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I. Progress at Geneva

A. Engineering Studies

1. Coconut investigations

In April 1968, the Agency for International Development requested that the scope of this project be extended to include the development of a protein-rich flour made from coconuts using the Carver-Greenfield process. It was suggested that the University consider the installation of a pilot plant in the Philippines capable of producing 100 pounds of coconut flour per hour. A trip was made to the Far East in early July to observe methods of handling coconuts and to obtain additional information pertaining to the manufacture of coconut flour.

The following facts became apparent during visits to desiccated coconut plants, a number of copra drying units, and talks with university and government officials:

1. The preparation of the coconut flour would be a by-product of the coconut oil industry; thus, any new process for preparing coconut flour would have to yield a quality and quantity of oil comparable to that currently obtained from dried copra.

2. The starting point for the production of coconut flour would be the coconut meat or coconut kernel after removal of the husk and shell. No satisfactory mechanical means have been devised, to date, for eliminating the large quantity of manual labor required to perform this task.

3. Approximately 15 processes have been described in the literature or in patents for the production of coconut flour, but none of them, to date, has proved satisfactory. The proposed methods may have appeared practical in the laboratory but for various reasons have not been feasible on a commercial scale.

4. The coconut meat contains appreciable quantities of fiber which is found chiefly in the cell walls, and difficulties may be encountered in separating the fiber from the protein.

5. Lauric acid is a major constituent of coconut fat, and its tendencies to form stable emulsions may cause serious difficulties in wet extraction methods.

It is apparent that the successful development of a process for manufacturing satisfactory coconut flour will require a

combination of biochemical and engineering talents which are usually not available in the coconut growing areas of the world. For this reason, it would seem more logical to transport the coconuts to a center of technology in the temperate zone.

The problem appeared to be similar to that associated with development of many other high-protein foods from tropical crops where the technical ability for successfully developing such a process is in the temperate zones of the world while the products are in the tropics.

Upon returning from the Far East, a visit was made to the Carver-Greenfield Corporation in Summit, New Jersey, and each step in the process was reviewed in detail with the company's technical personnel. The Carver-Greenfield Company has prepared samples of coconut flour on a pilot scale by grinding the coconut meat with water and feeding the slurry into a falling-film evaporator containing oil at approximately 150°F. The water is evaporated off under vacuum as the mixture is recycled through the evaporator. A side stream is continuously removed from the evaporator, and the flour is separated by centrifugation. Excess oil adhering to the flour may be removed by solvent extraction or under pressure in an expeller. Expelling the oil is a simpler procedure, but considerable heat is generated during the operation which detracts from the quality of the protein.

During the discussion with the members of the Carver-Greenfield staff, it became apparent that there were a number of variables in the process that had not been explored to date. For this reason it seemed desirable to conduct further studies on production of coconut flour using the Carver-Greenfield process in this country and to relate the effects of variations in the process to the functional and nutritional properties of the flour. Following these studies, the suitable pilot plant equipment capable of producing 100 pounds of flour per hour would be set up in the Philippines for demonstration purposes.

More recently, the Agency has decided that further work on this contract should be devoted solely to the manufacture of high-protein soy products. Further work on the production of satisfactory coconut flour was, therefore, abandoned.

However, in the interim, a falling-film evaporator was built in this Department's workshop, having an evaporator surface of approximately 5 sq. ft. and complete with the necessary preheater, feed and discharge pumps, flow meters, separation chamber, condenser and condensate receiving equipment. Negotiations were also carried out with various manufacturers regarding suitable solvent extraction and expeller equipment.

2. Soybean investigations

(a) Particle size measurements

A method for determining particle size distribution was required for measuring the effectiveness of grinding equipment and particle classification where regrinding is required to improve the stability of a milk. Particles encountered, to date, in the grinding of soybeans have ranged from 1,000 to less than 2 microns in size. Since no single method of particle size measurement will encompass this range in size, a combination of wet-sieving and sedimentation tests have been employed. Particles in the size range of 1,000 to 45 microns are separated on a series of sieves mounted on electromagnetic vibrating apparatus with sprays of wash water applied to the upper sieve. The residue on each screen is transferred by washing weighed filter papers, and the per cent residual solids on each screen is calculated on a dry weight basis.

Samples of the waste water from the final screen are then subjected to sedimentation tests using an MSA particle size analyzer. From the sedimentation rates of the particles obtained with different centrifugal forces, the size of the particle is computed.

Since the results of the wet-sieving tests are calculated on a weight basis, while those of the sedimentation tests are on a volume basis, it has been necessary to work out a system of interconvertibility so that the results of the sieving and sedimentation tests may be arrayed to give a continuous spectrum of the particle size distribution. Work has continued on the wet grinding of soaked soybeans in the presence of hot water and steam to prevent development of a rancid flavor due to lipoxidase action. Into this preliminary grinding step, it is desirable to coordinate the addition of beans, water, and steam so that a slurry of constant composition is obtained. Mechanical difficulties have been encountered in the metered feeding of the soaked beans to the mill because of a gummy exudate which forms on the beans after removal from soak water. This exudate causes erratic feeding rates to the mill. Several samples are being studied to obtain a uniform feed of the soaked beans.

After the preliminary combination of the beans, the resulting slurry is then pumped to a colloid mill where additional heat is generated in the action of the carborundum stones. To minimize heat damage, a wiped film heat exchanger is installed between the preliminary grinder and the colloid mill. With the introduction of this heat exchanger, the milks were found to have rancid flavors indicating that a holding period at an elevated temperature may be necessary after discharge from the initial grinder.

B. Biochemical Studies

1. Redispersibility tests

Powdered soy milk is easily transported and preserved and, therefore, suitable for centralized large scale production. Accordingly, the manufacture of soy milk powder is one attractive means for supplying it in underdeveloped countries. In the last semi-annual report the effects of pH, heating time, concentration, emulsifier, and disulfide bond splitting reagents during heating, before drying, on the redispersibilities of dried soy milk have been reported. The present report deals with the effects of factors other than those described above and the combined effects of some factors.

(a) The effect of chelating agents

Chelating agents might be expected to increase the redispersibility of dried soy milk by preventing the formation of Ca bridges between the polypeptide chains. Therefore, the effect of the addition of Na-ethylenediaminetetra-acetate (EDTA) was investigated and showed that the redispersibilit of dried soy milk was increased by the addition of EDTA, reaching a maximum at 20×10^{-6} mol concentration. However, the extent of this increase was small, indicating that metal ions were not important in the solubilization of the soy milk proteins after drying.

(b) The combined effect of additives

The results of the previous experiments showed that the formation of disulfide bonds play an important role in the insolubilization of soy milk proteins after drying. For instance, cysteine improved the redispersibility of soy milk proteins after drying from 25 to 41% at 1×10^{-3} mol. Now the combined effects of cysteine with other additives, such as emulsifiers and EDTA, have been examined. The positive effects were found to be independent of cysteine. The results showed that emulsifiers and cysteine were additive, while EDTA plus cysteine were inferior to cysteine alone.

(c) The effect of heating temperature

Redispersibility increased with time and temperature in the heating of soy milk before drying. For instance, the redispersibility increased from 27% at 100°C to 40% at 120°C in 30-minute heating periods and from 32% at 100°C to 45% at 120°C in 60-minute heating periods. Further, the final redispersibility was changed by the rate of heating. In the comparison of rapid heating versus slow heating, the redispersibility increased from 40% at the slow rate to 50% at

the rapid rate for 30-minute heating periods at 120°C and from 45 to 52% for 60-minute heating periods at the same temperature. These results suggest the possibility that still higher temperatures might further improve the redispersibility. However, since coagulation occurs at higher temperatures, conditions resulting in coagulation were examined in detail.

There were limiting temperatures below which coagulation did not occur. These limiting temperatures depended upon the concentration of soy milk and were higher with decreases in concentration. Namely, the 3.5, 5.0, 6.5, and 8.0% soy milks had limiting temperatures of about 131.5, 129.5, 127.5, and 125.5°C, respectively. Above these limiting temperatures, coagulation occurred at heating times which decreased with the degree of elevation of temperature above the limiting temperature and with increase of the concentration of soy milk. It has also been found that preliminary heating of soy milk below the limiting temperature inhibited the coagulation which otherwise occurs in subsequent treatment above the limiting temperature. For example, in the 6.5% soy milk, the coagulation occurred at 3-minute heating periods at 130°C, whereas by a preliminary treatment for 60 minutes at 100°C, the coagulation did not occur even after 50-minute heating periods at 130°C. This phenomenon is interesting in connection with the facts described before showing that the redispersibility of soy milk is closely correlated with the temperature history of soy milk.

Under current study are the redispersibilities of soy milks treated at temperatures above the limiting temperature, yet within the time prior to coagulation.

C. Flavor Studies

When soybean milk is prepared by a cold water extraction, a great array of volatile compounds are formed which produce a rancid-beany flavor in the product. These compounds have been separated by gas chromatography and analyzed by gas chromatographic retention time and mass spectrometry. The largest component was identified as hexanal which comprised about 25 weight per cent of the collected volatiles. Other components which have been identified or tentatively identified are listed below. Those with appreciable flavor impact are indicated with an asterisk.

Pentane	1-octen-3-ol*
1,7-octadiene	2-octen-1-ol*
Pentanal*	2-octenal*
Decane	2,trans-4,cis-heptadienal*
Diphenyl ether*	2,trans-4,trans-heptadienal*
Hexanal*	Benzaldehyde*
1-penten-3-ol*	Nonanal*

Heptanal*
2-heptanone*
2-hexenal*
n-propylbenzene
5-hydroxymethyl furfural*
3-octanone*
2-octanone*
Octanal*
Vinyl amyl ketone*
n-butylbenzene
Hexanol
3-octanol
2,4-hexadienal*
1-octanol
2-nonenal*
2,trans-4,cis-nonadienal*
2,trans-4,trans-nonadienal*
Hexanoic acid*
Heptadecane
2,trans-4,cis-decadienal*
2,trans-4,trans-decadienal*
Heptanoic acid*
Benzathiazole*
Gamma-nonalactone*
Propyl furan*
Pentyl furan*

D. Nutritional Studies

1. Evaluation of alkali extracted soy milk

The samples of soy milks and residues from the pH study, described in the previous report (June 30, 1968), were evaluated nutritionally by amino acid analyses and rat feeding experiments. Soy milks of four different pH's were each divided into two parts, and one of the samples of each pH was canned and processed for 10 minutes at 250°F. The resulting 12 samples (eight milks and four residues) were incorporated as the protein source into diets at a level of 10% protein and were fed to groups of ten male weanling rats for a period of 28 days. In addition to the 12 treated samples, a casein control was also fed to a group of rats in order to calculate adjusted protein efficiency ratios.

The P.E.R. values indicate that heat treating soy milk of high pH results in a decreased nutritive value. As yet unexplained, however, is the low P.E.R. value (1.88) obtained with the heat-treated pH 7.37 milk. Another feeding experiment is being conducted in order to check this value.

The P.E.R. values for the residues showed little apparent affect of pH. The non-heat-processed samples showed an improvement in nutritional value of the protein with increasing pH of the milk. The improvement would appear to be attributable to the decline in trypsin inhibitor values with increasing pH. The per cent trypsin inhibitor retention values represent the inhibiting activity of the samples expressed as a per cent of the activity of ground, whole soybeans. The values for the non-heat-treated milk clearly show that raising the pH of the milk diminishes the trypsin inhibitor activity until, at pH 9.18, the activity is very near that of a heat-treated sample.

The amino acid content of the samples shows that the effect of pH is minimal, with the possible exception of cystine and

available lysine. Available lysine analyses are presently under way.

2. Evaluation of the nutritional value of dry roasted soybeans

Also under way is the evaluation of the nutritional value of dry roasted soybeans. Twelve different samples were prepared by soaking soybeans in water at 50°C for four different times in order to obtain beans of four different moisture levels. Samples from each moisture level were then roasted in gas-fired roasters to three different degrees of roast. Animal feeding experiments and amino acid analyses are in progress.

II. Progress at Los Baños

A. Pilot Plant Development

The renovation of the Food Science pilot plant in the Chemistry building has been completed over the past six months. A small addition was built to house the steam boiler, air compressor, water heater, and water softener. All electricity and plumbing connections have now been installed. The inside of the pilot plant is being painted. The retort, the Rietz disintegrator, the homogenizer, and the plate filter, as well as other hand grinders, are now being used in various experiments. Although the large steam boiler is installed and ready to operate, we have been handicapped by a shortage of fuel oil.

B. Research on Soybean Products

Most of the current soybean research has been directed toward the production of soy milk, soybean curd (tokua), taosi (fermented soybeans), and Indonesian tempeh at the village and even household level. A draft for a brochure has been written entitled, "How to Make Soybean Milk and Other Soybean Products." This will be an illustrated, simple presentation of methods of preparing the following: (1) soybean milk; (2) steamed green soybeans; (3) tokua (soybean curd); (4) taosi (fermented salted soybeans); and (5) tempeh.

Experiments have been directed at producing these products using equipment readily available in the barrios. For example, quantities were measured in evaporated milk cans which are commonly used in the villages for measuring. Grinding of soybeans for soy milk was carried out in small stone mills (called rice mills in the barrio) available in nearly every home. It was found that the hole in the top stone should be made larger to facilitate the passage of soaked soybeans which must pass through the hole and between the top and bottom stone during grinding. Photographs

were made of each step in processing to help describe the methods. Eventually, the brochure will be translated into Tagalog.

At present, Dr. Lantican, Head of the Department of Horticulture, is writing a short section on the sources of soybean seeds in the Philippines and methods of growing them in the home garden. With this section incorporated, the villager or small entrepreneur can grow and process his soybeans into protein-rich foods for his family and possibly for limited sale to his neighbors.

As soon as the final draft of this brochure is completed, it will be circulated for examination and suggestions.

1. Flavor studies on soy and/or soy coconut milks

Mrs. Lourdes T. David, who is working on an M.S. degree on flavor aspects of soy and/or soy-coconut milks, is ready to begin the last phases of her studies. These are designed to compare, critically, flavor of local varieties of soybean (commonly lumped and designated as Davao) and selected imported varieties such as Hsieh-Hsieh and Taichung currently being cultivated and produced at the International Rice Research Institute under the direction of Dr. Richard Bradfield. She also will critically evaluate the influence of sugar, vanilla, coconut milk, and other flavoring materials upon consumer acceptance by taste panels.

Recently we sent a bottle of soybean milk containing 10% coconut milk to Mr. K. S. Lo of Hong Kong Soyabean Products Company Ltd. for evaluation. It also contained 9% sucrose and 0.1% vanilla. His response was that he could hardly believe it contained any soybean milk. He double checked the covering letter to see that it actually was soy. The flavor was very bland. This illustrates the possible value coconut milk may have in the manufacture of soybean milks.

The coconut milk was produced by grating the coconut meat, adding an equal part of water (w/v), grinding in the Waring blendor, and filtering. The coconut milk was mixed with soybean milk in the proportion of 90% soybean milk and 10% coconut milk. The 9% sucrose and 0.1% vanilla were calculated and added on the basis of total volume.

2. Soy milk from defatted soybean grits

Large companies like San Miguel might be interested in manufacturing soybean-based beverages similar to soft drinks if there were an adequate supply of soybeans. This is not likely to be the case for some time to come. The duty on soybean grits is much lower than on the whole soybeans. Therefore,

in discussions with Mr. Fred Traeger, U. S. Embassy Agricultural Attache, and Dr. Zialcita, Director of Research of San Miguel Corporation, it was decided to try to produce soy milk by extracting soybean grits and adding coconut oil as a source of fat. San Miguel supplied soybean grits for the experiments. It was found that the soybean grits had a low solubility than soybeans. They also were apparently lacking in fat emulsifiers, and the added fat tended to separate as a layer at the tops of the bottles. Flavor was judged to be inferior to the regular soy milks prepared from whole soybeans.

3. Peace Corps activities

Two groups of Peace Corps volunteers with about 25 persons in each group were taught soy milk, soybean curd (tokua), and tempeh manufacture this past six-month period so that they could teach the villagers to grow soybeans and how to utilize them.

C. Coconut Fractionation

Coconut can be fractionated by "dry" processes in which the coconut meat is first dried. The traditional process involving production of copra by a combination of hot air and smoke drying or sun-drying followed by pressing out the oil is the most common. The Carver-Greenfield process involving vacuum dehydration of the coconut meat slurried with coconut oil is a much more sophisticated process involving a combination of centrifuging, pressing, and finally solvent extraction to separate the oil and other components of the coconut meat.

Traditional processing of copra is presently poorly controlled resulting in infestations of the coconut meat by molds and insects. The equipment for the Carver-Greenfield process was unavailable. We have concentrated on the "wet" processing of the coconut meat. In the traditional "wet" processing of coconut milk (gata), the coconut meat is grated and pressed. In a second pressing, water may be added, but the quality of the gata is poorer. Since the oil and protein are contained within the coconut cells, the traditional process is poor as far as recovery of coconut oil is concerned. Protein has not been a consideration, but its recovery would be poor.

In our studies, two types of grinders were studied for rupturing the coconut cells. First was the Waring blendor type grinder. The second was the Rietz disintegrator using the .023 screen. Using the Waring blendor, it was possible to grind with a 1:1 (w/v) mixture of coconut meat and water. Higher proportions of water 1:2 (w/v) were used but were found to be more difficult to fractionate in subsequent processing. With the Rietz disintegrator, it was found that a 1:1 (w/v) proportion of coconut

meat to water was insufficient for grinding. Of necessity a 1:2 (w/v) dilution was used. Neither grinder ruptured all the coconut cells nor even broke up all chunks of cells thereby releasing all the oil and other components. Moreover, the Rietz produced a more stable emulsion which could not be broken using methods which proved acceptable for breaking the emulsion produced in the Waring blendor.

Currently, a total solid, oil, and protein recovery study is under way comparing the traditional process, Waring blendor, and the Rietz processes.

After the coconut meat has been disintegrated, the resulting emulsion must be processed to separate the oil, protein, and other components. The oil, being the most valuable component economically, must be recovered efficiently and economically with the best over-all quality, i.e., low free fatty acid content, and freedom from color and undesirable odor.

To date, no process thus far suggested has proved commercially feasible for the "wet" processing of coconut meat. With the greater interest in recovering coconut protein in a wholesome form, preferably undenatured so that use could be made of its unique functional properties (i.e., coagulable with heat much like egg albumen), the decision was reached to study the fermentation process further in the hopes that it could be made efficient and commercially feasible.

Initial studies were carried out using the Waring blendor for grinding. Coconut meat was ground with water in proportions of 1:1, 1:1.5, 1:2, and 1:2.5 (w/v) and filtered through cloth to remove the fibrous residue. Various problems were studied including pre-separation of coconut cream, with and without a pre-fermentation. The types of fermentation vessel, i.e., relationship of surface to volume, were studied to determine whether aerobic-anaerobic relationships played a part. Fermentations using two different types of Lactobacilli were carried out at 30, 40, and 50°C. Stimulants for growth of micro-organisms such as yeast, extract, tryptone, sucrose, or lactose were tried as adjuncts to stimulate the fermentation and facilitate early breaking of the emulsion. Upon breaking of the emulsion, the oil was separated by centrifuging. The protein was obtained as a precipitate which formed as acid produced by the microorganisms lowered the pH to 4.5, close to the isoelectric point.

Results:

A method for the wet processing of coconut to efficiently separate a high-quality, water-white oil and a relative undenatured protein was developed. The steps include the following:

1. Remove coconut meat from the shell with a mechanical grater.

2. Grind the grated coconut meat with water 1:1 (w/v) in a Waring blendor.

3. Filter press to remove oil, water, protein, and all filterable material.

4. Add 1% sucrose (w/v).

5. Inoculate with 10% (v/v) of a culture of Lactobacillus plantarum grown on a medium containing tryptone 0.5%, yeast extract 0.25%, sucrose 1.5%.

6. Incubate at 40°C.

Using the above process, the emulsion was broken, and water-white oil began to separate in 4 hours. Separation was relatively complete in 8 hours under optimum conditions. The protein was concentrated and separated as a layer at the top of the water phase. The oil separated as a layer at the top of the fermentor where it was removed by siphoning and centrifuging.

Further, it was found that the optimum dilution was 1:1 (w/v). Use of lower proportions failed to introduce sufficient fluidity. Higher proportions required longer fermentation times to effect release of oil from the emulsion.

It was found that inoculation of the coconut milk immediately after grinding decreased the time required for initial separation of the oil containing cream from several hours to 20 minutes.

Although organisms present in the coconut milk will produce a natural fermentation and cause separation of the oil from the emulsion, the fermentations under such conditions are unpredictable and would be unreliable commercially. It was found that Lactobacillus plantarum was faster and more reliable as a fermenting microorganism than L. delbruckei which has been used previously in the processes of Beckman (1930), Harovitz-Vlasona and Novatelnov (1935), and Soliven and de Leon (1938).

Optimum temperature was found to be 40°C.

The above studies were made using the Waring blendor as the grinder. When the Rietz disintegrator became available in the pilot plant, the new grinder was used in disintegrating the coconut meat. The first change necessary was increasing the proportion of water to 1:2 (w/v) in order to introduce sufficient fluidity. It was found that the Rietz, along with the altered ratio of coconut to water, produced an emulsion which was more stable than that

obtained using the Waring blendor and 1:1 (w/v) ratio of coconut to water. The Rietz emulsion would not break using the fermentation developed above.

Thus far, no satisfactory method of breaking the emulsion formed in the Rietz has been formed. Research is, however, continuing in that direction. The only other alternative is to use grinders with an action similar to the Waring blendors.

We are determining recoveries of oil and protein by the various "wet" processes including rendering of the coconut cream, fermentation using the Waring blendor as disintegrator, and the possibility of using centrifuging in a Sharples super centrifuge to break the emulsion using coconut cream produced with the Rietz This research should be completed within the next month and will permit us to forecast the commercial feasibility of the various processes.

D. Quick-Cooking Mungo Beans

At the request of Dr. R. W. Engel, of the U. S. AID/Virginia Polytechnic Project and the Philippine National Nutrition Program, experiments were conducted on the production of a "quick-cooking" mungo bean which could be used in feeding studies with infants, toddlers, and mothers at Mothercraft Centers being set up on an experimental basis in various parts of the Philippines. Since this was an opportunity to help a nutrition project closely related to our interests, both by way of basic support and general objectives, we undertook the extra task.

Mungo beans are available in nearly all markets in the Philippines. They are familiar to the Filipinos and used in various recipes. The fact is, however, that there is generally an insufficient supply to permit an expanded use of mungo beans in various nutrition programs. They are more readily available than soybeans, and the Filipinos know how to use mungo beans. Filipinos, in general, are not as familiar with soybeans. However, the protein content of mungo is about 25% versus 40% in soybeans.

Mungo beans, like most other beans, require a rather long cook to make them palatable. At the Mothercraft Centers, where thy U. S. AID/Virginia Polytechnic-Philippine National Nutrition Program are feeding mixtures of mungo, rice, and dried pulverized fish to infants, children, and mothers, one of the problems is the long cook required for the mungo beans. Therefore, it would be valuable to have a pre-cooked, dehydrated mungo bean that could be added to the mixtures and would require very little, if any, additional cooking.

To this end, following discussions with Dr. R. W. Engel, mungo beans were subjected to two processes: (1) toasting in dry

oven at 250°F for 1 hour followed by dry grinding, and (2) soaking (4 hours), draining, boiling in water for 30 minutes, draining, drying in hot air (180 to 200°F for 2-1/2 to 3 hours), and dry grinding. These powders were incorporated in the diets at one Mothercraft Center near Santa Cruz, Laguna. It was found that some of the infants developed diarrhea when the mungo bean flours were incorporated in the soups without additional cooking.

Therefore, mungo beans were subjected to increased cooks as follows: (1) Mungo beans were pre-soaked to double weight and then toasted by drying in an oven at 250°F until dry--approximately 3 hours followed by dry grinding. (2) Mungo beans were pre-soaked to double weight, drained, boiled in water for 1 hour, drained, and dried in a hot air oven at 200°F until dry (approximately 2-1/2 hours), and dry ground. In this second experiment, the toasted mungo beans were definitely toasted as shown by a slight darkening which was not present in the first experiment. Boiling time was doubled with the pre-cooked mungo beans. One hour boiling is about the maximum cook in water that can be followed without causing disintegration of the bean structure. Cooking could still be further increased with a steam process. We are now awaiting results of feeding tests with infants using these "quick-cooking" mungo bean flours.

The mungo bean research should be expanded to determine the exact heat treatment required to inactivate any trypsin inhibitor present. Nutritional studies should be run to determine optimum process to release and also preserve maximum protein value.

It is our intention to continue working with the U. S. AID/Virginia Polytechnic-Philippine National Nutrition Program group to provide a "quick-cooking" mungo bean both pulverized and as a whole bean for use in the nutrition program and also as a potential new product for the market place. The objective is to prepare a "quick-cooking" mungo bean which requires only the addition of boiling water to prepare them for consumption.

N3

III. Publications

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Badenhop, A. F., and W. F. Wilkens. 1969. The formation of 1-octen-3-ol in soybeans during soaking. *J. Am. Oil Chem. Soc.* (in press).

Mattick, L. R., and D. B. Hand. 1969. Identification of a volatile component in soybeans that contributes to the raw bean flavor. *J. Agr. Food Chem.* (in press).

Wilkens, W. F., and L. R. Hackler. 1969. The effect of processing conditions on the composition of soy milk. *Cereal Chem.* (in press).

IV. Papers Presented

A. Geneva

Hackler, L. R., and W. F. Wilkens. Nutritional and biochemical evaluation of deep-fat-fried soybeans. AACC-AOCS 1968 Joint Meeting, Washington, D. C., March 31-April 4.

Hackler, L. R. Problems associated with the development of a high-protein soy beverage in alleviating protein malnutrition. AACC-AOCS 1968 Joint Meeting, Washington, D. C., March 31-April 4.

Wilkens, W. F. The effect of lipoxidase on the lipid composition and flavor of soy milk. AACC-AOCS 1968 Joint Meeting, Washington, D. C., March 31-April 4.

Wilkens, W. F., A. F. Badenhop, and L. R. Hackler. Volatile components of deep-fat-fried soybeans. AACC-AOCS 1968 Joint Meeting, Washington, D. C., March 31-April 4.

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Fukushima, D. Denaturation of soybean proteins with organic solvents and enzymatic hydrolysis of denatured proteins. AACC-AOCS 1968 Joint Meeting, Washington, D. C., March 31-April 4.

B. Los Baños

Steinkraus, K. H. New developments in food science at the U. P. College of Agriculture, Los Baños, Laguna. 1968 National Science and Technology Week, Manila, July 15-21.

Steinkraus, K. H. Effect of processing on nutritive value of foods. Annual Meeting of the Philippines Association of Food Technologists National Science Development Board, Manila, October 16-18, 1968.

Demonstrations of methods and soy milk and soybean curd products developed on the AID-Cornell Project U.P.C.A. were presented at a Soybean Symposium, October 29-November 4, 1968, sponsored by the FAO Applied Nutrition Project in Suwon, Korea, under the direction of Dr. Y. H. Yang. Formal papers presented in Korea included the following:

Steinkraus, K. H. Effect of processing on nutritive value of foods. Seoul National University, Suwon.

Banzon, J. Food processing studies at the U.P.C.A. Seoul National University, Suwon.

Steinkraus, K. H. Studies on the tempeh, ontjom, and idli fermentations. Annual Meeting Korean Society of Microbiology.

Steinkraus, K. H. Studies on the production of soy milks and other protein-rich vegetable-based foods at U.P.C.A. FAO Applied Nutrition Project, Suwon.

Banzon, J. Studies on coconut protein processing at U.P.C.A. FAO Applied Nutrition Project, Suwon.

Research findings on the soy/coconut-based food project were also extended to laboratories in Taiwan, Japan, and Hong Kong on the way to and from the Korean Symposium.