hypocotyl + root of *P. vulgaris*, *P. coccineus*, and *P. lunatus* but was absent in *P. aureus*. The inequality of breadth of taxonic (group) specificity of the protein characters was reconfirmed. This fact is discussed in connection with the relative phylogenetic age of the characters. On the basis of the results obtained a developmental scheme of the studied species is proposed. (Author's summary)

4695 SILBERANGEL, M.J. Bean protein studies. In *Bean Improvement Cooperative Annual Report no. 11. 1968. p.45. En.*

Phaseolus vulgaris. Protein content. Human nutrition. Diets.

Work has been initiated to screen all available materials on a Udy Protein Analyzer for gross protein content. Protein content variation from 17-30 percent has been found in *Phaseolus vulgaris*. The ultimate objective of this program is to improve both the quantity and the quality of bean protein as a human dietary protein source. Concerning quality, the essential amino acids that are most lacking in beans, according to FAO reports, are met. plus cystine, and tryptophan. Current efforts are centered around establishing some of the environmentally influenced parameters that affect overall protein content in beans, such as location, water stress, photoperiod, fertilizer, etc. A breeding program has also been initiated to hybridize high X high, high X low, and low X low protein containing lines to try to establish to what extent protein content is genetically controlled. At present we are still attempting to find rapid, inexpensive assay techniques for screening large numbers of bean lines for the met. and tryptophan content. (Full text)

3564 RIES, S.K. The relationship of protein content and size of bean seed with growth and yield. *Journal of the American Society for Horticultural Science* 96(5):557-560. 1971. En., Sum. En., 10 Ref. II.

Phaseolus vulgaris. Protein content. Growth. Seeds. Productivity. N. Field experiments. Laboratory experiments. Plant breeding. Statistical analysis.

Phenotypic differences in seed size and protein content were expressed in one v. of snap beans by growing them at 2 Michigan locations under 3 N regimes (1969). Each trait was increased by supplemental N applications. Greenhouse studies with ungraded seed of these different phenotypes showed that both seedling size and protein per seedling were positively correlated with seed size and the quantity of protein per seed. When seedlings were grown from small (1975 mg) seed and large (275 mg) seed of different protein content there was a correlation between protein content per seed and the size of plants for each size of seed. Field studies in Central and Northern Michigan (1970) supported the greenhouse findings. Seedling size, yield and number of fruit were more highly correlated with protein per seed than with seed size. When the factor of seed size

was eliminated by correlating the percent protein with growth or yield, there were significant correlations for all but one of the field parameters. Most importantly there was also, with one exception, a significant increase in seedling size, yield and number of fruit from high protein seeds, obtained by supplemental N applications the previous year. These studies provide both correlative, and cause and effect evidence that within a genotype, seedling vigor and yield are related to the protein content or some factor related to protein in snap bean seed. (Author's summary)

0170

4947 RUTGER, N.J. Variation in protein content and its relation to other characters in beans (*Phaseolus vulgaris* L.). Ithaca, New York, Cornell University. Department of Plant Breeding and Biometry, 1971? 11p. En., 3 Ref. II.

Phaseolus vulgaris. Protein content. Agronomic characters. Cultivars. Ecology.

CP content and its relation to other characters of the plant were studied in bean lines cultivated in nurseries of the state of New York (USA). Over 1000 lines were evaluated with regard to maturity, seed wt., yields, protein, and oil content. Exptl. conditions affected protein content significantly; this varied between 9-31 percent with an av. of 24.6 percent for 343 lines that were selected for a 2nd evaluation. Protein content was positively correlated to late-maturing lines and negatively to seed wt. and oil content. Yield and growth habit did not show a significant correlation. The frequency of high protein lines was higher in the Central American collection. Information is presented in table form. (Summary by C.P. G. Trans. by L.M.F.)

0171

23902 ADAMS, M.W. 1972. On the quest for quality in the field bean. In Milner, M., ed. Nutritional improvement of Food Legumes by Breeding, Rome, Italy, 1972. Proceedings of a Symposium. New York, Protein Advisory Group of the United Nations System. pp.143-149. En., 10 Ref., II.

Plant breeding. Proteins. Protein content. Amino acids. Nutritive value. USA. Human nutrition. North America. America.

From the standpoint of human needs, the most urgent problems in dry beans are the necessity of improving their yielding ability across broad geographical regions and improving the biological value of their seed protein. Concerning these 2 breeding aspects, the strategy that should be adopted to achieve both yield and quality could be summarized in 3 major aspects: (1) select for high protein levels; (2) aim for 20-33 percent protein content; and (3) in this last range of protein, concentrate on the selection for yield and for quality (S-containing amino acids). The expectation is that higher levels of yield and quality could be achieved with less difficulty than by any alternative strategy. (CIAI)

0172

8611 YOMO, H.; SRINIVASAN, K. Protein breakdown and formation of protease in attached and detached cotyledons of *Phaseolus vulgaris* L. *Plant Physiology* 62:671-673. 1973. En., Sum. En., 11 Ref., II.

Phaseolus vulgaris. Proteins. Cotyledons. Seed. Enzymes. Amino acids. N.

In contrast to previous results for peas, increases in protease activity were found in both attached and detached cotyledons of beans (*Phaseolus vulgaris*). In attached cotyledons the activity began to decrease after 6 days, but in detached cotyledons the increase continued for 12 days. In detached cotyledons amino acid content was highest at 11 days and increase in protease activity leveled off after 50 percent of the original seed protein had been digested, which suggested that the increase in protease activity may be inhibited by high amino acid concn. In detached cotyledons, protease activity increase was inhibited 30 percent by 10 ug cycloheximide/cm(3) and 50 percent by 5 micrometers ABA, while

alpha-amylase activity increase was inhibited 90 percent by 10 micrograms cycloheximide/cm(3) and 95 percent by 20 micrometers ABA. It is suggested that only part of the increase in protease is due to protein synthesis. (Summary by field Crop Abstracts)

0173

8371 ILELEJI, O.I. et al. Variability in protein content of seed from different portions of the bean plant, *Phaseolus vulgaris* L., and within individual seeds. *Nigerian Agricultural Journal* 11(1):31-34. 1974. En., Sum. En., 4 Ref.

Phaseolus vulgaris. Protein content. Seed. Pods. Analysis. Statistical analysis. Laboratory experiments. Field experiments.

Protein content of bean seeds was not influenced by seed position within the pod. Pod position on the plant influenced the percentage of protein when plants were grown in the greenhouse, but not in the field. This was probably due to variation in pod maturity. The proximal end of the seed contained slightly more protein (0.40 percent) than the distal end, but there was a high ($r = 0.99$) correlation between the distal end and the av. protein content of the seed. Thus an accurate and nondestructive method of analyzing seeds is available to the breeder although a composite of seeds is still preferable for protein analysis. (Author's summary)

0174

5252 ROCABADO R., J.F.; PINCHINAT, A.M. Rendimiento y contenido proteínico de grano en frijoles común y costeno tratados con TIBA. (Grain yield and protein content in common beans and cowpeas treated with TIBA). *Turrialba* 25(1):72-78. 1975. Es., Sum. Es., 17 Ref.

Phaseolus vulgaris. *Vigna sinensis*. Growth. Developmental stages. Cultivation. Cultivars. Experiment design. Productivity. Protein content. Seeds. Costa Rica.

Determinate and indeterminate common bean (*Phaseolus vulgaris* L.) and cowpea (*Vigna sinensis* Endl.) varieties were treated with 5 different rates of TIBA (triiodobenzoic acid) during 4 different stages of plant growth, in an attempt to increase grain yield and protein content. TIBA-treated plants showed many morphological modifications including, in most cases, darker green foliage, a more conical shape of the leaf canopy, slower pod maturation and reduced stature. The younger the plants at the time of TIBA application, the more pronounced these symptoms were. As applied in this study, TIBA had practically no effect on no. of pods/plant, no. of grains/pod, and grain yield. Statistically, 100-grain weight and grain protein content ($N \times 6.25$) were significantly increased by TIBA only in the determinate common bean var. (27R). (Author's summary)

0175

4832 DERBYSHIRE, E. et al. Seed proteins of *Phaseolus* and *vigna*. *New Phytologist* 76:382-288. 1976. En., Sum. En., 23 Ref.

Phaseolus vulgaris. *Vigna sinensis*. Legume crops. Protein content. Seed. Analysis. cultivars. Agglutinins. Human physiology.

Protein band patterns of globulins extracted from the seeds of a no. of different species of *Phaseolus* and *Vigna* were obtained by disc electrophoresis, and the subunits of the major seed proteins were separated on gels by use of continuous SDS electrophoresis. The agglutinin potential of seed extracts with respect to human Group O red blood cells was also determined. the globulin extracted from *P. lunatus* was different from that from *P. acutifolius*, *P. coccineus*, *P. dumosus*, and *P. vulgaris*; and these globulins were different from the major globulins extracted from other species which differed among themselves. The globulin patterns for *P. atropurpureus* and *P. lathyroides* were not the same as those of the other species examined and saline extracts from the 2 species lysed red

blood cells. Agglutinin activity was detected only in extracts from *P. acutifolius*, *P. coccineus*, *P. dumosus*, and *P. vulgaris*. Glycoprotein II, the major seed protein of *P. vulgaris*, was tentatively identified as the major globulin in extracts from *P. acutifolius*, *P. coccineus*, and *P. dumosus* and was not detected in the other species, with the possible exception of *P. atropurpureus* and *P. lathyroides*. Data are discussed in relation to recent reclassifications of species of *Phaseolus* and *Vigna*. (Author's summary)

0176

8135 ORTEGA D., M.L.; RODRIGUEZ, C., C.; HERNANDEZ, X., E. Análisis químico de 68 genotipos del género *Phaseolus* cultivados en México. (Chemical analysis of 68 genotypes of the genus *Phaseolus* grown in Mexico). *Agricultura* no. 24:23-42. 1976. Es., Sum. Es., En., 12 Ref., 11.

Phaseolus vulgaris. *Phaseolus coccineus*. Analysis. N. Protein content. Ash content. Fiber content. Seed. Cultivars. Seed color. Mexico.

A chemical analysis was made of 68 genotypes of *Phaseolus*, 10 of which belong to *P. coccineus* L. (Ayocote group) and 58 to *P. vulgaris* L. These 58 genotypes are representative of the following 6 infraspecific groups: Blancos, Colores, Canario, Negro Tropical, Negro Arribeño, and Bayo. Within each group there are samples with superior protein content; i.e., in the Colores group there are the genotypes Jal. 132 and Mor. 32 with more than 35 percent protein on a dry wt. basis. The significance of the absolute quantity of protein/seed and the percentage of protein in the flour is discussed. (Author's summary)

0177

10870 KLOZOVA, E.; TURKOVA, V. Variability of some seed proteins of the species *Phaseolus vulgaris* and their relationship to phytohaemagglutinating activity. *Biologia Plantarum* 20(2):129-134. 1978. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Seed. Protein content. Cultivars. Antisera. Phytohaemagglutinins. Laboratory experiments.

The presence of protein I specificity Veltruská Saxa was established for 26 cv., but the presence of protein I of specificity Krupnaya sakharnaya (Large Sugar) and protein II of specificity Veltruská Saxa or Krupnaya sakharnaya showed great variability. Protein II of the specificity Veltruská Saxa was shown to exhibit hemagglutinating activity. (Summary by Plant Breeding Abstracts)

0178

10174 MA, Y.; BLISS, F.A. Seed proteins of common beans. *Crop Science* 18(3):431-437. 1978. En., Sum. En., 35 Ref., 11.

Phaseolus vulgaris. Amino acids. Seed. Proteins. Cotyledons. N. Hydrolysis.

Fractionation of bean cotyledon storage proteins using an improved separation procedure revealed a protein profile in which globulin-1 was the major fraction (about 40 percent of the total cotyledon protein), followed in importance by an alkali-soluble fraction (Ca.25 percent) containing glutelin and albumin, free amino acids, globulin-2, prolamine, and residue fractions. SDS-acrylamide gel electrophoresis was performed to determine banding patterns of total cotyledon polypeptides and the purity of the fractions. amino acid analyses using an autoanalyzer were performed on total protein and protein fractions. The alkali-soluble fraction had the highest concn. of met. (2 percent of the protein by wt.), while the met. percentage of globulin-1 (0.88 percent) and albumin (1.0 percent) was less than that of the respective cotyledons (1.10 percent). The alkali-soluble and globulin-1 fractions comprised 3/4 of the total cotyledon met. Total cotyledon protein was positively correlated with globulin-1, free amino acid, alkali-soluble and globulin-2 fractions. Significant positive correlations between amount of met. in the cotyledons and

that in the alkali-soluble fraction were also found. This finding suggests that selection for high-protein genotypes in which the alkali-soluble fraction is increased should result in improved met. content. Since quantitative estimation of this fraction is time consuming, a simplified procedure for determining the amount of protein insoluble in ascorbate-NaCl solution is suitable for identifying strains with large amounts of the alkali-soluble fraction. (Author's summary)

0179

11164 TULMAN NETO, A.; KOO, F.K.S.; CUEVAS-RUIZ, J. Influence of plant competition and pod position on seed yield components and protein content in beans. *Journal of Agriculture of the University of Puerto Rico* 62:186-190. 1978. En., Sum. En., Es., 2 Ref.

Phaseolus vulgaris. Pods. Yield components. Yields. Spacing. Agronomic characters. Protein content. Statistical analysis. Cultivars. Puerto Rico.

The indeterminate var. Carioca and the determinate bush var. Jamapa were planted at within-row spacing of 10 cm and between-row spacings of 60 cm using 5 replicates and 20 plants/row. No difference was found in seed wt. between seeds from pods from lower and central positions in Carioca; seeds from the upper pods were lighter. In Jamapa, seeds from the 3 pod positions differed in wt., those from the lower pods being heaviest and those from the upper pods being lightest. Protein content was not affected by pod position. Carioca had the heavier seeds, but the seeds of Jamapa had the higher protein content. (Summary by field Crop Abstracts)

0180

10849 ORTEGA D., M.L. Bioquímica. (Biochemistry). In Engleman, E.M., ed. *Contribuciones al conocimiento del frijol (Phaseolus) en México*. Chapingo, México, Colegio de Postgraduados, 1979. pp. 101-112. Es., 3 Ref., II.

Phaseolus vulgaris. *Phaseolus coccineus*. Biochemistry. Analysis. Protein content. Seed Characters. Amino acids. Seed color. Composition. Mexico.

A brief resumé is given of ongoing research projects on the biochemistry of *Phaseolus* species. Results are given of the analysis of the chemical composition (protein content) of the crude seed of 68 genotypes--58 of *P. vulgaris* and 10 of *P. coccineus*. A significant positive correlation was found between protein content and seed wt. Data are also given on the amino acid composition of the seed; there was a deficiency in the sulfur-containing cystine and met. Because of the low digestibility of beans, the proteins in the seed were characterized; 75 percent are constituted by globulins, which are difficult to digest. Nevertheless, when treated with an alkali 9pH (12.5) for 24 h, they become digestible. This is important for industrial processing. (Summary by F.G. Trans. by T.B.)

0181

15856 ALLI, I.; BAKER, B.E. Constitution of leguminous seeds: the microscopic structure of proteins isolated from *Phaseolus* beans. *Journal of the Science of Food and Agriculture* 31:1316-1322. 1980. En., Sum. En., 14 Ref., II.

Phaseolus vulgaris. Composition. Seeds. Proteins. Analysis. Biochemistry.

Proteins were isolated from citric acid and sodium hydroxide extracts of *Phaseolus* beans. Examination of the proteins under the light microscope revealed that they had different micro-structures. Bipyramidal crystalline and spheroidal protein were obtained from the citric acid extracts of the white kidney beans, the navy bean, and the baby lima bean. Cubical crystalline, rosette-type and needle-like structures were isolated from the navy bean under certain conditions. Analysis of the proteins revealed the presence of phytic acid and carbohydrate material. There was some indication that neither of these materials affect the microscopic structure of the proteins. (Author's summary)

0182

28216 WESCOTT, C. 1980. Nebraska dry bean protein extraction process. Michigan Dry Bean Digest 5(1):7-8. En., II.

Phaseolus vulgaris. Proteins. Processing. Uses. Human nutrition. USA.

The advantages of using bean protein concentrate in human nutrition, in particular in bread making or as a protein emulsifier and extender in processed meat, are briefly discussed. A flow chart of the Nebraska (USA) dry bean protein extraction process is also included. (CIAT)

0183

16017 ALLI, I; BAKER, B.F. 1981. Constitution of leguminous seeds. The effect of some physico-chemical factors on the yield of proteins isolated from *Phaseolus* beans. Journal of the Science of Food and Agriculture 32:503-507. En., Sum. En., 9 Ref.

Phaseolus vulgaris. *Phaseolus lunatus*. Seed. Protein content. Analysis. pH. Temperature. Nutritive value.

The yields of acid-soluble proteins isolated from white kidney beans, navy beans, and baby lima beans (*Phaseolus lunatus*) were determined under different conditions of extraction. Highest yields of protein material were obtained when malic acid solutions (0.4 M (pH 3.5) white kidney bean and navy bean; 0.05 M (pH 3.5) baby lima bean) were used and under the following conditions; shaking time 20-30 min; extraction temperature 40-50 degrees Celsius; particle size 0.50-1.00 mm. (Author's summary)

0184

16016 ALLI, I; BAKER, B.F. 1981. Constitution of leguminous seeds. A note on protein-phytic acid interactions during isolation of acid-soluble protein from *Phaseolus vulgaris* beans. Journal of the Science of Food and Agriculture 32:588-592. En., Sum. En., 20 Ref.

Phaseolus vulgaris. Seed. Protein content. Phytic acid. Analysis.

Acid-soluble proteins isolated from 3 types of *Phaseolus* beans (white kidney beans, navy beans, and lima beans) were found to contain phytic acid. The amount of phytic acid complexed by the proteins was unaffected by the phytic acid content of the bean extracts from which the proteins were isolated but depended on the no. of positively charged basic groups which were available for reaction with the phytate anion. It was found that the Neuberg formula for phytic acid (C₆H₁₂P₆) represents more accurately the mol. formula of phytic acid associated with the isolated proteins, than does the Anderson formula (C₆H₁₆O₂₄P₆). (Author's summary)

0185

25305 SATHI, S.K. 1981. Investigations on the Great Northern beans (*Phaseolus vulgaris* L.): Protein functionality, antinutrients, flatus factors, fermentation, and carbohydrates. Ph.D. Thesis. Logan, Utah State University. 219p. En., Sum. En., 218 Ref., II.

Cultivars. Proteins. Protein content. Amino acids. Starch content. Fermentation. Dietary value. USA. Composition. Carbohydrate content. North America. America.

The bean flour proteins, albumins, globulins, protein concentrates, and protein isolates were evaluated for several functional properties including electrophoretic properties, water and oil absorption, foaming and emulsion, gelation, viscosity, sorption isotherms, buffer capacity, dielectric property, adhesive strength, trypsin and chymotrypsin inhibitory activities, and phytohemagglutinating activity. Protein concentrates had the

highest water absorption, oil absorption, and emulsion capacity (5.93, 4.12, and 72.6 g/g, resp.), significantly reduced trypsin and chymotrypsin inhibitory activities, and no hemagglutinating and flatulence activities. Baking expt. indicated that wheat flour could be replaced by bean flour and protein concentrates up to 30 and 20 percent, resp., in cookie preparation with corresponding figures of 10 and 10 percent for breadmaking. Fermentation of beanrice blends suggested that beans have a potential for developing fermented foods. [Dissertation Abstracts International (Extract)]

0186

19729 CHANG, K.C.; SATTERLEE, L.D. 1982. Chemistry of dry bean proteins. *Journal of Food Processing and Preservation* 6(4):203-225. En., 87 Ref., Il. (Food Protein Research Group, Dept. of Food Science & Technology, Univ. of Nebraska, Lincoln, NE 68583, USA)

Phaseolus vulgaris. Seed. Biochemistry. Proteins. Inhibitors. Digestibility. Processing. Nutritive value. USA.

Recent development in the protein chemistry and nutritional quality of bean are reviewed. The physicochemical properties of these proteins are analyzed, in particular trypsin inhibitory activities in different bean cv. The role of lectins, quite toxic to exptl. animals and partially responsible for the poor nutritive value of raw beans, is explained and lectins isolated from red and white kidney beans are reported. The isolectin with an isoelectric point of 5.7 was found to be the most effective agglutinin for both red and white cells. The amino acid composition of several lectins is discussed as well as the characterization of storage proteins and globulins. The stability of various storage proteins is attributed to their tertiary and quaternary structure, which is stabilized by numerous hydrogen bonds, hydrophobic interactions, and electrostatic forces. The factors affecting the nutritional quality of bean proteins are discussed. The amino acid pattern, generally characterized by its deficiency in sulfur amino acids and tryptophan, is reviewed. Digestibility of raw bean proteins generally ranges from 25 to 60 percent. Cooked beans have a protein digestibility ranging from 65 to 85 percent, depending on the var. and the cooking process used. Factors affecting digestibility are analyzed. The identification of nutritional characteristics through detailed compositional and structural studies is of 1st importance. The different methods used for the qualification and quantification of nutritional characteristics is described. The effects of processing (heat, trypsin inhibitors, soaking, and pH) on protein quality are described. The different methods used in the study of bean protein nutritional quality are analyzed, giving advantages and disadvantages. A procedure modified to determine available cystine and cystine is given. Recommendations for future research are included. (Summary by EDITOR. Trans. by L.M.F.)

0187

22173 PILOSOFF, A.M.R.; BARTHOLOMAI, G.B.; CHIRIFF, J.; BOUQUET, R. 1982. Effect of heat treatment on sorption isotherms and solubility of flour and protein isolates from bean *Phaseolus vulgaris*. *Journal of Food Science* 47(4):1288-1290. En., Sum. En., 18 Ref., Il. (Depto. de Industrias, Univ. de Buenos Aires, Ciudad Universitaria, 1428 Buenos Aires, Argentina)

Phaseolus vulgaris. Proteins. Bean flour. Heat treatment. Water absorption. Water content. Argentina.

The effect of heating at 50, 70, or 90 degrees Celsius and low MC on water sorption behavior (about 0.65 water activity) and N solubility of bean flour and protein isolates, was investigated. For higher MC, heat treatment induced a considerable decrease in N solubility in both flour and protein isolate. Bean flour samples heated in the dry state showed very little loss of N solubility (max. loss of 13.4 percent), while the protein isolate evidenced considerable losses. The results suggested that relative water sorption changes, in the range studied, may not be the most adequate indicators of N solubility changes in "dry"/"moist" heated protein products since heated samples may undergo very important

changes in N solubility while having experienced relatively little modifications in water sorption capacity. (Author's summary)

0188

29669 SGARBIERI, V.C.; ANTUNES, P.L.; JUNQUEIRA, R.G. 1982. Algumas propriedades fisicoquímicas e nutricionais das proteínas de feijão (*Phaseolus vulgaris* L., var. Rosinha G2). (Some physicochemical and nutritional properties of proteins of bean var. Rosinha G2). *Ciencia e Tecnologia de Alimentos* 2(1):1-20, Pt., Sum. Pt., En., 40 Ref., Il.

Phaseolus vulgaris. Seeds. Proteins. Digestibility. Temperature. Biochemistry. Animal nutrition. Brazil.

The 2 main protein fractions of beans are globulins and albumins, which are deficient in met. supplementation with DL-met. plus L-cystine increased the PER of the whole ground seed from 1.17 to 2.47 and those of isolated proteins from values lower than 1.0 to values equal or higher than 4.0. The *in vitro* digestibility was 59 percent for the whole ground bean and between 72-83 percent for the isolated protein fractions autoclaved 15 min at 121 degrees Celsius. The apparent BV (28-33 percent) were very low compared with the casein (84 percent). The biological availability of met. was the highest (51 percent) in the globulin fraction and very low (5.8 and 4.6 percent) for the albumin fraction and insoluble residue, resp. The trypsin and chymotrypsin inhibitor was stable in aqueous solutions at 97 degrees Celsius. Inactivation at this temp. was possible in alkaline solution or by the action of disulfide bond reducing agents. The introduction of inhibitor (1 percent of casein) in the rat diet did not cause any detrimental effect on growth, apparent digestibility, and BV; on the other hand, 0.5 percent lectin, same base, was detrimental to growth, digestibility, and BV. (AS)

0189

19948 SGARBIERI, V.C.; WHITAKER, J.R. 1982. Physical, chemical, and nutritional properties of common bean (*Phaseolus*) proteins. *Advances in Food Research* 28:93-166. En., 328 Ref., Il. (Univ. Estadual de Campinas, Cidade Universitaria, Barao Geraldo, Caixa Postal 1170, Campinas-SP, Brasil)

Phaseolus vulgaris. Proteins. Analysis. Amino acids. Digestibility. Nutritive value. Phytohaemagglutinin. Storage. Processing.

Aspects covered in this comprehensive review are: biosynthesis, identification and quantitation of storage proteins, protein body membrane proteins, and composition of the protein body storage proteins; amino acid composition of bean protein and of protein isolates and fractions, biological value and digestibility of bean proteins, biological availability of amino acids; toxicity associated with *Phaseolus* proteins, i.e. lectins (phytohemagglutinins), covering occurrence and nomenclature, distribution and physiological importance in the plant, composition and physicochemical properties in different *Phaseolus* spp., and nutritional and medical importance, and protein inhibitors of digestive enzymes (proteolytic enzymes and α -D-galactosidase). The influence of storage and processing on chemical and nutritional properties of bean proteins, and additional research needs are also discussed. (Summary from Food Science and Technology Abstracts)

0190

22194 SEYAM, A.A.; BANASIK, O.J.; BREEN, M.D. 1983. Protein isolates from navy and pinto beans: their uses in macaroni products. *Journal of Agricultural and Food Chemistry* 31(3):499-502. En., Sum. En., 19 Ref., Il. (Drake Bakeries, Wayne, NJ 04770, USA)

Phaseolus vulgaris. Proteins. Protein content. Amino acids. Composition. N. Dietary value. Processing. Human nutrition. Nutritive value. USA.

Navy and pinto bean flour proteins were extracted with dilute alkali. Proteins precipitated by adjusting the pH to 4.5 were isolated by centrifugation then lyophilized or spray-fried. The protein content of the 1st extraction was 60.5 and 64.3 percent, resp. The lysine content of the protein isolates was more than 4 times that found in durum wheat semolina. Acceptable spaghetti was prepared by using the protein isolates as a source of protein enrichment in macaroni products. The cooking quality of spaghetti was better when semolina was mixed with navy bean protein isolate rather than with pinto bean protein isolate. (Author's summary)

0191

26029 DESHPANDE, S.S.; CHERYAN, M. 1984. Preparation and antinutritional characteristics of dry bean (*Phaseolus vulgaris* L.) protein concentrates. *Qualitas Plantarum Plant Foods for Human Nutrition* 34(3):185-196. En., Sum. En., 21 Ref., 11. (Dept. of Food Science, 382-D, Ag. Eng. Sci. Bldg., Univ. of Illinois, Urbana, IL 61801, USA)

Bean flour. Bean starch. Cultivars. *Phaseolus vulgaris*. Protein content. Proteins. Tannin content. USA. Uses.

Protein concentrates and starches were prepared by a wet extraction process from 5 dry bean cv. The protein contents ranged from 69.7 to 76.4 percent. Concentrates prepared from dehulled beans under similar conditions had higher protein contents (80.6-87.9 percent). Each additional washing of the concentrates with distilled water increased their protein content. The protein recovery progressively decreased. The yield of starch ranged from 48.0 to 51.1 percent of the starting material. The solubility of bean proteins was minimal at pH 4.0, and under alkaline conditions, it was influenced by the tannin contents of the concn. Protein concentrates had lower trypsin, chymotrypsin, and amylase inhibitory activities as well as lower phytic acid and tannin contents compared with whole bean flours. (AS)

0192

29116 PHILOSOF, A.M.R.; BOQUET, R.; BARTHOLOMAI, G.B. 1986. Effect of heat-moisture treatment to field bean (*Phaseolus vulgaris*) flour and protein isolate on water uptake. *Cereal Chemistry* 63(5):456-458. En., Sum. En., 13 Ref., 11.

Phaseolus vulgaris. Bean flour. Proteins. Processing. Temperature. Timing. Water absorption. Argentina.

Bean flour or protein isolates, equilibrated to MC between 14-40 percent, were heated at either 70 or 90 degrees Celsius for various times. At every MC the hydration capacity of bean flour increased with the time of heat treatment; increasing the MC increased the hydration capacity of the flour. The rate of water uptake of flour was increased by almost all heat-moisture treatments. The hydration capacity of bean protein isolate was reduced by heat-moisture treatments; extensive losses and hydration capacity occurred with increasing temp. and MC. The effect of heat-moisture treatments on the rate of water uptake of bean protein was not as pronounced as for bean flour.

Nutritive value

0193

3537 SEIDI, D.; JAFFE, M.; JAFFE, W.G. Digestibility and proteinase inhibitory action of a kidney bean globulin. *Journal of Agricultural and Food Chemistry* 17:1318-1321. 1969. En., sum. En., 28 Ref.

Phaseolus vulgaris. Nutritive value. Nutrient loss. Amino acids. Inhibitors. Enzymes. Biochemistry. Hydrolysis. Proteins. Digestibility.

A globulin fraction, isolated from black beans (*Phaseolus vulgaris*), was resistant to hydrolysis by pepsin, trypsin, chymotrypsin, papain, ficin, hurain, and subtilisin. After denaturation of the globulin by heat or urea, only slight hydrolysis by enzymes could be detected. The activity of all seven proteinase on their respective substrates was inhibited by the bean globulin. Preincubation of enzyme and globulin enhanced the inhibitory effect. When heat denatured, insoluble globulin was stirred with papain, proteolytic activity was diminished. The name globulin proteinase inhibitor is proposed for this factor. Adsorption with bentonite and celite of a crude bean extract eliminated the specific trypsin inhibitor activity but not that of the unspecific proteinase inhibitor. Trypsin inhibitor and proteinase inhibitor activities could also be separated by dialysis against distilled water, the former remaining in solution while the latter precipitated. The possible nutritional significance of these observations are discussed. (Author's summary)

0194

5064 GABRIAL, G.N.; HUSSEIN, I.; MORCOS, S.R. Some nutritional studies on kidney bean proteins (*Phaseolus vulgaris* var. Giza 3). *Plant Foods for Human Nutrition* 24(1-2):61-70. En., Sum. En., De., 12 Ref., II.

Phaseolus vulgaris. Protein content. Analysis. Soluble carbohydrates. Ash content. Fibre content. Nutritive value. Toxicity. Laboratory animals. digestibility. Proteins.

Three feeding expt. were carried out on weanling rats fed diets containing 40 percent kidney bean as the sole protein source in the diet (NDPCal percentage = 4.0) or in the presence of wheat (NDPCa percentage = 6.9), or wheat and casein (NDPCa percentage = 10.2). Animals fed diet containing 20 percent casein (NDPCal percentage = 10.2) were the only group which grew up almost normally. The first two groups lost wt. persistently and the mortality rate reached 50 percent within 18 days. Soaking of the beans did not raise the mortality of animals. Autoclaving of the beans for 1 h at 16 lb/sq. in. improved the digestibility of the bean protein and gave a net protein utilization of 58. (Author's summary)

0195

27386 SANTOS, T.M.E.; O' VEIRA, J.E.D. DE. 1972. Valor nutritivo de frações proteicas isoladas do feijão (*Phaseolus vulgaris* L.). (Nutritive value of protein fractions isolated from beans). *Archivos Latinoamericanos de Nutrición* 22(4):547-560. Pt., Sum. Pt., En., 23 Ref. II.

Phaseolus vulgaris. Proteins. Nutritive value. Diets. Animal nutrition. Digestibility. Methionine. Brazil.

Bean proteins were extracted with 1 percent NaCl solution at pH 8. Treatment of the extract with HCl solution at pH 4 and heat yielded 3 protein fractions with the different physicochemical characteristics, their protein content varying from 59.13 to 66.49 percent. The yield of 1 fraction (65 percent) was twice that of the other 2. Studies with rats of the 3 isolated protein fractions showed a lower nutritive value than that of the cooked bean when both diets were supplemented with met. On the other hand, the digestibility of the fractions was better than that of the cooked bean. Met. supplementation did not influence the digestibility of the diets. Phytohemagglutinin was not present in the isolated fractions and in the cooked beans. Blastogenic activity was observed in the isolated fractions, although to a lesser degree than in raw beans. (AS)

0196

6381 KELLY, J.D.; BLISS, F.A. Quality factors affecting the nutritive value of bean seed protein. *Crop Science* 15:757-760. 1975. En., Sum. En., 19 Ref.

Phaseolus vulgaris. Seed. Protein content. Methionine. Seed character. Amino acids. Analysis. N. Nutritive value.

Seeds of 4 bean (*Phaseolus vulgaris* L.) strains with a range in protein content from 21.5-31.9 percent were selected and analyzed for their constituent amino acids. Differences in the levels of certain essential amino acids were detected. Total met. and microbiologically available met., each as percentage of protein, were similar in 3 of the 4 strains, but one had a lower level of available met., suggesting that part of the total met. was unavailable. Correlation between protein efficiency ratio (PER) for rats and available met. as percentage of protein in the 4 strains was positive and significant, while similar correlations between PER and total met. as percentage of protein, with or without cystine, were not. The microbial assay used in determination of available met. levels is outlined and its value in a breeding program for improving nutritive quality of beans is discussed. (Author's summary) 1100 1101

0197

5677 LINDGREN, E. The nutritive of peas and field beans for hens. *Swedish Journal of Agricultural Research* 5:159-161. 1975. En., Sum. En., 4 Ref.

Phaseolus vulgaris. Animal nutrition. Protein content. Metabolism. Analysis. N. Cultivars. Digestibility.

The contents of metabolizable energy and digestible protein in different cv. of peas and field beans were determined in expt. with laying hens. A strong correlation was obtained between the digestion coefficients of crude protein and of the content of tannins in percent of crude protein. (Author's summary)

0198

14734 EL-HAG, N.A. The effect of germination on the nutritive value of red kidney beans. Ph.D. Thesis. New Brunswick, Rutgers University, 1976. 93p. En., sum. En., 136 Ref. II.

Phaseolus vulgaris. Nutritive value. Digestibility. Antinutritional factors. Plant toxins. Protein content. Proteins. Inhibitors. Diets. Heat treatment. Plant anatomy. Germination.

Phaseolus vulgaris comprises a significant portion of the human diet in many parts of the world. The salient characteristic of these beans is their high protein content. The expanded use of these beans is limited because of the indigestibility of a portion of the bean protein. Germination of kidney beans improves the digestibility coefficient. The protein globulin in kidney beans possesses a potent trypsin inhibitor, and milder inhibitors of chymotrypsin, pepsin, and papain. The active inhibiting fractions of the protein globulin have mol. wt. of 5200 and 8000. The inhibitor can be inactivated by heat exposure (100 degrees Celsius for 30 min). (Author's summary)

0199

19760 BRESSANI, R.; ELIAS, L.G. 1977. The problem of legume protein digestibility. In Hulse, J.H.; Rachie, K.O.; Billingsley, L.W., eds. *Nutritional standards and methods of evaluation for food legume breeders*. Ottawa, Canada, International Development Research Centre. IDRC-TS7c. pp.61-72. En., 28 Ref., II.

Phaseolus vulgaris. Digestibility. Proteins. Nutritive value. Biochemistry. Heat treatment. Storage.

The low protein digestibility of legume grains is analyzed and possible reasons for this are discussed. Nutritional and biochemical studies carried out with legume grain have dealt mainly with antiphenological substances (trypsin and amylase inhibitors, and hemagglutinins) and the deficiency of self-containing amino acids. Studies on lab. rats and on human adults to evaluate fecal N excretion are reported. It is suggested that the low protein digestibility of legume grains may be a characteristic common to all or al-

most all vegetable protein sources. Antiphysiological factors could be partially responsible for this low digestibility. The effect of heat treatment on protein digestibility (different cooking processes, toasting, autoclave, and extrusion) and on protein quality as well as that of storage time were analyzed. Standard methods of processing these products are needed. The digestibility of the water-soluble N fractions of processing these products are needed. The digestibility of the water-soluble N fractions was analyzed, being significantly lower than that of the insoluble N fraction. However, a better identification of these fractions is required. Proteins resistant to enzymatic hydrolysis and seed coat pigments are discussed. Black beans have the highest protein digestibility and red beans, the lowest. The role of the rate of passage of food residues through the alimentary tract and the effect of fractions on gastric pH are analyzed. It is concluded that at least 4 conditions control protein digestibility: antiphysiological factors; the effect of heat that inactivates trypsin inhibitors, hemagglutinin compounds, and others; heat or other treatment that would cause breakdown of heat resistant proteins, cell walls, and sugars; and the control of protein complexing substances as well as storage conditions. The efficiency of land utilization in terms of protein from bean is analyzed. (Summary by EDITEC. Trans. by L.M.F.)

0200

9247 BRESSANI, R. et al. Estudios sobre la digestibilidad de la proteína de varias especies de leguminosas. (Digestibility of protein from several legume species). *Archivos Latinoamericanos de Nutrición* 28(2):215-231. 1977. Es., Sum. Es., En., 17 Ref., II.

Phaseolus vulgaris. Digestibility. Proteins. Legume crops. Laboratory animals. Dry matter. Fibre content. Fat content. N. Processing. Diets. Guatemala.

Studies were conducted with 3 var. of *Phaseolus vulgaris* beans (black, white, and red seed coats) and with 1 var. each of cowpeas (*Vigna sinensis*), pigeon peas (*Cajanus cajan*), and a soybean flour obtained by solvent extraction and low temp. to obtain a better understanding of the low digestibility of proteins from legume foods. Casein was used as the reference protein. Feeding trials were carried out with young growing dogs, fed diets containing the cooked legume grains as the sole source of protein. Utilization of the protein was measured by N balance, total apparent and true protein digestibility; digestibilities of the soluble and insoluble N fractions of the cooked beans, and digestibility of the DM and of the calories ingested. The data obtained suggest that white beans are superior in quality to black and red beans; the order of quality for the other 3 legumes being soybeans, cowpeas, and pigeon peas. Total protein digestibility of the legume grains was significantly lower than that of casein and increased with respect to intake, with the exception of red beans. The digestibility of DM and energy decreased as intake increased, with the exception of soybeans and casein. Regression analyses showed that as bean intake increased, there was a significant increase in fecal N. The coefficients of regression were higher for *Phaseolus* than for cowpeas, pigeon peas, and soybeans; and among the bean samples, it was higher for red beans. No such relationship was evident for casein. The digestibility of the soluble and insoluble N fractions of the cooked legume grains was low; but of the 2 fractions, digestibility of the soluble fraction was significantly lower. Based on the information presented and on data found in the literature, it was suggested that 4 factors possibly contribute in different ways to the low digestibility of legume protein: trypsin inhibitors, processing conditions, the structure of the protein, and perhaps certain substances such as phenols, which react with the protein making it partially unavailable. (Author's summary)

0201

12331 EL-HAG, N.; HAARD, N.F.; MORSE, R.E. Influence of sprouting on the digestibility coefficient, trypsin inhibitor and globulin proteins of red kidney beans. *Journal of Food Science* 53(6):1874-1875. 1978. En., Sum. En., 15 Ref., II.

Phaseolus vulgaris. Digestibility. Trypsina. Proteins. Bean sprouts. Cooking Diets. Inhibitor. Enzymes.

The digestibility of raw kidney beans increased from 29.5 to 66.4 percent and that of cooked beans from 69.3 to 84.4 percent after sprouting for 10 days. The globulin fraction of raw and sprouted beans was 62.5 and 73.4 percent digestible. Sprouting decreased trypsin inhibitor activity (TIA) by ca.50 percent and the globulin E protein fraction, which was rich in TIA, by ca.33 percent. (Summary by Nutrition Abstracts and Reviews)

0202

14704 BENDER, A.E.; MOHAMMADHIA, H.; ALMAS, K. Digestibility of legumes and available lysine content. *Qualitas Plantarum-Plant Foods for Human Nutrition* 29(1):219-226. 1979. En., Sum. En., 5 Ref.

Phaseolus vulgaris. Digestibility. Dietary value. Nutritive value. Protein content. Amino acids. Lysine. Cooking. Toxicity.

While legumes are regarded as good sources of protein they are poorly digested so improved digestibility would be a desirable objective in a breeding program. From the point of view of protein quality they are limited by the sulphur amino acids (SAA) so an increase in these is a primary nutritional objective of a breeding program and their lysine content is regarded as being of secondary importance. However, some traditional methods of preparation are far more severe than that necessary to cook the food and may result in loss of lysine. these 2 problems are being investigated. True digestibility of the nitrogen (TD-N) of cooked, white haricot beans was measured by feeding to rats at 20, 40, and 80 percent levels in the diet (5, 10, and 20 percent), for 10 days periods when 23 days old and again when 63 days old. TD-N at the 3 dietary levels was 80, 74, and 67 percent for the young animals and 63, 55, and 51 percent when more mature. True digestibility (TD) of DM was much higher at 97, 92, and 83 percent for younger and 95, 90, and 81 percent for older animals. The considerable difference between TD-N and TD-DM together with the apparently greater TD-N by the younger rats suggests that the extra faecal N does not come from the undigested food but possibly from residues of digestive juices. Results suggest that it is necessary to standardize the conditions for measuring TD. Five legumes were boiled for 2 h and 8 h; available lysine fell by 5-10 percent after 2 h and by 15-20 percent after 8 h. Improvement in flavor appeared to parallel development of the Maillard reaction and loss of available lysine. SAA were still limiting so that net protein use (NPU) does not reveal loss of available lysine. However, in diets where legumes are used to supplement cereals in such proportions that lysine is limiting this loss may become of nutritional importance. (Author's summary)

0203

12396 PUSZTAI, A. et al. Nutritional evaluation of kidney beans (*Phaseolus vulgaris*): chemical composition, lectin content, and nutritional value of selected cultivars. *Journal of the Science of Food and Agricultural* 30:843-848. 1979. En., Sum. En., 25 Ref., 11.

Phaseolus vulgaris. Amino acids. N. Mineral content. Seed. Nutritive value. Laboratory animals. S. Digestibility. Phytohemagglutinins. Electron microscopy. Cultivars.

Phaseolus vulgaris composition, lectin content and nutritional value of selected bean cv. were determined. Mainly due to different amounts of reserve globulins deposited, seed N content varied from 3.4-5.0 percent. The amino acid composition and the corresponding chemical score values of 40-60, however, were similar for all the beans, with the sulfur-containing amino acids limiting. Despite similarities in composition, 11 out of the 13 cv. examined were highly toxic for rats in the raw state. these were all found to contain high concn. of hemagglutinating lectins (over 10 percent of the total protein). On the other hand, 2 low-lectin bean var. (Pinto III and Greater Northern) had no appreciable disruptive effects on the intestines and were essentially nontoxic for rats. (Author's summary)

19431 MARQUEZ, U.M.L.; LAJOLLO, F.M. 1981. Composition and digestibility of albumin, globulins, and glutelins from *Phaseolus vulgaris*. *Journal of Agricultural and Food Chemistry* 29(5):1068-1074. En., Sum. En., 39 Ref., II.

Phaseolus vulgaris. Cultivars. Digestibility. Protein content. Inhibitors. Trypsin. Proteins.

Fifteen Brazilian var. of *Phaseolus vulgaris* were examined for digestibility in vitro, trypsin inhibitors, and protein content. Four var. with extreme digestibility values were given to rats and showed similar digestibilities. The protein from var. Carioca, fractionated for detailed studies, had albumin 31.5 (richest in sulphur amino acids and trypsin inhibitors), globulin G1, 38.5, globulin G2 13.8, and glutelin 22.4 percent. The in vitro digestibilities of the unheated globulins and glutelins were low but were improved by heating. The albumins were well digested in the raw state but after heating digestibility decreased; the effect was pH-dependent. The residue left after digestion of autoclaved albumin contained peptides with mol. wt. 14,000 and 20,000. A trypsin inhibitor in the albumin fraction was relatively heat-stable. The extent of digestion of the 4 fractions was tested by using trypsin, pancreatin, or pepsin-pancreatin. (Author's summary)

19014 SGARBIERI, V.C.; CLARKE, F.M.W.; PUSZTAI, A. 1982. Proteolytic breakdown of kidney bean (*Phaseolus vulgaris*) storage proteins: nutritional implications. *Journal of the Science of Food and Agriculture* 33:881-891. En., Sum. En., 22 Ref., II.

Phaseolus vulgaris. Proteins. Digestibility. Laboratory animals.

Glycoprotein II (phaseolin), the major storage protein of the seeds of white kidney bean cv. Processor was largely resistant to hydrolysis by pure gut endopeptidases. However, the protein was extensively digested in vitro and nearly 90 percent of it became soluble in 5 percent trichloroacetic acid by treatment 1st with extracts of rat stomach followed by intestinal contents of alternatively 1st with pepsin, followed by pancreatin. Heat denaturation (100 degrees Celsius for 10 min) had no appreciable effect on the digestion. A similarly high extent (between 80-90 percent) and rate of digestion of pure Glycoprotein II was observed in vivo. However, intubation of pure Glycoprotein II into the stomach of previously fasted rats increased the production of insoluble intestinal secretions containing relatively large amounts of N. As this N passed into the caecum, it reduced both the apparent digestibility of Glycoprotein II and the net gain of N for the animal. Moreover, in the presence of a mixture of raw bean protein in the stomach of rats the time taken to empty its content into the intestine was increased appreciably. Additionally, the toxic effects of the lectins in these mixtures, particularly on continuous feeding, were observed. The results of detailed in vivo and in vitro digestion studies in male rats using undenatured Glycoprotein II, alone or in combination with lectin, are reported. (Author's summary)

22186 DESHPANDE, S.S.; SATHE, S.K.; CHERRYAN, M. 1983. In vitro proteolytic digestibility of dry bean (*Phaseolus vulgaris* L.) protein concentrates. *Nutrition Reports International* 27(5):931-936. En., Sum. En., 12 Ref., II. (Dept. of Food Science, 104 Dairy Mfg. Bldg., Univ. of Illinois, Urbana, IL 61801 USA)

Phaseolus vulgaris. Proteins. Digestibility. Cooking. Cultivars. USA.

In vitro protein digestibility of native and heated suspensions of bean concentrates was investigated. Moist heating up to 30 min improved the in vitro protein digestibility. Trypsin digestion, expressed as TCA (trichloroacetic acid) soluble N released, suggested Light Red Kidney bean proteins to be more resistant to in vitro proteolysis than those

of the other cv. investigated. Electrophoresis of tryptic digests indicated the resistance of major storage proteins of beans to in vitro proteolysis. (Author's summary)

0207

25207 BRESSANI, R.; ELIAS, L.G. 1984. Relación entre la digestibilidad y el valor proteínico del frijol común (*Phaseolus vulgaris*). (Relationship between digestibility and protein value of common beans). Archivos Latinoamericanos de Nutrición 34(1):189-197. Es., Sum. Es., En., 14 Ref. (Inst. de Nutrición de Centro América y Panamá, Apartado Postal 1188, Guatemala, Guatemala)

Digestibility. Proteins. Amino acids. Seed color. Methionine. Guatemala. Dietary value. Seed characters.

Fifty-seven bean samples of different color (28 red, 21 black, 10 white, and 3 brown) were analyzed and no relationship was found between protein digestibility and its quality as measured by NPR. Nevertheless, white beans have a higher protein digestibility than black, red, and brown beans. The greater digestibility of white beans, however, does not increase the protein quality when mixed with cereal grains above that observed with black and red beans, probably because the protein that gives the higher digestibility is highly deficient in S containing amino acids. (AS)

0208

29119 MOHAMMADHUA, H.; MOSTAFAVI, P. 1984. Enzyme digest and acid hydrolyzed index of protein quality evaluation. Iranian Journal of Public Health 13(1-4):43-54. En., Sum. En., 20 Ref., II. (Biochemistry Dept., Medical School, Univ. of Teheran, Teheran, Iran)

Phaseolus vulgaris. Proteins. Enzymes. Digestibility. Analysis. Amino acids. Animal nutrition. Hydrolysis. Iran.

A pancreatopeptidase (elastase) digest index was devised for a rapid and accurate estimation of protein quality. This index was calculated on the basis of all the amino acids released by an in vitro elastase digestion, acid hydrolysis of same sample, and the residue of enzyme hydrolyzed. The amino acids were determined by TLC. Samples used were cooked white kidney beans, cooked and overheated soybean powder, and skimmed milk powder. Good correlation was observed between elastase index value and their biological values reported in the literature from feeding trials. The pattern of amino acids released by acid and by enzyme hydrolysis were about the same. (AS)

0209

28228 BRESSANI, R. 1985. Protein quality and nutritional value of beans. Research Highlights 2(6):1-4. En., II. (Incap, P.O. Box 1188, Guatemala, Guatemala)

Phaseolus vulgaris. Nutritive value. Digestibility. S. Protein content. Cooking. Proteins. Guatemala.

The hard-to-cook condition, bean protein quality and digestibility are analyzed. In research carried out by the Instituto de Nutrición de América Central y Panamá, a significant interaction between environmental and genetic factors and cooking time as found. Studies on S content show a significant interaction between var. and locality; however, the var. has a greater effect on S content. The broth from cooked beans contains around 1 percent protein and high levels of polyphenols and K. (CIAT)

0210

28914 LEVY-BENSHIMOL, A.; GARCIA, R. 1986. Digestibility of the globulin fraction of *Phaseolus vulgaris* seeds in mice. Nutrition Reports International 34(4):509-520.

En. Sum. En., 25 Ref., II. (Centro de Biología Celular, Escuela de Biología, Apartado 21201, Venezuela)

Phaseolus vulgaris. Seeds. Digestibility. Toxicity. Proteins. Animal physiology. Cooking. Venezuela.

The globulin fraction of *Phaseolus vulgaris* seeds was extensively purified. Only 1.3 percent of the original polyphenol content, 3.1 percent of the hemagglutinating activity, and 1.2 percent of the antitryptic activity remained in the globulin fraction. Low toxicity was demonstrated in this fraction by intraperitoneal injections in mice and by in vitro incubation with rat enterocytes. WL loss was observed in mice fed on the raw globulin fraction as compared with casein-fed controls; this was not attributable to a reduction in food ingestion. Protein digestibility was improved by cooking. No pancreatic hypertrophy was shown in mice fed on the raw globulin fraction but spleen atrophy was observed. (AS)

0211

29617 OLIVERIA, A.C. DE; SGARBIERI, V.C. 1986. The influence of rat endogenous nitrogen excretion on the assessment of bean protein quality. *Journal of Nutritional Science and Vitaminology* 32(4):425-436. En., Sum. En., 28 Ref., II. (Depto. de Planejamento Alimentar e Nutricao, Faculdade de Engenharia de Alimentos, Univ. Estadual de Campinas, 13.100 Campinas-SP, Brasil)

Phaseolus vulgaris. Proteins. Digestibility. Protein content. Nutritive value. Brazil.

The interference of rat endogenous N excretion with the assessment of digestibility and BV of dry bean protein was studied. Dry bean plants were cultivated under (15N114)2.S04 fertilization and at harvest dry beans had 1.080 atoms percentage of 15(N)-excess. N balance studies indicated that bean protein digestibility and BV were higher when N-balance was based on (15)N-excess as compared with total N, both for undenatured and heat-denatured protein. The (15)N-balance also showed that heat treatment significantly improved (P equal to or less than 0.05) the digestibility of bean protein in the integral flour and in protein isolate while the BV decreased for both materials. Results indicated that the conventional methods employed for calculation of bean protein digestibility and BV, based on total N balance and protein-free diet, underestimate these indices of protein quality. (AS)

Genetics

0212

5175 KLOZ, J.; KLOZOVA, E.; TURKOVA, V. Protein characters and relationship between *Phaseolus vulgaris* sp. aborigineus Burk. and related taxons of the genus *Phaseolus*. *Biologia Pantarum* 8(3):187-196. 1966. En., Sum. En., Cs., Ru., 30 Ref., II.

Phaseolus vulgaris. Protein content. Cotyledons. Antisera. Seed. Analysis. *Phaseolus coccineus*. *Phaseolus acutifolius*. *Phaseolus lunatus*.

Both quantitative and qualitative immunochemical methods were used for studying the mutual relationships of several species and subspecies of the genus *Phaseolus*: *P. vulgaris* L. ssp. *vulgaris*, *P. vulgaris* L. ssp. *aborigineus* Burk., *P. coccineus* L., *P. acutifolius* A. Gray, *P. lunatus* L. (American endemites), and *P. aureus* L. (a typical Asian bean). Protein characters of cotyledons (i.e., storage proteins) of the above species were compared with the aid of antisera prepared against seed (cotyledon) proteins of *P. vulgaris* L. ssp. *vulgaris* cv. *Veltruská Saxa*, using (a) the whole complex of cotyledon protein, (b) the albumin fraction of this complex, (c) the globulin fraction, (d) crystalline phaseoline. Results were in agreement with the morphological and genetic data of Burkart and Brucher on the close relationship between *P. vulgaris* L. ssp. *vulgaris* and *P. vulgaris* L.

spp. aborigineus (both contain a character designated as *P. vulgaris* protein 1, which is lacking in the others; both contain an identical phaseolin and exhibit only negligible differences in the specificity of proteins). The closest of these 2 species is *P. coccineus* (almost identical phaseolin, small differences in the albumin and globulin fractions, a greater quantitative difference in protein specificity. *P. acutifolius* contains a somewhat different phaseolin, exhibits greater deviations in the albumin and globulin fractions and a greater quantitative difference in protein specificity. *P. lunatus* and *P. aureus* are quite different in all these respects. these data are in good agreement with genetic data (crossability). (Author's summary)

0213

7614 LELEJLI, O.I. The genetics of crude protein and its relation to physiological and agronomic factors in dry beans. Ph.D. Thesis. Ithaca, N.Y., Cornell University, 1971. 128p. En., Sum. En., 129 Ref.

Phaseolus vulgaris. Protein content. Genetics. N. Seed. Composition. Inheritance. Hybridizing.

Kjeldahl methods were used to analyze different dry bean genotypes and their progenies for crude protein. A microbiological method using *Streptococcus zymogenes* was used to determine available met. (1) Nonprotein nitrogen. On a dry wt. basis, high protein genotypes ranked higher in nonprotein N than low genotypes. There was no difference in ranking between high and low protein genotypes when compared on a basis of protein N. Thus an increased percentage of protein was not necessarily followed by increased nonprotein N. (2) Position effect. Position within the pod or the seed did not influence percentage of crude protein significantly. When genotypes were grown in the plastic house, pod position influenced percentage of crude protein. (3) Correlation between bean grain yield and percentage of crude protein. There was generally a negative correlation between yield and percentage of crude protein in F₂ and F₃ plants. The highest total protein/plant came from those that were av. or below in percentage of crude protein, since breeding for protein should be focused on total protein production/unit area, efforts should be directed towards increased bean yields while maintaining the percentage of crude protein near av. level. Since percentage of protein is affected by the N and carbohydrate, low-yielding segregates tended to be relatively high in percentage of protein. Among F₂ and F₃ progenies, however, there were high-yielding plants with an above av. percentage of crude protein; thus it should be possible to improve both characters and hence total protein production. (4) Efficient utilization of nitrogen. Genotypic differences in bean yield, N uptake and translocation were found. No single genotype had all these qualities combined. Hybridization among the superior ones should produce segregating progenies that would combine the desired quality. (5) Effect of seed genotype on crude protein content. The genotype of the maternal parent determined the quantity of crude protein. A highly significant difference was found between reciprocal F₁ hybrid seeds; no significant difference existed between F₁ hybrid and selfed seeds on the same maternal plant. There was no indication of segregation for protein among F₂ seeds on an F₁ plant originating from a cross between high- and low-protein parents. Protein quality, as measured by met., was jointly influenced by maternal and seed genotypes. There was a highly significant difference between reciprocal F₁ hybrid seeds; no significant difference was noted between F₁ hybrids and selfed seeds on plants of the parent with low available met. A highly significant difference was found between F₁ hybrid and selfed seeds on maternal plants with high available met. The selfed seeds were higher in available met. than the hybrids on plants with high available met. The range in available met. of F₂ seeds from an F₁ plant originating from a cross between parents low and high in available met. was wide enough to indicate segregation for available met. within the plant. It is concluded that there is no advantage in single seed selection for protein quantity; however, if there were a high correlation between protein quality of seed and that of its progenies, more progress would probably be made through single seed selection for protein quantity; however, if there were a high correlation between protein quality of a seed and that of its progenies, more progress would probably be made through single seed selection. (6) Genetics of crude protein. No reciprocal differences were found in percentage of crude protein of F₁ plants. Mean percentages of crude

protein contents for the F1s, F2s, and F3s were generally between the parents but slightly closer to the low-protein parent (partial dominance of low percentage protein over high percentage protein). Broad-sense heritability estimates ranged from 30.66 to 63.43 percent. The narrow-sense estimate, calculated with backcrosses, was 20.12 percent; based on F3/F2 regression, it was 47.6 percent. Correlation and regression coefficients between F2s and their F3 progenies were 0.122 and 0.46, resp. These low values indicate the high environmental influence on crude protein, suggesting that early generation selection would not be effective in increasing percentage of protein. There was strong evidence in support of transgressive segregation for low protein in 1 of the 5 families. Genotypic differences were found for available met., suggesting a partial dominance of low available met. (Author's summary)

0214

4946 SILBERNAGEL, M.J. Bean protein improvement work by USDA--bean and pea investigations. Prosser. Washington State University. Irrigated Agricultural Research and Extension Center, 1971?. 14p. En.

Phaseolus vulgaris. Seed. Protein content. Methionine. Fertilizers. N. P. Zn. Cultivars. Amino acids. Seed treatment. Plant breeding.

The importance of research on improving legume protein quality, especially that of beans, is emphasized. Several investigations conducted to fulfill USDA objectives in this area are described and utilized to obtain information on protein and met. content of different bean samples. The following factors were studied: seed quality; differences in location and photoperiod; genetic differences between var. and even within the same var.; differences due to the N carrier or rate and those caused by N and P. variation; Zn fertilization; effects of Zn seed treatments with and without soil Zn; and irrigation needs. None of these was a determining factor of the protein and met. content of bean seed. Some crosses are being made between lines of known protein content. It is noted that years of extensive research are needed to develop a bean that is as good a source of dietary protein as meat. (Summary by I. B. Trans. by L.M.F.)

0215

6047 PORTER, W.M. Genetic control of protein and sulfur contents in dry bean, *Phaseolus vulgaris*. Ph.D. Thesis. Lafayette, Indiana. Purdue University, 1972. 55 p. En., Sum. En., 35 Ref., II.

Phaseolus vulgaris. Cultivars. Plant breeding. Inheritance. Genetics. Seed. Human nutrition. Protein content. Amino acids. Composition. Methionine. cystine. S. Nutritive value. Crossbreeding. Productivity.

Total sulfur as a percent of crude protein was highly correlated ($r^2 = .87$) with the sum of met. and cystine as a percent of protein. Significant regressions of protein efficiency ratios (PER) on each of these above variables were obtained, whereas neither met. or cystine alone was significantly correlated with PER except for cystine in one set of data. these data indicate the potential for using analysis of total sulfur as a screening technique for nutritive quality in dry bean. The site of control of percentage protein and sulfur content was shown to be in the plant producing the seed and not in the seed itself. There was no significant difference for percent protein in seeds with maternal or hybrid genotypes at the same node, whereas hybrid seeds with the same genotype on plants with different genotypes differed significantly in their percentage protein. Although there was a significant difference for sulfur content between seeds with hybrid and maternal genotype at the same node, the difference was smaller than that of hybrid seeds on different genotypes. Selection on a single seed basis for these two characters would not be successful. Narrow-sense heritability of percentage protein estimated by Warner's method was 49.4 percent. Estimates of heritability obtained by regression of F3 family means on F2 plants were: percentage protein, 81.8 percent; and sulfur content, 77.4 percent. Gene action appeared to be mostly additive, although there was a skewness towards the low protein and sulfur lines. Significant differences among 8 commercial var. of

Colombia were observed for percentage protein, sulfur content, and sulfur as percent of protein in different plantings, and for sulfur content and sulfur as percent of protein over all plantings. Significant interactions of var. with plantings were observed for percentage protein and sulfur content. significant general combining effects were obtained in a 7 parent diallel for percentage protein, sulfur content, and sulfur as percent of protein; significant SCA effects, for the first 2 var. In a Wr Vr analysis, significant regressions were obtained for percentage protein and sulfur content, but not for sulfur as percent of protein. There was an association of excess dominant genes with lines low in sulfur content. Yield and percentage protein were negatively correlated, the inverse correlation being greater at smaller yields than large ones. In general percentage protein and sulfur content were positively correlated as would be expected if most of the sulfur were contained in the protein. In the commercial var. seed wt. tended to be negatively correlated with percentage protein, sulfur content, and sulfur as percentage protein. sulfur content was positively correlated with sulfur as percent of protein. (Author's summary)

0216

11147 RUBAIHAYO, R.P.; LEAKEY, C.L.A. Protein improvement in beans and soybeans by mutation breeding. In Nuclear techniques for seed protein improvement. Vienna, Austria, International Atomic Energy Agency, 1973. pp.291-296. En., Sum. En., 31 Ref.

Phaseolus vulgaris. Mutation. Seed. Proteins. Protein content. Amino acids. Legume crops. Cultivars. Uganda.

The grain legume improvement program at Makerere U., Kampala, was initiated in 1965. Its major objectives include the improvement of protein (i.e., higher protein content and better amino acid composition (more met.), yield potential and disease resistance. Studies of important nutritional factors (such as trypsin inhibitors) will soon be included. A substantial amount of germplasm of each crop has been assembled and tested. Mutation breeding will soon be initiated. In beans emphasis has been on hybridization for higher yield (large-seeded Colombian Diacol Nima x stringless french bean var. carrying the arc gene from Versailles). Evaluation of germplasm has revealed var. resistant to rust and tolerant to *Xanthomonas phaseoli*. work is also being done to obtain a new navy bean cv. to replace susceptible Mexico 142 for the Govt's 30,000 ha project. (Summary by T.B.)

0217

2913 KELLY, J.D. The heritability of protein and methionine in beans (*Phaseolus vulgaris*): research report. Cali, Colombia, Centro Internacional de Agricultura Tropical, 1974. 30p. En., 18 Ref., II.

Phaseolus vulgaris. Plant breeding. Protein content. Methionine. Inheritance. Cultivars.

The progress and partial results are given of the research on the variability of protein and met. contents in beans. Crosses were made between 3 PI lines and Bush Blue Lake 240 (BBL 240), using the latter as female parent. The resulting generations were grown in Wisconsin, USA (1972) in a completely random design and selection of F1 and F2 hybrid material were grown at CIAT, Colombia (1973). Heritability estimates were based on the regression of hybrid material on the parent material. A rat feeding trial was conducted to evaluate the BV of 4 parent lines, with a large variability in protein and met. contents. Frequency distribution of percentage protein indicates the partial dominance for high protein content in hybrids (BBL 240 x PI 207227); broad sense heritability estimate was 69.1 percent, while the narrow sense estimate was 0. The presence of an overdominance component for low protein content was observed in cross BBL 240 x PI 229815. Broad sense heritability was 71.2 percent and narrow sense estimate was 0. There is a possible dominance for high protein content in cross BBL 240 x PI 302542. Broad sense heritability was 31.9 percent and narrow sense estimate, 49.4 percent. A partial dominance was found for low met. content in BBL 240 x PI 207227. Regression analysis showed the difficulty of early selection as all the seed on the F2 plant is segre-

gating, and the environmental effects on the progeny. In the feeding trial, BHL 240 has the highest BV with respect to the level of met. (Summary by I.B. Trans. by L.M.F.)

0218

1351 KELLY, J.D. Genetic modification of protein quantity and quality in bean *Phaseolus vulgaris* L. Ph.D. Thesis. Madison, University of Wisconsin, 1974. 79p. En. Sum. En., 61 Ref., 11.

Phaseolus vulgaris. Genetics. Protein content. Methionine. Seed analysis. Crossbreeding Cultivars. Lysine. N. Mineral content. Amino acids. Laboratory animals. Inheritance Genes.

Four bean strains with a range in seed protein content of 21.5-31.9 percent were analyzed for their constituent amino acids. Met., the major limiting essential amino acid in bean protein, ranged from 0.87-1.32 g/100 g protein. The levels of microbiologically available met., determined using the bacterium *Streptococcus zymogenes*, were similar to the level of total met. in 3 bean strains. The 4th strain contained 28 percent less available met. than total met. The positive correlation between the protein efficiency ratio (PER) for rats and the available met. content was large and significant ($r = 0.95$), while correlation between PER and total met. alone or plus cystine were not significant. These data indicate that certain bean proteins are unavailable to a biological organism and that the microbial assay determines the availability of amino acids better than does a technique that measures only the total amino acid content. Since the microbial assay is inexpensive and fast compared to ion exchange chromatography, it could be used as a screening technique in a breeding program for the nutritional improvement of beans. Individual plant measurements of parental, F₁, F₂, and backcross populations from 3 crosses involving the 4 bean strains grown in Wisconsin, were used to determine the inheritance of percentage protein, available met. and available met as percentage of protein (% met.) The 3 traits were quantitatively inherited and percentage protein and percentage met were independent. Broad sense heritability estimates ranged from 0.32-0.71, 0.43-0.56 and 0.38-0.60 for percentage protein, available met. and percentage met., resp. Additional heritability estimates for the 3 traits were obtained from the parental and F₂ population: grown in Colombia and were of similar magnitude, indicating a moderately large genetic variance. Narrow-sense heritability estimates calculated by the standard unit regression analyses of F₃ and F₄ family means on F₂ and F₃ parental values, resp., ranged from 0.63-0.79, 0.82-0.89, and 0.81-0.85 in the F₃ generation and from 0.32-0.61, 0.52-0.87 and 0.51-0.81 in the F₄ generation for the 3 traits, resp. These data indicate that the gene action is mainly additive. Additional estimates calculated using the among-family variance of the F₃ and F₄ generations were lower than those obtained by regression analysis: since part of the total genetic variance in the F₃ and F₄ generations is within-family variance. Despite a large genotype x location interaction for the 3 traits, the moderately high heritability estimates and the additive gene action indicate that these traits can be improved by selection. The low negative correlation ($r = -0.30$) between seed yield and percentage protein suggests that selection should be made initially for high yield. Within high-yielding families, plants having the highest percentage protein should be identified for further selection and intermating. The absence of a correlation between seed yield and percentage met. indicates that selection for either trait could be made without adversely affecting the other, while the positive correlation ($r = 0.33$) between percentage protein and percentage met. suggests that both characters could be improved simultaneously. (Summary by Dissertation Abstracts)

0219

4582 WOOLFE, J.A.; HAMBLEN, J. Within and between genotypes variation in crude protein content of *Phaseolus vulgaris*. *Euphytica* 23(1):121-128. 1974. En., Sum. En., 6 Ref., 11.

Phaseolus vulgaris. Protein content. Analysis. Cotyledons. Pods. Statistical analysis. Field experiments. N.

A study of source of variation in protein content within and between genotypes of *Phaseolus vulgaris* L. was carried out. The results show that bean to bean variation is large within a plant but that it is not due to systematic effects within pods or between nodes in determinate varieties. Pod to pod variation within nodes does occur. For indeterminate var., with large numbers of nodes, the protein content of seeds decreases with increasing node number from the base to the top of the plant. Plant to plant variation may be large, but depends on the genotype used. There is a large range of variability present within the species and selection for high protein content should be effective. (Author's summary)

0220

6371 KELLY, J.D.; BLISS, F.A. Heritability estimates of percentage seed protein and available methionine and correlations with yield in dry beans. *Crop Science* 15:753-757. 1975. En., Sum. En., 19 Ref. II.

Phaseolus vulgaris. Seed. Protein. Methionine. Inheritance. Yields. Crossbreeding. Field experiments. Experiment design. Analysis. Genes.

Individual plant measurements of parental, F₁, F₂, BP₁, and BP₂ populations, F₃ and F₄ progenies of 3 crosses involving 4 bean strains (*Phaseolus vulgaris* L.) were used to determine inheritance of percentage of protein, percentage of available met., available met. as percentage of protein, and the correlations among these traits and with seed yield. Broad-sense heritability estimates for populations grown in Wisconsin ranged from 0.32-0.71, 0.43-0.56, and 0.38-0.60 for these 3 factors, resp. Narrow-sense heritability estimates calculated by the standard unit regression analyses of F₃ and F₄ family means of F₂ and F₃ parental values, resp., ranged from 0.63-0.79, 0.82-0.89, and 0.81-0.85 in the F₃ generation and from 0.32-0.61, 0.52-0.87, and 0.51-0.81 in the F₄ generation for the 3 traits. The moderately high heritability estimates and the apparent additive gene action indicated that selection within genetically variable populations should be effective. A low negative correlation ($r = 0.30$) between seed yield and percentage of protein suggested that selection should be made initially for high yield. Within high-yielding families, plants having the highest percentage of protein should be identified for further selection and intermating. Absence of correlation between seed and yield and percentage of available met. indicated that selection for either trait could be made without adversely affecting the other, while the positive correlation ($r = 0.33$) between percentage of protein and percentage of available methionine suggested that both characters could be improved simultaneously. (Author's summary)

0221

6221 ROMERO, J. et al. Heritable variation in a polypeptide subunit of the major storage protein of the bean, *Phaseolus vulgaris* L. *Plant Physiology* 56: 776-779. 1975. En., Sum. En., 18 Ref., II.

Phaseolus vulgaris. Seed. Proteins. Inheritance. Methionine. Analysis. Seed coat. Genetics. USA.

Electrophoretic analysis of the major seed protein, G1 globulin, from 4 strains of *Phaseolus vulgaris* L. revealed a 3-banded pattern for 2 strains having a high met. content (BBL 210 and PI 302,512). The other 2 strains (PI 207,227 and PI 229,815), known to have a lower seed met. content, had a 2-banded subunit pattern for the G1 globulin. analytical ultracentrifugation confirmed that globulin from the 2-banded strains underwent pH-dependent reversible dissociation similar to that previously found for a 3-banded cv.; additionally, the protomer mol. wt. showed that 3 subunits of about 50,000 mol. wt. each were present in the G1 globulin of the 2-banded strain. Gel patterns of G1 globulin from the 2 strains used as parents, BBL 210 and PI 229,815, showed differences in the largest subunit, which appeared as either a 53,000 mol. wt. polypeptide known to be present in the 3-banded strain, or as a shorter polypeptide having a mol. wt. close to 47,000. Analysis of G1 protein from single hybrid seeds showed a banding pattern intermediate between the 2- and 3-banded types. The subunit pattern from all seeds with

intermediate-banded parents segregated in a manner consistent with that expected for control of the polypeptide by a single Mendelian gene. The remaining portions of the seeds were grown to confirm that they represented true crosses. The procedures used are essentially nondestructive and can be used as a basis for selecting seeds having different protein characters. (Author's summary)

0222

6014 TULMAN NETO, A. Contribucao ao melhoramento do feijoeiro (*Phaseolus vulgaris* L.) visando aumentar a quantidade e melhorar a qualidade da proteina. (The improvement of protein quantity and quality in beans). Tese Ph.D. Piracicaba, Brasil, Universidade de Sao Paulo. Escola Superior de Agricultura Luiz de Queiroz, 1975. 150p. Pt., Sum. Pt., En., 54 Ref.

Phaseolus vulgaris. Plant breeding. Proteins. Germplasm. Protein content. Statistical analysis. Seed. Aminoacids. Analysis. Brazil.

Several expt. of a diverse nature were conducted to learn more about improving protein quantity and quality in beans (*Phaseolus vulgaris* L.). The following conclusions were drawn: (1) Expt. conducted to determine the influence of competition on seed yield and percentage of protein in bean seed indicate that av. yield/plant increased with absence of competition among neighboring plants. The av. protein content in the seed, however, remains unchanged. Thus care should be taken in screening for high yield, especially when there are open spaces near the plants being evaluated; however, this would not be necessary when screening for protein content. Other methods should be studied before generalization can be made. (2) Expt. were carried out to determine the influence of pod position on the plant upon protein percentage of the seed, using var. with different growth habits. Results showed that protein content in the seed does not depend on pod position. Because of the limited no. of var. used, further studies should be done with a larger no. of var., especially with indeterminate growth habits and with one internodes. Results also suggest that pods in any position on the plant may be analyzed for determining protein content; it is recommended, however, that seeds from various pods in the same position be mixed and used for analysis. (3) Studies to determine the influence of seed position in the pod on protein percentage proved that protein content is the same, irrespective of seed position in the pod. As only those pods containing the same no. of seeds were used in these experiments, further studies should be done to compare protein content using pods with different no. of seeds. (4) Aspects related to seed and protein yield were analyzed for 8 var. of interest in bean improvement work in the state of Sao Paulo. The relationship was somewhat different in some var. It was generally observed that the content of 17 amino acids analyzed was the same and that met. content was very low in all 8 var. Correlation between seed yield and protein percentage was negative but not significant, suggesting the possibility of obtaining lines with higher yield and protein content. Besides trying to increase met. content, screening could be done for increasing other essential amino acids such as lysine since rice and bean consumption is very high in Brazil and rice is deficient in lysine. The positive correlation among the percentages of 7 essential amino acids observed here and also in works of other authors implies that screening can be done for one specific amino acid without sacrificing the others. (5) Expt. were carried out to determine the contribution of different components (i.e., integument, embryo, and cotyledons) to protein content. Although only 8 var. were analyzed, significant differences were observed with regard to contribution of components to total seed wt., protein content of components, and contribution of components to seed protein content. Although the embryo is one of the seed components and has the highest protein content, its contribution to total seed protein content is low because of its low contribution total seed wt. The same occurs with the integument, which has a low protein content and a low contribution to total seed wt. On the other hand, the cotyledons represent the highest protein source in bean seeds because they have a high contribution to total seed wt. although protein content is low. (6) In expt. conducted to determine intravarietal protein content, it was noted that phenotypical var. is higher in some var.; however, broad-sense heritability (calculated for 5 var.) was generally low. The environmental components comprising this phenotypical var. are very high. This may be a limiting factor in selecting for high-protein plants within the var. tested. In spite of this re-

striction, the present method was recommended for its advantages, especially in cases where heritability is high. Since most var. cultivated in Brazil show a visible mixture of various genotypes, selection work within a population to be improved for protein content should also be done along with the use of other methods. Environment can be a hampering factor improving protein content, irrespective of the methods used. (7) Bean germplasm from the Uberaba and Lamprecht collections was evaluated. Protein content varied from 19-34 percent. Lines with higher protein content than the ones normally cultivated in the state of Sao Paulo were found. A greater no. of material existing in Brazil should be tested, not only for protein content but also for amino acid quality. (8) A biological assay was carried out with 8 bean var., using rats. There were differences, based on a possible difference in cystine content or protein digestibility. correlation between the protein utilization coefficient and the total of 17 amino acids or the total of 7 essential amino acids was positive but not significant. further biological assays should be made with a larger no. of var. to identify exact causes of these differences, which is a valuable element when trying to increase the nutritional value of beans. (9) The great importance of beans, not only because of their relatively low cost but also for their high nutritional value (principal protein source for Brazilians), is emphasized. Cooperative efforts should be made to increase the nutritional value of beans in spite of the complexity of the work involved. (Author's summary)

0223

9727 HALL, T.C.; McLEESTER, R.C.; BLISS, F.A. Equal expression of the maternal and paternal alleles for the polypeptide subunits of the major storage protein of the bean *Phaseolus vulgaris* L. *Plant Physiology* 59:1112-1124. 1977. En., Sum. En., 11 Ref., II.

Phaseolus vulgaris. Seed. Proteins. RNA. Cultivars. Storage proteins. Crossbreeding. heterozygosis.

Discontinuous sodium dodecyl sulfate slab gel electrophoresis of G1 globulin from several strains of *Phaseolus vulgaris* seed permitted clear resolution of the constituent polypeptides. Three strains (Tendergreen, Canadian Wonder, and BBI. 240) had subunits with a mol. wt. 53,000, 47,000, and 43,000 while 2 strains (Seafarer and PI 229,815) had 50,500, 47,000, and 43,000. F1 seed from the cross BBI. 240 x PI 229, 815 showed 4 polypeptides on dissociation of the G1 protein; however, the amount of each of the 53,000 and 50,500 subunits was half that of the 47,000 subunit. This is interpreted as evidence that both the maternal and paternal loci for these polypeptides are transcribed and translated with similar efficiency. All of the polypeptides were found to have associated sugar residues. (Author's summary)

0224

380 MA, Y. Improvement of nutritive value of dry bean seeds (*Phaseolus vulgaris* L.). Ph.D. Thesis. Madison, University of Wisconsin, 1977. 105p. En., Sum. En., 40 Ref., II.

Phaseolus vulgaris. Nutritive value. Plant breeding. Protein content. Methionine. Seed color. Seed coat. Yields. Genotypes. Tannin content. Amino acids. Hydrolysis. Cotyledons. Inheritance. USA.

The low nutritive value of legume seed protein is a result of several factors. The present studies show that increasing protein and met. concn. and decreasing tannin content can be accomplished through breeding. Improved nutritional value should result to the extent that these factors are restrictive and their effects are alleviated. Fractionation of bean cotyledon proteins showed a general profile of which globulin-1 was the major protein fraction (ca. 40 percent of the total cotyledon protein), followed in importance by glutelin (25 percent), albumin (15 percent), free amino acids, globulin-2, prolamine, and residue fractions. Enhancement of seed proteins was associated with a large increase of globulin proteins and proportionate but lesser amounts of free amino acids and glutelin fractions. Amino acid analyses indicated that globulin-1 and glutelin combined contributed 3/4 of the total cotyledon met. The glutelin proteins had the highest met. concn. (ca. 2 percent of the protein by wt.); thus increasing the amount of glutelin proteins may re-

sult in high met. content in bean seeds. A simplified procedure was shown to be effective for identifying high-glutelin lines of beans by determining the amount of I-fraction proteins insoluble in ascorbate-NaCl solution. This implies that identifying high-yielding lines that have a high percentage seed protein in which the amount of glutelins is increased may result in high met. content. Tannin was found in the testa of colored dry bean seeds, but intensity of color was not strongly associated with tannin content. White seeds were free of tannin. Genetic studies indicated that tannin content is highly heritable (broad sense heritability = 0.48-0.97) and that it is likely controlled by multiple loci. Segregation patterns were different for 4 F₂ generations, suggesting that different genes responsible for tannin synthesis were present in different parents and that genes may function differently. Bean lines with low-tannin seeds may be obtained either by selecting among existing pure lines or through crossing and selection (Summary by Dissertation Abstracts)

0225

11102 SAIHAI, S.; RANA, R.S. Seed protein homology and elucidation of species relationships in Phaseolus and Vigna species. *New Phytologist* 79:527-534. 1977. En., Sum. En., 10 Ref., 11.

Phaseolus vulgaris. Seed. Proteins. Legume crops. Analysis. Protein content. Laboratory experiments.

Electrophoretic seed proteins from *Phaseolus* and *Vigna* species was carried out on polyacrylamide gels with cationic and anionic systems. The species were grouped into 7 clusters. On the basis of matrices of similarity index, keeping 60 as the min intracluster similarity coefficient, a 3-dimensional model was constructed to represent the relationships amongst the clusters. Five Asiatic species (*Phaseolus aureus*, *P. mungo*, *P. sublobatus*, *P. angularis*, and *P. calcaratus*) formed a cluster that was separate from a cluster of American species. The *Vigna* species forming a third cluster showed greater affinity with the Asiatic *Phaseolus* species than with the American ones. *P. aconitifolius*, a form cultivated in India, and 2 American species (*P. lunatus* and *P. lathyroides*) were distinct between themselves and also from other species. (Author's summary)

0226

4654 WAINES, J.C. Protein contents, grain weights, and breeding potential of wild and domesticated tepary beans. *Crop Science* 18(4):587-589. 1978. En., Sum. En., 18 Ref.

Phaseolus vulgaris. *Phaseolus acutifolius*. Protein content. Cultivars. Seed. Yield components. Plant breeding.

Protein contents and 1000 gram wt. of wild and domesticated tepary beans (*Phaseolus acutifolius*) were compared with values for domesticated common beans (*P. vulgaris*). The wild teparies tested had significantly more than mean protein values, but significantly less than grain wt. than the domesticated teparies. Domesticated teparies had a greater than range of protein values than the wild teparies. Wild and domesticated teparies had significantly less than mean protein contents and much less than mean grain wt. than the cv. of *P. vulgaris* tested. Only in cv. of common bean were protein content and grain wt. significantly negatively correlated. (Summary by Food Science and Technology Abstracts)

0227

16087 MA, Y.; BLISS, F.A.; HALL, T.C. Peptide mapping reveals considerable sequence homology among the three polypeptide subunits of G1 storage protein from French bean seed. *Plant Physiology* 66:897-902. En., Sum. En., 20 Ref., 11.

Phaseolus vulgaris. Seed. Proteins. Protein content. Analysis. Enzymes. Snap bean.

The major storage protein, G1 globulin, of bean cv. Tendergreen seeds was subjected to limited proteolysis with trypsin, chymotrypsin, papain, proteinase K, and protease V8, and to cleavage with cyanogen bromide and 2-(2-nitrophenylsulfanyl)-3-methyl-3-bromoindolenine. Mapping of peptides separated from each of the 3 G1 subunits by polyacrylamide gel electrophoresis revealed that many proteolytic cleavage sites were present at similar positions on the subunits. Evidence was adduced that the G1 subunits are homologous in amino acid sequence for about 61 percent of their length. The remaining region (possibly COOH-terminal) of the subunits appears to be heterologous, with the alpha subunit bearing an additional met. residue. (Author's summary)

0228

16473 BOLLINI, R.; VITALE, A. 1981. Genetic variability in charge microheterogeneity and polypeptide composition of phaseolin, the major storage protein of *Phaseolus vulgaris*; and peptide maps of its three major subunits. *Physiologia Plantarum* 52:96-100. En., Sum. En., 24 Ref., II.

Phaseolus vulgaris. Phaseollins. Proteins. Biochemistry. Analysis. Enzymes. Protein content. Seed.

Mol. polymorphism of phaseolin, the major storage protein of *Phaseolus vulgaris*, and structural homology of its subunits were investigated. A high degree of charge heterogeneity was evidenced by isoelectric focusing. Comparison among phaseolins isolated from 7 different cv. showed genetic variability both in isoelectric focusing pattern and subunit composition. However, tryptic peptide maps of these phaseolins were very similar. The 3 phaseolin subunits isolated from cv. Greensleeves were compared by peptide mapping after limited enzymatic digestion, having very similar primary structures. (Author's summary)

0229

18537 BROWN, J.W.S.; OSBORN, T.C.; BLISS, F.A.; HALL, T.C. 1981. Genetic variation in the subunits of globulin-2 and albumin seed proteins of French bean. *Theoretical and Applied Genetics* 60(4):245-250. En., Sum. En., 20 Ref., II.

Phaseolus vulgaris. Proteins. Analysis. Cultivars. Seed. Genetics. Snap beans.

Globulin-2 and albumin fractions of the seed proteins of *Phaseolus vulgaris* were analyzed by 2-dimensional electrophoresis. These fractions had major polypeptides in common but differed in their minor components. Two groups of polypeptides were identified in 10 of the 11 cv. studied: Tendergreen G2 and Sanilac G2. Their presence in the seed was correlated with hemagglutinating activity and at least some of these polypeptides corresponded to lectin proteins. (Extracted from Author's summary)

0230

15410 MUTSCHLER, M.A.; BLISS, F.A. Inheritance of bean seed globulin content and its relationship to protein content and quality. *Crop Science* 21:289-294. 1981. En., Sum. En., 25 Ref., II.

Phaseolus vulgaris. Protein content. Inheritance. Cultivars. Amino acids. Methionine. Plant breeding.

Globulin-1 (G1) protein, the major storage protein fraction of common bean, was measured in mature seed using rocket immunoelectrophoresis. Percentage total protein was measured by infrared reflectance. Heritability estimates were calculated for the protein traits and seed yield, and correlations between traits were determined using parental, F2, and F3 populations. Among the 6 parents grown in the field in 1977, Endogava Z.N. had the highest percentage protein (27.8 percent protein), while PI 229815 produced the most G1 protein (136.5 mg G1/g flour). Both were low-yielding, producing 12 and 13 g

seed/plant compared to the highest yielding parent, Bonita that produced 66 g seed/plant. Bonita showed the most favorable combination of traits, with levels of 24 percent protein and 108 mg G1/g flour, in addition to high yield. Swedish Brown and WI 74-2047 had the lowest levels of total protein (17.4 and 18.5 percent, resp.) as well as G1 protein (75 and 61 mg/g flour, resp.). Analyses of 5 of the 15 F₂ populations derived from crosses among the 6 parents were presented in detail. Inheritance of both percent protein and mg/g flour was quantitative with broad sense heritability estimates, ranging from 0.19-0.65 and 0.37-0.95, resp. Narrow sense heritability estimates ranged from 0.59-0.86 and 0.43-0.74 for percent protein and mg G1/g flour, resp. in 4 populations. mean F₂ values of populations resulting from crosses between parents that differed widely for protein amounts were usually intermediate between the 2 parents. The av. values of the 5 F₂ populations resulting from one common parent produced rankings similar to those based on parental values for percent protein and mg G1/g flour. Moderate positive correlations between yield and percent protein were observed in F₂ and F₃ populations. There was no correlation between yield and mg G1/g flour and low negative correlation between yield and percent protein. No obvious consistent relationship between available met. and G1 content was seen, perhaps because of variation in other constituent fractions or the confounding effects of seed tannins. Implications of genetic manipulation of protein fractions and total protein on protein quality improvement are discussed. (Author's summary)

0231

19847 SULLIVAN, J.G. 1981. Recurrent selection for increased seed yield and percent seed protein in the common bean (*Phaseolus vulgaris* L.) using a selection index; and isolation and analysis of major genes controlling phaseolin. Ph.D. Thesis, Madison, University of Wisconsin. 114p. En., 107 Ref., II.

Phaseolus vulgaris. Cultivars. Backcrossing. Selection. Plant breeding. Yields. Protein content. Seed. Phaseolin. Genes. USA.

Recurrent mass selection based on a desired gain index was employed to simultaneously increase seed yield and seed protein percentage in bean. Seed protein percentage was increased from 21.9 to 24.6 percent after 2 cycles of selection. Of particular interest was the family 2-4-1, which had seed yields as high as those of the highest yielding parent and a seed protein percentage which exceeded that of all parental lines in both years in which the expt. was conducted. An inbred-backcross technique was employed to isolate and analyze major genes for percentage seed protein and phaseolin. Two populations were developed by 2 successive backcrosses of 2 high-protein lines, BBI.240 and PI 229815, to Sautlac, followed by selfing to near homozygosity. In one population, 3 lines which had high amounts of phaseolin are thought to have received a major gene for increased phaseolin from BBI.240. Evidence is presented for possible linkage between this gene and a gene controlling the electrophoretic banding pattern of phaseolin. (Summary by Plant Breeding Abstracts)

0232

24408 BLISS, E.A.; BROWN, J.W.S. 1982. Genetic control of phaseolin protein expression in seeds of common bean, *Phaseolus vulgaris* L. *Qualitas Plantarum Plant Foods for Human Nutrition* 31(3):269-279. En., Sum. En., 58 Ref., II. (Dept. of Horticulture, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Cultivars. Phaseolin. Proteins. Genetics. Dietary value. USA.

Phaseolin, the major globulin seed storage protein of common bean accounts for up to 50 percent of the total seed protein. The rapid accumulation of phaseolin in maturing seeds begins about 14 days after flowering and continues for some 12-14 days longer. However, the amount and rate of phaseolin accumulation, related to variation in onset, length, termination, and rate of synthesis, have been shown to vary between genotypes. Only 3 phaseolin electrophoretic types, designated T, S, and C after the cv. Tendergreen, Sautlac, and Contender, resp., have been identified among over 100 cultivated accessions.

The narrow ranges of mol. wt. and isoelectric points of the 14 protein polypeptides of phaseolin, as well as the homology observed from peptide mapping, suggest that the phaseolin polypeptides are similar proteins. Based on the results of crosses among cv. having the 3 electrophoretic patterns, the genes controlling the polypeptides of each of the phaseolin types appear to be tightly linked, inherited in a block and the alleles are codominant. Substantial variation in phaseolin content, based on estimations using rocket immunoelectrophoresis, has been found among bean lines. Although most segregating populations show continuous distributions and quantitative inheritance, some inbred backcross lines having enhanced phaseolin accumulation appear to carry a few genes with major effects. A single gene that reduces the amount of phaseolin to less than one-half of the normal levels has been identified recently in an accession of wild *Phaseolus vulgaris*. (AS)

0233

17795 POLIGNANO, G.B. 1982. Breeding for protein percentage and seed weight in *Phaseolus vulgaris* L. *Journal of Agricultural Science* 99:191-197. En., Sum. En., 22 Ref., II.

Phaseolus vulgaris. Genotypes. Seed characters. Protein content. Seeds. Inheritance.

Three successive generations (parents, F₁, F₂) and backcrosses of the common bean hybrid between the cv. Swedish Brown and Seafarer were used to assess the relationship between the seed wt./plant and the protein percentage of the seed. Protein percentage showed a higher estimated heritability and a greater stability over environments than seed wt. Partial dominance for low percent protein and low seed wt. was noted. Negative and low regression coefficient between these 2 characters was also observed. SDS-gel electrophoresis was used to examine the variation in banding patterns of total seed polypeptides and their stability over environments. (Author's summary)

0234

19044 SULLIVAN, J.G.; BLISS, F.A. 1983. Recurrent mass selection for increased seed yield and seed protein percentage in the common bean (*Phaseolus vulgaris* L.) using a selection index. *Journal of the American Society for Horticultural Science* 108(1):42-46. En., Sum. En., 32 Ref., II.

Phaseolus vulgaris. Selection. Cultivars. Protein content. Crossbreeding. Yields. Seed.

Recurrent mass selection based on a desired gain index was employed to increase simultaneously seed yield and seed protein percentage in the common bean. Seed protein was increased from 21.9 to 24.6 percent after 2 cycles of selection. Mean seed yields of selected populations were not significantly greater than the mean of the unselected parents, but high-yielding individual families were identified. Of particular interest was the family 2-4-1, with seed yields equal to the highest-yielding parent, and seed protein percentage higher than all parental lines in both years in which the expt. were conducted. Modifications in the selection procedure were proposed which should increase the efficiency of selection for seed yield. (Author's summary)

0235

24985 ROMANI, V.L.M. 1983. Estudos bioquímicos sobre a variabilidade da composição proteica em feijão (*Phaseolus vulgaris* L.). (Biochemical studies on protein content variability in bean). Tese Mestrado. Piracicaba-SP, Brasil, Escola Superior de Agricultura Luiz de Queiroz da Universidade de São Paulo. 109p. Pt., Sum. Pt., En., 127 Ref., II.

Phaseolus vulgaris. Cultivars. Mineral content. N. Protein content. Bean flour. Amino acids. Brazil.

The erythroagglutinating activities of 20 Brazilian bean cv. were determined and the possibility of correlating these activities with their lectin compositions was verified. The N and protein contents of cotyledonary meals from the different cv. varied from 2.9 to 4.1 percent and from 18.4 to 25.9 percent, resp. Meal hydrolysates were rich in aspartic and glutamic acids, less rich in basic amino acids, and with low met. contents. Except for cv. Pinto, all the extracts showed erythroagglutinating activities against 5 of 6 types of erythrocytes used; however, their activities were not the same and varied among the cv. and also in relation to the type of erythrocytes. Cv. Pintado, Jalo, and Goiãno Pretoce could be distinguished from all others, since their activities were relatively high against trypsin-treated cow erythrocytes. Samples also differed when examined by electrophoresis under nondissociating conditions. Under acidic conditions, differences were observed in the relative concn. of isolectin-type proteins, whereas under dissociating condition sit was observed that the polypeptide compositions of the major protein, glycoprotein II, varied. The agglutinating activities of Brazilian bean cv. do differ, attributable to variations in lectin composition. Also, at least 2 forms of the major bean protein occur among the cv. examined. [AS (Extract)]

0236

20817 SULLIVAN, J.G.; BLISS, F.A. 1983. Genetic control of quantitative variation in phaseolin seed protein of common bean. *Journal of the American Society for Horticultural Sciences* 108(5):782-787. En., Sum. En., 15 Ref., II. (Dept of Horticulture, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Phaseolin. Proteins. Cultivars. Plant breeding. Backcrossing. Seed. Protein content. Inheritance. Yields. Genes. USA.

Three populations of near-homozygous inbred backcross lines of common bean were produced using Sanilac as the recurrent parent and 3 donor parents, BBI-240, 15R-148, and Swedish Brown. The method for producing inbred backcross lines included 2 successive backcrosses to the recurrent parent followed by 3 or 4 generations of self-fertilization using single seed descent. There was no selection during the backcrossing of selfing stages. Lines were grown in the field and analyzed for seed protein content, percentage of protein, seed yield and size. In each population, the frequency of lines recovered having enhanced levels of phaseolin (compared with Sanilac) suggested that one or a few major genes (effective factors) for phaseolin had been contributed by the donor parent. In population 2, derived from Sanilac crossed to BBI-240, there was evidence for possible linkage between enhanced phaseolin and the gene(s) controlling the electrophoretic banding pattern of the phaseolin polypeptide subunits. The nonprotein portion of the seeds of these lines was also less than that of the recurrent parent, resulting in generally smaller seeds. In contrast, some families in population 6 (donor 15R-148) having enhanced phaseolin also showed increased levels of the nonprotein constituents of the seed. Population 8 (donor Swedish Brown) was unique since lines with enhanced levels of phaseolin were recovered although the donor parent had a low phaseolin concn. (phaseolin 100 g flour) but large seeds with a high concn. of the nonprotein fraction. These results show that breeding lines with increased levels of phaseolin seed protein can be produced either directly by increasing the phaseolin concn. or indirectly by decreasing the nonprotein fraction of seed. (Author's summary)

0237

20818 SULLIVAN, J.C.; BLISS, F.A. 1983. Expression of enhanced seed protein content in inbred backcross lines of common bean. *Journal of the American Society for Horticultural Science* 108(5):787-791. En., Sum. En., 17 Ref. (Dept. of Horticulture, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Seed. backcrossing. Cultivars. Protein content. Seed characters. Yields. Phaseolin. USA.

Four populations of inbred backcross lines of common bean, developed from crosses between Sanilac, the recurrent parent, and 4 donor parents (BBI-240, 15R-148, Swedish

Brown, and PI 229815), were analyzed for total seed protein percentage. In each population a substantial no. of lines having significantly higher protein levels than Sanilac were recovered. The basis for enhanced protein percentage was attributed to increased amounts (g/seed) of phaseolin and nonphaseolin protein, either singularly or together, and either with or without a decrease in the nonprotein seed fraction. Lines from different populations were characterized by different combinations of altered levels of the various seed fractions. Although seed size varied depending on the seed fractions present, no obviously shriveled seeds were observed. Lines having enhanced protein and seed yields comparable with or greater than the recurrent parent, Sanilac, were recovered. (Author's summary)

0238

26030 GEPTIS, P.; BLISS, F.A. 1984. Enhanced available methionine concentration associated with higher phaseolin levels in common bean seeds. *Theoretical and Applied Genetics* 69(1):47-53. En., Sum. En., 24 Ref. (Dept. of Horticulture, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Seed. Methionine. Phaseolin. Composition. Mineral content. N. Inheritance. USA.

The relationship between available met. concn. and the levels of phaseolin, the major seed storage proteins of the common bean, was studied using 3 groups of genetic materials: (1) the F₂ progenies of interspecific crosses between *Phaseolus vulgaris* cv. and *P. coccineus* subsp. *coccineus* cv. Mexican Red Runner having no detectable phaseolin; (2) the F₂ progenies and segregating F₃ families of crosses between cultivated *P. vulgaris* lines and a Mexican wild bean accession (PI 325690.3) carrying a gene producing a reduction in phaseolin content; (3) 2 inbred backcross populations: Sanilac x Bush Blue Lake 240 (population 2) and Sanilac x ISR 148 (population 6). Total seed N levels were determined by micro-Kjeldahl, phaseolin levels by rocket immunoelectrophoresis, and available met. levels by the *Streptococcus zymogenes* bioassay. In all the genetic materials studied, with the exception of population 6, higher phaseolin levels lead to increased available met. concn. Although phaseolin has a low met. concn., it is actually a major source of available met. in common bean seeds, because it represents a large part of the total seed N and because limited differences exist between the met. concn. of the different protein fractions. In population 6, no relationship was observed between available met. and phaseolin content. Other factors, such as additional met.-rich polypeptides or the presence of tannins, might obscure the positive relationship between phaseolin and available met. content in population 6. (AS)

0239

27321 ROMERO-ANDREAS, J. 1984. Genetic variability in the seed phaseolin of nondomesticated bean (*Phaseolus vulgaris* L. var. *Aborigineus*) and the inheritance and physiological effects of Arceclin, a novel seed protein. Ph.D. Thesis. Madison, University of Wisconsin-Madison, 168p. En., Sum. En., 94 Ref., II.

Phaseolus vulgaris. Phaseolin. Seed. Composition. Proteins. Genetics. USA.

SDS-polyacrylamide gel electrophoresis and differential solubility studies of seed proteins from Mexican nondomesticated beans (*Phaseolus vulgaris* var. *Aborigineus*) revealed the presence of phaseolin, the major seed storage protein in domesticated common bean. However, the phaseolins were structurally different from the S, T, and C types found in domesticated beans and were designated M-type phaseolins. Genetic analyses of F₂ populations from crosses between nondomesticated beans and Sanilac, a domesticated bean cv., showed that the M phaseolin variants were allelic to the 3 phaseolin types of domesticated beans. A novel 35 kilodalton seed protein was discovered in a seed from P.I. 325690 during electrophoretic screening. Studies revealed that the 35 kilodalton protein was neither an altered phaseolin, nor an enhancement of the lectin fraction. The protein was named Arceclin, after Arceclia, the Mexican village closest to where P.I. 325690 was collected. The seed from P.I. 325690 was planted and results selfed seed

from this plant gave rise to the pure line UW 325. Despite a low percentage of seed phaseolin (14.6), uw 325 displayed no abnormalities in plant or seed phenotype, plant growth, fertility, or seed germination. The percentage seed protein (25.5) was within the normal range for common beans. [AS (Extract)]

0240

27767 BLISS, F.A.; OSBORN, T.C.; ROMERO-ANDREAS, J.; GEPTS, P.L. 1986. Mutant alleles affecting bean seed protein expression. Bean Improvement Cooperative. Annual Report 29:18-19. En., 5 Ref., (Dept. of Hort., Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Protein content. Seed. Mutation. USA.

The alleles that control the protein content in bean seeds are briefly analyzed. (CIAT)

0241

27282 CHAPPELL, J.; CHRISPEELS, M.J. 1986. Transcriptional and posttranscriptional control of phaseolin and phytohemagglutinin gene expression in developing cotyledons of *Phaseolus vulgaris*. Plant Physiology 81(1):50-54. En., Sum. En., 23 Ref., I. (Agronomy Dept., N-212 Agriculture Center-North, Univ. of Kentucky, Lexington, KY 40546, USA)

Phaseolus vulgaris. Cultivars. Phytohemagglutinins. Phaseollin. Genes. Cotyledons. USA.

The expression of phaseolin and phytohemagglutinin in the developing cotyledons of a normal (Greensleeves) and a phytohemagglutinin-deficient (Pinto 111) cv. of *Phaseolus vulgaris* was investigated. Phaseolin mRNA translational activity and abundance were present at similar levels in both cv. In contrast, phytohemagglutinin mRNA translational activity and abundance in Pinto 111 were less than 1 percent of the levels measured in Greensleeves. Using nuclear runoff assays, the transcription rate of phaseolin gene sequences was similar in both cv. The transcription rate of phytohemagglutinin gene sequences in Pinto 111 was only 20 percent of that measured in Greensleeves. Comparison of the transcription rates with the relative mRNA amounts measured in RNA blot hybridizations indicated that the normally expressed storage protein gene MRNAs were very stable with half-lives greater than several days. Because a low level of phytohemagglutinin gene transcription in Pinto 111 was measurable but no phytohemagglutinin mRNA accumulated, these results suggest that the phytohemagglutinin deficiency in Pinto 111 is due to a reduced transcription rate and possibly an instability of the mRNA. (AS)

0242

28298 GEPTS, P.; OSBORN, T.C.; RASHKA, K.; BLISS, F.A. 1986. Phaseolin-protein variability in wild forms and landraces of the common bean (*Phaseolus vulgaris*): evidence for multiple centers of domestication. Economic Botany 40(4):451-468. En., Sum. En., 35 Ref., II. (Dept. of Botany & Plant Sciences, Univ. of California, Riverside, CA 92521, USA)

Phaseolus vulgaris. Germplasm Seed. analysis. Proteins. USA.

A sample of 106 wild forms and 99 landraces of common bean from Middle America and the Andean Region of South America was screened for variability in phaseolin seed protein using 1-dimensional SDS-polyacrylamide gel electrophoresis and 2-dimensional isoelectric focusing SDS-polyacrylamide gel electrophoresis. The Middle American wild forms exhibited phaseolin patterns similar to the 'S' pattern described previously in cultivated forms, as well as a wide var. of additional banding patterns such as 'M' (Middle America) types, not encountered among common bean cv. The Andean wild forms showed only the 'T' phaseolin pattern, also described previously among cultivated forms.

Landraces from Middle America showed 'S' or 'S'-like patterns except for 2 lines with 'T' phaseolin. In Andean South America, a majority of landraces had the 'T'; phaseolin. Additional types represented in that region were (in decreasing order of frequency) the 'S'; and 'C'; types (already described among cultivated forms) as well as the 'H' (Huevo de Huanchaco), and 'A' (Ayacucho) types, which are new patterns previously undescribed among wild and cultivated beans. In each region (Middle America and Andean South America) the seeds of landraces with 'T' phaseolin were significantly larger than those of landraces with 'S'; phaseolin. No significant differences in seed size were observed among landraces with 'T'; 'C'; 'H', and 'A' phaseolin types of the Andean region. Data favor 2 primary areas of domestication, one in Middle America leading to small-seeded cv. with 'S' phaseolin patterns and the other in the Andes giving rise to large-seeded cv. with 'T'; (and possibly 'C', 'H', and 'A') phaseolin patterns. (AS)

0243

27337 OSBORN, T.C.; BLAKE, T.; GEPTS, P.; BLISS, F.A. 1986. Bean Arceclin. 2. Genetic variation, inheritance and linkage relationships of a novel seed protein of *Phaseolus vulgaris* L. Theoretical and Applied Genetics 71(6):847-855. En., Sum. En., 12 Ref., II. (Dept. of Agronomy, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Proteins. Seed. Inheritance. Germplasm. Cultivars. Genetics. Cross-breeding. resistance. Stored grain pests. USA. CIAT-2.

Crude proteins from seeds of wild bean accessions of Mexican origin were analyzed by 1-dimensional SDS-polyacrylamide gel electrophoresis. Several accessions had electrophoretic patterns showing unique protein bands. When analyzed by 2-dimensional isoelectric focusing-SDS-polyacrylamide gel electrophoresis, 4 protein variants that had electrophoretic mobilities similar to each other but different from the other major seed proteins, phaseolin, and lectin, were observed. All 4 variants, which have not been described in cultivated beans, were tentatively named Arceclin protein and designated as Arceclin 1, 2, 3, and 4. Arceclins 3 and 4 had polypeptides that comigrated on 2-dimensional gels and these variants occurred in accessions that were collected in the same location. Analysis of single F2 seeds from crosses among Arceclin-containing lines and from crosses between cultivated bean lines without Arceclin and Arceclin-containing lines revealed that differences in Arceclin polypeptide expression were inherited monogenically. The alleles for different Arceclin variants were codominant to each other and dominant to the absence of Arceclin. The gene(s) controlling the presence of lectin proteins (less than 0.30 percent recombination). The possible origins of Arceclin genes and their potential role in the bruchid resistance are discussed. (AS)

0244

28656 SULLIVAN, J.G.; FREYTAG, G. 1986. Predicting interspecific compatibilities in beans (*Phaseolus*) by seed protein electrophoresis. Euphytica 35(1):201-209. En., Sum. En., 22 Ref., II. (101A Horticulture Field Lab., 1707 S. Orchard St., Univ. of Illinois, Urbana, IL 61801, USA)

Phaseolus vulgaris. *Phaseolus polystachyus*. *Phaseolus metacalfei*. Hybridizing. Analysis. Proteins. Seed. Puerto Rico.

Seed proteins of 17 wild species of *Phaseolus* were separated by electrophoresis on SDS-polyacrylamide gels. There was very little variation of the protein pattern within most species, while considerable variation among species was evident. Relative interspecific similarities of protein patterns were estimated using Jaccard's similarity index, and a cluster analysis was performed on these values. The resultant dendrogram generally agreed with previous research on interspecific relationships in *Phaseolus* based on morphological characteristics, and also generally agrees with current information on interspecific similarities based on hybridization studies. Suggestions are made regarding interspecific hybridizations among *Phaseolus* species which have not been attempted, but which may be possible based on cluster analysis. These hybrids include *P. vulgaris* x *P.*

polystachyus, *P. vulgaris* x (*P. polystachyus* x *P. metcalfei*), and *P. anisotrichos* x *P. angustissimus*. (AS)

Methods

0245

5824 KLOZOVÁ, E.; KLOZ, J. Protein characters in species hybrids of the genus *Phaseolus* studied by means of serological methods. *Acta Agriculturae Scandinavica, Supplement* 16:225-228. 1966. En., II.

Phaseolus vulgaris. *Phaseolus coccineus*. Hybridizing. Protein content. Seed characters.

Protein characters in seeds of hybrids between *Phaseolus vulgaris* var. *nanus* cv. *Veltruská Saxa* (as mother) and *P. coccineus* var. *coccineus* *semine nigro flore rubro* or *P. coccineus* var. *coccineus* cv. *Weisse Riesen* (as father) were investigated and compared with the interspecific morphological characteristics of Lampricht (position of cotyledons and shape of stigma) during 3 generations. The protein character that distinguishes *P. coccineus* from *P. vulgaris* behaves in the same manner as interspecific morphological characters and thus, can be considered as another interspecific character. Regularities were also established in the behavior of protein characters after crossing not only in the F1 generation but also in subsequent generations when they again behave as morphological characters. No correlation was found between the interspecific morphological and protein characters. (Summary by I.B. Trans. by L.M.F.)

0246

1404 ADRIAANSE, A.; KLOP, W.; ROBBERS, J.F. Characterization of *Phaseolus vulgaris* cultivars by their electrophoretic patterns. *Journal of the Science of Food and Agriculture* 20:647-650. 1969. En., Sum. En., 9 Ref., II.

Phaseolus vulgaris. Seed. N. Analysis. Cultivars. Fertilizers. Climatic requirements. Proteins.

Thirty-two var. were characterized by means of starch-gel electrophoresis of protein fractions. It was concluded that the electrophoretogram of a particular var. is unlikely to be affected by external conditions such as N fertilization, soil and climate and that the protein patterns is probably controlled genetically. (Summary by Plant Breeding Abstracts)

0247

1112 PALOZZO, A. DE; JAFFE, W.G. Immunoelectrophoretic studies with bean proteins. *Phytochemistry* 8:1255-1258. 1969. En., Sum. En., 17 Ref., II.

Phaseolus vulgaris. Proteins. Antisera. Analysis. Laboratory animals. Lipoproteins. Phytohaemagglutinins.

Immunoelectropherograms of 24 extracts from different kidney bean var. differed, revealing 8-11 precipitation lines. A crystalline protein and a pure globulin from black beans gave identical immunological reactions although their chemical composition was different. antisera from rabbits sensitized with this crystalline protein produced 1-2 precipitation lines with different bean extracts. Hemagglutinating activity was found in 19 of the extracts, which originated 1-2 precipitation lines that could be stained with sudan black. This indicated the presence of lipoproteins; none of the hemagglutinin-free extracts originated stainable immunoprecipitates. It is concluded that the bean phytohemagglutinins are probably lipoproteins. (Authors summary)

18023 ALLI, I.; BAKER, B.E. 1981. Constitution of leguminous seeds. Scanning electron microscopy of proteins prepared from Phaseolus beans. *Journal of the Science of Food and Agriculture* 32(11):1069-1073. En., Sum. En., 10 Ref., II.

Phaseolus vulgaris. Proteins. Analysis. Electron microscopy. Seed.

Proteins were isolated from citric acid and NaOH extracts of navy beans, white kidney beans, and baby lima beans (*Phaseolus lunatus*). Examination of the proteins under the scanning electron microscope revealed that several types of particulate microstructures were present in the proteins obtained by citric acid extraction of the beans followed by precipitation by cooling. Examination of the proteins obtained by extraction with NaOH solution and isoelectric precipitation revealed the presence of only 1 type of nonparticulate microstructure. (Author's summary)

15420 SATHI, S.K.; SALUNKHE, D.K. Functional properties of the Great Northern bean (*Phaseolus vulgaris* L.) proteins: emulsion, foaming, viscosity, and gelation properties. *Journal of Food Science* 46(1):71-74, 81. 1981. En., Sum. En., 23 Ref., II.

Phaseolus vulgaris. Proteins. Composition. Analysis. Bean flour. Electron microscopy.

Functional properties of the Great Northern bean flour, albumins, globulins, protein concentrates, and protein isolates were investigated. Protein concentrates had the highest water and oil absorption capacity (5.93 and 4.12 g/g, resp.) among all the samples studied. Protein concentrates registered the highest emulsion capacity (72.6 g oil emulsified/g) while albumins had the highest emulsion stability (less than 5 ml separation of phase in 780 h at room temp. of 21 degrees Celsius). Foaming ability of the Great Northern bean proteins was fair and concn. dependent. (Author's summary)

15419 SATHI, S.K.; SALUNKHE, D.K. Solubilization and electrophoretic characterization of the Great Northern bean (*Phaseolus vulgaris* L.) proteins. *Journal of Food Science* 46(1):82-87. 1981. En., Sum. En., 27 Ref., II.

Phaseolus vulgaris. Composition. Proteins. Biochemistry. Analysis. Laboratory experiments.

Protein content of dry bean cv. Great Northern, was 26.10 percent (dry wt. basis). The isoelectric pH of the NaCl extractable proteins was about 4.4. Several salts, NaOH, and HCl were employed to solubilize the Great Northern bean proteins. Among all the protein solubilizing agents, Na₂CO₃, K₂SO₄, SDS, and NaOH at resp. concn. of 0.5, 5, 5 percent (all wt./vol.), and 0.02N were found to be better protein solubilizers than the rest; solubilizing 93.6 g of Lowry protein/100 g of Kjeldahl protein. Albumins and globulins accounted for 21.18 and 73.40 percent, resp. of the total bean proteins. Protein content of albumins, globulins, protein concentrates, and protein isolates was 81.68, 92.26, 85.44, and 92.43 percent (dry wt. basis), resp. SDS-polyacrylamide gel electrophoresis (SDS-PAGE) of the bean flour, albumins, globulins, protein concentrates, and protein isolates revealed the presence of 22, 14, 10, 14, and 11 subunits, resp. The bean flour, albumins, globulins, protein concentrates, and protein isolates were characterized by the predominance of subunits with apparent mol. wt. of 294,000, 266,000, 123,000, 146,000, and 135,000 daltons, resp. Isoelectric focusing of the bean flour, albumins, globulins, protein concentrates, and protein isolates indicated 15, 13, 15, 16, and 11 subunits, resp. Mol. sieve chromatography of the bean flour proteins, albumins, and globulins followed by SDS-PAGE was also employed to study the complexities of these proteins. (Author's summary)

29160 YANAGI, S.O.; MATSUKURA, U.; GALEAZZI, M.A.M.; KITO, M. 1984. Ultracentrifugal and electrophoretic studies on common bean (*Phaseolus vulgaris*) protein. *Agricultural and Biological Chemistry* 48(10):2457-2462. En., Sum. En., 14 Ref., II. (National Food Research Inst., Ministry of Agriculture, Forestry & Fisheries, Kannondai, yatabe-Machi, Tsukuba-Gun, Ibaraki 305, Japan)

Phaseolus vulgaris. Seeds. Proteins. Analysis. Biochemistry. Japan.

Phaseolus vulgaris seed protein was extracted with 85-95 percent efficiency, mildly without precipitation or low ionic treatment. No distinct 11-12S, 28S, nor 33S (which were reported before) was observed by ultracentrifuge analyses of 11 var. The main components, 7S and 18-19S in acidic solutions, were separated with sepharose 6B chromatography into peak 2(P2) and peak 1 (1), resp. P1 seemed to correspond to G1 (1 of *P. vulgaris* main proteins). Following DEAE-sepharose chromatography eliminated a part of the minor components from P1. Sedimentation coefficients, dissociation-association behavior, and mol. wt. of P1 were studied. (AS)

29603 HUSSAIN, A.; RAMIREZ, H.; BUSHUK, W.; ROCA, W. 1986. Field bean (*Phaseolus vulgaris* L.) cultivar identification by electrophoregrams of cotyledons storage proteins. *Euphytica* 35:729-732. En., Sum. En., 11 Ref., II. (Dept. of Plant Science, Univ. of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada)

Phaseolus vulgaris. Cultivars. analysis. Seeds. Proteins. Identification. Canada.

Electrophoretic procedures were developed for seed proteins which can discriminate cv. of field beans. Proteins were extracted from 7 var. (Aurora, Kentwood, GN-1140, Midnight, R-275, Loop, and Swedish Brown) and the extracts were analyzed using acid and SDS-polyacrylamide gel electrophoresis. Electrophoregrams are presented to illustrate the results that can be obtained with the methods described. Results indicate that sufficient variation is present among the 7 var. examined to afford unambiguous discrimination and identification of the cv. Banding patterns were stable for each genotype. (AS)

29712 PLIETZ, P.; DAMASCHUN, G.; SCHWENKE, K.D.; SCHLESTER, B. 1986. Small-angle X-ray scattering investigations on seed proteins. *Nahrung* 30(3-4):245-250. En., Sum. En., De., Ru., 10 Ref., II. (Central Inst. of Molecular Biology, DDR-1115 Belin-buch, Robert-Rossle- Str. 10, German Democratic Republic)

Phaseolus vulgaris. Snap beans. Seeds. Proteins. Analysis. German Democratic Republic.

The 11S globulins from sunflower and rape seeds as well as from broad beans were investigated by small angle X-ray scattering. The 7S globulin from french beans was also investigated by small angle X-ray scattering. It has a molar mass of 1.45×10^5 g/mole. The shape of the molecule is disk-like. The molecule consists of 3 subunits separated by deep clefts filled with solvent, and has a 3-fold symmetry axis perpendicular to the plane of the disk. [AS (Extract)]

Fractions

5054 RACUSEN, D.; FOOTE, M. Glycoprotein II in developing and germinating bean seeds. *Canadian Journal of Botany* 51(2):495-497. En., Sum. En., 6 Ref., II.

Phaseolus vulgaris. Seed. Germination. Protein content. Laboratory experiments. Seed coat. analysis. Seed character.

A study was made of the accumulation of glycoprotein II during seed development and its subsequent disappearance during germination. It was found to increase most rapidly when growing bean seeds became gray and neared their maximal length and fresh wt. During germination this protein decreased most rapidly between 7-10 days. (Author's summary) C01

0255

5773 JAFFE, W.G.; HANNIG, K. Fractionation of proteins from kidney beans (*Phaseolus vulgaris*). Archives of Biochemistry and Biophysics 109:80-91. 1965. En., Sum. En., 42 Ref., 11.

Phaseolus vulgaris. Proteins. Phytohemagglutinins. Amino acids. Sugars. Hydrolysis. Serology. Analysis.

Proteins extracted from the seeds of black beans have been separated by ammonium sulfate fractionation and free-flow electrophoresis into fractions: 2 soluble in salt solutions and 9 water soluble. Four fractions had hemagglutinating activity, but only 2 different hemagglutinating proteins could be determined with reasonable certainty. Amino acids and sugars were determined in all fractions; rhamnose, fucose, galactose, xylose, mannose, arabinose, glucose, an amino sugar, and one unidentified reducing compound were detected by a double-diffusion technique between the different hemagglutinating fractions, as well as between the inactive fractions. Six different precipitation lines were observed when the water-soluble proteins containing the 6 fractions, which precipitate with ammonium sulfate, were submitted to immunoelectrophoresis. Similar extracts from red or white var. of *Phaseolus vulgaris* gave very different patterns. (Author's summary)

0256

5775 PUSZTAI, A. Studies on the extraction of nitrogenous and phosphorus-containing materials from the seeds of kidney beans (*Phaseolus vulgaris*). Biochemical Journal 94(3):611-616. 1965. En., Sum. En., 49 Ref., 11.

Phaseolus vulgaris. N. P. Seeds. Proteins. Antisera. analysis. Hydrolysis. Na. pH.

The conditions of extracting components containing N, P, and glucosamine from common bean seeds were studied. Protein dispersion was incomplete below pH 7; the exact amount of protein extracted depended on the pH and the ionic strength of the solvent. protein extraction was practically complete at pH 7-9; but the relative amounts of the individual proteins obtained still depended on the pH of the extracting media, indicating a pH-dependent association/dissociation reaction between the protein molecules present. The extraction of material containing P reached an optimum at pH 6-7; there was a definite decrease in the amount of material containing P when solubilized at higher pH values. On the other hand, precipitates obtained with trichloroacetic acid retained very little material containing P. The significance of these findings is discussed. (Author's summary)

0257

8685 KOZ, J.; KLOSOVA, E.; TURKOVA, V. Chemotaxonomy and genesis of protein characters with special reference to the genus *Phaseolus*. Prelia 38:229-236. 1966. En., Sum. En., Cs., 16 Ref., 11.

Phaseolus vulgaris. Seed. Proteins. Analysis. Legume crops. Cotyledons. Cross breeding. Hybrids.

Serological studies have shown that protein characters are relatively objective species characteristics and may indicate kinship. Proteins from the cotyledons of 13 species of *Phaseolus* were compared with those of *P. vulgaris* and *P. aureus*. *P. vulgaris* appeared to be closely related to a group of endemic American species. Protein characters were clearly correlated with geographical distribution. Scions of *P. vulgaris* were grafted onto stocks of species of *Phaseolus* and other genera. A positive correlation was found between graft affinity and protein characters. A positive correlation was also found between the crossability of species of *Phaseolus* and the degree of similarity of protein characters. Immunoelectrophoretograms of the cotyledon albumens of *P. vulgaris* and *P. coccineus* showed a marked difference. The F1 hybrids between these species were intermediate both in protein characters and morphological features. The F2 generation segregated into maternal, paternal, and transitional types with respect to protein and morphological features. Thus it is concluded that similar laws govern the genesis of both protein and morphological characters. (Summary by Plant Breeding Abstracts)

0258

5345 RACUSEN, D.; FOOTE, M. The major glycoprotein in germination bean seeds. *Canadian Journal of Botany* 49:2107-2111. 1971. En., Sum. En., 18 Ref., II.

Phaseolus vulgaris. Proteins. Germination. Seed. pH. Na. Cl. Soluble carbohydrates. Amino acids. Analysis. Hydrolysis.

Bean seeds yielded a soluble glycoprotein that accounted for about 35 percent of the total protein as determined by combined analysis with DEAE-cellulose and disc electrophoresis. Germination for up to 114 h had little effect on this glycoprotein or on the total soluble protein. The glycoprotein had an apparent mol. wt. of 130,000 (6.1 S), contained 14.7 percent N and yielded mannose, glucosamine and some pentose upon hydrolysis. (Author's summary)

0259

14298 INSHINO, K.; ORTEGA, D., M.L. Fraccionamiento y caracterización de las proteínas de reserva más abundantes en las semillas de *Phaseolus vulgaris* L. (Fractionation and characterization of the most abundant reserve proteins in *Phaseolus vulgaris* seeds). In *Avances en la enseñanza y la investigación en el Colegio de Postgraduados de Chapingo, México, 1973*. pp.32-33. Es.

Phaseolus vulgaris. Composition. Protein content. Proteins. analysis.

A protein content of 29.8 percent, consisting of 75 percent globulin protein formed by 4 components named alpha, beta, gamma, and delta, was found in bean var. "negro mecenital". Component alpha is a non-sulfurated glycoprotein, containing 4.95 percent carbohydrates and 1.1% percent hexosamine; it was isolated homogeneously by gel filtration. This component shows a min. solubility at pH 4.1; it was not separated by a treatment of 8 M urea but it was partially separated in an alkaline treatment 9 pH 12.5) during 24 h. (Summary by C.P.G. Trans. by L.M.F.)

0260

10176 McLEESTER, R.C. et al. Comparison of globulin proteins from *Phaseolus vulgaris* with those from *Vicia faba*. *Phytochemistry* 12(1):85-93. En., Sum. En., 30 Ref., II.

Phaseolus vulgaris. *Vicia faba*. Maturation. Seed. Proteins. Cotyledons. Seed coat. Embryo. Analysis. Laboratory experiments.

Extraction of maturing *Phaseolus vulgaris* seeds with an ascorbic acid-NaCl medium facilitated the preparation of 2 globulin fractions which were shown by acrylamide gel electrophoresis and by analytical ultracentrifugation to be completely separated from each other. These 2 fractions, which are equivalent to legumin and vicilin, were shown

to differ from similar fractions from *Vicia faba*. Dissociation of the proteins of each globulin fraction by SDS resulted in differing peptide band patterns for these 2 plants. Conditions necessary for fractionating the individual globulin components from bean seeds are discussed, and the usefulness of the specific names legumin and vicilin is questioned. (Author's summary)

0261

12387 SUN, S-M.S. Isolation of physical and chemical characterization of globulins from *Phaseolus vulgaris* seed. Ph.D. Thesis. Madison, University of Wisconsin, 1974. 134p. En., Sum. En., 60 Ref., II.

Phaseolus vulgaris. Seed. Gibberellins. Amino acids. Carbohydrate content.

Two globulin fractions, G1 and G2, obtained from french bean seed by an ascorbate-NaCl extraction procedure developed in this lab (McLester et al., 1973) were characterized in respect to the following physicochemical properties: solubility, electrophoretic profile; amino acid content, carbohydrate content, mol. wt., configurational and conformational changes, and genetic control of polypeptide subunit structure. Both G1 and G2 were found to possess some properties in common. These include the requirement of salt for solubilization; a low content of the sulfur-containing amino acids met. and cystine, a high level of aspartic and glutamic acids, and the presence of carbohydrate. Both fractions undergo pH-dependent dissociation and have principally random coil and beta-structure, properties that have been noted for globulins from several other legume seeds. Despite the above similarities, these 2 fractions were found to differ from their equivalent globulin fractions from other legume seeds in their electrophoretic profiles, mol. wt., and subunit structure. Moreover, they differed from each other in regard to the following properties: the G1 globulin requires a higher salt concn. than does the G2 fraction for solubilization; they have different isoelectric points (G1, 4.4-5.6; G2, 3.8); and the G1 fraction contains 2.9 percent sugar and 0.6 percent hexosamine, while the G2 fraction contains 4.9 percent sugar and 1.3 percent hexosamine. Furthermore, the G1 fraction is capable of pH-dependent reversible dissociation between tetrameric (18.2S, mol. wt. 654,000) protomeric (7.1S, mol. wt. 163,000), and peptide (3.0S, mol. wt. 44,000) configuration forms, while the G2 fraction (6.6S, mol. wt. 143,000) does not undergo reversible dissociation, but irreversibly dissociates into its peptide components (1.6S, mol. wt. 16,500) at pH 13.0. The ionization of the buried tyrosine residues in G1 globulin is a time-dependent process while that in the G2 fraction is not; and the G2 fraction appears to contain more random coil and beta-structure, and less alpha-helix than does the G1 globulin. The G1 globulin consists of 3 polypeptide subunits with mol. wt. 53,000, 47,000, 43,000 while the G2 appears to consist of one major polypeptide with a mol. wt. 32,000. A preparative SDS gel electrophoresis system was developed in this study which permitted the quantitative isolation of the subunits of G1 globulin. This procedure will also be of value for other proteins having polypeptide subunits whose mol. wt. differ little from each other. Differences in the polypeptide subunit structure of G1 globulin for some cv. appear to be under the control of one pair of alleles as judged by evidence from electrophoretic patterns of single-seed extracts. Substantiation of genetical differences in definitively characterized seed proteins will be of use to plant breeders in the development of nutritionally enhanced bean plants, and represent a necessary step in understanding the regulation of higher plant protein synthesis at the mol. level. (Summary by Dissertation Abstracts)

0262

8642 ISHINO, K.; ORTEGA D., M.L. Fractionation and characterization of major reserve proteins from seeds of *Phaseolus vulgaris*. *Journal of Agricultural and Food Chemistry* 23(3):529-533. 1975. En., Sum. En., 39 Ref., II.

Phaseolus vulgaris. Proteins. Seed. Amino acids. analysis. Carbohydrate content. Composition. Laboratory experiments.

The globulin fraction (75 percent of the total protein) of bean *Phaseolus vulgaris* var. Negro Mecentral consisted of 4 major components alpha, beta, gamma, and delta, designated in order of decreasing electrophoretic mobility, which accounted for 50, 19, 10, and 12 percent of the globulin, resp. The component (14.55 percent of N) had a S₂₀, w_{0.53} percent 7.42 S and an approx. mol. wt. of 170,000. Also this component was a glycoprotein which contained 4.95 percent of carbohydrate (as mannose) and 1.19 percent of hexosamine (as glucosamine) and was deficient in the sulfur-containing amino acids. Although neither 8 M urea nor 0.2 M 2 mercaptoethanol treatments induced dissociation of the alpha component, alkali treatment 9pH 12.5) caused dissociation into the subunits, although not completely even after 24 h. The beta and gamma components dissociated immediately with alkali. At pH 4.1, 62 percent of the globulin remained soluble in acetate buffer with micro τ = 0.5, and 57 percent with micro τ = 0.1. The solubility of acid precipitated protein was 65 percent in the phosphate buffer (pH 7.5), micro τ = 0.5, the alpha and beta components seemed to form insoluble complexes during acidification. (Author's summary)

0263

6220 SUN, S.M.M.; BUCHBINDER, B.U.; HALL, T.C. Cell-free synthesis of the major storage protein of the bean, *Phaseolus vulgaris* L. *Plant Physiology* 56:780-785. 1975. En., Sum. En., 27 Ref., II.

Phaseolus vulgaris. Proteins. Analysis. Cell structure. Cotyledons. Seed. Sucrose. Amino acids. USA.

As seeds of the french bean (*Phaseolus vulgaris* L. cv. Tendergreen) mature, a single protein, G1 globulin (analogous to legumin), represents the majority of protein synthesized. Washed polysomes extracted from developing cotyledons had little endogeneous activity in amino acid incorporation; but on addition to cell-free extracts from wheat germ, active incorporation was obtained, the level being similar to that with viral RNA as messenger. The Mg(24) optimum for protein synthesis in the presence of bean polysomes was 6 mM, compared with 4 mM for synthesis of viral polypeptides in the heat perm system. Using T-2 toxin as an inhibitor, it was shown that 29 percent of the incorporation depended on initiation events. Electrophoretic analysis of the total polypeptide products of cell-free synthesis gave a disperse profile. Centrifugation to remove polysome-bound peptides after 60 min of incubation gave a supernatant having a product with the same electrophoretic mobility as G1 globulin and containing 26 percent of the radioactivity present in the pel. Protein eluted from this peak was subjected to reelectrophoresis and shown to consist of the 3 polypeptide subunits characteristics of G1 globulin. (Author's summary)

0264

8641 SUN, S.M.; HALL, T.C. Solubility characteristics of globulins from *Phaseolus* seeds in regard to their isolation and characterization. *Journal of Agricultural and Food Chemistry* 23(2):184-189. 1975. En., Sum. En., 26 Ref., II.

Phaseolus vulgaris. Seed. Proteins. Analysis. pH.

Gel electrophoresis was used to compare the relative efficiency of several extraction procedures for seed globulin fractions from *Phaseolus vulgaris* without cross-contamination. Acidic conditions were shown to be particularly effective. The isoelectric point of the globulin 1 fraction was found to be at pH 4.4-5.6, and that the globulin 2 fraction was at pH 3.7. Differences in solubility characteristics for these fractions in respect to protein and salt concn., temp., and ionic species are detailed. (Summary by Field crop Abstracts)

0265

7224 BARKER, R.D. et al. Purification and characterization of the major storage proteins of *Phaseolus vulgaris* seeds, and their intracellular and cotyledonary distribution. *Phytochemistry* 15:751-757. 1976. En., Sum. En., 40 Ref., II.

Phaseolus vulgaris. Proteins. Seed. Storage. Cotyledons. Amino acids. Composition. Analysis. Carbohydrate content. England.

Several extraction and fractionation procedures were employed to isolate the major storage proteins of mature seeds of *Phaseolus vulgaris* cv. Seafarer; 3 proteins that were soluble at pH 4.7 and 1 that was insoluble at that pH were identified. The characteristic subunits of the 3 pH 4.7-soluble proteins had MWs 50000 and 47000, 32000, and 23000, resp.; those of the pH 4.7-insoluble fractions had MW 60000 and 20000. Amino acid compositions, N-terminal amino acid residues and the presence of carbohydrate in these proteins were determined. All these proteins occurred in the protein body fraction, and their relative amounts were different in the outer and central parts of the cotyledons. (Author's summary)

0266

6367 DERBYSHIRE, E.; WRIGHT, D.J.; BOULTER, D. Review: legumin and vicilin, storage proteins of legume seeds. Phytochemistry 15(1):3-24. 1976. En., Sum., En., 27 Ref., II.

Phaseolus vulgaris. Seed. Storage, Seed characters. Protein content. Legume crops. Seed coat. Amino acids. England.

The structure, location in the seed and distribution of the storage protein of legume seeds are described. Method which have been employed for the extraction, purification, and characterization of seed globulins are reviewed in relation to modern biochemical practice. The physical, chemical, and immunological characteristics of the classical legumin and vicilin preparations from *Pisum sativum* are summarized, and the distributions of proteins with sedimentation coefficients and/or immunological determinants similar to those of legumin and vicilin are tabulated. The structure and composition of various purified legumin and vicilin-type proteins from a variety of legumes, including *Phaseolus vulgaris*, are compared. (Author's summary)

0267

6417 DERBYSHIRE, E.; BOULTER, D. Isolation of legumin-like protein from *Phaseolus aureus* and *Phaseolus vulgaris*. Phytochemistry 15(3):411-414. En., Sum. En., 43 Ref., II.

Phaseolus vulgaris. *Phaseolus aureus*. Proteins. Seed. Storage. N. S. Amino acids. Composition. England.

An 11S seed globulin has been isolated from *Phaseolus aureus* and *P. vulgaris* by zonal isoelectric precipitation and the MWs of the constituent subunits determined. The protein of *P. vulgaris* occurs in the protein body fraction and its chemical composition, including the N-terminal amino acids and amino acid composition, has been determined. The similarity between the 11S globulin of the two *Phaseolus* spp. and legumin from other legumes is discussed. (Author's summary)

0268

8487 STOCKMAN, D.R.; HALL, T.C.; RYAN, D.S. Affinity chromatography of the major seed protein of the bean (*Phaseolus vulgaris* L.). Plant Physiology 58: 272-275. 1976. En., Sum. En., 18 Ref., II.

Phaseolus vulgaris. Seed. Proteins. Analysis. Laboratory experiments.

The major globulin of the french bean (*Phaseolus vulgaris* L.) undergoes a reversible pH-dependent polymerization. At pH values above 6.5, the monomeric form of the protein predominates; and at pH values below 6.5, the protein occurs as a polymer, probably a tetramer. At extremes of pH, the protein dissociates further into peptides.

The reversible pH-dependent interaction between globulin subunits is used in this report as the basis for an affinity chromatography procedure for isolation of the globulin. The major globulin from several genetic variants can be obtained in gram quantities and does not indicate the presence of any impurities on discontinuous sodium dodecyl sulfate gel electrophoresis. (Author's summary)

0269

5962 MERS, J.C.; OLSON, A.C.; GRAY, G.M. Bean protein separations using laboratory and continuous decanter centrifuges. *Journal of Food Sciences* 42(2):367-369. 1977. En., Sum. En., 6 Ref., ll.

Phaseolus vulgaris. Proteins. Protein content. Seed. pH. Processing. Laboratory experiments. Analysis. N.

California Small white bean meal was given 3 acidic extractions at low pH followed by 3 at high pH by laboratory and pilot plant procedures under similar conditions. Extracts and residues were neutralized to pH 6.5 and lyophilized. Acid-extracted bean solids were 32 percent of the origin. l bean meal by both laboratory and pilot plant procedures. The basic-extracted solids were 6 percent by the 2 procedures. Protein content in the acid extract was 14 percent of the original meal by both procedures whereas that in the basic extract was 3 percent. The decanter-centrifuge was effective for the separation if the ground bean was not too fine. (Author's summary)

0270

20605 BOLLINI, R.; CHISPEELS, M.J. 1978. Characterization and subcellular localization of vicilin and phytohemagglutinin, the two major reserve proteins of *Phaseolus vulgaris* L. *Planta* 142(3):291-298. En., Sum. En., 26 Ref., ll.

Phaseolus vulgaris. Cotyledons. Proteins. Analysis. Phytohemagglutinins.

Extracts of *Phaseolus vulgaris* cotyledons contained 2 abundant proteins, vicilin and phytohemagglutinin. Vicilin, a 6.9S protein fraction at neutral pH, associated to an 18.0S form at pH 4.5 and had 3 nonidentical subunits with mol. wt. of 52,000, 49,000, and 46,000. Phytohemagglutinin, a 6.4S protein fraction, had 2 nonidentical subunits with mol. wt. of 34,000 and 36,000. Phytohemagglutinin could be separated by isoelectrofocusing with mol. wt. 34,000 and a mitogenic and erythroagglutinating protein fraction which contained both subunits. Vicilin is apparently identical with the so-called glycoprotein II and with globulin G1 while phytohemagglutinin is identical with globulin G2. Since vicilin and phytohemagglutinin are internationally used names there is no need to introduce new names to describe *P. vulgaris* reserve proteins. Both proteins are catabolized in the course of seedling growth and are located in the protein bodies, indicating that they are reserve proteins. Vicilin isolated in its 18.0S form from the cotyledons of young seedlings contains substantial quantities of smaller polypeptides, in addition to the 3 original ones. It is suggested that the presence of these small polypeptides represents partial breakdown of the vicilin prior to its complete catabolism. (Author's summary)

0271

13531 DAVIES, H.M.; DELMER, D.P. Seed reserve-protein glycosylation in an in vitro preparation from developing cotyledons of *Phaseolus vulgaris*. *Planta* 146:513-520. 1979. En., Sum. En., 21 Ref., ll.

Phaseolus vulgaris. Cotyledons. Seed. Protein content. Phytohemagglutinin. Plant physiology.

A particulate preparation from developing cotyledons of *P. vulgaris* was incubated with uridine-5'-diphospho-N-acetyl-D-glucosamine and by polyacrylamide gel electrophoretic analysis it was shown that the labelled N-acetyl glucosamine (GlcNAc) was incorporated

into the principal reserve protein of the cotyledons, vicilin and also into phytohaemagglutinin. some of the labelled product also reacted with antiserum to vicilin from mature seeds. In contrast it was not possible to detect the incorporation of labelled mannose from guanosine-5'-diphospho-D-mannose into either of these proteins by gel-electrophoretic analysis of the mannose-labelled products, but a low incorporation of mannose into material which reacted with antiserum to vicilin was observed. The predominant glycosylation reaction *in vitro* was therefore probably a transfer of GlcNAc alone, rather than in combination with mannose as performed oligosaccharide. (Author's summary)

0272

16086 BROWN, J.W.; BLISS, F.A.; HALL, T.C. Microheterogeneity of globulin-1 storage protein from French bean with isoelectrofocusing. *Plant Physiology* 66:838-840. 1980. En., Sum. En., 11 Ref., Il.

Phaseolus vulgaris. Snap bean. Seed. Proteins. Biochemistry. Analysis.

The major storage protein fraction, globulin-1 protein, of French bean was analyzed by 2-dimensional electrophoresis. The protein pattern suggested a more complex system for globulin-1 protein than the model of 3 polypeptides, alpha, beta, and gamma, differing in mol. wt. Isoelectrofocusing analyses of the individual proteins showed that each exhibited charge microheterogeneity over a similar pH range. Isoelectrofocusing banding patterns may help to understand the relationships between the globulin-1 polypeptide subunits. (Author's summary)

0273

21769 CHANG, K.C.; SATTERLEE, L.D. 1981. Isolation and characterization of the major protein from Great Northern beans (*Phaseolus vulgaris*). *Journal of Food Science* 46(5):1368-1373. En., Sum. En., 30 Ref., Il. (Food Protein Research Group, Dept. of Food Science & Technology, Univ. of Nebraska, Lincoln, NE 68583, USA)

Phaseolus vulgaris. Proteins. Analysis. Digestibility. Amino acids. USA.

The major protein of Great Northern beans was isolated through salt extraction, ammonium sulfate fractionation, gel filtration, and DEAE-cellulose ion exchange chromatography. Physicochemical properties of the major bean protein were determined. Results from heat stability studies showed that the protein was most stable at pH values between 4-6. A complete unfolding of the bean protein was not essential in order to improve its digestibility. The native protein had a compact structure and therefore was resistant to the attack by proteolytic enzymes. A glycopeptide containing a N-glycosidic protein-carbohydrate linkage, isolated from a protease digestion of the major bean protein, was also characterized. Results implied that the carbohydrate moiety might have a negative influence on the digestibility of the native protein. (Author's summary)

0274

27378 HERNANDEZ U., H.Y.; ORTEGA D., M.L. 1985. Trypsin activity on globulins and albumins from common bean seeds (*Phaseolus vulgaris* L.). *Bean Improvement Cooperative. Annual Report* 28:30. En., 4 Ref. (Colegio de Postgraduados, Chapingo 56230, México)

Phaseolus vulgaris. Trypsin. Seeds. Proteins. Temperature. Laboratory experiments. Analysis. Cultivars. Inhibitors. Mexico.

The localization of the trypsin inhibitors in the protein fractions of seeds of 4 dry bean var. (Negro Mccentral, Flor de Mayo, Canario 107, and Negro Tropical) and the effect of the heat denaturation were studied. Tryptic activity (200 micrograms/ml) was assayed during 10 min on 1 percent casein (pH 7.6) as a substrate. The same amount of trypsin was tested on the casein substrate, with the addition of 500 micrograms of globulins and

albuminic fractions, native and heat denatured (93 degrees Celsius) for 20 and 40 min. The antitryptic activity was located in the albumin fraction. By heat treatment of the albumin fractions, the trypsin inhibitor was partially inactivated; however, the addition of the heat-denatured globulin fraction yielded a higher trypsin proteolytic activity. (CIAT)

0275

27083 PERNOUËT, J.C. 1985. Biosynthesis and accumulation of storage proteins in seeds. *Physiologie Vegetale* 23(1):45-59. En., Sum. En., Fr., 113 Ref. (Laboratoire d'Etude des Protéines, Département de Physiologie et Biochimie Vétales, Centre Inst. National de Recherches Agronomiques, Route de Saint-Cyr, 78000 Versailles, France)

Phaseolus vulgaris. Proteins. Seed. Genes. Plant breeding. France.

The biosynthesis of seed storage proteins of cultivated species belonging to 2 botanical groups accumulating 2 kinds of proteins, prolamins in maize, wheat, and barley and globulins in *Phaseolus vulgaris*, peas, and soybeans, is reviewed. The time course accumulation of reserve protein groups in the developing storage tissue (endosperm for cereals and cotyledons for legumes) and the formation of protein bodies are described, and seed storage proteins and animal secretory proteins are compared. the co- and post-translational modifications are discussed in relation to their mode of synthesis. the organization and expression of the relevant genes and some factors controlling protein synthesis are outlined and the prospects of using plant gene transfer through genetic engineering in order to improve the quantity and quality of the seed proteins are considered. (AS)

0276

28640 BOLWELL, G.P. 1986. Microsomal arabinosylation of polysaccharide and elicitor-induced carbohydrate-binding glycoprotein in French bean. *Phytochemistry* 25(8):1807-1813. En., Sum. En., 45 Ref., II. (Dept. of Biochemistry, Bourne Building, Royal Holloway & Bedford New College, Univ. Of London, Egham, Surrey, TW20 0EX, England)

Phaseolus vulgaris. Snap beans. Analysis. Phytohemagglutinins. Proteins. United Kingdom.

In contrast to microsomal membranes from suspension cultured cells of French bean cv. Canadian Wonder undergoing primary wall synthesis, which incorporated arabinose directly from uridine 5'-diphosphate-beta L-arabinose into arabinan, membranes from cells treated with fungal elicitor catalyzed the formation of a lipid oligosaccharide intermediate in the arabinosylation of an inducible Mr 42500 glycoprotein. These variations in the patterns and mechanism of arabinosylation observed between the cells in response to the differing stimuli were detected in both the kinetics of incorporation and the demonstration that the lipid oligosaccharide after purification on ion-exchange chromatography could act as primary donor for the glycoprotein and not polysaccharide. These results distinguish mechanisms for the transfers of arabinose onto glycoprotein and polysaccharide by enzyme systems known to be immunologically distinct. The fungal elicitor-induced Mr 42500 glycoprotein binds to thyroglobulin- and fetuin-sepharoses in a specific manner and this binding is prevented by chitin oligomers. The glycoprotein thus appears to be a carbohydrate-binding protein and the sugar specificity together with the demonstration of hydroxyproline residues in acid hydrolysates of the glycoprotein purified by affinity chromatography indicates a close similarity to the arabinosylated hydroxyproline-rich lectins of the solanacea, which can function as bacterial agglutinins. The Mr 42500 glycoprotein, which undergoes rapid transient induction, also clearly differs from other extensin-like hydroxyproline-rich glycoproteins, arabinogalactan proteins, and the characteristic bean seed lectin, phytohemagglutinin, in a no. of properties. (AS)

28964 DOYLE, J.J.; SCHULER, M.A.; GODETTE, W.D.; ZENGER, V.; BEACHY, R.N.; SLIGHTON, J.L. 1986. The glycosylated seed storage proteins of *Glycine max* and *Phaseolus vulgaris*. Structural homologies of genes and proteins. *Journal of Biological Chemistry* 261(20):9228-9238. En., Sum. En., 61 Ref., II. (L.H. Bailey Hortorium, 467 Mann Library Bldg., Cornell Univ., Ithaca, NY 14853, USA)

Phaseolus vulgaris. Seeds. Proteins. Phaseollini. Analysis. Biochemistry. USA.

Considerable information is now available concerning the 7 S seed storage proteins of legumes and the genes that encode them. The gene encoding a beta-type subunit of phaseolin (PVU beta), the 7 S protein of common bean, was compared with the gene encoding an alpha'-subunit of beta-conglycinin (GMA alpha'), the 7 S protein of soybean. The comparison involves 2880 base pairs of PVU beta and 3836 base pairs of GMA alpha' and includes approx. 1 kilobase pair of 5'-flanking sequences, and 5' and 3' untranslated sequences, as well as the 6 exons and 5 introns that are found to occur in similar position in both genes. Conserved sequences in the 5'-flanking regions of these genes are discussed in light of their potential regulatory role. [AS (Extract)]

Mutations

1821 SARAFI, A. Utilisation de rayons ionisants dans l'amélioration du haricot (*Phaseolus vulgaris* L.). (Use of ionizing radiations in bean breeding). *Annales de l'Amélioration des Plantes* 23(1):77-81. 1973. Fr., Sum. Fr., En., 9 Ref.

Phaseolus vulgaris. Mutation. Cultivars. Irradiation. Co. Seeds. Proteins. Yields. Productivity. France.

Seeds of 4 bean var. irradiated with gamma and neutronic rays were studied from 1967-70. The M3 mutants were higher yielding than the nonirradiated var. Six mutants of 2 var. were compared with the checks for percentage of protein and seed wt. Some of the mutant had seeds 12.8 percent bigger and 14.8 percent richer in protein. There was a positive and significant correlation ($r = 0.703$) between the percentage of protein and seed wt. of mutants and checks. (Author's summary)

8992 RUBAHAYO, P.R. Gamma-ray induced mutations in *Phaseolus vulgaris* (L.). *East African Agricultural and Forestry Journal* 41(2):134-138. 1975. En., Sum. En., 10 Ref., II.

Phaseolus vulgaris. Irradiation. Mutation. Protein content. Seed coat. Genes. Seed. Yields.

Following treatment of dry seeds of *Phaseolus vulgaris* var. Banja with 5 doses (7, 11, 14, 17, and 21 kR) of gamma rays, a no. of desirable mutants were isolated in the M2 generation. The M1 generation had shown physiological stimulation of growth at low doses and growth retardation at high doses. Several mutant lines showed significant improvement in seed and protein yield compared to the initial line. (Author's summary)

15201 MCGINNIS, J. 1978. Nutritional evaluation of varieties and breeding lines of dry beans (*Phaseolus vulgaris*) and studies on improvement in the nutritional value of beans by gamma irradiation. A report. Pullman, Washington State University, 119p. En.

Phaseolus vulgaris. Cultivars. Seeds. Irradiation. Nutritive value. Plant breeding. Cooking. Amino acids. USA.

A series of reports is given on expt. conducted by 4 projects of the Department of Animal Sciences, Washington State University (USA) on the nutritional value of bean cv., breeding lines, and genetic crosses and on the improvement in the nutritional value of beans and other grain legumes by gamma irradiation. The results of different growth trials in poultry with different levels of beans in the diet showed that beans at a 50 percent level decreased growth and feed efficiency. Result showed marked variability in the nutritional value of the different bean cv. and breeding lines, indicating that plant breeders can improve the nutritional value of beans through genetic crossing and selection. Various cv. and breeding lines were subjected to gamma irradiation and fed to chicks and rats. Gamma irradiation improved chick growth in comparison with nonirradiated beans; results also showed that cv. and breeding lines were improved by approx. the same magnitude, indicating that all the tested materials contained the same factor that was being inactivated or destroyed by irradiation. Even after cooking and gamma irradiation, bean growth and feed efficiency was inferior to that of the control diet (SBM and glucose). In other trial on the effects of different processing methods on the nutritional value of beans, it was found that salt-soaked beans gave better chick growth than beans soaked only in water. In additional studies no effects were observed of the frequency of irrigation and location of the crop on bean protein content. Separate progress reports with detailed results are included. (Summary by A.J.C. Trans. by L.M.F.)

0281

11446 RUBAHAYO, P.R. The performance of gamma-ray induced mutants of three pulse crops. In *Seed protein improvement by nuclear techniques*. Vienna, Austria, International Atomic Energy Agency, 1978. pp.235-241. En., Sum. En., 2 Ref.

Phaseolus vulgaris. Mutation. Seed. Protein content. Yields. Cultivars. Field experiments. Legume crops. Production. Irradiation. Uganda.

The M6-M9 generations of white seeded beans, French beans, and soybean elite mutants were evaluated for their seed and protein yield potential in replicated trials over several seasons. Several mutant lines of each crop with significantly higher yield potential than the initial lines were identified and given to the government field trials officer for further testing on stations throughout Uganda for at least 3 more seasons. Results will then be considered by the National Variety Release Committee if any of these mutants show outstanding performance in these trials. (Author's summary)

0282

14702 REDDY, S.J.; PUBOLS, M.H.; MCGINNIS, J. Effect of gamma irradiation on nutritional value of dry field beans (*Phaseolus vulgaris*) for chicks. *Journal of Nutrition* 109(7):1307-1312, 1979. En., Sum. En., 17 Ref.

Phaseolus vulgaris. Irradiation. Nutritive value. Diets. Digestibility. Enzymes. Protein content. Cultivars.

The effect of gamma irradiation [^{60}Co] of different var. and breeding lines of dry field beans on chick growth was determined using a chick growth assay in which the diet contained approx. 50 percent beans. Total protein (N x 6.25) in beans was not changed appreciably by irradiation (21 Mrad) but protein solubility in water was decreased. Irradiation increased in vitro enzymatic digestibility of bean protein by pepsin and by a mixture of trypsin, chymotrypsin, and peptidase. In the bioassay the diet was formulated to derive half of the total protein (22.6 percent) from beans. autoclaved Pinto and Pink beans gave significantly better growth than Red Mexican and White Pea beans. The differences between Red Mexican and White Pea beans were not significant except for Red Mexican breeding line no. RS-59. the nutritional value of all var. of beans, based on chick growth, was significantly improved by gamma irradiation. The irradiation treat-

ment of beans tended to increase N retention by chicks and decrease uric acid N excretion in relation to N intake. (Author's summary)

0283

14376 ROMERO, I.; GARCIA, A. Efectos mutagénicos en frijol variedad Jamapa. (Mutagenic effects on bean variety Jamapa). México, Northrup King y Cía. 1979?, 17p. Es., 6 Ref. Paper presented at Reunión Anual de PCCMCA, 26a. Guatemala, 1980.

Phaseolus vulgaris, cultivars. Irradiation. Genes. Laboratory experiments. Selection. Yields. Protein content. Plant anatomy. Plant breeding. Agronomic characters. Mexico.

Artificial means exist to incite genetic changes and it is not improbable that these means will be used to reestablish genetic variation. The technique to obtain greatest variation by physical mutagenic agents has been used in a great amount of crops and mutants of agricultural interest, including commercial var., have been obtained by this process. In the present study, the effects of Co 60 gamma rays were used to obtain greater variation in grain yield and in the amount of protein in beans. Three generations (M1, M2, and M3) were used with 12 different doses of radiation from 0-40,000 rads; individual selection was practiced in each generation and yields of these materials, as well as vigor and early-n...ration, were taken as a basis. An increase in the C.V. of both yields and protein was obtained, indicating that the technique of irradiation was effective in generating genetic variability and subsequently in selecting the characters of agronomic interest. On the other hand, it was feasible to select good yielding genotypes with acceptable protein percentage, since a 13.63 percent differential in selection was observed for yields and 15.88 percent for protein percentage, compared to non-selected bean var. Jampa. Finally a stepwise analysis was conducted in order to select a regression model that could explain yield response in such a way that the following model was selected as the best; $R = 51.01 - 0.06SP(2) + 0.0971(2) - 2.57U(2)$, where P is the protein percentage, V are the days to flowering, and U, the ranking of Uromyces. (Author's summary. Trans. by L.M.F.)

0284

22968 ROMERO A., I. 1980. Efectos mutagénicos M(4) sobre el rendimiento y cantidad de proteína en frijol Jamapa. (Mutagenic M(4) effects on Jamapa bean yield and protein quality). Tesis Ing. Agr. Jalisco, México, Universidad de Guadalajara. 68p. Esp., 26 Ref.

Phaseolus vulgaris. Plant breeding. Irradiation. Genotypes. Seeds. Selection. Protein content. Seed characters. Yields. Statistical analysis. Mutation. Plant development. Cultivars. Genetics. Mexico.

The genetic variation induced to a population of bean var. Jamapa by applying Co(6) gamma rays and to select genotypes with high yield and high protein percentage was studied. Gamma radiation doses for the 12 treatments ranged between 0-40,000 rads. Of the 500 seeds irradiated treatment, the M1 was planted in La Huerta (Jalisco, Mexico) for individual selection, the M2 in Los Belenes for individual selection, the M3 in La Huerta for family evaluation, and the M4 for protein analysis. Changes were observed in the M1 regarding seed coat color (from black to light brown) in treatments with 10,000 and 20,000 rads. Bean germination decreased from 57 to 21 percent as radiation increased from 20,000 to 40,000 rads. Growth and flowering were delayed with these treatments, and cotyledons developed considerably. In the M2, morphological modifications were observed in the leaf and foliage color. Regarding C.V. for yield, an increase in the variance of some irradiation treatments was observed indicating that the irradiation technique is effective to create mutations or induce genetic variability. A similar response was observed for protein percentage but the C.V. were lower at a higher irradiation dose. The selection differential was 13.63 percent for yield and 15.88 percent for protein. Other bean var. should be irradiated and this screening process from high protein families should continue for at least 2 more cycles. If lab. facilities are available, met. should be taken as a criterion in order to obtain higher protein quality in the selected population. (Summary by EDITEC)

25874 MORALES S., R. 1984. Incremento del contenido de proteína en el frijol común (*Phaseolus vulgaris* L.) mediante irradiación de la semilla con cobalto-60. (Increase in protein content in common beans by means of seed irradiation with cobalt-60). *Revista Tikalia* 3(2):93-104. Es., Sum. Es., 8 Ref., II.

Phaseolus vulgaris. Seed. Irradiation. Cultivars. Mutation. Agronomic characters. Protein content. Guatemala.

Seed of 4 bean var. (Suchitan, Cuarenteo, Jutiapan, and San Martín) at 12 percent humidity was exposed to different doses of Co-60 gamma radiation. The M1 (irradiated seeds) were planted in 1982 using randomized block designs with 4 replications for Cuchitan and Cuarenteo, and with 5 replications for Jutiapan and San Martín. The effect of radiation on the M1, M2, and M3 generations was analyzed. Mutations were generated for various characteristics such as days to flowering, growth habit, pod color, leaf texture and size, and chlorophyll content. It was determined that doses between 15-20 krad caused the largest no. of mutations. An analysis of total protein content was performed for M2 of Cuchitan and Cuarenteo, and for M3 of Jutiapan. The analysis showed that the effect of irradiation, especially for doses between 15-20 krad, was the broadening of the range of seed protein content percentage towards values lower or higher than the control. The wider ranges of some irradiated materials allowed those families having a min. of 26 percent protein to be selected. In the future it is expected to obtain lines with acceptable yields and a higher seed protein content. (AS-CIAT)

26014 SALAZAR L., S. 1984. Evaluación de mutaciones inducidas por radiación gamma (Co-60) en dos variedades de *Phaseolus vulgaris* L. (Evaluation of mutations induced by gamma (Co-60) radiation in two bean varieties). Tesis Ing. Agr. Guatemala, Universidad de San Carlos. 101 Es., Sum. Es., 54 Ref., II.

Cultivars. Guatemala. Irradiation Mutation. *Phaseolus vulgaris*. Plant physiological disorders. Protein content. Seed. Yield components.

Different doses of Co-60 gamma rays (0, 8, 15, and 30 krad) were evaluated in seeds of bean var. Jutiapan and San Martín to (1) identify those producing more mutations and approx. 20 percent lethality; (2) select material presenting differences in earliness, leaf type, stem thickness, grain color, and other morphological mutations; (3) study the differences in sensibility to radiation of the var. treated, using the physiological effects expressed in the M1 generation as criteria, (4) recover seeds with a greater potential for improving protein quality and quantity. Acute radiation caused physiological and anatomic effects in the M1 generation that are only expressed in this generation: reduction in plant height, decrease in no. of seeds treatment dose, low survival at high doses, and sterility. Doses of 20 and 30 krad produced 20 percent lethality in the M1, especially in var. San Martín. The 30-krad dose produced a 34 percent reduction in plant height in var. San Martín and less emergence in the field for both var. also at 20 and 30 krad, less flowering was observed in var. Jutiapan. Compared with the control, at high doses reductions of 58 and 50 percent were observed in 100-seed wt. in the M1 for var. San Martín and Jutiapan, resp. Var. Jutiapan showed more mutations and morphological changes in the M2, but it was demonstrated that most changes obtained in the M2 are not mutations but alterations due to general environmental effects. However, good results were obtained for earliness and information is given on some broad-leaf mutants. [AS (Extract)-CIAT]

Environmental effects

6246 KKHAE, F.S.; PLESHKOV, B.P. The effect of phosphorus regime on fractional distribution and amino acid composition of proteins in bean. *Doklady Botanical Science* 157/159:126-129. 1964. En., 9 Ref.

Phaseolus vulgaris. P. Protein content. Amino acids. Composition. Maturation. Leaves. Pods. Laboratory experiments.

The effect of a P regime on fractional distribution and amino acid composition of protein from leaves and maturing pods of beans was studied. Amino acid composition was determined by paper partition chromatography in 4 solvent solutions, from precipitated protein of aqueous extract obtained by homogenization, dialysis, and centrifugation. These methods of extraction are described and the results of amino acid composition of leaf and pods are presented in 2 tables. It was concluded that the amino acid composition of proteins from leaves and maturing pods of bean plants is fairly stable and is only slightly affected by reducing the amount of P supplied; only in the borate soluble fraction was there a certain reduction in amide content with P deficiency. There was also an increase in cystine content of various fractions. (Summary by I.B. Trans. by L.M.F.)

6245 KHAI, F.S.; PLESKOV, B.P. Change in the composition of protein of bean seeds as a function of the conditions of nutrition. *Doklady Botanical Science* 160/162:82-85. 1965. En., 15 Ref.

Phaseolus vulgaris. Seeds. Protein content. Amino acids. P, K. Nutritional requirements. Nutrient solution. Seed production. Yields. Laboratory experiments.

Expt. were conducted to determine the influence of the conditions of P and K nutrition on amino acid composition of total seed proteins and the composition of individual protein fractions. Var. Saksa beans were grown in water cultures of Knop's complete nutrient mixture (NPK variation) and on mixtures with a 0.1 dose of P during the vegetation period (NK variation) or a 0.1 dose of K (NP variation) in comparison with the contents of those elements in Knop's mixture. Proteins were extracted by repeated treatments of the flour obtained with a 0.2 M borate buffer (pH 10.0) with an addition of 0.2 percent sodium bisulfite. Individual protein fractions were isolated by successive extractions on the flour with water, with 1 M KCl, with 75 percent ethanol, and with a buffer; successive precipitations and purifications were conducted. Amino acid composition of protein hydrolyzates was determined by paper chromatography; amides, according to the Conway method; proline, according to the Chuard method; and tryptophan, according to Spies and chambers. P and especially K deficiencies produced a substantial reduction of the content of proteins extractable by water, and a corresponding increase in the content of proteins soluble in NaCl, which causes a deterioration of the assimilability of seed proteins. Protein composition is practically independent of nutrition conditions of the plant. (Summary by I.B. Trans. by L.M.F.)

11634 KON, S. Pectic substances of dry beans and their possible correlation with cooking time. *Journal of Food Science* 33:437-438. 1968. En., 10 Ref.

Phaseolus vulgaris. Cooking. Nutritive value. Digestibility. Water content.

The var. Samiac, cultivated in Michigan (USA) was used to investigate if the deterioration of the cooking quality of beans stored at a high moisture and temp. is due to changes in the pectic substances present in beans. Shortly after harvest, the beans were divided into 2 lots with moisture contents of 8.1 and 13.3 percent by drying at room temp. under vacuum. Both lots were stored at 90 degrees Fahrenheit for 4 yr. 1 pectic substance fractionation, 2 forms were used to extract the precipitated mare: in 0.05 N NaOH and 1 percent EDTA solution at pH 6.0 and in boiled distilled water, cooled and incubated

with alpha-amylase (40 mg/g marc) at 40 degrees Celsius for 12 h at pH 7.0. Cooking time, pectin substance fractionation, total pectin and the anhydrouronic acid content were determined for the samples. Results showed a marked increase in cooking time (29 min vs. 210 min) for beans with a higher moisture. There were not significant differences in the content of pectic substances in fractions extracted from both lots. It is suggested that the alpha-amylase treatment affects the solubility of pectic substance, wherefore higher values were obtained for total pectin extracted with alpha-amylase treatments. (Summary by C.P.G. Trans. by L.M.F.)

0290

7507 WAGNER, D.F. The influence of inorganic nutrition on the nutritional value of Sanilac pea beans. Ph.D. Thesis. East Lansing, Michigan State University. 1968. 59p. En., Sum. En., 54 Ref.

Phaseolus vulgaris. P. Zn. Fe. N. Amino acids. Nutritive value. Analysis. Nutrient absorption. Proteins. USA.

In trials in 1966-67, measurements were made of the N and amino acid contents of seeds of *Phaseolus vulgaris* cv. Sanilac grown in soil with various levels of P, Zn, and Fe. Increase in Zn uptake increased the met. content of the seeds, but amino acid contents were not affected by P and Fe treatments. The N content of the seeds was not affected by fertilizer treatments but differed by 16-17 percent from one year to the other. Nutritional problems, arising from the fact that this crop's nutritional value is somewhat dependent on environmental conditions, are discussed. (Summary by Field Crops Abstracts)

0291

8577 SISTACHIS, E. Efectos de la fertilización nitrogenada y la inoculación en el rendimiento y contenido de nitrógeno del frijol negro (*Phaseolus vulgaris*). (Effects of nitrogen fertilization and inoculation on yield and nitrogen content of black beans). Revista Cubana de Ciencias Agrícolas 4:233-237. 1970. Es., Sum. Es., 16 Ref.

Phaseolus vulgaris. *Rhizobium phaseoli*. N. Field experiments. Experiment design. Fertilizers. Nodulation. Seed. Leaves. Mineral content. Yields. Protein content. Cuba.

The effect of applying 90 kg N/ha on the growth and yield of *Phaseolus vulgaris* plants inoculated with *Rhizobium phaseoli*, alone or together with *Azotobacter chroococcum*, was investigated. Applying N reduced nodulation and N content of seeds and leaves, but increased seed yields by 32 percent. Including *A. chroococcum* in the inoculant did not affect nodulation, but increased leaf and seed N content. It was concluded that both N fertilization and inoculation were necessary to obtain a high seed yield with a high N content. (Summary by Field Crop Abstracts)

0292

5972 WAGNER, D.F.; KNEZEK, B.D.; NOVIK, J. Influence of P, Zn, and Fe fertilization upon yield and protein quality of Sanilac navy bean seed. Soil Science and Plant Analysis 2(3):219-225. 1971. En., Sum. En., 13 Ref.

Phaseolus vulgaris. P. Zn. Fe. Fertilizers. Seed. Analysis. Amino acids. Protein quality. Yields. N. Nutrient absorption.

Treatments of P, Zn, and Fe fertilizers were added to a Zn-deficient, Wisner silty clay loam soil. Sanilac bean plants were grown as the Zn-responsive test crop and tissue samples were taken 5 wk after planting for early growth and Zn-uptake responses. At maturity, yield data were obtained and composite samples of beans were taken for determination of protein quality as evaluated by percentage of N, percentage of crude protein and relative contents of essential amino acids. A growth and Zn-uptake response was obtained to ZnSO₄, ZnNTA, and FeNTA fertilization at both P levels, whereas a yield

response to the same treatments was obtained only at high soil P (448 kg/ha) levels. The percentage N, percentage crude protein, and relative contents of essential amino acids did not change as a result of P, Zn, or Fe fertilization even when yields were tripled due to Zn fertilization. (Author's summary)

0293

4872 EDGE, O.T.; MUGHOGHO, L.K.; AYONOADU, U.W.U. responses of dry beans to varying nitrogen levels. *Agronomy Journal* 67:251-254. 1975. En., Sum. En., 25 Ref.

Phaseolus vulgaris. N. Fertilizers. Soil analysis. Productivity. Field experiments. Leaf area. Spacing. Canopy. Productivity. Seed. Pods. Protein content.

Dry beans (*Phaseolus vulgaris* L.) are poor nitrogen fixers; therefore, nitrogen fertilizers are recommended for even reasonable production. We studied the effects of six levels of nitrogen (0, 40, 80, 120, 160, and 200 kg/ha) on determinate dry bean yields for 2 yr. Seed yields increased significantly in both yr with increasing rates of N. Average yields were 2150, 2704, 3048, 3147, 3366, and 3779 kg/ha, resp., for the six rates of N indicating that higher rates of N might have produced greater seed yields. Yield components (yield/plant, pods/plant, seed/size) also increased with increasing N. Percent crude protein and crude protein yield were closely related to the amount of N applied. (Author's summary)

0294

17404 CARELLI, M.L.C.; FAHL, J.I.; TEIXEIRA, J.P.F. 1981. Efeito do nitrogênio no teor de proteína e composição em aminoácidos de sementes de feijão. (Effect of nitrogen on protein content and amino acid composition of bean seeds). *Pesquisa Agropecuária Brasileira* 16(6):795-799. Pt., Sum. Pt., En., 18 Ref.

Phaseolus vulgaris. N. Fertilizers. Plant nutrition. Amino acids. Seed. Analysis. Brazil.

Greenhouse and field expt. at the Centro Exptl. de Campinas, SP, Brazil, were conducted with bean cv. Aroana in order to study the effect of N on protein content of seeds. In the greenhouse, the plants were cultivated in pots, with vermiculite and irrigated with nutrient solution containing 70, 210, and 630 ppm N. In the field, N was top dressed in the form of NH_4NO_3 , at rates of 0, 50, and 100 kg/ha, at the flowering stage. Protein content in the seeds at harvest was 24.7, 27.6, and 33.7 percent, resp. for levels of 70, 210, and 630 ppm. In the field, 100 kg N/ha resulted in increases of 27.8, 20.7, and 28.1 percent, resp. in total N, protein-N, and nonprotein-N contents when compared with check. N application increased lysine, cystine, and leucine contents and reduced that of valine, threonine, and met., while phenylalanine and isoleucine contents were not affected. (Author's summary)

0295

19848 McCLIFAN, P.E. 1982. Water stress effects on protein and yield traits in dry bean. Ph.D. Thesis. Fort Collins, Colorado State University. 89p. En., Sum. En., 79 Ref., II.

Phaseolus vulgaris. Seed. Irrigation. Analysis. Protein content. Water stress. Yields. Cultivars. Yield components. Flowering. USA.

Percent protein is usually higher in seeds from nonirrigated plants than seeds from fully-irrigated plants. An insight into the mechanism of this difference may provide the plant breeder with selection techniques for increased protein percentage. Three dry bean cv. (Olathe, UI 111, and Roza) were grown with full, half, and no irrigation during 1980 and 1981. Precipitation and irrigation provided 17 percent max. seasonal evapotranspiration (ET) for the nonirrigated plots, 38 percent for the half-irrigated plots, and 65 percent for the fully-irrigated plots. The 2-yr. mean for percentage protein was 28.7, 27.5, and 25.8 percent for nonirrigated, half-irrigated, and fully irrigated plots, resp. Seed compositional

analysis revealed that seed size was increased with each added increment of water. Significant cv. differences for percentage protein in the mature seed were observed. Calculating protein content on a per seed basis showed that each cv. had a characteristic quantity of protein that was independent of the irrigation treatment. The seed wt. increased with increasing soil moisture coupled with constant protein content resulted in a decreased percentage protein. Globulin I (G1) content was related to the seed protein content and was found to be constant for each cv. for all irrigation treatments. Correlation analysis and path coefficient analysis revealed that the relationships between yield and its components changed with added irrigation. The no. of pods/plant was highly correlated with yield within each water treatment. Seeds/pod, however, was highly correlated with yield within each water treatment. Seeds/pod, however, was highly correlated with yield for the nonirrigated and half irrigated plants but not for fully irrigated ones. Further, seeds/pod was the only yield component significantly correlated with selected ET parameters. This indicates that selecting for more seeds/pod may produce increased yields for plants grown with limited irrigation. A large negative correlation was found between percentage protein and yield. Yield was associated with percentage nonstructural carbohydrates. Delflowering treatments had no significant effect on yield or on the yield components. However, the fully delflowered treatments (flowers removed for 2 wk. during peak bloom period) resulted in an increase quantity of protein/seed. Since seed protein percentage did not increase, this data suggested that both protein and carbohydrate were utilized for deposition in seeds when the delflowering treatments were terminated. (Author's summary)

Enzymes

0296

1832 YOMO, H.; TAYLOR, M.P. Histochemical studies on protease formation in the cotyledons of germinating bean seeds. *Planta* 112:35-43. 1973. En., Sum. En., 15 Ref., II.

Phaseolus vulgaris. Cotyledons. Germination. Enzymes. Inhibitors. Seed. Proteins. Biochemistry

Protease formation in *Phaseolus vulgaris* cotyledons during seed germination was studied histochemically using a gelatin film substrate method. Protease activity was detected by this method on the 5th day of germination, at approx. the same time that a rapid increase of activity was observed by a test tube assay with casein as a substrate. At the early stage of germination, protease activity was observed throughout the cotyledon except in 2 or 3 cell layers below the cotyledon surface and in several cell layers around the vascular bundles. A highly active cell layer surrounding the protease inactive cells near the vascular bundles is suggested to be a source of the protease. (Author's summary)

0297

7940 BROWN, E.G.; AL-NAJAFI, T.; NEWTON, R.P. Partial purification of adenosine 3':5'-cyclic monophosphate phosphodiesterase from *Phaseolus vulgaris* L.: associated activator and inhibitors. *Biochemical Society Transactions* 3:393-395. 1975. En., 12 Ref.

Phaseolus vulgaris. Proteins. Enzymes. Seed. Ammonium sulphate. Analysis.

The enzyme cyclic AMP phosphodiesterase (CAPD) was isolated from bean tissue and some of its properties determined. CAPD was extracted from various plant parts and partially purified by dialysis. Mature dried seeds possess CAPD activity equivalent to 10.4 nmol of Pi released/min/g. Activity was also found in the shoot, root, and cotyledon of seedlings. Further purification of the crude CAPD was effected by centrifugation, ammonium sulfate precipitation and column chromatography on Sephadex G-200. Two peaks (I and II) exhibiting CAPS activity were obtained. During dialysis a diffusible

inhibitor, probably phosphate, was removed. The active material in peaks I and II had apparent mol. wt. of 3.37×10^5 and 8.12×10^3 , resp. Both activities required addition of Mg^{2+} and ammonium sulfate for full effect. Several substrates other than cyclic AMP were tested but were not as effective. Isoelectric-focusing studies of peaks I and II revealed the presence of several bands of protein in each. Only two of these bands in peak I exhibited CAPD activity. They had the sample pI values as two corresponding bands in peak II. (Summary by R.A.L.)

0298

27385 IOLAS, G.M.; MARKAKIS, P. 1977. The phytase of navy beans (*Phaseolus vulgaris*). *Journal of Food Science* 42(2):1094-1097, 1106. En., Sum. En., 24 Ref., II.

Phaseolus vulgaris. Enzymes. Bean flour. Hydrolysis. Human nutrition. USA.

The phytase of Sanilac navy beans was extracted with 2 percent $CaCl_2$ and purified by ammonium sulphate fractionation and diethylaminoethyl-cellulose chromatography. The enzyme showed an optimum pH of 5.3 and KM of 0.018 millimolar with phytic acid as substrate. The optimum temp. was 50 degrees Celsius. The activation energy of the enzymic hydrolysis of phytic acid was 11,500 calories/mole and the inactivation energy of the enzyme, 55,800 calories/mole. The purified phytase showed broad specificity. This enzyme may be described as a nonspecific phosphomonoesterase with phytase and potent pyrophosphatase activities. It was inhibited by high concn. of phytic acid. Phytase activity was increased by about 35 percent in the presence of 1 millimolar CO_2 . Soaking beans in distilled water did not affect their phytic acid content and phytase activity. Germination of the beans resulted in an increase in phytase activity and breakdown of phytic acid. (AS)

0299

29195 KERMASHA, S.; MITCHE, M. 1986. Characterization of seed lipoxygenase of *Phaseolus vulgaris* cv. Haricot. *Journal of Food Science* 51(5):1224-1227. En., Sum. En., 24 Ref., II. (Dept. of Food Science & Agricultural chemistry, MacDonald College of McGill Univ., 2111 Lakeshore Road, St. Anne de Bellevue, Quebec, Canada H9X 1C0)

Phaseolus vulgaris. Seeds. enzymes. Analysis. Ammonium sulphate. pH. Canada.

Phaseolus vulgaris cv. Haricot seed lipoxygenase was extracted and partially purified. The precipitation of an active lipoxygenase fraction with solid ammonium sulfate (at 20-50 percent of saturation) increased its activity by a factor of 3. The pH for optimum activity was 7.3. The addition of 40 millimolar potassium cyanide resulted in a doubling of the enzyme activity. enzyme activity was completely lost on storage at 4 degrees Celsius for 48 h. The activity of haricot lipoxygenase extract was considerably greater on linoleic acid than on its esters, and decreased in the order: mono- more than di- more than tri-linolen. The haricot lipoxygenase shares many of the characteristics of the corresponding enzyme found in several seed sources. (AS)

0300

29659 KERMASHA, S.; VAN DE VOORT, F.R.; MITCHE, M. 1986. Lipase activity and fatty acid composition in stored full-fat french bean flour. *Canadian Institute of Food Science and Technology Journal* 19(3):92-94. En., Sum. En., Fr., 14 Ref., II. (Dept. of Food Science & Agricultural Chemistry, MacDonald College, McGill Univ., 2111 Lakeshore Road, St. Anne de Bellevue, P.Q. H9X 1C0, Canada)

Phaseolus vulgaris. Snap beans. Bean flour. Storage. Temperature. Fatty acids. Organoleptic properties. Canada.

The production on free fatty acids due to lipase action in full-fat french bean flour may be closely related to the autoxidation of the lipid present, which has ramifications in terms of organoleptic quality. Lipase activity was determined in the succulent green

bean, freshly prepared mature bean flour, and flour stored for 2 yr at 4 degrees Celsius and was found to be 21, 42, and 125 X 10⁽⁻⁶⁾ microequivalents acid/mg protein/min, resp. The fatty acid profile of the mature bean flour was measured following storage at -18, 4, 20, and 35 degrees Celsius. The fatty acid profile of the bean flour did not change significantly in samples stored at -18 and 4 degrees Celsius; however, obvious changes took place in the samples stored at 20 and 35 degrees Celsius with a loss of long chain and the appearance of shorter chain fatty acids. The results indicated that lipase was active in the flour, increasing in activity with storage and that temp. above 4 degrees Celsius accelerated the process of lipolysis in full fat flour significantly, even at low moisture levels. The action of lipase could therefore be a significant factor in the development of off-flavors and odors by contributing free fatty acids which in turn are more readily oxidized. (AS)

OTHER NUTRIENTS

0301

22122 MITIMUNI, J.P. 1972. Proximate analysis of local feedstuffs. Lilongwe, Malawi, Bunda College of Agriculture. Research Bulletin no.3. pp. 68-69. En.

Phaseolus vulgaris. Seeds. Dry matter. Protein content. Fibre content. Ash. content. Mineral content. N. Malawi.

The results of chemical analyses of several feedstuffs used in Malawi are given in table form. A relatively small no. of samples was chosen and variation can be expected. The av. total composition of field beans is the following: 87.0 percent DM, 19.1 percent CP, 1.1 percent ether extract, 5.6 percent crude fiber, 4.6 percent ash, and 56.6 percent N-free extract. Other feedstuffs included were pigeon pea, soybean seed, maize, rice husks, *Leucaena* leaves, and *Stylosanthes gracilis*. (Summary by I.B.)

0302

1268 SEIFERT, R.M. Analysis of myo-inositol in dry beans by gas chromatography of its hexaacetate. *Journal of the Association of Official Analytical chemists* 55(6): 1194-1198. 1972. En., Sum. En., 11 Ref.

Phaseolus vulgaris. Analysis. Cooking. Biochemistry. Gas chromatography. Leaves. Vitamin content.

A method has been developed for the analysis of myo-inositol in California small white beans, pinto beans, and 2 pinto bean flake products by gas-liquid chromatography of myo-inositol hexaacetate. The identity of myo-inositol hexaacetate from bean samples was confirmed by mass spectrometry and chromatographic retention time. A standard curve prepared by plotting peak height vs. microgram myo-inositol hexaacetate was linear over the range studied, 0.2 to 0.6 microgram. Peak heights were measurable in all samples, although inositol hexaacetate was not completely separated in California small white bean samples. An internal standard, perisitol, was used to correct for losses in the procedure. Hydrolysis of phytin was negligible during sample preparation or analysis. Recoveries of 12 to 49 micrograms inositol from 40 mg samples of California small white beans averaged 113 percent. These beans contained an average of 71 ppm inositol compared to 215 ppm inositol in similarly prepared pinto beans. (Author's summary)

0303

22540 HABIB, F.G.K.; MAHRAN, G.H.; HILAL, S.H.; GABRIEL, G.N.; MORCOS, S.R. 1976. Phytochemical and nutritional studies on pigeon pea and kidney bean cultivated in Egypt. *Zeitschrift fur Ernahrungswissenschaft* 15(2):224-230. En., Sum. En., 36 Ref.

Phaseolus vulgaris. Seed. Biochemistry. Protein content. Carbohydrate content. Water content. Amino acids. Cooking. Human nutrition. Egypt.

Preliminary phytochemical screening of pigeon pea and kidney bean var. Guiza III established the presence of carbohydrates and/or glycosides, flavonoids, unsaturated sterols and/or triterpenes, saponins, trypsin inhibitors, and hemagglutinins. In addition, it established the absence of cardenolides, tannins, alkaloids, and oxidase enzyme. Certain pharmacopeial constants, including moisture, ash, acid-insoluble ash, water-soluble ash, and crude fiber, were determined. The 2 legumes were subjected to successive extractions with different organic solvents such as petroleum ether (50-70 degrees Celsius), diethyl ether, chloroform, and ethyl alcohol. The successive yields of extractives were determined. Examination of the crude extracts showed that petroleum ether extract contained sterols and/or triterpenes, while ether, chloroform, and ethyl alcohol extracts contained reducing substances. General analysis of the 2 seeds for proteins, fats, carbohydrates, fiber and ash contents were carried out and the results are given in g/100 g dry seeds. The protein content of kidney bean was 23 g, while Ca and Fe contents were 134 and 8.02 mg, resp. Extractions of the proteins using different solvents such as cold water, hot water, saline buffer pH 7, and sodium hydroxide pH 11 showed that sodium hydroxide was the best extractant. The amino acid content of the 2 legumes, whether raw or cooked, showed that they were deficient in met., cystine, and tryptophan. Other essential amino acids were present in amounts higher than that given by the FAO provisional pattern. Cooking the seeds by the popular method used in Egypt resulted in an increase in the amounts of the amino acids threonine, leucine, and isoleucine, while the other amino acids present remained unchanged or decreased. It was also observed that cooking the seeds destroys the trypsin inhibitors and hemagglutinins found in the 2 legumes. (Author's summary)

0304

16100 CHILLARD, J.; CHILLARD, P.; DELAGE, F. 1979. Etude qualitative et quantitative de la repartition des tocopherols dans les graines de legumineuses. (Study of the qualitative and quantitative distribution of tocopherols in leguminous seeds). *Plantes Medicinales et Phytotherapie* 13(4):278-291. Fr., Sum. Fr., En., 15 Ref., II.

Phaseolus vulgaris. Seed. Composition. Analysis. Chromatography. Identification.

In all 10 leguminous species tested the seeds contained alpha-tocopherol, gamma-tocopherol, and delta-tocopherol, and traces of epsilon-tocopherol in various ratios. Pea cv. Kelvedon Wonder, bean, and broad bean seeds contained the least total tocopherol (ca. 10 mg/100 g fresh wt.) but *Cereus siliquastrum* seeds contained the highest tocopherol level (60 mg/100 g fresh wt.). (Summary by Horticultural Abstracts)

0405

19454 AUGUSTIN, J.; BECK, C.B.; KALBEFISH, G.; KAGEL, L.C.; MATTHEWS, E.H. 1981. Variation in the vitamin and mineral content of raw and cooked commercial *Phaseolus vulgaris* classes. *Journal of Food Science* 46(6):1701-1706. En., Sum. En., 20 Ref.

Phaseolus vulgaris. Seed. Mineral content. P. Na. K. Ca. Mg. Zn. Mn. Cu. Fe. Vitamin content. USA.

Raw and cooked samples of 9 different commercial classes of *Phaseolus vulgaris* (Black Turtle, Cranberry, Great Northern, Navy, Dark Red Kidney, Pink, Pinto, small Red, and small White) were analyzed for their contents of 5 water-soluble vitamins and 9 minerals. On a 100 g dry wt. basis, the mean vitamin and mineral values of the raw bean samples were thiamin 0.99, riboflavin 0.20, niacin 1.99, vitamin B₆ 0.49, folic acid 0.30, P 460, Na 10.3, K 1540, Ca 150, Mg 200, Zn 3.2, Mn 1.4, Cu 0.91, and Fe 5.84 mg. Generally variations in these nutrients between classes exceeded those within classes and were greater in cooked than in raw samples. Av. retention of water-soluble vitamins during cooking ranged from 70 to 75 percent between classes. Least and most mineral retention

was Na 39 percent and Ca 100 percent with most minerals 80-90 percent. (Author's summary)

0306

20090 RODRIGUEZ, M.; RODRIGUEZ, F.; SUAREZ, A. 1982. Características morfológicas y composición química de las semillas de distintas variedades de judías (*Phaseolus vulgaris* L.) cultivadas en la Provincia de León. (Morphological characteristics and chemical composition of dry bean seeds grown in the Province of León, Spain). Anales de la Facultad de Veterinaria de León 28:131-146. Es., Sum. Es., En., 40 Ref., II. (Estación Agrícola Experimental (C.S.I.C.), Grulleros, León, España)

Phaseolus vulgaris. Seed. Seed characters. Seed color. Water content. Protein content. Ash content. Carbohydrate content. Mineral content. Ca. P. K. Na. Fe. Cu. Mn. Zn. Cultivars. Spain.

Morphological characteristics (color, drawings, form, and size), chemical composition (moisture, CP, ether, extract, ash, and carbohydrates), and mineral content (Ca, P, K, Na, Fe, Cu, Mn, and Zn) of seeds of 26 bean var. grown in the Province of León, Spain, were studied. White and colored var. were compared regarding their chemical composition and mineral content. (Author's summary)

0307

19077 ROBINSON, R.G. 1983. Yield and composition of field bean and adzuki bean in response to irrigation, compost, and nitrogen. Agronomy Journal 75(1):31-35. En., Sum. En., 19 Ref.

Phaseolus vulgaris. Irrigation. Dung. Fertilizers. N. Yields. Mineral content. Protein content. Nutritive value. Amino acids.

Field bean (*Phaseolus vulgaris*) and adzuki bean (*Vigna angularis*) were grown on Udorthentic Haploborolls, sandy, mixed soils in central Minnesota, USA, to measure the effects of irrigation, rhizobial inoculant, and N on seed yield, protein concn., and nutritive value. Main plot treatments were rainfall of 16-36 cm during June, July, and Aug. and rainfall + irrigation of 24-30 cm. Subplot treatments for field bean were untreated, compost at 3.6 MT/ha, rhizobia, inorganic N at 74-310 kg/ha, SBM at 112 kg N/ha, corn grits + inorganic N at 112 kg N/ha, and compost + inorganic N. Subplot treatments for adzuki bean were untreated, rhizobia, and inorganic N at 112 kg/ha. Seed harvested from the treatments was analyzed by standard methods for amino acids, N, P, K, S, Ca, mg, Fe, Zn, Mn, Al, B, Cu, Na, Mo, Ni, Pb, Cr, and Cd. Yield increases from irrigation ranged from 1198 to 1940 kg/ha. Yields from the subplot treatments differed significantly under irrigated but usually not under dryland treatment. Highest yields of field bean were obtained from compost + inorganic N. The effect of compost on seed yield and quality was equivalent to that of 74-112 kg/ha of inorganic N fertilizer. SBM, corn grits + N, and N fertilizer treatments at equal rates of N did not differ in field bean yield or protein percentage. Irrigation resulted in low-protein bean seed but compost and/or inorganic N at high rates usually maintained protein at acceptable levels. Amino acid composition of bean protein was not significantly affected by irrigation or other treatments. Bean seed from dryland plots was superior to seed from irrigated plots in protein and Zn concn. N to protein conversion factors among treatments ranged from 6.19 to 6.26 for field bean and from 6.06 to 6.24 for adzuki bean. (Author's summary)

0308

29611 WILLS, R.B.H.; EVANS, T.J.; LIM, J.S.K.; SCRIVEN, F.M.; GREENFIELD, H. 1984. Composition of Australian foods. 25. Peas and beans. Food Technology in Australia 36(11):512-514. En., Sum. En., 10 Ref. (School of Food Technology, The Univ. of New South Wales, P.O. Box 1, Kensington, NSW 2033, Australia)

Phaseolus vulgaris. Seeds. Cooking. Water content. Protein content. Fat content. Sugar content. Starch content. Fiber content. Ash content. Mineral content. K. Na. Ca. Mg. Fe. Zn. Vitamin content. Australia.

Fresh peas and beans were analyzed raw and cooked (boiled in water) for water, protein, fat, sugars, starch, dietary fiber, organic acids, ash, K, Na, Ca, Mg, Fe, Zn, vitamin C, thiamin, riboflavin, niacin, and carotenes. The energy content was also calculated. Frozen, canned, and dried peas and beans and a multiprocessed canned dried pea product were analyzed as purchased for water protein, and vitamin C, and after cooking for the full range of nutrients except for organic acids. Results are included in table form. (AS)

0309

26287 SATHE, S.K.; DESHPANDE, S.S.; SALUNKHE, D.K. 1984. Dry beans of *Phaseolus*. A review. 2. Chemical composition: carbohydrates, fiber, minerals, vitamins, and lipids. *Critical Reviews in Food Science and Nutrition* 21(1):41-93. En., 463 Ref., II. (Dept. of Nutrition & Food Science, Muscle Biology Group, Univ. of Arizona, Tucson, AZ, USA)

Carbohydrate content. Cultivars. Digestibility. Fatty acids. Fiber content. Mineral content. *Phaseolus vulgaris*. Proteins. Seed. Starch content. USA. Vitamin content.

An extensive bibliographic review on the current status of research on the chemical composition of dry bean carbohydrates is presented. Isolation techniques, size, shape, and appearance of starch granules, amylose content, granule crystalline characteristics, mol. structure analyzed by debranching enzymes, gelatinization temp. and pasting properties, and functional properties such as swelling and solubilization are indicated. Investigations on the oligosaccharides of the raffinose family, carbohydrates as crude fiber, and pectic substances that affect bean cooking quality are reviewed. The digestibility of carbohydrates, BV, NPU, and the influence of starch content on the digestibility of proteins are taken into account, as well as some aspects of the alpha amylase inhibitors. The investigations on the bean fiber content show important nutritional implications in human nutrition such as its possible influence on the protection against atherosclerosis and certain venous diseases. Studies on mineral content of bean seed such as Ca, Fe, Cu, Zn, P, K, Na, Mn, and Mg, and the content of the other substances as phytic acid, oxalic acid, and polyphenols that form complex substances which prevent the mineral absorption by the organism are reviewed. The vitamin contents of beans such as Ayocote, Bayo Gordo, Red Kidney, Small White, Great Northern, Pinto, and even other species as *Phaseolus lunatus*, *P. limensis*, and *P. aureus*, are presented and compared. Lipids are included in this review. (CIAT)

0310

27423 BENSHIMR, A., L.; STEIN, R.L. DE; MARQUEZ, C.G.; JAFFE, W.G. 1985. El valor bioquímico y nutricional de las semillas del haba de lima (*Phaseolus lunatus*) en comparación con las del frijol común (*Phaseolus vulgaris*). (Biochemical and nutritional value of lima bean seeds as compared to those of common beans). *Archivos Latinoamericanos de Nutrición* 35(1):70-79. Es., Sum. Es., En., 18 Ref. (Escuela de Biología de la Facultad de Ciencias, Univ. Central de Venezuela, Apartado Postal 2101, Caracas 1020, Venezuela)

Phaseolus vulgaris. Antinutritional factor. Water content. Fat content. Fiber content. Ash content. Mineral content. Amino acids. Vitamin content. Nutritive value. Animal nutrition.

Nutrient composition and antinutritional factors, digestibility, and growth were compared in rats fed diets prepared with a black cv. of *Phaseolus vulgaris*, Tacarigua, and a black cv. of *P. lunatus*, Tapiramo. Cooked grains from both cv. are similar in appearance, taste, nutritional value, and acceptability. Protein and P contents were greater in *P. vulgaris* than in *P. lunatus* seeds. The chemical score and availability of lysine were greater for *P. lunatus*. Diets prepared with raw *P. lunatus* were nontoxic for the rats

during a 12-day feeding period. All rats fed with raw *P. vulgaris* died in the same period of time. Protein efficiency was better with cooked *P. lunatus*. The production of cv. Tapiramo is recommended for self-consumption by small farmers. (AS)

0311

28815 VIEIRA, R.F. 1986. Influência de teores de fósforo solo sobre a composição química, qualidade fisiológica e desempenho no campo de sementes de feijão (*Phaseolus vulgaris* L.). (The influence of soil phosphorus levels on bean seed chemical composition, physiological quality, and field performance). *Revista Ceres* 33(186):173-188. Pt., Sum. Pt., En., 27 Ref., Il. (Depto. de Fitotecnia da Univ. Federal de Vicosa, 36.570 Vicosa-MG, Brasil)

Phaseolus vulgaris. Cultivars. Seeds. Fertilizers. P. Germination. Seed vigor. Rainfall. Mineral content. N. K. Ca. Mg. Zn. Yields. Yield components. Brazil.

Seeds from 2 bean cv., produced in soils with 2, 15, and 36 ppm P (seeds P1, P2, and P3, resp.), were submitted to germination and vigor tests and chemically analyzed for N, P, K, Ca, Mg, and Zn. They were also included in 2 yield trials in the field (Goiania, Brazil) during the rainy and dry seasons. In these trials the treatments included 2 bean cv. (PIA 7419 and Rio Tibagi), 3 seed origins (P1, P2, and P3), and 2 fertilization levels (0-30-0 and 30-100-60 kg NPK/ha). Seed origins did not affect their germination; however, seeds from soil with a larger amount of P yielded more vigorous and heavier seeds. Increasing amounts of P in the soil increased the P, Mg, and Zn levels and decreased the percentage of N in the seed. In the dry season trial, the stand was lower with P1 seeds, but the plants produced more pods/plant and seeds/pod, so that the final yield was not affected. In the rainy season trial with the higher level of fertilization, seeds P2 and P3 of cv. PIA 7419 yielded more than seeds P1. (AS)

ANTINUTRITIONAL ASPECTS

GENERAL

0312

10175 KAKADE, M.L.; EVANS, R.J. Growth inhibition of rats fed raw navy beans (*Phaseolus vulgaris*). *Journal of Nutrition* 90(2):191-198. 1966. En., Sum. En., 21 Ref., Il.

Phaseolus vulgaris. Laboratory animals. Inhibitors. N. Amino acids. Diets. Hydrolysis. USA.

Growth inhibition of rats fed raw navy beans and the action of antibiotics in overcoming it were investigated. The growth inhibitory action of a navy bean fraction isolated by NaCl extraction and precipitation by 0.75 ammonium sulfate saturation was also studied. More N and more of 5 amino acids studied were excreted in the feces of rats fed raw navy beans than in the feces of rats fed heated beans. Nitrogen and amino acid retention in the animals was increased by feeding antibiotics. The intestinal contents of rats fed raw navy beans contained more insoluble N, protein N, and amine N, and these were not changed by supplementation with antibiotics. Proteolytic activity in the intestine of animals receiving raw navy beans was similar to that of those receiving heated navy beans. Increased insoluble matter and proteolytic activity in the cecum and increased size of the cecum of rats receiving antibiotics suggest that this may be the site of antibiotic action. No significant effect on N or amino acid absorption due to the inclusion of the navy bean fraction in the diet was observed. Growth inhibition of rats fed raw navy beans may, in part, be the result of endogenous loss of N and impaired absorption of amino acids. (Author's summary)

20831 DESHPANDE, S.S.; SATHI, S.K.; SLAUNKHE, D.K.; CORNFORTH, D.P. 1982. Effects of dehulling on phytic acid, polyphenols, and enzyme inhibitors of dry beans (*Phaseolus vulgaris* L.). *Journal of Food Science* 47(6):1846-1850. En., Sum. En., 65 Ref. (Dept. of Food Sci., Univ. of Illinois, Urbana, IL 61801, USA)

Cultivars. Enzymes. Inhibitors. Digestibility. Proteins. USA. Phenol content. Composition. Dietary value. North America. America.

The effect of seed coat removal on certain antinutritional factors (phytic acid; trypsin, chymotrypsin, and alpha-amylase activities; and tannins) of 10 dry bean cv. (Sanilac, Great Northern, Small white, Cranberry, Viva Pink, Pinto, Light Red Kidney, Dark red Kidney, Small Red, and Black Beauty) commonly grown in the USA, were determined. Phytic acid content of whole beans ranged from 1.16 to 2.93 percent. Dehulling significantly increased the phytic acid content of beans (1.63-3.67 percent). Dehulling also increased trypsin, chymotrypsin, and alpha-amylase inhibitory activities of the beans. Tannin contents of whole and dehulled beans ranged from 33.7 to 282.8 and from 10.0 to 28.7 mg catechin equivalents/100 g beans, resp. Removal of seed coats lowered the tannin content of beans by 68-95 percent. Tannins were not detected in white-seeded cv. of Sanilac, Great Northern, and Small White. Dehulling significantly improved the *in vitro* digestibility of bean proteins. (AS)

21048 FUKUDA, G.; ELIAS, L.G.; BRESSANI, R. 1982. Significado de algunos factores antiñisiológicos y nutricionales en la evaluación biológica de diferentes cultivares de frijol común (*Phaseolus* sp.). (Significance of some antiphsyiological and nutritional factors in the biological evaluation of different bean cultivars). *Archivos Latinoamericanos de Nutrición* 32(4):945-960. Es., Sum. Es., En., 24 Ref. (Inst. de Nutrición de Centro América y Panamá, Guatemala, Guatemala)

Phaseolus vulgaris. Cultivars. Diets. Animal nutrition. Proteins. Nutritive value. Digestibility. Guatemala.

Groups of 8 Wistar rats 21-23 days old were given for 28 days one of 35 diets with 10 percent protein supplied by different var. of *Phaseolus vulgaris* or *P. coccineus* so that cooked beans supplied 100, 75, 50, 25, or 0 percent and raw beans 0, 25, 50, 75, and 100 percent of the protein, resp. Met. 0.3 percent was added to some of the diets. Wt. gain:protein intake ratio increased and mortality decreased as the proportion of raw beans in the diet decreased. Met. had no effect in diets with high proportions of raw beans but increased biological response to diets with high proportions of cooked beans. In diets with high proportions of cooked beans, digestibility was greater for white than for black or red beans. Antiphsyiological factors were destroyed by heat. It is concluded that the low nutritive value of cooked beans was the result of a deficiency in S-containing amino acids. (Summary by Nutrition Abstracts and Reviews) 1101

19057 MYER, R.O.; FROSETH, J.A.; COON, C.N. 1982. Protein utilization and toxic effects of raw beans (*Phaseolus vulgaris*) for young pigs. *Journal of Animal Science* 55(5):1087-1098. En., Sum. En., 52 Ref.

Phaseolus vulgaris. Animal nutrition. Diets. Digestibility. Amino acids. Nutritive value. Tannin content. Trypsin.

One balance trial and 2 pair-feeding expt. were made to determine the effects of raw small red beans on young pigs. In the balance trial, the substitution of 5 and 15 percent raw beans for SBM and maize starch in the semipurified diet depressed apparent digestibilities of CP, total S, and all individual amino acids measured. Urinary excretion of N and sulfate was increased and N retention was decreased. Pigs given a semipurified diet with

15 percent raw beans in one pair-feeding trial gained less and had slightly larger livers and slightly smaller spleens than did pigs given the control diet without raw beans. There was no difference in pancreas size as a percentage of body wt.; pancreatic trypsin, chymotrypsin, and amylase activities were lower in pigs given raw beans. Pigs given raw beans also had higher serum urea and lower albumin concn. and higher alkaline phosphatase activities and plasma Zn concn. Pigs given raw beans had a higher total leukocyte count, primarily because of an increase in neutrophils; eosinophil no. were depressed. Similar results were obtained in the other pair-feeding trial with pigs given a diet of maize and SBM without or with 15 percent raw beans; leukocyte no. and differential counts were affected only slightly by the feeding of raw beans. Size of pancreas of pigs given raw beans was decreased. The feeding of raw red beans decreased protein digestibility and appeared to interfere with systemic protein utilization. (Author's summary)

0316

29129 THORN, K.A.; TINSLEY, A.M.; WEBER, C.W.; BERRY, J.W. 1983. Antinutritional factors in legumes of the Sonoran desert. *Ecology of Food and Nutrition* 13(4):251-258. En., Sum. En., 17 Ref. (Dept. of Nutrition & Food Science, Univ. of Arizona, Tucson, AZ. 85721, USA)

Phaseolus vulgaris. *Phaseolus acutifolius*. Antinutritional factors. Lectins. Trypsin. Nutritive value. Laboratory animals. USA.

Ten samples of legumes indigenous to the Sonoran desert (*Phaseolus acutifolius* var. *Latifolius*, *Phaseolus vulgaris*, *Lysiloma watsonii*, and *Parkinsonia aculeata*) were analyzed for antinutritional factors: flatulent oligosaccharides, trypsin inhibitors, lectins, phytic acid, and cyanogenic glycosides. The raffinose and stachyose contents of the beans ranged from 0 to 3.57 percent and from 0 to 5.45 percent, resp. The TIA ranged from 2.3 to 60.4 trypsin inhibitor units/mg; heat treatment decreased TIA from 0 to 97 percent. Phytic acid ranged from 0.48 to 1.02 percent. Cyanogenic glycosides were not detected in any of the samples. Lectin extracts from all of the legume samples agglutinated rabbit, hamster, and bovine red blood cells. Reduction of hemagglutinating activity upon heat treatment ranged from 0 to 100 percent. (AS)

0317

28963 DESHPANDE, S.S.; SATHE, S.K.; SALUNKHE, D.K. 1984. Dry beans of *Phaseolus*: a review. Part 3. *Critical Reviews in Food Science and Nutrition* 21(2):137-195. En., 463 Ref., II. (Dept. of Food Science, Univ. of Illinois, Urbana, IL, USA)

Phaseolus vulgaris. Processing. Timing. Nutritive value. Antinutritional factors. Human nutrition.

A comprehensive literature review on the different aspects of dry bean processing is given: time required for preparation, effects of processing on the nutritional quality, and miscellaneous processing methods for eliminating some antinutritional factors (extraction, enzymatic methods, irradiation, membrane filtration, precipitation, anion exchange, or certain specific chemical treatments). The different current uses given to beans and the production of protein concentrates and isolates are also analyzed. (CIAT)

0318

26084 SATHE, S.K.; SALUNKHE, D.K. 1984. Technology of removal of unwanted components of dry beans. *CRC Critical Reviews in Food Science and Nutrition* 21(3):263-287. En., 165 Ref. (Dept. of Nutrition & Food Science, Univ. of Arizona, Tucson, AZ. 85721, USA)

Analysis. Human nutrition. Inhibitors. Lectins. *Phaseolus vulgaris*. Phytoalexins. USA.

The effects of the following unwanted components of beans are discussed: enzyme inhibitors, lectins, phytates, raffinose, oligosaccharides, polyphenolics, off-flavors, goitrogens, lathyrism, favism, phytoalexins, allergens, saponins, estrogens, antivitamin, lysinoalanine, and amino acid racemization. The technologies used to remove these components are reviewed, namely soaking, cooking, germination, fermentation, extraction, enzymatic methods, irradiation, and membrane filtration. (Food Science and Technology Abstracts)

0319

27485 LAGRECA, L. 1976. *Phaseolus vulgaris* (poroto com' ún): sus características y toxicidad (*Phaseolus vulgaris*: its characteristics and toxicity). *Gaceta Agronómica* 6(29):44-49. Es., Sum. Es., En. (Facultad de Ciencias Veterinarias, Univ. Nacional de la Planta, Argentina)

Phaseolus vulgaris. Cultivation. Yields. Intercropping. Nutritive value. Argentina.

The following aspects of bean cultivation in Argentina are briefly described: identification and geographical location, climatic requirements, av. yields, intercropping systems, nutritive value, toxicity, and trials with animals. (CIAT)

ENZYME INHIBITORS

0320

2684 HERNANDEZ, A.; JAFFE, W.C. Inhibidor de la amilasa pancreática en caraotas (*Phaseolus vulgaris*). (An inhibitor of pancreatic amylase from beans). *Acta Científica Venezolana* 19(5):183-185. 1968. Es., Sum. Es., En., 9 Ref., II.

Phaseolus vulgaris. Enzymes. Diets. Pancreatic amylase. Inhibitors. Analysis.

Aqueous extracts from beans (*Phaseolus vulgaris* var. Cubagua) contain an inhibitor of pancreatic amylase, which can be purified partially by heating to 60 degrees Celsius at pH 4. Incubation of enzyme and inhibitor for 2 h is required to attain complete inhibition. The factor is destroyed by heating to 100 degrees Celsius for 15 min, it is nondialyzable and not retained by Sephadex G-75. Inhibition is noncompetitive. (Author's summary)

0321

2828 JAFFE, W.G. Factores tóxicos en leguminosas. (Toxic factors in legumes). *Archivos Venezolanos de Nutrición* 17(3):205-218. 1968. Es., Sum. Es., En., 67 Ref.

Phaseolus vulgaris. Enzymes. Pancreatic amylases. Toxicity. Seeds. Diets. Legume crops. Animal nutrition. Physiology. Biochemistry. Inhibitors. Phytohemagglutinins.

Data on the physiological action of trypsin inhibitors and other enzyme inhibitors from legumes, especially kidney beans (*Phaseolus vulgaris*) and soybeans are presented and their possible toxic action is discussed. Their importance as causative agents of the toxicity of the legume seeds is probably small. Other enzyme inhibitors may be present but their physiological importance is unknown. Phytohemagglutinins are found in many legumes, and the toxicity of some has been demonstrated. Toxic agglutinins may interfere with intestinal absorption. The toxicity of crude legumes is probably caused by a combination of several factors. (Author's summary)

0322

28943 PUSZTAI, A. 1972. Metabolism of trypsin-inhibitory proteins in the germinating seeds of kidney bean (*Phaseolus vulgaris*). *Planta* 107(2):121-129. En., Sum. En., 38 Ref., II.

Phaseolus vulgaris. Seeds. Proteins. Trypsin. Germination. Metabolism. Analysis. Laboratory experiments. United Kingdom.

Several proteins with TIA were separated by isoelectric focusing and their amounts measured in the extracts of kidney bean seeds at various stages of germination up to 16 days. The total trypsin inhibitor content of the dormant seed was 2.2 mg/g bean, rose to about 3.6 mg by the 7th day, and declined slowly after the 10th day of germination. The individual trypsin inhibitors, however, appeared to change independently of each other and some components disappeared almost completely with the progress of germination. The emergence of an inhibitor not found in the dormant seed was also observed. Some of the inhibitor proteins attained a max. concn. by the 7th-8th day of germination, coinciding with a similar max. in the general protein and proteolytic enzyme content of the germinating bean seeds. The results suggested that the main function during germination of these protein components might not be related to their TIA. (AS)

0323

10180 . . . LIMER, R.; McINTOSH, A.; PUSZTAI, A. The nutritional evaluation of kidney beans (*Phaseolus vulgaris*); the effect of nutritional value of seed germination and changes in trypsin inhibitor content. *Journal of the Science of Food and Agriculture* 24(7/9):937-944, 1973. En., Sum. En., 30 Ref.

Phaseolus vulgaris. Nutritive value. N. Germination. Laboratory animals. Diets. Seed. Dry matter. Amino acids. Analysis.

The total N content of kidney beans was found to increase on germination. The overall amino acid composition however changed very little. Rats fed on a diet containing raw beans lost more wt. than the protein-free controls (negative NPU value). Germination was found to bring about a gradual improvement in nutritive value, probably through the elimination of some of the toxic constituents of the seed. The near doubling of the amount of trypsin inhibitors by the 8th day of germination, taken together with the substantial improvement in the nutritive value of the bean, appeared to rule out trypsin inhibitors as the main toxic components of raw beans. (Author's summary)

0324

14740 WILSON, K.A. Studies on the trypsin inhibitors of the garden bean, *Phaseolus vulgaris*. Ph.D. Thesis. Amherst, N.Y. State University of New York at Buffalo, 1973. 199p. En., Sum. En., 145 Ref., 11.

Phaseolus vulgaris. Enzymes. Trypsin. Inhibitors. Proteins. Amino acids. Composition. Analysis. pH. Plant physiology. Germination. Plant development. Laboratory experiments.

Three iso-inhibitors of trypsin have been isolated from the garden bean in a highly purified state as indicated by disc gel electrophoresis, equilibrium chromatography, and amino acid analysis. The amino acid composition is characterized by the absence of free sulfhydryl groups, with half-cystine (14), and absence of met. in iso-inhibitors II and IIIb. Isoinhibitor I contains 74, II - 79, and IIIb - 81 amino acid residues. Isoinhibitor I has lysine in the reactive site, while isoinhibitor II has arginine. Isoinhibitor II is significantly displaced from the trypsin complex by 1 mM substrate; isoinhibitors I and IIIb are not. I and II inhibit alpha-chymotrypsin weakly (0.2 units/mg). Isoinhibitor IIIb inhibits strongly (2.87 units/mg) and has an independent site for each enzyme: trypsin and chymotrypsin. The partial sequence of isoinhibitor II is reported. A high degree of homology is noted with lima bean trypsin inhibitor IV and Bowman-Birk soybean trypsin inhibitor. (Author's summary)

7222 GALLARDO, F. et al. Factores tóxicos de leguminosas cultivadas en Chile. II. Inhibidor de tripsina. (Toxic factors in Chilean legumes. II. Trypsin inhibitor activity). *Archives Latinoamericanas de Nutrición* 24(2):183-189. 1974. Es., Sum. Es., En., 13 Ref.

Phaseolus vulgaris. Inhibitors. Toxicity. Legume crops. Seed. Human nutrition. Enzymes.

An analysis was made of trypsin inhibitor activity in the following legume seeds grown in Chile: *Phaseolus vulgaris* var. Tórtola, Coscorrón, Zeus; *Vicia faba*; *Pisum sativum*; *Lens esculenta*; *Cicer arietinum*; *Lathyrus sativus*; *Glycine max*; *Lupinus albus*; *L. luteus*; and *Prosopis tamarugo*. Highest activity was found in soybeans (28.39 units/mg of defatted dry sample). *Lathyrus sativus* and all the *Phaseolus* cv. studied also showed high activity. Cooking eliminated almost all inhibitor activity. When oven dried only, there was partial inactivation; more positive results were obtained when the materials had been soaked for 14 h. (Author's summary)

14731 HWANG, D.I.-R. Isolation and characterization of growth inhibitors from Great Northern beans. Ph.D. Thesis. Lincoln, The University of Nebraska, 1975. 67p. En., Sum. En., 109 Ref., 11.

Phaseolus vulgaris. Plant-growth substances. Inhibitors. Growth. Protein content. Carbohydrate content. Nutritive value. Heat treatment. Analysis. Laboratory experiments.

Growth inhibition factors other than trypsin inhibitors and hemagglutinins have been isolated and characterized from the protein portion of the *Phaseolus vulgaris* var. Greater Northern beans. Three components of the growth inhibition factors were fractionated from a Sephadex G-75 gel filtration column. The approx. mol. wt. of each component was 58,000, 12,000, and 7200, resp. The carbohydrate content was 48.6, 25.8, and 14.9 percent while the protein was 50.00, 71.56, and 71.25 percent of each of the resp. components. Only the 3rd component showed high trypsin inhibitor activity. The trypsin inhibitor activity of this fraction was less than 25 percent of the activity of commercial trypsin inhibitors. No pancreatic enlargement or hyperplasia was observed when each of these three fractions was fed to rats at a 1 percent level. The hemagglutinating activity of all 3 components was zero to negligible. Based on the PER, inclusion of each of the above components at a level of 1 percent in the diet of rats produced growth retardation by 35.2, 50.7, and 41.5 percent. (Summary by Dissertation Abstracts International)

14757 I.O, T.N. Partial characterization of a navy bean esteroprotease inhibitor and its use in the study of the fragmentation of fibrinogen by trypsin. Ph.D. Thesis, Bloomington, Indiana University, 1974. 172p. En., Sum. En., 137 Ref., 11.

Phaseolus vulgaris. Inhibitors. Enzymes. Proteins. Amino acids. Trypsin. Plant toxins. Dietary value. Human nutrition. Animal nutrition.

A proteinase inhibitor, isolated from the navy beans, was shown to inhibit human plasmin as well as bovine trypsin and chymotrypsin but it failed to inhibit bovine thrombin, bovine plasmin, bacterial plasmin and human urokinase. Bovine trypsin, plasmin, and thrombin are serine esteroproteases capable of catalyzing the hydrolysis of amino acid esters containing side chains of lysine or arginine; yet they interacted differently with the navy bean inhibitor (NBI). Selected proteinase inhibitors may serve as tools for the differentiation and study of closely related enzymes. Since the NBI inhibited human plasmin but not bovine plasmin, this again indicates the need for caution in extrapolating results obtained with an enzyme system of a given species to the counterpart system of another species. Although the NBI is an esteroprotease inhibitor it did not inhibit the serine esterases, bovine erythrocyte acetylcholinesterase and horse serum

colinesterase. Negative results were also obtained with other esteroprotease inhibitors including the Bowman-Birk inhibitor of soybeans and the Kazal pancreatic trypsin inhibitor. Other proteins of navy beans obtained by complete ammonium sulfate fractionation also failed to inhibit the 2 esterases. SDS-gel electrophoretic analysis revealed that tryptic digestion of the alpha (A) chains of the fibrogen preceded that of beta (B) chains. The gamma chains survived 2 h digestion at a trypsin:fibrinogen M ratio of 0.01. The latter chains might have resided in tightly packed structure that was less accessible to trypsin whereas the alpha (A) chains, and to a lesser extent, the beta (B) chains appeared to be more highly exposed. Progressive fragmentation of the fibrinogen correlated with impairment of clottability. Two h fragmentation by trypsin resulted in a non-clottable product. However, if trypsin was preincubated with the NBI at pH 7.05 prior to the addition of fibrinogen buffered at pH 7.05, the clot interfering action of trypsin was inhibited; the protective action of the NBI on clotting was less effective if the preincubation pH was lowered to 3. Nevertheless, the pH 3 preincubation mixture, when incubated for 2 h with a fibrinogen solution buffered at pH 7.05, maintained sufficient structural integrity of fibrinogen for proper clotting. Presumably, peptide bonds that participated in the functional activity of this biologically important protein was protected from hydrolysis by the inhibitors. In view of the above clotting results, it was of particular interest to find that the fragmentation pattern obtained with a pH 3 preincubation mixture of trypsin and inhibitor differed from the pattern obtained with pH 7.05 preincubation. The fragmentation patterns were studied by means of SDS gel electrophoresis. These results are in keeping with those of Bowman who found that preincubation at pH 3 produced an inhibitor with less potent activity and altered electrophoretic mobility. Controlling mechanisms beyond protein synthesis are believed to be involved in dynamic processes such as blood coagulation and fibrinolysis. Protease inhibitors may play important roles in the regulation of these processes. (Author's summary)

0328

14275 SEIDL, D.S.; ABREU, H.; JAFFE, W.G. Purification of a subtilisin inhibitor from black bean seeds. FEBS Letters 92(2):245-250, 1978. En., 17 Ref., B.

Phaseolus vulgaris. Human nutrition. Inhibitors. Enzymes. Proteins. Laboratory experiments. Venezuela.

The method of purifying of a low mol. wt. protein which inhibits subtilisin (SI), until it reaches electrophoretic homogeneity, and its properties are described. The process of purification consisted in preparing an extract which was precipitated by acetone, chromatography on a DEAE-Sephadex A-25 column, and on a Sephadex G-75 column. Purification obtained was 800 fold and the extractable inhibitor content represented about 0.006 percent of seed dry wt. In contrast with some other inhibitors of subtilisin, SI does not possess inhibitor activity against either trypsin or chymotrypsin. It does not inhibit elastase, pepsin, papain, or ficin. The specificity spectrum of SI is restricted to subtilisin and pronase. (Summary by I.B. Trans. by L.M.F.)

0329

23971 OCHETIM, S.; BOGERE, C. 1979. Trypsin inhibitors and phytohaem-agglutinin activities in raw and autoclaved beans and peas consumed in Kenya. East African Agricultural and Forestry Journal 44(4):352-354. En., Sum. En., 12 Ref. (Dept. of Animal Production, Faculty of Veterinary Medicine, Univ. of Nairobi, P.O. Box 29053, Kabete, Kenya)

Seed. Processing. Phytohemagglutinins. Analysis. Composition. Nutritive value. Kenya. Human nutrition. Africa.

Four types of common beans (Mwezi Moja, Mexican 142, Rose Coco, and Canadian Wonder), cowpea, and pigeon pea grown in Kenya were analyzed for TIA and phytohemagglutinin activity (PA) either fresh or after autoclaving at 121 degrees Celsius, 30 min, 103 kpa. Raw beans had TIA of 24.3-45.1 ml falling to 7.0-14.8 ml after autoclaving; the other 2 species had corresponding values of 12.8-21.7 and 9.7-11.0 PA

values (per ml) were correspondingly 114-17,066 (raw) and 0 (autoclaved) and 2.5-9.8 (raw) and 0 (autoclaved). (Food Science and Technology Abstracts)

0330

17778 ORTEGA D., M.L.; RUIZ, G., J.L. 1979. Efecto térmico en las globulinas de frijol negro Mecentral (*Phaseolus vulgaris* L.). (Heat effect on globulins of Mecentral black beans). *Agrociencia* 37:3-15. Es., Sum. Es., En., 23 Ref., II.

Phaseolus vulgaris. Proteins. Toxicity. Cooking. Heat treatment. pH. Nutritive value. Mexico.

The effects of pH and heat denaturation were studied in the globulin fraction of seeds of Mecentral black beans. This protein consists of 4 major components: alpha, beta, gamma, and delta, with different electrophoretic mobility. The electrophoretic pattern remained constant between pH 6.0-10.6; at pH 12.5 the alpha and beta bands were diffused and at pH 13.5 one single band was formed. The heat effect (93 degrees Celsius) on dissolved globulins at different pH values and different times of heating was observed. At pH 6.0 there was a slight reduction of alpha and beta fractions; where as at pH 7.6 there was a 90 percent reduction of the alpha fraction in only 20 min of heating. The beta fraction was resistant to the thermic effect. The denaturation was greater when the pH of the solution or the time of heating increased. A reduction of solubility was also observed. At pH 13.5 there was a partial hydrolysis and irreversible denaturation of proteins. heat effects at pH 6.0 and 7.6 in relation to digestibility are discussed. (Author's summary)

0331

27435 ELLENRIEDER, G.; GERONAZZO, H.; BOJARSKI, A.B. DE 1980. Thermal inactivation of trypsin inhibitors in aqueous extracts of soybeans, peanuts, and kidney beans: presence of substances that accelerate inactivation. *Cereal Chemistry* 57(1):25-27. En., Sum. En., 14 Ref., II.

Phaseolus vulgaris. Antinutritional factors. Analysis. Bean flour. Argentina.

Thermal inactivation of trypsin inhibitors in aqueous suspensions and centrifuged water extracts of dehulled and defatted soybean and peanut flours and of flours prepared from whole kidney beans depended on concn. Thermal stability (after heating at 96 degrees Celsius for 15 min) of TIA was greatly increased when these aqueous suspensions and extracts were diluted. High mol. wt. components, separated from soybean extracts by gel filtration on Sephadex G-75, accelerated thermal destruction of TIA in purified inhibitor preparations. (AS)

0332

16090 FERNANDEZ, R.; ELIAS, L.G.; BRESSANI, R. 1981. Variabilidad genética y ambiental en inhibidores de tripsina y hemaglutininas, observadas en cultivares de frijol común (*Phaseolus vulgaris*) provenientes de Centroamérica y Colombia. (Genetic and environmental variability of trypsin inhibitors and hemagglutinin, observed in common bean cultivars from Central America and Colombia). *Turrialba* 31(2):153-161. Es., Sum. En., Es., 21 Ref., II.

Phaseolus vulgaris. Cultivars. Seed color. Toxicity. Ecology. Digestibility. Amino acids. Human nutrition. Central America.

The effects of environment and the color of seed coat on the concn. of trypsin inhibitors and hemagglutinin compounds in bean seeds were studied. A total of 20 cv. obtained from the Centro Internacional de Agricultura Tropical, Colombia was planted at the same time in Colombia, El Salvador, and Honduras. These samples were then sent to the Instituto de Nutrición de Centro America y Panamá (INCAP), Guatemala and were classified into 4 color types: black, white, red, and brown. Samples were analyzed for

trypsin inhibitors and hemagglutinin compounds and the results were statistically analyzed through a factorial analysis of variance. This indicated a significant effect of environment on trypsin inhibitors (P equal to or less than 0.05), with samples from Honduras having higher concn. than those from the other localities. Seed color and the interaction between environment and color had not effect on TIA. The concn. of hemagglutinin activity was significantly affected by environment, with samples from Honduras having lower activities than those from the other localities. In this case, seed color influenced statistically the activity of hemagglutinin compounds with values for color seed higher than those found in white seeds. The interaction between environment and color did not affect hemagglutinin content in the seed. TIA was highly correlated with met. concn. Because of this, it would be of practical interest to determine the influence of specific environmental factors on TIA such as water availability and mineral composition of the soil. (Author's summary)

0333

22946 DESHPANDE, S.S.; CHERYAN, M. 1983. Changes in phytic acid, tannins, and trypsin inhibitory activity on soaking of dry beans (*Phaseolus vulgaris* L.). Nutrition Reports International 27(2):371-377. En., Sum. En., 16 Ref. (Dept. of Food Science, Univ. of Illinois, Urbana, IL 61801, USA)

Phaseolus vulgaris. Cooking. Human nutrition. Nutritive value. Phenolic content. Cultivars. Nutrient loss. USA.

Changes in phytic acid, tannins, and TIA of 4 dry bean cv. (Pinto, Sanilac, Cranberry, and Viva Pink) on soaking in distilled water, sodium bicarbonate, and a mixed salt solution were investigated. A greater reduction in the antinutritional factors of beans was observed on soaking in sodium bicarbonate or mixed salt solutions than on soaking in distilled water. Leaching losses during soaking of beans were highest for tannins among the 3 antinutritional factors investigated. (Author's summary) h01

0334

22962 VALUEVA, T.A.; MALOVA, L.I.; KHOSOVA, G.V.; CHEBAN, A.N.; KULIKOV, V.A.; MOSOLOV, V.V.; SEATRIN, E.S. 1983. Isolation and characterization of the trypsin and chymotrypsin inhibitor protein with pI 4.3 from kidney bean seeds. Applied Biochemistry and Microbiology 19(1):96-102. En., Sum. En., 31 Ref., Il. (A.N. Bakh Inst. of Biochemistry, Academy of Sciences of the USSR, Moscow, U.S.S.R.)

Phaseolus vulgaris. Proteins. Composition. Seed.

A group of proteins was isolated from kidney bean seeds by affinity chromatography on trypsin sepharose. These are the inhibitors of serine proteinases with isoelectric points at pH 4.3, 4.5, 4.7, and 5.1. One of the inhibitors (the protein with pI 4.3) was obtained in homogeneous form with preparative isoelectric focusing. The inhibitor protein with mol. wt. of about 10,000 suppresses the activity of trypsin and chymotrypsin but does not act on elastase, subtilisin, and proteinase from *Aspergillus oryzae*. The inhibitor protein has a high content of cystine, aspartic acid, serine, and proline. At the same time, valine, met., and tryptophan are absent. With the help of Edman degradation and hydrolysis with carboxypeptidase A, the NH₂ and COOH terminal sequences of the inhibitor molecule have been determined. (Author's summary)

0335

27329 ANDRIOLO, S.; ROUANE I, J-M.; LATONT, J.; BESANCON, P. 1984. Inactivation of phaseollamin, and alpha-amylase inhibitor from *Phaseolus vulgaris* by gastric acid and digestive proteases. Nutrition Reports International 29(1):149-156. En., Sum. En., 15 Ref., Il. (Laboratoire de Physiologie de la Nutrition, US111, 34060 Montpellier, France)

Phaseolus vulgaris. Inhibitors. Antinutritional factors. Enzymes. France.

An attempt is made to explain the inefficiency of phaseolamin, an alpha-amylase inhibitor from *Phaseolus vulgaris*, on in vivo starch digestion. In vitro digestion of phaseolamin by some proteases from the digestive tract of bovines was tested. Pepsin was ineffective, but the inhibitory activity was denatured by acidity below pH 3.0. Furthermore, although unaffected by trypsin, this activity was entirely destroyed by chymotrypsin within 2 h at pH 8.1 when the wt. ratio (protease vs. phaseolamin extract) was 1:50. (AS)

0336

29742 BUERA, M.P.; PILOSOFF, A.M.R.; BARTHOLOMAI, G.B. 1984. Kinetics of trypsin inhibitory activity loss in heated flour from bean, *Phaseolus vulgaris*. *Journal of Food Science* 49:124-126. En., Sum. En., 14 Ref., II. (Depto. de Industrias, Facultad de Ciencias Exactas y Naturales, Univ. de Buenos Aires, Ciudad Universitaria, 1428 Buenos Aires, Argentina)

Phaseolus vulgaris. Trypsin. Bean flour. Nutritive value. Temperature. Timing. Analysis. Argentina.

The effect of temp., time, and MC on TIA of bean flour was studied. TIA loss followed 1st order reaction kinetics and the rate of loss was greatly increased with increasing MC of flour from 2 to 55 percent. Activation energies for the 1st order reaction constants were calculated and ranged between 13-27 kcal/mole, showing a max. value at 30 percent MC. (AS)

0337

28942 FRELS, J.M.; RUPNOW, J.H. 1984. Purification and partial characterization of two alpha-amylase inhibitors from black bean (*Phaseolus vulgaris*). *Journal of Food Biochemistry* 8(4):281-301. En., Sum. En., 54 Ref., II. (Dept. of Food Science & Technol., Inst. of Agriculture & Natural Resources, Univ. of Nebraska-Lincoln, Lincoln, NE 68583-0919, USA)

Phaseolus vulgaris. Enzymes. Analysis. Amino acids. Biochemistry. Human nutrition. Animal nutrition. USA.

Two alpha-amylase inhibitors from black bean were purified to homogeneity using ammonium sulfate fractionation, DEAE-Sephadex chromatography, phenyl-Sepharose hydrophobic interaction chromatography, and gel filtration with Sephadex G-100. The inhibitors were designated I-1 and I-2 based on their order of elution from the phenyl-Sepharose column. Both inhibitors are mannose containing glycoproteins, composed of subunits; active against porcine pancreatic, human salivary, and insect alpha-amylases and inactive against bacterial, mold, and plant alpha-amylases. The inhibitors I-1 and I-2 have mol. wt. of 49,000 and 47,000 and isoelectric points 4.93 and 4.86, resp. Both inhibitors have similar amino acid compositions and are rich in aspartic acid, serine, glutamic acid, valine, and threonine and are low in S-containing amino acids. I-2 is more resistant to heat denaturation than I-1. (AS)

0338

24149 LAJOLO, F.M.; MANCINI FILHO, J.; MENEZES, E.W. 1984. Effect of a bean (*Phaseolus vulgaris*) alpha-amylase inhibitor on starch utilization. *Nutrition Reports International* 30(1):45-54. En., Sum. En., 17 Ref., II. (Depto. de Alimentos e Nutricao Experimental, Faculdade Ciencias Farmaceuticas, Univ. de Sao Paulo, Caixa Postal 30.786, Sao Paulo-SP, Brasil)

Laboratory animals. Diets. Composition. Proteins. Brazil. Animal nutrition. South America. America.

An alpha-amylase inhibitor prepared from black kidney beans, and given to young rats by stomach tubing mixed with a starch meal, was able to reduce dose-dependently the

hyperglycemia resulting from starch utilization. the higher the dose of the inhibitor given, the bigger and longer lasting was the smoothing effect on the serum glucose levels. In a 10-day growing expt. with rats, the inhibitor was able to reduce caloric availability, as measured by growth in rats fed, under restricted conditions, a calorie-deficient diet based on raw starch. (AS)

0339

25887 CINCO, F.J.; FRELS, J.M.; HOLT, D.L.; RUPNOW, J.H. 1985. Determination of the number and heat stability of alpha-amylase inhibitors in white and red kidney bean (*Phaseolus vulgaris*). *Journal of Food Science* 50(2):533-535. En., Sum. En., 12 Ref., II. (Univ. of Sonora, Apartado Postal 336 Y 106, Hermosillo, México)

Phaseolus vulgaris. Proteins. Inhibitors. Enzymes. Seed color. USA.

The alpha-amylase inhibitors from *Phaseolus vulgaris* cv. Great Northern UI-59 (White) and cv. I.R.K California (Red) were isolated using a heat-free procedure. Phenyl-Sepharose chromatography resolved 2 inhibitors from white beans, one of which was much less stable than the other at 70 degrees Celsius, and one from red beans. (AS)

0340

26592 GREER, F.; BREWER, A.C.; PUSZTAI, A. 1985. Effect of kidney bean (*Phaseolus vulgaris*) toxin on tissue weight and composition and some metabolic functions of rats. *British Journal of Nutrition* 54(1):95-103. En., Sum. En., 52 Ref. (Rowett Research Inst., Bucksburn, Aberdeen AB2 9SB, England)

Animal physiology. Diets. *Phaseolus vulgaris*. Proteins. Plant toxins. United Kingdom.

Inclusion of raw kidney bean proteins in the diet for rats was shown to affect the wt. of some internal organs. Of these, in addition to the well-known hypertrophy of the pancreas attributable to dietary trypsin inhibitors, the observed atrophy of the thymus and the doubling in wt. of the small intestine are related to the protein or lectin content of the bean diet, or both. Changes in tissue composition of the small intestine were also recorded. Its protein content increased by about 40-50 percent and carbohydrate content doubled, suggesting the occurrence of increased mucinous glycoprotein secretion. Increased DNA content (by about 30-40 percent), however, also indicated mucosal hyperplasia. Changes were also observed in mineral content, urea concn., and some enzyme activities in serum and urine, possibly as a result of disturbances in systemic metabolism or hormone concn., or both. Results gave further support to previous suggestions that the oral toxicity of kidney bean lectins involves local reaction in the small intestine in combination with their effects on the systemic immune system and general metabolism. (AS)

0341

29705 LAYER, P.; CARLSON, G.L.; DIMAGNO, E.P. 1985. Partially purified white bean amylase inhibitor reduces starch digestion in vitro and inactivates intraduodenal amylase in humans. *Gastroenterology* 88(6):1895-1902. En., Sum. En., 35 Ref., II. (Gastroenterology Unit, Mayo Clinic & Foundation, Rochester, MN 55905, USA)

Phaseolus vulgaris. Enzymes. Digestibility. Biochemistry. USA.

Whether commercial, bean-derived alpha-amylase inhibitor preparations failed to decrease starch digestion in humans because of insufficient anti-amylase activity, destruction by gastrointestinal secretions, or decreased activity in the presence of starch was investigated. A simple partial purification procedure to markedly concentrate the inhibitor (6-fold to 8-fold by total protein content, and 30-fold to 40-fold by dry wt.) was used. Compared with a commercial preparation and crude bean extract, this partially purified inhibitor inactivated intraduodenal, intraileal, and salivary amylase in vitro faster and more completely (P less than 0.001); its specific activity was not affected by exposure to

gastric juice and was only minimally reduced by duodenal juice. Whereas the rate of amylase inhibition by inhibitor was markedly slowed in the presence of nondietary liquid starch, dietary solid starch had only a minimal effect. Consequently, the partially purified inhibitor had no effect on liquid starch digestion, but decreased *in vitro* digestion of dietary starch in a dose-dependent manner (*P* less than 0.001). Perfusion of the partially purified inhibitor (2.0, 3.5, or 5.0 mg/ml at 5 ml/min) into the duodenum of humans rapidly inhibited more than 94.0, 99.0, and 99.9 percent of intraluminal amylase activity. It was concluded that commercial amylase inhibitors failed to decrease starch digestion *in vivo* mainly because they have insufficient antiamylase activity; however, a partially purified inhibitor with increased specific activity is table in human gastrointestinal secretions, slows dietary starch digestion *in vitro*, rapidly inactivates amylase in the human intestinal lumen, and, at acceptable oral doses, may decrease intraluminal digestion of starch in humans. such an inhibitor therefore deserves study. (AS)

0342

29117 LOWGREN, M.; LIENER, I.E. 1986. The effect of slow-cooking on the trypsin inhibitor and hemagglutinating activities and *in vitro* digestibility of brown beans (*Phaseolus vulgaris*, var. Stella). *Qualitas Plantarum* 36(2):147-154. En., Sum. En., 26 Ref., II. (Dept. of Nutrition, Univ. of Uppsala, Box 551, Uppsala 75122, Sweden)

Phaseolus vulgaris. Cooking. Timing. Digestibility. Nutritive value. Laboratory experiments. Digestibility. Fermentation. USA.

Brown and kidney beans were subjected to a 2 modes of cooking in a household slow cooker A, a fixed low setting (120 watts) for 10 h; B, a high setting (210 watts) for 2.5 h, and a low setting (120 watts) for 7.5 h. Temp. changes in the beans were recorded. With treatment A, over 90 percent of the hemagglutinating and trypsin inhibitor activities occurred after 6 h at which time the temp. had reached 80 degrees Celsius. With treatment B, inactivation of these activities was almost complete at the end of the 2 h when a max. temp. of 100 degrees Celsius had been attained. The *in vitro* digestibility of the bean protein was considerably increased by either treatment. By way of contrasts, only 20 min of heating was required to destroy these activities when the beans were brought to a boil in an open vessel. (AS)

0343

27290 SANTHRIAN, S.; REYES, F.; LARRALDE, J. 1986. Liver hydrolytic activity in growing male rats fed a raw kidney bean (*Phaseolus vulgaris* L.) diet. *Nutrition Reports International* 33(5):821-829. En., Sum. En., 27 Ref. (Dept. of Physiology, School of Pharmacy, Univ. of La Laguna, Tenerife, Canary Islands, Spain)

Phaseolus vulgaris. Animal nutrition. Diets. Enzymes. Spain.

Liver cathepsin A and D and acid phosphatase activities, both total and free, were measured in growing male rats fed ad libitum over periods of 7, 15, 30, and 45 days on diets containing either heated soybean alone or with raw kidney bean as the sole sources of protein. Diets were isocaloric and contained about 12 percent protein. Compared with rats fed heated soybean alone, those fed the diet containing kidney bean showed a significant reduction (*P* less than 0.05) in growth rate and liver wt. with no changes in the amount of food intake (per 100 g body wt.); these effects were accompanied by a significant increase (*P* less than 0.05) in the activities of the 2 liver cathepsins, as well as in the activity of liver acid phosphatase. (AS)

0344

27300 TAJIRI, H.; LEE, P.C.; LEBENTHAL, E. 1986. Small intestinal mucosal hyperplasia caused by an enterokinase inhibitor from red kidney bean in rats. *Journal of Nutrition* 116(5):873-8680. En., Sum. En., 25 Ref., II. (International Inst. for Infant Nutrition & Gastrointestinal Disease, Children's Hospital of Buffalo, 219 Bryant Street, Buffalo, NY 14222, USA)

Phaseolus vulgaris. Enzymes. Diets. Inhibitors. USA.

A specific enterokinase inhibitor (EKI) was purified from red kidney bean. Male weanling rats fed a diet containing this purified EKI (0.06 percent) for 6 days showed increases in mucosal wt., protein, DNA, and lactic dehydrogenase contents in their small intestines compared with age-matched control rats fed a standard diet. Total mucosal enterokinase and disaccharidase activities were, however, decreased in EKI-fed rats. Thus, oral consumption of EKI from red kidney bean lead to small intestinal mucosal hyperplasia in rats. The mucosal hyperplasia observed in EKI-fed rats is not likely due to decreased turnover of mucosal proteins as a result of reduced luminal proteases since luminal contents of trypsin, chymotrypsin, and elastase in EKI-fed rats were similar to those of control rats. Enterokinase inhibitor may have a direct hyperplastic effect on the small intestine of rats. (AS)

LECTINS/PHYTOHEMAGGLUTININS

0345

10171 KAKADE, M.L.; EVANS, R.J. Growth inhibition of rats fed navy bean fractions. *Journal of Agricultural and Food Chemistry* 13(5):450-452. 1965. En., Sum. En., 14 Ref.

Phaseolus vulgaris. Laboratory animals. Diets. Toxicity. Phytohaemagglutinins. Protein content. Inhibitors. Animal physiology.

Five fractions from raw navy beans were found to inhibit growth of rats. Fraction 4 was the major growth-inhibiting fraction. The growth-inhibitory effect of fraction 3 and possibly of fractions 1 and 2 on rats could be attributed to trypsin-inhibitor activity. The possibility of the presence of a toxic factor other than hemagglutinin and/or trypsin inhibitor in navy beans is discussed. (Author's summary) H01

0346

10172 HONAVAR, P.M.; SHIH, C.A.; HENER, L.F. Inhibition of the growth of rats by purified hemagglutinin fractions isolated from *Phaseolus vulgaris*. *Journal of Nutrition* 77(1):109-114. En., Sum. En., 24 Ref.

Phaseolus vulgaris. Laboratory animals. Legume crops. Toxicity. Phytohaemagglutinins. N. Protein content. Amino acids. Animal physiology.

A study was made of the growth promoting properties of raw and heated samples of a no. of legumes including *Phaseolus vulgaris*, *Cicer arietinum*, *Cajanus cajan*, and *P. aureus*. Two *P. vulgaris* beans, the black and kidney beans, were highly toxic in the raw state, but this toxicity could be largely eliminated by autoclaving beans that had received prior soaking in water. The other legumes were relatively nontoxic in the raw states and were little affected by heat treatment. Fractions possessing high hemagglutinating activity, but which were devoid of antitryptic activity, were isolated from black and kidney beans and fed to rats supplied with a basal diet containing 10 percent of protein derived from casein. These fractions inhibited growth markedly and caused death at levels as low as 0.5 percent of the diet. (Author's summary)

0347

5836 JAFFE, W.G.; VEGA L., C.L. Heat-labile growth-inhibiting factors in beans (*Phaseolus vulgaris*). *Journal of Nutrition* 94:203-210. 1968. En., Sum. En., 18 Ref.

Phaseolus vulgaris. Growth. Inhibitors. Laboratory animals. Phytohemagglutinins. Diets.

A comparative study in vitro was made of enzyme-inhibiting and hemagglutinin activities, and the effect on rat growth of 5 var. of beans (*Phaseolus vulgaris*). Extracts of 2 bean samples were active in agglutinating rabbit blood cells and toxic when fed to growing rats. Diets prepared with these seeds supplemented with met. caused wt. loss and death to rats when fed alone or with a supplement of 10 percent enzymatically or acid-digested casein. Hemagglutinating activity was observed in the feces of rats fed the raw bean diets. The possibility that the hemagglutinins are at least partly responsible for the toxic effects was examined. Three other samples of beans had no significant hemagglutinating or lethal effect. Rats fed the raw bean meals supplemented with met. did not gain wt. but grew well with a similar diet supplemented with enzymatically digested casein. Supplements of 10 percent casein, 1 percent Na glutamate, or 10 percent acid-digested casein did not improve growth significantly, but the latter did when tryptophan was added. Antitrypsin and amylase activities were low or absent in some of the seeds and high in others and did not appear to be directly related to the growth inhibition observed. The low growth-promoting action of the hemagglutinin-free beans might be explained by low digestibility and an enzyme-inhibiting activity of the bulk proteins different from that of the trypsin or amylase inhibitors. (Author's summary)

0348

5122 BRUCHER, O. et al. Comparison of phytohaemagglutinins in wild beans (*Phaseolus aborigineus*) and in common beans (*Phaseolus vulgaris*) and their inheritance. *Phytochemistry* 8:1739-1743. 1969. En., Sum. En., 14 Ref.

Phaseolus vulgaris. Phytohemagglutinins. Inheritance. Genetics. Analysis. Crossbreeding.

Populations of wild beans (*Phaseolus aborigineus*) giving both positive and negative haemagglutination test were detected. The positive extracts had the same specificity as common bean (*Phaseolus vulgaris*) phytohaemagglutinin (PHA) and induced mitosis in human lymphocyte cultures. They behaved similarly to common bean extracts in immunoelectrophoresis. The genetic analysis pointed to a single dominant trait of inheritance of the PHA. From the occurrence of positive and mixed wild populations it is concluded that no significant selection pressure and, hence, no vital role exists for the bean agglutinins. (Author's summary)

0349

1564 BRUCHER, O. Absence of phytohemagglutinin in wild and cultivated beans from south America (*Phaseolus aborigineus* Burk and *Phaseolus vulgaris* L.). *Proceedings of the American Society of Horticultural Science* 12:68-85. 1969. En., Sum. En., Es., 11 Ref.

Phaseolus vulgaris. Phytohemagglutinin. Genetics. Mutation. Cultivars. Plant breeding. Venezuela.

It was shown that among wild bean populations from N.W. Argentina there exist individual plants without agglutinating activity. In an earlier (unpublished) study the presence of agglutinin was proved to be governed by a single dominant gene. Seeds of a great number of indigenous bean cv. have been analyzed for their agglutinating activity in order to study the distribution area of agglutinin-free cv., and to draw conclusions about the origin of the corresponding cv. Absence of agglutinin activity occurs in about 10 percent of the investigated material. Grouping of the native bean cv. in 2 principal evolutionary trends is presented in connection with the distribution of the genetic factor for absence of agglutinin. It seems that agglutinin-free cv. are not phylogenetically related, and cannot be derived directly from agglutinin-free *P. aborigineus* populations. Thus absence of agglutinin in bean seeds seems to be caused by sporadically occurring 'lost mutations'. (Author's summary)

3764 JAFFE, W.G. Factors affecting the nutritional value of beans. In Milner, M., ed. Symposium of Nutritional Improvement of Food Legumes by Breeding, Rome, Italy, 1972. Proceedings. New York, N.Y., United Nations, 1972. pp.43-48. En., 10 Ref.

Phaseolus vulgaris. Nutritive value. Amino acids. Cooking. Digestibility. Plant breeding.

In expt. conducted with rats, it was found that diets containing raw beans were toxic while those with cooked beans were not. However, in the latter, the addition of met. was necessary. The presence of different types of hemagglutinins in red and white bean var. originate significant differences in toxicity. Soaking and cooking destroy the agglutinating activity and reduces their toxic action. Studies conducted on antinutritional factors contained in bean seeds presented the following results: a bean globulin, different from the trypsin inhibitor, interfered with the hydrolic action of 7 proteases tested and cannot be destroyed by autoclaving, affecting digestibility. The digestibility of starch by pancreatic amylase was evaluated in vitro. An amylase inhibitor, present in most bean species, is destroyed by heat; little is known about its physiological importance. Other adverse factors that are not destroyed by heat are: phytic acid, which interferes with Fe absorption, and flatulence-producing factors, which are being studied. In conclusion, any study related to the genetic improvement of the nutritional value of beans should be directed not only at a protein and sulfur-containing amino acid level but also at the content of toxic hemagglutinins and digestibility. (Summary by C.P.G. Trans. by L.M.F.)

0351

5098 JAFFE, W.C.; BRUCHER, O.; PALOZZO, A. Detection of four types of specific phytohemagglutinins in different lines of beans (*Phaseolus vulgaris*). Zeitschrift fur Immunitätsforschung and Bildung 142:439-447. 1972. En., Sum. En., De., Fr., 15 Ref.

Phaseolus vulgaris. Phytohemagglutinins. Cultivars. Seeds. Field experiments. Analysis.

When the hemagglutinating action of extracts from ground seeds of different lines or cv. of beans (*Phaseolus vulgaris*) was tested with blood cells from different animals, 4 different patterns of activity were distinguished. The most common type, called A, agglutinated all blood types tested with the exception of cow blood cells which were rendered susceptible to agglutination by treatment with trypsin. Type-B beans were active on all the blood types except trypsin-treated cow blood, type-C bean extracts agglutinated strongly only trypsin-treated cow blood cells and pronase-treated rat and hamster cells. The last type, called D, had little if any activity with the exception of its action on pronase-treated hamster blood cells. The hemagglutinating activity on trypsin-treated cow blood cells of A- or C-type extracts was not destroyed after 90 minutes heating at 80 degrees Celsius but the activity on rabbit blood cells was lost. The hemagglutinating activity of extracts of any one of these four bean types could be absorbed on rabbit or trypsin-treated cow blood cells and released again by heating to 56 degrees Celsius although some of the extracts would not agglutinate these types of blood cells. The disappearance of at least one component of the bean extracts after repeated absorption with blood cells was detected by immunoelectrophoresis. This component was detected in the supernatant after release from the cells. The corresponding immunoprecipitation line could be stained with sudan black indicating that it was caused by a lipoprotein. The possibility that the A-type activity is caused by a combination of B- and C-type hemagglutinins is discussed. The results of a cross breeding experiment which revealed the fact that this activity is inherited as a single, dominant trait is evidence against this possibility. The use of trypsin-treated cow blood cells and rabbit rbc for testing different fractions from bean extracts is recommended. (Author's summary)

0352

17816 KORTE, R. 1972. Heat resistance of phytohemagglutinins in weaning food mixtures containing beans (*Phaseolus vulgaris*). Ecology of Food and Nutrition 1:303-307. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Phytohaemagglutinins. Bean flour. Human nutrition. cooking. Composition. Tanzania.

The presence of hemagglutinins in foods prepared from bean indicates that they are inadequately cooked. Hemagglutinins were found in 22 percent of samples of a mixture of maize and bean flour cooked by African mothers in their homes. There is considerably less risk of incomplete hemagglutinin destruction when whole beans are prepared in the traditional way. The possible hazards of incomplete destruction of bean toxin and the possibilities of breeding toxin-free strains of *Phaseolus* beans are discussed. Data suggest that bean flours which have not been adequately heat-treated should not be used, especially as a weaning food for infants. (Author's summary) 1100

0353

3717 HAMBLEN, J.; KENT, S.P. Possible role of phytohaemagglutinin in *Phaseolus vulgaris* L. *Nature New Biology* 245(140):28-30. 1973. En., 5 Ref., II.

Phaseolus vulgaris. Phytohaemagglutinins. *Rhizobium phaseoli*. Seedlings. Roots. Nodulation. Light microscopy. Seed.

In expt. with plants of *Phaseolus vulgaris* var. Seaway and *Rhizobium phaseoli* isolated from these plants, it was concluded that phytohemagglutinin (PHA) is capable of binding bacteria to the roots of *P. vulgaris* at sites suitable for the infection of the plant by the bacteria (roots hairs). The initial source of the PHA in the germinating seedling is probably the cotyledon, but the plant is capable of synthesizing PHA when mature. (Summary by Field Crop Abstracts)

0354

5059 MALONIER, G. et al. Isolement, propriétés physico-chimiques et localisation in vivo d'une phytohemagglutinine (lectine) de *Phaseolus vulgaris* L. (var. rouge). (Isolation, physicochemical properties, and localization in vivo of lectin from *Phaseolus vulgaris* L.). *Physiologie Vegetale* 2(3):519-537. 1973. Fr., Sum. Fr., En., 41 Ref., II.

Phaseolus vulgaris. Phytohemagglutinins. Analysis. Amino acids. Cotyledons. Cell structure.

The lectin from a red bean var. was isolated from flour by extraction with physiological serum and purified by ammonium sulfate precipitation and Sephadex G-50, DEAE Sephadex, Sephadex G-200 and CM-cellulose chromatography. The main physicochemical properties--mol. wt., amino acid and carbohydrate composition, absorption, fluorescence, and dichroic spectra--of this glycoprotein are reported. Immunodiffusion, immuno-electrophoresis and immunoperoxidase assays indicated that lectin is localized in the cytoplasm of cotyledon and embryo cells. (Author's summary) 1100

0355

7040 CONTRERAS, S.; TAGLE, M.A. Factores tóxicos de leguminosas cultivadas en Chile III. Hemagglutininas. (Toxic factors in Chilean legumes. III. Hemagglutinins). *Archivos Latinoamericanos de Nutrición* 24(2):191-199. 1974. Es., Sum. Es., En., 20 Ref.

Phaseolus vulgaris. Legume crops. Seed. Phytohemagglutinins. Cultivars. Human nutrition. Toxicity. Chile.

The presence of hemagglutinins was determined in the following legumes grown in Chile: *Phaseolus vulgaris* var. Tórtola, Arroz, Zeus, and Coscorrón; *Vicia faba*, *Lathyrus sativus*; *Pisum sativum*; *Cicer arietinum*; *Lens esculenta*, *Glycine max*, *Lupinus albus*, *L. luteus*, and *Prosopis tamarugo*. Trypsin-activated rabbit and cow erythrocytes were used for the tests. *P. vulgaris*, especially Tórtola and Coscorrón, had the highest activity on both types of erythrocytes. With the exception of *L. luteus* (no activity), all the seeds

studied had active hemagglutinins on rabbit erythrocytes. *P. vulgaris* var. *Tortola* was used to study the effect of different heat treatment on hemagglutinating activity. Best results were obtained when cooked at temp. over 100 degrees Celsius. Soaking alone or used as a pretreatment did not decrease hemagglutinating activity. (Author's summary) 1100

0356

4890 JAFFE, W.G.; LEVEY, A.; GONZALEZ, D.I. Isolation and partial characterization of bean phytohemagglutinins. *Phytochemistry* 13(12):2685-2693. 1974. En., Sum. En., 32 Ref., II.

Phaseolus vulgaris. Phytohemagglutinins. Seeds. analysis. Cultivars. Field experiments. Sugars.

Extracts of seeds of 21 bean cv. were screened for hemagglutinating specificity and for mitogenic activity. Four types could be distinguished in different beans, two of which are mitogens. Two lectin fractions (alpha and beta) were isolated from each of the four bean types. The MW were estimated by exclusion chromatography and component sugars by paper chromatography. Hemagglutinating activity, inhibition of hemagglutinating action by sugar-derivatives and glyco-peptides as well as mitogenic action were determined for the 8 purified lectins and 4 control preparations. The alpha and beta fractions isolated from two bean types had only min. mitogenic action, while those from the other 2 bean types and all of the control preparations were potent mitogens. All the mitogenic preparations agglutinated trypsin-activated cow red cells and pronase-activated hamster red blood cells in high dilutions but some were inactive when tested with human or rabbit red blood cells. (Author's summary)

0357

3961 JAYNE-WILLIAMS, D.J.; BURGESS, C.D. Further observations on the toxicity of navy beans (*Phaseolus vulgaris*) for Japanese quail (*Coturnix coturnix japonica*). *Journal of Applied Bacteriology* 37(1):149-169. 1974. En., Sum. En., 33 Ref.

Phaseolus vulgaris. Toxicity. Diets. Soluble carbohydrates. Protein content. Phytohemagglutinins. N. Bacteria. Analysis. Poultry. Animal physiology. Animal nutrition. Bacteriology.

The lethal and growth depressing effects of feeding raw navy beans (RNB) to Japanese quail have been shown to be due neither to poor palatability nor to dialysable, lipid or carbohydrate constituents, but to a protein material soluble at pH 3 and precipitable to saturation with $(NH_4)_2SO_4$. This material proved resistant to digestion by pepsin and proteolytic bacteria but was destroyed by autoclaving at 121 degrees for 15 min. Germ-free birds given a diet containing RNB which had been fermented by coliforms grew well, indicating that toxicity of RNB is not dependent on the release by intestinal bacterial of poisons from innocuous precursor in the beans. Examination of the effects of feeding diets containing other raw legume seeds to quail have shown that toxicity is associated with the presence of high concentrations of phytohaemagglutinins (PHAs). Quail given RNB diet showed a greater incidence of liver infection than birds fed an autoclaved bean diet but bacteriological examination of gut contents of such birds revealed no marked qualitative differences. Chemical examination of gut contents likewise revealed no marked differences. Expt. with gnotobiotic quail showed that coliforms derived from a var. of sources were capable of causing the death of birds on RNB diet and that the no. attained in different parts of the intestine by a single coliform strain were not affected by the diet fed. The results suggest that toxicity of RNB may be due to impairment of body defense mechanisms by PHA leading to tissue invasion by normally innocuous components of the intestinal microflora. (Author's summary)

7105 PUSZTAI, A.; WATT, W.B. Isolectins of *Phaseolus vulgaris*; a comprehensive study of fractionation. *Biochimica et Biophysica Acta* 1(365): 57-71. 1974. En., Sum. En., 67 Ref., II.

Phaseolus vulgaris. Seed. Phytohemagglutinins. Analysis. Inhibitors. Proteins. N. Amino acids. Sugars.

The results of fractionation studies and chemical, physical, and immunochemical investigations established the existence of a range of closely related glycoprotein in the albumin fraction of the seeds of beans (*Phaseolus vulgaris*). The isoelectric point of these glycoproteins was found by isoelectric focusing to vary between about pH 4.5-6.9. Their subunit composition, however, was very similar; they were all made up of 2 types of subunits, 30,000 plus or minus 1,000 and 35,000 plus or minus 1,000, resp., in a ratio of about 3:1. The chemical composition of these glycoproteins bore a close resemblance to each other. However, small differences were also found that might have accounted for the charge heterogeneity. An immunochemically related glycoprotein was also found in the globulin fraction. This, however, was made up by subunits of the size of 30,000 plus or minus 1,000 and was different in amino acid composition. These glycoproteins were shown to be agglutinins or isolectins of red or white blood cells. They were also found to interact with other cells such as fat cells and to be able to bind carbohydrate-type materials. However, these isolectins had negligible effects on lymphocyte transformation. The extent of all activities was strongly dependent on the isoelectric point of the isolectins. The specificity of the interaction, however, was apparently the same; i.e., they were all inhibited by the same compounds including N-acetyl-D-galactosamine and glycopeptides containing N-acetyl-D-glucosamine, mannose, and galactose and obtained from fetuin. The possible involvement of these isolectins in bean toxicity is discussed. (Author's summary)

5313 JAFFE, W.G.; GOMEZ, M.J. Beans of high or low toxicity. *Qualitas Plantarum; Plant Foods for Human Nutrition* 24(3/4):359-365. 1975. En., Sum. En., De., 11 Ref., II.

Phaseolus vulgaris. Seed. Phytohemagglutinins. Laboratory animals. Toxicity. Diets. Cultivars. Animal physiology. Venezuela.

Extracts from seeds of 4 bean cv., representing the 4 hemagglutinin specificity types, were injected into mice. When injected by the intraperitoneal route, the LD50 for type A was 470 mg/kg; B, 1500; C, 590; and D, greater than 3000 mg/kg, calculated as injected bean protein kg/body wt. When applied intravenously, the D-type extract was also the least toxic. Intradermal injections of the 4 extracts produced local lesions that were most severe with the A-type extracts and very mild with the D-type. Genetic selection for the nontoxic D-type bean is recommended. (Author's summary)

14733 NOCHUMSON, S. A nucleoside triphosphate phosphohydrolase found in preparations of red kidney bean phytohemagglutinin-purification and characterization. Ph.D. Thesis. Philadelphia, Pennsylvania, The Hahnemann Medical College and Hospital of Philadelphia, 1975. 111p. En., Sum. En., 126 Ref., II.

Phaseolus vulgaris. Enzymes. ATP. Biochemistry. analysis. Protein content. Human nutrition. Ca. N.

The red kidney bean has been found to be a good source of an enzyme which catalyzes the hydrolysis of the gamma-phosphate or purine and pyrimidine nucleoside triphosphates (NTPase). Throughout the purification of the NTPase a complete separation from a hemagglutinin protein proved difficult and was suggestive that both the enzyme and hemagglutinating activities were inherent to the same molecule. However,

by adsorbing the hemagglutinin of human red blood cells it was possible to effectively separate the 2 activities. The enzyme, although devoid of any lectin-like activity was very active in hydrolyzing nucleoside triphosphates (1500 micromoles Pi/min,mg.protein). The enzyme reaction can be stimulated by either Ca ions or by Na ions in the absence of any divalent cations. A mol. wt. of 125,000 for the enzyme has been estimated using gel filtration chromatography. During SDS polyacrylamide gel electrophoresis a single band was found corresponding to a mol. wt. of 65,000 indicating that the enzyme is a dimer. The enzyme has a visible absorption spectrum consisting of a single broad absorption peak having a max. at 565 mu. In the presence of dithionite the absorption peak disappears. An EPR (electron paramagnetic resonance) scan of the enzyme has detected the presence of iron III in the oxidized enzyme and iron II in the dithionite reduced enzyme. A quantitative determination for iron resulted in a min. mol. wt. of 70,000 suggesting 2 g atoms of iron/mol. of enzyme. the enzyme is also a glycoprotein containing 4 percent neutral sugars. A possible role in ion transport has been suggested for the enzyme. (Author's summary)

2761

5957 PUSZTAI, A.; GRANT, G.; PALMER, R. Nutritional evaluation of kidney beans (*Phaseolus vulgaris*): the isolation and partial characterization of toxic constituents. *Journal of the Science of Food and Agriculture* 26:149-156. 1975. En., Sum. En., 20 Ref., 11.

Phaseolus vulgaris. Protein content. Toxicity. Laboratory animals. Diets. Seed. analysis. Amino acids.

Comprehensive fractionation studies on the contents of the seeds of two var. of common beans (*Phaseolus vulgaris*) were carried out. The fractions obtained were evaluated for toxicity on the basis of growth depression of rats fed on a mixed diet containing 5 percent casein protein and 5 percent unfractionated bean proteins or proportional amounts of fractionated materials. The low mol. wt. diffusible materials and the structural water-insoluble carbohydrate-protein complexes (10 and 73 percent of the seeds, resp.) had little deleterious effect on rat growth performance. However, both protein fractions--the albumins (6.3 percent of the seeds) and the globulins (11 percent of the seeds)--were found to be toxic. Further fractionation with continuous high-voltage electrophoresis indicated that most of the toxicity of the albumin fraction might be related to the presence of a range of isolectins. A similar, but not identical isolectin might also be implicated in the toxicity of the globulin fraction. These results also demonstrated that the 3 major storage proteins--phyc protein I and II and the trypsin inhibitors, which altogether made up about 3.4 of the total protein content--could have made only a small contribution to the toxicity of common beans. (Author's summary)

0362

27422 LEAVITT, R.D.; FELSTED, R.L.; BACHUR, N.R. 1977. Biological and biochemical properties of *Phaseolus vulgaris* isolectins. *Journal of Biological Chemistry* 252(9):2961-2966. En., Sum. En., 26 Ref., 11.

Phaseolus vulgaris. Phytohemagglutinins. Carbohydrate content. Proteins. Analysis. Biochemistry. USA.

Affinity-purified phytohemagglutinin from red kidney bean resolves into 5 isolectins by SP-Sephadex ion exchange chromatography. Recoveries ranging from 30 to 130 mg of protein for each isolectin are easily achieved. The isolectins have similar amino acid compositions which differ only in threonine, lysine, and arginine. A distinguishing feature of the amino acid composition is the total lack of S containing amino acids. Each isolectin contains about 4 percent mannose and 2.2 percent N-acetyl-D-glucosamine. All isolectins on electrophoresis form single protein bands under denaturing and nondenaturing conditions in polyacrylamide gels, and all have apparent subunit mol. wt. of 33,000 by SDS-polyacrylamide gel electrophoresis.

9608 MOREIRA, R. DE A.; PERRONE, J.C. Purification and partial characterization of a lectin from *Phaseolus vulgaris*. *Plant Physiology* 59:783-787. 1977. En., Sum. En., 24 Ref., 11.

Phaseolus vulgaris. Analysis. Amino acids. Phytohemagglutinins. Hydrolysis. Carbohydrate content. Ammonium sulphate. N. Brazil.

A method is presented for the isolation of a lectin from Brazilian dry bean var. Rico 23, through extraction in acidic (pH 4.2) medium, fractionation with ammonium sulfate and chromatography on DEAE-cellulose. The lectin was shown to be homogeneous by gel electrophoresis and isoelectric focusing. Mol. wt., determined by osmometry, was 100,250 daltons; the isoelectric point, determined by isoelectric focusing, was pH 5.1; and the extinction coefficient at 280 nm and pH 7 was $E_{1cm}^{1\%}(1\text{ percent}) = 7.85$. The lectin was shown to be a glycoprotein with 9.11 percent neutral sugars and 1.44 percent amino sugars. Amino acid composition was characterized by the absence of met. and a very low content of half-cystine, with a predominance of acidic and hydroxylated amino acids. The lectin presented no specificity when tested with red blood cells of all groups of ABO system. (Author's summary)

3081 UNTAWALE, G.G. Effects of dietary ingredients including raw and autoclaved beans (*Phaseolus vulgaris*) on chick growth, survival rate, intestinal microflora, and response to antibiotic supplements. Ph.D. Thesis. Pullman, Washington State University. Department of Animal Science, 1977. 141p. En., Sum. En., 206 Ref., 11.

Phaseolus vulgaris. Animal nutrition. Diets. Phytohaemagglutinins. Toxicity. Chicks. Nutritive value. Dietary value.

Expt. were conducted for 3 wk. with day-old broiler chicks to study the effects of diets containing maize, rye, and Red Mexican dry beans, raw or autoclaved, on growth survival rate and intestinal microflora. The influence of chick age and supplementation of antibiotics to the diet on toxicity of raw beans was also studied. Chicks fed maize grew significantly better than those on either rye or beans and harbored 10(2) to 10(8) of each of the coliforms, Lactobacilli and *Streptococcus fecalis* organisms/g of wet intestinal tissue. Adding a penicillin supplement to maize diets did not improve growth or influence microbial counts in the intestines. Rye caused depressed growth, reduced tibia ash, a 10- to 100-fold increase in the intestinal microbial counts and adhesion of microbes to the intestinal mucosa of the chicks. A significant growth response, along with a 10-fold decrease in the intestinal counts of coliforms and *s. fecalis* and a reduction in the counts of microorganisms adhered to the intestinal mucosa was observed when the rye diet was fed with procaine penicillin. High levels of raw beans caused poor growth, high mortality and a 10- to 1000-fold increase in the no. of microorganisms in the intestinal lumen, adhesion and colonization of microbes to the intestinal mucosa, and passage of microorganisms across the intestinal wall into the circulatory system. A var. of aerobes and facultative anaerobes were isolated from blood, livers, and kidneys and pathologic changes were observed in livers of the chicks on these diets. The high levels of raw beans also resulted in a significant reduction in glucose absorption from the duodenum. Absorption of glucose was significantly increased when the raw beans were given with penicillin. dietary antibiotic supplements to the raw bean diets improved chick growth, influenced the counts of intestinal microbes, reduced adhesion of microbes to the intestinal mucosa and reduced chick mortality. A combination of procaine penicillin (500 ppm) and carbadox (250 ppm) reduced mortality from 64 to 11.1 percent. Parenterally administered antibiotics were equally effective in reducing mortality in chicks on the raw bean diets. Autoclaving beans improved chick growth, decreased the counts of intestinal microbes in the lumen and the no. of microbes adhering to the intestinal mucosa, and reduced chick mortality. Addition of penicillin to the autoclaved bean diet further reduced microbial adhesion and eliminated mortality. Chick age and dietary level of raw beans influenced bean toxicity. Delaying the feeding of raw beans until the 4th day after

hatching or reducing the dietary level of raw beans from 80 to 40 percent significantly reduced mortality. A bean fraction high in hemagglutinin caused *in vitro* clumping of chick erythrocytes and intestinal mucosal cells; whereas a fraction isolated from autoclaved beans did not. These observations show that some of the dietary ingredients and antibiotic supplements to the diet influenced the intestinal microflora of young chicks. The results also indicate that both bean agglutinins and intestinal microbes could be partly responsible for the toxicity observed in chicks on the raw bean diet. (Author's summary)

0365

13108 EGORIN, M.J. et al. Phaseolus vulgaris isolectin binding to human erythrocytes. *Journal of Biological Chemistry* 254(3):894-898. 1979. En., Sum. En., 32 Ref., 11.

Phaseolus vulgaris. Phytohaemagglutinins. Analysis. Human physiology. USA.

Bean isolectins I_A, I_B, I₂F₂, I₁I₃, and I₄ were isolated by affinity and ion exchange chromatography. Pure isolectins were radiolabeled by the chloramine-T method with Na(125)IO₄, and their binding to human erythrocytes was studied. A normal erythrocyte has approx. $8 \times 10(5)$ receptor sites/isolectin; however, the association constants (K_a) of binding increased from $1.1 \times 10(7)$ M⁻¹, with increasing no. of E subunits/tetrameric isolectin molecule. Isolectin to erythrocyte binding reached equilibrium rapidly and was reversed by fetuin. All isolectins competed with (125)I-I₄ for erythrocyte binding sites, with a constant (K_1) similar to the K_a calculated for each resp. radiolabeled isolectin. When isolectin binding at 0, 4, or 8 degrees was compared to that at 25 degrees Celsius, there was no reduction in the no. of binding sites/cell, but the K_a of I₄ was reduced to $3 \times 10(7)$ M⁻¹. Fixed erythrocytes displayed similar isolectin binding characteristics. (Author's summary)

0366

17462 MANCINI FILHO, J.; LAJOLLO, F.M.; VIZEU, D.M. 1979. Lectins from red kidney beans: radiation effect on agglutinating and mitogenic activity. *Journal of Food Science* 44(4):1194-1196, 1200. En., Sum. En., 31 Ref., 11.

Phaseolus vulgaris. Seed. Phytohaemagglutinins. Toxicity. Analysis. Biochemistry.

The effect of ionizing radiation on hemagglutinating and mitogenic activity of purified phytohemagglutinin in solution was studied. Beans irradiated were var. Rico 23 and Pintado from Brazil. A dose of 10 krad is needed for 50 percent destruction of the agglutinating capacity; the mitogenic effect is more resistant, 70 krad for 50 percent inactivation. Results indicate that the agglutinating and mitogenic effects are due to different structures. The radiation effect on agglutinating activity is an exponential function of the lectin concn. Macromolecular changes, followed by polyacrylamide gel electrophoresis, were evident for doses higher than 40 krad. A dose up to 3 Mrad was ineffective to inactivate the hemagglutinin in kidney beans even with 30 or 60 percent water content. (Author's summary)

0367

14665 ANTUNES, P.L.; SGARBIERI, V.C. 1980. Effect of heat treatment on the toxicity and nutritive value of dry bean (Phaseolus vulgaris var. Rosinha G2) proteins. *Journal of Agricultural and Food Chemistry* 28(5):935-938. En., Sum. En., 21 Ref., 11.

Phaseolus vulgaris. Seed. Protein content. Proteins. Amino acids. enzymes. Inhibitors. Phytohaemagglutinins. Heat treatment. Analysis. Toxicity.

Proximate composition, amino acid pattern, and toxicity of an unheated dry bean flour and of 6 other materials obtained by fractionation of the flour were studied. When fed to weanling rats the flour and all 6 fractions were toxic. Most of the toxicity was eliminated by heating the soaked beans 2.5 min at 97 degrees Celsius, but max. P.I.R. was at-

tained after 10 min at the same temp. Not all trypsin inhibitor and phytohaemagglutinin activities had been eliminated by any of these treatments. Autoclaving (121 degrees Celsius, 15 min) decreased the availability of lysine in the whole flour and in the water-insoluble solids by 36.7 and 29.3 percent, resp., whereas it did not affect significantly that of the other fractions. Heating at 121 degrees Celsius for 7.5 min was deleterious to the nutritive value of the isolated protein fractions. (Author's summary)

0368

17731 WILSON, A.B.; KING, T.P.; CLARKE, E.M.W.; PUSZTAI, A. 1980. Kidney bean (*Phaseolus vulgaris*) lectin-induced lesions in rat small intestine: 2. Microbiological studies. *Journal of Comparative Pathology* 90(4):597-602. En., Sum. En., 10 Ref., 11.

Phaseolus vulgaris. Animal nutrition. Proteins. Diets. Toxicity. Cultivars. Laboratory animals.

The differences in coliform populations in rats fed on diets containing either a high-lectin highly toxic kidney bean var. Processor or a low-lectin, relatively non-toxic var. Pinto III were studied. When var. Processor was included in the rat diets, there was a dramatic overgrowth of *Escherichia coli* in the small intestine. No overgrowth occurred when the bean var. Pinto III was fed to the rats. Kidney bean lectins appear to indirectly or directly enhance the virulence of coliform strains either through aggregation and elimination of competitive strains or by agglutination of certain strains of *E. coli* to one another and to the mucosal surfaces of the gut. Severe disruption of microvilli precedes and accompanies the proliferation of *E. coli* and it is possible that malabsorption provides a suitable growth substrate for intestinal bacteria, augmented by cell fragments in the form of microvilli, and possibly also by cellular exudates due to loss of polarization in membrane transport systems. (Author's summary)

0369

24041 LIMA, A.L.; MANCINI FILHO, J.; DOMINGUES, J.B.; LAJOLO, F.M. 1980. Propriedades hemaglutinantes mitogenica e toxica de variedades brasileiras de feijões (*Phaseolus vulgaris* L.). (Hemagglutinating, mitogenic, and toxic properties of Brazilian french bean varieties). *Revista de Farmacia e Bioquimica* 16(1-2):145-154. Pt., Sum. Pt., En., 12 Ref.

Brazil. Cultivars. Nutritive value. *Phaseolus vulgaris*.

Seed extracts of all the 16 bean var. investigated were capable of agglutinating trypsinized red cells in ox or rabbit blood, and also untrypsinized rabbit blood. Most var. also induced mitosis in human lymphocyte cells. Var. Moruna and Pirata I were among the most active in all these respects. None was effective with untrypsinized ox blood. Toxicity, after intraperitoneal injection in mice, was strongest in Moruna and Pirata I, but several var. with high mitogenic capacity were nontoxic. In general, toxicity was associated with capacities for ox and rabbit blood agglutination. (Field Crops Abstracts)

0370

28924 NOAH, N.D.; BENDER, A.E.; REARD, G.B.; GILBERT, R.J. 1980. Food poisoning from raw red kidney beans. *British Medical Journal* 281(6234): 236-237. En., Sum. En., 11 Ref.

Phaseolus vulgaris. Plant toxins. Human nutrition. Phytohemagglutinins. United Kingdom.

Outbreaks of gastroenteritis associated with eating raw red kidney beans are reported and results from biochemical examinations of beans and expt. carried out with rats to determine the cause of the poisoning are presented and analyzed. A hemagglutinin appears to be the toxic factor; however, it is destroyed by adequate cooking. Recommendations are

given on adequate cooking of red kidney beans, which should not be eaten raw or undercooked. (CIAT)

0371

16474 REAIDI, G.B.; McPHERSON, L.; BENDER, A.E. 1981. Toxicity of red kidney beans (*Phaseolus vulgaris*). *Journal of the Science of Food and Agriculture* 32(8):846-847. En., 6 Ref.

Phaseolus vulgaris. Cultivars. Plant toxins. Phytohaemagglutinins. Cooking. Timing. Analysis. Human nutrition.

Twelve samples of legumes, including red kidney, white kidney, and rose coco beans, were analyzed for lectin content (LC) and their degree of destruction after soaking in water for 18 h or after cooking at 100 degrees Celsius for 2, 5, 10, and 20 min. LC was estimated by an agglutination test on rabbit red blood cells performed according to Leiner's method. Only red and white kidney beans and, to a lesser extent, red lentils contained considerable amounts of lectins. Soaking removed 25-50 percent of the lectins. Most hemagglutinins were destroyed after 10 min of cooking; however, one bean cv. contained considerable amounts even after 20 min of cooking. It has been suggested that the toxic effects in vivo are due to a combination of lectins with carbohydrate moieties on the mucosal cells lining the small intestine. (Summary by C.P.G. Trans. by L.M.F.)

0372

16783 PUSZTAI, A.; CLARKE, E.M.W.; GRANT, G.; KING, T.P. 1981. The toxicity of *Phaseolus vulgaris* lectins. Nitrogen balance and immunochemical studies. *Journal of the Science of Food and Agriculture* 32:1037-1046. En., Sum. En., 39 Ref., II.

Phaseolus vulgaris. Proteins. Toxicity. Animal nutrition. Diets. Phytohaemagglutinins. Biochemistry.

Inclusion of pure lectins isolated from the seeds of kidney bean cv. Processor in diets for rats increased both faecal and urinary losses of N and resulted in a negative N balance for the animals. The relationship between total body N change [y (mg)] and lectin concentration [x g/kg] of the diets was: $y = 42.5 - 75.1x$, which was statistically significant ($P = 0.05$). These rats developed circulating antibodies of low avidity to the dietary lectins, while no other proteins of the diet elicited a similar antibody response. Additionally, in several serum samples from rats which had been fed raw beans, the presence of small amounts of a protein reactive with rabbit anti-lectin antibodies was detected. This protein was isolated from the immune precipitate and was shown by SDS-gel electrophoresis to contain a protein subunit of 30,000, which was very similar to that of pure lectins. It is tentatively suggested that lectin toxicity results from the combined effects of the interference with normal intestinal digestion and/or absorption of N through the damaged enterocytes and of systemic immune (and other) responses of the rat to the internalized lectin. (Author's summary)

0373

17760 MANCINI FILHO, J.; LAJOLO, F.M. 1981. Factores antinutricionais em diferentes variedades de feijoes (*Phaseolus vulgaris* varieties). *Ciencia e Cultura* 33(1):94-97. Pt., Sum. En., Pt., 13 Ref.

Phaseolus vulgaris. Cultivars. Phytohaemagglutinins. Toxicity. Amino acids. Inhibitors. Analysis. Laboratory experiments. Brazil.

In a study of hemagglutinins and trypsin and amylase inhibitors in 15 *Phaseolus vulgaris* var., there was a close positive correlation between agglutination of bovine red blood cells and toxicity in mice. Trypsinization of red cells affected sensitivity to agglutination differently according to var. Var. were placed in 4 groups according to their agglutinating

ability and toxicity. No hemagglutinins and no trypsin or amylase inhibitors were found in the one *Vigna unguiculata* var. used. (Summary by Nutrition Abstracts and Reviews)

0374

19066 GRANT, G.; MORE, L.J.; MCKENZIE, N.H.; PUSZTAI, A. 1982. The effect of heating on the haemagglutinating activity and nutritional properties of bean (*Phaseolus vulgaris*) seeds. *Journal of the Science of Food and Agriculture* 33:1324-1326. En., Sum. En., 14 Ref., II.

Phaseolus vulgaris. Seed. Heat treatment. Phytohaemagglutinins.

The toxic lectins present in red, white, and black kidney beans were sensitive to heat treatment and the efficiency of that treatment is greatly improved by presoaking of the seeds. Heating of presoaked seeds at all temp. above 75 degrees Celsius and a continuous reduction in both their hemagglutinating activity and toxicity. However, the only safe method of eliminating toxicity was to heat the fully hydrated seeds to 100 degrees Celsius for a min. of 10 min. (Author's summary)

0375

19453 DUPUIS, G.; LECLAIR, B. 1982. Studies on *Phaseolus vulgaris* phytohemagglutinin. Structural requirements for simple sugars to inhibit the agglutination of human group A erythrocytes. *Febs Letters* 144(1):29-32. En., 20 Ref., II. (Dept. de Biochimie, Univ. de Sherbrooke, Sherbrooke, Quebec, J1H 5N4, Canada)

Phaseolus vulgaris. Phytohaemagglutinins. Analysis. Sugars.

The specificity of phytohemagglutinin, the lectin from bean, toward agglutination of the major human erythrocyte blood groups was investigated. Agglutination assays were performed according to Liener's technique (1955). Concn. of lectin necessary to bring 50 percent agglutination of the cells were 8 micrograms (group A), 12 micrograms (group O), and 22 micrograms (group B), whereas complete agglutination was observed with 15 micrograms (group A), 40 micrograms (group O), and 40-50 micrograms (group B). A series of monosaccharides was used to assess the structural requirements for these compounds to inhibit the agglutination reaction. Phytohemagglutinin possess, at its sugar binding site, at least one locus which recognizes and discriminates specifically between the nature and configuration of substituents at positions 2 and 4 of the pyranose ring. (Summary by EDITEC. Trans. by L.M.F.)

0376

20851 CHRISPPELS, M.J.; BOLLINI, R. 1982. Characteristics of membrane-bound lectin in developing *Phaseolus vulgaris* cotyledons. *Plant Physiology* 70(5):1425-1428. En., Sum. En., 18 Ref., II. (Dept. of Biology C-016, Univ. of California, San Diego, La Jolla, CA 92093, USA)

Phaseolus vulgaris. Cotyledons. Phytohaemagglutinins. Lectins. USA.

Cotyledons of developing *Phaseolus vulgaris* cv. Greensleeves seeds were labeled for 2-3 h with H-amino acids, and newly synthesized phytohemagglutinin was isolated by affinity chromatography with thyroglobulin-Sepharose. The presence of 1 percent Tween in the homogenate increased the yield of radioactive phytohemagglutinin by 50-110 percent. Isopycnic sucrose gradients were used to show that this detergent-released phytohemagglutinin was associated with the endoplasmic reticulum, and pulse-chase expt. showed that the half-life of the phytohemagglutinin in the endoplasmic reticulum was 90-120 min. Since phytohemagglutinin is transiently associated with the endoplasmic reticulum and accumulates in protein bodies, it was postulated that this rapidly turning over pool of phytohemagglutinin in the endoplasmic reticulum represents protein en route to the protein bodies. The phytohemagglutinin in the endoplasmic reticulum has the same sedimentation constant as mature phytohemagglutinin and is capable of

agglutinating red blood cells. The observations substantiate earlier claims that plant cells contain membrane-bound lectins. However, they also indicate that these lectins are not necessarily functional components of the membranes with which they are associated, but may represent transport pools of lectin normally localized in other cellular compartments. (Author's summary)

0377

17860 MANEN, J.F.; PUSZTAI, A. 1982. Immunocytochemical localisation of lectins in cells of *Phaseolus vulgaris* L. seeds. *Planta* 155(4):328-334. En., Sum. En., 18 Ref., Il.

Phaseolus vulgaris. Seeds. Analysis. Cell structure. Antibodies. Electron microscopy.

Antibodies against pure E- and L-lectins from the seeds of *Phaseolus vulgaris*, raised in rabbits, were made monospecific by immunoaffinity chromatography on E- or L-lectin Sepahrose 4B columns. Localization of lectins in bean seeds was investigated by indirect immunofluorescence and by electron microscopy on sections stained with colloidal gold particles coated with monospecific anti-E- and anti-L-IgG. In parenchyma cells from the cotyledons both E- and L-type lectins were found inside the protein bodies. Apparently the matrix of all protein bodies contained both types of lectins. On the other hand in vascular and in axis cells the 2 types of lectins were localized in the cytoplasm, outside the protein bodies. Thus these findings suggest different roles for the lectins: in cotyledons this may be a specific form of N storage, while in vascular and axis cells lectins may have a more direct metabolic part to play. (Author's summary)

0378

21139 BROWN, J.W.S.; OSBORN, T.C.; BLISS, F.A.; HALL, T.C. 1982. Bean lectins. 1. Relationships between agglutinating activity and electrophoretic variation in the lectin-containing G2/albumin seed proteins of French bean (*Phaseolus vulgaris* L.). *Theoretical and Applied Genetics* 62(3):263-272. En., Sum. En., 15 Ref., Il. (Agrigenetics Corporation, Agrigenetics Research Park, 5649 East Buckeye Road, Madison, WI 53716, USA)

Phaseolus vulgaris. Cultivars. Protein content. Biochemistry. Analysis. Seeds. Amino acids. Snap beans. USA.

Single seeds of 107 bean cv. were analyzed by 2-dimensional electrophoresis. The cv. could be classified into 8 groups by virtue of their G2/albumin electrophoretic patterns. The polypeptide compositions of these types were largely interrelated having particular polypeptides in common. It was possible to correlate the G2/albumin patterns with agglutinating activity of cow and rabbit blood cells as measured by the agglutination ratio (min. concn. of extract required to agglutinate rabbit blood cells). The active lectin polypeptides were identified by extracting lectins from agglutinated erythrocytes and by comparing the qualitative similarities and differences of the G2/albumin patterns and their agglutination activities. A reference catalogue of 107 bean cv., giving their phaseolin and G2/albumin electrophoretic patterns, and agglutination ratios, is presented. (Author's summary)

0379

21320 BROWN, J.W.S.; OSBORN, T.C.; BLISS, F.A.; HALL, T.C. 1982. Bean lectins. 2. Relationship between qualitative lectin variation in *Phaseolus vulgaris* L. and previous observations on purified bean lectins. *Theoretical and Applied Genetics* 62(4):361-367. En., Sum. En., 41 Ref. (Agrigenetics Corporation, Agrigenetics Research Park, 5649 East Buckeye Road, Madison, WI 53716, USA)

Phaseolus vulgaris. Phytohaemagglutinins. Cultivars. Proteins. Seeds. Amino acids. USA.

The relationship between the polypeptide composition and the agglutination behavior of the lectin-containing G2/albumin protein groups allowed the identification of the active

lectin polypeptides in different cv. of *Phaseolus vulgaris*. These results were used to ascertain the particular G2/albumin group contained in the various lectin sources used previously for the purification of lectin proteins. Many studies were found to have included lectin sources which contained the same G2/albumin pattern (FG2) and this permitted direct comparison of the properties reported for these purified lectins. Thus, much of the extensive literature on bean lectins is confirmed. (Author's summary)

0380

72253 BENDER, A.E.; READI, G.B. 1982. Toxicity of kidney beans (*Phaseolus vulgaris*) with particular reference to lectins. *Journal of Plant Foods* 4(1): 15-22. En., Sum. En., 13 Ref., Il. (Dept. of Food Science & Nutrition, Queen Elizabeth College, London W8, England)

Proteins. Toxicity. Animal nutrition. Human nutrition. Nutritive value. Protein content. Cooking. United Kingdom. Composition. Europe.

Toxicity of kidney beans, with particular reference to lectins, was evaluated. All samples of beans were purchased locally and their history was not known. Beans were soaked in 3 parts of tap water for 16-18 h at room temp. If they were to be cooked, the soaking water was discarded and the beans cooked in fresh water for 30 min at 100 degrees Celsius in an open pan. Cooking times were measured from the time of addition of beans to boiling water. Hemagglutinating activity was determined. Only 3 bean var. (red, white kidney, and rose coco) contained large amounts of lectins relative to the amounts found in the other 6 types examined. Red and white kidney beans were lethal to all 3 rats in each group when fed at 20 percent of the diet for 14 days. When fed at 10 percent of the diet, despite the fact that this provided only 2.5 percent protein, the animals survived the 14-day feeding period. The group of animals gained approx. 55 g in 15 days when fed cooked red or white kidney beans. Lectins can be destroyed by heat. Heating at 80 degrees Celsius increases the amount of lectin (as determined by in vitro hemagglutination) about 5-fold, so that incompletely cooked beans may be more toxic than when eaten raw. (CIAT)

0381

20666 CHRISPEELS, M.J. 1983. Incorporation of fucose into the carbohydrate moiety of phytohemagglutinin in developing *Phaseolus vulgaris* cotyledons. *Planta* 157(5):454-461. En., Sum. En., 37 Ref., Il. (Dept. of Biology, C-016, Univ. of California/San Diego, La Jolla, CA 92093, USA)

Phaseolus vulgaris. Cotyledons. Phytohaemagglutinins. Proteins. Analysis. Enzymes.

Incubation of developing *Phaseolus vulgaris* cotyledons with (3)H-fucose resulted in the incorporation of radioactivity into the cell wall, membranous organelles, and soluble macromolecules. Fractionation of the proteins showed that phytohemagglutinin (PHA) was the major fucosylated protein synthesized in the cotyledons. Incorporation of fucose into PHA occurred in the membranous organelle fraction and the radioactive fucose remained associated with the PHA during a 20-h chase of the radioactivity. Tunicamycin inhibited incorporation of glucosamine and fucose into PHA to the same extent (65 percent), indicating the involvement of a lipid intermediate in the incorporation of fucose, or the attachment of fucose to the high-mannose oligosaccharide moiety of newly synthesized PHA. Digestion with proteinase K of (3)H-fucose- or (3)H-glucosamine-labelled PHA resulted in the formation of glycopeptides of similar size. These glycopeptides were partially resistant to digestion with endo-beta-N-acetylglucosaminidase N, even after the removal of fucose by mild acid hydrolysis. It is suggested that the transport of PHA from the endoplasmic reticulum to the protein bodies is accompanied by the modification involves the attachment of fucose and renders the oligosaccharide side-chain resistant to digestion with endo-beta-N-acetylglucosaminidase H. Analogy with animal glycoproteins indicates that this modification probably occurs in the Golgi apparatus. (Author's summary)

21563 OSBORN, T.C.; AUSLOOS, K.A.; BROWN, J.W.S.; BLISS, F.A. 1983. Bean lectins. 3. Evidence for greater complexity in the structural model of Phaseolus vulgaris lectin. Plant Science Letters 31:193-203. En., Sum. En., 17 Ref., Il. (Dept. of Horticulture, Univ. of Wisconsin, Madison, WI 53706, USA)

Phaseolus vulgaris. Lectins. Bean flour. Proteins. USA.

Purified lectin proteins from the bean cv. Tendergreen were separated on S-P Sephadex C-50. The 5 major fractions obtained corresponded to the postulated 5 tetrameric forms: E4, E3L1, E3L2, E1L3, and L4, composed of an erythro-agglutinating subunit (E) and a leuco-agglutinating subunit (L). Further separation using 1- and 2-dimensional electrophoresis showed greater complexity for the polypeptide composition of these fractions. In particular, 2 major polypeptides differing from the major erythro-agglutinating polypeptides were found in the L4, E1L3, and E2L2 fractions. Also, 2 minor polypeptides were present in the E4, E3L1, E2L2, and E1L3 fractions. (Author's summary)

25632 BENDER, A.E. 1983. Haemagglutinins (lectins) in beans. Food Chemistry 11(4):309-320. En., Sum. En., 18 Ref., Il. (Dept. of Nutrition, Queen Elizabeth College, Univ. of London, London, England)

Phaseolus vulgaris. Lectins. Composition. Cooking. Human nutrition. United Kingdom.

Studies on lectin content of beans (red kidney, white kidney, and rose coco beans), in vivo toxicity, heat destruction, and inadequate cooking were conducted. Of 9 types of legumes tested, only the types of *Phaseolus vulgaris* contained large amounts of lectins (from 17,000 to 53,000 hemagglutinin units). Lectin removal by overnight water soaking was high, ranging from 20 to 70 percent for 3 red kidney bean samples. Most of the rats fed diets containing raw beans at 6-80 percent levels died within 7 days on both red and white kidney beans. Differential results were obtained on lectin destruction by heating for varying intervals (2, 5, 10, or 20 min); a small amount of agglutinating power remained in red kidney beans after 20 min cooking at 100 degrees Celsius. There is an increase in toxicity when cooking is at 70-80 degrees Celsius. Comments are made on infant feeding with beans. (CIAT)

28655 HARA, T.; TSUKAMOTO, I.; MIYOSHI, M. 1983. Oral toxicity of Kintoki bean (*Phaseolus vulgaris*) lectin. Journal of Nutritional Science and Vitaminology 29(5):589-595. En., Sum. En., 24 Ref., Il. (Graduate Division of Human culture, Nara Women's Univ., Nara 630, Japan)

Phaseolus vulgaris. Laboratory animals. Animal nutrition. Lectins. Diets. Japan.

Expt. with mice and rats revealed that lectin is mainly responsible for growth impairment. Mice fed raw Kintoki (*Phaseolus vulgaris*) bean as the only protein source lost body wt. and died in 8 days, while mice fed autoclaved bean (120 degrees Celsius for 20 min) grew normally. When mice on a 10 percent albumin diet ingested 20, 40, or 6 mg Kintoki bean lectin by daily stomach feeding, their body wt. were reduced to 84, 74, and 71 percent of the control group after 5 days, resp., and some of them did not live to complete the expt. The apparent rates of the intestinal absorption of carbohydrate, lipid, and protein were considerably reduced when protein absorption was decreased from 55.5 to 26.3 percent of the control rate. The main tissues of mice that had ingested Kintoki bean lectin by stomach feeding were subjected to microscopic observation. No changes were observed in the liver, kidney, spleen, and pancreas, but in the small intestine the epithelial cells lining the villi were considerably disordered and conspicuously disrupted. These results indicate that the Kintoki bean lectin is one of the main factors promoting growth

impairment in exptl. animals and that the 1st target organ in the case of oral feeding is the small intestine. (AS)

0385

28962 BANWELL, J.G.; BOLDT, D.H.; MEYERS, J.; WEBER JUNIO, F.L.; MILLER, B.; HOWARD, R. 1983. Phytohemagglutinin derived from red kidney bean (*Phaseolus vulgaris*): a cause for intestinal malabsorption associated with bacterial overgrowth in the rat. *Gastroenterology* 84(3):506-515. En., Sum. En., 53 Ref., II. (Division of Gastroenterology & Clinical Nutrition, Dept. of Medicine, Case Western Reserve Univ., Cleveland, OH 44106, USA)

Phaseolus vulgaris. Phytohemagglutinins. Analysis. Animal nutrition. Diets. Animal Physiology. USA.

The effects of phytohemagglutinin, a lectin derived from raw red kidney bean, on small intestinal absorptive function and morphology, and on the intestinal microflora, were studied. Phytohemagglutinin was isolated in purified form by thyroglobulin-Sepharose 4B affinity chromatography. Red kidney bean and phytohemagglutinin (6.0 and 0.5 percent, resp., of dietary protein) were fed in a purified casein diet to weanling rats for up to 21 days. Wt. loss, associated with malabsorption of lipid, N, and vitamin B12, developed in comparison with animals pair-fed isonitrogenous casein diets. Antinutritional effects of red kidney bean were reversible on reinstatement of a purified casein diet. An increase in bacterial colonization of the jejunum and ileum occurred in animals fed red kidney bean and phytohemagglutinin. When antibiotics were included in the diet, malabsorption of (3H)triolein and (S7)covitamin B12 in red kidney bean-fed animals was partially reversed and, in germ-free animals, purified phytohemagglutinin had no demonstrable antinutritional effect. [AS (Extract)]

0386

26088 PUSZTAI, A.; GREER, F. 1984. Effects of dietary legume proteins on the morphology and secretory responses of the rat small intestine. *Protides of the biological fluids. Proceedings of the Colloquium* 32:347-350. En., Sum. En., 19 Ref. (Rowet Research Inst., Bucksburn, Aberdeen, Scotland, UK)

Animal physiology. Diets. Laboratory animals. Lectins. *Phaseolus vulgaris*. Proteins. United Kingdom.

The dry wt. of the small intestine of rats fed on a diet containing kidney bean proteins doubles in 10 days, while the wt. of all other organs and total body mass decreases. The effect is reversible initially. Both secretion of mucin (protein and carbohydrate content increases by nearly 100 percent) and increases in cell no. (DNA up by nearly 40 percent) are stimulated by these proteins. The increased secretion into the lumen is partly the result of a lectin-related local anaphylaxis and partly of a direct stimulatory effect of phaseolin (glycoprotein II) on the secretory response of small intestinal cells including goblet cells. Small intestinal cell proliferation is probably due to a stimulation by the lectins of beans (perhaps mitogenic effect) on cellular processes. A combination of all these results in large losses of endogenous N for the animal and leads to an apparent poor utilization of legume proteins. (AS)

0387

26283 MANEN, D.; MANEN, J.F.; MORGAN, M.R. 1984. *Phaseolus vulgaris* lectin heterogeneity related to their metal content. *Plant Science Letters* 37(1-2): 105-110. En., Sum. En., 19 Ref., II. (Inst. de Botanique, University de Geneve, 1 Chemin de l'Imperatrice, 1292 Chambesy/Geneve, Switzerland)

Ca. Lectins. Mineral content. Mn. *Phaseolus vulgaris*.

The seed lectins of *Phaseolus vulgaris* cv. Contender typically consist of 5 tetrameric isolectins E4, E3L, E2L2, E13, and 1A. However, electrophoretic and isoelectric focusing analysis of each purified protomer show a great heterogeneity. It was demonstrated that each tetrameric isolectin exists in 5 different electrophoretic forms depending on the amount of Mn(2+) cation bound to each isolectin. The effects of Mn(2+) binding on charge and/or mol. properties of the promoters are discussed. Under the sample exptl. conditions, if Ca(2+) ions are used instead of Mn(2+), the above modifications are not observed. (AS)

0388

25657 OSBORN, T.C.; BROWN, J.W.S.; BLISS, F.A. 1985. Bean lectins. 5. Quantitative genetic variation in seed lectins of *Phaseolus vulgaris* L. and its relationship to qualitative lectin variation. Theoretical and applied genetics 70(1):22-31. En., Sum. En., 32 Ref., II. (Arco Plant Cell Research Inst., 6560 Trinity Ct., Dublin, CA 94596, USA)

Phaseolus vulgaris. Phytoalexins. Phaseollin. Seed. Cultivars. Proteins. Bean flour. Composition. USA.

Seeds of 40 bean cv. having different lectin types were analyzed for quantities of lectin, phaseolin, and total protein. Significant differences were found among groups of cv. with different lectin types for the quantity of lectin and phaseolin. Cv. with more complex lectin types based on isoelectric focusing-SDS-polyacrylamide gel electrophoresis tended to have higher quantities of lectin and lower quantities of phaseolin than cv. with simple lectin types. An association between lectin type and the quantity of lectin and phaseolin was found also in the seeds of F2 plants that segregated in a Mendelian fashion for 2 lectin types. Seeds from plants with the complex lectin type had more lectin and less phaseolin than seeds from plants with the simple lectin type. Therefore, the genes controlling qualitative lectin variation also may influence the quantitative variation of lectin and phaseolin. The results of this study are related to other studies on the quantitative variation for seed proteins and to the possible mol. basis for variation in the quantity of lectins in beans. (AS)

0389

25666 GRANT, G.; GREER, F.; MCKENZIE, N.H.; PUSZTAI, A. 1985. Nutritional response of mature rats to kidney bean (*Phaseolus vulgaris*) lectins. Journal of the Science of Food and Agriculture 36(5):409-414. En., Sum. En., 14 Ref., 1. (Rowett Research Inst., Bucksburn, Aberdeen AB2 9SB, England)

Phaseolus vulgaris. Nutritive value. Animal nutrition. Animal physiology. Diets. Proteins. United Kingdom.

In a series of 10-day pair feeding expt. it was found that the nutritional value of diets containing beans was essentially the same for rats aged between 30-123 days. Thus, NPU values of 25-39 on diets containing processor bean (35 g protein/kg) + egg albumin (65 g protein/kg) were obtained. As food intakes were considerably reduced when rats were fed diets containing more than 35 g protein/kg processor bean, the measurement of protein utilization became increasingly more difficult. The severe disruption of the brush borders of duodenal and jejunal enterocytes, originally observed when bean-containing diets were fed to young (30-day-old) rats, was also found with rats up to the age of 120 days on similar diets. Similarly, the development of circulating antilectin antibodies in the animals showed no age dependence within the age limits investigated. It was also shown that oral immunization did not protect the rats from the effects of toxicity and that the immune response was a result of continuous absorption of lectin throughout the feeding period. Thus, the extent and the mechanism of toxicity of *Phaseolus vulgaris* bean lectins were found not to be dependent on the age of maturity of the animal. (AS)

26081 NAKTA, S.; KIMURA, T. 1985. Effect of ingested toxic bean lectins on the gastrointestinal tract in the rat. *Journal of Nutrition* 115(12): 1621-1629. En., Sum. En., 31 Ref., II. (Laboratory of Food & Nutrition, Dept. of Home Economics, Osaka Kyoiku Univ., Ikeda, Osaka 563, Japan)

Animal physiology. Diets. Enzymes. Laboratory animals. Lectins. *Phaseolus vulgaris*.

A study was undertaken to provide further evidence for the mechanisms proposed for the toxicity of ingested bean lectins in animals: (1) to show the stability of concanavalin A (Con A) in the gastrointestinal tract so that it has enough time to interact with some enzymes localized in the intestinal membrane and (2) to find its effect on the activities of those enzymes that have been adopted as criteria for adaptive changes in response to altered diets, namely intestinal sucrase, alkaline phosphatase, and leucine aminopeptidase. Significant amounts of ingested Con A were recovered unaltered (as seen from affinity chromatography and electrophoresis) from the cecal content of rats 4 h after its oral administration and from feces (90 percent recovery) 4 days later. This indicated that the Con A is quite stable during its passage through the gastrointestinal tract. Con A, given at a level of 0.3 or 0.5 percent in the diet, completely prevented adaptive changes in the activities of those enzymes. These results substantiate the mechanisms proposed earlier by other investigators that the toxicity of ingested bean lectins involves their binding to the luminal surface of the small intestine, where they disturb the function of the brush-border membrane. (AS)

26250 BOLLINI, R.; CERIOTTI, A.; DAMINATI, M.G.; VITALE, A. 1985. Glycosylation is not needed for the intracellular transport of phytohemagglutinin in developing *Phaseolus vulgaris* cotyledons and for the maintenance of its biological activities. *Physiologia Plantarum* 65(1):15-22. En., Sum. En., 31 Ref., II. (Istituto Biosintesi Vegetali, Consiglio Nazionale Delle Ricerche, Via Bassini 15, I-20133, Milano, Italy)

Cotyledons. Italy. *Phaseolus vulgaris*. Phytohemagglutinin. Proteins.

Approx. 10 percent of the total protein contained in *Phaseolus vulgaris* cv. Greensleeves seeds is composed of the glycoprotein lectin, phytohemagglutinin. Whether the presence of N-linked oligosaccharide side chains is a prerequisite for the correct intracellular transport of this protein and whether unglycosylated phytohemagglutinin maintains its biological activities were investigated. Excised developing cotyledons were incubated in the presence of tunicamycin to prevent glycosylation *in vivo*, and the fate of the unglycosylated protein synthesized in such cotyledons determined. It was found that unglycosylated phytohemagglutinin reaches its normal site of accumulation, the protein bodies, and maintains erythroagglutinating and mitogenic activities. (AS)

26268 OSBORN, T.C.; BLISS, F.A. 1985. Effects of genetically removing lectin seed protein on horticultural and seed characteristics of common bean. *Journal of the American Society for Horticultural Science* 110(4):484-488. En., Sum. En., 25 Ref., II. (Arco Plant Cell Research Inst., 6560 Trinity Ct., Dublin, CA 94568, USA)

Backcrossing. Cultivars. Genetics. Phaseollin. *Phaseolus vulgaris*. Phytohemagglutinins. Proteins. USA.

The absence of lectin in common bean was shown to be inherited as a single recessive gene and allelic to genes conditioning 6 different lectin types. In inbred backcross lines, the allele from Sanilac (a navy class bean) for the presence of lectin was semidominant to the lectinless allele from U.I. 1140 (a Great Northern class bean) for quantity of lectin. Backcross lines with lectin (L/L) and without lectin (l/l) were developed using 2 lectinless donor parents (U.I. 1140 and U.I. 111, a Pinto class bean) and Sanilac as the

recurrent parent. Backcross lines and parents were grown in the field (Wisconsin, USA) and analyzed for days to flower, seed yield and wt., percentage protein, and quantities of lectin and phaseolin. There were significant differences between lectin genotypes (L/L vs L./L.) for all traits except yield, seed wt., and nonphaseolin nonlectin protein. Backcross lines without lectin had substantially higher levels of phaseolin and slightly more total protein than lines with lectin. The data suggested that phaseolin overcompensated for the absence of lectin L./L. backcross lines. The implications of these findings toward the nutritional improvement of bean protein are discussed. (AS)

0393

27231 VITALE, A.; CERIOTTI, A.; BOLLINI, R. 1985. Molecular analysis of a phytohemagglutinin-defective cultivar of *Phaseolus vulgaris* L. *Plant* 166(2): 201-207. *En., Sum. En.*, 26 Ref., II. (Inst. Biosintesi Vegetali, Consiglio Nazionale Delle Ricerche, Via Bassini 15, I-20133 Milano, Italy)

Phaseolus vulgaris. Phytohemagglutinins. Cultivars. Genes. Proteins. DNA. Nucleic acids. Italy.

Using phytohemagglutinin complementary-DNA clones and monospecific antibodies, bean cv. Pinto III genomic DNA and cotyledonary proteins, synthesized both in vitro and in vivo, were analyzed. Genomic DNA sequences that hybridize with complementary-DNA clones for the 2 different classes of phytohemagglutinin polypeptides (E and L), at levels comparable with a normal bean cv., were detected. This indicated that the cv. Pinto III phenotype was not the result of a large deletion of the phytohemagglutinin structural genes. Messenger RNA isolated from cv. Pinto III developing cotyledons synthesized in vitro very small amounts of a protein which was recognized by antibodies specific for phytohemagglutinin, and gave, on SDS-polyacrylamide gel electrophoresis, a single band with mol. wt. similar but not identical to that of phytohemagglutinin-L polypeptides. This protein was also synthesized in vivo at a very reduced level, less than 1 percent compared with phytohemagglutinin in normal cv., and had mitogenic activity comparable with that of the phytohemagglutinin-L-subunit, while it showed very weak erythroagglutinating activity. The initial steps in the synthesis and processing of this protein were identical to those already identified for phytohemagglutinin polypeptides. The cv. Pinto III protein could be either a phytohemagglutinin-L polypeptide whose synthesis is not affected by the mutation or a phytohemagglutinin-like lectin present normally at low levels in beans. (AS)

0394

27228 HOFFMAN, L.M.; DONALDSON, D.D. 1985. Characterization of two *Phaseolus vulgaris* phytohemagglutinin genes closely linked on the chromosome. *European Molecular Biology Organization Journal* 4(4):883-889. *En., Sum. En.*, 38 Ref., II. (Agrigenetics Advanced Research Division, 5649 East Buckeye Road, Madison, WI 53716, USA)

Phaseolus vulgaris. Phytohemagglutinins. Lectins. DNA. Genes. USA.

A lambda 1059 library of *Phaseolus vulgaris* cv. Tendergreen DNA was screened with a cloned lectin-like cDNA. Among the phages selected was clone lambda B10 containing 2 complete lectin genes in the same orientation approx. 4 kilobases apart. The DNA sequences of the lectin genes and their flanking regions were determined and their transcriptional initiation sites were located by S1 nuclease mapping. On the basis of the deduced amino acid sequences and compositions and the mol. wt. of their encoded glycoproteins, the genes, DLEC1 and DLEC2, are predicted to encode erythro- and leucoagglutinating phytohemagglutinins, resp. [AS (Extract)]

0395

27456 ROUANET, J.M.; LAFONT, J.; CHALET, M.; CREPPY, A.; BESANCON, P. 1985. Effects of dietary kidney bean (*Phaseolus vulgaris*) lectins in growing rats. *Nutrition*

Reports International 31(1):237-244. En., Sum. En., 24 Ref. (Laboratoire de Physiologie de la Nutrition, Universite de Montpellier II, 34060 Montpellier, France)

Phaseolus vulgaris. Phytohemagglutinins. Diets. Animal nutrition. Animal physiology. France.

Growing rats were fed for 17 days with a diet containing purified lectins (0.25 percent of the DM) from *Phaseolus vulgaris* (phytohemagglutinin). The dietary lectins elicited mainly a food intake decrease and extensive alterations of the small intestinal mucosa; growth was concomitantly impaired, but this impairment appeared to be a consequence of the food intake decrease. In this process, however, a possible contribution of the mucosal alterations is not ruled out. Besides, mucosal alterations did not appear to be mediated through direct inhibition of brush border hydrolases by phytohemagglutinin. (AS)

0396

27771 BOLLINI, R.; ALLAVENA, A.; VITALE, A. 1985. Genomic analysis of phytohemagglutinin-deficient *Phaseolus vulgaris* cultivars. Bean Improvement Cooperative. Annual Report 28:82. En. (Istituto Biosentesi Vegetali, Consiglio Nazionale Delle Ricerche, Via Bassini 15, 20133 Milano, Italy)

Phaseolus vulgaris. Phytohemagglutinins. Cultivars. Genes. DNA. Mutation. Hybridizing. Italy.

A total of 160 bean cv. of the collection maintained at the Centro Ricerche Orticole in Minoprio, Italy, were screened for lack of phytohemagglutinin. eight of them (Degli Ortolani, Heidi, S. Fiacre Verde, 3067, 3628, 103221, 103249, and 197181) resulted deficient in phytohemagglutinin. Tests of allelism among these cv. were made. The presence of phytohemagglutinin genes on the DNA of these mutants was investigated using cDNA probes for the 2 phytohemagglutinin subunits. Positive hybridization was obtained for all cv., ruling out the possibility of major deletions of the phytohemagglutinin genes. (CIAT)

0397

29662 GREER, F.; PUSZTAI, A. 1985. Toxicity of kidney bean (*Phaseolus vulgaris*) in rats: changes in intestinal permeability. Digestion 32(1):42-46. En., Sum. En., 16 Ref., (The Rowett Research Inst., Bucksburn, Aberdeen AB2 9SB, Scotland)

Phaseolus vulgaris. Animal nutrition. Antinutritional factors. Proteins. Lectins. United Kingdom.

Rats fed con diets containing kidney bean showed increased intestinal permeability to intravenously injected (125)I-labelled rat serum proteins after an intragastric challenge with bean proteins. The enhanced accumulation of radioactive serum proteins in the lumen and walls of the small intestine indicated increase vascular permeability. It is suggested that dietary lectins may, at least in part, be responsible for this loss of serum proteins and thus contribute towards the overall toxicity of kidney bean proteins. (AS)

0398

24437 COFFEY, D.G.; UEBERSAX, M.A.; HOSFIELD, G.L.; BRUNNER, J.R. 1985. Evaluation of the hemagglutinating activity of low-temperature cooked kidney beans. Journal of Food Science 50(1):78-81,87. En., Sum. En., 22 Ref., II. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824-1244, USA)

Cooking. Dietary value. USA. North America. America.

A methodology was developed that allowed sensitive measurement of phytohemagglutinin, the lectin of kidney beans. Trypsinated porcine red blood cells were

treated with saline extracts of kidney beans, incubated, and the nonagglutinated cells were quantitated using a coulter counter. This hemagglutinated activity assay was then used to monitor the phytohemagglutination in cooked kidney beans. The thermal treatment required to reduce hemagglutination activity by 1 log cycle was: 12, 62, 136, and 160 min at 100, 93, 88, and 82 degrees Celsius, resp. Beans were prepared in commercially available low-temp. cookers and evaluated for tenderness and residual hemagglutinating activity. (AS)

0399

25617 BANWELL, J.G.; HOWARD, R.; COOPER, D.; COSTERON, J.W. 1985. Intestinal microbial flora after feeding phytohemagglutinin lectins (*Phaseolus vulgaris*) to rats. *Applied and Environmental Microbiology* 50(1):68-80. En., Sum. En., 41 Ref., II. (Division of Gastroenterology, Dept. of Medicine, Case Western Reserve School of Medicine, Cleveland, OH 44106, USA)

Dietary value. *Phaseolus vulgaris*. Phytohemagglutinins. USA.

In all rats treated with phytohemagglutinin lectins derived from red kidney beans, bacteria formed adherent monospecific or mixed adherent microcolonies on the tissue surface. Tissue damage was observed in phytohemagglutinin-exposed jejunal tissue. On the ileal surfaces of controls, there was a thick mucous layer within which small no. of bacteria and protozoa were seen. Segmented filamentous bacteria were anchored in the tissue surface. In phytohemagglutinin-treated rats, the ileal surface was only incompletely covered by a mucous layer, and the overlying mucosal surface was extensively covered by large no. of protozoan cells (predominantly *Hexamita muris*). [AS (Extract)]

0400

28064 MANEN, J.F.; COMTE, M. 1986. Each *Phaseolus vulgaris* isolectin exists in five electrophoretic forms related to the number of metal ions bound per molecule. *Plant Science* 43(1):51-56. En., Sum. En., 21 Ref., II. (Inst. de Botanique, Univ. de Geneve, 1 Chemin de l'Imperatrice, 1292 Chambesey/Geneve, Switzerland)

Phaseolus vulgaris. Lectins. Analysis. Switzerland.

Analysis of the pH 8.3 electrophoresis of the *Phaseolus vulgaris* seed lectins suggests that each of the 5 isolectins exists in 5 different forms. Incubations of the lectins in the presence of EDTA or of metal ions such as Mn(2+), Mg(2+), Co(2+), and Ni(2+) show that their different electrophoretic behaviors are related to the binding of metal ions to the molecules. Determinations of the isolectin metal content by atomic absorption measurements demonstrate that at pH 8.3 their 5 electrophoretic forms are related to the no. of subunits (0, 1, 2, 3, or 4) that contain metal ions in the tetrameric molecules. (AS)

0401

28941 WOOLF, N.J.; HERNIT, M.C.; BUTCHER, L.L. 1986. Cholinergic and noncholinergic projections from the rat basal forebrain revealed by combined choline acetyltransferase and *Phaseolus vulgaris* leucoagglutinin immunohistochemistry. *Neuroscience Letters* 66(3):281-286. En., Sum. En., 12 Ref., II.

Phaseolus vulgaris. Animal physiology. Biochemistry. Lectins. Analysis. USA.

A 2-color fluorescence method is described for demonstrating immunohistochemically and anterogradely transported plant lectin *Phaseolus vulgaris* leucoagglutinin (Phal, fluorescein isothiocyanate label) and cholineacetyltransferase (CHAT, rhodamine label) on the same rat brain section. Application of this method to the study of projection neurons in the vertical and horizontal limbs of the diagonal band, the substantia innominata, and nucleus basalis revealed that both cholinergic and noncholinergic pathways followed similar trajectories to their targets. [AS (Extract)]

29114 FAYE, L.; STURM, A.; BOLLINI, R.; VITALE, A.; CHISPEELS, M.J. 1986. The position of the oligosaccharide side-chains of phytohemagglutinin and their accessibility to glycosides determines their subsequent processing in the golgi. European Journal of Biochemistry 158(3):655-661. En., Sum., En., 28 Ref., II. (Dept. of Biology, Univ. of California, San Diego, La Jolla, USA)

Phaseolus vulgaris. Phytohemagglutinins. Analysis. Enzymes.

Phytohemagglutinin (PHA), the glycoprotein lectin of *Phaseolus vulgaris*, has 2 types of asparagine-linked oligosaccharides/polypeptide: a high-mannose chain with the formula (MAN)₈₋₉(G1.C1NAC)₂ on ASN(12) and a modified chain with fewer mannose residues and additional fucose and xylose residues on ASN(60). Glycosylation of PHA is a cotranslational process, which occurs in the endoplasmic reticulum, and newly synthesized PHA has 2 high-mannose chains. Transport of PHA to the protein bodies via the golgi complex is accompanied by the modification of 1 of the 2 high-mannose chains. By determining the effect of digestion with various glycosidases (alpha-mannosidase, endo-beta-N-acetylglucosaminidase II, and endo-beta-N-acetylglucosaminidase F) on native and denatured PHA, evidence was obtained that was consistent with the interpretation that the accessibility of oligosaccharide chains to modify enzymes is of major importance in determining whether a high-mannose chain becomes modified or not. The high-mannose chain of mature undenatured PHA is only partially accessible to glycosidases, while PHA obtained from the endoplasmic reticulum has 1 high-mannose chain, which is readily accessible to alpha-mannosidase and endoglycosidases II and F. This readily accessible chain was in the same position on the polypeptide (ASN(60)) as the modified oligosaccharide on mature PHA. Thus, accessibility of the oligosaccharide side-chains to processing enzymes in the golgi determines whether a particular oligosaccharide side-chain is processed or not. (AS)

0403

29183 DOBBINS, J.W.; LAURENSEN, J.P.; GORELICK, F.S.; BANWELL, J.G. 1986. Phytohemagglutinin from red kidney bean (*Phaseolus vulgaris*) inhibits sodium and chloride absorption in the rabbit ileum. Gastroenterology 90(6):1907-1913. En., Sum. En., 22 Ref., II. (Dept. of Medicine, Yale Univ. School of Medicine, P.O. Box 3333, New Haven, CT 06510, USA)

Phaseolus vulgaris. Phytohemagglutinins. Diets. Animal nutrition. USA.

Phytohemagglutinin, derived from red kidney bean, can induce malabsorption and diarrhea when fed to rats. The effect of phytohemagglutinin on ion transport in the rabbit ileum *in vitro* was determined. Compared with control tissues, phytohemagglutinin (1 mg/ml) added to the mucosal solution increased short-circuit current, decreased net Na and Cl absorption, and decreased tissue conductance. It is suggested that dietary lectins may play a role in regulating intestinal fluid and electrolyte transport. [AS (Extract)]

0404

29194 KING, T.P.; PUSZTAI, A.; GRANT, G.; SLATER, D. 1986. Immunogold localization of ingested kidney bean (*Phaseolus vulgaris*) lectins in epithelial cells of the rat small intestine. Histochemical Journal 18(8):413-420. En., Sum. En., 22 Ref., II. (Rowett Research Inst., Bucksburn, Aberdeen, AB2 9SB, Scotland)

Phaseolus vulgaris. Lectins. Animal nutrition. Analysis. United Kingdom.

The interactions between dietary kidney bean lectins and the epithelial cells of the rat small intestine were investigated by immunogold electron microscopy. The results demonstrated that the lectins bind to the glycocalyx of duodenal and jejunal microvilli and that some of these dietary constituents are endocytosed into lysosomal pathways within

both absorptive and secretory gut cells. It is concluded that the lysosomal response serves to limit the absorption of nutritionally significant levels of these dietary toxins. (AS)

0405

29631 KOEHLER, H.H.; HERRICK, H.E.; BURKE, D.W. 1986. Differentiating the lectin activity in twenty-four cultivars of dry beans (*Phaseolus vulgaris* L.). *Journal of Food Science* 51(6):1471-1475. En., Sum. En., 43 Ref., II. (Dept. of Food Science & Human Nutrition, Washington State Univ., Pullman, WA 99164-2032, USA)

Phaseolus vulgaris. Cultivars. Phytohemagglutinins. Animal nutrition. Antinutritional factors. Analysis. USA.

Hemagglutination activity of 24 dry bean cv. was estimated with rabbit, rat, bovine, and human erythrocytes. NPU evaluated the nutritional toxicity to weanling rats of the beans fed at 10 percent protein. Nonprotein and 10 percent-casein control diets were included. SDS-polyacrylamide gel electrophoresis indicated lectin-containing beans. Beans evaluated (in order of decreasing lectin activity) were: Aurora, Sanilac, Royal Red, Red Kloud, Roza, Rufus, Harris, Viva, Fiesta, Black Turtle Soup, Chief, Hyden, UI-59 Sutter. The following were nontoxic: Blue Mountain, GN-1140, Holberg, Nodack, Olathe, Pindak, JM-126, NW-410, NW-590, UI-114. Combined hemagglutination tests and SDS-polyacrylamide gel electrophoresis enabled rapid screening of dry beans for toxic lectins. (AS)

0406

29673 BOUFASSA, C.; LAFONT, J.; ROUANET, J.M.; BESANCON, P. 1986. Thermal inactivation of lectins (PHA) isolated from *Phaseolus vulgaris*. *Food Chemistry* 20(4):295-304. En., Sum. En., 22 Ref., II. (Laboratoire de Physiologie de la Nutrition, Universite des Sciences et Techniques du Languedoc, 24060 Montpellier Cedex, France)

Phaseolus vulgaris. Seeds. Phytohemagglutinins. Heat treatment. Analysis.

The influence of the thermal process on the loss of ability to bind a carbohydrate target was studied on lectins (phytohemagglutinin) purified from *Phaseolus vulgaris* seeds. Thermal inactivation of aqueous solutions of pure phytohemagglutinin occurred according to a biphasic 1st-order mechanism. The 1st order rate constants appeared to be dependent on pH (minimal around 7) and divalent cations. All different subunits constituting the whole phytohemagglutinin were inactivated at the same rate. The biphasic nature of this process is independent of the presence of 10 millimolar Ca(++) or Mg(++) and appeared to indicate a discrete aggregation of phytohemagglutinin molecules. [AS (Extract)]

0407

29722 ESTRUCH, R.; DAMHANOV, I. 1986. Lectin histochemistry applied to human nerves. *Archives of Pathology and Laboratory Medicine* 110(8):730-735. En., Sum. En., 24 Ref., I. (Dept. of Pathology & Laboratory Medicine, Hahnemann Univ., Philadelphia, PA 19102-1192, USA)

Phaseolus vulgaris. Lectins. Biochemistry. Human physiology. Analysis. USA.

Eight plant lectins, among them types E1 and I4 from *Phaseolus vulgaris*, were found to bind to normal and pathologically altered nerves in humans. Only 2 lectins, from *Helix pomatia* and *Maclura pomifera*, were found to bind selectively to pathologically altered nerves. The changes recognized by lectin histochemistry were not pathognomonic of any specific type of nerve injury. This study provides baseline data on the reaction pattern of human peripheral nerve with a series of lectins and shows that lectin histochemistry could provide means for the study of peripheral nerve pathology. [AS (Extract)]

29971 CASTRESANA, M.C.; SERRA, M.T.; RODRIGUEZ, J.F.; TEJERINA, G. 1987. Distribution of lectin during the life cycle of *Phaseolus vulgaris* L. *Plant Science* 48(2):79-88. En., Sum. En., 22 Ref., II. (Centro de Investigaciones Biológicas, CSIC Velázquez 144, 28006, Madrid, Spain)

Phaseolus vulgaris. Seeds. Seedling. Developmental stages. Lectins. Composition. Spain.

Phaseolus vulgaris cv. Garrafal Encarnada plants were used to study the distribution of lectins accumulated in the seeds and throughout the life cycle of the plant. The distribution of both total proteins and lectins was studied in aqueous and saline (1 molar NaCl) extracts from different parts and organs in 4 distinct stages of plant development (small seedling, plant with 1st trifoliate leaves, plant in preflowering state, and mature plant with fruit). Lectin concn. decreased sharply during the 1st weeks of plant growth, reaching the lowest value in the trifoliate leaf stage and increasing during the following phases of plant development. The presence of lectins, however, was detected in all the plant tissues throughout every phase of the life cycle. The differences observed in lectin levels (radioimmunoassay) and lectin activity (hemagglutination) indicate the presence of different mol. forms of the lectin in aqueous and saline extracts of plant tissues. These results, as well as the observations on the fixation of lectin on the bacterial surface, support the idea that the function of lectins in the plant may not be limited to storage proteins, but may be involved in specific host-parasite recognition. (AS)

TANNINS

0409

3061 RONNENKAMP, R.R. The effect of tannins on nutritional quality of dry beans, *Phaseolus vulgaris* L. Ph.D. Thesis. West Lafayette, Indiana, Purdue University; 1976. 52p. En., Sum. En., 62 Ref.

Phaseolus vulgaris. Phenolic content. Analysis. Protein content. Seed characters. Seed color. Diets. Amino acids. Seed coat. Nutritive value. Crossbreeding.

Tannin compounds are often associated with a bitter taste in foods. In sorghum they are a factor in the nutritional quality of the grains. They have not, however, been investigated as a factor in the nutritional problem in edible legumes. This experiment was conducted to determine the occurrence of tannins in dry beans and some of the other common edible legumes and to screen for levels that could have nutritional significance. A white, black, and red bean were selected for low, medium, and high tannin content. These beans were used to prepare 8 diets for evaluation with weaning rats. The testae were removed or extra testae were added to change the tannin content of the diets. The influence of tannins on the albumin and globulin portion of the protein for the beans used in the diets and for other sources of white, black, and red beans was determined. The association of tannin content with color was observed in the F₂ generation of white and red bean crosses. A range in tannin content was found: white beans had none while colored beans ranged from very low to 2.5 catechin equivalents (highest values were found in red beans). Wt. gain and P.E.R. of rats improved when the red testa of a red bean was replaced by a white testa and the tannin content of the beans in the diets increased. Tannin content did not influence the distribution of the albumins and globulin fractions of the bean protein although differences in these fractions were observed among the different bean types. The use of initial rat wt. as a covariate in analyzing the data was significant for the dependent variables wt. gain and food consumption, but not for P.E.R. The F segregation of tannin content was not controlled by the genes for testa color. A range of high and low values were observed within a given color. (Author's summary)

10356 MA, Y; BLISS, F.A. Tannin content and inheritance in common bean. *Crop Science* 18(2):201-204. 1978. En., Sum. En., 26 Ref.

Phaseolus vulgaris. Tannin content. Seed. Seed coat. Genotypes. Inheritance. Cultivars. Nutritive value. Analysis.

Estimation of tannin in common bean seed using a modified vanillin HCl procedure revealed that white-seeded strains contained no detectable amounts, and that when present in colored seeds, tannin was located in the testae. Although dark-colored seeds contained the highest amount, no strong relationship was found between tannin content and seed coat color. Analyses of 4 F₂ populations, resulting from crosses between parents that differed in testa color and tannin content, revealed a high broad sense heritability for tannin content. The segregation patterns were similar in 3 of the 4 F₂ populations, and a few genes seem to be responsible for genetic differences. In the F₂ populations, seeds with black testae contained the most tannin, but recombinant types having black and other colors and relatively low tannin were identified. Low strains may be obtained either by selecting among existing pure lines or by crossing and selecting for appropriate recombinants. (Author's summary)

12334 ELIAS, L.G.; FERNANDEZ, D.G. DE; BRESSANI, R. Possible effects of seed coat polyphenols on the nutritional quality of bean protein. *Journal of Food Science* 44(2):524-527. 1979. En., Sum. En., 29 Ref.

Phaseolus vulgaris. Seed coat. Seed color. Tannin content. Analysis. Laboratory animals. Cooking. Protein content. Diets. Cultivars. Methionine. Digestibility. Phytohemagglutinin. Costa Rica.

Studies were carried out to determine the possible relationship between the seed coat color of beans and the nutritive value of its protein. Beans with white, red, and black seed coats and a black coated bean and its white mutant were chosen for the study. Hemagglutinin activity was located in the cotyledons of all samples with low activity in the seed coat. No activity was found in the cooked beans or in the cooking broth. Trypsin activity was reduced by a heat labile factor (true trypsin inhibitor) and by a heat resistant factor (tannin). The heat labile factor or true trypsin inhibitor was higher in the cotyledons [16.18 trypsin inhibitor units (TIU)/mg sample] than in the seed coat, while the heat-resistant factor was found in highest concn. in the seed coat. Red and black seed coats had a higher concn. (23-31 TIU/mg sample) of the heat-resistant factor than did the white seed coat of the normal white bean and of the mutant (7.9 TIU/mg sample). Cooked beans and their broth showed IIA of the heat-resistant type. Cooked cotyledons had 7.9 TIU/mg sample. Tannin concn. was high in colored seed coats (38-43 mg/g) and low in white coated beans (1.4 mg/g) while values ranged from 3.8-5.9 mg/g in the cotyledons. A highly significant correlation ($r = 0.88$) was found between tannin concn. in the seed coat and IIA. No correlation between these 2 components was found in the cotyledons. Samples of cooked beans supplemented with met. without the cooking broth had higher protein quality values (2.9-3.4) than samples fed with the broth (1.7-2.1). Protein digestibility was lower for red (70.4 percent) and black beans (75.0 percent) fed with the broth than beans fed without the broth (78.7 and 77.9 percent, resp.), but the broth had no effect on the protein digestibility of white-coated beans (81.3 and 81.4 percent). The data suggest that seed coat color is related to the protein quality of beans. (Author's summary)

26981 WASSIMI, N.N.; HOSFIELD, G.L. 1980. A comparative study of seed coat color, tannin content, storage conditions, nutritional quality, and cookability in dry edible beans (*Phaseolus vulgaris* L.) and lentils (*Lens culinaris* L.); their interrelationships and inheritance. In Michigan State University, Agricultural Experiment Station, Saginaw

Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing, 1980 Research Report. pp.90-94. En., 16 Ref.

Cooking. Genotypes. Inheritance. Nutritive value. *Phaseolus vulgaris*. Seed characters. Seed coat. Seed color. Storage. Tannin content. USA.

Twenty bean genotypes grown near Saginaw (Michigan, USA) during the summer of 1980 were used to initiate the screening process for finding parents to be used in the inheritance study of some of the factors influencing texture and cooking time. The preliminary results showed differences between lines for the rate of water uptake. The percentage of hard seed ranged from 0 to 56 percent with red- and brown-seeded strains. Tannin and lignin contents may be involved in the hard seed phenomenon. (CIAT)

0413

15411 PHILLIPS, D.E. et al. Protein quality in seed meals of *Phaseolus vulgaris* and heat-stable factors affecting the utilization of protein. Journal of the Science of Food and Agriculture 32:423-432. 1981. En., Sum. En., 22 Ref., II.

Phaseolus vulgaris. Seed. Protein content. Digestibility. Nutritive value. Amino acids. S. Analysis.

The polyphenol content of several cv. of *Phaseolus vulgaris* was measured. The true digestibility (TD) and BV of the cooked meals of 2 high-polyphenol cv. and one low-polyphenol cv. were determined by N-balance expt. with growing rats. Removal of the testa caused a significant (P less than 0.05) increase in TD of Canadian Wonder and Masterpiece (high-polyphenol) of 7.2 and 8.4 percent, resp., but no significant increase in that of Processor (low-polyphenol). Testa removal caused no significant change in BV. Supplementation of the 3 cv. with met. and cystine raised the BV to values similar to those obtained with egg albumin. Supplementation of Masterpiece with tryptophan caused no further increase in BV. The polyphenol content of the bean meals did not appear to affect the utilization of their S-containing amino acids. Isolated Masterpiece globulins were found to be highly digestible (TD 95.4 percent) but with a low BV (28.36 percent) which was caused by a low S-containing amino acid content. The effects measured by rat feeding expt. could not be accounted for by trypsin inhibitors of phytohemagglutinin activity as the heat treatment used prior to the N-balance studies was sufficient to destroy their activity. For the samples Masterpiece, Canadian Wonder, and Processor, both with and without testa, and the isolated globulin fraction, the BV was highly correlated (P less than 0.001) with the total protein S-containing amino acid content. (Author's summary)

0414

16767 TELEK, L.; FREYTAG, G.F. 1981. Componentes fenólicos de las testas del frijol común (*Phaseolus vulgaris* L.). (Phenolic components of the seed coats of bean). Mayaguez, Puerto Rico, Instituto Mayaguezano de Agricultura Tropical. pp. 1.15-1-1.15-8. Es., 7 Ref.

Paper presented at the Reunión Anual del PCCMCA, 27a., Santo Domingo, República Dominicana, 1981.

Phaseolus vulgaris. Seed coat. Phenolic content. Seed color. Phaseollin. Analysis. Puerto Rico.

A method of horizontal paper chromatography was used for the preliminary study on the phenolic components of the seed coat of *Phaseolus vulgaris* and an attempt was made to list the phenolic components of black-, red-, and white-seeded beans. The reactivity of some of these components with a bean protein (phaseollin) and egg albumin was also determined. Using simple chromatography, polyphenolic compounds were isolated and identified in seed coats of red- and black-seeded bean. No significant amounts of polyphenols were found in seed coats of white-seeded beans. The reaction of extracts in

methanol of total phenolic components with the phaseollin and egg albumin removed procyanidins to which they are strongly linked. These trials show that bean seed coat procyanidins are superior to bean protein. (Summary by F.G. Trans. by L.M.F.)

0415

28921 BRESSANI, R.; ELIAS, L.G.; BRAHMAN, J.E. 1982. Reduction of digestibility of legume proteins by tannins. *Journal of Plant Foods* 4(1): 43-55. En., Sum. En., 13 Ref., Il.

Phaseolus vulgaris. Tannin content. Proteins. Digestibility. Trypsin. Human nutrition. Seed coat. Guatemala.

The effect of polyphenolic compounds present in the seed coat of colored var. of common bean is discussed. From human studies it was estimated that polyphenols accounted for only 7 percent of true protein digestibility, while other factors such as trypsin inhibitors and poorly-digested storage proteins may account for as much as 25 percent. It was concluded that the effect of polyphenolic compounds on protein digestibility is relatively small and would be expected to be lower when beans were a part of a mixed diet. Therefore, other factors in coked beans may be responsible for most of the low digestibility values reported. (AS)

0416

28960 FERNANDEZ, R.; ELIAS, L.G.; BRAHMAN, J.E.; BRESSANI, R. 1982. Trypsin inhibitors and hemagglutinins in beans (*Phaseolus vulgaris*) and their relationship with the content of tannins and associated polyphenols. *Journal of Agricultural and Food Chemistry* 30(4):734-739. En., Sum. En., 25 Ref., Il. (School of Chemical & biological Sciences, Univ. of San Carlos de Guatemala, Guatemala)

Phaseolus vulgaris. Phytohemagglutinins. Analysis. Animal nutrition. Diets. Animal physiology. USA.

For differentiation of true trypsin inhibitor (TI) from inhibition caused by polyphenolics, water extracts at pH 7.6 from whole seeds, cotyledons, and seed coats of 3 common bean var. (black, white, and red) were treated as follows: (1) raw extract, untreated; (2) raw extract treated with poly(vinylpyrrolidone); (3) cooked extract (115 degrees Celsius and 15 PSI, 20 min); and (4) cooked extract plus 1 percent poly(vinylpyrrolidone). Trypsin inhibitor was determined by the bapa (N-benzoyl-DL-nitroamide hydrochloride) method. Group 1 would show total inhibition (TI + polyphenolics, A), group 2, inhibition due only to TI(B), group 3, polyphenolics inhibition plus possible remanent TI(C), and group 4, the inhibition due only to possible remanent TI(D). Their algebraic relationships expressed by the equation $A = B + (C-D)$, where A = calculated value and B + (C - D) = analytical value. There were no differences between calculated and analytical values. A highly significant correlation ($r = 0.97$) indicated that this methodology, trypsin inhibition due to TI and polyphenolics can be separated with a good degree of reliability. (AS)

0417

26243 RODRIGUEZ DE MORA, D. 1982. Efecto de los polifenoles sobre la digestibilidad in vivo e in vitro de la proteina del frijol. (Effect of polyphenols on in vivo and in vitro digestibility of bean protein). Tesis Mag. Sc. Guatemala, Universidad de San Carlos. 98p. Es., Sum. Es., 113 Ref., Il.

Digestibility. Guatemala. *Phaseolus vulgaris*. Phenol content. Seed color.

Two methods to quantify polyphenols in legumes and develop an in vitro methodology were evaluated to determine the digestibility of white, black, and red bean protein. Finally, the polyphenol content with both methods varied with the seed coat color and the heat treatment reduced its content. In the cooked or dried bean flours with broth, the

percentage of total polyphenol loss determined by folin-denis reached 37 percent and a reduction of 94 percent was obtained for biologically active polyphenols determined by the Hagerman-Butler's method. The major reduction of polyphenols was observed in the cooked and dried beans without broth, reaching values of up to 51 and 96 percent for total and biologically active polyphenols, resp. In the trial with rats the digestibility of bean protein with broth was 73.21, 69.56, and 64.51 percent for white, red, and black beans, resp.; in beans without broth digestibility of bean protein was 71.97; 71.96, and 68.83 percent for white, red, and black beans, resp. [AS (Extract)-CIAT]

0418

26037 SWANSON, B.G.; SEIB, P.; WOOD, D.; HOSFIELD, G.; UEBERSAX, M.A.; TELEK, L.; BRESSANI, R.; BRATHAM, E.; ELIAS, L.; MOLINA, M.; GOMEZ-BRENES, R. 1982. Improved biological utilization and availability of dry beans. In Bean/Cowpea Collaborative Research Support Program. U.S.A. 1982. Annual Report. East Lansing, Michigan State University. pp.57-63. En.

Phaseolus vulgaris. Agricultural projects. Lectins. Phytohemagglutinins. Seed coat. Proteins. Socioeconomic aspects. Digestibility. Phenolic content. USA. Guatemala.

Achievements of the project to improve the biological utilization and availability of dry beans in the USA and Guatemala are summarized and goals for 1983 are given. A method was developed to assess hemagglutinating lectins in dry and processed beans, as well as a method to determine procyanidins and other components in seed coats of dry beans. A strong binding capacity of procyanidins and some pigments was observed. Globular protein G-1 from dry beans was also isolated and purified. The results of a survey of rural Guatemalan bean-producing areas are presented. Factors associated with the hard-to-cook phenomenon and low digestibility are discussed; if polyphenolic compounds are eliminated, digestibility values would increase 8-10 percent for colored beans. Two methods to determine total and biologically active polyphenol in colored beans are described as well as 2 methods to prevent the development of the hard-to-cook phenomenon. (CIAT)

0419

29157 ARTZ, W.E.; SWANSON, B.G.; SENDZICKI, B.J.; RASYID, A.; BIRCH, R.E.W. 1986. Protein-procyanidin interaction and nutritional quality of dry beans. American Chemical Society Symposium Series 312:126-137. En., Sum. En., 38 Ref., II. (Food Science, Univ. of Illinois, Urbana, IL 61801, USA)

Phaseolus vulgaris. Proteins. Nutritive value. Laboratory experiments. Digestibility. Fermentation. USA.

Research data that delineates the relationship of dry bean proteins to dry bean procyanidins is presented; the constraint protein-procyanidin interaction placed on nutritional quality of beans is also discussed. Procyanidin intubation was found to restrict rat growth and damage intestinal villi. Procyanidins intubated with food or as dry beans were not as inhibitory as procyanidins intubated alone. Digestibility and PER of tempeh (an Indonesian food prepared from soybeans) prepared with red beans and maize were less than the digestibility and PER of soybean tempeh. Tempeh, fermented by *Rhizopus oligosporus*, did not improve digestibility or nutritional quality of dry black beans. (CIAT)

0420

24435 AW, T-L.; SWANSON, B.G. 1985. Influence of tannin on *Phaseolus vulgaris* protein digestibility and quality. *Journal of Food Science* 50(1): 67-71. En., Sum. En., 22 Ref., II. (Dept. of Food Science & Human Nutrition, Washington State Univ., Pullman, WA 99164-6330, USA)

Proteins. Digestibility. Enzymes. USA. Phenol content. Dietary value. Composition. North America. America.

The influence of tannin on protein digestibility and quality of black beans was evaluated using an enzyme-tetrahymena thermophila bioassay. In vitro digestibility and T-PEER (tetrahymena-based PER) were inversely related to tannin content. Bioavailability, expressed by tetrahymena growth, of black bean globulin G1 in the presence of black bean condensed tannins correlated well ($r = 0.95$) with the in vitro digestibility of the protein. Black bean condensed tannins complexed readily with black bean globulin G1 to form insoluble precipitates from pH 2.0 to 8.0. Bean tannin-G1 precipitates, at tannin:G1 ratios of 0.55 or greater, were resistant to pepsin digestion at pH 2.0. Digestion of bean tannin-G1 precipitates was 69-74 percent at pH 8.0, using a multienzyme system of trypsin, chymotrypsin, and peptidase. (AS)

0421

21770 BRESSANI, R.; ELIAS, L.G.; WOLZAK, A.; HAGERMAN, A.E.; BUTLER, L.G. 1983. Tannin in common beans: methods of analysis and effects on protein quality. *Journal of Food Science* 48(3):1000-1001, 1003. En., Sum. En., 22 Ref. (Division of Agricultural & Food Sciences, INCAP, Carretera Roosevelt Zone 11, Guatemala, Guatemala)

Phaseolus vulgaris. Tannin content. Animal nutrition. Diets. Digestibility. Proteins. Guatemala.

Condensed tannins and related phenols in 13 samples of red common beans collected from rural markets in Guatemala were determined by 4 chemical assays. The results were highly correlated although the degree of variation among the samples differed greatly according to the assay. In rat feeding trials, tannin content was negatively correlated with NPR, a measure of protein quality, and positively correlated with protein digestibility. Neither correlation was statistically significant due primarily to the low tannin content of the diet. Met. supplementation not only improves the protein quality but may also play a role in metabolic detoxification of tannin.

0422

26598 DESHPANDE, S.S.; CHERYAN, M. 1985. Evaluation of vanillin assay for tannin analysis of dry beans. *Journal of Food Science* 50(4):905-910. En., Sum. En., 23 Ref., II. (Dept. of Food Science, 382-D, Ag. Eng. Sci. Bldg., Univ. of Illinois, Urbana, IL 61801, USA)

Bean flour. Cultivars. *Phaseolus vulgaris*. Processing. Storage. Tannin content. USA.

Several parameters that might influence the vanillin assay for tannin analysis of dry bean var. were investigated. The assayable tannin content decreased with decreasing particle size of the bean flours. Time elapsed after grinding as well as storage under high humidity conditions markedly influenced tannin assays. The solubility of tannins depended on the type of solvent used, with methanolic extraction requiring shorter periods as compared with extraction with acidified methanol. Color differences within the bean samples appeared to be the prime cause of variation in tannin analysis of beans. Extractions on seed coats alone increased the assayable tannin by 1.1-2.5 times compared with extractions of bean flours. (AS)

0423

19746 MOTHVA, M.J.; MARTINEZ, J.A.; HUNDAIN, A.; LARRALDE, J. 1983. Effect of extracts from bean (*Phaseolus vulgaris*) and field bean (*Vicia faba*) varieties on intestinal D-glucose transport in rat in vivo. *Journal of the Science of Food and Agriculture* 34(3):239-246. En., Sum. En., 27 Ref.

Phaseolus vulgaris. Seeds. Phenolic content. Laboratory animals. Glucose. Spain.

Saline extract solutions from seeds of both *Phaseolus vulgaris* and *Vicia faba* var. were prepared and tested for their total polyphenolic content and effect on intestinal D-glucose transport across rat ileum in vivo. Intestinal D-glucose transport was significantly reduced (P less than 0.001) by the presence of seed extracts in the intestinal loop, regardless of the source of the extract. The order of potency (*P. vulgaris* var. atropurpureum more than *V. faba* var. Caballar more than *V. faba* var. minor more than *P. vulgaris* var. albus) is closely related to the polyphenolic content. Clear differences in the mode of action of the extracts were also observed. Extracts with appreciable polyphenolic content caused both a reversible and a lasting inhibitory effect on glucose transport, while extracts with negligible polyphenolic content only induced a reversible inhibition. Polyamide treatment of the extracts decreased their ability to inhibit glucose transport, but their inhibitory effect was not completely abolished by the treatment, further suggesting the presence of some other antiabsorptive factor(s) in the seeds. (Author's summary)

0424

26086 REDDY, N.R.; PIERSON, M.D.; SATHI, S.K.; SALUNKHE, D.K. 1985. Dry bean tannins: a review of nutritional implications. *Journal of the American Oil Chemists' Society* 62(3):541-549. En., Sum. En., 91 Ref. (Dept. of Food Science & Technology, Virginia Polytechnic Inst. & State Univ., Blacksburg, VA 24061, USA)

Antinutritional factors. Cooking. Digestibility. Nutritive value. *Phaseolus vulgaris*. Phytoalexins. USA.

Recent research on legume tannins and their possible influence on nutritional quality of legumes as human food is reviewed and summarized. The tannin content of dry beans ranges from 0.0 to 2.0 percent, depending on the bean species and color of the seed coat. Many high tannin bean var. are of lower nutritional quality than low tannin bean var. Naturally occurring food legume tannins are reported to interact with proteins (both enzyme and nonenzyme proteins) to form tannin-protein complexes resulting in inactivation of digestive enzymes and protein insolubility. Both in vitro and in vivo studies indicate that bean tannins decrease protein digestibility, either by inactivating digestive enzymes or by reducing the susceptibility of the substrate proteins after forming complexes with tannins and absorbed ionizable Fe. Other deleterious effects of tannins include a lowered feed efficiency and growth depression in exptl. animals. The antinutritional activity of bean tannins can be reduced by processing (1 or a combination of 2 or more methods), for example dehulling, soaking, cooking, and germination. Genetic selection also may help in breeding var. low in tannins. Potential chemical treatments such as use of tannin complexing agents are discussed. (AS)

OTHER COMPONENTS

0425

0735 MONTGOMERY, R.D. Observations on the cyanide content and toxicity of tropical pulses. *West Indies Medical Journal* 13(1):1-11. 1964. En., Sum. En., 36 Ref., 11.

Phaseolus vulgaris. *Phaseolus lunatus*. Cassava. HCN. Toxicity. Cooking. Laboratory animal. Hydrolysis.

The content of cyanogenetic glucosides in West India and other pulses was estimated by the release of HCN on hydrolysis. In the var. of *Phaseolus lunatus* (lima bean) examined, the CN content was under 20 mg/100 mg and not of the order previously known to cause acute poisoning. A comparison of hydrolytic procedures in *P. lunatus* showed that whereas the cyanogenetic glucoside is stable on cooking the intact bean, neither human saliva nor dilute HCl at 37 degrees Celsius was effective in releasing free HCN from beans crushed after cooking. Animal feeding tests with crushed, uncooked beans showed that the toxicity of these var. was unrelated to their CN content. Severe

"toxicity" of the common bean (*P. vulgaris*) in rats and guinea pigs was mainly, if not entirely, due to unpalatability, causing starvation. Palatability was much improved by cooking. Absorption and utilization of other species were good when fed to rats, even at the 50 percent level. There was some evidence of pancreatic hypertrophy and of impaired absorption or utilization of *Vigna* sp. (cowpea) and *Cajanus cajan* (gungo pea) in guinea pigs. No neurological lesions were detected in rats in feeding tests of up to 6 months' duration. (Author's summary)

0426

5474 CONTRERAS, S. et al. Factores tóxicos de leguminosas cultivadas en Chile. I. Glucósidos cianogénicos. (Toxic factors in Chilean legumes. I. Cyanogenic glucosides). *Archivos Latinoamericanos de Nutrición* 23(2):251-259. 1973. Es., Sum. Es., En., 18 Ref.

Phaseolus vulgaris. Legume crops. Seed. Toxicity. Cyanogenic glucosides. Human nutrition. Chile.

A study was made of cyanogenic glucosides in seeds of the following legumes grown in Chile: *Phaseolus vulgaris* var. Tórtola, Coscorrón, Zeus, and Arroz; *Lathyrus sativus*; *Vicia faba*; *Glycine max.*; *Pisum sativum*; *Lens esculenta*; *Cicer arietinum*; *Lupinus albus*; *L. lutens*, and *Prosopis tamarugo*. Values ranged from 0.42-1.86 mg HCN/100 g dry sample. *P. vulgaris* var. Tórtola had the highest content. All levels were lower than the toxicity range (10-20 mg HCN/100 g). *P. vulgaris* var. Tórtola was then used to study the effect of different treatments on HCN concn. Treatment combining soaking and cooking were the most effective. There was no decrease in concn. when using heat without previous soaking, but soaking alone did not decrease the HCN level either. (Author's summary)

0427

14390 JANSZ, E.R.; PIERIS, N. Studies on some local legumes. II. Cyanogenic glucosides. *Journal of the National Science Council of Sri Lanka* 6(1):1-9. 1978. En., Sum. En., 15 Ref.

Phaseolus vulgaris. *Phaseolus lunatus*. *Vigna unguiculata*. Anti-nutritional factors. Cyanogenic glucosides. Biochemistry. Analysis. Enzymes. Lanamerase. Toxicity. Nutritive value. Sri Lanka.

The seeds of nearly 50 selected legumes (mainly those commonly found in Sri Lanka) were screened for the presence of cyanide and cyanogenic glucosides. Only 4 of these contained significant amounts of cyanogenic glycosides; all were var. of *Phaseolus lunatus* (sieva bean or lima bean). Methods of processing to eliminate the cyanogenic glucoside was investigated with success. Local strains of *Vigna sinensis*, *Phaseolus vulgaris*, and *Pisum sativum* were found to contain less cyanogenic glucoside than previously reported for strains grown elsewhere. (Author's summary)

0428

26511 SOPIDO, O.A.; ARINZE, H.U. 1985. Saponic content of some Nigerian foods. *Journal of the Science of Food and Agriculture* 36(5):407-408. En., Sum. En., 6 Ref. (Dept. of Biochemistry, College of Medical Sciences, Univ. of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria)

Phaseolus vulgaris. Dietary value. Nutritive value. Nigeria.

Saponins were extracted and purified from millet, beans, *Sorghum vulgare*, and groundnut. Beans were found to contain a considerable amount of saponin (245.0 mg/kg), while millet, *S. vulgare*, and groundnut contained 194.7, 72.7, and 48.8 mg/kg dry wt. basis, resp. (AS)

ACCEPTABILITY ASPECTS

GENERAL

0429

7093 FOX, M.; KRAMER, A. Objective tests for determining quality of fresh green beans. *Food Technology* 20(12):88-92. 1966. En., Sum. En., 4 Ref.

Phaseolus vulgaris. Cultivars. Analysis. Statistical analysis. Seed. Storage. Cooking.

This study was undertaken to determine whether certain sensory evaluations of raw produce could be replaced by objective tests. Thirteen objective tests were correlated with 6 sensory evaluations and programmed into a stepwise multiple regression and computed on an IBM 7094 computer. The results indicated that the factors of quality looked for by institutional buyers differ significantly and importantly from those looked for by the ultimate consumers. Correlations between objective tests and sensory evaluations were significantly higher for the cooked product than for the raw product. Best correlations were obtained between textural measurements as performed by the shear-press or qualitometer and sensory evaluations for texture as well as appearance and flavor. Gas chromatographic data were not as highly correlated even with sensory evaluation of flavor. (Author's summary)

0430

14307 FONSECA, H. et al. Efeito da radiação gama (60)Co nas propriedades organolepticas e nutritivas do feijão (*Phaseolus vulgaris* L., cv. mulatinho). (Effect of gamma radiation (60)Co) on the organoleptic and nutritive properties of common bean cv. mulatinho). Piracicaba-SP, Brasil, Centro de Energia Nuclear na Agricultura. *Boletim Científico* no. 018. 1974. 20p. Pt., Sum. Pt., En., 6 Ref., Il.

Phaseolus vulgaris. Irradiation. Nutritive value. Composition. Vitamin content. Storage. Deterioration. Brazil.

The influence of gamma radiation on the organoleptic and nutritive properties of kidney beans is studied. Seed samples of this vegetable were irradiated with 15 krad (1 rad = 100 ergs/g of irradiated material) and stored for 5 mo. Immediately after irradiation and monthly sensory evaluations and chemical analysis of the vitamins thiamine (B1) and riboflavin (B2) were accomplished in the samples studied. The results showed an evident influence of radiation during its application since the higher losses occurred immediately after this treatment, mainly in riboflavin, which from the total losses observed, 47.9 percent occurred during irradiation. The total losses (av.) of thiamine were 58.7 percent in the irradiated samples and 51.9 percent in the controls, and for riboflavin, 25% in the irradiated samples and 16.7 percent in the controls. Thus, riboflavin is much more sensitive to gamma radiation. In terms of organoleptic properties it was observed the development of an undesirable flavor and a hardening of the texture in the irradiated samples. However, at the end of the expt. no difference was found between control and irradiated samples. (Author's summary)

0431

10687 BRENNER, A.M. et al. Quality control standards for cooked frozen green beans held on a steam table for varying holding times. *Journal of Food Science* 43:1066-1070. 1978. En., Sum. En., 33 Ref., Il.

Phaseolus vulgaris. Palatability. Cooking. Cultivars. Temperature. Laboratory experiments. Experiment design. Statistical analysis. Seed color. Water content. Human nutrition. Consumption.

Two var. of whole green beans, prepared by steaming, were held on a steam table (more than 60 degrees Celsius) with portions removed at 10-min intervals up to 60 min. Dominant wavelengths and Instron measurements for force, shear peak area, and work were determined for the 7 holding periods. Var. were inherently different in color (P less than 0.01). Holding time affected dominant wavelength (P less than 0.01), Munsell color (P less than 0.01), force (P less than 0.05), and work (P less than 0.05). Texture, color, and overall acceptability were evaluated by a trained sensory panel; a consumer panel also evaluated overall acceptability. Orthogonal comparisons of sensory and objective evaluations for dominant wavelengths, force, and work were linear. Acceptability scores were highest at 30-min heated holding time. Statistical analysis indicated that objective quality control standards could be defined by a range of Munsell colors or dominant wavelengths and/or force and work measurements obtained at optimum holding periods. (Author's summary)

0432

16847 INSTITUTO CENTROAMERICANO DE INVESTIGACION Y TECNOLOGIA INDUSTRIAL. GUATEMALA. 1978. Granos comerciales: frijol. Métodos de ensayo y análisis. (Commercial grains: beans. Test and analytical methods). Guatemala. Norma Centroamericana ICATI 34 052 h4. 5p. Esp., 4 Ref.

Phaseolus vulgaris. Seeds. Deterioration. Marketing. Storage. Legal aspects. Guatemala.

This standard, which replaces the standard of the same no. issued in 1976, specifies methods for the initial inspection of bean samples; and for the determination of moisture total impurities, proportions of insect-infested, damaged, split, or broken grains, and proportion of beans differing in color from the majority of the batch. (Summary by Food Science and Technology Abstracts)

0433

11163 LUMIEN, B.O. DE et al. Formation of volatile Flavor compounds in green beans from linoleic and linolenic acids. *Journal of Food Science* 53:698-708. 1978. En., Sum. En., 45 Ref., 11.

Phaseolus vulgaris. Seed. Analysis. Fatty acids. Cultivars. Leaves. Enzymes.

Both french beans and seeds formed n-hexanol, n-hexanal, and 1-octen-3-ol as the principal volatile compounds from [U-(14)C]linolenic acid but at proportionately different ratios. With [U-(13)C]linolenic acid, french beans developed mainly trans-2-hexanal, 1-penten-3-ol, 3-penten-1-ol, trans-2-hexanol and cis-3-hexanol, while seeds produced largely 1-penten-3-ol and 3-penten-3-ol with a small amount of trans-2-hexanal. French beans showed the highest lipoxygenase activity of the several fruits and vegetables compared. Though alcohol oxidoreductase was relatively low, rapid reduction of aldehydes/ketones to alcohols was found in french beans. French bean lipoxygenase was inhibited by cyanide, and a small fraction appeared to be quite heat stable, compared with alcohol oxidoreductase, which was much more unstable. The optimal activity of french bean lipoxygenase was found to be at pH 5.3. (Author's summary)

0434

26980 AGBO, N.G.; UEBERSAX, M.A.; HOSFIELD, G.L. 1980. Genetic and physico-chemical parameters affecting texture of processed dry beans. In Michigan State University. Agricultural Experiment Station, Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1980 Research Report. pp.85-90. En.

Ash content. Cultivars. Embryo. Fat content. *Phaseolus vulgaris*. Processing. Protein content. Seed. Seed coat. Starch content. USA. Water absorption. Water content.

The genetic and physicochemical parameters affecting texture were evaluated on 3 bean cv. (Sanilac, Nep-2, and San Fernando). Mean values for proximate analysis and starch, wa-

ter absorption, processing evaluations, and flour pasting characteristics for the 3 cv. are included. The mean MC for the 3 cv. was 8.7 percent and the protein content ranged from 24.0 to 25.4 percent. Pasting curves and texture showed perfect correlation, indicating that gelatinization properties of seeds are different in the 3 cv. (CIAT)

0435

13518 HOSFIELD, G.L.; UEBERSAX, M.A. Variability in physico-chemical properties and nutritional components of tropical and domestic dry bean germplasm. *Journal of the American Society for Horticultural Science* 105(2):246-252. 1980. En., Sum. En., 22 Ref., II.

Phaseolus vulgaris. Seed coat. Cultivars. Canned beans. Protein content. Ash content. Water content. Cooking. USA.

Food-quality comparisons between tropically adapted genotypes of dry bean and accessions from domestic breeding agencies showed there is sufficient variability in important nutritional and canning traits among tropical beans to justify their use in temperate-climate breeding programs. Specifically, tropical bean germplasm may be of use to transfer stress tolerance and lodging resistance to commercially acceptable genotypes while the breeder is simultaneously breeding to maintain or improve nutritional composition and canning quality. Seed of 35 bean accessions representing plant introductions, breeding lines, and cv. were screened for proximate chemical composition, yield, and several horticultural characters. Seventeen of these accessions, including several commercial dry bean cv., were selected for canning evaluations. Beans were adjusted to 16 percent moisture before soaking and processing. Soaked and processed beans were evaluated for water uptake, texture (with a Kramer Shear Press), and general canning quality. Protein content was highest in domestically adapted beans (31 percent) and lowest in the nonblack tropical array of genotypes (22 percent). Tropical beans showed a greater tendency to clump in the can after cooking. This indicates excessive breakdown of tropical beans during thermal processing. Nonsignificant correlation coefficients indicated that textural differences and soaking properties of the beans were not associated; however, textural differences were correlated with the final moisture percentage in processed tropically adapted beans. Several tropical genotypes were much firmer or much softer after cooking than 'Sanilae', which is considered the industry standard for making canning comparisons. Further evaluation of texture by examining Kramer Shear Press tracings showed that textural differences among genotypes could be broken down into a configuration showing a large shear force component, and a curve characterized by mostly compression. The curve types appeared to be a characteristic of the genotype rather than of seed-coat color, size of bean, or final moisture percentage. (Author's summary)

0436

26978 HOSFIELD, G.L.; GHADERI, A.; UEBERSAX, M.A. 1980. Interrelationships among yield and food quality characters: A factor analysis approach. In Michigan State University. Agricultural Experiment Station. Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing, 1980 Research Report. pp.75-80. En.

Analysis. Cooking. Nutritive value. *Phaseolus vulgaris*. Proteins. Seed. Seed color. USA. Water content. Yields.

An expt. was carried out to evaluate the application of factor analysis in bean breeding research and to examine interrelationships between bean yield, protein, and 16 sensory and cooking quality traits. Soaking, thermal, moisture, cooked and dry bean color, and protein factors were considered. The soaking and thermal factors accounted for nearly half (45.7 percent) of the total variation in the original data and were the most important factors. These 2 characteristics of dry bean cooking quality are separate and independent processes. Although dry beans are generally soaked prior to cooking, results indicate that the degree of hydration of beans is not related to cooking properties. (CIAT)

17320 KORBAN, S.S.; COYNE, D.P.; WEHNING, J.L.; HANNA, M.A. 1981. Testing methods, variation, morphological and genetic studies of seed-coat cracking in dry beans (*Phaseolus vulgaris* L.). *Journal of the American Society for Horticultural Science* 106(6):821-828. En., Sum. En., 32 Ref., 11.

Phaseolus vulgaris. Cotyledon cracking. Seed coat. Genes. Inheritance. Heterosis. Seeds. Harvesting. Mechanical damage. Resistance. Selection. Statistical analysis. Field experiments. Cultivars. USA.

Seed-coat cracking injury was determined in Great Northern (GN) dry bean lines in 1977-78 and Pinto beans in 1978 using 3 methods as follows: Vogel small plot thresher (field), seed dropping, and a controlled rotating impact disk machine. Differences in susceptibility for seed-coat cracking were observed within each testing method. Overall, GN Emerson, near-isogenic determinate GN Nebraska no. 1, and Pinto UI 111 had the best resistance to seed-coat cracking. A genotype x yr. interaction for seed injury occurred with the Vogel thresher but not with the other 2 methods. These gave consistent results but the rotating disk machine method was preferred because of ease, rapidity of operation, and standardization of the rotation speed. The early- and late-maturing determinate near-isogenic lines of GN Nebraska no. 1 had less seed-coat injury than the early and late indeterminate lines using the Vogel and rotating impact disk method. The early determinate line had the least amount of seed-coat injury for all 3 methods. Pinto UI 111, Bulgarian White, and GN-D-88, which exhibited the best resistance to seed-coat cracking in the 7 parent diallel crossing study, had the most uniform seed-coat thickness as well as having quick seed coats. The cv. which had thin or thick but nonuniformly thick seed coats were susceptible to seed-coat cracking. Differences in thickness in macrosclerid, osteosclerid, and parenchyma cell layers of the seed coat were observed between cv., but no relationship between these cell layers and the seed-coat cracking response was established. Seed-coat cracking was quantitatively inherited. Bulgarian White, Pinto UI 111, and GN D-88 showed high combining ability for resistance to seed-coat cracking. The estimates of the genetic effects indicated that additive effects were mainly involved. (Author's summary)

0438

16096 KOEHLER, I.H.; BURKE, D.W. 1981. Nutrient composition, sensory characteristics, and texture measurements of seven cultivars of dry beans. *Journal of the American Society for Horticultural Science* 106(3):313-318. En., Sum. En., 19 Ref.

Phaseolus vulgaris. Cultivars. Nutritive value. Composition. Protein content. Ash content. Fat content. Mineral content. Vitamin content. Analysis. Food technology. Cooking. USA.

Seven cv. representing 5 principal types of dry beans produced commercially in the state of Washington, USA, were analyzed chemically for content of moisture, fat, ash, total protein, Ca, Fe, K, Zn, thiamin, riboflavin, and amino acids when raw or when freeze-dried following cooking. Samples of cooked beans were subjected to sensory evaluation and shear-force measurement. Protein quality was evaluated using *Tetrahymena pyriformis*. Results are being used for comparison with values for new cv. produced later in the breeding program. The cv. contained significant percentages of the United States Recommended Daily Allowances (USRDA) for Fe, Ca, K, thiamine, and riboflavin. The nutritional quality of their protein was 1/2-1/3 that of casein. All cv. were judged to be acceptable in flavor and texture. Pinto UI-114 was outstanding for both nutritional content and sensory quality. (Author's summary)

0439

15403 LINARES B., S. et al. Características tecnológicas y nutricionales de 20 cultivares de frijol común (*Phaseolus vulgaris*). I. Características físicas del grano. (Technological

and nutritional characteristics of 20 common bean cultivars. I. Physical characteristics of the grain). Turrialba 31(1):1-10. 1981. Es., Sum. En., Es., 18 Ref. II.

Phaseolus vulgaris. Cultivars. Seed characters. Food technology. Nutritive value. Plant habit. Seed coat. Cooking.

The objective of this work was to estimate the possible effect of var. on the physical organoleptic, and culinary characteristics of 20 bean var. (10 black, 4 red, 3 beige, and 3 white) and the information obtained was correlated on the basis of yields. The following 10 physical characteristics were measured in each var.: color, brilliance or shine of the seed coat, wt., vol., cooking time, thickness of broth, percentage of seed coat, percentage of cotyledon, water absorption, and harness of the seed. In general, a high variability was found in the different parameters measured, between and within var. Yield/unit area was higher for black and beige var. The negative correlation between this parameter and wt. and vol. suggests that smaller seeds have higher yields. The physical parameters that showed better practical possibilities were size of the seed and cooking time. A positive significant (P less than 0.01) correlation ($r = 0.96$) was found between wt. and vol., and since dry wt. is a less variable and easier parameter to measure, it was taken as representative of seed size. Cooking time, a relevant parameter since it determines acceptability, was negatively (P less than 0.05) correlated with seed wt., and positively and significantly (P less than 0.01) correlated with percentage of seed coat. These relationships indicate that cooking time is influenced by seed size and, possibly to a higher degree, by the percentage of seed coat. Hardness of the seed, as measured by the Instron penetrometer, was positively correlated with percentage of seed coat; on the other hand, it was found that a seed with a shinier seed coat absorbs less water and requires more time for cooking. From these results, it was concluded that cooking time, perhaps the main factor determining acceptability by the consumer, is determined by several physical characteristics of beans, such as color, shine of the seed coat, size, percentage of seed coat, and probably other characteristics not considered in this work. (Author's summary)

0440

19500 ANDALDUA-MORALES, A.; BRENNAN, J.G. 1982. Relationship between the physical properties of dried beans and their textural characteristics after processing. Journal of Texture Studies 13(2):229-240. En., Sum. En., 42 Ref., II. (National College of Food Technology, Univ. of Reading, St. Georges Avenue, Weybridge, Surrey, England)

Phaseolus vulgaris. Seed. Cooking. Seed characters. Canned beans. Processing.

To ascertain if the textural characteristics of baked beans can be related to mechanical properties of field dried bean, baked beans in brine and in tomato sauce were prepared using samples from 6 different bean var. Baked beans were tested by means of compression and puncture, shearing, back extrusion, and compression tests, as well as sensory evaluation of texture; dry beans were tested by means of compression and puncture. Scales chosen for scoring included firmness, chewiness, smoothness of skin, and general hedonic rating. For canned beans in brine, the max. forces for compression and back extrusion exhibited linear dependence. When tomato sauce was used, some softening was observed. The max. force for back extrusion was correlated to sensory firmness, and the energy for back extrusion to sensory chewiness. (Author's summary)

0441

21962 DURAN, I.; CALVO, C. 1982. Calidad de alubias blancas en conserva. I. Selección de los parámetros que definen su calidad sensorial. (Quality of canned white beans. I. Selection of sensory quality parameters). Revista de Agroquímica y Tecnología de Alimentos 22(2):271-281. Es., Sum. Es., En., 19 Ref., II. (Inst. de Agroquímica y Tecnología de Alimentos, Jaime Roig, 11, Valencia-10, España)

Phaseolus vulgaris. Seed characters. Canned beans. Spain.

Sensory parameters to define quality of canned white beans were selected. With this aim a panel for sensory descriptive analysis was selected and trained. A score sheet with nonstructured scales and a descriptive list with definitions of attributes were developed. Based on acceptance data, obtained with an untrained panel, the parameters that best define total sensory quality were selected: hardness, skin consistency, graininess, adhesiveness, flavor intensity, and off-flavor. (Author's summary)

0442

22232 HERREA D., G.E. 1983. Determinación de la calidad de consumo en frijol común. (Determination of consumer quality in beans). In Tapia B., H. ed. Dos años de cooperación para el mejoramiento del frijol común *Phaseolus vulgaris* L. en Nicaragua. Managua, Nicaragua, Ministerio de Desarrollo Agropecuario y Reforma Agraria. Dirección General de Técnicas Agropecuarias. Sit-1. pp.100-102. Es.

Cultivars. Seed characters. Seed color. Cooking. Timing. Nicaragua. Seed. Central America. America.

The organoleptic properties of 11 exptl. and commercial bean var. were determined. Measured parameters included grain color and luster (for uncooked seeds), cooking time, flavor, cotyledon and seed coat textures, broth thickness and color, and time before seed fermentation. (CIAT)

0443

23046 KELLY, J.D.; HOSFIELD, G.L. 1983. Navy bean seed quality comparisons. Michigan Dry Bean Digest 8(1):10-11. En., II. (Michigan State Univ., Dept. of Crop & Soil Sciences, East Lansing, MI 48824, USA)

Seed characters. Seed color. Cultivars. USA. Seed. North America. America.

An organoleptic (sensory) triangle test was conducted at the agricultural exposition (Michigan, USA) to distinguish between seed of different bean var. on a visual basis; the preference or acceptability of seeds was rated on a hedonic (liking) scale. A total of 52 visitors participated in the triangle test and 25 percent of these also participated in the hedonic test. The information collected in these different tests supports the conclusion that navy bean seed size and color should be major quality characters considered in breeding programs to meet industry quality standards. (CIAT)

0444

26100 DEL POZO, R.; TORRICELLA, R.; IGLESIAS, I. 1984. Efecto de las radiciones gamma en algunos componentes nutricionales y propiedades organolépticas del frijol negro. (*Phaseolus vulgaris* L.). Estudio preliminar. (Effect of gamma radiation of black beans. Preliminary study). Revista de Ciencias Biológicas 15(1):163-170. Es., Sum. En., Es., 21 Ref., II. (Centro Nacional de Investigaciones Científicas, Ciudad de La Habana, Cuba)

Phaseolus vulgaris. Irradiation. Nutritive value. Storage. Starch content. Sugar content. Protein content. Organoleptic properties. Cuba.

A preliminary study was carried out on the effect of Co-60 gamma rays on the main nutritional components and organoleptic properties of black bean var. Ica Piajo, cultivated and stored under Cuban conditions. Beans irradiated with doses of 15, 30, and 60 krad did not vary significantly in starch, total soluble sugars, and total protein contents. The organoleptic evaluation did not detect significant differences between irradiated and nonirradiated samples as to odor and consistency, but tastewise the irradiated samples had a better panel acceptance than check samples after 4 mo. of storage. [AS (Extract)]

23035 GHADERI, A.; HOSFIELD, G.L.; ADAMS, M.W.; UEBERSAX, M.A. 1984. Variability in culinary quality, component interrelationships, and breeding implication in navy and pinto beans. Journal of the American Society for Horticultural Science 109(1):85-90. En., Sum. En., 15 Ref., II. (Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Genotypes. Cultivars. Ecology. Selection. Analysis. Seed characters. Cooking. Adaptation. USA.

The extent of genetic variations and the interrelationships of several quality traits of cv. of navy and pinto bean, grown at 3 locations in Michigan, USA, were studied. The measured traits were seed wt., initial wt. of solids, surface color of dry and processed beans (L, al., 5L), wt. of soaked beans, hydration ration, clumps, splits, texture, washed and drained wt., and processed bean moisture. Significant cv. differences were observed for most of the traits in both classes of beans. Location effects were highly significant for all traits. Certain traits showed significant cv. x location interactions. Phenotypic correlation coefficients among pairs of characters indicated that, with few exceptions, there were low associations among quality characters. Principal component analysis confirmed the independence of traits. A selection strategy based on a tandem selection procedure followed by construction of selection indices was suggested. (Author's summary)

23143 HOSFIELD, G.L.; UEBERSAX, M.A.; ISLEIB, T.G. 1984. Seasonal and genotypic effects on yield and physico-chemical seed characteristics related to food quality in dry, edible beans. Journal of the American Society for Horticultural Science 109(2):182-189. En., Sum. En., 31 Ref., II. (Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Genotype. Plant breeding. Processing. Cooking. Drying. Statistical analysis. Yields. Cultivars. Nutritive value. USA.

The yields and physicochemical seed traits related to food quality of 25 strains of dry beans, representative of the Black Turtle Soup commercial class, were evaluated for 3 seasons. The strains differed significantly over seasons for washed drained wt., textural properties, and surface color characteristics of coked seeds. All the other traits were nonsignificant in the combined analysis. Trait expression was strongly influenced by genotype x season interactions. Spearman's coefficient of rank correlation between pairs of years indicated that the interactions were due primarily to inconsistent strain rankings from yr.-to-yr. The season and genotype x season variance component estimates for yield, soaking, and several cooked bean traits were larger than the genotypic component, indicating that seasonal effects predominated over genotypic effects. These results suggested that several years of testing are needed to assess strain performance accurately for food quality. The contribution made by each strain to the genotype x season variance component was ascertained by calculating a stability variance statistic. Based on this statistic, strains were found to differ in their genetic potential to respond to varying environments. Several genotypes were phenotypically stable for most traits. Strain no. 23 (CIAT pedigree FF 4-13-M-M-M-M), which had good yield (2.8 t/ha) and protein percentage (27.7) and favorable culinary quality, was of particular interest. (Author's summary)

24438 ESTEVEZ, A.M.; LUH, B.S. 1985. Chemical and physical characteristics of ready-to-eat dry beans. Journal of Food Science 50(3):777-781. En., Sum. En., 31 Ref., II. (Depto. de Agroindustria, Univ. de Chile, Casilla 1004, Santiago, Chile)

Nutritive value. Processing. Cooking. Chile. Animal nutrition. South America: America.

Red kidney and Pinto dry beans were processed into a ready-to-eat snack food by several methods. The dry beans were soaked in water overnight or germinated under controlled conditions at 22 degrees Celsius for 4 days prior to processing. The germination process removed most of the raffinose and stachyose in the beans as revealed by high pressure liquid chromatography analysis. Protease inhibitor activity in the beans was greatly reduced by cooking the rehydrated beans in tomato sauce or by frying the beans in hydrogenated vegetable oil at 180 degrees Celsius for 6 min. The in vitro protein digestibility of the beans was improved as evidenced by the decrease in trypsin and chymotrypsin inhibitors in the cooked and fried products. (AS)

0448

28918 INFANTE Y., D.; PEREZ T., G.; BRITO L., M. 1986. Análisis de las características físicas y nutricionales de nueve variedades de frijol colorado. (Analysis of the physical and nutritional properties of nine red bean varieties). Centro Agrícola 13(2):68-73. Es., Sum. Es., En., 6 Ref.

Phaseolus vulgaris. Cultivars. Cooking. Seed character. Dry matter. Protein content. Venezuela.

Nine var. of red beans were evaluated for several physical and nutritional characteristics (color, brilliance, cooking time, broth thickness, percent of peel, DM and protein contents). Var. M-112 had the highest protein content. Likewise, the correlations between cooking time and color and brilliance were significant, confirming that var. of more brilliance and darker color required a longer cooking time. It was also proved that the var. that required less cooking time do not have thicker broths. (AS)

0449

28054 PAREDES L., O.; MONTES R., R.; GONZALEZ C., J.; ARROYO F., M.G. 1986. Comparison of selected food characteristics of three cultivars of bean *Phaseolus vulgaris*. Journal of Food Technology 21(4):487-494. En., Sum. En., 26 Ref. (Inst. Politécnico Nacional, Unidad Irapuato, Apartado Postal 629, 36500 Irapuato, Gto. México)

Phaseolus vulgaris. Cultivars. Seed. Cooking. Timing. Phytic acid content. Digestibility. Organoleptic properties. Mexico.

Three bean cv., Bayocel, Canario 101, and Flor de Mayo, were selected to study some of the physical properties of the seeds, hydration capacity, cooking time, phytic acid content, digestibility, color changes as a function of soaking and cooking, and sensory properties. The water uptake was much lower for the cv. with larger seeds. Some slight losses of phytic acid were found due to the cooking treatment; cooking improved the protein digestibility. Cv. Flor de Mayo exhibited the most desirable sensory attributes. (AS)

0450

27064 WASSIMI, N.N.; ISLEIB, T.G.; HOSFIELD, G.L. 1986. Fixed effect genetic analysis of a diallel cross in dry beans (*Phaseolus vulgaris* L.). Theoretical and Applied Genetics 72(4):449-454. En., Sum. En., 10 Ref., (Dept. of Crop & Soil Sciences, United States Dept. of Agriculture, Agricultural Research Service, Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Genetics. Proteins. Yield. Heterosis. Crossbreeding. Cultivars. Genotypes. Dietary value. USA.

A full diallel cross among 4 diverse homozygous strains of dry edible beans was evaluated for yield, protein content, and culinary quality traits in the F2 and F3 generations in 2 locations: East Lansing and Saginaw (Michigan, USA). Interpretation of diallel effects (Method 1 Model 1) using a fixed-effect genetic model made it possible to combine data

from 2 generations into a single analysis and quantify the relative contributions of additive and dominance genetic effects to general and specific combining abilities. General combining ability was found to arise from 3 potential sources: additive effects, dominance interactions at homozygous loci, and av. dominance interactions in hybrids involving the parent in question. Specific combining ability was found to be a function solely of dominance. Additive effects were the primary determinant of general combining ability and were highly significant. Specific dominance interactions were significant for seed yield, cooked bean MC, and texture but not for protein content. Texture was the only trait for which the additive-dominance model failed to provide an adequate fit to the data, suggesting that texture is significantly affected by epistatic interaction. One cross (Brazil-2 x Sanilac) was identified that exhibited a large heterotic effect for seed yield although the parent's additive effects were nonsignificant. Such a nicking effect was attributed to complementation between the 2 parents. (AS)

WATER IMBIBITION

0451

21542 JOUBERT, T.G. LA G. 1954. Hard-skin in beans. *Farming in South Africa* 29(337):225-232. En., 2 Ref., II.

Phaseolus vulgaris. Seeds. Deterioration. Mechanical damage. Seed coat. Relative humidity. Storage. South Africa.

A case of hard-skin in one of the best runner bean var., Green Savage, was reported for the 1st time during the summer season at the Horticultural Research Station, Pretoria (South Africa). More than 90 percent of the seed planted at the beginning of Sept. 1953 was hard-skinned. After soaking for a few wt. it still remained hard-skinned. Germination was brought about by mechanical injury of the seed coat only. At the end of Nov. 1953, all signs of hard-skin had completely disappeared from tested seed. Later planting of the same seed (Jan. 1954) revealed no hard-skin in any sample. Other var. and crosses were unaffected and, since no hard-skin occurred at the 2nd planting, environmental conditions rather than heredity seemed to influence this phenomenon, ascribed to a decrease in humidity since the min. percentage of RH for the planting, harvesting, and storage periods were very low. Storage of beans at a low humidity is therefore considered as the principal reason for hard-skin in beans. (Summary by I.B.)

0452

5958 KYLE, J.H.; RANDALL, T.E. A new concept of the hard seed character in *Phaseolus vulgaris* L. and its use in breeding and inheritance studies. *Proceedings of the American Society of Agricultural Science* 83:461-475. 1963. En., Sum. En., 17 Ref., II.

Phaseolus vulgaris. Seed. Cultivars. Plant breeding. Seed characters. Seed coat. Statistical analysis. Inheritance.

Hard seeds are generally considered to be caused by impermeability of the seed testa. The effect of micropylar size on water absorption and the most important areas of water absorption were determined for two var., Great Northern and Red Mexican. Based on results, the inheritance of the hard seed coat character was then studied. The micropylar area was found to be the major area of water entry into Great Northern beans. Water absorption through the micropyle in Red Mexican beans was not effective during the first 12 h but by 24 the micropyle accounted for a definite, but very small proportion of the total water absorbed. The size of the micropylar orifice did not directly influence water absorption in the Red Mexican var., where the major areas of water absorption were the raphe and hilum areas, resp. These areas were effective in water entry in Great Northern as well but only accounted for 18 percent of the total water intake. This difference in water absorption in the hilum and raphe areas of the testa was considered to be the cause of the hard seed condition and to be genetically controlled. The remaining areas of the

testa of these 2 var. in absorption in the hilum and raphe areas, a technique was developed to evaluate individual F₂ plants for the hard seed character. A cross between the hard-seeded Great Northern and the nonhard-seeded Red Mexican var. showed the hard seed character to be controlled by a single recessive gene pair. A very close association was shown between the white seed coat color in Great Northern and the hard seed character. Insufficient data were obtained to differentiate between 2 closely linked genes or a pleiotrophic effect of the main nonpigment gene (p), but presumptive evidence was given to indicate that probably 2 closely linked genes were involved. (Author's summary)

0453

11132 KAKADE, M.L.; EVANS, R.J. Effect of soaking and germinating on the nutritive value of navy beans. *Journal of Food Science* 31:781-783. 1966. En., Sum. En., 12 Ref.

Phaseolus vulgaris. Germination. Nutritive value. Protein content. Phytohemagglutinins. Inhibitors. Toxicity. Laboratory animals. USA.

The effect of soaking or germination on protein content, trypsin inhibitor activity, and hemagglutinin activity of navy beans was studied. Soaking navy beans for 1-4 days decreased trypsin inhibitor activity, especially that of hemagglutinin. The decrease in protein content due to soaking did not account for all of the decrease in antitrypsin and hemagglutinin activity. No significant changes were observed in hemagglutinin activity due to germination although some decrease in the trypsin inhibitor activities of germinated beans was noticed. Protein content increased progressively in beans germinated 1-4 days and decreased in beans soaked 1-4 days. Rats fed raw, soaked, and germinated navy beans as a source of dietary protein lost wt. and died 8-16 days after the beginning of the expt. It is concluded that soaking prior to heating is not necessary to eliminate toxicity. (Author's summary)

0454

8136 MOLINA, M.R.; FUENTE, G. DE LA; BRESSANI, R. Interrelaciones entre tiempo de remojo, tiempo de cocción, valor nutritivo y otras características del frijol (*Phaseolus vulgaris*). (Interrelationships between soaking time, cooking time, nutritive value, and other characteristics of beans). *Archivos Latinoamericanos de Nutrición* 24(4):469-483. 1974. Es., Sum. Es., En., 17 Ref., II.

Phaseolus vulgaris. Storage. Protein content. Nutritive value. N. Analyses. Methionine. Lysine. Cooking. Statistical analysis. Nutrient loss.

The interrelationships between soaking time, cooking time, and nutritive value of bean protein were studied using recently harvested beans and beans stored for a 3-mo. period. It was found that for both lots, the optimum cooking time needed to obtain max. nutritive value was 10 min. for the samples soaked for 8, 16, or 24 h. The same was true for the unsoaked samples of the recently harvested lot, while the unsoaked samples from the lot stored for 3 mo. needed a cooking time of 20-3 min. to attain max. nutritive value. The decrease of the latter parameter did not correlate with any lowering in available lysine or met. values. The detrimental effect on protein quality appear to have a direct relationship to the rehydration coefficient of the product. It is suggested, that storage could affect the nutritive value of beans, as well as the optimum process to be chosen based on protein quality. (Author's summary)

0455

11116 DURIGAN, J.F.; FALEIROS, R.R.S.; LAM-SANCHES, A. Determinação das características tecnológicas e nutricionais de diversas variedades de feijão (*Phaseolus vulgaris* L.). Características tecnológicas. (Determination of the technological and nutritional characteristics of several Brazilian bean var. I. Technological characteristics). *Cientifica* 6(2):215-223. 1978. Pt., Sum. Pt., En., 29 Ref., II.

Phaseolus vulgaris. Cooking. Cultivars. Water absorption. Seed. Brazil.

Technological qualities, hydration properties and cooking time were studied in bean var. Bico de Ouro, Roxao Lustroso, Preto Mato Grosso, Manteigao Fosco, Jalo, Floresta 5, Rosinha G2, and Rico 23. Hydration properties and cooking time showed varietal differences. It is concluded that the preparation of these beans is too time consuming and that genetic improvements should seek to reduce this time. (Summary by T.H.)

0456

17461 KON, S. 1979. Effect of soaking temperature on cooking and nutritional quality of beans. *Journal of Food Science* 44(5):1329-1334,1340. En., Sum. En., 20 Ref., II.

Phaseolus vulgaris. Seed. Water absorption. Temperature. Cooking. Timing. Composition. Analysis. Nutritive value.

California small white beans were soaked at different temp. in 10 degrees Celsius increments, from 20 to 90 degrees Celsius, until max. imbibition was achieved. Losses of total solids, N compounds, total sugars, oligosaccharides, Ca, Mg, and 3 water-soluble vitamins (thiamin, riboflavin, and niacin) were measured and found to be very small at soaking temp. up to 50 degrees Celsius. An increase in those losses of from 3- to 4-fold was found when the soaking temp. was raised to 60 degrees Celsius or above. Cooking rates followed a bell-shaped pattern with the peak, longest cooking time, being for beans soaked at 70 degrees Celsius and shortest cooking time for beans soaked at 90 degrees Celsius. Cooking rates corresponded closely to the amount of organic phosphate left in the beans after soaking at the different temp. (Author's summary)

0457

14278 MULLET, J.H. The relationship between seed size, total seed electrolytes, electrolyte leakage, and embryo growth of *Phaseolus vulgaris* (L.). *Australian Seed Science Newsletter* 5:60-64. 1979. En., 6 Ref.

Phaseolus vulgaris. Seeds. Seed characters. Composition. Nutrient loss. Cotyledons. Embryo. Laboratory experiments.

A method of determining total seed electrolytes in *Phaseolus vulgaris* seeds was developed at Knoxfield, Victoria (Australia). The method involves the use of twin cotyledons of individual seeds. One cotyledon is detached from the imbibed seed and weighed, the other cotyledon with the embryonic axis is left for 72 h in 10 ml of water, so that it is not submerged. Conductivity of the leachate was determined at intervals over the 48-h period and the fresh wt. of the embryonic axis was recorded. The detached cotyledon is frozen for 24 h, leached as described above, and conductivity is measured up to 24 h to determine the diffusion rate without membranes. By directly comparing the original seed wt., membrane efficiency, total electrolytes, and seedling growth it is concluded that the total electrolyte content in the seed is not related to seed wt. and that none of these factors affected embryo fresh wt. 48 h after imbibition. Electrolyte loss did not correlate with seed size or total electrolytes but presented a significant negative correlation with seedling wt. at 48 h. (Summary by I.B. Trans. by L.M.F.)

0458

4670 VARRIANO-MARSTON, E.; OMANA, E. DE. Effects of sodium salt solutions on the chemical composition and morphology of black beans (*Phaseolus vulgaris*). *Journal of Food Science* 44(2):531-536. 1979. En., Sum. En., 30 Ref., II.

Phaseolus vulgaris. Salinity. Plant anatomy. Analysis. Seed color. Water content. Electron microscopy. Fat content. Statistical analysis. Mineral content. Water absorption.

The effects of Na salts on the chemistry and morphology of black beans was studied. The amount of Na in the soaking water did not significantly affect the amount of water absorbed by beans; the pH was the critical determinant. However, the Na salts affected

the mineral content as well as the amount of pectic substances solubilized from the beans during soaking and cooking periods. The greatest alterations in these components occurred when beans were soaked in a solution containing 4 salts (NaCl, NaHCO₃, NaCO₃, and Na₅P₃O₁₀). X-ray microanalysis suggested that mechanisms of ion exchange and chelation were operative in the dissolution of the intercellular cement and the subsequent cell separation. (Author's summary)

0459

17326 KORBAN, S.S.; COYNE, D.P.; WEIHING, J.L. 1981. Rate of water uptake and sites of water entry in seeds of different cultivars of dry bean. *HortScience* 16(4):545-546. En., Sum. En., 11 Ref., 11.

Phaseolus vulgaris. Seed characters. Water requirements. Germination. Plant assimilation. Seeds. Cotyledon cracking. Water content. Cultivars.

The rate of water uptake of seeds of *Phaseolus vulgaris* differed between cv.; Pinto UI 111 had the highest and Bulgarian White the lowest water uptake in 24 h. Water entered through the micropyle in cv. Great Northern but through the raphe and hilum in Pinto UI 111. Little or no water uptake occurred through the seed coat. Other cv. tested were Great Northern Emerson, Great Northern 1140, Great Northern D-88, and Great Northern UI 59. (Summary by Seed Abstracts)

0460

21758 SILVA, C.A.B.; BATES, R.P.; DENG, J.C. 1981. Influence of pre-soaking on black bean cooking kinetics. *Journal of Food Science* 46(6): 1721-1725. En., Sum. En., 20 Ref., 11. (Dept. of Food Science & Human Nutrition, Univ. of Florida, Gainesville, FL 32611, USA)

Phaseolus vulgaris. Seed. Cooking. Processing. Temperature. Timing. Human nutrition. USA.

Soaking of black beans and the subsequent effect on cooking kinetics was investigated. Unsoaked beans and beans soaked in water or a salt combination solution were water cooked at temp. of 90-135 degrees Celsius. Bean softening did not follow 1st order kinetics. Using DT values (defined as cooking times necessary to reach an eating-soft texture: Instron puncture force of 150 g), softening activation energies (E_a's) for unsoaked, water, and salt combination soaked were 19.1, 31.3, and 38.9 kcal/mole, resp. Z values (increase in temp. to shorten the destruction time by a factor of 10) were calculated as 17, 22, and 36 degrees Celsius, resp. These relationships suggest ways of safely reducing cooking time and energy expenditures. (Author's summary)

0461

17724 DICKSON, M.H.; BOETTGER, M.A. 1982. Heritability of semi-hard seed induced by low seed moisture in beans (*Phaseolus vulgaris* L.). *Journal of the American Society of Horticultural Science* 107(1):69-71. En., Sum. En., 11 Ref.

Phaseolus vulgaris. Seed coat. Seed. Water content. Storage. Germination. Cultivars. Backcrossing. Inheritance. Seed characters. Genes.

Semi-hard seed in beans is defined as dry seed which does not imbibe water during a 24 h soak, but which will gain moisture rapidly at high RH within 14 days and then germinate normally. The inheritance of semi-hard seed was found to involve several genes. Soft seed was incompletely dominant to semi-hard seed. Narrow sense heritability ranged from 20-50 percent in the populations studied. Semi-hard seed was associated with excellent seed quality resulting in unusually vigorous seedlings. (Author's summary) D04

0462

21753 GROTE, M.; FROMME, H.G. 1982. Electron microscopic morphometry of cell wall swelling in rehydrated carrots and green beans: the influence of various blanching, drying, and storing parameters. Zeitschrift fuer Lebensmittel-Untersuchung und Forschung 175(3):191-194. En., Sum. En., De., 15 Ref. (Inst. of Medical Physics, Munster Univ., Hufferstr. 68, D-440 Munster, Federal Republic of Germany)

Phaseolus vulgaris. Analysis. Cell walls. Water content. Storage.

By morphometric analysis of transmission electron-micrographs, the degree of cell wall swelling in rehydrated vegetables (carrots and green bean var. Koralle and Cascade) was examined as a function of various blanching, dehydration, and storing parameters. Less cell wall swelling was observed in green beans at low drying temp. and drying at 90 degrees Celsius reduced cooking time considerably. The results show a clear correlation between food technology parameters and cellular morphology of the samples. (Author's summary)

0463

18702 OLSON, A.C.; GRAY, G.M.; GUMBMANN, M.R.; WAGNER, J.R. 1982. Nutrient composition of and digestive response to whole and extracted dry beans. Journal of Agricultural and Food chemistry 30(1):26-32. En., Sum. En., 23 Ref.

Phaseolus vulgaris. Cooking. Analysis. Mineral content. Vitamin content. Amino acids. Sugars. Sucrose.

The distribution of nutrients between hot water diffusible and nondiffusible constituents of whole California small White (CSW), Light Red Kidney, and *Phaseolus lunatus* cv. Baby Lima was examined. For CWS, 15 percent of the solids were hot water diffusible and contained more than 90 percent of the sugar sucrose, raffinose, and stachyose, 12 percent of the N, 10 percent of the fat, 60 percent of the ash, none of the crude fiber, 60 percent of the thiamin, 80 percent of the niacin, and 0 percent of any detectable starch or precipitable protein of the whole beans. PERs for cooked extracted beans were the same or better than those for nonextracted beans. A 50 percent reduction in flatulence potential measured by H₂ production was observed when rats were fed extracted beans. A significant reduction in subjective gastrointestinal distress was reported by human subjects interviewed 24 h after eating cooked extracted beans compared with cooked nonextracted beans. (Author's summary)

0464

29181 SWANSON, B.G.; HUGHES, J.S.; RASMUSSEN, H.P. 1985. Seed microstructure: review of water imbibition in legumes. Food Microstructure 4(1):115-124. En., Sum. En., 137 Ref., II. (Dept. of Food Science & Human Nutrition, Washington State Univ., Pullman, WA 99164-6330, USA)

Phaseolus vulgaris. Seed coat. Seed hardening. Water content. USA.

Scanning electron microscopy observation of the microstructural changes occurring in legumes during water imbibition offers a better understanding of differences that exist between hard and normal beans. Structural changes during imbibition typical of those found in legumes were observed in 3 dry bean cv. (Sanilac, Nep-2, and San Fernando). [AS (Extract)]

0465

29628 AGBO, G.N.; UEBERSAX, M.A.; HOSFIELD, G.L.; MARKAKIS, P. 1986. Water uptake and flour gelatinization of three dry bean cultivars (*Phaseolus vulgaris* L.). Journal of Food Science 51(3):850-851. En., Sum. En., 10 Ref., II.

Phaseolus vulgaris. Cultivars. Palatability. Starch content. Bean flour. Human nutrition. USA.

The water uptake and starch pasting of 3 dry bean cv. Sanilac, San Fernando, and Nep-2, were examined in an effort to understand certain palatability differences among them. Sanilac displayed the highest water uptake, followed by Nep-2, and that by San Fernando. Brabender amylograms on whole bean and decorticated bean flours did not show sharp pasting peaks, but paste viscosity of all cv. increased on cooling, indicating retrogradation occurred. The San Fernando flour pastes were the least viscous among the 3 cv.; the pastes of the other 2 cv. differed slightly in viscosity. Water absorption and pasting viscosity do not fully explain differences in palatability among these cv. (AS)

BRILLIANCE

0466

3618 MOH, C.C.; ALAN, J.J. A note on the inheritance of shiny factor in the seed coat of beans. *Turrialba* 14(3):156-157. 1974. En., Sum. Es., 1 Ref.

Phaseolus vulgaris. Seed coat. Inheritance. Genetics. Crossbreeding. Seed color. Plant breeding.

The gloss of the seed coat of the common bean is an agronomic character that determines the market value of the grain in many parts of Latin America. The condition of the presence of gloss is called shiny and its absence, dull. To study the genetic character of the inheritance of the shiny factor in the seed coat of beans, a cross was made between two var.: Mexico-80R and the line Lamprecht 214. Mexico-80R has dull red seeds and line 214 has shiny white seeds. All the F1 seeds were shiny. In the F2s there were three shiny seeds to one dull. These results were confirmed with the F3s. Therefore, the shiny character in the bean seed coat is genetically controlled and is inherited as a simple Mendelian character, the shiny factor being dominant over the dull. (Author's summary. Trans. by T.M.)

COLOR

0467

9991 PRAKKEN, R. Linkage relations in *Phaseolus vulgaris* L. *Genetica* 19:242-272. 1937. En., Sum. En., 13 Ref.

Phaseolus vulgaris. Inheritance. Seed color. Seed coat. Plant habit. Backcrossing. Pod characters. Agronomic characters.

The cross of the french beans Fijne Tros and Wagenaar was analyzed for 10 factors (stem height, strength of string, toughness of the pods wall, 7 color factors); their linkage relations are discussed here. The material consisted of 2042 F2 and 434 backcross plants. Only one F2 family (of 219 plants) segregated for the shine factor for seed coat color Sh-sh; the information regarding the linkage relations of this factor is rather inadequate; no case of linkage with the other factors could be stated with certainty. The factors for mottling C-c and M-m are absolutely linked; Fijne Tros in Cm Cm, Wagenaar Cm Cm; the dominant allele M locally suppresses the darkening influence of the complementary color factor C; mottling therefore is of the ever-segregating type. A rather strong linkage exists between the complementary color factor B-b (called greenish brown factor) and the factor for strength of string St-st. Fijne Tros is BB St St, Wagenaar bb st st. The crossover value computed from the F2 materials is 23.8 plus or minus 1.27; from the backcross, 27.9 plus or minus 2.15. All the remaining factors are inherited independently. (Author's summary)

10182 SMITH, F.L.; MADSEN, C.G. Seed-color inheritance in beans; interaction of the alleles at the R, Rk, and Bl loci in *Phaseolus vulgaris*. *Journal of Heredity* 39(1):191-194. 1948. En., Sum. En., 8 Ref.

Phaseolus vulgaris. Seed color. Inheritance. Crossbreeding. Genetics. Genes. Seed coat.

A study of the interactions of 8 seed coat color genes showed they belong to 3 independent allelomorphous series: R, R(ma), and r; Rk, rk, and rk(d); and Bl and bl. The R gene makes the seed coats oxblood red when homozygous dominant; when heterozygous, seed coats are oxblood red mottled on a ground color determined by other genes; when homozygous recessive, the color is determined entirely by other color genes. In contrast, R(ma) produces a true red mottling whether homozygous dominant or heterozygous. The r allele has no effect on color. The Rk series has 3 known alleles, Rk buff, rk testaceous and rk(d) garnet brown. The rk(d) allele was found in Michigan Dark Red Kidney and is reported for the 1st time in this paper. In order of dominance, these alleles are Rk, rk, rk(d). Trihybrid ratios involving the 3 gene loci are modified by the following interactions: Bl modifies the red color of R or R(ma) to purple, but has no effect in the presence of r r. It has no effect on the Rk series of alleles. The homozygous dominant R is epistatic to all genes in the Rk series. The Rk series determines the color of beans homozygous for r r and the ground color in beans mottled by either R(ma) or heterozygous R r. Commodore was found to have the color genes R Rk bl; Michigan Dark Red Kidney was found to contain r rk(d) Bl. (Author's summary)

0469

6786 NAKAYAMA, R. Genetical studies on kidney beans (*Phaseolus vulgaris*). V. On the inheritance of seed-coat color I. *Bulletin of the Faculty of Agriculture, Hirotsuki University* no. 6:21-36. 1960. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Genetics. Inheritance. Seed coat. Genes. Seed color. Crossbreeding. Cultivars. Hypocotyls. Flowers. Backcrossing.

This expt. is part of studies on the inheritance of seed coat color in kidney beans. This is mainly a report on a gene i(e) inhibiting the color genes. Ever Green, one parent var. of all crosses, in this expt. produced seed of cartridge buff, which cannot be expected readily from the presence of gene V, which is inferred from its violet flower. Relative to this, the author assumes a recessive inhibiting gene i(e) of gene V; based on this assumption, the inheritance of seed coat color in the crosses Sanpaki (seed coat color primrose yellow) x Ever Green, Premier (seed coat, color buffy citrine) x Ever Green and Ever Green x Kurotenashi (seed coat color black) is clearly explained. The genotypes of the var. used here are as follows: Ever Green, PPci(e)ci(e)JJggbbVV; Sanpaki, PPcI(e)CI(e)jjggbb(lae) v(lae); Premier, PPcI(e)CI(e)JJggBBv(lae); Kurotenashi, PPcI(e)CI(e)JJGGBBvv. The gene i(e) inhibits genes V, B, and G from producing their characteristic color on seed coat. Alternately, the dominant allele i(e) is considered to be a basic gene for the color production of genes V, B, and G. There may be very strong linkage between c and i(e), but the phenotypically observable recombinants between them could not be found in this expt. The heterozygote C'i(e)ci(e) produces the marbled seed coat, the colors of light r background and of marbling stripes being resp. similar to those produced by the corresponding ci(e)ci(e) and C'I(e)CI(e) homozygotes. (Author's summary)

0470

5826 NAKAYAMA, R. Genetical studies on kidney beans (*Phaseolus vulgaris*). VI. Genetical behavior of plant color, with special reference to seed-coat color in the hybrids between white kidney and other varieties. *Bulletin of the Faculty of Agriculture, Hirotsuki University* no. 7:37-65. 1961. En., Sum. En., 21 Ref.

Phaseolus vulgaris. Genetics. Seed coat. Seed color. Cultivars. Crossbreeding. Hybrids. Hypocotyls. Inheritance. Genes.

A study was made of the inheritance of plant color in the hybrids between White Kidney and several var. of kidney beans, with special reference to seed coat color. White Kidney was used as a parent in all crosses. The var. mated to White Kidney were divided into 2 classes, one of which was those with red self-colored or red striped seed [RR of R(st) R(st)] and the other, those with nonred seed (rr). From this expt., the gene formulas of the var. are found to be as follows: White Kidney [p c i e r J g B V(lae) r k H l n u d]], Akasando [P C l e R V(lae) R k n u d]], and Premier [R C l e r J g B v(lae) R k n u d]]. The inheritance Masterpiece [P C l e r J g b v(lae) R k n u d], and Premier [R C l e r J g B(lae) R k n u d]]. The inheritance of seed coat color in these crosses is clearly explained from these gene formulas, by the assumption of nearly similar behavior of the individual gene to that described by previous investigators. The presence of a dominant, inhibiting gene of the v(lae) gene in White Kidney was discovered, but the detailed studies on the behavior of the inhibitor were not made in this expt. Also the appearance of plants with pink hypocotyl in crosses between White Kidney and Kikuchi-Nagauzura and between White Kidney and Kurihara, all var. with green hypocotyls, suggests the complicated nature of hypocotyl color. (Author's summary)

0471

5817 MOH, C.C. Seed-coat color changes induced by ethyl methanesulfonate in the common bean (*Phaseolus vulgaris* L.). *Mutation Research* 7:469-471. 1969. En., 2 Ref., 11.

Phaseolus vulgaris. Genetics. Mutation. Seeds. Seed coat. Seed color. Genes.

A potent mutagenic agent was used to explore the possibility of a change of seed-coat color in black bean var. San Fernando. Seeds were treated with 0.04, 0.06, or 0.08 M aqueous unbuffered EMS (ethyl methanesulfonate) solution (1 ml/seed, 6 or 12 h at 20 degrees Celsius). Positive results were obtained; it is indicated that the white-seed mutants, induced by EMS, were due to the change from the dominant pigmentation factor (P) to its recessive, or merely due to a P deletion. This induced mutation technique will greatly facilitate the breeding process for the obtainment of seed-coat colors in beans. (Summary by I.B. Trans. by L.M.F.)

0472

3617 MOH, C.C.; ALAN, J.J. Correlation between seed-coat color and the seedling characters in *Phaseolus vulgaris* L. *Turrialba* 21(2):173-175. 1971. En., Sum. Es., En., 1 Ref.

Phaseolus vulgaris. Plant breeding. Genetics. Seeds. Seed coat. Cultivars. Hypocotyls. Cotyledons. Leaves. Mutation.

Studies on 271 var. of beans, randomly selected from the bean collection in the Tropical Training and Research Center, IAIAS, revealed that there is a close relationship between the color of the seed-coat and the color of the seedling. More strikingly, the black seed var. produced a red color in the hypocotyl, cotyledon, and leaf vein, while the white seed var. produced a green color in the same organs. These correlative results provide a clue to predict the seed-coat from the seedling color. Thus, a screening method can be developed for isolating the possible seed-coat color mutants from the black seed var. in a mutation breeding program. (Author's summary)

0473

20624 DELGADO DE LA FLOR, L.F. 1972. Cambios de color del episperma mediante inducción de mutaciones en diferentes estados de germinación en frijol (*Phaseolus vulgaris* L.). (Changes in seed coat color following the induction of mutations at different stages of germination in bean). *Anales Científicos* 10(1-2):76-79. Es., Sum. Es., En., 7 Ref.

Phaseolus vulgaris. Seed coat. Seed color. Mutation. Germination. Peru.

Two bean cv., Turrialba 1 and Porrillo, both with a red hypocotyl, violet flowers, and black episperm, were used to induce changes in the color of seminal integuments from black to any other color by mutagenic agents such as ethyl methanesulfonate, and by gamma radiations applied at different stages of germination of bean seeds. Changes were observed in episperm color from black to white and bay, using ethyl methanesulfonate to induce the mutations. With gamma radiations there was no change in episperm color. (Author's summary. Trans. by L.M.F.)

0474

2761 PRAKKEN, R. Inheritance of colors in *Phaseolus vulgaris* L. III. On genes for red seed coat color and a general synthesis. Mededelingen Landbouwhogeschool Wageningen. 72(29):1-82. 1972. En., Sum. En., 52 Ref., 11.

Phaseolus vulgaris. Inheritance. Seed coat. Crossbreeding. Genes. Seed.

After discussing yellow-black and red colors, 2 diallel crosses between 4 var. each are analyzed, not only for seed-coat color but also (per individual plant) for the "accompanying" colors of seedlings (cotyledons and hypocotyle), flowers and fruits. The crosses are discussed with respect to inheritance of seed coat color; segregation for all 9 main loci occurred. Pleiotropic actions of loci in boldface type are described; those in normal type appeared to be without such actions: P, T.; C, D, J.; G, B, V, and Rk. A chart for the relations between flower and seed coat color is given. (Summary by T.M.)

0475

8284 PRAKKEN, R. Inheritance of colors in *Phaseolus vulgaris* L. IV. Recombination within the "complex locus C". Mededelingen Landouwhogeschool Wageningen 74(24):1-36. 1974. En., Sum. En., 40 Ref., 11.

Phaseolus vulgaris. Inheritance. Crossbreeding. Seed color. Seed coat. Genes. Genetics. Cultivars.

A study was made of the complex locus C in 2 groups of material of *Phaseolus vulgaris* L. In a cross between Citroen (CC) and Orange-redstriped [C(st) C(st)] and in 2 diallel crosses, each involving 4 var., 7 deviating plants appeared with new testa colors. For these, 2 new alleles are suggested: C(st') and C(st''). In the F₂, C(st) C(st') resembled C(st) C(st), and C(st) C(m') was similar to CC(st), as was C(m') C(st'). It is suggested that the complex locus C consists of 6 subloci, one of which is itself complex. (Summary by Plant Breeding Abstracts)

0476

3204 SARAFI, A. New genes for seed coat color in American and Iranian blotch bean varieties. Journal of Heredity 65(5):319-320. 1974. En., Sum. En., 7 Ref.

Phaseolus vulgaris. Seed color. Seed coat. Genetics. Inheritance. Laboratory experiments. Plant breeding. Pods. Backcrossing. Genes.

Two var. of *Phaseolus vulgaris* (Pinto III, a cream-colored American var. with irregular brown veins, and Torbat, an Iranian red bean with regular black veins) were crossed and their F₂, F₂, and F₃ progenies studied for seed coat color inheritance. The results show that seed color is controlled by 2 pairs of genes, RR and CC, which produce milky (RC), cream (rC), red (Rc), and pink (rc) phenotypes; vein orientation is controlled by a pair of genes (II), and irregular orientation is dominant; black vein color (BB) is dominant over brown vein color (bb); BB and II are located on 2 different chromosomes. Plants with the genotype rrec-iibb (pink seed color with regular brown veins) produce the seed type with the best marketing value in Iran. (Author's summary)

0477

6223 HUGHES, P.A.; SANDSTED, R.F. Effect of temperature, relative humidity, and light on the color of "California Light Red Kidney" bean and seed during storage. HortScience 10(4):421-423. 1975. En., Sum. En., 11 Ref., 11.

Phaseolus vulgaris. Seed. Seed color. Temperature. Light. Storage. Seed coat. USA.

Seed of *Phaseolus vulgaris* L. cv. California Light Red Kidney was stored at 1, 12, and 24 degrees Celsius and 30 and 80 percent RH for 1 yr. The higher temp. accelerated darkening of seed coat color. High RH at 24 degrees Celsius resulted in the darkest colored beans, a complete loss of germination, a 4-fold increase in fat acidity, and a nearly 2-fold increase in the time required to cook until tender. Beans stored at 1 degree Celsius and 30 percent RH very nearly retained their original color, germination percentage and fat acidity in addition to retaining their cooking time requirements. Ultraviolet and cool-white light also darkened beans in storage; but in contrast to the darkening caused by high RH and temp., light-promoted darkening was not associated with loss in quality factors. (Author's summary)

0478

8384 NAKAYAMA, R.; SAITO, K. Genetical studies on kidney beans (*Phaseolus vulgaris*) XI. Inheritance of striped pattern of seed coat. Bulletin of the Faculty of Agriculture Hiroasaki University no. 24:1-12. 1975. En., Sum. En., Ja., 17 Ref., 11.

Phaseolus vulgaris. Inheritance. Seed coat. Hybrids. Crossbreeding. Hypocotyls. Flowers. Pods. Seed color. Dwarf beans.

In kidney bean, types of testa stripe are produced by different alleles at the same locus, C. The symbols used to designate the genes determining the two stripes are C(S) for narrow and C(BS) for broad. Segregation ratios from crosses between plants with broad testa stripes and those with narrow stripes indicated that C(S) and C(BS) belong to the C multiple allelic series. While inhibits the formation of hypocotyl color even in the presence of genes P, I, and V [or V(lac)], C(BS) shows no such inhibiting action. Striping of the pod occurs in the presence of C(S) when the genes for pigment production are present C(BS) does not have this effect. (Summary by Plant Breeding Abstracts)

0479

11128 HUSSEIN, H.A.S.; DISOUKI, I.A.M. Mutation breeding experiments in *Phaseolus vulgaris* (L.). I. EMS and gamma-ray-induced seed coat color mutants. Zeitschrift fur Pflanzenzuchtung 76:190-199. 1976. En., Sum. En., De., 7 Ref., 11.

Phaseolus vulgaris. Mutation. Seed color. Seed coat. Germination. Selection. Cultivars. Yields. Protein content. Seed characters.

Seeds of 5 bean var. were treated by different gamma ray doses or ethyl methanesulfonate concn. The mutagen effects on M1 germination, survival, and fertility are briefly reported. Varietal differences in mutagen sensitivity were found. A no. of seed coat color mutants were selected during the M2-generation. Repeated simultaneous selection for characters of practical values within and between the mutants was practiced from M3 and onwards. Nine new mutants with breeding value were continued through self-fertilization to the M6. The 9 mutants were evaluated for yield and protein content during 2 successive generations (M5 and M6). Some of the mutants surpassed their parental lines in yield and protein. (Author's summary)

0480

7682 MOH, C.C. Mutability of the mottling gene in pinto bean. Turrialba 26(3):308. 1976. En., Sum. Es., 2 Ref., 11.

Phaseolus vulgaris. Mutation. Seed. Seed color. Seed coat. Genes.

Treating seeds of a Pinto bean cv. (Brasileño) with a mutagenic product (ethyl methanesulfonate), it was possible to change the mottling character from dominant to recessive. Thus the new mutant produced a pure seed coat color rather than its typical mottled seed coat. This shows that the gene controlling the mottled pinto character in beans is mutable. (Author's summary. Trans. by T.M.)

0481

24651 NYABYENDA, P.; MPABANZI, A. 1980. Resultats d'un essai d'induction de mutation de la couleur du tegument noir du haricot volubile *Wulma*. (Results of a mutation induction trial of the black tegument color of climbing bean *Wulma*). Rubona, Institut des Sciences Agronomiques du Rwanda. Note Technique no.1. 11p. Fr., 3 Ref.

Phaseolus vulgaris. Mutation. Cultivars. Seed color. Flowers. Protein content. Yields. Rwanda.

A mutation induction trial of the black tegument color of var. *Wulma* was carried out at Rubona (Rwanda) during 1980. EMS (0.04-0.08 molar for 6-12 h) was used for a total of 6 treatments with 200 seeds each. The washed seeds were planted in the field (2nd cropping season of 1972); only 600 seedlings were established, which were planted in plots in the greenhouse. Subsequently, plants with green hypocotyl were selected. The trial continued during 8 generations and a comparative trial was carried out with 15 stable lines. Several types of mutation were obtained, notably changes in flower and seed color and increases in 1000-seed wt. and protein content. The lines kept *Wulma*'s vegetative cycle and also its susceptibility to viroses. Line *Wuca 5* outyielded *Wulma* (not significantly) and had production stability. (CIAI)

0482

16999 KORBAN, S.S.; COYNE, D.P.; WEHING, J.L. 1981. Evaluation, variation, and genetic control of seed-coat whiteness in dry beans (*Phaseolus vulgaris* L.). *Journal of the American Society for Horticultural Science* 106(5):575-579. En., Sum. En., 13 Ref.

Phaseolus vulgaris. Seed coat. Seed color. Genes. Inheritance. Adaptation. Heterosis. Statistical analysis.

A Hunter Color Difference meter and a white-paint color chart were used to determine the degree of whiteness among 8 white-seeded Great Northern (GN) cv. of *Phaseolus vulgaris*. A correlation coefficient of +0.84 was found between the 2 methods. The former method provided better separation of cv. for degrees of whiteness than the latter method. Two genetic studies were conducted, with seed-coat whiteness determined by use of the white-paint color strip. Cv. GN Emerson had the whitest seed coat. The inheritance of seed coat whiteness was investigated in 1978 using parents, F₂s of the crosses Plant Introduction (PI) 165078 (bright white) with GN Emerson (moderately bright white), GN Valley (dull white), and GN UI 59 (dull white), and in the reciprocal cross Bulgarian White (brightest white) x GN UI 59 (dull white). A quantitative pattern of inheritance was observed. Broad sense heritability estimates for this trait ranged from 46-57 percent. The Gardner and Eberhart model, Analysis II, was used in 1979 to estimate genetic effects for the trait in a 6 parent diallel cross involving GN Emerson, GN UI 59, Bulgarian White, GN Star, GN 1140, and GN D-88 (the last 3 all dull white). Additive genetic effects were predominant; but heterosis effects were also important, including significant effects for specific combining ability for brighter whiteness. The genetic data indicate that improvement of seed coat whiteness in dry beans should be relatively easy to accomplish. (Author's summary)

28211 WASSIMI, N.N.; HOSFIELD, G.L.; UEBERSAX, M.A. 1981. Dry edible beans: the effect of seed coat color on soaking characteristics. *Michigan Dry Bean Digest* 5(4):12. En., 3 Ref.

Phaseolus vulgaris. Seed coat. Seed color. Cooking. USA.

Twenty strains of dry beans differing in seed coat color were grown and screened for soaking characteristics. Results showed large differences among strains for the rate of water uptake. In addition, interstrain differences were noted for the percentage of hard seed after 48 h soaking time. Strains with few hardshell beans after 48 h soaking reached a water uptake plateau for soaking after 12 h, but strains with a significant amount of hard beans after 48 h soaking never reached their water uptake plateau. The percentage of hard seed among genotypes ranged from 0 to 56 percent with red-seeded and brown-seeded strains apparently most affected. These results suggest that the hard shell defect may be associated with testa color but further work is needed to corroborate this idea. (CIAT)

26245 OKONKWO, C.A.; CLAYBERG, C.D. 1984. Genetics of flower and pod color in *Phaseolus vulgaris*. *Journal of Heredity* 75(6):440-444. En., Sum. En., 10 Ref., 11. (Federal Univ. of Technology, P.M.B. 0248, Bauchi, Nigeria)

Crossbreeding. Flowers. Inheritance. *Phaseolus vulgaris*. Pods. USA.

A new locus, PRP (purple pod), having 5 alleles affecting anthocyanin pigmentation of corolla and pod, is described in *Phaseolus vulgaris*. The allele PRP produces 1 dark purple corolla and is fully dominant in this respect over the 4 alleles that determine light purple corolla. In the absence of RO (rose color), PRP is responsible for medium purple pods when homozygous and light purple pods in combination with the other alleles. The alleles PRP (SH2) and PRP (SH) give green pods shaded with purple and are codominant with the PRP(SI) allele, which causes green pods to be striped with purple. These 4 alleles are dominant for pod color over PRP, an allele causing green pods when homozygous. The interaction of these alleles with the genes GRI, V, and RO, which also affect anthocyanin pigmentation of corolla and pod, is described. No linkages among these 4 loci were observed.

27039 WASSIMI, N.N.; HOSFIELD, G.L.; UEBERSAX, M.A.; ADAMS, M.W. 1982. Consumer color acceptability of dry edible beans (*Phaseolus vulgaris* L.). In Michigan State University. Agricultural Experiment Station, Saginaw Valley Bean-Beet Research Farm and Related Bean-Beet Research. East Lansing. 1982 Research Report. pp.73-81. En., 4 Ref.

Phaseolus vulgaris. Cultivars. Seed color. Palatability. USA.

Two expt. were conducted to determine the importance of the color in navy beans and evaluate color in Black Turtle Soup beans using consumer preference test panels. In the 1st expt., a comparison was made of the degree of whiteness of 3 navy bean lines maintained by the bean breeding program of Michigan State U. (cv. Sanilac and lines 61618 and 790053) and 2 commercially packed dry samples of navies purchased at local markets in Michigan (USA). The 5 lines were evaluated in a triangle test and 51 judges were instructed to select the sample they perceived different and to classify each sample according to its acceptability. The seed coat color of Sanilac was judged as the most acceptable and 61618 was considered as the different samples although it showed little difference in appearance from some commercial samples found in supermarkets in the Lansing area. The 2nd expt. evaluated the degree of lightness of 24 dry bean samples consisting of 10 navy bean strains and 7 strains of Black Turtle Soup-type beans. Fleetwood had the

highest acceptability while 61618 had the lowest. Samples were separated into 3 preference groups; the degree of lightness given to a line had little influence on the acceptability score it received. For the Black Turtle Soup group, Midnight was the most preferred black-seeded bean while Black Turtle Soup was the least preferred. (CIAT)

0486

22101 WASSIMI, N.N.; HOSFIELD, G.L.; UEBERSAX, M.A.; ADAMS, M.W. 1982. Consumer color acceptability of dry edible beans. Michigan Dry Bean Digest 6(4):2-3. En., 4 Ref. (Dept. of Crop & Soil Science, Michigan State Univ., USA)

Seed color. Cultivars. Consumption. Human nutrition. USA. Seed characters. Economics. Seed. North America. America.

Two expt. were carried out to assess the severity of the color problem in navy beans and in Black Turtle Soup beans. The range of surface color among breeding lines of Michigan State U. (USA) was assessed and archetypes (white and black-seeded) were compared with commercial cv. already accepted by growers, shippers, and consumers. In expt. 1, cv. Sanilac, Archetype breeding lines 61618 and 790053 (soon to be released as Swan Valley and Neptune, resp.), and 2 commercially packed samples of navy beans were evaluated. In expt. 2 the degree of lightness of 24 bean samples, including 10 navy bean strains and 7 strains of Black Turtle Soup (breeding lines 61380 and 61356), was assessed. Results of expt. 1 show that seed coat color of Sanilac was judged more acceptable than that of 61618, 790053, and the 2 commercial samples. Except for commercial sample A, 61618 was easily perceived as the odd sample. Seed coat appearance of 61618, although darker than the other strains, showed little difference in appearance from commercial samples found in supermarkets in the Lansing (Michigan) area. Results of expt. 2 show that fleetwood had the highest acceptability score among the navy beans tested, whereas 61618 had the lowest. Unfavorable climatic conditions at harvest in certain districts are thought generally to account for the less attractive appearance of the occasional market sample. There is concern about the off-white appearance of seed of the strain 61618, soon to be released. In the breeding, producing, and processing of navy beans, a higher level of seed whiteness should be encouraged. There is no indication that these relatively minor color variations carry over to the canned product. (CIAT)

BROTH

0487

1086 JAFFE, W.G.; GONZALES Y MARIA, I.D.; MONDRAGON, M.C. Composición de caldos de frijoles. (Composition of bean broth). Archivos Latinoamericanos de Nutrición 26:75-83. 1976. Es., Sum. Es., En., 7 Ref.

Phaseolus vulgaris. Cooking. Seed. Analysis. N. Amino acids. Vitamin content. Chemical composition. Tryptophane. Lysine. Methionine. Cystine. Venezuela.

Bean broths are used for weaning babies. An analysis was made of the chemical composition of 6 broths, the corresponding bean residue and the raw beans to determine the loss of nutrients during cooking. The proportion of nutrients in the broths (percentage of that in the raw beans) was 11.9 percent protein, 9.4 percent tryptophan, 4.7 percent lysine, 5.6 percent met., 3.2 percent cystine, 13.1 percent thiamine, 26.5 percent riboflavin, and 24.1 percent niacin. Cystine, thiamine, and niacin contents were most affected by cooking. Based on results, the broth proteins have a lower nutritive value than cooked beans. (Author's summary)

0488

4656 MONDRAGON, M.C.; GONZALEZ, D.I. Caldos de frijoles en relación a su contenido de aminoácidos y polifenoles. (The nutritional value of bean broth in relation to

its amino acid and polyphenol contents). *Archivos Latinoamericanos de Nutrición* 28(1):41-62. 1978. Es., Sum. Es., En., 24 Ref., 11.

Phaseolus vulgaris. Cooking. Cultivars. Seed color. N. Methionine. Cystine. Lysine. Tryptophane. Tannin content. Diets. Laboratory animals. Mineral content. Digestibility. Venezuela.

Three batches of black beans and 1 of white beans were boiled in open pans; the broth was then separated from the cooked beans; the yield, total N, met., cystine, lysine, tryptophan, and tannin contents of the broth and the beans were determined; and nutritional values were determined in rat feeding trials. Tables of results are given. The bean broth has a very low nutritional value, due to low lysine, met., and tryptophan concn. and high polyphenol concn. (Summary by Food Science and Technology Abstracts)

0489

26540 BRAHAM, J.E.; BRESSANI, R. 1965. Effect of bean broth on the nutritive value and digestibility of beans. *Journal of the Science of Food and Agriculture* 36(10):1028-1034. En., Sum. En., 15 Ref. (Division of Agricultural Sciences, Inst. of Nutrition of Central America & Panama, P.O. Box 1188, Guatemala, Guatemala)

Cooking. Digestibility. Guatemala. Methionine. *Phaseolus vulgaris*.

Black, red, and white beans were cooked (1:3, water:beans) at 120 degrees Celsius and 1.12 kg/square centimeter for 20 min. Chemical analysis of the broth showed that it contained low levels of protein, ether extract, and carbohydrates, and high levels of ash and polyphenols. The effect of the addition of bean broth on the PER and digestibility of beans was studied in rats. PER values and protein digestibility decreased as the amount of bean broth increased in the diet. White beans showed highest values of PER, wt. gain, and protein digestibility; the latter was lower in the groups supplemented with met. than in those not supplemented. There was no interaction between level of met. and amount of bean broth in the diet on digestibility. The effect of met. was not related to either metabolic N in feces or amount of food consumed. A high proportion of the feces N was soluble in NaOH. When rats from the different groups were fed diets containing 18 percent bean protein and killed at 6 wk. of age they showed no difference in pancreas wt. that could be related to the amount of broth in the diet, nor were the levels of trypsin in the pancreas or the amount of P-aminobenzoic acid excreted upon ingestion of N-benzoyl-L-tyrosine-P-aminobenzoic acid related to the amount of broth in the diet. (AS)

SPOILING

0490

1354 SWANSON, B.G. et al. Proximate composition, respiration rate and fungi growth of dry beans. *Journal of Food Science* 42(3):799-801. En., Sum. En., 13 Ref.

Phaseolus vulgaris. Seed. Mycoses. Storage. Harvesting. Analysis. N. Fat content. Mineral content. *Aspergillus*. *Penicillium*. Water content. Plant respiration.

Field and storage fungi were associated with problems encountered in processed dry bean products. Representative sampling and analytical techniques provided comprehensive information on environmental conditions, proximate composition and fungi growth of dry beans harvested in 1974-75. Environmental condition of bean storage vary dramatically with facilities, climates, and composition of the harvested beans. Mean proximate composition of the beans was 11.02 percent moisture, 2.2 percent soluble N, 3.26 percent total N, 0.92 percent fat, 3.77 percent ash, and 63.91 percent carbohydrate. Respiration rates ranged from 20.93 microM/g per h O₂ uptake for immature beans (67 percent moisture) to less than 0.3 microM/g per h O₂ uptake for harvested beans (14 percent moisture). Fungi were prominent on dry beans. Surface disinfection of mature dry

beans, followed by embedding in PDA containing 10 percent salt, was selective for storage fungi. Fungi were observed to invade the seed coat, depending on environmental conditions. (Author's summary)

0491

19956 NESTER, S.; WOODBURN, M. 1982. Contamination and growth of *Bacillus cereus* and *Clostridium perfringens* in Mexican-style beans. *Journal of Food Protection* 45(7):638-642. En., Sum. En., 30 Ref., 11. (Dept. of Foods & Nutrition, School of Home Economics, Oregon State Univ., Corvallis, OR 97331, USA)

Phaseolus vulgaris. Seed. Temperature. Storage. *Bacillus cereus*. *Clostridium perfringens*. Cooking. Human Nutrition. USA.

Two major problems in production procedures used in Mexican restaurants, identified through interviews with managers, were failure to cool large quantities of beans rapidly and failure to reheat beans thoroughly before placement on the steam table. Expt. were designed to study the effects of varying temp., incubation time, and location in the product on growth of *Bacillus cereus* and *Clostridium perfringens*, singly and combined, in cooked mashed pinto beans. Growth of both *B. cereus* and *C. perfringens* was rapid at 37 degrees Celsius, with no. of cells associated with illness reached in 4 and 6 h, resp. *B. cereus* may present more of a health hazard, since obvious signs of spoilage did not occur in these beans until 12 h, whereas *C. perfringens* caused obvious spoilage of beans within 6-8 h. No. of *B. cereus* usually associated with illness were found at 12 h at 23 degrees Celsius. The beans appeared to be spoiled before this level was reached with *C. perfringens* at 24 h. Good growth of both species occurred in both top and bottom locations. Of 42 restaurant samples of bean dip and mashed beans analyzed for contamination with *B. cereus* and *C. perfringens*, only 2 samples were found to contain either organism and these were present in low no. Two samples were, however, found to contain large no. of coagulase-positive *Staphylococcus aureus* (more than 100,000/g). (Author's summary)

FLATULENCE

0492

5533 RICHARDS, E.A.; STEGGERDA, F.R. Production and inhibition of gas in various regions in the intestine of the dog. *Proceedings of the Society for Experimental Biology and Medicine* 122:573-576. 1966. En., Sum. En., 7 Ref.

Phaseolus vulgaris. Gas production. Animal physiology. Bacteria. Inhibitors. Analysis.

The relationship between the small intestinal and colonic flora and the gas volumes and composition resulting from the introduction of navy bean homogenates into surgically prepared intestinal segments of normal and antibioticly pretreated dogs was investigated. Intestinal gas production was effectively inhibited or greatly reduced in animals pretreated with neomycin sulfate and sulfathiazine, mexaform, and Vioform, following the administration of navy bean homogenates. Mexaform and Vioform effectively destroyed the anaerobic bacteria of the intestinal tract whereas the normal aerobic and coliform bacteria increased in total no., indicating that the increased gas production from a navy bean homogenate was due to the anaerobic intestinal flora. Contrary to some current belief, it has been shown that bacterial action in the duodenum, jejunum, and ileum of the dog may add significantly to the total intestinal gas volume of animals fed navy bean homogenates. (Author's summary)

0493

5543 STEGGERDA, F.R.; DIMMICH, J.F. Effects of bean diets on concentration of carbon dioxide in flatus. *American Journal of Clinical Nutrition* 19(2): 120-124. 1966. En., Sum. En., 15 Ref.

Phaseolus vulgaris. Gas production. CO₂. Human physiology. Diets. Analysis.

Expt. were undertaken to study quantitative differences in flatus volume in adult male subjects and its composition produced by isocaloric diets containing no beans, methylcellulose and 6 different bean preparations. Although rigid dietary conditions were imposed, flatus volume and its gaseous composition varied widely from subject to subject. A direct relation exists between the volume of flatus produced and the volume of beans consumed in amounts of 27 percent or more of the diet. The principal gas accountable for the increased flatus volume is CO₂. Neither the high fiber content of beans nor changing the bean structure by homogenization alters the flatus-producing mechanisms in beans. (Author's summary)

0494

5484 RICHARDS, E.A.; STEGGERDA, F.R.; MURATA, A. Relationship of bean substrates and certain intestinal bacteria to gas production in the dog. *Gastroenterology* 55(4):502-509. 1968. En., Sum. En., 28 Ref., 11.

Phaseolus vulgaris. Bacteria. Gas production. Laboratory animals. Animal physiology.

In vivo and in vitro tests indicated that certain anaerobic bacteria in the small and large intestine are closely related to gas production in the presence of navy bean and soybean products. The characteristic high carbon dioxide and hydrogen content of the gas produced in the in vitro expt. gives support to the assumption that the gas production is closely related to fermentation by the clostridia type of bacteria. Gas production in the presence of bean homogenates was completely inhibited with antibiotic and bacteriostatic agents. After injection of gas-producing bean products into intestinal loops the no. of anaerobic spore-forming organisms present in mucosal samples of the ileum and colon were markedly increased. The methods used in this study can be used effectively for detecting the presence of gas-producing factors in foods. (Author's summary)

0495

5456 ROCKLAND, I.B.; GARDINER, B.L.; PIECZARKA, D. Stimulation of gas production and growth of *Clostridium perfringens* Type A (No. 3624) by legumes. *Journal of Food Science* 34:411-414. 1969. En., Sum, En., 21 Ref.

Phaseolus vulgaris. Gas production. Cooking. Animal physiology. Analysis. Inhibitors. Bacteria.

Dry beans and other legumes contain an unidentified factor that stimulates rapid growth and gas production by *Clostridium perfringens*, Type A. This factor may be related to the flatus-inducing properties of dry beans. It is suggested that flatus gases are product of accelerated gas production by the intestinal anaerobe. Gas production and growth of *C. perfringens* were inhibited by some of the same antibiotics that are known to block flatulence in higher animals. Hydrogen and carbon dioxide, the major constituents in flatus gases, were also found to be the primary gases collected over cultures of the anaerobe grown in a synthetic medium. Bland foods such as rice and barley evoked minimal response. Pure carbohydrates including lactose, ralloinose, stachyose, and starch had no effect on gas production when the organism was grown in a complete basal medium containing glucose. An assay procedure was developed for measuring the response of the microorganism to various substrates. This procedure should facilitate isolation, purification, and characterization of the unknown factor. If a direct relationship can be established between this factor and the flatulence factor in dry beans, the assay procedure should have applications in establishing a flatus index for foods and aid in the development of nonflatulent food products. (Author's summary)

6241 CALLOWAY, D.H.; HICKEY, C.A.; MURPHY, E.J. Reduction of intestinal gas-forming properties of legumes by traditional and experimental food processing methods. *Journal of Food Science* 36:251-255. 1971. En., Sum. En., 18 Ref.

Phaseolus vulgaris. Gas production. Human nutrition. Legume crops. CO₂. Analysis.

The propensity of legumes to promote formation of intestinal gas was evaluated by healthy young men by measuring flatus passed from the rectum and the amount of bacterially formed gas in the exhaled breath. Previous experience has shown that flatulent test meals fed in the morning cause elevation of breath hydrogen concn., flatus volume and flatus hydrogen, and carbon dioxide content 5-7 h later. Test responses were measured against a baseline derived from feeding a bland, low-residue formula diet. Mature dry lima beans were found to be as high in flatulence-inducing factors (FF) as California small white beans. Mung beans and soybeans caused the same excretion of hydrogen in the breath as did white beans, but only about 2/3 as much flatus. Several products processed by methods that might be expected to alter FF concn. or activity were also evaluated. Ethanol extraction of whole white beans reduced, but did not eliminate their gas-forming quality. (Author's summary)

0497

5482 GUMBAN, M.R.; WILLIAMS, S.S.N. The quantitative collection and determination of hydrogen gas from the rat and factors affecting its production. *Proceedings of the Society for Experimental Biology and Medicine* 137:1171-1175. 1971. En., Sum. En., 10 Ref.

Phaseolus vulgaris. Laboratory animals. Diets. Gas production. Analysis. N. Animal physiology. Enzymes. H. Proteins.

The action of microflora on fermentable substances in the intestine produces hydrogen, which has been associated with pathologic conditions resulting in carbohydrate malabsorption. Therefore, a technique was developed to determine the total H₂ produced and the factors influencing H₂ production following bean consumption. A life-support system for the rat is described in which the H₂ evolved after consumption of a given diet, is quantitatively trapped and determined. The max. rate of production after feeding a dried bean diet occurred between 4 and 5 h. The quantity of H₂ arising from such a diet increased as bean consumption did and was directly proportional to the amount of beans eaten over a range that produced 2-8 ml of H₂/feeding. Dietary regimen of the animal before testing was found to influence response. With consecutive daily feedings of a bean diet, H₂ production decreased by 18.6 percent of the initial value/day for approx. 4 days. (Summary by T.M.)

0498

54985 MURPHY, E.L.; HORSLEY, H.; BURR, H.K. Fractioning of dry bean extracts with increased carbon dioxide egestion in human flatus. *Agricultural and Food Chemistry* 20(4):813-817. En., Sum. En., 16 Ref.

Phaseolus vulgaris. CO₂. Human physiology. Alcohol. Cooking. Analysis. Amino acids. Hydrolysis.

A series of successive chemical and physical fractionations of cooked dry California Small White beans were made, and the activity of each fraction was measured, using human subjects, for its ability to increase the carbon dioxide component of flatus. The activity was found to be: extractable with 60 percent aqueous ethanol; dialyzable through a reconstituted cellulose membrane; soluble in 85 percent ethanol; and unadsorbed by a column packed with a strong cation exchange resin. This active column fraction was shown to contain the sugars, fructose, sucrose, raffinose, stachyose, and at least four polypeptides hydrolyzable into 22 amino acids. Raffinose and stachyose fed alone at

levels found in California Small White beans did not increase the carbon dioxide level of the flatus. (Author's summary)

0499

25958 LIEBMAN, B. 1983. Fear of bloating: beans needn't be bland or embarrassing. *Nutrition Action* 10(1):12-14. En., II.

Phaseolus vulgaris. Human nutrition. Cooking. USA.

The reason why many North Americans do not consume beans--bloating (also called indigestion or flatulence)--is discussed. Flatulence is caused by the indigestible sugar raffinose and by stachyose and verbacose, which are acted upon by intestinal bacteria causing fermentation and gas production. A method for leaching out some of these sugars from beans by soaking in water is given, although valuable vitamins and minerals can be lost in the process. (CIAT)

PROCESSING

General

0500

21045 BOLLES, A.D.; UEBERSAX, M.A.; HOSFIELD, G.L.; HEMLINK, R.C. 1982. Textural parameters derived from shear curves of processed dry edible beans. *Michigan Dry Bean Digest* 6(3):21-23. En., 5 Ref., II.

Seed. Canned beans. Seed characters. USA. Processed products. North America. America.

Selected factors affecting processed bean texture were examined through detailed evaluation of shear resistance curve components. In expt. 1, 4 levels of bean solids (40, 80, 100, and 120 g) of var. Seafarer and Black turtle Soup, canned in brine solution, were used. Four canned bean:brine ratios were obtained and it was found that the compression peak for the 40 g sample of Black Turtle Soup was significantly higher than the other 3 levels of bean solids and also significantly higher than any of the solid levels of Seafarer, indicating a genotypic difference in texture. Black Turtle Soup's shear peak, however, was lower than Seafarer's, once again indicating a genotypic texture difference. The inflection point, compression curvature, and shear acceleration all increased as bean solids increased. In the holding time study, it was concluded that canning beans is a dynamic system during the 1st wk. after processing. Displacement of soluble solids into the brine occurs and at the same time beans imbibe more water. In the packing medium osmolarity study (brine solution), an increase in osmotic pressure produced an increase in compression peak and a decrease in shear peak. The 7th degree polynomial for characterization of the texture curve generated new parameters which may assist in the examination and interpretation of bean texture. (CIAT)

0501

28070 HOSFIELD, G.L.; UEBERSAX, M.A.; VARNER, G.V. 1984. Processing quality evaluation of Michigan dry beans. *Michigan Dry Beans Digest* 9(1):10-11, 28-29. En.

Phaseolus vulgaris. Canned beans. Seed characters. Processing. USA.

Quality considerations of dry edible beans demanded both by consumers and producers are mentioned and different methods of evaluation or calculation of food quality traits of beans (dry, soaked, and cooked bean surface color, soaked bean wt. and hydration ratio, cooked bean texture, washed drained wt. (g and ratio), splits, and processed bean

moisture) are briefly described. Results of canning trials conducted to evaluate the processing quality of beans are included and analyzed. (CIAT)

0502

28908 RODRIGUEZ-SOSA, E.J.; VILLAFANE DE COLOM, S.; PARSI-ROS, O. 1984. Effect of processing on selected nutrients of beans (*Phaseolus vulgaris*). *Journal of Agriculture of the University of Puerto Rico* 68(1):45-51. En., Sum. En., Es., 17 Ref.

Phaseolus vulgaris. Processing. Canned beans. Mineral content. Ca. Mg. Fe. P. K. Chlorine. Na. Fat content. Cultivars. Puerto Rico.

Twenty-two dry bean selections were commercially canned and analyzed for Ca, Mg, Fe, Mn, P, Na, Cl, K, protein (N x 6.25), and fat content before and after processing. The retention percent for Mg, Fe, Mn, P, and K were 89.0, 95.0, 89.8, 67.4, and 55.4, resp. The Ca, Na, and Cl contents increased with processing. The increase in Ca content can be attributed to the hardness of processing water. Na and Cl were added as table salt. When all selections were taken into account, no significant differences were observed between raw, dry, and processed beans with resp. to Fe, Mn, protein, and fat content, but here were significant differences with respect to Ca, Mg, P, Na, Cl, and K. (AS)

0503

29186 MUGGIO, B.N.; UEBERSAX, M.A.; HOSFIELD, G.L.; THOMPSON, S.S. 1985. Characterization and bioconversion of Great Northern Bean blancher effluent. *Journal of Food Science* 50(4):918-921. En., Sum. En., 35 Ref., II. (Gordon Food Service, Grand Rapids, MI 49501, USA)

Phaseolus vulgaris. Canned beans. Fermentation. Microbiology. Biochemistry. USA.

Chemical characterization of a Great Northern bean blanching effluent and bioconversion by *Hansenula anomala* was performed. The effluent contained 27,000 mg/liter and 31,000 mg/liter total solids including 49.5 percent starch and 23.6 percent protein (dry basis). A high bod:cod ratio (0.95) indicated a waste easily and completely degradable, with N and P levels above those necessary for unimpeded microbial growth. Batch fermentations of raw effluent produced 12 g dry cells/liter, containing 53 percent protein, with a corresponding 84 percent reduction in bod. Great Northern bean blanching effluent was demonstrated to be a suitable growth medium for *H. anomala*.

0504

29653 CRIBELLI, G.; SENESI, E.; BERTOLO, G. 1986. Aspetti qualitativi di alcune linee e cultivar di fagioli surgelati. (Qualitative aspects of some bean cultivars and lines for freezing). *Informatore Agrario* 42(11):59-60. It., Sum. It., 2 Ref., II.

Phaseolus vulgaris. Cultivars. Seed characters. Seed color. Processing. Italy.

Bean cv. Taylor's, Big Borlotto, Giulia, Minia, and Lena and the lines P262, P288, and P282 were evaluated during 1984-85 in several environments of Italy to determine the effect on the homogeneity of bean seed pigmentation. Cv. Giulia performed satisfactorily irrespective of yr. and environment. The characters seed coloration, shape, and texture were necessary for a high quality frozen product. (CIAT)

0505

28958 JOOD, S.; MEHTA, U.; SINGH, R. 1986. Effect of processing on available carbohydrates in legumes. *Journal of Agriculture and Food Chemistry* 34(3):417-420. En., Sum. En., 17 Ref. (Haryana Agricultural Univ., Dept. of Foods & Nutrition, Hisar 125 004, India)

Phaseolus vulgaris. Cultivars. Soil. Soil compaction. Fertilizers. Dry matter. Mineral content. Shoot. Roots. Ca. Zn. B. Fe. Mn. Brazil.

The effect of various treatments, such as soaking in plain water and sodium bicarbonate solution, cooking of soaked seeds, autoclaving of soaked seeds, germination and drying of germinated seeds, commonly employed to destroy the flatulence factors in legumes, was investigated on available carbohydrates of *Phaseolus vulgaris*, *Cicer arietinum*, *Phaseolus mungo*, *Cajanus cajan*, and *Vicia faba*. Total soluble sugars, reducing sugars, nonreducing sugars, and starch content in above pulses ranged from 7.09 to 10.33 percent, 0.18 to 0.83 percent, 6.91 to 9.60 percent, and 43 to 53 percent, resp. The contents of all these components decreased under various treatments; however, on germination for 24 h, the losses in the amount of total sugars, reducing sugars, and nonreducing sugars were higher than observed in seeds germinated for 48 h. On further germination up to 96 h, the contents of these sugars increased. Starch content, on the other hand, decreased. When the present observations are combined with those of a previous paper, it appears that germination of pulses for 24 h is a reasonably good treatment for reduction of flatus-producing carbohydrates as well as avoiding excess losses of the available carbohydrate. (AS)

Germination

0506

5432 CHEN, L.H.; WELLS, C.E.; FORDHAM, J.R. Germinated seeds for human consumption. Journal of Food Science 40(6):1290-1294. 1975. En., 34 Ref.

Phaseolus vulgaris. Seed. Germination. Human nutrition. Animal nutrition. Statistical analysis. Food energy. Fatty acids. Analysis. Vitamin content. Mineral content. Cultivars.

Five pea and 2 *Phaseolus vulgaris* cv. (Pinto and White Navy) were germinated on cellulose sponges; and effects on chemical composition, energy value, fatty acid composition, contents of ascorbic acid, tocopherol, carotene, thiamine, riboflavin, niacin and minerals, organoleptic quality and effects on animal growth were studied. The best cv. for germinating and animal feeding were pea cv. Laxton Progress, which could be consumed raw and pea cv. Dwarf Gray. All cv. were organoleptically acceptable. (Summary by Field Crop Abstracts)

0507

14769 MUÑOZ G., J.A. Cambios químicos y nutricionales del frijol (*Phaseolus vulgaris* L.) en su proceso de germinación. (Chemical and nutritional changes in beans during germination). Tesis Ing. Agr. Guatemala, Universidad de San Carlos de Guatemala, 1975? 43p. Es., Sum. Es., 31 Ref., Il.

Phaseolus vulgaris. Nutritive value. Germination. Seeds. Amino acids. S. Protein content. Fat content. Fibre content. Mineral content. Digestibility. Inhibitors.

The effect of germination on the nutritive value of black beans was studied. Samples were taken at 0, 3, 6, and 9 days for each germination stage. An increase in water content and a reduction in protein, fat, crude fiber, and ash contents, expressed on a fresh basis, were observed. A reduction in protein content was correlated with an increase in lysine, total S-amino acid contents and of the biological activity of growth inhibitors. A decrease in protein solubility in NaOH 0.01 N was observed while the soluble fraction of KCl at 5 percent increased. The soluble fractions in water ethanol at 70 percent remained constant. A decrease was observed in the nutritive value during germination and protein digestibility was not significantly affected. Results suggest that during germination, the decrease that of the S-amino acids analyzed, met. remained constant while cystine decreased significantly. A positive correlation ($r = 0.91$) was found be-

tween the PER and total S-amino acids and ($r = 0.95$) between the PER and cystine. It was also concluded that in this physiological stage, the seed has an enzymatic system capable of hydrolyzing some of the growth inhibitors. Finally, results showed the importance of carrying out biochemical and physiological studies in order to evaluate the importance of toxic factors, different protein fractions, and amino acid composition on digestibility, and the nutritive value of legume seeds, that constitute an important protein resource for L.A. countries. (Author's summary. Trans. by L.M.F.)

0508

13192 LEE, T.E.G.; CROCOMO, O.J. Protein pattern changes in the germinating bean seed. *Turrialba* 30(1):87-91. 1980. En., Sum. Es., En., 16 Ref., Il.

Phaseolus vulgaris. Seed. Germination. Plant physiological processes Cotyledons. Protein content.

The change of total soluble proteins, glycoproteins and their subunit patterns in the cotyledons of germinating *Phaseolus vulgaris* L. beans were investigated. Polyacrylamide gel electrophoresis techniques were used to detect these proteins and subunits. The disappearance of these protein bands was found to be in sequence with the legumin-like protein as the first one to be hydrolyzed followed by the vicilin-I and finally the vicilin-II. The synthesis of new protein in the cotyledons of germinating bean seed was also detected. (Author's summary)

0509

14257 TABEKHIA, M.M.; LUH, B.S. Effect of germination, cooking, and canning on phosphorus and phytate retention in dry beans. *Journal of Food Science* 45:406-408. 1980. En., Sum. En., 22 Ref.

Phaseolus vulgaris. Germination. Cooking. Digestibility. Dietary value. Human nutrition. USA.

The effects of germination, cooking, and canning on the changes in total P, inorganic P, and phytate retention in black-eyed, red kidney, mung, and pink beans were determined in this study. Soaking the dry beans in water for 12 h at 24 degrees Celsius resulted in a slight decrease in phytate. After germination for 96 h or longer there was a significant breakdown in phytic acid, and an increase in organic P. Cooking the dry beans at 100 degrees Celsius for 3 h had little effect on phytate retention. Heat processing the dry beans at 115.5 degrees Celsius for 3 h in cans resulted in some increase in inorganic P and a reduction in phytate. (Author's summary)

0510

27074 HAESA, L.B.; ATUTUBO, E.O.; DQUIL, M.M. 1984. Sensory quality attributes of products prepared from flours of germinated legumes. *NSTA Technology Journal* 9(4):48-57. En., 7 Ref.

Phaseolus vulgaris. Bean flour. Organoleptic properties. Nutritive value. Philippines.

To evaluate whether the consumer would accept nutritionally superior flours from germinated legumes, among them beans, their organoleptic properties were studied. Products developed from flours were subjected to sensory evaluation, employing at least 12 experienced panel members, and the consumer evaluation was conducted employing preschool and school children. The panel members were confronted with products from germinated and ungerminated legumes, and wheat; the children only evaluated germinated legumes. The results from the sensory evaluation indicated that, generally germinated legumes were superior to ungerminated legumes and comparable with wheat. Consumer evaluation indicated that most products of germinated legumes will be accepted. (Food Science and Technology Abstracts)

Extrusion

0511

23468 MARTINEZ R., E.R. 1977. Frijol extruido en la alimentación de las aves. (Extruded beans in poultry feeding). Tesis Ing. Agr. Chapingo, México, Escuela Nacional de Agricultura. 38p. Es., Sum. Es., 34 Ref.

Animal nutrition. Cooking. Nutritive value. Diets. Mexico. North America. America.

Two expt. were conducted with chickens fed on beans subjected to different extrusion levels. In the 1st expt. 240 78-day-old chickens were fed with levels of 5, 15, and 25 percent extruded beans with treatments of 10 and 15 lb/in² for 30 min. Although there was no significant difference ($P = 0.05$), greater wt. gains were obtained at low levels of autoclaved beans. In the 2nd expt. 147 8-day-old chickens were fed with levels of 25, 50, and 75 percent extruded beans with different energy contents (2832 to 2432 kcal). As the bean content in the diet increased, wt. gains were lower, becoming more critical when the amount of energy was deficient. Even though beans underwent extrusion, the toxic factors persisted and were more evident at high levels. [AS (Extract)-CIAT]

0512

17756 PAK, N.; ARAYA, H. 1981. Frijol extruido: potencialidad de su utilización en la alimentación infantil. (Extruded beans: potential use in feeding children). Archivos Latinoamericanos de Nutrición 31(2):371-383. Es., Sum. Es., En., 19 Ref.

Phaseolus vulgaris. Cooking. Nutritive value. Bean flour. Analysis. Protein content. Methionine. Human nutrition. Chile.

The nutritional value of extruded bean flour (*Phaseolus vulgaris* var. Tórtola) obtained from the food industry was assessed in terms of chemical composition, BV of protein, amino acid supplementation, and hemagglutinin content. The assessment also included several mixtures with extruded bean that could be applicable for infant and preschool feeding. The NPU of the samples ranged from 37.3-43.9 and hemagglutinin activity, from 0-2. Protein quality was increased considerably by adding DL-met. but no tryptophan. Six mixtures using extruded bean in concn. ranging from 30-80 percent, plus rice, wheat flour, skimmed milk, and DL-met. were formulated. Protein contents varied from 16.4-26.8 percent, with a NPU of 58.5-69.7 percent. The usefulness of these mixtures to meet the energy and protein allowances, according to the WHO/FAO report of 1973, is discussed. It is concluded that extruded bean flour is a promising food for infant and preschool feeding, especially when added to mixtures that will improve their efficiency in meeting nutritional allowances. (Author's summary)

0513

19067 GUALBERTO, D.G.; BICUDO, M.H.; COELHO, D.T.; MAFFIA, L.M.; TEIXEIRA, S.M. 1982. Avaliação nutricional de misturas de feijão (*Phaseolus vulgaris* L.) e soja (*Glycine max* L.) processados por extrusão. (Nutritional assessment of extruded bean and soybean mixtures). Revista Ceres 29(163):233-241. Pt., Sum. Pt., En., Il., Ref.

Phaseolus vulgaris. Proteins. Nutritive value. Laboratory animals. Methionine.

Nutritional quality of protein mixtures from texturized soybeans and precooked red beans at different levels of combinations (80:20, 60:40, 40:60, and 20:80), compared with texturized soybean and precooked red beans taken separately, was evaluated in a biological assay using male albino rats, 21 days old. The effects of the addition of 0.2 percent met. were also studied. The criterion selected for evaluation was the NPR. A completely randomized exptl. design was used. The products were also sensory evaluated. The addition of increasing amounts of soybean to bean gradually increased the level of protein

in the mixture. Among the nonsupplemented mixtures, a better protein quality was obtained with 20 percent of the protein from red beans and 80 percent from soybeans, which corresponded to 37 and 63 g of bean and soybean, resp. Supplementation with met. improved the quality of the mixtures. The mixture of 60 percent precooked red beans and 50 percent texturized soybean supplemented with 0.2 percent met. was found to be the best combination since it had good acceptability and high protein quality. (Author's summary)

Roasting

0514

19459 AGUILERA, J.M.; LUSAS, E.W.; UEBERSAX, M.A.; ZABIK, M.E. 1982. Development of food ingredients from navy beans (*Phaseolus vulgaris*) by roasting, pin milling, and air classification. *Journal of Food Science* 47(4):1151-1154. En., Sum. En., 27 Ref., II.

Phaseolus vulgaris. Bean flour. Processing. Analyses. Protein content. Water content. Fat content. Ash content. Fibre content. Human nutrition. USA.

Eight navy bean samples, roasted between 91-125 degrees Celsius in a particle-to-particle heat exchanger, were ground to produce whole bean and hull flours. Dehulled bean flours were also separated into high protein (HPF) and high-starch fractions (HSF) by air classification. Whole bean flours contained 1.92 percent fat and 25.8 percent protein on the av. Hull flours contained between 31.2-50.2 percent dietary fiber, of which approx. 60 percent was crude fiber. Dehulled bean flour containing 26.8 percent protein was fractionated into HSF and HPF with av. protein contents of 15.6 and 43.1 percent, resp. Greater protein shift may be further accomplished by finer grinding and adjustment of the cut point. Residual trypsin inhibitor activity (TIA) of the HPFs ranged from 25 to 108/mg protein, down from 116 units in the raw control HPF. Hemagglutinins (HA) were inactivated from 110 ha units/mg to values ranging 2.4-105 HA units/mg. (Author's summary)

0515

17730 AGUILERA, J.M.; LUSAS, E.W.; UEBERSAX, M.A.; ZABICK, M.E. 1982. Roasting of navy beans (*Phaseolus vulgaris*) by particle-to-particle heat transfer. *Journal of Food Science* 47(3):996-1000,1005. En., Sum. En., 25 Ref., II.

Phaseolus vulgaris. Seed. Processing. Mechanization. Temperature. Water content. Protein content. Ash content. Amino acids.

A rotating chamber dry roaster using preheated ceramic beads as heat transfer media was used to roast navy beans. Processing conditions were: beads temp., 240 and 270 degrees Celsius; bean-to-bead ratio, 1:10 and 1:15; and contact times, 1 and 2 min. Product temp. achieved ranged from 92-125 degrees Celsius for the 8 runs. Heat transfer coefficient (W) varied from 3.6-23.4 superficial W/(m²) (degrees Celsius). Roasted products showed reduced water-soluble N content and gel forming capacity, increased water-holding capacity and cold paste viscosities. There were no changes in available lysine and degree of starch damage. Residual trypsin inhibitor (TIA) and hemagglutinin activity varied from 92 to 22 percent, and 48 to 1 percent, resp. A correlation was found between N solubility index and TIA of products. Roasting caused fracture and separation of hulls, and facilitated their removal. (Author's summary)

0516

17864 DRYER, S.B.; PHILLIPS, S.G.; POWELL, T.S.; UEBERSAX, M.A.; ZABIK, M.E. 1982. Dry roasted navy bean flour incorporation in a quick bread. *Cereal Chemistry* 59(4):319-320. En., 12 Ref.

Phaseolus vulgaris. Bean flour. Uses.

The quality characteristics of bread prepared using navy bean flour (25.5 percent protein) to substitute wheat flour at levels of 0, 20, 35, and 50 percent were compared. Ingredients were used: all-purpose flour (100.65 g), baking powder (2.00 g), salt (3.00 g), baking soda (2.00 g), cinnamon (0.50 g), ground cloves (0.25 g), brown sugar (133.35 g), shortening (31.35 g), whole eggs (50.00 g), canned pumpkin (123.00 g), whole fluid milk (60.50 g), and vanilla (1.25 g). The batter was baked at 177 plus or minus 2 degrees Celsius for 45 min. Specific gravity, viscosity, and pH for all levels of navy bean incorporation were similar. Color of the bread was darker, less red, and less yellow with increasing levels of substitution. MC of the baked products did not differ significantly. Odor, color, and tenderness of the bread were not affected by navy bean flour substitution. Flavor scores decreased with increasing levels of substitution; the only statistical difference was between the control (0 percent) and 50 percent. Protein contents of the breads were 5.0, 5.6, 6.2, and 6.7 percent for substitution levels of 0, 20, 35, and 50 percent, resp. Dry roasting and beans reduced the antinutritional factors present in legumes. A high quality bread was produced with 35 percent navy bean flour. (Summary by EDITOR. Trans. by L.M.F.) C03

0517

28217 UEBERSAX, M.A.; ZABLIK, M.F.; LEE, J.P. 1982. Composition and utilization of dry roasted bean flour. Michigan Dry Bean Digest 7(1):16-17. En., II. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Bean flour. Drying Temperature. Fat content. Fiber content. Ash content. Protein content. Starch content. Organoleptic properties. Dietary value. Human nutrition. USA.

Navy beans were dry roasted under 8 conditions (2 heating temp. x 2 heating times x 2 bean/bean ratios) in a solid-to-solid heat exchanger, dehulled by air aspiration, pin-milled, and air-classified to obtain 4 flour fractions (whole, hull, high protein, and high starch). Chemical analyses of moisture, fat, dietary fiber, ash, and protein were conducted on all 4 flour fractions. The MC of these fractions ranged from 6.0 to 8.9 percent. Limited fat content was found in all fractions with the high protein fraction containing the greatest fat level. Highest ash content was found in hull flour. Fiber content of hull flour was very high (40.5 percent) as was protein content (52.5 percent) of high protein fraction. Three types of peanut butter cookies--control, high protein (30 percent bean protein concentrate substituted for flour), and high fiber (20 percent bean hulls substituted for flour)--prepared at Michigan State U. Bakery were evaluated for their physical and sensory characteristics. All cookies were rated acceptable by the panelists. (CIAT)

0518

25322 LEE, J.P.; UEBERSAX, M.A.; ZABLIK, M.F.; HOSFIELD, G.L.; LUSAS, E.W. 1983. Physicochemical characteristics of dry-roasted navy bean flour fractions. Journal of Food Science 48(6):1860-1862,1875. En., Sum. En., 20 Ref., II. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Bean flour. Composition. Proteins. Brazil. Animal nutrition. South America. America.

Navy beans were dry roasted in a particle-to-particle heat exchanger, dehulled by air aspiration, pin-milled, and air-classified to yield whole, hull, high protein, and high starch flour fractions. Proximate analysis, color enzyme neutral detergent fiber, starch, N solubility indices, and oligosaccharide contents of these flour fractions were determined. Compositional differences were demonstrated among all flour fractions. Stachyose was the major oligosaccharide in all fractions and was highest in the protein fraction. Substituting 10 percent bean flours for wheat changed water absorption and dough stability

for all fractions. Dry roasted navy bean flour fractions appeared to be suitable ingredients for use in appropriate food systems. (AS)

0519

26576 STEINSAPIR, A.; AGUILERA, J.M.; YAEZ, E. 1984. Effect of roasting on the nutritional value of dry beans (*Phaseolus vulgaris*). *Nutrition Reports International* 30(3):581-585. En., Sum. En., 8 Ref. (Univ. of California, Berkeley, CA 94720, USA)

Ash content. Fat content. Fiber content. Nutritive value. *Phaseolus vulgaris*. Protein content. Roasting. Seed. Storage. USA. Water content.

Dry beans of cv. Tortola Diana slightly roasted by solid-to-solid heat transfer to 105 degrees Celsius in 3 min stored at 20 degrees Celsius for 10 mo. After soaking and cooking in boiling water, roasted beans achieved eating texture 30 min before untreated controls. There was no major difference in approximate composition. Roasted and unroasted samples prepared at 3 cooking times (for proper texture and plus or minus 30 min) showed no significant difference in NPR when given to rats. NPR values ranged from 3.46 to 3.60 for the 6 samples.

Heat treatments

0520

10377 PAK, N.; MATELUNA, A.; ARAYA, H. Efecto de diversos tratamientos térmicos en el contenido de hemaglutinas y en la calidad proteica de frijol (*Phaseolus vulgaris*). (Effect of different types of heat treatment on the hemagglutinin content and protein content of beans). *Archivos Latinoamericanos de Nutrición* 28(2):184-195. 1978. Es., Sum. Es., En., 25 Ref.

Phaseolus vulgaris. Heat treatment. Seed. Phytohemagglutinins. Toxicity. Cooking. Human nutrition. Proteins. Digestibility. Processing. Food energy. Cultivars. Chile.

The effect of presoaking raw beans on detoxification and the biological quality of bean protein were evaluated. NPU10, true digestibility and hemagglutinin titer were determined in whole raw beans after 60, 90, and 120 min. of heat treatment, with and without 14 h of presoaking. Soaking prior to cooking was not necessary to eliminate toxicity, but it did contribute to the softening of beans, thus reducing cooking time. The hemagglutinin levels of 6 commercial bean flours were evaluated, almost all of which presented toxic levels. The effect of cooking method on flour toxicity was studied in 2 raw bean flours (var. Tortola and Burro) at 10 and 20 percent dietary protein, cooked for 5, 10, 15, and 30 min. The 2 raw samples contained high hemagglutinin levels, which were inactivated after 10 min cooking for the 10 percent samples and after 30 min for the 20 percent samples. (Author's summary)

0521

13506 CHANG, R.; KENNEDY, B.M.; SCHWIMMER, S. Effects of autolysis on the nutritional qualities of beans (*Phaseolus vulgaris*). *Journal of Food Science* 44:1141-1143. 1979. En., Sum. En., 24 Ref., II.

Phaseolus vulgaris. Laboratory animals. Cooking. Digestibility. Diets. P. Fe. Mn. Ca. N. Nutritive value.

In studies with rats availability of P, P/E, and apparent digestibility of N were not affected by heating California Small White beans at 60 degrees Celsius. Retention of Fe increased from control 13 to 20 and of Mn from 43 to 58 percent; Ca and P were not affected. (Summary by Nutrition Abstracts and Reviews)

19710 SHARIFF, G.; PENZ JUNIO, A.M.; VOHRA, P. 1981. Nutritional improvement of beans (*Phaseolus vulgaris*) by autoclaving or water extraction for *Tribolium castaneum* larvae. Nutrition Reports International 24(6):1087-1091. En., Sum. En., 14 Ref. (Dept. of Avian Sciences, Univ. of California, Davis, CA 95616, USA)

Phaseolus vulgaris. Cultivars. Cooking. Nutritive value. Protein content.

Trifolium castaneum larvae were used to evaluate the improvements in some bean var. by autoclaving or water extraction. Larval wt. of *T. castaneum* fed diets containing 35 percent finely ground test beans, 5 percent brewers yeast, and 60 percent pearl corn starch from 6-16 days of age, reflected the nutritive value of the beans. Raw beans significantly depressed the growth of *tribolium* larvae and caused heavy mortality. The autoclaved beans and water-extracted beans significantly improved the growth of larvae, and caused no mortality. The autoclaved beans were, in general, significantly superior to water-extracted beans. *T. castaneum* larvae can be used in nutritional evaluation of *Phaseolus vulgaris*. (Author's summary)

19422 WOLZAK, A.; BRESSANI, R.; GOMEZ B., R. 1981. A comparison of in vivo and in vitro estimates of protein digestibility of native and thermally processed vegetable proteins. Qualitas Plantarum Plant Foods for Human Nutrition 31(1):31-43. En., Sum. En., 14 Ref. (Inst. of Nutrition of Central America & Panama, P.O. Box 1188, Guatemala, Guatemala.)

Phaseolus vulgaris. Digestibility. Proteins. Processing. pH. Enzymes. Guatemala.

Comparative studies were conducted (i) in vivo protein digestibility assay using rats, and (ii) rapid multi-enzyme in vitro assay using trypsin, chymotrypsin, peptidase, and *Streptomyces griseus* protease. With (ii) digestibility was evaluated on the basis of pH decline of the protein suspension. Numerous native and thermally-processed cereal, legume, and oilseed proteins, and their blends were used. Tables and graphs of results are given. Regression analyses show the highest correlation between (i) and (ii) to be achieved when, for (ii), protein suspension pH was determined after 15 min of enzyme treatment. Differences were found between the different types of sample studied. Studies on *Phaseolus vulgaris* strains suggested that polyphenols may influence in vitro protein digestibility. the greatest difference between (i) and (ii) digestibilities was recorded for thermally-processed samples. Overall correlation coefficient between (i) and (i) (60 samples) was $r = 0.838$. (Summary by Food Science and Technology Abstracts)

24296 LAURENT, B. 1983. Incidence du traitement thermique sur les teneurs en glucides assimilables et en fibres alimentaires de certains legumes (celeris, carottes, haricots verts). (Incidence of heat treatment on available carbohydrates and dietary fiber content from some vegetables (celery, carrots, green beans). Medecine et Nutrition 19(2):87-93. Fr., Sum. Fr., En., 12 Ref., II. (Centre de Recherches Foch. 45, Rue des Saints-Peres 75006, Paris, France)

Phaseolus vulgaris. Snap beans. Cooking. Dietary value. Carbohydrate content. Fibre content. Canned beans. France.

Studies were conducted to evaluate effects of cooking and canning on concn. of carbohydrates and fiber constituents in celery, carrots, and green beans. Tables of data are given for raw, boiled, and canned samples, including DM, soluble sugars, fiber, and fiber constituents. Data for frozen green beans are also given. Cooking or canning reduced the soluble sugars content of celery and carrots but had little effect on fiber content. Slow cooking reduced soluble sugar and fiber contents of green beans; pectins are probably the fiber fraction degraded during cooking. Canned and frozen green beans had

slightly lower DM, soluble sugar, and starch contents than slow-cooked fresh samples. Fiber content was lower in canned than in frozen green beans, as a result of pectin degradation during heat treatment. (Food Science and Technology Abstracts)

0525

20838 NEILL, A.R.; BELL, S.L.; WILLIAMS, K.C. 1983. The dye absorption test as an indicator of the nutritive quality of heat-processed navy bean. *Animal Feed Science and Technology* 9(1):71-78. En., Sum. En., 10 Ref. (animal Research Inst., Dept. of Primary Industries, Yeerongpilly, Qld. 4105, Australia)

Phaseolus vulgaris. Bean flour. Heat. Treatment. Diets. Animal nutrition. Dry matter. Nutritive value. Cooking. Australia.

Under standardized conditions, the absorption of cresol red dye by navy bean meal increased from approx. 2.0 mg/g for raw samples up to 3.8 mg/g for optimally cooked samples. Within this range, a pooled correlation coefficient of 0.93 was obtained between dye binding value and gain:feed ratio of rats fed on diets comprising, in total, 51 differently processed navy bean meals in 5 bioassay expt. Overheating of navy bean, as judged by a deterioration in the gain:feed ratio of rats, caused no further change in dye binding value until samples charred, whereupon dye binding values of the order of 1.5 mg/g were observed. The practicality of the test for indicating the nutritive quality of heat-processed navy bean is discussed in the light of these findings. (Author's summary)

0526

20638 WYCKOFF, S.; VOHRA, P.; KRATZER, F.H. 1983. Improvement of nutritional value of common beans (*Phaseolus vulgaris*) by autoclaving or extraction. *Journal of the Science of Food and Agriculture* 34:612-618. En., Sum. En., 22 Ref. (Dept. of Avian Science, Univ. of California, Davis, CA 95616, USA)

Phaseolus vulgaris. Seed. Processing. Nutritive value. Cultivars. Diets. Protein content. Plant breeding. USA.

Larval wt. of *Tribolium castaneum* was used to evaluate 6 common bean var. (Small White 7799, Pink Gloria, Red Pinquito, Small White Auroa, Pinto UI-111, Black Turtle Soup. Beans incorporated into test diets were raw, autoclaved, or extracted with either water or 80 percent methanol. All treatments improved the nutritional quality of beans when compared with raw beans. Bean extracts were growth depressing. In another study heating of the freeze-dried water extract of black beans improved its nutritive value but not of the methanol extract. *T. castaneum* larvae may be used to evaluate the nutritional quality of *Phaseolus vulgaris* and different bean treatments. (Author's summary)

0527

27213 GARCIA, A.; BRESSANI, R. 1985. Efecto de la radiación solar sobre algunas características fisicoquímicas del grano de frijol (*Phaseolus vulgaris* L.). Observaciones Preliminares. (Effect of solar radiation on some physicochemical characteristics of bean seeds. Preliminary observations). *Turrialba* 35(2):155-158. Es., Sum. Es., En., 8 Ref., Il.

Phaseolus vulgaris. Solar radiation. Seed hardening. Seed. Sugar content. Guatemala.

An expt. was conducted at the Instituto de Nutrición de Centro América y Panamá to test the hypothesis that extended solar exposure increases bean hardening or resistance to a rapid cooking. A sample of recently harvested beans was exposed to solar radiation for various periods of time. The MC, water absorption index, cooking index, and total solids in the bean broth were determined. Results indicated that extended solar exposure increased cooking time and reduced MC and ammonium oxalate-soluble pectins. (AS)

Cooking

4232 BRESSANI, R.; ELIAS, L.G.; VALIENTE, A.T. Effect of cooking and of amino acid supplementation on the nutritive value of black beans (*Phaseolus vulgaris* L.). *British Journal of Nutrition* 17:69-78. 1963. En., Sum. En., 22 Ref.

Phaseolus vulgaris. Cooking. Nutritive value. Proteins. Analysis. Methionine. Lysine. Valine. Laboratory animals. Diets. Digestibility.

The effect of pressure cooking for various periods on the nutritive value of black bean protein was studied by chemical analysis and microbiological assessment of changes in met., lysine, and valine contents, as well as by determination of free epsilon-amino groups of lysine and biological tests with rats. Cooking for 10-30 min at 16 lb pressure (121 degrees Celsius) was optimal; longer times decreased nutritive value of bean protein. Open-kettle cooking for 4 h was as good as pressure cooking. Rats fed raw beans with or without met. died in less than 14 days; cooking destroyed the toxic factor in beans. Lysine, met., and valine concn. were not changed by cooking, but content of free epsilon-amino groups of lysine decreased as cooking time increased. The 1st limiting amino acid in bean protein was met.; addition of 0.20 percent of this amino acid to the bean diet significantly improved rat wt. gain, PER, and BV, but true digestibility of protein was not improved. Addition of lysine and tryptophan to the met.-supplemented diet improved the PER but not wt. gain. This improvement in PER seems important since beans were always considered good sources of both amino acids. (Author's summary)

5450 BOOGS, M.M.; MORRIS, H.J.; VENSTROM, D.W. Stability studies with cooked legume powder. I. Flavor-judging procedure. *Food Technology* 18(10): 114-117. 1964. En., Sum. En., 4 Ref.

Phaseolus vulgaris. Cooking. Palatability. USA.

Using duo-trio tests, judges compared air-packed Pinto bean powder stored for various periods at 32 degrees Celsius to control powder that was nitrogen packed and stored at -34 degrees Celsius. Scientists, clerks, and unskilled employees of the lab., as classes, did not differ in sensitivity or repetitive ability. The judges with the highest organoleptic acuities among the 56-member panel (ca. 1/3 of the group) found flavor change in the air-packed bean powder stored at 32 degrees Celsius after 26 days; the third with medium sensitivity, after 44 days; and the least-sensitive third after 66 days. (Author's summary)

5451 BERR, H.K.; KON, S.; MORRIS, H.J. Cooking rates of dry beans as influenced by moisture content and temperature and time of storage. *Food Technology* 22(3):88-90. 1968. En., Sum. En., 8 Ref.

Phaseolus vulgaris. Cooking. Temperature. Storage. USA.

Previous reports that stored dry beans sometimes require excessive cooking or heat processing times were confirmed by a quantitative and objective method. High temp., high moisture content, and long storage contributed to impaired cooking ability in Pinto, large Lima, and Sanilac beans. More cooking time was required for beans held under conditions often encountered in distribution; e.g., 1 yr. at 70 degrees Fahrenheit and a moisture content below 18 percent. Beans that had become very slow to cook rehydrated as quickly as normal beans. (Author's summary)

5824 KON, S. et al. Optimizing nutrient availability of legume food products. *Journal of Food Science* 36:635-639. 1971. En., Sum. En., 10 Ref., 11.

Phaseolus vulgaris. Cooking. Laboratory animals. Nutrition. Digestibility. Methionine. N. Analysis. Protein content.

Cooking ground, acid-treated, raw beans resulted in more digestible products as compared to beans cooked whole and then ground. The digestibility was determined by *in vitro* digestion with alpha-amylase and with pepsin, followed by pancreatin and by examining microscopically the intestinal contents of rats. Increased nutrient availability is suggested by some improvements in total digestibility but not by the protein efficiency ratio, where the increase does not seem to be significant. Process conditions on a laboratory scale for preparation of acid-blended bean slurries and soybean milks with and without met. supplementation, were studied. (Author's summary)

0532

5414 JAFFE, W.G.; FLORES, M.E. La cocción de frijoles (*Phaseolus vulgaris*). [Cooking of beans (*Phaseolus vulgaris*)]. *Archivos Latinoamericanos de Nutrición* 25(1):79-90. 1975. Es., Sum. Es., En., 15 Ref.

Phaseolus vulgaris. Cooking. Inhibitors. Hemagglutinating. Pancreatic analyses. Diets. Laboratory animals. Digestibility. Nutrient loss.

Cooking beans (at 85 degrees Celsius for 2 h) that had been previously soaked in water, 0.1 percent acetic acid, or 0.1 percent sodium bicarbonate solution for 2 h destroyed trypsin and chymotrypsin inhibitor activities but did not result in optimal digestibility or optimum growth in rats fed the corresponding diets nor was the amylases inhibitor activity and the hemagglutinating activity completely destroyed by these treatments. A sample of white beans improved more with the low temp. cooking than the sample of red kidney beans. Heating in sodium bicarbonate solution was more effective than heating in acetic acid solution. No correlation between nutritional value and enzyme inhibitor activity could be detected, but hemagglutinating activity was inversely related to growth promoting value. It was concluded that enzyme inhibitor activity measurement is inadequate to study the efficiency of heat treatment in beans and that the hemagglutination test using trypsin-activated cow red blood cells is better suited. Beans with low hemagglutinating activity should be selected for use where, due to high altitude and corresponding low water boiling temp. or to other reasons, complete heat destruction of thermolabile antinutritional factors is not assured. (Author's summary)

0533

20858 EJ. NAIRY, F.; DARWISH, N.M.; HAWAT, S. 1977. Effect of preparation and cooking on the nutritive value of local kidney bean (*Phaseolus vulgaris* var. Giza 3). *Qualitas Plantarum Plant Foods for Human Nutrition* 27(2):141-150. En., Sum. En., De., 25 Ref.

Nutritive value. Cooking. Analysis. Protein content. Mineral content. Food energy. Amino acids. Human nutrition. Composition. Dietary value. Africa.

The nutritive value and protein quality of kidney bean var. Giza 3, before and after different methods of preparation and cooking, were studied to determine whether they were affected by preboil soaking. Bean seeds were either boiled, or soaked and then boiled. MC, CP, fat, carbohydrate, ash, fiber, caloric value, and minerals (Ca, P, and Fe) were determined in both raw and prepared seeds. Protein quality was evaluated by determining the PER, NPR, and serum analysis of rats fed diets containing either raw or prepared seeds. Serum analysis included the estimation of total serum proteins, albumin:globulin ration, and free nonessential:essential amino acids ratio and a reasonably good source of dietary Fe. Results showed that kidney bean is rich in carbohydrate and protein; however, it is a poor source of dietary Ca. Although seeds boiled without soaking contained a higher percentage of minerals than those boiled after soaking, their protein quality was inferior. (AS)

29914 HULSE, J.H.; RACHIE, K.O.; BILLINGSLEY, L.W. 1977. Mechanical device (penetrometer) for measuring the degree of hardness in beans. In——. Nutritional Standards and Methods for Evaluation for Food Legume Breeders. Ottawa, Canada, International Development Research Centre. IDRC-TS 7E. pp.40-41. En., II.

Phaseolus vulgaris. Seeds. Temperature. Storage. Seed characters. Water content. Cooking. Mechanization. Canada.

A penetrometer that measures the degree of hardness of bean seeds is described; its calibration and use in research are discussed. Black beans were stored at temp. of 4, 25, and 32 degrees Celsius. MC of samples at each temp. was 8, 11, and 17 percent. Hardness of bean stored under these conditions was measured after 2, 4, and 6 mo. Beans were soaked in water at room temp. for 18 h and then tested on the penetrometer. Hardness increased from 2.53 to 3.28 as storage temp. and MC of samples increased; also, small seeds were harder than large seeds. With increased hardness of seeds during storage, it became necessary to cook them from 15 to 65 min to attain the same degree of softness as that of beans that had been stored in a freezer at low MC. The instrument can be useful in quality control testing because adequate cooking time can be determined to obtain the desired consistency even in hard raw seeds. (CIAT)

16948 INSTITUTO CENTROAMERICANO DE INVESTIGACION Y TECNOLOGIA INDUSTRIAL, GUATEMALA. 1978. Granos comerciales: frijol. Determinación del tiempo de cocción. (Commercial grains: beans. Determination of cooking time). Guatemala. Norma Centroamericana ICAMI 34 052 h8. 2p. Es.

Phaseolus vulgaris. Cooking. Timing. Human nutrition. Guatemala.

A total of 500 g clean beans are placed in 1500 ml boiling water. After boiling for 90 min (water vol. in the cooking vessel being maintained by addition of further boiling water as required), 50 beans are removed and tested for degree of cooking, by squeezing between the thumb and forefinger. If equal to or greater than 90 percent of the beans are cooked, the required cooking time is taken as 90 min, if not, batches of 50 beans are taken and tested at 20-min intervals until greater than or equal to 90 percent are cooked. The time taken to achieve this is taken as the cooking time of the bean sample. (Summary by Food Science and Technology Abstracts)

18511 KUMAGAYA, T. 1970. Automatic high-pressure flash cooker. United States Patent 4, 175,482. 4p. En., Sum. En., II.

Phaseolus vulgaris. Cooking. Human nutrition.

An automatic high pressure flash cooker, particularly for beans, comprises a cylindrically shaped steaming chamber, set in a slanted position with its lower end open, and a drain collector which has at its upper end a perforated plate permitting passage of water and is connected to the open end of the steaming chamber. The cooked beans are discharged by releasing the drain collector from engagement with the steam chamber. (Extracted from author's summary)

16419 IYER, V.; SALUNKHE, D.K.; SATHI, S.K.; ROCKLAND, L.B. 1980. Quick cooking beans (*Phaseolus vulgaris* L.): I. Investigations on quality. *Qualitas Plantarum* 30(1):27-43. En., Sum. En., 21 Ref. II.

Phaseolus vulgaris. Cooking. Food technology. Digestibility. Nutritive value. Phenolic content.

Soaking 3 bean cv. (Great Northern, kidney, and pinto) in mixed salt solution (sodium chloride 2.5 percent + sodium bicarbonate 1.5 percent + sodium tripolyphosphate 1.0 percent + sodium carbonate 0.5 percent) resulted in 80-85 percent reduction in cooking time over corresponding controls. Irradiation (gamma-rays) at 500 krad of soaked and dehydrated beans caused a reduction of nearly 50 percent in cooking time. Water uptake and leaching losses for each treatment during soaking at 22, 37, and 45 degrees Celsius were investigated. High temp. (37 and 45 degrees Celsius) and pH (9.0) caused greater imbibition and total solid loss than at room temp. (22 degrees Celsius). Organoleptic evaluation revealed that quick-cooking Great Northern beans appear to be more acceptable than kidney and pinto beans. Quick-cooking cooked beans had better in vitro protein digestibility than conventionally cooked beans. Phenolic content was found to be inversely related to in vitro digestibility. (Author's summary)

0538

22502 ABDEL-RAHMAN, A-H.Y. 1981. The nutritional value of some legumes as affected by cooking. *Alexandria Journal of Agriculture Research (Egypt)* 29 (1):173-180. En., Sum. En., Ar., 12 Ref. (Food Science & Technology Dept., Faculty of Agriculture, Univ. of Alexandria, Alexandria, Egypt)

Phaseolus vulgaris. Nutritive value. Dietary value. Composition. Mineral content. Fatty acids. Fibre content. Protein content. Ash content. Carbohydrate content. Cooking. Timing. Egypt.

Nine var. of legumes, collected in Italian markets and which included navy beans and red kidney beans, were analyzed for proximate components before and after cooking by standard household procedures. Determinations were made for Ca, Cu, Fe, Mg, Mn, K, Ni, and Zn contents in raw and cooked legumes and in the cooking water for each. The fatty acids constituents for the legume lipids were also determined. Data on yield in cooked legumes showed that lentils had the highest ratio of cooked wt. to dry wt. (2.99), with navy beans presenting 2.24 and red kidney beans, 2.38. Raw lentils and broad beans were the highest in protein content (26.8 and 28.1, resp.) while navy beans and red kidney beans presented 21.6 and 21.8, resp. Analysis of minerals showed differences between the different kinds of legumes. Minerals in cooked legumes were about 1/3 and 1/2 of the values of raw legumes. Cooking water contained measurable amounts of all the minerals. Main components of fatty acids in the lipids of the 9 kinds of legumes were palmitic, stearic, oleic, linoleic, and linolenic. (Author's summary)

0539

16940 BRESSANI, R.; ELIAS, I.G.; ESPAÑA, M.E. DE 1981. Posibles relaciones entre medidas físicas, químicas y nutricionales en frijol común (*Phaseolus vulgaris*). (Possible relationships among physical, chemical, and nutritional characteristics in common beans). *Archivos Latinoamericanos de Nutrición* 31(3):550-570. Es., Sum. Es., En., 24 Ref.

Phaseolus vulgaris. Cultivars. Seed size. Seed color. Seed coat. Protein content. Amino acids. Toxicity. Digestibility. Cooking diets. Zea mays. Human nutrition. Guatemala.

The present study was carried out in order to establish relationships among physical, chemical, and nutritional characteristics in 5 black, 2 red, and 2 white-seeded common bean cv. of local consumption. Physical characteristics were grain wt. and size, color, seed coat percentage, hydration coefficient, cooking time, and seed hardness. Chemical characteristics studied included protein, met. and cystine, lysine and tryptophan, trypsin inhibitors, tannins and in vitro protein digestibility. Nutritional properties were determined by assaying protein quality of the beans alone, with 0.3 met., or in 90:10 or 70:30 maize:bean mixtures using the PER. The results indicated that grain color plays an important role regarding some physical properties. Cooking time for white-seeded beans

was less than for black- and red-seeded ones. Color is also related to some chemical properties, such as tannins, which are found in lower content in white beans. On the other hand, seeds of a high wt. and vol. tend to have a lower protein concn. Large seeds absorbed less water than smaller seeds and seed coat percentage is a variable that may influence this parameter. Protein digestibility varied from 66-75 percent. A significant relationship was found between protein and DM digestibility. Data confirmed a high lysine content and low sulfur amino acids content in beans. Supplementation with 0.3 percent met. improved protein quality of all cv.; the improvement, however, was not proportional to the initial value. Improvement in quality was also observed when the protein value of the bean cv. was tested in association with maize; however, the supplementary value was not proportional to the value of the beans tested alone. By statistical analysis it was established that in maize:bean mixtures, the important amino acids are lysine, met., and cystine. The results, therefore, illustrate that the quality of beans is determined by many factors intervening in different degrees. (Author's summary)

0540

16763 ELIAS, L.G. 1981. Conocimientos actuales sobre el proceso de endurecimiento del frijol. (Current information on the process of bean hardening). In Reunión Anual del Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, 27a., Santo Domingo, República Dominicana, 1981. Memoria. Santo Domingo, Secretaría de Estado de Agricultura. v.1-A, pp.SEF7-1-SEF7-34. Es., II.

Phaseolus vulgaris. Storage. Seeds. Water content. Climatic requirements. Seed quality. Cooking. Analysis. Guatemala.

A literature review on factors affecting the cooking quality of beans is given emphasizing grain moisture, temp., RH, and storage time. The parameters affected by these factors are discussed, including seed water absorption capacity and hardness. Regarding the mechanisms of the process of bean hardening, the physicochemical and structural changes of beans under storage conditions are discussed; the role of polyphenols, starches, proteins, and lipids are emphasized. From a structural point of view, cell walls and intermediate laminae are also discussed. It is concluded that the process of hardening during storage depends on various physical, chemical, and structural mechanisms of varying incidence. It is recommended to standardize a methodology to assess parameters in order to avoid the differences observed in the results obtained up to date. Moreover, it is recommended to select var. presenting a low tendency for bean hardening under storage conditions. (Summary by A.J.C. Trans. by L.M.F.)

0541

19714 KON, S.; SANSHUCK, D.W. 1981. Phytate content and its effect on coking quality of beans. *Journal of Food Processing and Preservation* 5(3): 169-178. En., Sum. En., 15 Ref., II. (Western Regional Research Center, Science & Education Administration, U.S. Dept. of Agriculture, Berkeley, CA 94710, USA)

Phaseolus vulgaris. Seed. Cooking. *P. lunatus*. Storage. Temperature. Relative humidity. Fibre content. Ash content. Fat content. Mineral content. Analysis. Timing.

Storage of dry beans under conditions of relatively high moisture and temp. increased the cooking time of the beans about 5-fold. The cause of this hardening was studied and a method was devised to reduce the time that is required for cooking under these circumstances. California Small White beans were treated to raise their MC to 16 percent and were stored at 32 degrees Celsius for 10 mo. Other legume var. and species used were black beans, pinto beans, and kidney beans, *Phaseolus lunatus*, 2 var. of *Vicia faba*, *Vigna unguiculata*, and *Pisum sativum*. Among the changes that occur in beans stored in this way, the reduction (about 65 percent) in phytic acid content was the best indicator of increased cooking time. Cooking times of the various legumes studied correlated well with the ratio of percentage phytic acid:percentage Ca present in the beans. Soaking high moisture beans in a solution of either phytic acid or EDTA reduced cooking time to that

of control beans. Cooking time of control beans soaked under the same conditions was reduced by between 1/3-1/2, depending on the solution used. (Author's summary)

0542

16761 MOLINA, M.R.; RIZZO, M.E.; BATEN, M.A.; BRESSANI, R. 1981. Prevención del endurecimiento del frijol y aprovechamiento del grano endurecido. (Prevention of bean hardening and utilization of hardened grain). In Reunión Anual del Programa Cooperative Centroamericano para el Mejoramiento de cultivos Alimenticios, 27a., Santo Domingo, República Dominicana, 1981. Memoria. Santo Domingo, Secretaría de Estado de Agricultura. v.1-A, pp.SEF9-43. Es., 30 Ref., II.

Phaseolus vulgaris. Seed. Storage. Deterioration. Food quality. Cooking. Human nutrition. Animal nutrition. Guatemala.

A critical literature review is given on available technologies on the prevention of hardness and biodeterioration of stored bean grain in order to assure its cooking quality and/or for processing; the techniques applicable on a rural communal level, especially for Central American and Caribbean countries, are highlighted. The following technological alternatives are discussed: low storage temp. and/or low water content of grain; heat treatment; treatment in saline solution (NaCl); modified atmospheres (greater CO₂ concn.); precooking of the whole grain; and storage of pods with their grains. Technological alternatives to the use of beans hardened under storage conditions are discussed: in human (canned and extrusion cooking) and animal nutrition (extrusion cooking). It is concluded that heat treatment for short periods, soaking in 15 percent saline solutions, and storage of pods with their grains are the best alternatives to prevent the hardening of stored grain. (Summary by A.J.C. Trans. by L.M.F.)

0543

16762 MORA, M.A. 1981. Estudios realizados por el CIGRAS sobre el endurecimiento de frijol (*Phaseolus vulgaris*). (Studies carried out by CIGRAS on bean hardening). Costa Rica, Centro para Investigaciones en Granos y Semillas. pp.SEF10-1-SEF10-17. Es., 3 Ref., II.

Paper presented at the Reunión Anual del PCCMCA, 27a., Santo Domingo, República Dominicana, 1981.

Phaseolus vulgaris. Seed. Cooking. Temperature. Relative humidity. Storage. Deterioration. Water content. Timing. Costa Rica.

The 4 trials conducted by the Centro para Investigaciones en Granos y Semillas (Costa Rica) on bean performance under different storage conditions are described in detail. In the 1st trial the effect of 3 MC (9.3, 13, and 15.4 percent) and 3 temp. (15, 20, and 25 degrees Celsius) on the hardness of beans stored for 6 mo. was determined. Monthly samples were taken for each storage condition and MC and cooking time, with or without previous soaking, were determined for each one. Beans did not harden under the conditions and time periods tested, except for a slight increase in coking time when beans stored for 6 mo. at 25 degrees Celsius with 15.4 percent MC were assessed. In the 2nd trial storage conditions similar to the 1st were used except that storage time was prolonged to 18 mo.; monthly evaluations regarding cooking and MC were made as of the 7th mo. Initially an increase in cooking time of beans stored under all conditions was observed but hardness decreased after a certain time. In the 3rd trial recently harvested beans were used with MC of 13 and 16 percent; these were placed in a forced-air oven at 125 degrees Celsius during 0, 2, 4, and 6 min. Beans of each combination were then stored at 25 degrees Celsius with 13 and 16 percent MC during 12 mo., assessing MC and cooking quality at 0, 3, 6, 9, and 12 mo. There was no considerable change in hardness. Only a slight hardening was noticed in beans whose MC had been lowered to 13 percent to be subjected to a heat treatment and then were remoistened to 16 percent MC for storage. In the 4th trial beans were stored under 3 environmental conditions: (a) in a coking chamber (av. temp. 22 degrees Celsius and 50 percent RH); (b) at a site lo-

cated at 2300 m.a.s.l. (temp. 8-20 degrees Celsius); and (c) another site located at 1000 m.a.s.l. (temp. 15-29 degrees Celsius). At each site beans were stored under 2 initial MC (9.4-13 and 13.8-15.4 percent). Grain MC was considerably affected. Storing beans at a low-temp. site was as effective as storage in a controlled environmental chamber. (Summary by F.G. Trans. by L.M.F.)

0544

23912 OSINUBI, O.A.; EKA, O.U. 1981. Effect of cooking on the nutritive value of Koko/Kosai-A traditional breakfast meal of the Hausas in northern Nigeria. *Food Chemistry* 7(3):181-187. En., Sum. En., 24 Ref. (Dept. of Biochemistry, College of Medicine, Univ. of Lagos, Nigeria)

Nutritive value. Bean flour. Cooking. Analysis. Mineral content. Vitamin content. Amino acids. Water content. Ash content. Protein content. Carbohydrate content. Fiber content. Nigeria Human nutrition. Composition. Africa.

The effect of cooking on the nutritive value of Koko (Guinea corn pap)/Kosai (bean cake) was assessed by chemical analysis. There was significant loss in the proximate composition due to cooking. In addition, losses of some mineral elements and vitamins were observed. K, Fe, Zn, and P losses were 23.0, 6.7, 25.0, and 13.3 percent, resp., and those of vitamins B1, B2, C, and carotene were 20.0, 46.0, 37.0, and 9.6 percent, resp. The amino acid pattern of Koko/Kosai was only slightly affected by the traditional method of cooking employed. Some suggestions and recommendations are made on how to retain most of the nutrients during cooking. (AS)

0545

18029 SUAREZ, S., M.E.; ALUJA, A.S. DE; BERRA, R.; NIETO, Z.; VIALLENUEVA, J. 1981. Efecto de la alimentación con frijol negro (*Phaseolus vulgaris*) sometido a diferentes tiempos de cocción en ratas. Estudio histológico de hígado y gónadas. (Effect of feeding rats with diets containing black beans cooked for different lengths of time. Histological study of liver and gonads). *Veterinaria (México)* 12(3):129-145. Es., Sum. Es., En., 40 Ref., Il.

Phaseolus vulgaris. Laboratory animals. Cooking. Diets. Animal nutrition. Nutritive value.

Wistar rats were fed for 65 days on diet with black beans Querétaro as the only source of protein. The beans were cooked in an autoclave for 10, 30, 50, 60, or 80 min at a pressure of 15 lb in². The PER of the diet decreased with cooking up to 50 min. At 60 and 80 min the value increased again but did not equal the value at 10 min. Female rats showed much delay in sexual maturity when given beans cooked for 50 and 60 min; no corpus luteum was present in their ovaries. Male rats had delayed spermatogenesis when fed o beans cooked for 50, 60, and 80 min, no sperm cells being present in the epididymides. The liver cells showed variable degrees of vacuolization in all groups except controls. Black beans for human consumption should be cooked in autoclave for 60-80 min at 15 lb pressure. (Extracted from author's summary)

0546

21756 VARRIANO-MARSTON, E.; JACKSON, G.M. 1981. Hard-to-cook phenomenon in beans: structural changes during storage and imbibition. *Journal of Food Science* 46(5):1379-1385. En., Sum. En., 37 Ref., Il. (Dept. of Grain Science & Industry, Kansas State Univ., Manhattan, KS 66506, USA)

Phaseolus vulgaris. Seed. Storage. Water absorption. Germination. Cell structure. Cooking. USA.

The mode of water penetration into aged beans was followed and structural characteristics of fresh and stored black beans, in their dry state, during imbibition and after

cooking, were determined. Dry black beans stored at high temp. (41 degrees Celsius) and humidities (75 and 100 percent) for short-time periods showed alterations in attachments between plasmalemma and cell wall as well as disintegration of organelles and inclusions of the cytoplasm. Although those structural changes did not affect the mode of water penetration into aged beans, as determined by autoradiography, electron micrographs clearly revealed structural differences between fresh and aged beans during imbibition. (Author's summary)

0547

18549 GRULLON R., V.; JIMENEZ, J.S. 1982. Estudio de la propiedad de cocción en de algunas variedades de frijol común (*Phaseolus vulgaris* L.) y su relación con el contenido de ácido fítico, minerales y humedad. (Study on the cooking properties of some common bean varieties and their relationship with phytic acid, mineral, and moisture contents). Tesis. Ing. Agr. Santiago de los Caballeros, República Dominicana, Universidad Católica Madre y Maestra. Instituto Superior de Agricultura. 70p. Es., Sum. Es., 22 Ref., Il.

Phaseolus vulgaris. Cooking. Storage. Analysis. Composition.

Factors that alter organoleptic and cooking qualities of bean were studied by increasing cooking time. When beans were stored under environmental conditions for more than 9 mo., time required for cooking was tripled. A similar hardening of bean occurred when stored for more than 12 mo. under refrigerated conditions with a MC greater than 17 percent. Cooking time increased 1.5 times compared with recently harvested beans of the same var. Cooking time of the tested var. was significantly affected by the var. characteristics. Beans of var. José Beta (red-seeded) took longer to soften than those of var. Pompadour Checa (red-seeded), BAT-258 (black-seeded), and BAT-482 (white-seeded). Beans of var. Pompadour Checa and BAT-258, however, did not show significant differences regarding cooking time. Initial MC of fresh beans did not significantly affect their cooking time. MC of beans of each var. was adjusted to 14 percent and then was decreased in amounts of 2 percent until it reached 8 percent. Phytic acid and Ca contents of beans were determined. A slight variation was found among the tested var., but not relationship was found between cooking time and phytic acid:Ca ratios. (Author's summary. Trans. by L.M.F.)

0548

23354 PHIRKE, A.V.; CHAVAN, J.K.; JADHAV, S.J.; SLAUNKHE, D.K. 1982. Physical properties, chemical composition, cookability and solubilization of proteins of dry beans (*Phaseolus vulgaris* L.). Legume Research 5(2):91-96. En., Sum. En., 22 Ref., Il. (College of Agricultural Technology, Parbhani & Mahatma Phule Agricultural Univ., Rahuri-413722, India)

Seed. proteins. Cooking. Starch content. Protein content. India. Composition. Asia.

Several extractants like salts, acid, or alkali were tested to solubilize proteins of bean seeds; the solubility of the extracted proteins was also studied. The beans of different cv. differed considerably in their size and wt. seed size had no effect on hull, protein, or starch contents. The larger seeds required less cooking time than the smaller seeds. Soaking the seeds in water for 12 h reduced the cooking time by about 60 percent in the various types of seeds. Black seeds contained more polyphenols followed by purple, reddish purple, brown, and white ones. Dehulling of the seeds decreased the polyphenol content by 60-70 percent and increased the protein content by 10 percent. Among the various agents employed to solubilize the bean proteins, NaOH (0.02 M, pH 10.5) extracted max. Lowry's proteins (238 mg/g seed) followed by $(\text{NH}_4)_2\text{CO}_3$ (0.5 percent, pH 8.8, 236 mg/g), and Na_2CO_3 (0.5 percent, pH 10.5, 226 mg/g). The Na_2CO_3 in 0.1 M phosphate buffer, pH 7.4, was found to be an effective protein solubilizer (232 mg/g seed). Bean proteins showed least solubility at pH 4.0. (AS)

17735 SILVA, H.C.; BRAGA, G.L. 1982. Effect of soaking and cooking on the oligosaccharide content of dry beans (*Phaseolus vulgaris* L.). *Journal of Food Science* 47(3):924-925. En., Sum. En., 11 Ref., 11.

Phaseolus vulgaris. Cooking. Sugars. Sucrose. Seed. Composition.

The effect of cooking conditions commonly used in Brazilian homes was determined by measuring the oligosaccharide content (sucrose, raffinose, and stachyose) of beans by TLC. Dry seeds were submitted to different periods of (1) water soaking at room temp. (as done at home) and (2) pressure cooking in autoclave. Soaking in water caused a small decrease in the oligosaccharide content of the beans and the relative amount removed was not proportional to the solubility of the sugars in water. Cooking of the whole seeds led to a larger decrease in oligosaccharide content, especially when large amounts of water were used. (Author's summary)

22182 FAIRWEATHER-TATT, S.J.; GEE, J.M.; JOHNSON, I.T. 1983. The influence of cooked kidney beans (*Phaseolus vulgaris*) on intestinal cell turnover and faecal nitrogen excretion in the rat. *British Journal of Nutrition* 49(3):303-312. En., Sum. En., 24 Ref., 11. (ARC Food Research Inst., Colney Lane, Norwich, Norfolk NR4 7UA, England)

Phaseolus vulgaris. Laboratory animals. diets. Proteins. Digestibility. Nutritive value. Animal nutrition. Nutrient loss.

Male Wistar rats were fed semisynthetic diets containing cooked white kidney beans or equivalent levels of protein and carbohydrate. No change was observed in overall N balance in animals fed on the bean diet, but there was a 2- to 3-fold increase in their fecal excretion, compared with control rats. This was compensated by a decrease in urinary-N excretion. Homogenized small intestinal mucosa, prepared from bean-fed animals, showed a 28 percent increase in protein content compared with control material. Measurements of (3)H-labeled thymidine turnover indicated that mucous cell exfoliation was increased by approx. 35 percent in the small intestines of bean-fed rats compared with controls. Though a diet rich in cooked beans leads to some increase in mucous cell turnover in the small intestine of rats, the consequent increase in mucosal protein loss could not account for the increased fecal-N excretion seen in these animals. (Author's summary)

25893 HAYTOWITZ, D.B.; MATTEWS, R.H. 1983. Effect of cooking on nutrient retention of legumes. *Cereal Foods World* 28(6):362-364. En., 7 Ref. (United States Dept. of Agriculture, Human Nutrition Information Service, Hyattsville, MD, USA)

Phaseolus vulgaris. Cooking. Timing. Nutritive value. Composition. USA.

Three types of beans, broad beans, chickpeas, cowpeas, and lentils were cooked and analyzed for nutrient retention. The results allowed a degree of prediction of nutrient content of cooked legumes. Ultimate retention was affected not only by duration of cooking times but also by legume size, degree of binding of e.g. vitamins, and permeability of the seed coat to leached vitamins. (Food Science and Technology Abstracts)

22184 JELTEMA, M.A.; ZABIK, M.E.; THIEL, L.J. 1983. Prediction of cookie quality for dietary fiber components. *Cereal Chemistry* 60(3):227-230. En., Sum. En., 18 Ref., (Philip Morris Research Center, Richmond, VA 23261, USA)

Phaseolus vulgaris. Bear. flour. Analysis. Fiber content. Cellulose. Human nutrition. Nutritive value. USA.

Water-soluble pentoses, pectin, water-insoluble hemicellulose, cellulose, and lignin contents of a commercial wheat bran, oat bran, maize bran, navy bean hulls, and soy hulls were measured, and their quantities related to physical and sensory characteristics of sugar-snap cookies in which cookie flour was replaced with 0 or 20 percent of these dietary fiber sources. Top grain, spread, color, percentage moisture, and all sensory characteristics were significantly affected by fiber source. Of the variability in cookie spread, 97 percent was predicted based on fiber components. Hemicellulose was a factor in all of the prediction equations, indicating that variation in the hemicellulose components in cereal and legume sources affects the quality of cookie products. Cookies containing navy bean hulls scored highest when examined for top grain characteristics and spread of cookies. External and internal color were most acceptable for control cookies or those containing navy bean hulls, and interior cell distribution was significantly better for cookies containing oats and navy bean brans, and for control cookies. (Author's summary)

0553

27325 GARCIA-LOPEZ, J.S. 1984. Binding of minerals by cooked pinto beans (*Phaseolus vulgaris*) fiber, influence of fiber on iron absorption by normal and anemic rat intestinal segments. Ph.D. Thesis. Madison, University of Wisconsin-Madison. 139p. En., Sum. En., 159 Ref., II.

Phaseolus vulgaris. Cooking. Nutritive value. Dietary value. USA.

Neutral (NDF) and acid (ADF) detergent fiber contained from cooked pinto beans bound Fe, Cu, and Zn but not Mg at pH 6.50 plus or minus 0.05 and 25 degrees Celsius. Binding depended on the mineral concn. Bound Fe (micrograms Fe/mg fiber) increased with increasing pH and smaller fiber particle size, but decreased as the fiber concn. increased. Cu decreased Fe bound by NDF but increased Fe bound by ADF. Zn decreased Fe bound to both NDF and ADF. Scatchard plots suggested the presence of 2 types of binding sites for Zn, 1 type for Fe and 1 type for Cu. Oxidation of ferrous to ferric Fe may have occurred in the presence of fiber as pH increased. Polyphenolic compounds were associated with NDF and ADF and their presence may have enhanced the ability of fiber to bind minerals. NDF did not significantly decrease the absorption of ⁵⁹Fe in noninverted intestinal segments from normal and anemic rats, but a trend towards lower absorption of Fe as fiber concn. increased was observed. Normal rat intestinal segments absorbed more Fe when exposed to a smaller fiber particle size (0.125 mm vs. 0.180 mm NDF particle size). The ability of fiber to decrease Fe absorption seems to depend on: fiber source, particle size, and concn.; the presence of competing minerals; and the Fe status of the animal. (Dissertation Abstracts International)

0554

26077 MOSCOSO, W.; BOURNE, M.C.; HOGD, L.F. 1984. Relationships between the hard-to-cook phenomenon in red kidney beans and water absorption, puncture force, pectin, phytic acid, and minerals. *Journal of Food Science* 49(6):1577-1583. En., Sum. En., 27 Ref., II. (Inst. Superior de Agricultura, Apartado No. 166, Santiago, Republica Dominicana)

Cooking Dominican Republic. Mineral content. *Phaseolus vulgaris*. Seed characters. Storage. Timing. Water content.

The effect of high temp.-high humidity storage on cooking quality and physicochemical properties of dry, mature red kidney beans was evaluated over a storage period of 9 mo. The rate of softening of beans during cooking and the rate of dissolution of pectin during cooking followed apparent 1st-order kinetics, and their apparent rate constants correlated highly with each other. The apparent softening rate constants decreased with increasing time of storage. The loss of cookability in mature bean seeds stored under high temp.-

high humidity conditions probably results from a decrease in phytic acid P and alterations in the ratio of monovalent:divalent cations in the tissue. (AS)

0555

22511 RODRIGUEZ-SOSA, E.J.; CALONI, I.B. DE; CRUZ, C., J.R.; BADILO F., J. 1984. Hydration and cooking properties of dry beans. *Journal of Agriculture of the University of Puerto Rico* 68(3):259-267. En., Sum. En., Es., 15 Ref., II.

Cooking. Cultivars. *Phaseolus vulgaris*. Processing. Puerto Rico.

The hydration times of 22 dry bean selections of red kidney, white, and striped var. were determined. The *lajas* red kidney selection duplicates its wt. in 7 h, whereas the striped *Calima* and *Rosita* *lajas* selections duplicate their wt. in 10 h. All other selections duplicate their wt. in about 12-18 h. All bean selections were accepted when they were sensory evaluated for appearance, flavor, and overall acceptability. The red kidney selections *lajas* and 1973 (28), the white selections white 117 and white 142, and the striped selections *Dominicana*.

0556

27400 DESHPANDE, S.S. 1985. Investigations on dry bean (*Phaseolus vulgaris* L.): Microstructure, processing, and antinutrients. Ph.D. Thesis. Urbana, University of Illinois at Urbana-Champaign. 277p. En., Sum. En., 236 Ref., II.

Phaseolus vulgaris. Cultivars. Protein content. Fat content. Water content. Ash content. Carbohydrate content. Seed characters. Cooking. Phytic acid content. Tannin content. Phytohemagglutinins. Processing. USA.

The role of microstructure in processing and effects of several processing methods on antinutrients of dry beans were investigated. Proximate composition of whole beans showed minor differences among the 10 var. investigated. Dry beans had a well-organized ultrastructure with the characteristic features of a typical legume. Initial water uptake rates during soaking were characteristic of each var. The seed coat played a dominant role only after its initial resistance to water uptake was overcome. Water uptake during early stages of cooking was also characteristic of the var. All var. absorbed nearly 1.5 times their wt. of water and attained a MC of about 65 percent (wt. basis) when cooked for their optimal times. Excepting tannins, dehulling significantly increased phytic acid and enzyme inhibitory activity. Soaking in sodium bicarbonate or mixed salt solutions was more effective in removing these antinutrients than soaking in water. Cooking and germination followed by cooking were the most effective methods in the elimination of dry bean antinutrients. No single method, however, could effectively remove or eliminate all the undesirable components of dry beans. Since protein-bound tannins are usually not detected by the procedures routinely employed for their analyses, several parameters that might influence the commonly used vanillin, folin-ciocalteu, and Prussian blue assays for tannins of dry beans were investigated. Both phytate and tannins were potent inhibitors of digestive enzymes. The enzyme inhibitory fractions of legume tannins could be selectively removed by adsorption on starch. Such tannin starch association, however, decreased the *in vitro* digestibility of several starches investigated. Considering their heat-stable nature and interactions with proteins and carbohydrates, the residual phytate and tannins in processed beans may lower the overall nutritional quality of legumes. [AS (Extract)]

0557

27069 GÓMEZ-IBRÉNES, R.A.; BRESSANI, R. 1985. Evaluación de un aparato para medir la dureza del grano de frijol (*Phaseolus vulgaris*) y su utilización para la determinación de tiempos de cocción. (Evaluation of a device to measure bean grain hardness and its utilization in the determination of cooking time). *Archivos Latinoamericanos de Nutrición* 35(4):654-665. Es., Sum. Es., En., 10 Ref., II. (Inst. de

Phaseolus vulgaris. Cooking. Timing. Seed hardening. Guatemala.

A device (DUR-INCAP), developed by the Instituto de Nutrición de Centro América y Panamá (INCAP), to measure bean seed hardness is described. In addition, a study was conducted to determine cooking time and hardness of white-, black-, and red-seeded beans. All beans were cooked in boiling water at 95 degrees Celsius for 30, 60, 100, 140, and 180 min. At each cooking time, hardness was measured with DUR-INCAP and beans were classified into soft cooked beans (less than 100 g-force), medium (between 100-200 g-force), and hard (above 200 g-force). White and black beans reach softness at 140 min of cooking, with the exception of 1 black sample that required 180 min. Two of the 4 red beans required 180 min, and the other 2, 220 min. The effects of storage for 1 yr. at 25 degrees Celsius required 140 min of cooking, while the sample stored at 5 degrees Celsius was cooked in 100 min. [AS (Extract)]

0558

26596 LEE, K.; GARCIA L., J.S. 1985. Iron, zinc, copper, and magnesium binding by cooked pinto bean (*Phaseolus vulgaris*) neutral and acid detergent fiber. *Journal of Food Science* 50(3):651-653, 673. En., Sum. En., 21 Ref., Il. (Dept. of Food Science, Univ. of Wisconsin-Madison, 1605 Linden Dr., Madison, WI 53706, USA)

Phaseolus vulgaris. Cooking. Fibre content. Nutritive value. USA.

Fe, Cu, and Zn but not Mg were bound by neutral (NDF) and acid (ADF) detergent fiber obtained from cooked pinto beans. Fe binding increased with higher pH, higher Fe concn., higher fiber concn., and smaller fiber particle size. Max. binding of Fe was at pH 6.5 and min. at pH 4.0 for both NDF and ADF. A 50 percent decrease in particle size increased Fe binding by 8 percent. Binding of Cu and Zn increased with higher Cu and Zn concn. Both NDF and ADF had a greater affinity for Cu than for either Fe or Zn. Scatchard plots indicated the presence of 2 types of binding sites for Zn, 1 for Fe, and 1 for Cu. (AS)

0559

26948 MAEDA, E.E.; ROCKE, S. 1985. Cookability of bean cultivars. In Minjas, A.N.; Salema, M.P., eds. *Workshop on bean research in Tanzania, 4th., Morogoro, Tanzania, 1965. Proceedings. Tanzania, Sokoine University of Agriculture, pp.78-86. En., Sum. En., 11 Ref., Il. (Dept. of Food Science & Technology, Sokoine Univ. of Agriculture, Morogoro, Tanzania)*

Cooking. Cultivars. *Phaseolus vulgaris*. Tanzania. Timing.

Thirty bean cv. of outstanding agronomic characteristics were evaluated for their cookability using the Mattson type exptl. cooker. A high degree of variability was observed. Multiple correlation analysis revealed that the variation in cookability was largely due to differences in moisture imbibition ability among the bean cv. ($r = -0.52$). The percentage seed coat and the relative seed size were not significantly correlated with cookability. Determination of moisture imbibed/100 g of seed is proposed as a rational criterium for establishing the relative cookability. Determination of moisture imbeded/100 g of seed is proposed as a rational criterium for establishing the relative cookability of a large collection of bean cv. instead of carrying out actual cooking studies. The cooking time in min can then be predicted with a reasonable degree of accuracy by substituting the determined moisture in simple regression equations. (AS)

0560

24439 NELSON, L.R.; HSU, K.H. 1985. Effects of leachate accumulation during hydration in thermalscrew blancher on the water absorption and cooked texture of navy

beans. *Journal of Food Science* 50(3):782-788. En., Sum. En., 39 Ref., II. (Dept. of Food Technology, Iowa State Univ., Ames, IA 50011, USA)

Processing. Canned beans. USA. Processed products. North America. America.

Blanch water obtained from a commercial canner was evaluated for leachates that accumulated in a thermoscrew blancher during the rehydration of dried navy beans. These leachates were found to consist of acids, nitrogenous compounds, carbohydrates, and ash. A factorial design expt. and a central composite design expt. were conducted to isolate and quantitate the effects of these factors on the water absorption and final texture of navy beans that have been rehydrated in a thermoscrew blancher. Factors of major importance in the soaking water were found to be viscosity, divalent ion concn., and temp. both water absorption and texture of cooked beans responded linearly to these factors. (AS)

0561

28603 WASSIM, N.N. 1985. Genetic analyses of cooking time, nutritional, and culinary quality in dry beans (*Phaseolus vulgaris* L.). Ph.D. Thesis. East Lansing, Michigan State University. 198p. En., Sum. En., 114 Ref., II.

Phaseolus vulgaris. Cooking. Timing. Tannin content. Protein content. Inheritance. Crossbreeding. USA.

A study was undertaken to determine the inheritance of cooking time and uniformity, tannin and protein content, and the culinary quality of a diverse population of beans. Eight strains were crossed in diallel and the 8 parents and F2 and F3 progenies grown at 2 locations (Isabela, Puerto Rico, and Michigan, USA) for evaluation. Highly significant differences were observed among entries for cooking time, uniformity of cooking, tannin and protein content, and for 8 of 9 culinary quality traits. Quick cooking characteristics of parental strains were transmitted to progenies. Crosses of low x low and high x high protein parents had progenies that were also low and high, in protein content, resp. Selection aimed at improving the cooking time and cooking uniformity, soakability, and palatability of beans can be practiced in generations when plants are more heterozygous after the initial cross. Selection for low tannin and high protein among progeny from a cross should result in the stabilization of these traits in a single cv. [AS (Extract)]

0562

28953 DESHPANDE, S.S.; CHERYAN, M. 1986. Water uptake during cooking of dry beans (*Phaseolus vulgaris* L.). *Qualitas Plantarum Plant Foods for Human Nutrition* 36(3):157-165. En., Sum. En., 26 Ref., II. (Dept. of Food Science, Smith Hall, Purdue Univ., West Lafayette, IN 47907, USA)

Phaseolus vulgaris. Cooking. Timing. Water content. USA.

Water uptake during cooking of 10 dry bean var. was investigated. Water uptake during early stages of cooking was characteristic of the var. although the optimal cooking times varied widely (52-85 min), all the beans absorbed similar amounts of water when coked for their optimal times. Cooking times were significantly correlated with water uptake during the 1st 20 min ($r = -0.92$) and hardness index ($r = 0.76$) of beans. Most other physical characteristics, except the surface area of beans, were generally unrelated to the water uptake during the 1st 20 min, optimal water uptake, and cooking times. No significant correlation was observed between phytate content and cooking times of beans. On cooking for their resp. optimal times, all var. absorbed nearly 1.5 times their wt. of water and attained a MC of about 65 percent (wet basis). (AS)

27762 DESSERT, K. 1986. Compatibility of on-farm evaluation of bean cooking time in Rwanda with bar drop cooking time index bean improvement cooperative. Annual Report 29:122-123. En. (Inst. des Sciences Agronomiques du Rwanda, B.P. 138, Butare, Rwanda)

Phaseolus vulgaris. Seeds. Cooking. Timing. Cultivars. Technology evaluation. Rwanda.

Twenty Rwandan farmers who had participated in on-farm bean var. trials during the 2nd growing season of 1985 were requested to prepare and consume each of the var. in their homes under traditional preparation methods. After consuming each of the var., the farmers evaluated cooking time using a 5 point hedonic scale. Samples were also evaluated in the lab. using the bar method. This method consists of placing 25 seeds, soaked overnight, in a cooker with a 90 g metal rod resting on top of each bean. Cooking time is that required for 13 of the 25 rods to perforate the seeds. Good compatibility between farmers' evaluation of cooking time under traditional methods and the lab. cooking index was obtained. Ikiniba and Rubona 5 were rated as the longest cooking var. both on-farm and in the lab. The range in cooking time index between Ikinimba and Kirundo was 15 min. (CIAT)

30635 HINCKS, M.J.; STANLEY, D.W. 1987. Lignification: evidence for a role in hard-to-cook beans. *Journal of Food Biochemistry* 11(1):41-58. En., Sum. En., 33 Ref., Il. (Dept. of Food Science, Univ. of Guelph, Guelph, Ontario, Canada, N1G2W1)

Phaseolus vulgaris. Cooking. Seed hardening. Seeds. Cell walls. Canada.

Research was conducted to establish whether lignification was a possible mechanism contributing to the hard-to-cook defect in beans. Cell wall material from control and defective beans was isolated and microscopic techniques employed to compare the 2 fractions. Transmission electron microscopy indicated that K permanganate-fixed material had heavier deposition of MN dioxide in cell corners, secondary walls, and middle lamella of hard beans, a pattern seen during the lignification of plant tissue. Cell wall material from hard beans had a lamellated appearance not seen in the control as viewed by scanning electron microscopy. It is suggested that this is a result of cellulose deposition, a process known to occur before lignification. This tentative evidence of lignin within the cell walls of legume seeds has a host of implications for hydration during cooking, cell separation, and ultimately, texture. (AS)

Milling

9008 ELIAS, L.G.; HERNANDEZ, M.; BRESSANI, R. The nutritive value of pre-cooked legume flours processed by different methods. *Nutrition Reports International* 14(4):385-403. 1976. En., Sum. En., 18 Ref.

Phaseolus vulgaris. Nutritive value. Legume crops. Diets. Cooking. Analysis. Amino acids. Protein content. N.

The effect of different processing conditions on the nutritive value of 3 legume grains was studied. As regards black beans, raw whole and ground beans were soaked for 18 h in 3 liters water/kg beans and then autoclaved for 15, 30, and 45 min at 16 lb pressure (121 degrees Celsius). Preparations were fed to young rats in diets containing 10 percent protein to obtain PER and apparent digestibility values. Ratios for wt. gain over protein consumed were considered negative at all cooking times for the ground beans. The digestibility coefficient for black beans was 29.8 percent; to attain max. PER (0.94), 45 min cooking time was required. Protein digestibility was 74.2 percent at 45 min. Content of trypsin inhibitors was high for the cooked ground black beans but was very low

in whole cooked beans. These results are explained on the basis of an impairment in heat transfer and a decrease in lysine availability. It is concluded that grinding before cooking in the autoclave is not suitable for preparing precooked bean flours, either because trypsin inhibitors are not completely inactivated or because protein quality deteriorates. In the case of whole cooked samples, black beans require at least 30 min to render a product acceptable from the nutritional point of view. (Summary by T.M.)

0566

29156 UEBERSAX, M.A.; ZABIK, M.E. 1986. Processing and use of dry, edible, bean flours in foods. American Chemical Society Symposium Series 312:190-205. En., Sum. En., 34 Ref., II. (Dept. of Food Science & Human Nutrition, Michigan State Univ., East Lansing, MI 48824, USA)

Phaseolus vulgaris. Bean flour. Processing. Analysis. Digestibility. Nutritive value. Mineral content. Protein content. USA.

Navy, pinto, and black beans were dry roasted in a solid-to-solid heat exchanger, dehulled by air aspiration, pin-milled, and air-classified to yield whole, hulls, high protein, and high starch flour fractions. Proximate analyses were conducted and color, enzyme neutral detergent fiber, N solubility index, oligosaccharide content, SDS-polyacrylamide gel electrophoresis, and in vitro digestibility were determined and resulted in differences due to bean types, mill fractions, and processing variables. Samples of all fractions were analyzed by emission spectroscopy for minerals. Phytate P was present in the greatest quantity in the protein fraction (0.86-1.06 percent). Protein digestibility of the cotyledonary fractions, high protein, and high starch, was similar for both bean types; however, digestibility of the hull fraction was greater for navy bean than that obtained from pinto bean. All flour fractions retained stability during conventional storage protocols. Quality attributes of food incorporating fractions were objectively and subjectively evaluated. Acceptable cookies, donuts, quick breads, and leavened doughs were produced using high fiber or high protein fractions at moderate levels of substitution (20 percent) for wheat flour. (AS)

0567

28213 UEBERSAX, M.A.; ZABIK, M.E. 1981. 1980 update: bean flour product utilization. Michigan Dry Bean Digest 5(2):24-25. En., Sum. En., II.

Phaseolus vulgaris. Bean flour. Research. Human nutrition. Processing. USA.

Research advances toward the utilization of specific bean flour fractions such as whole bean flour, navy bean hulls, navy bean protein concentrate, and high starch fraction are reviewed. Potential uses of bean flour fractions in formulated food are included in table form. (CIAT)

0568

19463 ANDRES, C. 1981. High-protein flour from white beans. Food Processing 42(5):64. En., II.

Phaseolus vulgaris. Bean flour. Protein content. Uses.

Two high protein flours from white beans are described, having protein contents of 25 and 40 percent, resp. The flours are deflavored and debittered, and intended for use in bakery products, snacks, milk replacers, and pasta foods. In bakery foods, the bean flour can replace up to 30 percent of wheat flour. The protein-rich flours are prepared by air-classification of cooked milled beans. (Summary by Food Science and Technology Abstracts)

Canning

21539 SELLSCHOP, J.P.F. 1968. Beans in demand. Farming in South Africa 43(11):21. En., II.

Phaseolus vulgaris. Canned beans. Consumption. Human nutrition. Africa.

With the increase in the consumption of tinned and packaged foodstuffs, there is a growing demand for small white beans, which are generally preferred to other types of beans. However, spoilage in the field due to unfavorable weather conditions, use of sprawling var., or long stacking periods justify the lack of interest in the production of a greater proportion of small white beans. Pea beans, with a more upright growth habit, should therefore be studied in more detail. (Summary by I.B.)

0570

14722 AHLGOWALIA, B.S. 'Shel' - a new variety of dry beans. Farm and Food Research 10(2):58. 1979. En., II.

Phaseolus vulgaris. Cultivars. Seed production. Composition. Agronomic characters. Pods. seeds. Plant anatomy. USA.

The appearance, composition, cultivation, and possible uses of 'Shel' a new var. of dry bean developed primarily for grain seed production are described. The pods are 10-12 cm long and have 4-6 seeds each. The seeds are cream colored with purple specks, but the seed coat may turn chocolate brown on drying and after storage. 'Shel' contains 20-22 percent CP and 58 percent carbohydrates. Preliminary canning tests in 2 percent salt, or in tomato sauce and as chili-beans with minced beef, suggest an excellent canning quality. (Summary by Food Science and Technology Abstracts)

0571

14255 DAVIS, D.R.; BLACK, K.W.; NELSON, T.S. Protein quality of canned pinto and kidney beans. Arkansas Farm Research 29*2:10. 1979. En.

Phaseolus vulgaris. Harvesting. Maturation. Canned beans. Nutritive value. Animal nutrition. Diets. Protein content. Amino acids. Methionine.

Pinto and kidney beans can not be grown to complete dryness in Arkansas owing to rainfall pattern. Mature beans were harvested 1 wk. apart for 4 wk., canned in water, stored 1 mo. dried, powdered and used to provide 10 percent protein in the diet of 10 male albino rats for 21 days. In a 2nd trial 0.4 percent DL-met. was added to the diet. Reference standard was diet with 10 percent casein. Growth was most on casein and least on bean diet without extra met. though with met., growth was near that on casein diet except for 2 bean samples, thought to have germinated and to have lost protein quality. Only aspartic acid and met. concn. in beans, of 17 amino acids, varied significantly between harvest dates; changes in neither were critical. Results indicated that once the beans were mature, date of harvest had no apparent effect on quality or protein; addition of met. corrected their amino acid imbalance and improved their protein quality. (Summary by Nutrition Abstracts and Reviews)

0572

28204 HOSFIELD, G.L.; UEBERSAX, M.A. 1979. Canning quality evaluations of tropical & domestic dry bean germplasm. Michigan Dry Bean Digest 3(4):4-9. En., II.

Phaseolus vulgaris. Cultivars. Analysis. Canned beans. Processing. Genotypes. Nutritive value. Packaging. USA.

Seeds of 35 bean accessions representing plant introductions, breeding lines, and cv. of both tropical and domestic (Michigan, USA) origin were assayed for proximate chemical

composition. Seventeen of these accessions comprising several dry bean commercial class designations were selected for canning. Beans were adjusted to 16 percent moisture prior to soaking and processing. Soaked and processed beans were evaluated for water uptake while processed beans were evaluated further for texture (Kramer Shear Press) and general canning quality. Differences among genotypes were noted for most characters. Textural differences were associated with final MC in only the tropically adapted bean accessions. Tropical beans also showed a greater tendency to clump in the can after cooking than did the domestic genotypes. Evaluation of Kramer Shear Press tracings showed textural differences among genotypes could be broken down into a compression type and a shear type curve. These curve types appeared to be a characteristic of the genotype rather than a seed coat color per se, size of bean, or final MC. These results suggest there is considerable genetic variation available among tropical bean genotypes for nutritional and canning quality factors to justify their use in breeding programs. Specifically, tropical bean germplasm may be of use as parents to transfer stress tolerance and lodging resistance to commercially acceptable genotypes, while the bean breeder is simultaneously breeding to improve nutritional composition and canning quality. (AS)

0573

20693 ANDREOLLI, R.; TOMASICCHIO, M.; MACCHIAVELLI, L.; ARCAMONE, F. 1981. Fattori clinico-nutrizionali di fagioli secchi e di conserve derivate. (Chemical and nutritional factors in dry and canned rehydrated beans). *Industria Conserve* 56(4):254-258. It., Sum. It., En., 9 Ref. (Stazione Sperimentale per l'Industria delle Conserve Alimentari, Parma, Italy)

Phaseolus vulgaris. Cultivars. Processing. P, K. Proteins. Amino acids. Starch content. Canned beans. Nutritive value. Nutrient loss. Italy.

Contents of P, K, protein, amino acids, and starch were determined in different white-seeded (Cannelino, Bianco di spagna, Albia, Corona) and brown mottled bean var. (Ania, Pinto, Taylor, Cranberry, Borlotto). The same analyses were performed during the various steps of industrial processing and on the final products obtained by the conventional canning technique and by vacuum canning. The nutritional quality of the final products was also evaluated. No great differences were found between white and brown beans. Over 50 percent of K and P contents were lost during normal processing, less during vacuum canning. (Author's summary)

0574

17734 HALABY, G.A.; LEWIS, R.W.; REY, C.R. 1981. Variations in nutrient content of commercially canned legumes. *Journal of Food Science* 47(1): 263-266. En., Sum. En., 6 Ref.

Phaseolus vulgaris. Canned Beans. Carbohydrate content. Fat content. Protein content. Mineral content. Amino acid.

Nutrition information for label declaration on 8 canned bean products was generated through analyses. Variability between products and variability due to yr. of pack, production, plant, and can size were evaluated. Variability in caloric content, carbohydrates, and fats serving was attributed to formulation and processing variations. All the bean products tested supplied protein and Fe in amounts equal to or greater than 20 percent of the U.S. Recommended Daily Allowance serving. Seasonal variations in raw commodities, changes in blanching and/or processing methods, fluctuations in bean-to-bean sauce ratio, as well as analytical variability are probable causes of variations detected in the nutrient content of the canned products. Values are also tabulated for bean production in different states in the USA and for nutrients in raw beans, cooked beans, and canned bean products. (Author's summary)

19717 McDANIEL, M.R.; DIAMANT, R.; LOEWEN, E.R.; BERG, H.D. 1981. Dangerous canning practices in Manitoba. *Canadian Journal of Public Health* 72(1):58-62. En., Sum. En., 15 Ref. (Dept. of Foods and Nutrition, Univ. of Manitoba, Winnipeg, Manitoba R3T 2N2, Canada)

Phaseolus vulgaris. Canned beans. Human nutrition. Canada.

In Aug. 1977, 457 Manitoba households were surveyed on their canning practices. Many incorrect and potentially dangerous practices were found including incorrect processing methods, use of improper containers and lids, and inadequate cooking procedures prior to serving. Beans were the most popularly canned low-acid vegetable, yet only 17 percent of the people canning beans used the proper pressure canning method recommended by Agriculture Canada, and proper processing instructions are not readily available. Large no. of respondents did not boil low-acid canned foods before eating to ensure destruction of botulism toxin (*Clostridium botulinum*). (Extracted from author's summary)

18062 BOLLES, A.D.; UEBERSAX, M.A.; HOSEFIELD, G.L. 1982. Contamination of packaging material in processed beans. *Michigan Dry Bean Digest* 6(4):15. En., II.

Phaseolus vulgaris. Canned beans. Pollution. Processing. Analysis.

Processed bean quality and the condition of fragment pieces when cans were contaminated with linked laminated paper, printed burlap, and polypropylene packaging materials were assessed. Michigan navy beans containing 12 percent moisture were processed. After processing, cans were stored for 24 h and opened to evaluate bean and contaminant appearance. During the soaking process there were not changes in bean color quality with burlap. A considerable dye leaching from the paper and a small amount of polypropylene were observed; however, there was no change in bean color since the soaking medium was discarded afterwards. The physical integrity of the contaminants was not significantly affected by soaking. Neither burlap nor polypropylene produced changes in bean color after storage, but inked paper did. Adverse coloration was primarily due to an increase in contaminant size which resulted in more dye leaching. The processing or heat treatment applied did not cause contaminant breakdown, deterioration, or adherence to the beans. Recommendations to avoid incidental good quality bag materials from a reliable source, avoiding physical damage to bugs during all phases of shipping and handling; to minimize fragments, the use of proper opening and dumping techniques to minimize incorporation of packaging materials, and instructing final inspection line personnel to remove all foreign materials prior to filling. (Summary by EDFFLC. Trans. by L.M.F.)

19959 CHANDAN, R.C.; UEBERSAX, M.A.; SAYLOCK, M.J. 1982. Utilization of cheese whey permeate in canned beans and plums. *Journal of Food Science* 47(5):1649-1653. En., Sum. En., 12 Ref.

Phaseolus vulgaris. Canned beans. Processing. USA.

Navy and kidney beans were hydrated in water, then canned in brines designated as control, whey permeate (WP), and hydrolyzed lactose whey permeate (HP). Hunter Lab Color Difference and Kramer Shear texture analyses indicated general darkening and increased firmness in permeate-treated beans. Total solids and ash increased significantly in the treated samples. There was a significantly lower preference for beans treated with permeate fractions than for control beans. (Author's summary)

19458 STILWELL, M.R. 1982. Breeding dry beans for processing. *Proceedings of the Nutrition Society* 41(1):83-89. En., 25 Ref., 11.

Phaseolus vulgaris. Genotypes. Canned beans. Processing. Plant breeding. Yields. Seed characters. Cultivars.

Processing characteristics of the different bean genotypes have a great influence on appearance and acceptability of the final product. Breeding is currently directed toward the production of high yielding genotypes over a wide range of environmental conditions and the preservation of 3 characteristics that the grain must have in order to meet specific quality standards (appearance, flavor, and texture). Processing characteristics of high yielding bean genotypes selected from the CIAT bean germplasm collection and characteristics of adaptability to different environments are given. The latter were assessed by parameters such as mean yield of the var., regression coefficient (b), and mean square deviations from regression. Among the selected materials are Seafarer (1034 kg/ha, $b = 0.77$), Ex Rico 23 (1453 kg/ha, $b = 1.03$), S-630 (1704 kg/ha, $b = 1.23$), Jamapa (1627 kg/ha, $b = 1.05$), PI 309804 (1760 kg/ha, $b = 1.22$), and San Fernando (1552 kg/ha, $b = 1.09$), among others. (Summary by EDITEC. Trans. by L.M.F.) G01

22944 HUANG, Y.T.; BOURNE, M.C. 1983. Kinetics of thermal softening of vegetables. *Journal of Texture Studies* 14(1):1-9. En., Sum. En., 12 Ref., 11.

Phaseolus vulgaris. Processing. Canned beans. Hot water treatments. USA.

The rate of softening in several canned vegetables (including *Phaseolus vulgaris*) during the retort process was studied. The rate of softening is consistent with 2 simultaneous 1st order kinetic mechanisms, mechanism 1 acting on substrate a and mechanism 2 acting on substrate b. The rate constants for mechanism 1 are 10 times or more greater than the rate constants for mechanism 2. Approx. 85-90 percent of the firmness of the raw commodity is contributed by substrate a and the remaining firmness is contributed by substrate b. Mechanism 1 is probably due to pectic changes in the interlamellar layer. The biochemical nature of substrate b is a matter of speculation. The apparent Arrhenius activation energies range from 5.1 to 35.0 kcal/mole. The data indicates that softening kinetics of vegetables is more complex than formerly assumed. (Author's summary)

29188 ADSULE, P.G.; DAN, A.; SATYANARAYANA, A.; RAJENDRAN, R. 1984. Studies on the suitability for canning of new french bean (*Phaseolus vulgaris*) selections. *Journal of Food Science and Technology* 21(4):203-205. En., Sum. En., 4 Ref. (small Industries Service Inst., Government of India, 65/1 GST Road, Guindry, Madras-600 032, India)

Phaseolus vulgaris. Snap beans. Cultivars. Canned beans. Organoleptic properties. Storage. India.

Four selections of french beans developed at the Indian Institute of Horticultural Research (Bangalore, India) were assessed for physicochemical characteristics and suitability for canning. Selection No. 5 and 2 were found better than check var. Contender, which is reported to be the best for canning. Organoleptic score of canned french beans during storage for 12 mo. is included. (AS)

26027 DRAKE, S.R.; KINMAN, B.K. 1984. Canned dry bean quality as influenced by high temperature short time (HTST) steam blanching. *Journal of Food Science* 49(5):1318-1320. En., Sum., En., 15 Ref. (United States Dept. of Agriculture, Agricul-

tural Research Service, Irrigated Agriculture Research & Extension Center, Washington State Univ., Prosser, WA 99350, USA)

Canned beans. Cultivars. *Phaseolus vulgaris*. Processing. Seed characters. Seed color. USA. Water content.

High temp. short time (HTST) steam-blanching dry beans had greater drained wt. and shear values than water-blanching dry beans. The MC of dry beans was greater after water blanching. Subjective grade was closely related to drained wt. and shear values, and HTST steam-blanching dry beans. Water-blanching dry beans were lighter in color than HTST steam-blanching dry beans. As length of HTST steam blanching was increased, agron color of the beans darkened. High quality canned dry beans can be produced with HTST steam blanching with energy and time savings, but differences between water and HTST steam blanching and canning quality is highly dependent on cv. and length of HTST steam blanch. (AS)

0582

29707 KALDY, M.S. 1985. An improved shaking apparatus to measure matting in canned beans. *Laboratory Practice* 34(6):90. En., Sum. En., 2 Ref., II. (Agriculture Canada Research Station, Lethbridge, Alberta T1J 4B1, Canada)

Phaseolus vulgaris. Canned beans. Technology. Canada.

A shaking apparatus was modified to measure the extent of matting (clumping) in canned beans processed in heavy sauce. The operational procedure is simple and relatively quick. Wt. of beans remaining on a stainless steel screen after shaking indicates the extent of matting. Beans with the lowest matting index are preferred. The device can be used by both plant breeders and processors to assess the matting quality of beans. (AS)

0583

29716 THISEKWA, B. 1985. Laboratory studies on production of canned Mboga Ya Maharage. 2. Heat processing and product quality. *Mededelingen van de Faculteit Landbouwwetenschappen Rijksuniversiteit Gent* 50(4):1393-1399. En., Sum. En., NI., 8 Ref. (Laboratory of Food Chemistry & Microbiology, Faculty of Agricultural Sciences, State Univ. of Ghent, Coupure Links, 653 B-9000, Ghent, Belgium)

Phaseolus vulgaris. Canned beans. Temperature. Timing. Organoleptic properties. Protein content. Nutritive value. Tanzania. Belgium.

Heat processing factors and their effect on the quality of canned Mboga Ya Maharage a food eaten with rice, maize, cassava, or banana meal, were studied. A bean:sauce ratio of 45.0:68.5 (wt.:wt.) was found satisfactory for filling cans. Retorting canned Mboga at 121 degrees Celsius for 36 min gave a product of acceptable organoleptic quality and promising storage properties. Characteristic composition of the finished canned Mboga are: total solids, 29.4 percent; pH 5.6; CP, 8.7 percent; and ether extract, 3.7 percent. Further investigation is required to determine the stability of the product in different storage conditions, as well as the feasibility of using larger cans to contain more product in order to favor both the producer and the consumer. (AS)

0584

29196 VAN BUREN, J.; BOURNE, M.; DOWNING, D.; QUEALE, D.; CHASE, E.; COMSTOCK, S. 1986. Processing factors influencing splitting and other quality characteristics of canned kidney beans. *Journal of Food Science* 51(5):1228-1230. En., Sum. En., 12 Ref. (Dept. of Food Science & Technology, New York State Agricultural Experiment Station, Cornell Univ., Geneva, NY 14856, USA)

Phaseolus vulgaris. Processing. Canned beans. Cooking. Water absorption. Temperature. Timing. USA.

Single factor changes from a standard canning process indicated that significant reductions in splitting resulted from higher soak Ca concn., higher soak temp., higher brine Ca concn., and shorter cooking times. Splitting in canned kidney beans was markedly reduced by soaking beans before cooking at temp. of 66-71 degrees Celsius in solutions containing 150-350 PPM CaCl₂. Treatments giving lower gain in wt. during soaking led to less splitting. Lower splitting was associated with lower drained wt. and firmer cooked beans. (AS)

DEVELOPMENTAL ASPECTS

0585

4350 LOEWENBERG, J. The development of bean seeds (*Phaseolus vulgaris* L.). *Plant Physiology* 30(3):244-250. 1955. En., Sum. En., 32 Ref.

Phaseolus vulgaris. Seeds. Laboratory experiments. N. P. Pods. Analysis. Cytology. Developmental stages. Composition. Plant respiration. Water content. Mineral content. Timing. Plant assimilation. Cotyledons. Epicotyl.

The development of bean seeds has been described on a cellular and organ basis in terms of dry wt., nitrogen content, phosphorus content, fresh wt., and rate of oxygen uptake. A comparison of the per cell values of various plants indicates that while the cells differ in size and content, their rates of oxygen uptake are comparable. (Author's summary).

0586

20100 WALKER, K.A. 1974. Changes in phytic acid and phytase during early development of *Phaseolus vulgaris* L. *Planta* 116(2):91-98. En., Sum. En., 19 Ref., II.

Phaseolus vulgaris. Cotyledons. Enzymes. embryo. Water content. Developmental stages. Analysis. Amino acids.

Changes in phytic acid, phytase, and inorganic phosphate were examined in the cotyledon of *Phaseolus vulgaris* cv. Taylor's Horticultural during embryogeny and germination. Embryogeny usually took 36 days; phytic acid was accumulated most rapidly between days 24 and 30, during which time relatively high values of inorganic phosphate were observed in the cotyledon. Levels of inorganic phosphate in the developing cotyledon did not decrease until the dehydration phase, and this decrease could not be entirely accounted for by the residual synthesis of phytic acid during this time. Phytase activity was undetectable during embryogeny, but a rapid rise in phytase activity was observed after day 2 of germination. This rise was well correlated with the disappearance of phytic acid from the cotyledon. Phosphate levels remained much lower than those observed during embryogeny. (Author's summary)

0587

14766 CONDE M., C.A. Cambios químicos y nutricionales del frijol *Phaseolus vulgaris* L. durante el proceso de maduración del grano. (Nutritional and chemical changes of beans during grain maturation). Tesis Ing. Agr. Guatemala, Universidad de San Carlos de Guatemala, 1975? Es., Sum. Es., 55 Ref., II.

Phaseolus vulgaris. Plant development. Maturation. Nutritive value. Cooking. Protein content. Digestibility. Seeds. Pods. Amino acids. Analysis. Animal nutrition. Diets.

The effect of maturation on the chemical composition and nutritive value of black bean grain was studied. Four samples were harvested the 1st 72 days after planting and the others at 8-10 days intervals between samples. Sample no. 4 was divided in 4 "A" and 4 "B". Sample 4 "A" was harvested and immediately lyophilized, grinded and stored, and

sample 4 "B" was harvested and then sun-dried for 3 days. A part of each one of the 5 samples was cooked in autoclave for 15 min. The 5 samples were divided into 5 raw and 5 cooked ones. During maturation, an increase was observed in protein, fat, crude fiber, and ash content while water and free amino acids decreased. An increase in the amount of lysine and total S-amino acids increased as well as the activity of growth inhibitors. The fraction soluble in NaOH increased; solubility in KCl decreased, while the fractions soluble in water and alcohol remained constant. The nutritive value decreased with maturation; this, instead, did not have any effect on protein digestibility. Results indicate that the reduction in nutritive value can be explained by the presence of residual toxic factors, that are heat-resistant and present in the different pigments formed during maturation. It was also concluded that digestibility was not affected by the parameters under study. Finally, results demonstrated the importance of carrying out biochemical and physiological studies in order to evaluate the role toxic factors, the different protein fractions, and amino acid composition play on digestibility and nutritive value of legume seeds. (Author's summary. Trans. by L.M.F.)

0588

10872 SUN, S.M. et al. Protein synthesis and accumulation in bean cotyledons during growth. *Plant Physiology* 61:918-923. 1978. En., Sum. En., 33 Ref., II.

Phaseolus vulgaris. Proteins. Seed. Analysis. Cotyledons. Antibodies. Antisera. Protein content. Laboratory experiments. Growth.

Analysis of total protein, specific and protein synthetic activity in vitro confirmed that intense protein synthesis and accumulation occurred as the french bean seed grew from 12 to 20 mm in length. There was no globulin-1 (G1) fraction in 6-mm seeds and only very small amounts were synthesized in seeds less than 9 mm long but the 7-9 mm stages represented a 2-day transition period over which genetic information for the G1 protein became actively expressed. G1 accounted for at least 50 percent of all protein synthesized in this tissue during the following 14 days, and at maturity was the major storage protein, representing some 50 percent of the dry seed protein. Cell free protein synthesis assays clearly showed G1 polypeptides to be among the polysome-directed products. (Author's summary)

STORAGE

0589

11170 JACKIX, M. DE N.H. Influencia de armazenamento e diferentes tratamentos de maceracao e coccao na qualidade de feijoes (*Phaseolus vulgaris* L.) enlatados. (Influence of storage and different soaking and cooking treatments on the quality of canned beans). Tese Mag. Sci. Sao Paulo, Brasil, Universidade Federal de Campinas. Facultad de Engenharia de Alimentos e Agricola, 1978. 148p. Pt., Sum. Pt., En., 87 Ref., II.

Phaseolus vulgaris. Cooking. Canned beans. Storage. Soaking. Cultivars. Protein content. Water absorption. Seed. Composition. pH. Nutritive value. Processing. Brazil.

The main purpose of this work was to test the effect of soaking and cooking periods on different var. of dry beans used for canning. The var. used were Rosinha, Carioca, Rico 23 (black beans), Bico de Ouro, and Pirata beans grown during the rainy and dry seasons. Tests were performed soon after harvest and at 12-18 mo. of storage, resp. Soaking processes were as follows: water at 25 degrees Celsius for 8 h; 0.5 percent sodium hexametaphosphate (SHMP) solution at 25 degrees Celsius for 8 h; water at 25 degrees Celsius for 3 h, after scalding; water at 60 degrees Celsius for 1 h; and 0.5 percent SHMP solution at 60 degrees Celsius for 1 h. Cooking periods were 20, 30, or 40 min at 121 degrees Celsius. Protein content was significantly higher for dry season beans, especially for Bico de Ouro and Rico 23. Soaking did not increase water absorption when using

0.5 percent SHMP solution; however, cooked beans were significantly more tender and showed a greater wt. gain when SHMP was used, independent of the stage of the process at which it was added. For assessing the tenderness of the product, sensory analyses and Instron tests were carried out. A relation between organoleptic and mechanical tests was obtained when in addition to the measurement of the force applied in the Instron the C.V. of force was considered. The beans were classified as tender by the testing panel when the medium force applied in the Instron was less than 1200 gf and the C.V. less than 32 percent. After 1 yr of storage beans did not become tender even after 40 min of cooking, when only water was used for soaking and cooking. The use of 0.5 percent SHMP solutions as filling liquid dispensed with the necessity of soaking and made it possible to obtain a product considered "ideally" tender by the testing panel after 30 min of cooking. (Author's summary)

0590

12340 NORDSTROM, C.L.; SISTRUNK, W.A. Effect of type of bean, moisture level, blanch treatment, and storage time on quality attributes and nutrient content of canned dry beans. *Journal of Food Science* 44(2):392-395. 1979. En., Sum. En., 20 Ref.

Phaseolus vulgaris. Water content. Storage. Mineral content. Vitamin content. Processing. Plant habit. Canned beans. Nutritive value. Blanching.

The study was conducted on canned dry beans including 8 types, 2 moisture levels, 4 blanching treatments, and 4 storage times. Low original moisture level before soaking resulted in higher water uptake ratios in all beans except Pinks and Avenger. Drained wt. were higher in bean types that had lower shear press readings. Beans blanched in steam and lots containing 16 percent initial moisture were firmer in texture. Blanch method did not affect percentage splits, but type and storage time created significant differences. There were differences among types in riboflavin and vitamin E. Both vitamins decreased during storage of canned beans, but only riboflavin was lower in beans of 16 percent moisture, and blanched in steam as compared to water. Carbohydrate composition was significantly different between types of beans, but the greatest differences were in hemicellulose. Steam blanching leached out less sugars and high blanch temp increased the solubility of cellulose. Dwarf Horticulture no. 4 rated highest in quality followed by Red Kidney, Navy, and Pinto. (Author's summary)

0591

18703 GRANGE, A. 1980. Vieillessement des graines de *Phaseolus vulgaris* (L.) var. Contender. 1. Effets sur la germination, la vigueur, la teneur en eau et la variation des formes d'azote. (Aging of seeds of *Phaseolus vulgaris* cv. Contender. 1. Effects of germination, vigor, water content, and variation of forms of nitrogen). *Physiologie Vegetale* 18(4):579-586. Fr., Sum. Fr., En., 29 Ref., II.

Phaseolus vulgaris. Seed. Storage. Germination. Seed vigor. Water content. Seed characters. N. Analysis.

Kidney bean seeds were stored for 3 yr in F-cold (2 degrees Celsius, 30 percent RH), S-dry (22 degrees Celsius, 0.5 percent RH), and H-wet (22 degrees Celsius, 60 percent RH) conditions. MC reached a steady state value according to external RH. In F conditions, the studied parameters remained constant during the 3 yr of storage. In S and mainly in H conditions, an important decrease in vigor and germination was observed. Other effects such as root system modifications (S and H), abnormal seedling (H), and hard seeds (S) were also studied. In S conditions, a decrease in globulin N and at the same time an increase in albumin N were observed. Variations in macromolecular associations may be responsible for these modifications. It is probable that albumins and globulins, defined only by solubility properties, are heterogeneous and allow possible transformations between protein reserve molecules. (Author's summary)

17321 MORA C., M. 1980. Efecto de la humedad y temperatura sobre el endurecimiento de frijol (*Phaseolus vulgaris* L.) almacenado durante seis meses. (Effect of moisture and temperature on the cooking time of beans stored for six months). *Agronomía Costarricense* 4(2):195-197. Es., Sum. En., 3 Ref.

Phaseolus vulgaris. Storage. Water content. Cooking. Timing. Laboratory experiments. Costa Rica.

Cooking times for dry black beans stored during 6 mo. at 15, 20, and 25 degrees Celsius and 9.3, 13.0, and 15.4 percent MC were measured. Except for a slight increase in cooking time for beans stored at 25 degrees Celsius and 15.4 percent MC after 6 mo. storage, no other change was noted. A fairly constant difference between the time needed to reach 90 and 100 percent soft beans was found during the cooking tests. Under the tested conditions, cooking time was considerably reduced when samples were soaked overnight. More research is required to establish safe storage conditions for different bean cv. and storage time. (Author's summary)

20074 BASS, L.N. 1981. Report of the seed moisture and storage committee working group on seed storage 1977-1980. *Seed Science and Technology* 9(1):245-248. En., Sum. En., Fr., De.

Phaseolus vulgaris. Seeds. Water content. Storage. Temperature. Timing. Germination. USA.

No unified project is reported, but briefly details are given of expt., some of which are still incomplete, carried out by individuals or small groups of workers. *Phaseolus vulgaris* seeds dried at 38 degrees Celsius for 8 h to 10-11 percent MC were found to germinate best after sealed storage for 1 yr at 21 degrees Celsius. (Extracted from summary by Field Crop Abstracts)

16765 MOSCOSO, W. 1981. Efecto del almacenamiento a alta temperatura y alta humedad sobre algunas características físicas y químicas del frijol. (Effect of storage at high temperatures and high humidity on some chemical and physical characteristics of beans). In Reunión Anual del Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, 27a., Santo Domingo, República Dominicana, 1981. Memoria. Santo Domingo, Secretaria de Estado de Agricultura. v.1-A, pp SEFS-1-SEFS-36. Es., 28 Ref., II.

Phaseolus vulgaris. Seed characters. Storage. Water content. Temperature. Cooking. Timing. Dominican Republic.

A technical analysis of literature on the effect of high temp. and RH during storage on bean seed water absorption, culinary properties (cooking time, coloring, and flavor), and on chemical changes associated with pectic substances, phytic acid, and minerals is given. It was concluded that: (1) the problem of hard hulls is more evident in dry beans with a water content less than 15 percent, in addition to var. and climatic factors and those related to cultural practices; (2) storage under conditions of high RH and temp. favors water permeability of the hulls; (3) storage under these conditions results in a reduction of the causes of softening; (4) dissolution of pectic substances during cooking follows 1st order kinetic reactions; (5) storage under these conditions causes a reduction in phytic acid content; (6) under the mentioned storage conditions, grain has a greater loss of solutes of low mol. wt. during soaking; (7) the causes of softening and the dissolution of pectic substances show a high correlation with the causes of monovalent to bivalent cations; (8) beans stored at high RH and temp. lose their property of quick cooking. (Summary by A.J.C. Trans. by L.M.F.) 1101

16764 VALLE DE MEJIA, E. DEL. 1981. Efecto de diferentes condiciones de almacenamiento sobre el desarrollo de la dureza del frijol. (Effect of different storage conditions on the development of bean hardness). In Reunión Anual del Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos Alimenticios, 27a., Santo Domingo, República Dominicana, 1981. Memoria. Santo Domingo, Secretaría de Estado de Agricultura. v.1-A, pp SEF6-1-SEF6-20. Es., 23 Ref., 11.

Phaseolus vulgaris. Storage. Seeds. Deterioration. Seed color. Temperature. Timing. Tannin content. Water content. Enzymes. Cooking.

The effect of storage in black bean var. Suchitán and red bean Rojo de Seda (MC of 9, 13, and 17 percent) during 2, 4, and 6 mo. at 4, 20, and 36 degrees Celsius and different mixtures of CO₂ and O₂ on bean hardness, bean MC, and water absorption, cooking time, tannin content, and polyphenol oxidase enzyme activity is studied. Storage time increased both bean hardness and cooking time. However, hardness and cooking time do not correlate significantly, suggesting that these 2 characteristics are of different nature; the 1st, related to the seed coat and the 2nd, to biochemical factors of the endosperm. At higher temp. and higher storage moisture, bean cooking time was longer; moreover, high humidity (17 percent) favored fungal development. There was a negative and significant correlation between bean hardness and the coefficient of water absorption. Beans required longer cooking time when stored in an O₂ enriched atmosphere in comparison with a CO₂ atmosphere, indicating that hardness is an oxidative process. Tannin content decreased with storage time, especially at high temp. In the case of black beans, this decrease occurred along with an increase in polyphenol oxidase activity. Observations showed that red var. underwent more changes during storage. It is recommended to: (1) store beans with the lowest MC possible; (2) the storage site should be dry and ventilated; and (3) when possible, the exposure of stored beans to O₂ should be avoided. (Summary by A.J.C. Trans. by L.M.F.)

18067 GONZALEZ DE MEJIA, E. 1982. Efecto de diferentes condiciones de almacenamiento sobre el desarrollo de la dureza del frijol. (Effect of different storage conditions on bean hardening). Archivos Latinoamericanos de Nutrición 32(2):258-274. Es., 18 Ref., 11.

Phaseolus vulgaris. Storage. Seed. Water content. Temperature. Cooking. Seed characters. Tannin content.

The effect of different storage conditions (bean MC, 9, 13, and 17 percent; 40, 60, and 80 RH, resp.; temp., 4, 20, and 36 degrees Celsius; available O₂ regulation by injecting CO₂ into the storage containers) on the hardness, cooking time, and water absorption of seeds of black bean var. Suchitán and red bean var. Rojo de Seda was studied. Tannin content and polyphenol oxidase activity were also determined. A significant relationship exists between storage time and grain hardness and cooking time. Cooking time was longer with grain with 13 percent MC than with those containing 9 percent. Grains with 17 percent MC were infected by fungi, especially at higher temp. The correlation between bean hardness and MC was not significant. The correlation between hardness and cooking time was only statistically significant for black bean Suchitán. Storage temp. was another factor that affected cooking time, the latter increasing with increasing temp. Beans stored under normal air conditions required a longer cooking time and were harder compared with those stored in a CO₂-rich atmosphere. There is a significant negative relationship between bean hardness and the coefficient of water absorption. Tannin content decreases with storage time, especially at high temp. In black beans, this reduction is accompanied with an increase in the enzymatic activity of polyphenol oxidase. The red bean var. tended to undergo more changes during storage. (Summary by E.DITEC. Trans. by L.M.F.)

18073 LUSE, R.A. 1982. Estudios realizados por el Centro Internacional de Agricultura Tropical (CIAT) sobre el problema del endurecimiento del frijol. (Studies conducted by the Centro Internacional de Agricultura Tropical (CIAT) on aspects regarding bean hardness). Archivos Latinoamericanos de Nutrición 32(2):401-414. Es., II.

Phaseolus vulgaris. Seed coat. Storage. Cooking. Human nutrition. Seed treatment. Colombia.

Research work conducted by CIAT's Food Quality and Nutrition Lab. on the development of hard seed coat in stored beans, its interrelationship with water absorption, its relationship with seed treatment with edible oils, and its physicochemical characters (still in progress) is described and analyzed in detail. These studies are based on well-defined standardized tests as well as on the use of genetically pure bean lines developed by CIAT's bean improvement program. The following factors are used to describe nutritional value and consumer acceptability: protein content, water absorption, cooking time, broth thickness, flavor and texture, and the tendency to develop a hard seed coat during storage. The problem of hard seed coat can be minimized in some bean var. by storing freshly harvested seed under low temp. conditions. Housewives can reduce the effect of hard seed coats by soaking beans for a prolonged period under cool conditions. (Summary by F.G. Trans. by L.M.F.)

18595 ROZO, C. 1982. Effect of extended storage on the degree of thermal softening during cooking, cell wall components, and polyphenolic compounds of red kidney beans (*Phaseolus vulgaris*). Ph.D. Thesis. Ithaca, N.Y., Cornell University. 143p. En., 22 Ref., II.

Phaseolus vulgaris. Seed. Storage. Seed characters. Cooking. Analysis. Cell walls. Phenolic content.

The effect of storage under simulated tropical conditions of high temp. and RH on hardness, cell wall constituents, and polyphenolic compounds of red kidney beans was assessed. Three storage conditions were used: (1) 0 degrees Celsius, cold room storage (control); (2) 30 degrees Celsius, 80 percent RH; (3) 40 degrees Celsius, 80 percent RH. Samples of beans for chemical and textural analysis were taken at 0, 2, 4, 6, and 8 mo. Cotyledons and seed coats were separated before chemical analysis. The hardness of cooked beans increased significantly due to storage as shown by individual puncture measurements. Equilibrium MC were not reached for beans of treatments 2 and 3. Significant increases in cell wall contents measured as neutral detergent residue (NDR) occurred in cotyledons during storage at 40 degrees Celsius but not at 30 degrees Celsius. Hemicelluloses and cell wall N contents increased significantly at 40 degrees Celsius, showing high correlation with hardness of beans. Acid detergent residue (ADR), lignin, and cellulose values did not change in any of the treatments. Traces of condensed tannins and phenols were found in cotyledons. These results suggest that Maillard polymeric material synthesis occurs in cotyledons during storage. The increase in hemicelluloses and the presence of the Maillard polymer coats increased in the 3 treatments during storage. The ADR content in seed coats of beans stored at 40 degrees Celsius increased and was highly correlated with hardness of beans. This effect was not found in beans stored at 30 degrees Celsius. ADR nitrogen contents increased significantly, showing high correlation with hardness. Cellulose content and extractability of condensed tannins and phenols decreased significantly during storage, showing highly significant negative correlation with hardness. Increased toughness of seed coats may be caused by formation of protein-tannin complexes and/or polymerization of polyphenolic compounds with subsequent bonding to cell wall components. (Summary by Dissertation Abstracts International)

23927 SARTORI, M.R. 1982. Technological quality of dry beans (*Phaseolus vulgaris* L.) stored under nitrogen. Ph.D. thesis. Manhattan, Kansas State University. 66p. En., Sum. En., 70 Ref., II.

Storage. Cooking. Timing. Seed coat. Seed color. Palatability. USA. Seeds. Plant anatomy. Dietary value. North America. America.

Pinto beans (initial MC 14.7 percent) were stored for equal to or less than 6 mo. at 75 degrees Fahrenheit and 75 percent RH under: (a) forced air (10 cm³/min, 75 percent RH); (b) forced N₂ (10 cm³/min, 75 percent RH); or (c) in cotton bags. Samples were taken after 2, 4, and 6 mo. and evaluated for quality. Changes in cooking time, texture, fat acidity, and flavor during storage were generally similar for all treatments. Flavor scores indicated that the flavor quality of beans was reduced during storage; (b) resulted in a slight tendency for beans to retain a raw-vegetable flavor and to develop less beany flavor characteristics. A light colored seed color, characteristic of newly harvested beans, was retained with (b) throughout storage. (Dissertation Abstracts International)

0600

20029 BRESSANI, R. 1983. Effect of chemical changes during storage and processing on the nutritional quality of common beans. Food and Nutrition Bulletin 5(1):23-34. En., 38 Ref., II. (Division of Agriculture & Food Sciences, Inst. of Nutrition of Central America & Panama, Apartado Postal 1188, Carretera Roosevelt, Zona 11, Guatemala, Guatemala)

Phaseolus vulgaris. Storage. Processing. Cooking. Germination. Nutritive value. Timing. Guatemala.

Examples of the effects of storage and processing (milling, cooking, germination, and fermentation) on the nutritional value of food legumes, in particular beans, are given. On the basis of current home practices in Guatemala (standard cooking hardness at g-force of 90), beans stored at 35 degrees Celsius and 85 percent RH for 6 mo. required over 210 min to soften with the subsequent decrease in protein quality and increased energy cost. High moisture in the grain favors hardening as storage time increases. Although the mechanism of the hard to cook condition is not fully understood, it is probably related to an increase in the bound protein in the seed coat and aleurone layer. Milling techniques have been developed to maximize the aleurone layer. Milling techniques have been developed to maximize the yield of edible fractions since milling of food legumes by both wet and dry methods has disadvantages. Roasted beans had a protein quality equal to or better than that of cooked bean (bed heat exchange dryer operated at 190-200 degrees Celsius for 20-30 s); a similar treatment was useful to preserve cooking characteristics of the product. In rat feeding trials protein quality was better when extrusion cooking or drum drying (in that order) was used than when beans were autoclaved. Germination increases the vitamin content of legumes but its effect of protein quality should be studied. Fermentation increases vitamin and protein contents, increases the availability of various nutrients, and removes antiphenological factors. The role of polyphenolic compounds during cooking should be established. Areas that require further research to improve availability, utilization, and nutritive value of legumes are pointed out. (Summary by EDITEC. Trans. by L.M.F.)

0601

26063 BRESSANI, R.; BRAHAM, J.E.; ELIAS, L.G. 1983. Effects on nutritional quality of food legumes from chemical changes through processing and storage. In Shemilt, L.W., ed. International Conference on Chemistry and World Food Supplies: The New Frontiers: Papers presented. Oxford, England, Pergamon Press. pp.491-503. En., Sum. En., 38 Ref., II. (Inst. of Nutrition of Central America and Panama, P.O. Box 1188, Guatemala City, Guatemala)

Cooking. Guatemala. Nutritive value. *Phaseolus vulgaris*. Processing. Storage.

To demonstrate the effect on nutritive value arising from chemical changes induced by storage and processing of food, legumes were chosen because of their importance in human diets. Chemical components, most of them nutrients, found in foods as produced are affected by production, storage, processing, and consumption conditions. Improper storage will increase the hard-to-cook condition in common beans already initiated during postharvest processing. Dry or wet processing techniques, if properly carried out, will inactivate antiphenological substances and increase nutritive value. Improper processing will result in low digestibility of the protein. Germination and fermentation result in higher levels of vitamins and increased availability of nutrients, but germination effects have given contradictory results. Inadequate storage of processed food legumes reduce their nutritional value and thus the nutritional quality of diets. Recommendations for research include the understanding of the hard-to-cook problem, the chemical nature of low protein digestibility and resistance to insect attack. (AS)

0602

22183 JONES, P.M.B.; BOULTER, D. 1983. The cause of reduced cooking rate in *Phaseolus vulgaris* following adverse storage conditions. *Journal of Food Science* 49(2):623-649. *En., Sum. En., 20 Ref., II.* (Dept. of botany, Univ. of Durham, Science Laboratories, South Road, Durham, DH1 3LE, England)

Seed. Storage. Cooking. Seed characters. Human nutrition. United Kingdom. Europe.

The interrelationship between reduced cell separation rate, reduced imbibition value, and reduced pectin solubility was investigated with reference to reduced cooking rate in *Phaseolus vulgaris*, also termed the hardbean phenomenon. It was found that reduced imbibition value and reduced pectin solubility can both cause a reduction in the rate of cell separation during cooking of beans and hence an increase in their cooking time, and that these 2 factors act synergistically. Accompanying symptoms are solute leakage during soaking due to membrane breakdown, phytin catabolism, and pectin demethylation, all of which are key factors in the development of hardbean. (AS)

0603

22181 JONES, P.M.B.; BOULTER, D. 1983. The analysis of development of hardbean during storage of black beans (*Phaseolus vulgaris* L.). *Qualitas Plantarum* 33(1):77-85. *En., Sum. En., 19 Ref., II.* (Univ. of Durham, Dept. of botany, Science Laboratories, South Road, Durham, DH1 3LE, England)

Phaseolus vulgaris. Seed. Storage. Seed characters. Cooking. Starch content. Carbohydrate content. Water content. United Kingdom.

The course of development of hardbeans of *Phaseolus vulgaris* was followed during storage. After 40 days seed viability dropped rapidly and after 50 days leakage of solids, which had remained constant until then, increased rapidly. Increased metabolic activity led to phytin hydrolysis and membrane deterioration leading to leakage of Ca and Mg and then to pectin desolubilization and textural deterioration, i.e. hardbeans. (AS)

0604

24242 LEON M., D. 1983. Evaluación de resultados del almacenamiento de frijol negro en silos familiares en la Ciudad de Guatemala. (Evaluation of results of stored black beans in family silos in Guatemala City). *Tesis Ing. Agr.* Guatemala, Universidad de San Carlos de Guatemala. 171p. *Es., Sum. Es., 30 Ref., II.*

Storage. Seed. Water content. Cooking. Timing. Germination. Guatemala. Composition. Developmental stages. Central America. America.

At the Instituto Nacional de Comercialización Agrícola, Guatemala City, Guatemala, a study was conducted to compare results of black beans stored in family silos (Guatemala

type) with those obtained with storage in bags in open storehouses. In family silos, beans were stored with 12, 14, and 16 percent MC and received doses of 0, 1, 2, or 4 tablets of phosphine (PH3) at the beginning of storage for pest control. Beans stored in storehouses hardened faster, lost faster their germinating power, and were invaded more rapidly by storage fungi. In the silos, grain with MC between 12-14 percent hardened less and lost less germinating power than grain ensiled with 16 percent MC. Furthermore, in the case of grains with 16 percent MC, the dose of 4 tablets of PH3 interacted with grain MC and produced greater hardening and larger loss of germinating power. Among treatments used in the silos the treatment consisting of 12 percent MC and 2 tablets for PH3 resulted in better grain conservation. [AS (Extract)-CIAT]

0605

26919 MORA, M.A. 1983. Tiempo de cocción del frijol (*Phaseolus vulgaris* L.) almacenado durante un año a 13 y 16 por ciento de humedad y 25 grados centígrados. (Cooking time of beans stored for one year at 13 and 16 percent moisture and 25 degrees Celsius). *Tecnología en Marcha* 6(2):37-38. Es., Sum. Es., 4 Ref.

Cooking. Costa Rica. *Phaseolus vulgaris*. Seed. Storage. Temperature. Timing. Water content.

Recently harvested beans were stored at 25 degrees Celsius with 13 and 16 percent moisture for 1 yr, in plastic, air tight containers. Part of the beans were initially exposed to air at 125 degrees Celsius for 0, 2, 4, and 6 min to evaluate the effect of this treatment on changes in cooking time during storage. This heat treatment was carried out at 13 and 16 percent MC. In all treatments, cooking time changed very little during storage; therefore, it was not possible to evaluate the effects of the different MC or the heat treatment. Results, however, demonstrate that a combination of factors, not yet known, allow beans to be stored at high MC and temp. (16 percent and 25 degrees Celsius) without significantly affecting cooking time. (AS-CIAT)

0606

23691 BUTRA, M.P.; PI OSOF, A.M.R.; BARTHOLOMAY, G.B. 1984. Ensayo acelerado de almacenamiento para el estudio de la pérdida de valor nutritivo de las proteínas de harina de porotos (*Phaseolus vulgaris*). (Accelerated test for studying the loss of the nutritive value of bean flour protein). *Archivos Latinoamericanos de Nutrición* 34(2):376-383. Es., Sum. Es., En., 4 Ref., Il. (Depto. de Industrias de la Facultad de Ciencias Exactas y Naturales, Univ. de Buenos Aires, Ciudad Universitaria, 1428 Buenos Aires, Argentina)

Bean flour. Nutritive value. Lysine. Temperature. Water content. Storage. Argentina. Amino acids. Human nutrition. Composition. South America. America.

The loss of the nutritive value of bean flour protein was studied through a kinetic assay on the loss of available lysine of the flour at high temp. (70-110 degrees Celsius) and at different MC. Lysine loss followed at 1st order reaction kinetics; the activation energies for the different moisture levels were calculated and ranged between 8-13 kcal/mole. MC had a very important effect on the rate of loss of available lysine. Kinetic parameters at high temp. were used to predict the retention of available lysine at 34 degrees Celsius; these values agreed with those obtained by storing bean flour with different MC at 34 degrees Celsius. (AS)

0607

29714 AGUIRERA, J.M.; STEINSAPIR, A. 1985. Dry processes to retard quality losses of beans (*Phaseolus vulgaris*) during storage. *Canadian Institute of Food Science and Technology. Journal* 18(1):72-78. En., Sum. En., Fr., 25 Ref., Il. (Dept. of Chemical Engineering, Catholic Univ., P.O. Box 114-1), Santiago, Chile)

Phaseolus vulgaris. Seed hardening. Processing. Storage. Temperature. Irradiation. Analysis. Stored grain pests. Heat treatment. Chile.

Six samples of bean cv. Tórtola Diana, including a control and 5 dry-processed samples, were evaluated for hardness development after 2.5-10.0 mo. of storage in sealed polyethylene bags at 22 degrees Celsius. Treatment consisted of irradiation (10, 50, or 100 krad), high temp.-short time roasting (HHSR), and medium temp.-long time heating (MFLH). Most heat-processed samples and approx. 1/2 of the irradiated samples were significantly softer than the control (P less than 0.05) after autoclaving for 12 or 15 min. Scanning electron micrographs demonstrated that hard beans had a tougher middle lamella, showed no separation between cells when cooked, and contained ungelatinized starch granules. The processed samples showed no signs of insect infestation whereas insect losses in the control were in excess of 10 percent. (AS)

0608

29691 ALIZAGA, R. 1985. Efecto de la temperatura de secado y del contenido de humedad durante el almacenamiento sobre la calidad de la semilla de frijol. (Effect of drying temperature and moisture content during storage on bean seed quality). *Agronomía Costarricense* 9(2):165-170. Fs., Sum. En., Fs., 12 Ref. Il.

Phaseolus vulgaris. Seeds. Storage. Temperature. Water content. Drying. timing. Germination. Hypocotyl. Costa Rica.

The effect of 5 drying temp. (25, 35, 45, 55, and 65 degrees Celsius) and 2 MC (13 and 16 percent) on bean seeds, stored at 25 degrees Celsius for 12 mo., was evaluated. The drying temp., time of storage, and seed MC had a significant effect on germination and hypocotyl length. In seed stored 13 percent MC, the time of storage and the drying temp. had practically no effect on germination, except when drying was at 65 degrees Celsius. Significant reductions in germination began after 30 mo. of storage in seed stored at 16 percent MC. Damage increased when the time of storage and the drying temp. increased. Hypocotyl length was shorter for seed stored at 16 percent MC and decreased considerably when the storage time was extended, particularly when the drying temp. were 55 and 65 degrees Celsius. (AS CIAI)

0609

26564 GARRUTI, R. DOS S.; BOURNE, M.C. 1985. Effect of storage conditions of dry bean seeds (*Phaseolus vulgaris* L.) on texture profile parameters after cooking. *Journal of Food Science* 50(4):1067-1071. En., Sum. En., 26 Ref., Il. (Univ. Estadual de Campinas, 13.100 Campinas-SP, Brasil)

Phaseolus vulgaris. Seed. Storage. Organoleptic properties. Seed characters. Cooking. Temperature. Relative humidity. USA.

Red kidney beans were stored at constant moisture and high and low temp. for 6 mo. Instrumentally measured parameters of hardness, fracturability, gumminess, chewiness, springiness, and cohesiveness were higher in samples stored at elevated temp. than the control (2 degrees Celsius). The sensory panel found the stored beans had higher hardness, fracturability, lumpiness, chewiness, and skin toughness and less starchiness, gumminess, pastiness, and moisture absorption than the control. Puncture forces followed approx. a normal distribution curve, and there was always some overlap between stored and control beans even when the stored beans had a much higher mean puncture force than the control. All textural parameters of cooked bean cotyledons changed substantially during storage of the seeds at elevated temp. and high RH. (AS)

0610

27304 SAWAZAKI, ILE.; TEIXEIRA, J.P.F.; MORAES, R.M. DE; BULSANI, E.A. 1985. Modificações bioquímicas e físicas em grãos de feijão durante o armazenamento. (Biochemical and physical modifications of bean seeds during storage). *Bragantia*

44(1):375-390. Pt., Sum. Pt., Fn., 29 Ref., II. (Secao de Fitoquimica, Inst. Agronomico, Caixa Postal 28, 13.100 Campinas-SP, Brasil)

Phaseolus vulgaris. Seed. Storage. Cultivars. Protein content. Sugar content. Water content. Fiber content. Starch content. Fat content. Brazil.

Seeds of dry bean cv. Rico 23 and Carioca were chemically and physically characterized 3 times during 11 mo. of storage. SDS polyacrylamide gel electrophoresis of the globulin fraction showed an increase in the no. of bands at the 3rd sampling, probably due to a more efficient protein extraction. Mol. wt. of the G1 and G2 subunits, however, were constant (about 50,000-43,000 and 18,000, resp.). Total protein, soluble sugar, and water contents did not change during storage, while fiber increased and lipids decreased. Starch content also increased probably due to greater extractability. Both free fatty acids content and peroxide value increased according to the increase of the acidity value. Water absorption capacity initially increased and leveled off thereafter. The percentage of seeds with hard coat was not affected by storage. The behavior of the 2 cv. was similar. (AS)

0611

28611 SIEVWRIGHI, C.A. 1985. Effects of storage conditioning and chemical treatments on firmness, in vitro protein digestibility, condensed tannins, phytic acid and divalent cations of cooked black beans (*Phaseolus vulgaris*). Ph.D. Thesis, Ithaca, N.Y., Cornell University, 154p. Fn., 193 Ref., II.

Phaseolus vulgaris. Storage. Seed. Digestibility. Tannin content. Cooking. USA.

The effects of storage conditions and soaking solution on the firmness, in vitro protein digestibility, condensed tannins, phytic acid, and divalent cations of black beans were studied. Storage for 6 mo. at 30 and 40 degrees Celsius at 80 percent RH resulted in increased firmness and reduced protein digestibility, extractable condensed tannins, and phytic acid. These adverse effects were reduced at 5 degrees Celsius-50 percent RH storage. Under the above mentioned conditions, condensed tannins showed a small increase, while at 30 and 40 degrees Celsius 80 percent RH they increased, reached a plateau, and then declined. Changes in the distribution of the condensed tannin fractions as well as total tannins accompanied changes in in vitro protein digestibility and firmness. Sodium chloride, sodium tripolyphosphate, sodium carbonate, and sodium bicarbonate (the food grade salts used in soaking solutions) will overcome the hard to cook phenomenon in black beans. In combination, they appear to have a synergistic effect in producing soft beans by way of cation exchange, solubilization and leaching of protein, and increasing bean porosity. These salts will also partially overcome the problem of poor digestibility of black bean proteins. They released more tannins and phytic acid into the protein dialytrate during the digestion process. The addition of tannins and polyphenol oxidase to black bean protein isolates reduced digestibility. Polyvinylpyrrolidone improved the digestibilities of the mixtures. The reaction mechanism of the protein-tannin complex proceeds via H bonding as well as covalent bonding. H bonding seems to play the more dominant role. The reaction is enhanced by polyphenol oxidase. Soaking fresh as well as 6 mo. old beans in salt solutions resulted in greater losses of Mg than Ca. The uptake of Na from salt solutions was unaffected by storage conditions. Combined salt solutions raised the Na content of cooked beans 14-17 times over water-soaked beans. Blanching of black beans prior to storage will retain protein digestibility but enhance the development of firmness. During the course of the study, phytic acid and protein digestibility decreased while bean firmness increased. (Dissertation Abstracts International)

0612

28938 AGUIRERA, J.M.; HAU, M.I.; VIELABLANCA, W. 1986. The effect of solar drying and heating on the hardness of *Phaseolus* beans during storage. *Journal of Stored Products Research* 22(4):243-247. Fn., Sum. Fn., 11 Ref., II. (Dept. of chemical Engineering, Catholic Univ., P.O. Box 6177, Santiago, Chile)

Phaseolus vulgaris. Drying. Solar drying. Seeds. Storage. Water content. Seed hardening. Temperature. Chile.

Small white beans were dried and heat processed before storage. Water removal in a solar drier was 4 times faster than conventional field drying in the pods. Heat treatments included particle-to-particle roasting using hot sand, and microwave heating. All samples stored for 212 days at low MC (4-5 percent) showed a slow rate of hardening at a low temp. of 18 degrees Celsius and a high temp. of 34 degrees Celsius; however, heat-treated and control beans became much harder when stored at a humidity of 9 percent and a temp. of 34 degrees Celsius. Heating and solar drying are effective treatments prior to bean storage, as they greatly reduce moisture to safer levels. (AS)

0613

29626 SHEVWRIGHT, C.A.; SHIPE, W.F. 1986. Effect of storage conditions and chemical treatments on firmness, in vitro protein digestibility, condensed tannins, phytic acid and divalent cations of cooked black beans (*Phaseolus vulgaris*). *Journal of Food Science* 51(4):982-987. En., Sum. En., 22 Ref., II. (Del Monte Corp., Research Center, P.O. Box 9004, Walnut Creek, CA 94598, USA)

Phaseolus vulgaris. Storage. Temperature. Relative humidity. Proteins. Digestibility. Tannin content. enzymes. Phytic acid. USA.

Black beans stored at 30 or 40 degrees Celsius and 80 percent RH showed marked increases in firmness and decreases in in vitro digestibility of proteins. Changes in these properties were small when beans were stored at 5 degrees Celsius and 50 percent RH. The adverse effects of poor storage conditions could be practically eliminated by soaking beans in salt solutions instead of water. The changes in firmness and digestibility were accompanied by changes in the detectable concn. of tannins and phytates. Protein digestibility appears to be reduced by interactions between protein and tannins, especially high mol. wt. tannins. Concn. of these tannins is affected by polyphenol oxidase activity. Firmness increased and protein digestibility decreased as the phytic acid content decreased. (AS) Also 1050 1056 1062 1072

0614

28930 VINDIOLA, O.L.; SEIB, P.A.; HOSENEY, R.C. 1986. Accelerated development of the hard-to-cook state in beans. *Cereal Foods World* 31(8):538,540,542,546,550,552. En., Sum. En., 35 Ref., II. (Dept. of Grain Science & Industry, Kansas State Univ., Manhattan, Kansas, USA)

Phaseolus vulgaris. Cooking. Seeds. Seed hardening. pH. Storage. Water content. Bean starch. Cultivars. USA.

Differential scanning calorimetry of a 2:1 (wt:wt.) mixture of water and fresh pinto beans (freeze-dried and ground) showed 2 endotherms at 80.5 and 100 degrees Celsius that were assigned to starch gelatinization and protein denaturation. After boiling 15 min. in water, fresh (41 min. cooking time) and hard-to-cook pinto beans) approx. 120 min. cooking time) did not show either thermal event. When soaked at 41 degrees Celsius in buffers containing 0.002 percent chloramphenicol, pinto beans developed the hard-to-cook state most rapidly at pH 4; the beans were essentially uncookable in boiling water for 60 min. when soaked at pH 4 for 8 days, at pH 6.0 for 4 days, at pH 6.5 for 6 days, and at pH 7.0 for 7 days. When fluoride ion (0.05 molar) or metaphosphate (0.2 molar) was added to the soaking medium at pH 4.7 and 4.1, resp., the beans remained 90-100 percent cookable after soaking at 41 degrees Celsius for 16 h, whereas control beans were uncookable. Red and white beans developed the hard-to-cook condition at opposite times when stored at 100 percent RH and 45 degrees Celsius or when soaked in acidic buffers at 41 degrees Celsius. Beans that are prone to the hard-to-cook state may harden during soaking and/or storage. (AS)

ABBREVIATIONS AND ACRONYMS

A	Angstrom(s)	CSW	Cassava starch wastes
ABA	Abscisic acid	CV	Coefficient of variation
ac	Acre(s)	cv.	Cultivar(s)
AF.	Afrikaans	2,4-D	2,4-dichlorophenoxyaceti acid
a.i.	Active ingredient		
Al.	Albanian	Da.	Danish
alt.	Altitude	De.	German
AMV	Alfalfa mosaic virus	DM	Dry matter
approx.	Approximate(ly)	DNA	Deoxyribonucleic acid
Ar.	Arab	Dpt.	Department
AS	Author summary	DW	Dry weight
atm.	Atmosphere	EC	Emulsifiable concentrate
ATP	Adenosine 5'-triphosphate	EDTA	Ethylenediaminetetraacet acid
av.	Average	EE	Ether extract
BAP	6-Benzylaminopurine	EEC	European Economic Commun
BBMV	Broad bean mosaic virus	e.g.	Exempli gratia, for exam
BCMV	Bean common mosaic virus	ELISA	Enzyme-linked immunosorb assays
Bg.	Bulgarian	EMS	Ethyl methane sulfonate
BGMV	Bean golden mosaic virus	En.	English
BGYMV	Bean golden yellow mosaic virus	EP	Preliminary Trials
BLPMV	Bean line pattern mosaic virus	Es.	Spanish
BOD	Biochemical oxygen demand	expt.	Experiment(s)
BPMV	Bear pod mottle virus	exptl.	Experimental
BRMV	Bean rugose mosaic virus	Fi.	Finnish
BSMV	Bean southern mosaic virus	Fr.	French
BV	Biological value	ft-ca	Foot candle(s) (10.76 lu
BYMV	Bean yellow mosaic virus	FW	Fresh weight
BYSV	Bean yellow stipple virus	FYM	Farmyard manure
ca.	Circa, approximately	g	Gram(s)
CAMV	Cassava African mosaic virus	G	Giga (10 ⁹)
CCMW	Cassava chip meal wastes	GA	Gibberell ₃ acid
CBB	Cassava bacterial blight	gal	Gallon(s)
CBSV	Cassava brown streak virus	GE	Gross energy
CEC	Cation exchange capacity	GER	Glucose entry rate(s)
CER	CO ₂ exchange rate	GLC	Gas-liquid chromatograph
CF	Cassava flour	Gr.	Greek
CGR	Crop growth rate	h	Hour(s)
Ch.	Chinese	ha	Hectare(s)
CIAT	International Center for Tropical Agriculture	HCN	Hydrocyanic acid
CLM	Cassava leaf meal	HDP	Hydroxypropyl distarch phosphate
CLV	Cassava latent virus	He.	Hebrew
CM	Cassava meal	Hi.	Hindi
cm	Centimeter(s)	HI	Harvest index
CMV	Cassava mosaic virus	hp	Horsepower
COD	Chemical oxygen demand	Hu.	Hungarian
concn.	Concentration(s)	IAA	Indoleacetic acid
CP	Crude protein	IBA	Indolebutyric acid
Cs.	Czech	IBYAN	International Bean Yield and Adaptation Nursery
CSL	Calcium stearyl lactylate	i. e.	Id est, that is
		il.	Illustrations

in.	Inch(es)	NPU	Net protein utilization
In.	Indonesian	NW	Northwest
It.	Italian	OM	Organic matter
IU	International unit	oz	Ounce(s)
J	Joule(s)	p.	Page
Ja.	Japanese	P	Probability
kat	Katal	Pa	Pascal(s)
kcal	Kilocalorie(s)	PAN	Peroxyacetic nitrate
kg	Kilogram(s)	PCNB	Pentachloronitrobenzene
km	Kilometer(s)	PDA	Potato dextrose agar
KNap	Potassium naphthenate	PEER	Protein efficiency ratio
Ko.	Korean	pH	Hydrogen ion concentrati
kR	Kiloroentgen(s)	Pl.	Polish
l	Liter(s)	kJ	Kilojoule
La.	Latin	PAGE	Polyacrylamide gel elect
lab.	Laboratory(ies)	pp.	Pages
LAD	Leaf area duration	pphm	Parts per hundred millio
LAI	Leaf area index	PPI	Preplanting incorporatio
lat.	Latitude	ppm	Parts per million
lb	Pound(s)	PSA	Potato sucrose agar
LD50	Mean lethal dose	Pt.	Portuguese
LER	Land efficiency ratio	pv.	Pathovar
LFR	Leaf formation rate	Ref.	Reference(s)
LPC	Leaf protein concentrate	resp.	Respective(ly)
lx	Lux	Rf	Retardation factor
M	Mega (10 ⁶)		chromatography
m	Meter(s)	RGR	Relative growth rate
Mal.	Malay	RH	Relative humidity
m.a.s.l.	Meters above the sea level	RNA	Ribonucleic acid
max.	Maximum	Ro.	Romanian
MC	Moisture content	rpm	Revolutions per minute
ME	Metabolizable energy	Ru.	Russian
meq	Milliequivalent(s)	s	Second(s)
met.	Methionine	SBM	Soybean meal
mg	Milligram(s)	SCN	Thiocyanate
mho	Reciprocal ohm(s)	SCP	Single cell protein
min.	Minimum	SDS	Sodium dodecyl sulfate
min	Minute(s)	Sk.	Slovak
ml	Milliliter(s)	Sn.	Slovene
mm	Millimeter(s)	sp.	Species (singular)
mM	Millimolar	spp.	Species (plural)
mo.	Month(s)	SSL	Sodium stearyl-2-lactyla
mol. wt.	Molecular weight	Sum.	Summary
mp	Melting point	Sv.	Swedish
MT	Metric ton(s)	t	Ton(s)
NAA	Alpha-naphthalene acetic acid	Tai.	Thai
NAD	Nicotinamide adenine dinucleotide	TIDN	Total digestible nutrien
NADH	Nicotinamide adenine dinucleotide, reduced form	temp.	Temperature(s)
NAR	Net assimilation rate	TIA	Trypsin inhibitor activi
NCE	Net CO ₂ exchange	TIBA	2,3,5-Triiodobenzoic aci
NE	Northeast	TLC	Thin-layer chromatograph
NER	Net energy ratio	TMV	Tobacco mosaic virus
Nl.	Dutch	Tr.	Turkish
nm	Nanometer(s) (10 ⁻⁹ m)	TSH	Thyroid-stimulating horm
no.	Number(s)	U.	University
No.	Norwegian	UDPG	Uridine diphosphate gluc
NPF	Negative production factor(s)	Uk.	Ukrainian
NPR	Net protein ratio	UMS	Unmodified cassava starc
		Ur.	Urdu
		UV	Ultraviolet
		VAM	Vesiculo-arbuscular myco

var. Variety(ies), varietal
VEF Bean Team Nursery
VFA Volatile fatty acids
VICAR Central American Yield and
Adaptation Nursery
vol. Volume
VPD Vapor pressure deficit

vpm Volume per million
vs. Versus
W West, watt(s)
wk. Week(s)
WP Wettable powder
wt. Weight
yr Year(s)
/ Per

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0320 0321 0323 0338 0340 0343 0344
0345 0347 0357 0359 0361 0364 0368
0372 0384 0385 0386 0389 0390 0395
0403 0409 0411 0421 0488 0493 0497

0511 0521 0525 0526 0528 0532 0539
0545 0550 0565 0571 0587

DIGESTIBILITY

0014 0016 0030 0031 0033 0035 0043
0058 0067 0075 0077 0088 0094 0096
0098 0099 0103 0110 0111 0135 0137
0165 0186 0188 0189 0193 0194 0195
0198 0199 0200 0201 0202 0203 0204
0205 0206 0207 0208 0209 0210 0211
0273 0282 0289 0309 0313 0314 0315
0332 0341 0342 0350 0411 0413 0415
0417 0418 0419 0420 0421 0424 0449
0488 0489 0507 0509 0520 0521 0523
0528 0531 0532 0537 0539 0550 0566
0587 0611 0613

DISEASE CONTROL

MYCOSES
0294

DNA

0393 0394 0396

DOMINICAN REPUBLIC

0044 0554 0594

DROUGHT

0059

DRY MATTER

0115 0200 0301 0323 0448 0525

DRYING

0139 0446 0517 0608 0612

DUNG

0307

DWARF BEANS

0251 0478

ECOLOGY

0008 0029 0170 0332 0445

ECONOMICS

0011 0015 0027 0054 0486

ECUADOR

0044

EGYPT

0164

ELECTRON MICROSCOPY

0203 0248 0249 0377 0458

EMBRYO

0146 0260 0434 0457 0586

ENZYMES

0036 0088 0112 0127 0130 0145 0172
0193 0201 0208 0227 0228 0274 0282
0296 0297 0298 0299 0313 0316 0320
0321 0322 0324 0325 0327 0328 0335
0336 0337 0339 0341 0342 0343 0344
0360 0367 0381 0390 0402 0415 0416
0420 0427 0433 0497 0523 0586 0595
0613

EXPERIMENT DESIGN

0174 0220 0291 0431

FAT CONTENT

0022 0031 0068 0069 0092 0104 0107
0116 0200 0300 0308 0310 0438 0458
0502 0507 0514 0517 0538 0574
SEED
0129 0309 0434 0490 0519 0541 0556
0610

FATTY ACIDS

0104 0128 0129 0300 0309 0433 0506

FERMENTATION

0185 0419 0503

FERTILIZERS

0042 0048 0214 0246 0246 0291 0292
0293 0294 0299 0307 0311

FIBER CONTENT

0022 0041 0064 0080 0082 0107 0108
0116 0122 0127 0176 0194 0200 0301
0308 0309 0310 0507 0514 0517 0519
0524 0538 0541 0544 0552 0558 0610

FIELD EXPERIMENTS

0169 0173 0219 0220 0281 0291 0293
0351 0356 0437

FLATULENCE

0492 0493 0494 0495 0496 0497 0505

FLOWERING

0153 0295

FOOD ENERGY

0012 0048 0060 0069 0091 0506 0520
0533

FRANCE

0046 0125 0275 0278 0335 0395 0524

FRUCTOSE

0121

FUSARIUM SOLANI PHASEOLI

0197

GENES
 0218 0220 0231 0236 0241 0275 0279
 0283 0393 0394 0396 0437 0461 0468
 0469 0470 0471 0474 0475 0476 0480
 0482

GENOTYPES
 0021 0148 0219 0224 0410 0412 0450
 0572

GEOGRAPHICAL DISTRIBUTION
 0005 0006 0007 0008 0013 0037

GERMAN DEMOCRATIC REPUBLIC
 0253

GERMINATION
 0118 0198 0311 0322 0324 0479 0507
 0509 0600

SEED
 0120 0145 0197 0254 0258 0296 0323
 0459 0461 0473 0506 0508 0546 0591
 0604

TEMPERATURE
 0593 0608

TOXICITY
 0453

GERMPLASM
 0021 0037 0055 0057 0058 0059 0155
 0222 0242 0243

GIBBERELLINS
SEED
 0261

GLUCOSE
 0074 0121 0423

GREEN MANURES
 0032

GROWTH
 0014 0169 0174 0326 0347 0588

GUATEMALA
 0001 0011 0016 0044 0045 0049 0065
 0093 0094 0096 0097 0098 0108 0144
 0200 0207 0209 0285 0286 0314 0415
 0416 0417 0418 0421 0432 0489 0523
 0527 0535 0539 0540 0542 0557 0600
 0601 0604

HARVESTING
 0029 0042 0437 0490 0571

HEAT TREATMENT
 0080 0081 0162 0187 0198 0199 0326
 0330 0367 0374 0406 0520 0525 0607

HETEROSIS
 0437 0450 0482

HETEROZYGOSIS
 0223

HISTIDINE
 0144 0155

HISTORY
 0005 0008 0009 0032 0054

HONDURAS
 0044

HOSTS AND PATHOGENS
 0197

HOT WATER TREATMENTS
 0579

HUMAN NUTRITION
 0003 0011 0012 0014 0015 0020 0024
 0026 0031 0033 0034 0038 0040 0041
 0043 0044 0047 0049 0050 0051 0053
 0062 0063 0069 0070 0071 0072 0073
 0074 0075 0076 0077 0081 0086 0087
 0089 0090 0091 0093 0094 0096 0097
 0098 0101 0101 0102 0103 0104 0105
 0106 0108 0110 0111 0117 0122 0123
 0133 0137 0147 0151 0158 0168 0171
 0182 0183 0186 0189 0190 0198 0199
 0202 0209 0211 0215 0289 0298 0303
 0316 0317 0318 0319 0325 0327 0328
 0329 0332 0333 0336 0337 0342 0350
 0352 0355 0360 0376 0371 0380 0383
 0384 0385 0395 0403 0412 0415 0419
 0424 0426 0427 0428 0431 0436 0444
 0456 0460 0465 0486 0491 0496 0499
 0505 0506 0509 0511 0512 0514 0517
 0519 0520 0522 0526 0533 0535 0536
 0538 0539 0542 0544 0551 0552 0553
 0558 0566 0567 0569 0572 0573 0575
 0583 0594 0597 0600 0601 0602 0606

HUMAN PHYSIOLOGY
 0365 0407 0493 0498

HYBRIDIZING
 0059 0147 0148 0213 0244 0245 0396

HYBRIDS
 0019 0257 0470 0478

HYDROLYSIS
 0155 0178 0193 0208 0224 0255 0256
 0258 0298 0312 0363 0498

HYPOCOTYL
 0167 0469 0470 0472 0478 0608

INDIA
 0505 0548 0580

INDUSTRIALIZATION
 0017

INFLORESCENCES
 0484

INHIBITORS
 0004 0011 0015 0022 0035 0067 0108
 0186 0193 0198 0201 0204 0274 0296
 0312 0313 0318 0320 0321 0324 0325
 0327 0328 0335 0339 0344 0345 0358
 0367 0373 0453 0475 0492 0495 0507
 0532

GROWTH
 0347

INJURIOUS INSECTS
 0007 0009 0059
COLEOPTERA
 0110 0311

INTERCROPPING
 0032 0319
ZEA MAYS
 0047

IRAN
 0208

IRON
 0036 0082 0110 0290 0308 0502 0503
LEAVES
 0071
SEED
 0292 0305 0306

IRRADIATION
 0251 0278 0279 0280 0281 0282 0283
 0284 0285 0286 0430 0444 0607

IRRIGATION
 0009 0032 0295 0307

ISARIOPSIS GRISEOLA
RESISTANCE
 0057

ITALY
 0391 0393 0396 0504 0573

JAPAN
 0124 0384

KENYA
 0026 0041 0044 0329

LABORATORY ANIMALS
 0002 0004 0010 0016 0030 0036 0060
 0061 0064 0065 0068 0073 0085 0087
 0093 0102 0111 0157 0194 0200 0203
 0205 0213 0247 0312 0316 0323 0338
 0345 0346 0347 0359 0361 0364 0368
 0384 0386 0390 0411 0423 0453 0488
 0492 0494 0497 0513 0521 0528 0531
 0532 0545 0550

LABORATORY EXPERIMENTS
 0030 0078 0130 0136 0138 0165 0169
 0173 0177 0225 0250 0254 0260 0262
 0268 0269 0274 0283 0287 0288 0322
 0324 0326 0328 0373 0419 0431 0457
 0475 0476 0585 0588 0592

LEAF AREA
 0293

LEAVES
 0112 0115 0120 0125 0241 0270 0291
 0302 0312 0376 0381 0391 0433 0457
 0472 0475 0508

MINERALS AND NUTRIENTS
 0071 0287

LECTINS
 0108 0276 0316 0319 0342 0370 0383
 0384 0385 0386 0387 0390 0394 0395
 0396 0397 0400 0401 0402 0403 0404
 0405 0406 0407 0408 0416 0418 0556

LEGAL ASPECTS
 0432

LEGUME CROPPING
 0012 0014 0015 0016 0022 0023 0030
 0149 0167 0200 0216 0225 0257 0266
 0281 0321 0325 0346 0355 0426 0496
 0565

LIGHT
 0013 0477

LYSINE
 0001 0011 0022 0024 0062 0073 0162
 0202 0218 0454 0487 0488 0528 0606

MACROPHOMINA PHASEOLI
 0197

MAGNESIUM
 0046 0071 0153 0305 0308 0311 0502

MALAWI
 0044 0301

MANGANESE
 0305 0306 0387 0521

MANIHOT ESCULENTA
0061

MANURES
0032 0307

MAPS
0008

MARKETING
0028 0432

MATURATION
0029 0260 0287 0571 0587

MECHANICAL DAMAGE
0437 0451

MECHANIZATION
0048 0515 0534

METABOLISM
0071 0112 0145 0322

METHIONINE
0001 0004 0010 0011 0022 0024 0033
0039 0061 0062 0064 0066 0073 0094
0143 0147 0147 0148 0149 0151 0155
0156 0157 0158 0159 0161 0195 0196
0207 0214 0215 0217 0218 0220 0221
0224 0230 0238 0411 0454 0487 0488
0489 0512 0513 0528 0531 0571

MEXICO
0007 0059 0063 0113 0114 0127 0166
0176 0180 0274 0283 0284 0330 0449
0511

MICROBIOLOGY
0503

MICRONUTRIENTS
0042 0102 0110 0214 0308 0311 0502

MINERAL CONTENT
0010 0031 0036 0046 0049 0051 0079
0107 0108 0131 0161 0235 0301 0307
0308 0310 0311 0387 0438 0458 0463
0488 0502 0507 0533 0538 0544 0566
0574 0590

LEAVES
0071 0291

PODS
0585

SEED
0203 0218 0238 0291 0305 0306 0309
0490 0506 0541 0554

MINERAL DEFICIENCIES
0032

MINERALS AND NUTRIENTS
0032 0049 0073 0360

CALCIUM
0046 0071 0102 0305 0306 0308 0311
0387 0502

COPPER
0110 0305 0306

IRON
0071 0110 0305 0306 0308 0502

MAGNESIUM
0046 0071 0305 0308 0311 0502

MANGANESE
0305 0306 0387

NITROGEN
0048 0108 0111 0190 0214 0235 0238
0311 0591

PHOSPHORUS
0042 0287 0288 0305 0311 0573

POTASSIUM
0046 0209 0288 0305 0306 0308 0311
0502 0573

ZINC
0042 0102 0110 0214 0305 0306 0308
0311

MUTATION
0216 0240 0251 0278 0279 0281 0284
0285 0286 0349 0396 0471 0472 0473
0479 0480 0481

MYCOSES
0006

EPIDEMIOLOGY
0294

SEED
0490

TEMPERATURE
0059

NETHERLANDS
0059

NICARAGUA
0442

NIGERIA
0428 0544

NITROGEN
0036 0070 0075 0108 0131 0145 0150
0153 0172 0178 0200 0203 0238 0256
0267 0312 0323 0358 0363 0487 0488
0490 0497 0521 0591

FERTILIZERS
0048 0214 0246 0246 0291 0292 0293
0307 0311

NUTRIENT UPTAKE
0290 0292

PLANT ASSIMILATION
0585

PROTEIN CONTENT

0001 0004 0010 0018 0022 0030 0060
0111 0143 0144 0151 0154 0155 0156
0169 0173 0176 0190 0196 0213 0214
0218 0219 0235 0269 0291 0293 0301
0307 0346 0357 0454 0531 0565

NITROGEN FIXATION

0044 0059

NODULATION

0029 0291 0353

MINERALS AND NUTRIENTS

0032

NOXIOUS ANIMALS

0110 0311

NUCLEIC ACIDS

0393 0393 0394

NUTRIENT LOSS

0193 0333 0454 0457 0532 0550 0573

NUTRIENT SOLUTION

0046 0288

NUTRIENT UPTAKE

0290 0292

NUTRITIONAL REQUIREMENTS

0048 0214 0288 0294 0299 0307 0311

NUTRITIVE VALUE

0001 0002 0003 0004 0009 0011 0012
0015 0016 0017 0018 0019 0020 0022
0024 0025 0027 0030 0031 0032 0033
0036 0038 0040 0041 0042 0043 0047
0049 0051 0053 0059 0060 0061 0062
0063 0064 0065 0067 0069 0077 0078
0079 0081 0083 0084 0085 0086 0090
0091 0092 0093 0096 0099 0100 0107
0103 0108 0110 0111 0122 0143 0144
0158 0161 0171 0183 0186 0189 0190
0193 0194 0195 0196 0198 0199 0202
0203 0209 0211 0245 0224 0280 0282
0289 0290 0307 0310 0314 0315 0316
0317 0319 0323 0326 0329 0330 0333
0336 0342 0350 0361 0369 0380 0389
0409 0410 0412 0413 0419 0424 0427
0428 0430 0436 0438 0439 0444 0446
0447 0453 0454 0456 0507 0510 0511
0512 0513 0519 0521 0522 0525 0526
0528 0533 0537 0538 0544 0545 0550
0551 0552 0553 0558 0565 0566 0571
0572 0573 0583 0587 0589 0590 0600
0601 0606

OCEANIA

0099 0308 0525

OPHIOMYIA PHASEOLI
RESISTANCE

0057

ORGANOLEPTIC PROPERTIES

0106 0300 0439 0444 0449 0510 0517
0580 0583 0609

PACKAGING

0572

PALATABILITY

0003 0095 0431 0465 0485 0529 0599

PANCREATIC AMYLASES

INHIBITORS

0320 0532

PENICILLIUM

0490

PERU

0059 0473

PEST CONTROL

0044 0055 0294

PETIOLES

0115 0132

PHI

0032 0042 0153 0183 0256 0258 0264
0269 0299 0324 0330 0523 0589 0614

PHASEOLIN

0165 0167 0228 0231 0232 0236 0237
0238 0239 0241 0277 0388 0392 0414

PHASEOLUS ACUTIFOLIUS

0005 0212 0226 0316

PHASEOLUS AUREUS

0267

PHASEOLUS COCCINEUS

0005 0019 0029 0053 0114 0176 0180
0212 0245

PHASEOLUS LUNATUS

0005 0013 0019 0035 0183 0212 0427
0541

PHASEOLUS METACALFEI

0244

PHASEOLUS POLYSTACHYUS

0244

PHENOL CONTENT

0021 0038 0045 0108 0313 0315 0333

0409 0414 0415 0416 0417 0418 0420
 0421 0422 0423 0424 0537 0556 0561
 0595 0596 0598 0611 0613

PHILIPPINES
 0510

PHOSPHORUS
 0042 0128 0153 0214 0256 0287 0288
 0305 0306 0311 0502 0521 0573
NUTRIENT UPTAKE
 0290 0292
PLANT ASSIMILATION
 0585

PHOTOPERIOD
 0059

PHOTOSYNTHESIS
 0312

PHYTIC ACID
 0613

PHYTIC ACID CONTENT
 0449 0556

PHYTOALEXINS
 0231 0232 0236 0237 0238 0239 0241
 0277 0318 0388 0392 0414

PHYTOHEMAGGLUTININS
 0002 0108 0112 0177 0189 0203 0241
 0247 0255 0270 0271 0276 0321 0329
 0342 0345 0346 0347 0348 0349 0351
 0352 0353 0354 0355 0356 0357 0359
 0359 0362 0363 0364 0365 0366 0367
 0370 0371 0372 0373 0374 0375 0376
 0379 0381 0385 0391 0392 0393 0394
 0395 0396 0399 0402 0403 0405 0406
 0411 0416 0418 0453 0520 0532 0556

PLANT ANATOMY
 0006 0007 0008 0009 0023 0032 0052
 0124 0125 0126 0127 0129 0166 0188
 0198 0210 0241 0252 0253 0274 0277
 0283 0284 0287 0288 0299 0308 0311
 0322 0377 0406 0408 0415 0416 0437
 0451 0458 0464 0471 0484 0508 0534
 0563 0564 0570 0587 0599 0608 0612
 0614

PLANT ASSIMILATION
 0187 0192 0459 0584 0585

PLANT BREEDING
 0006 0008 0009 0014 0021 0038 0040
 0044 0055 0169 0171 0214 0217 0222
 0224 0226 0230 0236 0237 0275 0280
 0350 0392 0446 0452 0461 0476 0482
 0526 0578

CROSSBREEDING
 0025 0215 0450 0466 0561
HYBRIDIZING
 0059 0148 0244 0245 0396
MUTATION
 0240 0251 0284 0285 0286 0349 0396
 0471 0472 0473 0481
SELECTION
 0020 0025 0029 0039 0231 0283 0284
 0437

PLANT DEVELOPMENT
 0029 0129 0153 0284 0287 0324 0326
 0459 0571 0587

PLANT HABIT
 0009 0029 0032 0251 0439 0467 0590

PLANT NUTRITION
 0017 0531

PLANT PHYSIOLOGICAL DISORDERS
 0286 0437 0459

PLANT PHYSIOLOGICAL PROCESSES
 0324 0508
PLANT ASSIMILATION
 0192 0459 0584

PLANT PIGMENTS
 0312

PLANT RESPIRATION
 0490 0585

PLANT TOXINS
 0340 0370 0371

PLANTING
 0038 0058
SPACING
 0032

POD CHARACTERS
 0467

PODS
 0013 0023 0115 0132 0150 0173 0179
 0219 0287 0293 0476 0478 0484 0570
 0585 0587

POLAND
 0251

POTASSIUM
 0046 0153 0209 0288 0305 0306 0308
 0311 0502 0573

PROCESSED PRODUCTS

0038 0095 0106 0107 0127 0133 0136
 0137 0161 0192 0300 0336 0440 0441
 0465 0500 0501 0502 0503 0517 0524
 0560 0566 0567 0569 0572 0573 0574
 0575 0576 0577 0578 0579 0580 0581
 0582 0583 0584 0614

PROCESSING

0028 0038 0040 0065 0088 0099 0133
 0134 0137 0139 0162 0182 0185 0186
 0189 0190 0192 0200 0269 0317 0329
 0419 0422 0434 0440 0446 0447 0460
 0501 0502 0503 0504 0505 0514 0515
 0517 0520 0523 0526 0555 0556 0560
 0566 0567 0572 0573 0576 0577 0578
 0579 0581 0584 0589 0590 0600 0601
 0607 0608 0612

PRODUCTION

0017 0020 0028 0032 0153 0281 0293

PRODUCTIVITY

0169 0174 0215 0278 0293

PROPAGATION

0059

PROTEIN CONTENT

0001 0004 0010 0011 0012 0019 0020
 0022 0024 0027 0030 0031 0041 0051
 0052 0053 0055 0058 0060 0062
 0068 0069 0071 0084 0088 0092 0097
 0101 0107 0111 0116 0127 0143 0151
 0154 0158 0160 0161 0162 0166 0168
 0169 0170 0171 0174 0180 0185 0189
 0190 0191 0194 0198 0202 0204 0208
 0209 0211 0217 0224 0230 0233 0235
 0259 0273 0280 0282 0283 0288 0301
 0307 0308 0310 0315 0326 0327 0337
 0345 0346 0350 0357 0360 0373 0378
 0379 0380 0409 0411 0435 0435 0438
 0444 0453 0454 0463 0479 0489 0507
 0512 0514 0517 0522 0531 0533 0535
 0544 0561 0565 0566 0568 0571 0573
 0574 0583

PODS

0179 0219 0287

SEED

0016 0017 0018 0021 0029 0035 0039
 0045 0065 0090 0103 0114 0144 0146
 0149 0152 0155 0156 0173 0176 0177
 0183 0184 0196 0207 0212 0213 0214
 0215 0216 0218 0222 0225 0226 0227
 0228 0231 0234 0236 0237 0240 0245
 0254 0266 0269 0271 0272 0279 0281
 0284 0285 0286 0291 0293 0295 0303
 0306 0332 0361 0367 0413 0434 0448
 0481 0508 0515 0519 0526 0539 0548
 0556 0588 0589 0610

PROTEIN DEFICIENCIES

0012

PROTEINS

0003 0048 0070 0076 0078 0085 0087
 0093 0100 0105 0129 0157 0167 0182
 0187 0191 0192 0223 0232 0236 0239
 0243 0275 0278 0296 0317 0328 0330
 0334 0338 0339 0340 0368 0372 0380
 0382 0386 0388 0389 0391 0392 0393
 0397 0430 0548
AMINO ACIDS
 0014 0016 0033 0053 0064 0067 0068
 0073 0088 0094 0103 0111 0171 0172
 0178 0185 0189 0190 0193 0195 0207
 0208 0216 0222 0255 0258 0262 0263
 0265 0267 0273 0290 0292 0324 0327
 0358 0367 0379 0513 0573

ANALYSIS

0064 0068 0108 0112 0145 0154 0156
 0181 0189 0194 0208 0220 0221 0222
 0225 0227 0228 0229 0242 0244 0246
 0246 0247 0248 0249 0250 0252 0253
 0255 0256 0257 0258 0259 0260 0262
 0263 0264 0265 0268 0269 0270 0272
 0273 0274 0276 0277 0290 0292 0297
 0322 0324 0358 0362 0367 0381 0436
 0497 0528 0588

DIGESTIBILITY

0014 0016 0033 0043 0067 0075 0077
 0088 0094 0096 0098 0103 0110 0111
 0165 0186 0188 0189 0193 0194 0195
 0198 0199 0200 0201 0204 0205 0206
 0207 0208 0209 0210 0211 0273 0309
 0313 0314 0342 0415 0418 0419 0420
 0421 0520 0523 0528 0550 0613

PSEUDOMONAS SYRINGAE PV. PHASEOLIC

0057

PUERTO RICO

0021 0040 0179 0244 0414 0502 0555

PYTHIUM ULTIMUM

0197

RAINFALL

0311

RELATIVE HUMIDITY

0609 0613

RESEARCH

0018 0057 0118 0130 0136 0138 0250
 0274 0283 0287 0288 0322 0324 0326
 0328 0373 0419 0437 0457 0567 0592

RHIZOBIUM PHASEOLI**NOBILITATION**

0291 0353

RIHIZOCTONIA SOLANI
0197 0586

RIBOFLAVIN
0001

RNA
0223

ROOTS
0046 0115 0132 0353

ROTATIONAL CROPS
0040

RWANDA
0057 0481 0563

SALINITY
0046 0458

SCLEROTIUM ROLFII
0197

SEED

0113 0115 0117 0119 0129 0140 0142
0157 0167 0186 0223 0242 0244 0246
0246 0248 0251 0257 0260 0264 0268
0297 0304 0305 0309 0325 0329 0334
0339 0353 0355 0356 0359 0366 0374
0388 0410 0417 0426 0433 0440 0442
0443 0445 0449 0452 0455 0456 0457
0460 0464 0474 0474 0480 0485 0486
0500 0501 0504 0520 0527 0549 0564
0581

AMINO ACIDS

0014 0016 0018 0090 0103 0144 0146
0149 0150 0152 0153 0164 0172 0178
0203 0207 0214 0216 0218 0222 0238
0258 0261 0262 0263 0265 0267 0292
0303 0323 0332 0358 0361 0367 0487
0515

DISEASES AND PATHOGENS
0029

GENETICS

0147 0215 0218 0221 0229 0231 0239
0243 0275 0284 0461 0471 0482

GERMINATION

0110 0145 0197 0254 0258 0296 0323
0459 0473 0506 0508 0546 0591 0604

PRODUCTION
0153 0293

PROTEIN CONTENT

0016 0017 0018 0021 0029 0035 0039
0045 0065 0090 0103 0114 0144 0146
0149 0152 0155 0156 0173 0176 0177
0183 0184 0196 0207 0212 0213 0214
0215 0216 0218 0222 0225 0226 0227
0228 0231 0234 0236 0237 0240 0245
0269 0271 0272 0279 0281 0284 0285

0286 0291 0293 0295 0303 0306 0332
0361 0367 0413 0434 0448 0481 0508
0515 0519 0526 0539 0548 0556 0588
0589 0610

STORAGE

0045 0054 0138 0141 0159 0265 0266
0267 0429 0461 0477 0490 0491 0519
0534 0541 0542 0543 0546 0554 0589
0591 0594 0595 0596 0598 0602 0603
0604 0605 0607 0609 0610 0611 0612
0614

YIELDS

0021 0029 0039 0220 0231 0234 0236
0237 0279 0281 0284 0291 0292 0293
0295 0436 0481

SEED CHARACTERS

0026 0029 0045 0054 0056 0090 0092
0114 0119 0140 0141 0180 0196 0207
0233 0237 0245 0254 0266 0284 0306
0332 0409 0412 0414 0436 0439 0440
0441 0442 0443 0445 0448 0452 0457
0459 0461 0471 0473 0479 0481 0482
0485 0486 0500 0501 0504 0534 0539
0554 0556 0578 0581 0591 0594 0595
0596 0598 0602 0603 0609

SEED COAT

0017 0026 0080 0125 0127 0266 0279
0415 0418 0434 0435 0435 0439 0451
0464 0471 0472 0473 0477 0479 0480
0483 0539 0597 0599

ANALYSIS

0154 0221 0254 0260 0409 0411 0414

INHERITANCE

0221 0224 0410 0412 0437 0452 0461
0466 0467 0468 0469 0470 0474 0475
0476 0478 0482

SEED COLOR

0007 0026 0090 0092 0154 0176 0180
0207 0224 0279 0306 0332 0339 0409
0410 0411 0412 0414 0417 0431 0436
0442 0443 0458 0466 0467 0468 0469
0470 0471 0472 0473 0475 0476 0477
0478 0479 0480 0481 0482 0483 0485
0486 0488 0504 0539 0581 0595 0599

SEED HARDENING

0057 0464 0527 0557 0564 0607 0612
0614

SEED PRODUCTION

0057 0150 0288 0570

SEED TREATMENT

0158 0214 0597

SEED VIGOR

0311

SEEDLING

0167 0353 0408 0608

SEEDS0052 0080 0118 0124 0125 0126 0127
0128 0129 0132 0147 0148 0158 0165
0166 0169 0174 0181 0188 0210 0233
0252 0253 0256 0274 0277 0278 0280
0284 0288 0299 0301 0308 0311 0321
0322 0351 0377 0378 0379 0406 0408
0412 0414 0415 0416 0418 0423 0432
0434 0437 0441 0451 0459 0464 0471
0472 0507 0534 0540 0563 0564 0570
0585 0586 0587 0593 0595 0597 0599
0608 0612 0614**SELECTION**0052 0234 0445 0479
PLANT BREEDING
0020 0025 0029 0039 0231 0283 0284
0437**SEROLOGY**

0255

SHADING

0132

SOCIOECONOMIC ASPECTS

0418

SODIUM

0256 0258 0305 0306 0308 0360 0502

SOIL AMENDMENTS

0294

SOIL ANALYSIS

0293

SOIL COMPACTION

0038 0040

SOIL FERTILITY

0040

SOIL REQUIREMENTS

0009 0032 0040

SOLAR RADIATION

0527

SOLUBLE CARBOHYDRATES0074 0121 0126 0127 0194 0258 0357
0423**SOUTH AFRICA**

J003 0451

SPACING**PRODUCTIVITY**

0293

YIELDS

0032 0179 0293

SPAIN

0123 0312 0343 0408

STARCH CONTENT0127 0130 0131 0134 0135 0137 0185
0308 0444 0465 0505 0517 0573**PODS**

0132

SEED0114 0119 0120 0309 0434 0548 0603
0610**STATISTICAL ANALYSIS**0058 0139 0169 0173 0179 0219 0222
0284 0429 0431 0437 0446 0452 0454
0458 0482 0506**STEMS**

0115 0132

STORAGE0032 0037 0045 0049 0054 0062 0069
0141 0159 0166 0189 0199 0265 0266
0267 0360 0412 0422 0429 0430 0432
0444 0451 0454 0461 0462 0490 0519
0540 0542 0546 0547 0554 0580 0589
0590 0591 0592 0597 0598 0599 0600
0601 0602 0603 0604 0610 0611 0614
DISEASES AND PATHOGENS
0491
TEMPERATURE
0138 0300 0477 0491 0530 0534 0541
0543 0593 0594 0595 0596 0605 0606
0607 0608 0609 0612 0613**STORED GRAIN PESTS**

0032 0052 0243 0607

SUCROSE

0121 0126 0263 0463 0549

SUGAR CONTENT0113 0115 0125 0127 0255 0308 0356
0358 0375 0444 0463 0505 0518 0527
0549 0610**SULPHUR**0049 0153 0161 0200 0209 0215 0267
0413 0507**SWEDEN**

0342

SWITZERLAND

0400

SYMBIOSIS
NODULATION
0029

TANNIN CONTENT
0021 0038 0108 0191 0224 0410 0411
0412 0415 0416 0421 0422 0424 0488
0556 0561 0611 0613

TANZANIA
0044 0152 0352 0559 0583

TAXONOMY
0009

TECHNOLOGY
0044 0049 0050 0363 0582

TECHNOLOGY EVALUATION
0057 0563

TEMPERATURE
0138 0183 0188 0192 0274 0300 0336
0342 0431 0456 0460 0477 0491 0515
0517 0530 0534 0541 0543 0583 0584
0593 0594 0595 0596 0605 0606 0607
0608 0609 0612 0613
YIELDS
0059

THIAMIN
0001

TIMING
0038 0049 0055 0056 0057 0058 0192
0317 0336 0342 0371 0442 0449 0456
0460 0535 0538 0541 0543 0551 0554
0557 0559 0561 0562 0563 0583 0584
0585 0592 0593 0594 0595 0599 0600
0604 0605 0608

TOXICITY
0157 0194 0202 0210 0321 0325 0330
0332 0345 0346 0355 0357 0359 0361
0364 0366 0367 0368 0372 0373 0380
0426 0427 0453 0520 0539

TRANSFER OF TECHNOLOGY
0049 0055 0057 0059

TRYPSIN
0274 0316 0322 0336 0342 0415 0416

TRYPTOPHANE
0001 0024 0064 0073 0143 0144 0154
0155 0163 0166 0487 0488

UGANDA
0216 0281

UNITED KINGDOM
0029 0100 0162 0165 0265 0266 0267
0276 0322 0340 0370 0380 0383 0386
0389 0397 0404 0602 0603

UREA
0145

UROMYCES PHASEOLI
0475
RESISTANCE
0057

USA
0002 0021 0031 0038 0040 0048 0051
0053 0054 0064 0072 0083 0084 0088
0089 0090 0092 0095 0104 0106 0107
0109 0115 0116 0131 0132 0133 0137
0138 0141 0171 0182 0185 0186 0190
0191 0206 0221 0224 0231 0232 0236
0237 0238 0239 0240 0241 0242 0243
0263 0273 0277 0280 0290 0295 0298
0305 0309 0312 0313 0316 0317 0318
0333 0337 0339 0341 0344 0362 0365
0376 0378 0379 0382 0385 0388 0392
0394 0398 0399 0401 0403 0405 0407
0412 0418 0419 0420 0422 0424 0434
0435 0435 0436 0437 0438 0443 0445
0446 0450 0453 0460 0464 0465 0475
0477 0483 0484 0485 0486 0491 0499
0500 0501 0503 0509 0514 0517 0518
0519 0526 0529 0530 0546 0551 0552
0553 0556 0558 0560 0561 0562 0566
0567 0570 0572 0577 0579 0581 0584
0593 0599 0609 0611 0613 0614

USES
0018 0074 0076 0078 0079 0080 0081
0106 0182 0191 0516 0568

VALINE
0144 0528 0587

VARIETAL MIXTURES
0057

VENEZUELA
0087 0197 0210 0310 0328 0349 0359
0448 0487 0488

VICIA FABA
0260

VIGNA UNGUICULATA
0010 0035 0065 0174

VIROSES
0059

VITAMIN CONTENT

0014 0031 0071 0079 0302 0305 0308
0309 0310 0430 0438 0463 0487 0506
0544 0590

VITAMIN DEFICIENCIES
0073

WATER ABSORPTION

0057 0058 0187 0192 0434 0455 0456
0458 0546 0584 0589

WATER CONTENT

0064 0092 0101 0108 0131 0138 0140
0141 0142 0161 0162 0187 0289 0303
0306 0308 0310 0431 0434 0435 0435
0436 0458 0459 0461 0462 0464 0190
0514 0515 0519 0534 0540 0543 0544
0554 0556 0562 0581 0585 0586 0590
0591 0592 0593 0594 0595 0596 0603
0604 0605 0606 0608 0610 0612 0614

WATER REQUIREMENTS
0459

WATER STRESS
0040 0295

WEEDING
0032

WEEDS
0032

WILD PHASEOLUS
0124

XANTHOMONAS CAMPESTRIS PV. PHASEOLI
0057

YIELD COMPONENTS
0132 0179 0226 0286 0295 0311

YIELDS
0001 0021 0027 0029 0032 0038 0039
0040 0042 0057 0059 0131 0169 0179
0220 0224 0231 0234 0236 0237 0278
0279 0281 0283 0284 0288 0291 0292
0293 0294 0295 0307 0311 0319 0436
0446 0450 0479 0481 0578

ZAIRE
0057

ZEA MAYS
0016 0060 0062 0539
INTERCROPPING
0047

ZINC
0042 0064 0102 0110 0214 0290 0292
0305 0306 0308 0311