

Feb 1967

HS-3

CSD-1587

PROJECT SUMMARY

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Project Title : Effects of Extrusion Processing Variables on the Nutritional Quality of Inexpensive High Protein Food Mixtures
 Project # : 931-17-560-482 CSD-1587 Rev.
 Proposed By : Department of Food Science and Technology, University of California, Davis
 and
 Institute of Food Science and Technology, University of Chile, Santiago

Principal Investigators : C. Chichester, Ph.D.
 Professor Alvaro Pinto A.

Duration : 3½ years

Estimated Cost : Total - \$145,058
 1st year - 74,636
 2nd year - 35,936
 3rd year - 34,486

Action Officer : Dr. Daniel Rosenfield, TCR/HS/NB

1. Description of Proposed Project

Large scale efforts are being made by governments, voluntary relief organizations, and commercial companies to formulate low-cost protein foods and make these available in developing countries. These foods consist mainly of vegetable proteins though small amounts of animal protein, usually dry skim milk, may be incorporated. Such formulations are designed to balance the amino-acid deficiencies of one protein source by addition of another with an excess of the deficient amino-acid.

In order to present the consumer with a sanitary, palatable and attractive food material in which the components are combined and which are compatible with his normal diet, some processing is normally required. One technique being used more and more, particularly in the breakfast food industry, is so-called cooking extrusion processing. This procedure is without question one of the most economical for providing pre-cooked cereal-based food mixtures. An extruder is a heat-jacketed screw press into which the ingredients can be fed, mixed, and extruded through a heated die. The effect of this type of heat processing on the nutritional quality of the protein mixtures has not received sufficient attention. It has been assumed that the mixture will maintain its nutritional effectiveness during processing. However there are valid indications that these processing methods may deleteriously affect the nutritional quality of protein in such food substances.

as wheat, oats, soya, corn, milk, and cottonseed.

The proposed project is designed to complement an on-going project in Chile undertaken by the University of California in which vegetable-fish protein mixtures are being investigated for use in the feeding of pre-school children, infants, and lactating women. The investigators plan to study the effects of the extrusion processing variables of temperature and pressure and processing time upon the nutritional quality and acceptability of these vegetable-fish and other high protein mixtures. Protein sources for use in the mixtures will be sunflower seed meal, corn, wheat, fish protein concentrate, fresh raw fish, and local (Chilean) milk. The storage stability of the different products will be examined under typical Chilean conditions utilizing practical packaging materials.

In addition to a research aspect, this project also has training and institution-building components. Chilean nationals will be trained at the Department of Food Science and Technology, University of California, in the techniques of analysis, processing, acceptability testing and nutritional evaluation. Production facilities will be set up in the Institute of Food Science and Technology, at the University of Chile. The feeding trials will be conducted in conjunction with the Department of Pediatrics of the University of Chile Medical School.

2. Significance of the Project to AID Objectives

The major cause of malnutrition in the LDCs is protein deprivation. AID is attempting to alleviate this situation in many ways. In a major effort, formulated, inexpensive protein-supplemented cereal mixtures are being supplied to the LDCs via the Food for Peace Program. It is most important to AID to know that heat processing has not reduced the protein quality of these foods. The definition of processing conditions which do not alter the protein quality is also a significant corollary. In addition to the specific research objective, this project is important to AID because of its training and institution-building components. It is expected that this project will help the Institute of Food Science and Technology at the University of Chile become a center of excellence in Latin America capable of both solving problems specific to the region and educating local scientists.

3. Relevance of Proposed Project to Existing Knowledge

There is scientific evidence suggesting that food mixtures formulated and processed to provide improved and palatable protein intake may lack the full nutritional value of the individual ingredients incorporated in the mixture. However, mechanisms of this impairment and the factors which direct it have not been fully defined. Little attention has been paid to the inter-relationships between processing

factors, time, temperature, and chemical constituents. This study would extend our knowledge into those areas of processing and nutrition in which information is lacking.

4. Evaluation of Experimental Design and Research Methods

The experimental design and research methods are reasonable and technically sound. It is anticipated that the project will yield immediate and valuable results.

5. Evaluation of Research Competence of Investigators

Dr. G. Chichester is an internationally known and highly competent food scientist-engineer, and is Chairman of the Department of Food Science and Technology at the University of California, Davis. He is fully capable of conducting the type of research proposed. The co-investigator, Professor Pinto, is a young scientist from Chile who received his M.S. in Food Science in 1965 from the University of California. While his competence cannot be fully evaluated because he has not published extensively, his training and sponsorship indicate that he is capable of conducting appropriate phases of the proposed study.

6. Appraisal of Research Resources and Budget Provisions

The resources and facilities for research at the University of California are excellent. This project will strengthen the resources at the University of Chile. The estimated cost seems reasonable and fully justified in terms of knowledge the project will provide to AID and other groups interested in high protein foods.

7. Scientific Review and Assessment of Relevance to AID Programs

a. Within AID - In view of the emphasis the Agency is giving to the development of high protein foods for distribution in IDCs via government and commercial channels, the Health Service of TCR feels the proposal has great relevance to interests and objectives of AID. Contingent upon RAC approval, appropriate regional and Mission clearances will be sought.

b. External Review - An Interdisciplinary Nutrition Research Committee of NIH evaluated the technical merits of the proposal. The Committee recommended approval without change. On a priority scale of 100 to 500, the lower figure representing highest priority, the Committee assigned a value of 186 to the project.

Mr. Layton Allen, a leading food engineer with specific experience in this field as Senior Engineer at UNICEF, reviewed the

project and discussed the scope of activities with Dr. Chichester. Mr. Allen considered the project to have much merit. After discussion with Dr. Milner, AID Nutrition Branch Chief, he recommended certain changes to strengthen the project. These have since been incorporated in the proposal.

8. Evaluation Summary

This project is designed to study the effects of processing upon the nutritional quality and acceptability of inexpensive, simple, high-protein foods. It will provide knowledge on an important subject (processing impairment of proteins) in which information is lacking. The experimental procedures and capabilities of the investigators have been endorsed by competent authorities. The proposal is relevant to objectives of AID in that it will help to define processing conditions which do not impair protein quality and it will strengthen food science and nutrition competence at the University of Chile. Approval in the amount requested is recommended.

is supplemented with the amino acid lysine or other protein sources rich in lysine, the increase in protein effectiveness is larger than either of the two or more components of the mixture consumed separately. The same concept can be applied to most vegetable sources of protein, such as soya, corn, cottonseed, coco presscake, etc.

In order to present the consumer with a food material which is compatible to his normal diet, and one in which the components are maintained combined in the food material, some processing is normally required. The FAO, UNICEF, and INCAP have produced formula foods which have a comparatively good balance of total proteins, derived largely from various vegetable sources. These have been utilized, and are comparatively good foods from a nutritional basis. The effect of processing on mixtures of proteins, however, has not received very much attention. It has been assumed that the correct mixture will maintain its nutritional effectiveness during processing. Bressani, however, has shown that very small changes in processing techniques very radically alter cottonseed protein availability. Additional reports by numerous other individuals indicate that changes in processing techniques change the protein quality of such materials as wheat, oats, soya, corn, cottonseed, fish, etc. In experiments conducted at the University of California, Department of Food Science and Technology, it has shown that relatively small changes in the thermal processing conditions of vegetable-milk mixtures (amounting to as small as 20°F) will reduce the P.E.R. (Protein Efficiency Ratio) of the mixtures by 50%, as tested in rat feeding experiments.

As there are many proposals to utilize local vegetable materials in underdeveloped countries as protein sources, it is important to determine the effect of processing upon protein availability, acceptability, and utilization of proposed mixtures. As a project is underway in Chile upon the utilization of vegetable-fish protein mixtures in the feeding of pre-school children, infants, and lactating mothers, it is intended that the present studies will utilize the same target population in studies of the acceptability and nutritional factors under the experimental conditions. It is therefore proposed that the following specific aims will be investigated.

Research Plan.

Specific Aims:

- 1) The investigation of protein availability as influenced by thermal environment and other process variables of mixtures of food materials produced by extrusion processing.

2) The study of the effects of variations in processing techniques on vegetable protein mixtures currently under investigation for infant feeding in Chile. The mixtures which are currently being investigated, and will form part of the investigation, are as follows:

- a) Sunflower seed meal
- b) Rapeseed meal
- c) Fish protein concentrate
- d) Fresh raw fish (to be combined in extrusion processing with cereals)
- e) Corn
- f) Wheat
- g) Local milk

3) Studies will be made to determine the most suitable packaging for products which are studied and the effect of storage conditions on these products.

4) Techniques for enriching the extruder foods with vitamin and mineral mixtures will be determined.

5) The study will be made of the acceptability and effectiveness of processed foods produced from the components above on populations already under study in Chile.

Significance to AID: Many of the proposed protein supplements and protein foods are based upon the utilization of local or indigenous protein foods and presuppose that by mixing the correct types of vegetable protein (with or without supplementation) a good nutritional quality food will result. This is not always true, since processing must be utilized in most cases to compound the food into a single unit, increase its palatability, transportability and digestibility. The method of processing may achieve some of the desired effects, but in many cases at the expense of the nutritional quality of the food material. In some cases that have been investigated, this amounts to the almost complete loss of the desirable nutritional factors built into the formulation. Thus the supply of protein is actually decreased by the processing required to produce a stable, utilizable foodstuff. The mechanism of this destruction and the factors which affect it have not been defined, and as a consequence the total effectiveness of nutritional supplementation of diets is considerably less effective than it should be. Even when these factors have been considered, the approach to the solution of the problem has in many cases been empirical. The interrelations between processing factors have not been defined; thus

under production circumstances it is difficult to specify the limits of variability that can be allowed in commercial processing.

In short, by our lack of knowledge as to the magnitudes of the effect of processing of vegetable protein, the implementation of programs supplying supplemental food materials to populations of less well developed countries is substantially hindered. The present study would define practical limits of processing variables which might be used in extrusion processing and thus help to develop products which are highly acceptable, ready to eat, inexpensive, and possess high storage stability.

Procedure: General Physical Arrangements.- It is intended that the proposed research project be a cooperative one between the University of California, Department of Food Science and Technology, and the University of Chile, Institute of Food Science and Technology. The University of California would be primarily concerned with the training of Chilean nationals in the techniques of analysis, processing, acceptability testing, and nutritional evaluation. Production facilities would be set up in the Food Science and Technology Institute in Chile. The feeding trials would be conducted in conjunction with the Department of Pediatrics of the University of Chile Medical School, under whose auspices a project is now underway. As a consequence, the major portions of the equipment, such as the extruder, which are requested in this grant, would be installed in the University of Chile. Research assistants, trained in the United States, would be transferred to Chile to undertake the experiments there, although it is intended to initiate the Chilean portion of the experiments as soon as the production equipment can be delivered and installed.

Arrangements have been completed with the Carnation Research Laboratories to undertake experimental runs on an extruder identical to the type requested for installation in Chile. The processing equipment in this case would be rented on an hourly basis.

Experimental Procedure: It is intended to investigate the variables of time, temperature, and pressure upon the extrusion process of vegetable-based protein foods which could be added to the Chilean diet to increase the available protein in the infant and pre-school population. The storage stability of the products produced under various conditions will also be

examined under typical Chilean conditions, utilizing practical packaging materials. In all cases the examination will be concerned with nutritional effectiveness and palatability. The following products will be of primary concern: sunflower seed meal, rapeseed meal, fish protein concentrates, fresh raw fish (to be combined in extrusion processing with cereals), corn, wheat, and local milk.

The choice of sunflower seed meal and rapeseed meal is dictated by the fact that Chile derives a major source of its edible oils from these two products, and the meals are readily available. As Chile is also a major fishmeal producer and has done some of the early work on fish protein concentrate, these products are included in the study. The inclusion of wheat in the study is dictated by the fact that the Chileans traditionally utilize a toasted wheat product in feeding of children and infants; however, as wheat is not in excess in Chile, this will not receive major emphasis.

In order to illustrate the types of studies to be carried out, the following work which has been underway at the University of California, is cited. It should be emphasized, however, that this work is not to be duplicated, and is not of major concern. It is used only to illustrate a generally applicable technique.

The P.E.R. of wheat protein is approximately .9, and may be increased to 1.6 by supplementation with 10% non-fat milk solids, as shown by studies of Beate *et al.* Widdoson and McCance studied this effect with children ages 5 to 15 and confirmed the effectiveness of such supplementation. Calculation of the theoretical amino acid content of a 9:1 mixture of whole wheat powder and non-fat dry milk indicates that 200 grams of the mixture would supply the daily human requirements of the essential amino acids. Table I shows the nutrient content of 200 grams of a mixture of this type and the percentages of the N.R.C. recommended daily allowances.

TABLE I
Nutrient Composition
180 Grams Whole Wheat Flour + 20 Grams NFMS

<u>Nutrient</u>	<u>Unit</u>	<u>Quantity</u>	<u>% Daily N.R.C. Requirement</u>
<u>Approximate Composition:</u>			
Moisture	Grams	22.3	-
Protein	"	33.7	48
Fat	"	3.8	-
Carbohydrate	"	134	-
Fiber	"	4.1	-
Ash	"	4.64	-
Calories (per 200 grams)		672	21
PER	Grams	1.6	

TABLE I (continued)

<u>Nutrient</u>	<u>Unit</u>	<u>Quantity</u>	<u>% Daily N.R.C. Requirement</u>
<u>Amino Acids:</u>			
Tryptophane	Mg.	386	154
Threonine	"	1008	201
Isoleucine	"	1492	213
Leucine	"	2044	186
Lysine	"	1600	200
Methionine	"	540	49
Cystine	"	590	74
Total Sulfur A.A.	"	1130	113
Phenylalanine	"	1432	130
Tyrosine	"	1158	106
Total Aromatic A.A.	"	2590	185
Histidine	"	624	208

In order to render the whole wheat edible, the material must be cooked to gelatinize the starch, and in order to insure a homogeneous mixture, the other ingredients must be pre-mixed before gelatinization. The gelatinization and homogenization can be carried out by the use of an expander such as the Anderson. The expander is a heat-jacketed screw press into which the ingredients are introduced and extruded through a heated die. The temperature in the jacket can be varied, as well as the pressure placed upon the materials in order to extrude them. If extrusion temperature is too low, gelatinization does not occur. This then sets a minimum temperature requirement for the process. Higher temperatures increase the rate of production and consequently lower the processing cost of the product. High temperatures also produce a product which requires no drying after extrusion, again keeping the cost to a minimum. Lower temperatures result in a wet product which must be dried by a separate process before it can be utilized.

Experiments were conducted in which the jacket temperature was varied between 210°F and 300°F. The most heat-sensitive components were introduced at the normal loading portion of the screw. It was found that changes in expander temperature of as little as 20°F would substantially decrease Protein Efficiency Ratio in rat feeding experiments. It was found, however, that the most heat-sensitive components (and in these experiments it was the milk) could be introduced at a point in the extruder where gelatinization of the wheat partially occurred, and thus it was possible to avoid subjecting

them to as long a thermal process as the wheat had to undergo. Major increases in Protein Efficiency Ratio were achieved in this manner. It was also found possible to post-mix a portion of the milk solids and still retain a moderately homogeneous product. This further increased protein retention.

In the experiments which are to be conducted on the oilseed meals available in Chile, the effect of different processing conditions would be studied with respect to the production of an acceptable and nutritional product. Correlations would be obtained between extruder temperature, introduction position of various components, extruder pressure, and protein availability.

In low temperature procedures there would be a necessity for air-drying some components, and the effect of air-drying upon protein availability and acceptability would also be studied.

The storage stability under various packaging conditions would be studied. Storage conditions would be as follows: room temperatures in air, room temperature under nitrogen, and 100°F in nitrogen for periods of one year. Samples would be taken at the end of six months and one year to determine changes that might occur in the amino acids and P.E.R. value. Although no changes might be noted in amino acid composition, changes due to the oxidation of residual lipid materials could significantly alter the P.E.R.

The products would be tested for protein availability, using a conventional rat assay for protein efficiency, and the amino acid composition would be determined by the Moore and Stein ion exchange techniques. The ion exchange techniques have been found satisfactory in our previous studies.

Changes in palatability of the mixtures would be determined utilizing taste panels and the confusion matrix technique or the paired comparison methods.

The effectiveness of the more technologically promising processes will be utilized to produce products which will then be tested for their nutritional effectiveness on infants in the Department of Pediatrics (University of Chile Medical School) and subsequently their general acceptability will be measured on the target population already being utilized for the testing of simple non-processed mixtures by the same group.

Facilities Available: A complete pilot plant for food processing is available at the University of California. This includes drying and sifting equipment. No expander is available, but arrangements have been made with the Carnation

Research Laboratories to allow the use of their Anderson extruder in experiments. These arrangements include the training of Chileans on the operation of the unit. The cost agreed upon was \$15.00 per hour of operating time.

The University of Chile, Institute of Food Science and Technology, has a small pilot plant for food processing. It does not own an expander nor grinding equipment, and therefore it is proposed that an Anderson extruder and a Fitz mill be purchased and located in the Department's pilot plant. Sifting and drying equipment is available. The pilot plant has a sufficient supply of steam and electricity to allow the installation of the required equipment.

Both institutions are equipped with complete laboratory facilities, and the University of Chile, through its Department of Pediatric Nutrition of the Medical School under the direction of Dr. Fernando Monckeberg, maintains a metabolic unit which is to be used for studies in infant populations.

There is a record of cooperation in projects between the two institutions and many of the individuals in administrative positions in the Food Science and Technology Institute in Chile have been trained in the Department of Food Science and Technology in the University of California.

An additional amino acid analyzer is requested, since the ones in the possession of the two departments are at the present time running very close to capacity.

No packaging equipment is requested since the University of Chile possesses such equipment.

6. Personnel.

Principal Investigator: C. O. Chichester Title: Professor
Date of Birth: 2/11/25 City and State of Birth: Brooklyn, New York
Present Citizenship: U.S.A. Sex: Male

Educational Experience:

Degree	Institution conferring	Fields	Year
B.S.	Mass. Institute of Tech.	Chem. Eng.	1949
M.S.	Univ. of Calif., Berkeley	Food Sci.	1951
Ph.D.	Univ. of Calif., Berkeley	Biochem.	1954

Fields of Present Major Scientific Interest: Plant Biochem., Nutrition

Publications:

- Luh, B. S., C. O. Chichester, W. Gudel, y R. Perez. Evaluacion de los alimentos enlatados venezolanos. Arch. Venezolanos de Nutricion, Caracas. XIV: 151-166.
- Chichester, C. O. Agricultural and food technology in Uruguay. Nutritional Survey of Uruguay. ICNND I: 203-281.
- Slavetz, L. W., C. O. Chichester, A. R. Gauvin and Z. J. Ordal. Microbiological Quality of Foods. Proceeds. of a conf. at Franconia, N. Hamp. (Univ. of N. H.). Academic Press, 290 pp.
- Simone, M., N. Sharrah and C. O. Chichester. Instant bread mix: Variations in flavoring composition. Food Tech. 16: 93-96.
- Chichester, C. O., N. Sharrah, and M. Simone. Instant bread mix: Studies on the dehydration of flavoring materials. Food Tech. 14: 653-656.
- Simone, M., N. Sharrah and C. O. Chichester. Instant bread mix: Consumer evaluation of prepared bread. Food Tech. 14: 657-661.
- Chichester, C. O. Preservation of organoleptic properties and storage problems in freeze-dried foodstuffs. In Aspects Theoriques et Industriels de la Lyophilisation (ed. L. Rey), pp. 571-579. Nermann, Paris, July 1964.
- Simpson, K. L., T. O. M. Nakayama and C. O. Chichester. Biosynthesis of yeast carotenoids. J. Bact. 88: 1688-1694.
- Davies, B. H., W. J. Hsu, and C. O. Chichester. The metabolism of carotenoids in the brine shrimp. Biochem. J. 94: 26.
- Hsia, C. L., B. S. Luh, and C. O. Chichester. Anthocyanin in freestone peaches. J. Fd. Sci. 30: 5-12.
- Nakayama, T. O. M. and C. O. Chichester. Part III: Pigment changes in senescent and stored tissue. in Chemistry and Biochemistry of Plant Pigments (ed. T. W. Goodwin), pp. 438-457. Academic Press, London.
- Luh, B. S., H. Co, S. J. Leonard, and C. O. Chichester. Factors influencing storage stability of canned tomato paste. Food Tech. 18: 159-162.
- Berg, H. W., C. S. Ough, and C. O. Chichester. The prediction of perceptibility of luminous-transmittance and dominant wave-length differences among red wines by spectrophotometric measurements. J. Food Sci. 29: 661-667.
- Simpson, K. L., T. O. M. Nakayama, and C. O. Chichester. The biosynthetic origin of the carboxyl oxygen atom of the carotenoid pigment, torularhodin. Biochem. J. 92: 508-510.
- Schanderl, S., G. L. Marsh and C. O. Chichester. Color reversion in processed vegetables. I. Studies on regreened pea purees. J. Food Sci. 30: 312-316.

(Publications, cont. - C. O. Chichester)

Schanderl, S., G. L. Marsh and C. O. Chichester. Color reversion in processed vegetables. II. Model system studies. 30: 317-324.

Creasy, L. L., E. C. Maxie, and C. O. Chichester. Anthocyanin production in strawberry leaf disks. Phytochem. 4: 517-521.

Yasumatsu, K., T. O. M. Nakayama, and C. O. Chichester. Flavonoids of sorghum. Food Sci. 30: 663-667.

Yamamoto, H. Y. and C. O. Chichester. Dark incorporation of $18O_2$ into antheraxanthin by bean leaf. Biochim. Biophys. Acta 109: 303-305.

Pinto, A., and C. O. Chichester. Changes in the content of free amino acids during roasting of cocoa beans. J. Food Sci. 31: 726-732.

Chichester, C. O. Nutritional Effects of Processing. Abstract, VII International Congress of Nutrition, 1966.

Co-Principal Investigator: Alvaro Pinto A. Title: Professor

Date of Birth: 11/18/35 Country of Birth: Chile

Present Citizenship: Chile Sex: Male

Educational Experience:

<u>Degree</u>	<u>Institution Conferring</u>	<u>Fields</u>	<u>Year</u>
Ingeniero Agronomo	School of Agron., Univ. of Chile	Agron.	1961
M.S.	University of California, Davis	Fd. Sci.	1965

Publications:

Pinto, A. Contribution to the study of the bacterial flora present in canned peas. (Thesis).

Pinto, A. Food Technology. Textbook published for use of students.

Pinto, A. Project for the creation of regional courses for food technicians (to be given at the Regional University College of the University of Chile.

Pinto, A. and C. O. Chichester. Changes in the content of free amino acids during roasting of cocoa beans. J. Food Sci. 31: 726-732.

Field of Present Major Scientific Interest: Food Science

Co-Investigator: Fernando Monckeberg Title: Professor of Pediatrics

Department of Nutritional Biochemistry, University of Chile

Publications:

Donoso, Gonzalo and Monckeberg, Fernando. Progress Report (up to August 1966) for "A Nutritional Survey in Chile, S.A." (PH 43-65-572).

Non-expendable Equipment:

Expander and auxiliary equipment (to be installed in Dept. of Food Science & Technology, Chile) estimated	\$ 25,000
Amino Acid Analyzer	12,000
Fitz Mill Model M5 with screens (to be installed in Chile	2,700

Expendable:

Protein sources (sunflower seed meal, rape seed meal, fish, etc.)	1,000
Miscellaneous chemicals	1,500
Animals	500
Miscellaneous small equipment	1,500
(All of these will be consumed in the project)	

Travel:

3 Trips per year to and from Chile - various personnel in the project, depending upon need; each trip will be of approximately 20 days duration	3,600
Local travel	400

Publication Costs:

(Journal papers and reprints)	500
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Rental of Expander Facilities in Los Angeles 1,500

Transportation of Equipment and Raw Materials
Chile-U.S.-Chile 600

Secretarial Help: 700

Indirect Costs - 42% wages & salaries 6,636

FIRST YEAR TOTAL \$ 74,636

Second Year

<u>Personnel</u>	<u>Percent Time (%)</u>	<u>Salary</u>
Principal Investigator: C.O. Chichester	15	-0-
Co-Prin. Investigator: Alvaro Pinto A.	25	-0-
Summer	100	\$ 2,000
Co-Investigator: Fernando Monckeberg	10	-0-
3 Research Assistants (in U.S. & Chile)	60	11,100
Hourly Help (in U.S. & Chile)	-	2,000
Consultant Fees: 20 days @ \$70.00	-	1,400

Non-expendable Equipment:

Miscellaneous equipment with a life of over one year 1,500

Third Year Budget (continued)

Travel:

3 trips per year to and from Chile - various personnel
in the project, depending upon need; each trip will
be of approximately 20 days duration \$ 3,600
Local travel 250

Publication Costs:

It is intended to publish and distribute a summary
publication to government and industry 800

Secretarial Help: 700

Indirect Costs - 42% of wages & salaries 6,636

TOTAL FOR THIRD YEAR \$34,486

9. Other research projects currently being undertaken by the Principal Investigator:
"Transformation of Carotenoids in Foods" - National Institutes of Health (USPHS) -
\$21,374 - 1/1/66 - 12/31/66
10. None.



COLLEGE OF AGRICULTURAL AND
ENVIRONMENTAL SCIENCES
DEPARTMENT OF FOOD SCIENCE
AND TECHNOLOGY

DAVIS, CALIFORNIA 95616

January 16, 1970

Dr. Irwin Hornstein
Science Research Officer
Office of Nutrition
Department of State
Agency for International Development
Washington, D. C. 20523

RE: Contract AIB/csd-1587

Dear Dr. Hornstein:

I am enclosing the information requested in your letter of December 29, 1969. Interestingly enough, that letter was only received in my office on the 6 January. I have recently received another letter from your same building from Mr. Cordaro which took even longer to arrive in California. I wonder as to the mail service from your office.

I am somewhat puzzled by the period indicated in your letter - March 31, 1970 - December 29, 1970. In the proposal that was negotiated last year, the proposed ending date was March 31, 1971 -- in other words, a year of additional work after this March. This is noted in the negotiation in March, April and May 1969 and was submitted in the extension of the present contract, and as far as I am aware was incorporated into the contract.

I therefore have written the extension based upon your date as well as the remaining three months (e.g., Jan. 1, 1971 - March 31, 1971), utilizing the budget breakdown used originally.

I have developed the budgetary figures based upon direct costs, since our auditors inform us that the overhead costs are negotiated in this type of contract, and may vary rather widely depending upon which category of funds is utilized in a specific case. I assume that in most of the submission you, as Contract Officer, look primarily at these figures. We have been paying the personnel off-campus under direct costs on which there is no overhead. Normal overhead is 45% of Wages and Salaries; therefore I believe this overhead will only apply to on-campus salaries.

Could you indicate to me when you will have an opportunity to discuss this contract and the Summary Report that I submitted?

Sincerely,

C. G. Chichester

Chairman

Encl. #8

COC:dib

Enclosures: 1) Extension Request
2) 3 pages of budget sheets

Extension Request: Contract AID/cas-1587

A. Project Work Plan:

April 1, 1970 - Dec. 31, 1970 - March 31, 1971 - Sept. 30, 1971

- 1) Acceptability studies of flavored and fortified (vitamins and minerals) expanded wheat - sunflower meal - milk will be conducted in school and pre-school human populations. (Completion Dec. 31, 1970) -- This work is underway and should be completed in the period specified.
- 2) Products of expander processing consisting of mixtures of a) raw fish, wheat; b) corn, wheat; and c) rapeseed meal, wheat will be tested for acceptability by the use of taste panels and for nutritional effectiveness by amino acid analysis of the hydrolyzed product, and biologically by animal feeding experiments. (Completion March 31, 1971)
- 3) The toxicity testing of rapeseed protein isolates and detoxified rapeseed meals will be continued, since these are long-term animal feeding experiments. (Completion September 30, 1971)
- 4) One of the advantages of expander processing is in the delivering of a product of high sanitary quality. Therefore the microbiological effectiveness of expander processing will be determined by plate counts of raw materials entering the expander and those obtained after expansion. Primary work will be conducted on the Leche Alm formula (wheat, milk solids, sunflower meal and fish protein concentrate). The actual reduction in plate counts will be measured by the comparison of the quality of the starting materials with that of the finished material. This is important, particularly if the formula is to be used on a large scale. (Completion December 31, 1970)
- 5) Storage stability studies will be made of the products mentioned in Alm 2. (Completion March 31, 1971)

- 6) Expander runs will be made on a modified Lache Alin formulation in which the majority of proteins will be derived from plant sources. The amino acid pattern of the protein will be adjusted by amino acid fortification. Its nutritional qualities will be tested in animal experiments, in human infants, and in populations. (Completion September 30, 1971) -- Note: This is a modification of the aims of the original project, which did not consider amino acid fortification. It is now included to cover the contingency of the non-availability of fish protein concentrate.
- 7) Nutritional quality and acceptability of expander-processed products with added hydrogenated fish oil will be determined. This should allow the production of a higher caloric density, which is more nutritionally desirable for infants and preschool children. (Completion September 30, 1971)

THE RECEIPTS OF THE UNIVERSITY OF CALIFORNIA
ACCOUNTING OFFICE

FISCAL REPORT

Contract No. AID/csd 1587

Oct. 31, 1969

Report No. 14.

<u>Category</u>	<u>Budget Amount</u>	<u>Total Expenditures</u>	
		<u>This Period</u>	<u>To Date</u>
Salaries	\$ 48,900.00	\$	\$
a. On-Campus		-0-	2,494.27
b. Off-Campus		3,685.00	8,840.59
Staff Benefits	-0-	117.32	406.86
Travel & Transportation	14,250.00	797.50	4,234.76
Equipment	47,200.00	-0-	35,047.01
Supplies	11,500.00	3,770.05	9,011.41
Other Direct Cost	13,100.00	1,604.04	2,306.42
Overhead	11,600.00		
a. On-Campus		-0-	1,097.48
b. Off-Campus		.847.55	2,033.34
Consultants	10,250.00	-0-	1,100.00
Coop. Country Natl's.	700.00	-0-	-0-
Total	\$157,500.00	\$10,821.46	\$66,572.14

"The undersigned hereby certifies: (1) that payment of the sum claimed under the cited contract is proper and due and that appropriate refund to AID will be made promptly upon request of AID in the event of nonperformance, in whole or in part, under the contract; and (2) that information on the fiscal report is correct and such detailed supporting information as the AID may require will be furnished at the Contractor's home office or base office as appropriate promptly to AID on request."

BY

J. J. Polk

J. J. POLK

TITLE

Accountant-in-Charge
Extramural Division

DATE

1/9/70

LJP/NC/tdw

Enclosures

BUDGET

Firm Budget Estimate of Extension

April 1, 1970 through December 31, 1970

Personnel	
On-Campus	\$ 4,130
Off-Campus	24,800*
Equipment	5,000
Supplies	5,250
Travel	3,600
Consultants	1,500
Other Direct Costs	<u>800</u>
TOTAL	\$45,080

* This may appear as direct costs under
out existing method of payment.

Dec. 31, 1970 through March 31, 1971

Personnel	
On-Campus	\$ 1,370
Off-Campus	8,150
Equipment	-0-
Supplies	1,750
Travel	1,300
Consultants	500
Other Direct Costs	<u>-0-</u>
TOTAL	\$13,070

BUDGET

Firm Estimate of Expenditures

Nov. 1, 1969 through March 31, 1970

Personnel	
On-Campus	\$ 2,500
Off-Campus	15,500*
Equipment	11,500
Supplies	5,000
Travel	2,500
Consultants	<u>1,400</u>
TOTAL	\$38,400

* This may appear as direct costs under our existing method of payment.

DEVELOPMENT OF NEW TYPES OF FISH PROTEIN CONCENTRATES

Project = 751-7-5-01082
Introduction CS-1587

The problem of malnutrition and lack of adequate protein sources in Chile brings together a series of difficulties in different areas of the country's economy and national health. This protein deficiency is a direct cause, among other things, of the dramatic infant mortality rate which, according to the 1964 statistics, reaches 106 per thousand for children between 0 and 1 year old, of the intolerable degree of mental deficiency, and of the high percentage of illness caused by malnutrition.

The Fisheries Development Institute (IFOP) has always tried to maintain contact with pediatric and nutrition investigation centers, that have studied these subjects intensively, in order to have a clear picture of how to contribute with its efforts to the solution of this serious Chilean and Latin-American problem.

The problem of protein deficiency has some other ramifications, that IFOP has considered of great economic importance. It is general knowledge that protein deficiency is partly caused by the irrational use and erroneous marketing of milk products by the dairy industry. It was estimated from the 1965 livestock census that 172 million liters of milk are consumed annually for rearing calves to weaning age; these figures represent 22.6% of the annual milk deficit in Chile (762 million liters). In spite of this amount of milk being assigned for rearing calves, according to the same census, over 351,000 calves were being slaughtered annually in order not to aggravate this deficit even more. In other words, a satisfactory calf milk replacer could result in saving the country 50 percent of its present meat importations and increase existing milk supplies by over 20 percent. The economic importance of this can be appreciated from the fact that in 1965 Chile spent nearly 25 million dollars on meat imports and over 7 million dollars on milk.

Based on these considerations, IFOP initiated investigations toward the attainment and development of a partial or total milk substitute for rearing calves and of a fish protein concentrate of the highest quality for human consumption, very especially for school and pre-school children.

Founded upon earlier investigations carried out abroad, research was initiated by the Fisheries Development Institute into finding a solution to the physical and organoleptical problems which had previously prevented fish protein from being accepted by young calves. These problems were solved and small scale production of a fish protein concentrate was initiated. Calf feeding trials were conducted and it was shown that calves could be reared to weaning age without consuming milk in any form.

Although the production of this calf milk replacer has been done only on a small scale with equipment that can still be improved, a rough economic evaluation indicates that the price per unit protein in the concentrate is approximately 50 percent less than the cost per unit protein in skim milk powder.

Data gathered from previous investigations are sufficiently positive to warrant further work in the same direction, perfecting the product on a larger pilot plant scale and carrying out new calf feeding trials.

With respect to the fish protein concentrate (FPC) for human consumption it is worthwhile to note that some time ago a FPC plant was erected in Quintero; the process was based on solvent extraction of fish oil from the raw material. Engineering problems which could not be solved in a short time and which in turn fell into the high cost of the product, made the continuation of the project impossible.

Based on these facts, IFOP decided to attempt the manufacture of a fish protein concentrate for human consumption by means of enzymatic hydrolysis but avoiding, by means of adequate procedures, the typical defects of products so obtained. In these experiments IFOP has worked so far on a laboratory and semi pilot plant scale, and has obtained a product that complies entirely with the requisites for this type of protein concentrate. The fish protein concentrate so obtained is a white powder, bland, non-hygroscopic, practically odorless with no

fishy taste, and with a slight bitter after-taste. It is completely soluble in water and, once dissolved, is stable (it does not decant). The protein content which can be varied between 50 and 90 percent, with an available lysine content of 8.9 mgs./100 gms of total protein.

Samples of this product have been sent to specialized laboratories of the Universidad de Chile to determine its biological value, and to carry out toxicological tests. Results are expected in about three weeks from this date.

Obviously it is very difficult to work out a cost evaluation at this stage of the investigation; nevertheless very rough estimates permit us to predict that the cost per unit protein will be significantly lower than that of skim milk powder. Due to the simplicity of the manufacturing process of this FPC, it has been estimated that the final price for a product of this kind will be competitive with respect to that of skim milk powder.

In summary, IFOP has developed a manufacturing process for a calf milk replacer from lean fish (i.e. hake) and, based on the same raw material and on the early stages of the same process, has obtained a fish protein concentrate of high quality for human consumption. Biological assays are being carried out and it is now necessary to carry out experiments on a pilot plant scale.

2.- Objectives

As far as the fish protein concentrate for human consumption is concerned, the main objective of the Project is to continue with the line of investigation already mentioned, emphasizing the following aspects:

- a) To obtain more complete data on the enzymatic reaction at the laboratory level, so as to optimize the process and to improve the quality of the product.
- b) To design and install equipment for production on a pilot plant scale, flexible enough so as to permit feasibility studies and to assure the necessary production for other studies (i.e. nutritional studies, etc.).

- c) To carry out microbiological studies, together with studies toward obtaining more information on the stability of the product, in terms of proper storage, spoilage, packaging, etc.
- d) To run further biological and toxicity investigations, in order to determine the PDI, PER, amino-acid composition, etc. of the product.
- e) To study the addition of other nutritive sources such as carbohydrates, lipids, etc. to this type of food.

With respect to fish protein concentrate for animal consumption (calf milk replacer), the main objectives are:

- a) To continue with the nutrition studies in collaboration with a specialized animal husbandry research center and, according to the data and results obtained, to modify the composition and physical properties of the product in order to improve even more its nutritive values by means of introducing variations in its sources of lipids, carbohydrates, etc.
- b) To install definitely a pilot plant in order to produce sufficient quantities for other biological studies, and to make sounder feasibility studies.
- c) To carry out more complete microbiological studies on the product and also to evaluate the stability of the calf milk replacer under various conditions, in terms of spoilage, proper storage and packaging conditions.

Many of the storage, microbiological, and packaging studies are common for both products.

3.- Department, cooperating agencies and personnel

The Technology Department of the Fisheries Development Institute is a chemical and technological division responsible for many varied investigations of fish products. Preparation, nutrition and preservation are the larger areas currently under investigation.

The Department has the following Sections:

- 1.- Biochemistry
- 2.- Bio Engineering
- 3.- Regional Laboratories.

The Project on Fish Protein Concentrates is being carried out in this Department in collaboration with the Economic Studies Department of the Institute.

The Biochemistry and Bio Engineering Sections have facilities for microbiological studies, and laboratories for chemical, biochemical and pilot plant work. The laboratories have sufficient space for 20 people, and in them all the preliminary work of this project has been carried out.

The pilot plant, which is being enlarged at the present time, is about 200 sq meters in surface and possesses complete facilities for canning, smoking, drying, refrigerating, etc.

Each Section has a manager assisted by a team of technical and scientific personnel. The staff amounts to about 55, of which approximately 25 are professionals with degrees in Engineering, Chemistry, Biochemistry, Food Science and Technology, and Fisheries Technology. To improve the level of its technological research, IFOP is planning to bring from abroad specialists in various fields such as microbiology, food packaging and canning.

In the Fish Protein Concentrate Project the following personnel are actively participating:

- Claudio Romo: Head, Technology Department. Chemist. Master's Degree Oregon State University, Dept. Food Science and Technology.
- Max Rutman: Head, Bio Engineering Section. Chemical Engineer. Master's Degree Massachusetts Institute of Technology, Dept. of Nutrition and Food Science.
- Emilio Contreras: Head, Biochemistry Section. Chemist.
- Wilhelm Heimlich. Chemist. Studied at School of Chemistry University of California, Berkeley.
- Valerio Bifani. Chemical Engineer. Graduate Studies in Food Science and Technology at Universidad de Chile in collaboration with University of California, Davis.
- Ruth Gallardo. Fisheries Technologist.

- Pedro Miranda. Fisheries Technologist.
- Fresia Venegas. Chemist.
- Iván Asenjo. Fisheries Technologist.
- Hilarión Gómez. Economist.

4.- Financing. Equipment and Materials

By means of this Project IFOP intends to establish a well-equipped Chemical and Biochemical laboratory to continue its investigations on fish protein concentrates, with the objectives already mentioned.

The contribution from AID would be directed essentially to finance the purchase of equipment and materials for laboratory and pilot plant experiments, and, in addition, to establish contracts with collaborating institutions abroad doing similar studies.

EQUIPMENT AND MATERIALS TO BE PURCHASED FOR THE PROJECT

<u>Item</u>	<u>Quantity</u>	<u>US\$</u>
1. Spray Miro Atomizer Model Minor Production	1	12,000
2. Air Compressor	1	1,400
3. Reactor Kestner, Type 3H	1	1,500
4. Spectrophotometer U.V. visible, with accessories	1	5,300
5. Rotary evaporator with accessories	1	750
6. Pasteurizer. Alfa Laval	1	3,800
7. Pilot Plant Evaporator	1	10,000
8. Refrigerated Centrifuge, high speed accessories	1	4,000
9. Warburg Respirometer	1	1,500
10. Hammer Mill	1	2,000
11. Reagents	-	3,000
12. Measuring Instruments. Pilot Plant	-	2,000
13. Laboratory Fermentor	1	5,000
14. Sanitary Pumps	4	1,000
15. Stainless Steel Pipes and Fittings	-	2,000

<u>Item</u>	<u>Quantity</u>	<u>US\$</u>
16. Vacuum Plastic Container Sealer, with inert gas injection	1	9,500
17. Laboratory Fraction Collector	1	1,400
18. Viscometer High & low speed	2	1,700
19. Pilot Plant Centrifuge	1	1,500
20. Heat Separator, Pilot Plant	1	2,500
21. Various laboratory equipment	-	6,000
22. Variable Speed Motors	-	1,000
23. Microbiology Ovens, Incubators, etc.	-	1,200
24. Milk Homogenizer	1	1,300
25. Refrigerated Tank	1	1,000
26. Temperature-Registering Devices	2	5,000
27. Fluidizer	1	2,500
28. Gas Chromatograph	1	6,000
27. Various	-	<u>3,150</u>
TOTAL US\$		100,000

5.- Fisheries Development Institute Contribution

	<u>E²</u>	<u>US\$</u>
1. Pilot Plant and Laboratories (Chemistry, Biochemistry, Microbiology (400 sq mts.))		40,000
2. Equipment		38,000
3. Raw materials		5,000
4. Salaries (per year) 10 professionals	700,000	70,000
5. Service		10,000
6. Travel		5,000
7. Administration		<u>5,000</u>
TOTAL US\$		173,000

Project Title Effects of Extrusion Processing Variables

Project Number 931-17-560-482

Starting Date 6/30/67 Termination Date 12/29/70

Cumulative Obligations June 30, 1968 \$108,000
FY 1969 Actual 50,000
FY 1970 Estimate 50,000
FY 1971 Proposed ---

Name of Contractor(s) University of California

Contract Number(s) csd 1587

Cooperating Sponsor(s) _____

Project Summary (RAC)

Date of FROM 1/17/67 Date Approved 2/20/67 Evaluation Date (PRR) 3/3/69

Purpose

To study the effects on the nutritional quality and acceptability of low cost protein foods prepared by extruder processing utilizing different combinations of pressure, temperature and time

Description of Activity

The Institute of Food Science and Technology in Chile is developing techniques for the production of high protein mixes based on wheat, Fish Protein Concentrate (FPC) dried milk powder, and safflower seed meal that are suitable for extruder processing. These mixes are fortified, as required, with vitamins, minerals and flavors. The finished products are evaluated by the Laboratory of Pediatrics for toxicity and nutritional quality in animal studies. Final evaluations, if warranted, are done on human infants under controlled hospital conditions.

Accomplishments

In October 1968 a pilot-scale Wenger extruder was made operational in Chile. Preliminary tests were made with similar equipment in the USA to define operational parameters for the processes of food mixes prepared with combinations of wheat, defibered sunflower meal, dried milk powder and FPC. Acceptability and the nutritional value of finished products in these preliminary tests, were good.

Future Targets

It is planned to produce food mixture adaptable to child feeding and tailored to different population segments. The ultimate goal is to have these foods prepared commercially, once the required techniques have been developed for producing high quality, low cost foods.

RESEARCH

Technical Assistance Bureau

21

Major Types of Activity Development of Highly Nutritious Low-Cost Food Products

Project Title Effects of Extrusion Processing Variables
 Project Number 931-17-560-482 RAC Date PRAP Project Summary
 FKK. 2-20-67 Approved 1-17-67
 Name of Contractor University of California Contract No. csd 1587
 Starting Date Obligation FY 1967 Termination Funding FY 1972
 Work 6-30-67 Date Work 12-29-72
 Project Monitor I. Hornstein Extension 29771

Funding Data
 (in thousands)

	U.S. Contribution		
	Oblig.	Expend.	Unliquidated
Cumulative through 6/30/69	158	121	37
FY 1970	36	60	13
FY 1971	50	50	13
FY 1972	75	70	18

Project Target and Course of Action

To study the effects on the nutritional quality and acceptability of low cost protein foods prepared by extruder processing utilizing different combinations of pressure, temperature and time.

The Institute of Food Science and Technology in Chile is developing techniques for the production of high protein mixes based on wheat, Fish Protein Concentrate (FFC) dried milk powder, and safflower seed meal that are suitable for extruder processing. These mixes are fortified, as required, with vitamins, minerals and flavors. The finished products are evaluated by the Laboratory of Pediatrics for toxicity and nutritional quality in animal studies. Final evaluations, if warranted, are done on human infants under controlled hospital conditions.

Accomplishments to Date

In October 1968 a pilot-scale Wenger extruder was made operational in Chile. Preliminary tests were made with similar equipment in the USA to define operational parameters for the processes of food mixes prepared with combinations of wheat, defibered sunflower meal, dried milk powder and FFC. (a) "Leche Alim," a highly nutritive mixture of sunflower meal, FFC, NFDM and wheat flour has been found acceptable in limited studies with children. (b) Gelatinization by extrusion at 110°C of the Leche Alim formulation produces a superior product both nutritionally and organoleptically. (c) Micro-biological assays of extruded versus non-extruded products show a major reduction of viable micro-organisms in the

extruded products (d) A procedure for removing toxic factors from rapeseed meal has been developed. Rapeseed meal may replace sunflower seed protein in animal feeds releasing the latter for human consumption.

FY 72 Program and Future Targets

(a) Optimum processing conditions for a variety of cereal mixtures will be determined (b) The acceptability of "Leche Alim" by school children will be tested on a large scale.

9310482-1 (9)

U/C 259

PD-AAC-808

AID 1350-1X
(7-71)

DEPARTMENT OF STATE
AGENCY FOR
INTERNATIONAL DEVELOPMENT

1. Cooperating Country
Worldwide

Page 1 of 4 Pages

PIO/T

PROJECT IMPLEMENTATION
ORDER/TECHNICAL
SERVICES

2. PIO/T No.
931-17-560-482-73-3127632

3. Original or
Amendment No. 7

4. Project/Activity No. and Title
**The Development of Infant and Pre-School Foods
Based Upon Indigenous Proteins**

DISTRIBUTION

5. Appropriation Symbol
72-1121004

6.A. Allotment Symbol and Charge
254-31-099-00-22-21

6.B. Funds Allotted to:
 A.I.D. AV Mission

7. Obligation Status
 Administrative Reservation Implementing Document

8. Funding Period (Mo., Day, Yr.)
From **7/1/72** To **12/30/72**

9.A. Services to Start (Mo., Day, Yr.)
Between **6/7/72** and **6/30/72**

9.B. Completion date of Services
(Mo., Day, Yr.) **12/30/72**

10.A. Type of Action
 A.I.D. Contract Cooperating Country Contract Participating Agency Service Agreement Other

10.B. Authorized Agent
AD/P

Estimated Financing		(1) Previous Total	(2) Increase	(3) Decrease	(4) Total to Date
11. Maximum A.I.D. Financing	A. Dollars		\$28,951		\$28,951
	B. U.S.-Owned Local Currency				
12. Cooperating Country Contributions	A. Counterpart				
	B. Other				

13. Mission References

14. Instructions to Authorized Agent

This PIO/T provides funding for 6 months for the restructuring and initiation of the first phase of a project proposal entitled "The Development of Infant and Pre-School Foods Based Upon Indigenous Proteins." On completion of the restructured proposal it will be submitted to RIGC and RAC for approval.

15. Clearances - Show Office Symbol, Signature and Date for all Necessary Clearances.

A. The specifications in the scope of work are technically adequate.	B. Funds for the services requested are available.
C. The scope of work lies within the purview of the initiating and approved Agency Programs.	D.
E.	F.

16. For the cooperating country: The terms and conditions set forth hereon are hereby agreed to

17. For the Agency for International Development
6/29/72

Signature and date:

Signature: **R.J. O'Brien**
Title: **Contracting Officer**

3646
Note. 4

AID 1390-1X (8-70)	Cooperating Country Worldwide	PIO/T No. 931-17-560	Page 2 of 4 Pages
PIO/T	Project/Activity No. and Title The Development of Infant and Pre-School Foods Based Upon Indigenous Proteins.		

SCOPE OF WORK

19. Scope of Technical Services

A. Objective for which the Technical Services are to be Used

B. Description

See Attachment A

C. Technicians

See budget attachment

(1) (a) <u>Number</u>	(b) <u>Specialized Field</u>	(c) <u>Grade and/or Salary</u>	(d) <u>Duration of Assignment (Man-Months)</u>
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(2) Duty Post and Duration of Technicians' Services

N/A

(3) Language requirements

N/A

(4) Access to Classified Information

Not required

(5) Dependents Will Will Not Be Permitted to Accompany Technician

D. Financing of Technical Services

(1) By AID - \$ 22,201

(2) By Cooperating Country -

AID 1289-1X (8-20) PIO/T	Cooperating Country	PIO/T No.	Page 3 of 4, Pages
	Work Order No. and Title	931-17-560-	
The Development of Infant and Pre School Foods Based Upon Indigenous Protein			

20. Equipment and Supplies (Related to the services described in Block 19 and to be procured outside the Cooperating Country by the supplier of these services)

A. (1) Quantity (2) Description (3) Estimated Cost (4) Special Instructions

See budget and Project Statement attachments

B. Financing of Equipment and Supplies

(1) By AID - \$ 6,750

(2) By Cooperating Country -

21. Special Provisions

- A. This PIO/T is subject to AID (contracting) (PASA implementation) regulations.
- B. Except as specifically authorized by AID, or when local hire is authorized under the terms of a contract with a U.S. Supplier, services authorized under this PIO/T must be obtained from U.S. sources.
- C. Except as specifically authorized by AID/W, the purchase of commodities authorized under this PIO/T will be limited to the U.S. under Geographic Code 000.
- D. Other (specify):

AID 1850-1X (B-70)	Cooperating Country Worldwide	PIO/T No. 931-170560	Page 4 of 4 Pages
PIO/T	Project/Activity No. and Title The Development of Infant and Pre-School Foods Based Upon Indigenous Proteins.		

22. Reports by Contractor or Participating Agency (Indicate type, content and format of reports required, including language to be used if other than English, frequency or timing of reports, and any special requirements)

See Attachment B, January 20, 1972, "Guidelines for Preparation of the Research Annual Report"

Reports

The Contractor shall comply with the reporting requirements set forth in General Provision 16., Reports, except as may be modified herein. The Contractor shall prepare and submit to the Project Manager, Dr. I. Hornstein, TA/M Research Officer, A.I.D., Washington, D.C. 20523, thirty-five (35) copies of a final report prepared in the format as specified in Attachment B "Guidelines for Preparation of the Research Annual Report" dated January 20, 1972, describing the status of the work; changes in research personnel; management information deemed necessary; detailed information on expenditures of project funds as well as scientific progress and summarizing the accomplishments of the assignment; methods of work used; and recommendations regarding unfinished work and/or program continuation. The final report shall be submitted within 45 days after completion of the work hereunder unless this period is extended in writing by the Contracting Officer.

23. Background Information (Additional information useful to Authorized Agent and Prospective Contractors or Participating Agency; if necessary cross reference Block 19.C(4) above.)

Contract: Dr. C.O. Chester, Dept. of Food and Resource Chemistry, Woodward Hall
University of Rhode Island; Kingston, Rhode Island 02881 Tel: (401)792-2466

(a) TA/N, Dr. I. Hornstein, Research Officer, AID/W

Reference: Prior AID/csd-1587

24. Relationship of Contractor or Participating Agency to Cooperating Country and to AID

A. Relationships and Responsibilities

B. Cooperating Country Liaison Official

C. AID Liaison Officials

ATTACHMENT "A"

STATEMENT OF WORK

For the period as set forth in the Schedule, the Contractor shall make available and employ its research and development facilities and personnel at the level of effort specified in the Schedule, and shall perform a research and development program directed toward the development of infant and pre-school foods based upon indigenous proteins.

A. General Objectives

This research project is a continuation of the work previously performed under Contract A.I.D./csd-1587 with the University of California at Davis. The effort is concerned with the development of infant and pre-school foods based upon sources of proteins available in the southern Latin America region.

B. Services to be Performed

The Contractor shall continue the work previously performed under Contract AID/csd-1587 with the University of California. Specifically, acceptability data on Leche Alim in a 2000 member population group shall be correlated with psychological questionnaire data. The physical measurements must be interpreted in the light of the sociological or psychological reactions of the population. Initial results of this large scale acceptability and attitude study have already been reported, but the six month period will be utilized partly to assemble the data so that it may be published as scientific literature and distributed to agencies which have similar projects underway.

Plans for a large scale marketing survey of Leche Alim and Fortesan (a pre-cooked, instantly soluble soy-wheat milk blend) shall be developed for submission to A.I.D. This work will require liaison between the Catholic University of Santiago, the University of Concepcion, and the groups in INTEC and the University of Chile. Definitive plans for market promotion of these product with industrial firms shall be developed. Cooperation is available from the Nestle Corporation and several small private groups. In particular, a better liaison will be developed between the school feeding program in Chile and the research groups.

Work already initiated on the acceptability of Fortesan in children shall be continued utilizing orphanages in Santiago as initial test units. Data on growth rates (height and weight changes) and selected blood parameters shall be obtained under medical supervision.

Plans shall be formulated to utilize a population of over 1000 pre-school children to determine the acceptability and marketability of Fortesan in comparison with 12% fat milk and Leche Alim. The study is anticipated to take place in Curico, a city southeast of Santiago, Chile.

Efforts to formulate products of low toxicity and good nutritional value based upon legume proteins in combination with wheat and sunflower meal shall be initiated. This will require toxicity testing in animals, the determination of cooking parameters, the determination of amino acid profiles by chemical means, and the test of nutritional values in animals.

Work shall be initiated on the development of protein isolates from legumes, sunflower and rapeseed. These will be solubilized by

means of techniques already established in the project and precipitates of these three protein sources will be obtained for biological and chemical testing.

An individual selected from Chilean groups will be brought to the United States for short term training in the area of extrusion processing for the production of structured proteins to be utilized in latter parts of the project for the production of pickled Chilean dishes in which the animal protein is to be substituted by structured vegetable proteins.