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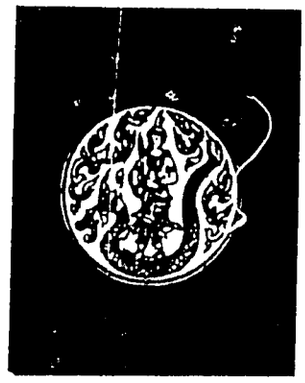


INSTITUTE OF FOOD RESEARCH AND PRODUCT DEVELOPMENT (IFRPD)

KASETSART UNIVERSITY

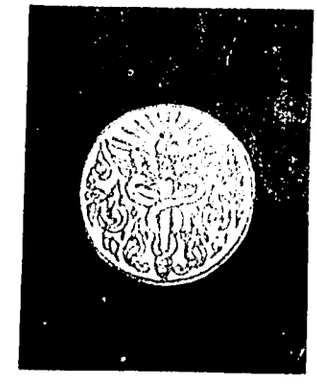
OFFICE OF THE PRIME MINISTER

REPORT ON PROTEIN FOOD DEVELOPMENT PROJECT

NUTRITION DIVISION

HEALTH DEPARTMENT

MINISTRY OF PUBLIC HEALTH



PREFACE

Protein Food Development, the Project No. 493-11-540-179.2, is the project set up according to necessity to improve nutritional conditions of the country. This project has successfully proceeded with collaboration of the 2 government agencies:

- Nutrition Division, Department of Health, Ministry of Public Health, and
- Institute of Food Research and Product Development, Kasetsart University, Office of the Prime Minister.

This is a 3-year project and the result of this work is satisfactory. This is the summary report of our 3-year work both in field of "Food Plant" and "Field Activity". The objective of this project is to search for new sources of protein to use as raw material to produce high nutrition low cost foods, conforming to the eating patterns of the people, so that people of poor income can afford to buy them.

Our project cannot be accomplished without cooperation in establishing Child Nutrition Centers in the 4 provinces (detail of this work is available in Report 1968, Report 1969 and Special Report including Report of the siminar on the PROTEIN FOOD PROMOTION held between November 22-December 1,1970).

From the seminar on PROTEIN FOOD PROMOTION, the 8 conclusions and recommendations are presented to the Cabinet (see appendix).

To these recommendations, the Cabinet hold a conference on February 16, 1971 and made a decision that this project be further proceeded by the government agencies related to the work.

Furthermore, we are very pleased to inform that the slides concerning activities of our work have been included in the FAO's Film Strip on "THE PROTEIN GAP" up to 35 pictures from totally 87 pictures (see P1-P6). This help spread activities of our work to all over the world. In order to illustrate this, we also put in this report the pictures of the FAO's Film Strip on "THE RROTEIN GAP"

Our work has not yet been completed. Theoretically speaking-it has just begun. From the ressult of our work in the past 3 years, both in "FOOD PLANT" and "FIELD ACTIVITY", we have passed from the stage of pilot project to

the stage of industry. We are pleased to inform here again that now the Tha Government and USOM have made an agreement to have this project of PROTEIN FOOD DEVELOPMENT be further proceeded for another 3 years under the "PROTEIN FOOD PROMOTION PROJECT" with an objective to convert the outcome of our research and development work into industry.

The compliers of this report hope that the finishing PROTEIN FOOD DEVELOPMENT PROJECT will surely make way for the research work and industrialization in the future.

AMARA and AMORN

ACKNOWLEDGEMENT

This project has already been completed. The outcome of our work does not result merely from the 2 agencies: Institute of Food Research and Product Development (Kasetsart University, Office of the Prime Minister) and Department of Health, Ministry of Public Health. Our project will not be able to achieve its target without assistance and cooperation from the following people:

- **Dr. John E. Kennedy**
- **Dr. William A. Smith**
- **Mr. Francis J. Murphy**
- **Dr. Eugene Robaidek and the Staff**
- **Dr. Gerald F. Combs**
- **Dr. C.C. Loo**

In addition to the persons mentioned above, we have also received a very good assistance and cooperation both from the government and from foreign agencies as follows:

- **Division of Biological Science, Department of Science**
- **Division of Food and Beverage Analysis, Department of Medical Science**
- **University of California, Davis**
- **The Wisconsin Alumni Research Foundation (WARF), Medison, Wisconsin**
- **Department of Technical and Economic Corporation (DTEC)**
- **TNO, Netherland**
- **NIH**

We would like to apologise herein if there is any person or any agency we miss to mention here, especially our coworkers and the personnel of every level of our 2 agencies. But sincerely, we have always remembered that without your assistance and cooperation our project will not be able to reach its achievement.

Again, the compliers would like to thank everyone we have already mentioned above especially the Department of Technical and Economic Corporation (DTEC) and the USOM.

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PROTEIN FOOD DEVELOPMENT

Protein Food Development Project has been set up from the cooperation between the DTEC on behalf of Thai Government and USAID on behalf of the US Government. This is a 3-year project whose purpose is to develop new products to meet the nutritional needs of the country. This work has been carried out by the two government agencies: Institute of Food Research and Product Development, Kasetsart University, to undertake research and development work to produce low cost protein foods, and Division of Nutrition, Department of Health, to undertake evaluation work and actual field trial and distribution. In this project we have received cooperation and financial supports both from USAID and from the DTEC.

The specific objectives of this project are:

- to promote development in food technology and in other work related.
- to research and develop high protein food supplements for weanlings and preschool children.
- to test the new products in laboratory and in field trial for suitability and acceptability by consumers.
- to promote the new products on commercial scale to be more widely consumed among the people.

This project also places the emphasis on promotion of the well-being and well-eating of the people according to their income and their consuming habits.

Nowadays, most of people all over the world are facing with the problem of malnutrition whose main causes are:

- lack of food in adequate amounts and quality (especially lack of protein rich foods)
- cost of food in relation to the people's low income
- lack of appropriate nutrition education.

In 1970, it is reported that the total food production in developing countries rose about 3%, but due to continued high rate of population growth, per capita production failed to rise.

From report on population growth of Thailand, the number of Thai population is increasing very rapidly at the rate of 3.2% per year.

ESTIMATED POPULATION OF THAILAND

1960–1970

YEAR	TOTAL
1960	26,392,000
1961	27,210,000
1962	28,054,000
1963	28,923,000
1964	29,820,000
1965	30,744,000
1966	31,698,000
1967	32,680,000
1968	33,693,000
1969	34,738,000
1970	35,814,000

With present rate of growth, the number of Thai population will double itself in every 22 years. One of the most important problems of this is the food supply for the increased number of population. It is evident that the amount of food production cannot be doubled in the next 22 years because of its slow increase and it even has downward trends in some years e.g. production of paddy which is the major staple of Thailand.

ESTIMATED PRODUCTION OF PADDY

1966–1970

YEAR	PRODUCTION (Million Tons)
1966	13.50
1967	11.19
1968	12.50
1969	13.41
1970	13.27

Another main cause relating to malnutrition is the people's low income. At present, per capita income of Thai people is averagely 200 baht per month which is rather low. About 50% of this amount is spent on food. This amounts to 100 baht per month or 3 baht per day. Hence an average person can only afford 3 baht per day for food. In the past 3 years the price of food in Thailand has increased up to 20%. The Price Index of food has increased regularly and quite rapidly comparing to the low increase of per capita income.

PRICE INDEX OF FOOD IN THAILAND

1962—1968

YEAR	PRICE INDEX
1962	100.0
1963	99.9
1964	104.2
1965	104.8
1966	111.6
1967	119.6
1968	123.3

With constant increase of Price Index of food, we can see that the average 100 baht per month is insufficient to purchase food with daily minimum nutritional requirements. It is just enough to keep one from feeling hungry. Though the average Thai may only take 2 meals a day, the minimum nutritional requirements are:

Calories	2,500 per day
Protein	70 gms. per day

For Thai people, rice is the major staple and major source of calories supplemented by small amount of animal protein.

We have studied the problem of nutritional deficiencies that exist among low income people in various regions of the country and we found that protein is an important factor in this case. Protein deficiency is very obvious among children of 2–5 years of age. This is a main cause of retarded growth and under-developed nervous system. It has been accepted that nutritive food, especially the supplementary protein foods needed by the human body is indispensable for physical and mental health and for proper development of intelligence in growing children. With these problems, arises the necessity of establishing high nutrition low cost foods for every age groups.

We all know that we can get high protein from animal sources such as from beef, pork and poultry but they are rather expensive. It's not possible for the people of poor income to acquire animal protein in the adequate amount of the body's requirement i.e. 1 g./1 kg. of body weight. If the meat costs 20 baht/kg. they will have no money left for other foods. Even fish which is once believed to be a cheap source of animal protein is now considered as luxurious food for most of Thai people.

From this fact, necessity arises of finding new sources of protein especially from vegetable sources. Our target was set for experimental work in 3-year period to make research and develop high nutrition low cost foods to satisfy the nutritional needs of the country especially for the problem of protein malnutrition. From the census, it appears that even in Bangkok there also exists the problem of protein

malnutrition up to 80% mostly in children in approximately 8-10 slum areas scattering around Bangkok.

Our target in developing high nutrition low cost foods is:

- to use local raw material
- to conform to the Thai eating pattern
- to provide high nutrition low cost products within the reach of everyone.

For this purpose, we have utilized local raw materials that are easily available to produce high nutrition low cost foods. These materials are soybeans, mungbeans coconut, sesame and mussel. With these local raw materials, we have developed the following new products:–

- Fortified Soy Bean Milk
- ,, Cookies
- ,, Noodles
- ,, Weaning Foods
- ,, Kaset Textured Protein
- ,, Coconut Products
- ,, Mung Bean Products

Developed products have been sent to the Wisconsin Alumni Research Foundation (WARF) for biological testing and all have passed acceptability test with satisfactory results.

Usually, Thailand spends lots of money each year on food mostly consisting of weaning food. We used to import powder milk to produce sweetened condensed milk which at the moment the Ministry of Public Health is trying to declare to all consumers that sweetened condensed milk is not suitable for feeding to baby. This is because sweetened condensed milk is only heavy in Carbohydrate but insufficient in Protein value. In order to improve the population's health and to improve the country's balance of payment, the Government has recognised the need to develop high nutrition low cost foods.

Our high nutrition low cost products are very cheap and so can be afforded by everyone because of their low cost, especially Kaset Protein which promises to be an excellent supplement to beef, pork and poultry meat at only one-fifth the cost to acquire the same amount of Protein.

To promote protein food consumption in infants and children is one of our main objectives for we realise that protein deficiencies in infants and children will have an effect on their growth and their nerve system. Hence we have produced weaning foods for infants at a very low cost. Furthermore, we have arranged a feeding program in 4 provinces in the North and Northeast for approximately 2,500 pre-school children with ages ranging from 2-5 years of age.

The data obtained from the Nutrition Centers indicate that there is growth both in weight and height and the mental development progresses very satisfactorily. This attributed to the low cost protein foods supplemented to the normal diet. We have also arranged lunch program for school children to provide them with low cost protein foods. The lunch is presently served to many schools at a cost of 1.25 baht per meal.

Nutrition education is an important factor for improvement of nutritional condition in our country. At present, plans have been made with the objective of educating people of all level of the importance of nutrition in daily life.

In feeding program, in addition to providing supplementary protein food products to various Child Nutrition Centers, we also provide a training of hygienic and nutrition methods both to children and parents. In this training, the mothers are invited to attend the feeding and demonstration that ranges widely from food preparation to personal hygiene and household decoration. The mothers are also encouraged to use high nutrition low cost baby weaning foods for feeding of their babies instead of using pounded rice.

Also the lunch program has been arranged with dual purpose: firstly, to provide low cost protein foods and secondly to provide education in sciences and arts of nutrition. We usually send out our staff to work with various schools in demonstrating food preparation of high nutrition low cost foods. Most of all we aim at educating the consumers towards the breaking down of prejudice and misconception of the value of low cost foods. They generally insist on a higher price of food believing that high price is high quality.

We have tested the suitability and acceptability of our new products both in laboratory and in field trial areas. Now we have progressed from pilot scale into commercial scale. Our products have received quite a lot of popularity in the market especially Soybean Milk which has been used widely in many schools and hospitals. In addition, there's a probability that our products will be extended to industrial stage in near future. The production of our new products will surely lead to modification of food consumption pattern among Thai people.

At this stage, the goal of Protein Food Development Project has been fulfilled but our work will be carried on for another 3 years under the Protein Food Promotion Project whose objective is to bring these new products into industry so that they can be in general availability to all people.

Another important consequence of converting these new products into industry is the raise in population's income. People will have more job and higher income. This will help increase their purchasing power of food. This is, most of all, a new approach to narrow the gap of malnutrition especially the gap in protein malnutrition.

SUMMARY OF 3–YEAR WORK
OF
PROTEIN FOOD DEVELOPMENT PROJECT

CONCLUSION:

1. Protein Foods are distributed to Child Nutrition Day Care Centers for the four provinces in the programme (Chiengmai, Ubol, Prae, Roi–et). The number of Child Nutrition Centers in the four provinces are 57 centers and the number of childern in the programme are 2,500.

2. Protein Foods are distributed to the Child Nutrition Day Care Centers in the 41 provinces not including in the programme (Sukhothai, Chiengrai, Sakol-Naorn, Stoon, Maha Sarakarm, Trang, Mae Hongsorn, Songkhla, Lampoon, Rajaburi, Pattani, Suraj Thani, Surin, Cholburi, Kampaeng Petch, Nakorn Rajasima, Chaiyapoom Leoi, Khon Khaen, Nakorn Phanom, Udorn Thani, Uthai Thani, Buri-rum, Utaradit, Lampang, Srisaket, Tak, Kalasin, Petchaburi, Nakorn Srithamaraj, Nakorn Sawan, Pang–Nga, Pisanulok, Samut Sakorn, Phu–ket, Pracheenburi, Samut Prakarn, Chai–nat, Kra–bi, Yala). The number of Child Nutrition Centers are 95 centers and the number of children are 2,500.

3. Lunch Programme for feeding school–childern with Protein Foods in Bangkok.

3.1	Wat Prasi Mahathat started in the year 1970 up to the present time.	600	children
3.2	Pibool Upatham School started in the year 1968 and ended in the year 1970.	80	children
3.3	Wat Dhama Pirataram School (everyday)	80	children
3.4	Demonstrated School of Kasetsart University (everyday)	330	children

4. Feeding of Soybean milk (stilled drink) for certain school in Bangkok (everyday)

4.1	Suan Dek School (500 childern)	90	litres
4.2	Satri Setabutra Bumpen School	38	litres
4.3	Air Men School	160	litres

5. Demonstration on Protein Foods

Year 1968–1969 Demonstration	12	times
Year 1969–1970 Demonstration	1	time
Year 1970–1971 Demonstration	71	times

6. Programme for training and lecture on Protein Foods

Year 1969–1970 Training and lecture	5	times
Year 1970–1971 Training and lecture	11	times

7. Quantity of Protein Food Production in the year 1968–1969

7.1	Kaset Noodle	46,578	pieces
7.2	Protein cookies (from Mungbean)	50,061	kgs.
7.3	Mungbean Starch	1,314	kgs.
7.4	TMP–9	297	kgs.
7.5	TMP–10	135	kgs.
7.6	TMP–11	963	kgs.
7.7	TFF–1	8	kgs.
7.8	TFF–1A	10	kgs.
7.9	TFF–2	206	kgs.
7.10	Biscuit from Mungbean	570	kgs.
7.11	Soybean milk (stilled drink)	7,155	litres
7.12	Evaporated Soybean Milk	10,593	cans

8. List of Protein Foods that have been distributed to Ubol Rajathani province for feeding 40–50 childern by the cooperation between the Institute of Food Research and Product Development (commonly called PFO Bangkhen) and the Nutrition Division, Public Health Department, staring from July 1968–September 1969.

8.1	Kang Jeed Woon Sen with Protein from Mungbean	22.2	kgs.
8.2	Cookies from Soybean residue	67.5	kgs.
8.3	Biscuit from Mungbean residue	56.3	kgs.
8.4	Evaporated Soybean Milk	5,910	kgs.
8.5	Protein from Mungbean	3.4	kgs.
8.6	Tom Yam Pla with Soybean residus	6	kgs.
8.7	Ingredient for Kang Liang Puk with Soybean residue	10 2	kgs
8.8	Ingredient for Kang Jeed Puk with Mung Protein	2.7	kgs.
8.9	Chaew with Mung Protein	2.4	kgs.
8.10	Ingredient for Fermented Fish with bamboo shoot and Mung Protein	1.2	kgs.
8.11	Ingredient for Kang Isan with Mung Protein	9.6	kgs.
8.12	Instant Kaset Noodle	419	kgs.
8.13	Instant Kaset Noodle (deep fry)	1.2	kgs.
8.14	Ingredient for Fermented Fish with boiled vegetable and Mung Protein	7.2	kgs.
8.15	Tam Yam Pla Krapong with Soybean residue	3.9	kgs.
8.16	Kang Som Dok-mai Cheen with Soybeen residue	4.2	kgs.
8.17	Ingredient for Yam Puk with Mung Protein	3	kgs.
8.18	Dried Fermented Fish Powder with		

	Soybean residue	15 kgs.
8.19	Mungbean starch	1 kgs.
8.20	Ingredient for Bamboo Shoot soup with Mung Protein	9.6 kgs.
8.21	PFD-1	71 kgs.
8.22	FFF-0	3 kgs.
8.23	FFF-1	189 kgs.
8.24	FFF-2	11 kgs.
8.25	FFF-2A	203 kgs.
8.26	FFF-3	1 kgs.
8.27	TMP-8 or K.P. 8	10 kgs.
8.28	TMP-9 or K.P. 9	126 kgs.
9.29	TMP-11 or K.P. 11	108 kgs.
8.30	TFF	5 kgs.
8.31	TFF-1	10 kgs.
8.32	TFF-1A	9.5 kgs.
8.33	Cookies from Mungbean	1,868 kgs.
8.34	Fish Protein Concentrate	100 gm.

Besider this, the Protein Foods are distributed through the Public Health Division by the Institute of Food Research and Product Development to the Child Nutrition Day Care Centers for the provinces in the programme as the following items:

1.	Cookies from Mungbean	2,840 kgs.
2.	TMP-11	800 kgs.
3.	Evaporated Soybean Milk	5,720 kgs.
4.	TFF-2	400 kgs.
5.	Instant Kaset Noodle	232 kgs.

9. In the year 19 9-1970

Quantity of Protein Food Production

9.1	Instant Kaset Noodle	44,542 pieces
9.2	Protein Cookies from Mungbean	2,158 kgs.
9.3	Biscuit from Mungbean	543 kgs.
9.4	TMP-10 or K.P. 10	248 kgs.
9.5	TMP-11 or K.P. 11	4,059 kgs.
9.6	TMP-12 or K.P. 12	11 kgs.
9.7	TMP-13 or K.P. 13	11 kgs.
9.8	TFF-2	659 kgs.
9.9	Mungbean starch	2,001 kgs.
9.10	Evaporated Soybean Milk	41,747 cans
9.11	Soybean milk (stilled drink)	36.785 litres
9.12	Dried Mussel Protein Isolate	16 kgs.
9.13	Canned Baby Food Formula 18	1,396 cans
9.14	Cookies from Mungbean with sesame	3,436 kgs.
9.15	Cookies from Full Fat Soy Flour	1.950 kgs.

9.16	Full Fat Soy Flour	2,156 kgs.
9.17	Canned Baby Food Formula 14, 15, 16	91 cane
9.18	Baby Food Powder Formula 18	29 kgs.

10. List of Protein Food distributed to the Child Nutrition Day Care Centers for the provinces in the programme through the Public Health Division in the year 1969-1970

10.1	Protein Cookies from Full Fat Soy Flour	5,280 kgs.
10.2	TMP-11 or K.P. 11	2,988 kgs.
10.3	Evaporated Soybean milk	21,410 cans
10.4	TFF-2	1,026 kgs.
10.5	Instant Kaset Noodle	696 kgs.
10.6	Cookies from Mungbean	2,640 kgs.

11. List of Protein Food that are distributed to Doi Tao, Opayob Village at Chiengmai province in the year 1969-1970

11.1	Evaporated Soybean Milk	645 cans
11.2	Protein Cookies from Mungbean	200 kgs.
11.3	TMP-11	48 kgs.

12. List of Protein Food that are distributed to Stoon and Lampang provinces in the year 1969-1970

12.1	TMP-11 or K.P. 11	26 kgs.

13. List of Protein Food distributed to the provinces outside the programme in the year 1969-1970.

13.1	K.P. 11	432 kgs.

14. In the year 1970-1971
Quantity of Protein Food Praduction

14.1	Soybean Milk (stilled drink)	90,835 litres
14.2	Evaporated Soybean Milk	66,207 cans
14.3	Full Fat Soy Flour	4,769 kgs.
14.4	Cookies from Full Fat Soy Flour	14,831 kgs.
14.5	Instant Kaset Noodle	54,750 pieces
14.6	Baby Food Formula 18	587 kgs.
14.7	K.P. 10	305 kgs.
14.8	K.P. 11	9,012 kgs.
14.9	TFF-2	833 kgs.
14.10	K.P. 18	100 kgs.
14.11	Mungbean starch	3,190 kgs.

15. List of Protein Food distributed to the Child Nutrition Day Care Centers at the provinces in the programme (Chiengmai, Ubol, Prae, Roi-et) through the Public Health Division in the year 1970-1971.

15.1	K.P. 11	2,856 kgs.
15.2	TFF-2	1,026 kgs.
15.3	Instant Kaset Noodle	696 pieces
15.4	Cookies from Full Fat Soy Flour	7,920 kgs.
15.5	Evaporated Soybean milk	18,300 cans

16. List of Protein Food distributed to the provinces outside the programme in the year 1970-1971.

16.1	K.P. 11	4,140 kgs

Field Activity Report

Summary :

1. The field trial of 5 protein food prototypes were conducted among the preschool children in the Child Nutrition Centres (day-care centres) in Chiengmai, Ubol, Prae and Roi-et for the period of one and a half year (1969-1970). The result shows that all prototypes (with the exception of soya milk), when given in the day-care centre setting, produced better growth of the preschool child as judged by their average height increment per month. In this respect, some prototypes (textured soya proteins) were better than the others (textured mung proteins).

2. Weight was not found to be as good an index of growth performance as height in a cohort study being employed in this trial.

3. There was a voluntary redistribution of the protein food within the family in favour of the preschool child who attended the Child Nutrition Centres, this is considered a contributing factor to the so-called "day-care centre effect".

4. No direct relationship was found between protein supplement intake and growth performance of the children. Protein supplementation was therefore considered to be beneficial only when given in an environment conductive to child growth and development such as in a day-care centre.

Background :

Although Thailand is a major rice producer and has overall favourable food supply, large areas of the country, particularly in the Northeast are deficient in quality foods particularly protein. As in other developing countries, the most vulnerable group is the young child between one to four years of age. In many villages in the North and Northeast, 40-50% of the weanlings and preschool children have some degree of protein-calorie malnutrition; Vitamin A and B deficiencies and nutritional anemia are all to common. Often the diet of these children is little more than highly polished rice and "something" for flavour and variety with little attention to nutrient value. Approximately eighty per cent of their total calories is derived from rice.

As in other countries, many interlocking factors contribute to malnutrition in these children, including such factors as low income, overdependency on rice, poor education of mothers, high birth rates, repeated infections and in many

areas resistant customs, beliefs and behaviour. The problem of protein malnutrition is therefore intimately enmeshed with all other factors that characterize and influence poverty and backwardness. Recent findings from Mexico and elsewhere have established that protacted protein-calorie malnutrition in early childhood can cause irreversible impairment to learning in later life. If this is so, then early correction of protein-calorie malnutrition is essential to the educational progress of the future generation.

The improvement of protein intake of the population, both quantitatively and qualitatively is possible through the use of protein rich supplement foods. This is not the only way to cope with the problem, as there are other measures such as those which place emphasis on increasing home food production. Certainly, each measure will have its own advantage and drawback. But applying these various measures together should produce better synergistic result.

These protein foods, in order to be widely utilized, have to be produced locally for economic and other reasons. The protein content and amino acid composition in the foods should be geared to satisfactorily supplement what are lacking in the people's diet. In 1968 the U.S. Government through AID/Thailand, the Royal Thai Government through the Division of Nutrition, Department of Health and the Institute of Food Research and Product Development of Kasetsart University had agreed to commence, on joint coordination, the Protein Food Development Project in Thailand. The project had three main objectives, viz. 1) to research and develop a family of inexpensive high protein supplements from local foods 2) to test the products in the field for suitability, and acceptability and in the laboratory for protein and amino acid composition and biological values and 3) to provide data on and give initial stimulus to the promotion, production and marketing of acceptable products by commercial sectors.

Activities

A number of prototype food supplements had beed developed from high protein food sources such as sea fish, mung beans, soya beans, etc. (see other sections and previous reports). The suitable prototype food supplements had undergone field trials to determine their acceptability and effect on growth.

The protein food prototypes under feeding trial in the project areas were textured fermented fish, textured mung protein (Kaset meat), canned sweetened soya milk, and textured vegetable soya proteins.

Subjects for the field trials were preschool children between the ages of twelve and eighty-four months from typical rural families. To facilitate the field trial, Child Nutrition Centers (CNC) were set up in several villages in four provinces of the North and Northeastern part of Thailand.

Grouping of Villages for the Experiment

For experimental purpose, villages had been grouped into 7 categories, viz.

i. Raw control group (Treatment 1). In this group were five average villages with no intervention from the program whatsoever. These villages were:-

Province	Villages
Chiengmai	Nong Kwai
	Bor Sang
Prae	Mae Yang Kard
Ubol	Ban Tam Yae
Roi-et	Ban Mao

ii. Control group with Child Nutrition Centers (Treatment 2). In areas where the Child Nutrition Centers (CNC) were set up, lunch served to the children have same basal food as in the Test group except for the presence of prototype to be tested. Included in this group were:-

Province	Villages
Chiengmai	Buag Kang
	Kee Leg
	Ban Sam Lung
Prae	Na Jak
	Rong Khem
Ubol	Ban Thepa
	Noi Na Vern
	Nong Song Hong
Roi-et	Ban Song

iii. Test group (Treatment 3-7) where Child Nutrition Centers were set up. In each of which one kind of the prototype was supplemented to the midday meal. These prototypes were the following:-

1) Textured fermented fish-TFF (Treatment 3). Since the fermented fish is not used extensively by the northerners, only 3 villages; Pon Muang Noi, Kam Nang Ruay, and Ban Koom Lek of Ubol province were selected as TFF test centers.

2) Textured mung protein-Kaset meat (Treatment 4). Selected for Kaset meat trial were the following villages:-

Province	Villages
Chiengmai	Mae Pong
	Sun Ka Yorm
	Tong Siew
	Pa Sa

Prae	Mae Yang
	Den Chai
Ubol	Ban Kamin
	Nong Khun
Roi-et	Ban Tak Dad

3) Canned sweetened soya milk (Treatment 5). Four villages undergoing this prototype feeding trial were the following:-

Province	Villages
Chiengmai	Nong Jom
Prae	Pong Pa Wai
Ubol	Dong Bang
	Nam Plik

4) Textured Vegetable Protein-TVP (Treatment 6). For this and the next type of protein supplement, which were later addition to the original set of prototypes, two villages were assigned for feeding trial, i.e., Ban Mai of Chiengmai and Koke Larm of Roi-et.

5) Textured Vegetable Protein with methionine-TVP-M (Treatment7). This is simlar to TVP except for added methionine. Two villages one in Chiengmai (Chompoo village) and an otner one in Roi-et (Ban One Mao) were selected for the test.

Of these five items, TVP and TVP-M were provided by Archer Daniel Midland Company of Illinois, U.S.A. through USOM, while the others were supplied locally by the Institute of Food Research and Product Development (IFRPD).

Feeding Program

Feeding program was arranged using the following protocol:

Mean weight of the children was set at 13 kg. The target daily protein intake which was set at 1.5 g./kg. body weight was presumed to contain at least 0.9 g. of protein from normal home diet (as indicated by previous surveys). Hence, 0.6 g. was to be supplemented by the prototypes to be tested.

Regular diet of the child was estimated to contain 0.3g./kg./meal (three meals a day would supply 0.9g./kg.) of protein which was mainly of vegetable origin.

The midday meal and snacks given at the Centers contained 0.3 g./kg. of protein from rice and 0.6g./kg. of protein from food supplements. Total amount of protein intake per child at that meal was 0.9g./kg. or 11.7 g./head with 500 calories allowance.

The distribution of protein in the meal was as follows:-

Control group	g. protein	Test group	g. protein
Rice and vegetables	4.0	Rice and vegetables	4.0
Animal protein in side dish	1.2	Animal protein in side dish	1.2
Filler	1.0	Filler	1.0
		Protein prototype supplement	5.5
Total	6.2	Total	11.7

Data Collection and Analysis

Anthropometric measurements

During the supplementary feeding trial (Jan. 69–June 70) weight and height measurement were done at the start and at three-month intervals thereafter. Weighing was made by beam balance scale of know accuracy and recorded to the nearest tenth of a kilogram. Standing height for children over two years old was recorded to the nearest tenth of a centimetre, using measuring rod provided with the beam scale. For children under two years of age, reclining length was measured.

Table 1 shows the average weight and height of children at initial measurements.

Since the height is considered better yardstick for growth development, actual height data were translated into percentages of reference (against Harvard Norm)

Table 2–3 show the mean and distribution of the percentages of reference for height of children in the trial villages of the four provinces. The initial height of children in each group were matched at the start in order to exclude the possibility of having different growth rates due to the difference in the initial growth status.

Table 1: Average Weight and Height at Initial Measurement.
(Age 1 = .12–36 months; Age 2 = 37–84 months)

Province	Treatment	Age	Sex			Weight (kg.)		Height (cm.)	
			Total	M	F	Mean	S.D.	Mean	S.D.
Chiengmai	1	1	33	17	16	10.10	1.30	80.16	4.56
		2	60	29	31	13.25	1.88	95.35	6.74
	2	1	20	8	12	10.73	1.12	84.11	5.06
		2	94	55	39	13.58	1.81	96.32	6.27
	3	–	–	–	–	–	–	–	–
		–	–	–	–	–	–	–	–
	4	1	20	11	9	11.31	1.47	85.71	5.16
		2	146	68	78	13.84	1.88	96.67	6.92
	5	1	2	2	0	13.60	2.30	87.50	5.00
		2	38	13	25	13.52	1.53	95.01	6.02
	6	1	14	9	5	11.41	1.86	85.61	7.79
		2	56	30	26	13.85	1.57	97.66	6.42
	7	1	2	2	0	11.05	0.05	81.60	2.10
		2	66	32	34	14.30	2.46	96.84	7.22
Prae	1	1	37	19	18	10.35	1.48	82.84	4.92
		2	57	22	35	12.82	1.65	92.63	6.02
	2	1	23	9	14	10.86	1.14	85.89	5.06
		2	101	42	59	13.60	1.95	95.83	6.69
	3	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
	4	1	28	17	11	10.90	1.69	83.66	5.12
		2	90	46	44	13.31	1.88	95.52	6.51
	5	1	3	1	2	11.00	0.82	85.83	1.55
		2	40	19	21	13.76	1.94	95.89	6.89
	6	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
	7	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–

Province	Treatment	Age	Sex			Weight (kg.)		Height (cm.)	
			Total	M	F	Mean	S.D.	Mean	S.D.
Ubol	1	1	15	9	6	10.10	1.59	83.37	6.08
		2	54	28	26	12.75	2.43	93.76	8.79
	2	1	39	17	22	10.53	1.53	83.59	6.76
		2	136	62	74	13.27	2.11	94.65	7.03
	3	1	75	36	39	10.39	1.28	83.11	3.84
		2	201	84	117	13.32	1.96	95.40	6.65
	4	1	9	4	5	10.91	1.05	85.33	3.15
		2	157	57	100	13.09	1.81	93.84	6.45
	5	1	38	25	13	11.52	1.89	85.70	5.61
		2	99	49	50	13.12	1.59	93.05	5.34
	6	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
	7	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
Roi-et	1	1	25	8	17	11.06	1.92	85.86	0.36
		2	49	25	24	13.31	1.92	94.74	6.53
	2	1	7	2	5	11.57	1.27	86.14	4.09
		2	44	24	20	12.95	1.72	92.01	5.37
	3	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
	4	1	18	6	12	10.72	1.30	83.04	4.99
		2	58	21	37	13.37	1.93	95.19	6.73
	5	1	–	–	–	–	–	–	–
		2	–	–	–	–	–	–	–
	6	1	11	3	8	10.78	0.91	83.69	2.16
		2	66	34	32	14.14	1.96	96.17	6.48
	7	1	7	3	4	10.44	0.73	82.26	2.34
		2	34	18	16	13.66	1.56	94.22	4.98

Table 2: Distribution of Body Height of Children Age 12–60 months at Initial Measurement.

Province	Percentage of Reference (Harvard Norm)	Treatment						
		1	2	3	4	5	6	7
Chiengmai	70–79	0	1	–	4	0	1	0
	80–89	38	28	–	58	21	19	27
	90–99	51	78	–	90	16	37	30
	100 and over	1	3	–	5	1	8	2
Prae	70–79	2	1	–	1	1	–	–
	80–89	37	39	–	25	14	–	–
	90–99	51	78	–	85	26	–	–
	100 and over	4	5	–	5	0	–	–
Ubol	70–79	3	3	3	2	1	–	–
	80–89	32	44	87	69	44	–	–
	90–99	25	112	117	77	77	–	–
	100 and over	2	11	7	4	11	–	–
Roi-et	70–79	1	0	–	0	–	1	1
	80–89	28	28	–	22	–	29	10
	90–99	33	22	–	48	–	37	29
	100 and over	11	1	–	4	–	2	1

Table 3: Distribution of Percentages of Reference (against Harvard Norm) for Height of Children
Age 12–60 Months at Initial Measurement

Treatment	1		2		3		4		5		6		7	
Province	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Chiengmai	90.53	3.50	92.45	4.35	–	–	90.99	4.90	90.00	5.20	91.70	5.10	90.65	4.50
Prae	91.50	6.55	92.00	4.65	–	–	92.65	4.60	90.80	4.50	–	–	–	–
Ubol	88.85	5.65	92.03	5.30	91.30	4.30	90.13	4.85	92.05	6.10	–	–	–	–
Roi–et	92.15	5.50	89.95	4.25	–	–	92.50	4.80	–	–	95.10	3.95	93.10	4.20

To determine weight or height gained per month for the children all data on weight or height at different age intervals of each child were computed using formula for the slopes(b) of the regression line $Y = a - bX$. After the slope for weight and height of each child was calculated, the mean values of the slopes for weight and height B(x), B(y) which were the average increment per month and their standard deviations were calculated in accordance with age groups and treatment. The result is shown in Table 4, 5

Table 4: Average and Standard Deviation of Monthly Weight Increment B(x) for Different Age Groups and Treatments.

Province	Age	Treatment													
		1		2		3		4		5		6		7	
		B(x)	S.D.	B(x)	S.D.	B(x)	S.D.	B(x)	S.D.	B(x)	S.D.	B(x)	S.D.	B(x)	S.D.
Chiengmai	1	0.150	0.060	0.110	0.056	–	–	0.159	0.152	0.144	0.091	0.179	0.100	0.154	0.017
	2	0.148	0.063	0.123	0.092	–	–	0.132	0.119	0.112	0.088	0.190	0.110	0.149	0.094
Prae	1	0.140	0.060	0.162	0.121	–	–	0.159	0.089	0.156	0.111	–	–	–	–
	2	0.129	0.090	0.130	0.129	–	–	0.134	0.094	0.200	0.147	–	–	–	–
Ubol	1	0.155	0.093	0.186	0.135	0.147	0.095	0.161	0.057	0.145	0.145	–	–	–	–
	2	0.140	0.082	0.166	0.158	0.148	0.121	0.154	0.130	0.135	0.175	–	–	–	–
Roi-et	1	0.103	0.068	0.114	0.079	–	–	0.150	0.066	–	–	0.155	0.102	0.169	0.150
	2	0.083	0.045	0.170	0.131	–	–	0.140	0.091	–	–	0.151	0.096	0.251	0.321

Age 1 : 12–36 months

Age 2 : 37–84 months

Table 5: Average and Standard Deviation of Monthly Height Increment B(y) for Different Age Groups and Treatments.

Province	Age	Treatment													
		1		2		3		4		5		6		7	
		B(y)	S.D.	B(y)	S.D.	B(y)	S.D.	B(y)	S.D.	B(y)	S.D.	B(y)	S.D.	B(y)	S.D.
Chiengmai	1	0.603	0.191	0.746	0.441	–	–	0.568	0.292	0.568	0.015	1.155	0.595	0.458	0.057
	2	0.543	0.109	0.576	0.190	–	–	0.585	0.361	0.546	0.185	0.673	0.324	0.480	0.248
Prae	1	0.603	0.201	0.518	0.288	–	–	0.912	0.355	0.709	0.060	–	–	–	–
	2	0.611	0.200	0.603	0.347	–	–	0.654	0.225	0.607	0.633	–	–	–	–
Ubol	1	0.473	0.303	0.639	0.298	0.592	0.236	0.537	0.226	0.730	0.481	–	–	–	–
	2	0.459	0.181	0.536	0.424	0.511	0.344	0.512	0.275	0.512	0.465	–	–	–	–
Roi-et	1	0.404	0.276	0.618	0.206	–	–	0.455	0.164	–	–	0.665	0.272	1.005	0.509
	2	0.305	0.175	0.655	0.366	–	–	0.523	0.247	–	–	0.725	0.439	0.875	0.756

Age 1 : 12–36 months

Age 2 : 37–84 months

In order to determine if there was a difference in the growth of the children in the Test Group as compared to that of the Raw Control and Control Groups, test of significance were made using test for small samples. At first, treatment 1 was tested against the rest, then treatment 2 was test in the same manner.

Table 6: Levels of Significant Difference between Average Monthly Weight and Height Increment of Children in Treatments. 2, 3, 4, 5 against 1, 2 (kg./cm.)

Treatment	Chiengmai				Prae				Ubol				Roi-et			
	av. weight increment	Significance	av. height increment	Significance	av. weight increment	Significance	av. height increment	Significance	av. weight increment	Significance	av. height increment	Significance	av. weight increment	Significance	av. height increment	Significance
1	0.149	0	0.573	0	0.135	0	0.607	0	0.147	0	0.466	0	0.093	0	0.355	0
2	0.116	p< .01 (neg.)	0.661	p< .05	0.146	–	0.560	–	0.176	–	0.587	p< .05	0.142	p .01	0.637	p.< 01
3	–	–	–	–	–	–	–	–	0.148	–	0.551	p.< 05	–	–	–	–
4	0.146	–	0.576	–	0.147	–	0.783	p< .01	0.157	–	0.524	–	0.145	p< .01	0.489	p< .01
5	0.128	–	0.557	–	0.178	.05	0.658	–	0.140	–	0.621	p< .05	–	–	–	–
2	0.116	0	0.661	0	0.146	0	0.560	0	0.176	0	0.587	0	0.142	0	0.637	0
3	–	–	–	–	–	–	–	–	0.148	–	0.551	–	–	–	–	–
4	0.146	p< .05	0.576	p< .05 (neg.)	0.147	–	0.783	p< .01	0.157	–	0.524	–	0.145	–	0.489	.01 (neg)
5	0.128	–	0.557	p< .05 (neg.)	0.178	–	0.658	–	0.140	.05 (neg.)	0.621	–	–	–	–	–

From the available data, certain salient points could be observed. Among which are the following:

1. The sensitivity of height vs. weight in a cohort study,

As shown in Table 6, height seems to show better sensitivity than weight in showing any significant difference. This is contrary to what is usually found in a longitudinal study of individual child where weight would show signs of improvement before height. The most plausible explanation for this phenomenon is that in the study which is a cohort in nature, the wide variability of the weight for age of children will reflect in the wider standard error of the means for each group. Consequently, a t-test of the difference between the two means will hardly have any high value. This is not so in the case of height where variability for each age is low, thus, low standard error for the means could be obtained. For this reason any change in the height performance is bound to produce better t-value, hence the significant difference.

As height or body length better indicates growth performance and are less affected by external influence, and since it is shown to be more sensitive in a cohort study it would seem to be a better index to use.

2. The day care centre effect,

Growth performance of children attending the group of "Control Child Nutrition Centre", in which basal quantity of protein was given at lunch, were that height gain per month was significantly better than that of the children in the raw control areas in 3 out of 4 provinces.

In the case of the children attending "Control Child Nutrition Centre", their better growth performance in many cases points to the potential merit of the Centre in providing children with environment conducive to their physical well-being. This particular quality, which could be termed "day-care centre effect", might have been produced by various causes. Some of them are suggested below:

1) The amount of protein normally consumed in the family is redistributed in favour of the preschool child. Because the child would be eating his lunch at the Centre among friends, it is considered prestigeous to the family if he carries some of the better foods (proteins) to eat along with rice. Hence, better foods are usually provided for the young child than he usually have at home.

This phenomenon happens even in the "Control Child Nutrition Centre" where protocol indicates that all side dishes that go with the rice at lunch must be prepared at the Centre in order to control the amount of protein. The home would provide only rice. Anyhow, this rule was frequently ignored by the parents. The usual practice then was that the extra protein from home was kept away but returned to the child when he left at the end of the day. Thus, no matter what precautions were made at the centre, this amount of protein would eventually be consumed by the child during the course of that day.

2) Children at the Centre were accessible to better health care than their counterpart at home. Activities other than nutrition provided by the Centre should contributed to their health as a whole.

Table 7: Average Protein Intake at Midday Meal in Raw Control and Control CNC in the Four Provinces under Experiment Compared to Protocol Estimates

Category	N	Source of Protein at Midday Meal				average g/kg	Remarks
		glutinous rice	foods from home	foods provided at CNC	total		
Control CNC (actual)	294	5.9	1.2	3.2	10.6	0.8	3-day Survey in Control CNC in Chiengmai,
Raw control (actual)	19	4.0	4.3	–	8.3	0.6	
Control CNC (protocol estimate)	–	4.0	–	2.2	6.2	0.5	Roi-et, Prae and Ubol in August,
Test CNC (protocol estimate)	–	4.0	–	7.7	11.7	0.9	

Table 7 gives evidence of the day-care centre effect on the protein intake of the child for comparison, the estimated quantity of protein as given by the protocol is also included in the table. Spot check of midday meals in the Control Child Nutrition Centres of the 4 provinces under experiment revealed a good amount of protein in foods being brought from home. It was found that the total protein intake at midday meal in the Control CNC was almost as high as that provided by the protocol at the Test Centres. Rice consumption was also found to be higher in the Control CNC than in the Raw Control.

Textured Fermented Fish and Kaset Protein (Treatment 3, 4)

Textured Fermented Fish is a combination of textured protein and fermented fish produced in dry form. This prototype was found to be more acceptable to the children in the Northeast than in the North during the feasibility study. Hence, it was subjected to trial only in the province of Ubol.

The result (Table 6, Treatment 3) shows that height gain of the children in the CNC where meals were supplemented with Textured Fermented Fish was significantly better than that of the children in Raw Control areas.

The effect of Kaset Protein was felt more in the smaller provinces under trial (Prae and Roi-et) than in the bigger ones (Chiengmai and Ubol), as shown in Table 6, Treatment 4. Here again, height gain was significantly higher in the Test than in the Control areas.

Because t-test on the data of these two Treatments was made against Treatment 1 (Raw Control). Any significant difference could only be ascribed to the combination effect of the prototype and the day-care centre. Attempts was also made to test the difference between Treatment 3 or 4 with Treatment 2 (Control CNC), but no significant difference was found. Consequently, the effect of the food supplement and the day-care centre could not be extricated.

Soya Milk

In the three provinces where soya milk was tested, only one (Ubol) showed any significant difference in height gain of the children from that of the Raw Control. The combined effect of supplementation and day-care centre in this case was weaker than that found when other prototypes were used.

Textured Vegetable Proteins

The textured soya proteins were supplied for field trials by the Archer-Daniel-Midland Co. of Illinois. It was tested in two provinces (Chiengmai and Roi-et). Table 8 shows the effect of two types of Textured Vegetable Protein (TVP and TVP-M) upon weight and height gain of the preschool children. The group attending the CNC supplemented with Textured Vegetable Proteins exhibited significantly higher height and weight gain than the Raw Control group in most instances. The growth-promoting quality of the products also showed up well, although not in all cases, when height of children under trial was compared with that of the Control CNC group.

The effect of attendance and supplement intake on growth performance

Table 9 shows for each child the average daily consumption of supplement during the trial period and the average attending days per month of children in each group of treatment. It may be noted that the higher the rate of attendance at the Centre (maximum 22 days/month), the higher the average daily consumption of supplement there tended to be. This supplement intake level, in case of good attendance, would be close to or reach the level set up by the protocol, that is 2.2 g. of protein for Control CNC and 7.7 g. of protein at Test CNC.

It is also of interest to note the relationship between number of attending days and supplement intake on one hand and the growth performance of children on the other. Though the findings were inconclusive, they seemed to suggest that when the average attending days and supplement intake per month were high, there were better chances of getting significantly higher height increment (compared with Raw Control). If, however, the average attending days and supplement intake were reduced, significantly higher height gain might still be obtained but not for weight gain. Finally, when both average attending days and intake were low, no significant difference in both weight and height increment may be found.

Table 8: Levels of Significant Difference between Average Monthly Weight & Height Increment of Treatments 6, 7 against 1, 2 (in kg. & cm).

Treatment	Chiengmai				Roi-et			
	Weight	Significance	Height	Significance	Weight	Significance	Height	Significance
Raw Control	0.149	0	0.573	0	0.093	0	0.355	0
6	0.185	$p < .01$	0.914	$p < .01$	0.153	$p < .01$	0.695	$p < .01$
7	0.151	–	0.469	$p < .01$ (neg.)	0.210	$p < .01$	0.940	$p < .01$
Control CNC	0.116	0	0.661	0	0.142	0	0.637	0
6	0.185	$p < .01$ *	0.914	$p < .01$	0.153	–	0.695	–
7	0.151	p .01 *	0.469	p .01 (neg.)	0.210	$p < .05$	0.940	$p < .01$

- *Significant difference in weight gain for Chiengmai Treatments 6, 7 against 2 could not be justified due to the abnormal delay in weight gain of Treatment 2.
- Treatment 6 : basal diet supplemented with TVP
- Treatment 7 : basal diet supplemented with TVF-M

Table 9: The Relationship of Average Attending Days and Average Daily Consumption of Protein Supplement to the Levels of Significance Difference.

Treatment	Chiengmai						Prae						Ubol						Roi-et					
			Increment						Increment						Increment						Increment			
	Av. Attending days per month	Av. Daily Supplement Consumption	Weight	Significance	Height	Significance	Av. Attending days per month	Av. Daily Supplement Consumption	Weight	Significance	Height	Significance	Av. Attending days per month	Av. Daily Supplement Consumption	Weight	Significance	Height	Significance	Av. Attending days per month	Av. Daily Supplement Consumption	Weight	Significance	Height	Significance
2	10.1	1.020	0.116	$p<0.01$ (neg.)	0.661	$p<0.05$	10.61	1.061	0.146	–	0.560	–	11.54	1.154	0.176	–	0.587	$p<0.05$	14.10	1.410	0.142	$p<0.01$	0.637	$p<0.01$
3	0	0	0	0	0	0	0	0	0	0	0	0	8.82	3.087	0.148	–	0.551	$p<0.05$	0	0	0	0	0	0
4	9.13	3.195	0.146	–	0.576	–	6.48	2.268	0.147	–	0.783	$p<0.01$	11.81	4.133	0.157	–	0.524	–	17.60	6.160	0.145	$p<0.01$	0.489	$p<0.01$
5	11.16	3.906	0.128	–	0.557	–	12.28	4.298	0.178	$p<0.05$	0.658	–	13.70	4.795	0.140	–	0.621	$p<0.05$	0	0	0	0	0	0
6	12.98	4.543	0.185	$p<0.10$	0.914	$p<0.01$	0	0	0	0	0	0	0	0	0	0	0	0	11.07	3.874	0.153	$p<0.01$	0.695	$p<0.01$
7	9.45	3.307	0.151	–	0.469	$p<0.01$ (neg.)	0	0	0	0	0	0	0	0	0	0	0	0	9.85	3.447	0.210	$p<0.01$	0.940	$p<0.01$
1	–	–	0.149	0	0.573	0	–	–	0.135	0	0.607	0	–	–	0.147	0	0.466	0	–	–	0.093	0	0.355	9

Table 10: Correlation Coefficients (r) between Average Daily Supplement Intake per Child (I) and His/Her Weight Increment $B_{(x)}$ or Height Increment $B_{(y)}$ per Month by Age Groups.

Treatment	Chiengmai				Prae				Ubol				Roi-et			
	$r_{IB(x)}$		$r_{IB(y)}$		$r_{IB(x)}$		$r_{IB(y)}$		$r_{IB(x)}$		$r_{IB(y)}$		$r_{IB(x)}$		$r_{IB(y)}$	
	Age1	Age2	Age1	Age2	Age1	Age2	Age1	Age2	Age1	Age2	Age1	Age2	Age1	Age2	Age1	Age2
Control CNC	0.287	0.412	-0.577	0.263	0.990	0.141	0.357	0.104	0.406	0.079	0.048	0.022	0.540	0.084	0.030	0.110
3	–	–	–	–	–	–	–	–	0.027	0.103	0.013	0.146	–	–	–	–
4	0.052	0.156	0.106	0.144	0.064	0.131	0.023	0.002	0.363	0.242	0.724	0.226	0.119	0.276	0.684	0.149
5	0.998*	0.110	1.000*	0.424	0.845	0.061	0.158	0.091	0.056	0.297	0.093	0.001	–	–	–	–
6	0.071	0.030	0.335	0.336	–	–	–	–	–	–	–	–	0.179	0.104	0.411	0.000
7	1.000*	0.165	1.000*	0.232	–	–	–	–	–	–	–	–	0.638	0.046	0.438	0.134

* Sample size too small to be of any significance

The relationship between supplement intake and growth performance.

In order to find out if there is any direct relationship between the average daily consumption of supplement and height or weight increment per month, the coefficients of correlation between weight or height increment versus supplement intake per month were computed according to age group and types of supplement used. The result, as shown in Table 10, shows that there were low correlation in all cases (except in a few cases where sample size were too small to be of any significance). Anyhow, this finding should not be regarded as irrelevant when one works on the hypothesis that growth performance of the cohort is the outcome of not only the average supplement intake alone but a combination of factors which, among other things are the average attending days, the rate of turnover of children at the Centre, the general health status, food intake at home.

Acknowledgement.

The Protein Food Development Project wishes to convey its gratitude to the National Bureau of Statistics and the Provincial Health Officers of Chiengmai, Prae, Ubol and Roi-et for their kind assistance and cooperation, without which no study of this nature would be possible.

WARF Institute, Inc.
MADISON, WISCONSIN

REPORT

A sample of mung bean extract was submitted to WARF Institute on February 13, 1970 by Dr. G.F. Combs, Dept. of Health, Education and Welfare of Rockville, Maryland, on behalf of Dr. Bhumiratana of Thailand for a protein evaluation using the rat PER assay.

The sample was assiqned WARF No. 0021856,

The assay was conducted according to the method outlined in the official methods of Analyses of A.O.A.C., p. 785 10th Edition (1965).

The sample was compared to ANRC reference casein.

Results

Sample	corrected PER
Mung bean extract	1.19
ANRC casein	2.50

Signed **Eugene Robaidek**
By and for WARF Institute Inc.
Date: May 5, 1970

WARF Institute, Inc.

MADISON, WISCONSIN

Data Summary
(Average of 10 animals per group)

Ave. Body wt. (gm)	Mung Bean Extract	ANRC Casein
0 wk	47	47
1 wk	50	65
2 wk	55	87
3 wk	67	107
4 wk	75	138
Av. Body Wt. Gain (gm)		
1 wk	3	18
2 wk	5	22
3 wk	12	20
4 wk	8	31
total	28	91
Ax. Food Consumption (gm)		
1 wk	31	44
2 wk	41	63
3 wk	57	85
4 wk	61	102
total	190	294
P.E.R.		
as is	1.47	3.10
Corrected	1.19	2.50

WARF Institute, Inc.
MADISON, WISCONSIN

REPORT

Analysis for	Amino Acid Analyzer, Methionine, Cystine, Tryptophan, Available Lysine, Sodium Chloride, Calcium, Phosphorus, Vit. B-1, Vit. B-2, Nicotinic Acid, PER, Proximate.
Description of Sample	
Date Received	4-21-70 Control Number
Submitted by	Mr. Amara Bhumiratana, Director Institute of Food Research and Product Development Kasetsart University P.O. Box 4-170 Bangkok 4, THAILAND
Claimed Content	
Results	See attachhed protocol.
Method	
Remarks	

Signed **Eugene Robaidek**
by and for the **WARF Institute, Inc.**
Date June 17, 1970
WARF Institute No. 0041652-1659

WARF Institute Inc.

MADISON, WISCONSIN

Method:

Amino Acid Analyzer:	Moore, Stein and Spackman, Anal. Chem., 30, 1190-1206, (1958)
Methionine, Cystine	
Tryptophan:	Henderson and Snell, J. Biol. Chem., 172, 15 (1948)
Available Lysine:	Biochem. Journal (1960), 77, P. 604.
Sodium Chloride:	A.O.A.C., 10th Edition, 1965, Page #107
Calcium:	Analytical Methods for Atomic Absorption Spectrophotometry. Perkin-Elmer.
Phosphorus:	A.O.A.C., P. 341 (1965) 10th Ed.
Vitamin B-1:	A.O.A.C., 758 (1965) 10th Ed.
Vitamin B-2:	A.O.A.C., 773 (1965) 10th Ed.
Nicotinic Acid:	A.O.A.C., 771 (1965) 10th Ed.
Protein:	A.O.A.C., 15 (1965) 10th Ed.
Moisture:	Vacuum oven A.O.A.C., 327 (1965) 10th Ed.
Ash:	A.O.A.C., 328 (1965) 10th Ed.
Fat:	A.O.A.C., 224 (1965) 10th Ed.
Ether Extract:	A.O.A.C., 321 (1965) 10th Ed.
Fiber:	A.O.A.C., 332 (1965) 10th Ed.
Carbohydrates:	By difference

WARF Institute, Inc.,

MADISON WISCONSIN

KASETSART UNIVERSITY

	Methionine (mg/gm)	Cystine (mg/gm)	Tryptophan (mg/gm)	Available Lysine %	Sodium Chloride %	Calcium %	Phosphorus %
#7 Protein Concentrate (Kaset)	14.4	8.30	7.62	4.02	4.28	0.086	0.76
8 Baby Food (Form. 17)	1.84	1.31	1.43	0.69	1.05	0.11	0.27
9 Soybean Milk	0.572	0.435	0.604	0.33	0.23	0.026	0.08
10 Baby Food (Form. 17)	0.838	0.687	0.848	0.34	0.48	0.14	0.15
11 Cookie Soy Flour	2.37	3.32	1.74	0.83	0.44	0.10	0.52
12 Baby Food Powder (Form. 17)	3.58	3.61	3.50	1.39	1.45	0.48	0.51
13 Full Fat Soy Flour (Kaset)	5·45	7.23	8.46	2.41	0.059	0.34	0.59
14 Baby Food Powder (Form. 18)	2.48	2.85	2.40	1.19	1.85	0.38	0.49

	Vitamin B-1 (mg/100 gms)	Vitamin B-2 (μ g/gm)	Nicotinic Acid (μ g/gm)	Protein %	Moisture %	Ash %	Fat %	Ether Extract %
#7 Protein Concentrate (Kaset)	0.03	80.0	976	56.1	9.6	7.5	--	15.2
8 Baby Food (Form. 13)	0.04	2.34	15	14.2	7.08	1.5	3.2	--
9 Soybean Milk	0.01	0.40	3.98	5.8	80.3	0.5	3.1	--
10 Baby Food (Form. 17)	0.13	2.98	24.8	7.7	73.1	1.0	4.8	--
11 Cookie Soy Flour	0.07	1.10	14.6	18.2	1.1	2.8	--	22.5
12 Baby Food Powder (Form. 17)	0.37	11.9	94 3	26.2	3.8	3.9	16.1	--
13 Full Fat Soy Flour (Keset)	0.08	1.64	18.7	48.8	3.2	4.3	20.9	--
14 Baby Food Powder (Form. 18)	1.44	11.2	90.8	20.6	4.3	4·0	25.8	--

	Fiber %	Carbohydrates %	Amino Acid Analyzer	P.E.R.
#7 Protein Concentrate (Kaset)	0.6	11.0	See attached protocol	See attached protocol
8 Baby Food (Form. 13)	0.7	9.6	See attached protocol	See attached protocol
9 Soybean Milk	0.1	10.2	See attached protocol	See attached protocol
10 Baby Food (Form. 17)	0.6	12.8	See attached protocol	See attached protocol
11 Cookie Soy Flour	0.5	54.9	See attached protocol	See attached protocol
12 Baby Food Powder (Form. 17)	1.4	48.6	See attached protocol	See attached protocol
13 Full Fat Soy Flour (Kaset)	2.2	20.4	See attached protocol	See attached protocol
14 Baby Food Powder (Form. 18)	1.0	44.3	See attached protocol	See attached protocol

WARF Institute, Inc.

MADISON WISCONSIN

KASETSART UNIVERSITY

Amino Acid Analyzer

		#7 Protein Concentrate (Kaset)	8 Baby Food (Form. 13)	9 Soybean Milk	10 Baby Food (Form. 17)	11 Cookie Soy Flour	12 Baby Food Powder (Form. 17)	13 Full Fat Soy Flour (Kaset)	14 Baby Food Powder (Form. 18)
Lysine	mg/gm	41.5	9.26	3.33	4.07	7.96	13.6	26.3	10.7
Histidine	mg/gm	12.2	3.97	1.22	1.75	2.99	6.08	12.4	4.24
Arginine	mg/gm	40.0	10.5	4.77	6.32	12.0	21.4	33.1	14.7
Aspartic	mg/gm	64.0	17.2	7.37	9.28	19.4	32.9	55.9	20.4
Threonine	mg/gm	27.3	5.09	2.47	3.00	6.47	9.69	18.7	6.57
Serine	mg/gm	24.7	6.95	2.92	3.64	8.75	12.7	24.2	8.86
Glutamic	mg/gm	76.0	25.1	10.9	14.1	39.4	50.0	91.9	33.4
Proline	mg/gm	23.8	6.65	3.38	3.65	11.4	13.2	28.7	9.81
Glycine	mg/gm	32.4	5.81	2.47	3.18	6.72	11.0	20.5	6.89
Alanine	mg/gm	24.2	6.86	2.57	3.32	10.1	12.3	21.1	8.21
Cystine	mg/gm	8.76	2.40	0.588	0.946	N.C.	2.76	9.78	2.98
Valine	mg/gm	25.5	6.83	2.49	3.32	7.72	11.7	29.7	8.75
Methionine	mg/gm	21.0	1.62	0.135	0.434	1.11	2.89	6.52	1.98
Isoleucine	mg/gm	24.5	6.21	2.55	3.24	7.40	11.6	21.5	7.83
Leucine	mg/gm	38.6	11.0	4.35	5.62	13.0	19.9	37.4	13.9
Tyrosine	mg/gm	21.7	4.42	1.99	2.52	5.43	8.62	16.6	6.03
Phenylalanine	mg/gm	24.3	7.62	2.74	3.55	7.92	12.2	23.6	8.28
Tryptophan	mg/gm	6.06	1.16	0.543	[illegible]	1.61	2.31	4.53	1.96
Ammonia	mg/gm	5.15	1.31	0.359	0.666	0.621	2.01	4.64	0.898
Cysteic Acid	mg/gm	7.64	0.0821	6.303	0.216	0.651	0.390	0.474	0.330
Meth. Sulfoxide	mg/gm	3.21	1.66	2.14	1.87	4.48	3.47	2.46	2.85

WARF Institute, Inc.

MADISON, WISCONSIN

TWO-WEEK PROGRESS REPORT

(Average of 10 Animals per Group)

Sample	Average Body Weight (Gm) 0 Wk	1 Wk	2 Wk
8 Baby Food (Form. 13)	44	55	69
9 Soybean Milk	44	55	74
10 Baby Food (Form. 17)	45	58	80
ANRC Casein	45	60	90

Sample	Average Body Weight Gain (Gm) 1 Wk	2 Wk	Total
8 Baby Food (Form. 13)	11	14	25
9 Soybean Milk	11	19	30
10 Baby Food (Form. 17)	13	22	35
ANRC Casein	15	30	45

Sample	Average Protein Consumption (Gm) 1 Wk	2 Wk	Total
8 Baby Food (Form. 13)	4.6	6.7	11.3
9 Soybeau Milk	4.5	8.0	12.5
10 Baby Food (Form. 17)	4.9	8.3	13.2
ANRC Casein	5.0	8.3	13.3

Sample	P.E.R. As is	Corrected
8 Baby Food (Form. 13)	2.21	1.64
9 Soybean Milk	2.40	1.78
10 Baby Food (Form. 17)	2.65	1.96
ANRC Casein	3.38	2.50

WARF Institute Inc.

MADISON, WISCONSIN

TWO WEEK PROGRESS REPORT
(Average of 10 Animals per Group)

Sample	Average Body Weight (Gm) 0 Wk	1 Wk	2 Wk
#7 Kaset Marine Prot. Conc.	47	63	94
#11 Cookie Soy Flour	47	65	94
#12 Baby Food Powder (Form. 17)	46	61	85
#13 Kaset Full Fat Soy Flour	47	61	83
#14 Baby Food Powder (Form .18)*	46	64	91
ANRC Casein	46	59	82

Sample	Average Body Weight Gain (Gm) 1 Wk	2 Wk	Total
#7 Kaset Marine Prot. Conc.	16	31	47
#11 Cookie Soy Flour	18	29	47
#12 Baby Food Powder (Form. 17)	15	24	39
#13 Kaset Full Fat Soy Flour	14	21	36
#14 Baby Food Powder (Form. 18)*	18	27	45
ANRC Casein	13	23	36

Sample	Average Food Consumption (Gm) 1 Wk	2 Wk	Total
7 Kaset Marine Prot. Conc.	43	69	112
11 Cookie Soy Flour	50	84	134
12 Baby Food Powder (Form. 17)	44	70	114
13 Kaset Full Fat Soy Flour	46	72	118
14 Baby Food Powder (Form. 18)*	43	74	117
ANRC Casein	41	64	105

WARF Institute, Inc.

MADISON, WISCONSIN

P.E.R.

Sample	As is	Corrected
7 Kaset Marine Prot. Conc.	4.20	3.06
11 Cookie Soy Flour	3.51	2.56
12 Baby Food Powder (Form. 17)	3.42	2.49
13 Kaset Full Fat Soy Flour	3.05	2.22
14 Baby Food Powder (Form. 18)*	3.85	2.81
ANRC Casein	3.43	2.50

*Average of 9 Animals

WARF Institute Inc.
MADISON, WISCONSIN

REPORT

Analysis for	Complete Proximate
Description of Sample	
Date Received	8-28-70 Control Number
Submitted by	MR. Amara Bhumiratana, Director Kasetsart University Institute of Food Research and Product Development P. O. Box 4-170 Bangkok 4, THAILAND
Claimed Content	
Results	See attached protocol
Method	Protein: A.O.A.C., 15 (1965) 10th Ed. Moisture: Vacuum oven A.O.A.C., 327 (1965) 10th Ed. Ash: A.O.A.C., 328 (1965) 10th Ed. Ether Extract: A.O.A.C., 331 (1965) 10th Ed. Fiber: A.O.A.C., 332 (1965) 10th Ed. Carbohydrates: By difference
Remarks	

Signed **Eugene Robaidek**
by and for the WARF INSTTTUTE, INC.
Date October 7, 1970
WARF Institute No. 0082607-2611

WARF Institute, Inc.

MADISON, WISCONSIN

Two-week Progress Report
(Average of 10 Animals per Group)

Sample	Average Body Weight (Gm) 0 Wk	1 Wk	2 Wk
Prod. 17, Form. 14	49	67	90
Prod. 18, Form. 15	49	70	101
Prod. 19, Form. 16	49	63	84
Prod. 20, Form. 17A	49	65	84
Prod. 21, Form. 17B	49	65	81
ANRC Casein	49	67	87

Sample	Average Body Weight Gain (Gm) 1 Wk	2 Wk	Total
Prod. 17, Form. 14	18	23	41
Prod. 18, Form. 15	21	31	52
Prod. 19, Form. 16	14	21	35
Prod. 20, Form. 17A	16	19	35
Prod. 21, Form. 17B	16	16	32
ANRC Casein	18	20	38

WARF Institute, Inc.

MADISON, WISCONSIN

October 7, 1970

Sample	Average Food Consumption (Gm) 1 Wk	2 Wk	Total
Prod. 17, Form. 14	48	71	119
Prod. 18, Form. 15	50	77	127
Prod. 19, Form. 16	44	66	110
Prod. 20, Form. 17A	46	64	110
Prod. 21, Form. 17B	45	59	104
ANRC Casein	48	65	113

Sample	P.E.R. As is	Corrected
Prod. 17, Form. 14	3.45	2.57
Prod. 18, Form. 15	4.09	3.04
Prod. 19, Form. 16	3.18	2.37
Prod. 20' Form. 17A	3.18	2.37
Prod. 21, Form. 17B	3.08	2.29
ANRC Casein	3.36	2.50

WARF Institute Inc.

MADISON, WISCONSIN

INSTITUTE OF FOOD RESEARCH AND PRODUCT DEVELOPMENT

Kasetsart University

WARF No.	Sample	Protein (%)	Moisture (%)	Ash (%)	Ether Extract (%)	Fiber (%)	Carbohydrates (%)
0082607	Formula-17 PROD :17	45.9	3.4	7.7	25.5	1.9	15.6
0082608	Formula-15 PROD :18	44.0	3.2	7.6	25.6	1.7	17.9
0082609	Formula-16 PROD :19	58.7	3.6	7.9	15.5	0.7	13.6
0082610	Formula-17A PROD :20	56.3	3.2	7.1	17.7	1.3	14.4
0082611	Formula-17B PROD: 21	54.9	3.2	7.0	17.3	1.3	16.3

WARF Institute, Inc.
MADISON WISCONSIN

REPORT

Five samples of Kaset Protein were submitted to WARF Institute on August 28th by Dr. Amara Bhumiratana of Kasetsart University of Bangkok, Thailand for amino acid analysis and protein evaluation using the rat PER assay. The samples were identified and assigned WARF Numbers as follows :

	Sample	WARF Number
Product No. 17	Kaset Protein (Formula 14)	0082607
Product No. 18	Kaset Protein (Formula 15)	0082608
Product No. 19	Kaset Protein (Formula 16)	0082609
Product No. 20	Kaset Protein (Formula 17A)	0082610
Product No. 21	Kaset Portein (Formula 17B)	0082611

The PER assay was conducted according to the method outlined in The Official Methods of analyses of the A.O.A.C. 10th Ed. (1965)

The samples were compared to ANRC reference casein. The data obtained are attached.

Signed **Eugene Robaidek**
By and for WARF Institute, Inc.
Date Nov. 6, 1970

WARF Institute, Inc.

MADISON, WISCONSIN

Data Summary

(Average of ten animals per group)

Sample	Average Body Weight (Gm)				
	0 wk.	1 wk.	2 wk.	3 wk.	4 wk.
Prod. 17, Form. 14	49	67	90	117	147
Prod. 18, Form. 15	49	70	101	132	177
Prod. 19, Form. 16	49	63	84	106	141
Prod. 20, Form. 17A*	50	65	84	110	138
Prod. 21, Form. 17B	49	65	81	103	128
ANRC Casein	49	67	87	106	134

Sample	Average Body Weight Gain (Gm)				
	1 wk.	2 wk.	3 wk.	4 wk.	total
Prod. 17, Form. 14	18	23	27	39	98
Prod. 18, Form. 15	21	31	31	45	128
Prod. 19, Form. 16	14	21	22	35	92
Prod. 20, Form. 17A*	15	19	26	28	88
Prod. 21, Form. 17B	16	16	22	25	79
ANSC Casein	18	20	19	28	85

Sample	Average Food Consumption (Gm)				
	1 wk.	2 wk.	3 wk.	4 wk.	total
Prod. 17, Form. 14	48	71	88	104	311
Prod. 18, Form. 15	50	77	93	119	339
Prod. 19, Form. 16	44	66	79	103	292
Prod. 20, Form. 17A*	45	64	87	104	300
Prod. 21, Form. 17B	45	59	79	92	275
ANRC Casein	48	65	78	98	289

Sample	P.E.R.	
	as is	corrected
Prod. 17, Form. 14	3.15	2.68
Prod. 18, Form. 15	3.78	3.21
Prod. 19, Form. 16	3.15	2.68
Prod. 20, Form. 17A*	2.93	2.49
Prod. 21, Form. 17B	2.87	2.44
ANRC Casein	2.94	2.50

*Average based on 9 animals.

WARF Institute, Inc.

MADISON WISCONSIN

	Methionine (mg/mg)	Cystine (mg/mg)	Tryptophan (mg/mg)
Product No : 17 Form. 14	8.10	7.78	5.41
Product No . 18 Form. 15	8.75	7.04	5.70
Product No . 19 Form. 16	11.1	7.22	7.36
Product No . 20 Form. 17A	10.6	6.24	6.05
Product No . 21 Form. 17B	10.5	6.38	7.79

Methods :

Methionine :
Cystine :
Tryptophan :
} Henderson and Snell, J. Biol. Chem., 172, 15, (1948)

WARF Institute Inc.
MADISON, WISCONSIN

REPORT

Analysis for	Amino acid analyzer
Description of Sample	Kaset Protein
Date Received	8-28-70 Control Number
Submitted by	Kasetsart University Bangkok, Thailand
Claimed Content **Results**	(See attached)
Method	Moore, Stein & Spackman Anal. Chem. 30 1190-1206 (1958).
Remarks	

Signed **Eugene Robaidek**
by and for the WARF INSTITUTE, INC.
Date Nov. 6, 1970
WARF Institue No. 0082607-2611

WARF Institute, Inc.

MADISON, WISCONSIN

WARF No.	0082607	0082608	0082609	0082610	0082611
	No. 17	No. 18	No. 19	No. 20	No. 21
Lysine (mg/gm)	25.8	25.6	39.4	30.7	35.3
Histidine (mg/gm)	11.2	11.4	14.7	13.6	15.7
Ammonia (mg/gm)	4.42	4.09	6.15	4.5	5.54
Arginine (mg/gm)	29.2	29.5	39.0	33.6	38.9
Aspartic (mg/gm)	52.2	59.3	74.3	71.8	76.2
Threonine (mg/gm)	16.1	17.8	22.7	19.6	20.4
Serine (mg/gm)	20.7	23.0	29.7	28.7	30.5
Glutamic (mg/gm)	82.4	94.5	106.0	110.	117.0
Proline (mg/gm)	20.9	21.3	23.5	24.7	25.7
Glycine (mg/gm)	18.3	21.0	28.3	23.7	23.1
Alanine (mg/gm)	20.5	23.2	29.4	27.5	27.5
Cystine (mg/gm)	NC	NC	NC	NC	NC
Valine (mg/gm)	20.5	22.8	30.1	28.9	30.7
Methionine (mg/gm)	13.7	15.9	18.6	17.8	17.9
Isoleucine (mg/gm)	21.0	23.1	28.1	27.0	28.5
Leucine (mg/gm)	33.5	37.3	47.6	47.0	48.5
Tyrosine (mg/gm)	15.0	17.4	22.4	23.1	21.6
Phenylalanine(mg/gm)	20.4	24.4	32.9	33.6	35.0
Tryptophan (mg/gm)	4.41	5.18	6.15	7.26	7.1

WARF Institute, Inc.
MADISON WISCONSIN

REPORT

Analysis for Complete Proximate

Description of Sample

Date Received 8-28-70 Control Number

Submitted by Kasetsart University
Bangkok, Thailand

Claimed Content

Results	Protein %	Moisture %	Ash %	Ether Extract %	Fiber %	Carbo-hydrates %
Prod. 17 Form. 14	44.8	3.4	7.6	25.5	1.8	16.8
Prod. 18 Form. 15	44.0	3.2	7.5	25.6	1.7	18.1
Prod. 19 Form. 16	58.6	3.6	7.8	15.4	0.6	13.8
Prod. 20 Form. 17A	56.3	3.2	7.1	17.6	1.3	14.5
Prod. 20 Form. 17B	54.9	3.1	7.0	17.3	1.3	16.4

Method

Protein : A.O.A.C., 15 (1965) 10th Ed.
Moisture : Vacuum oven A.O.A.C., 327 (1965) 10th Ed.
Ash : A.O.A.C., 328 (1965) 10th Ed.
Ether
Extract : A.O.A.C. 331 (1965) 10th Ed.
Fider : A.O.A.C. 332 (1965) 10th Ed.
Carbohydrates . By difference.

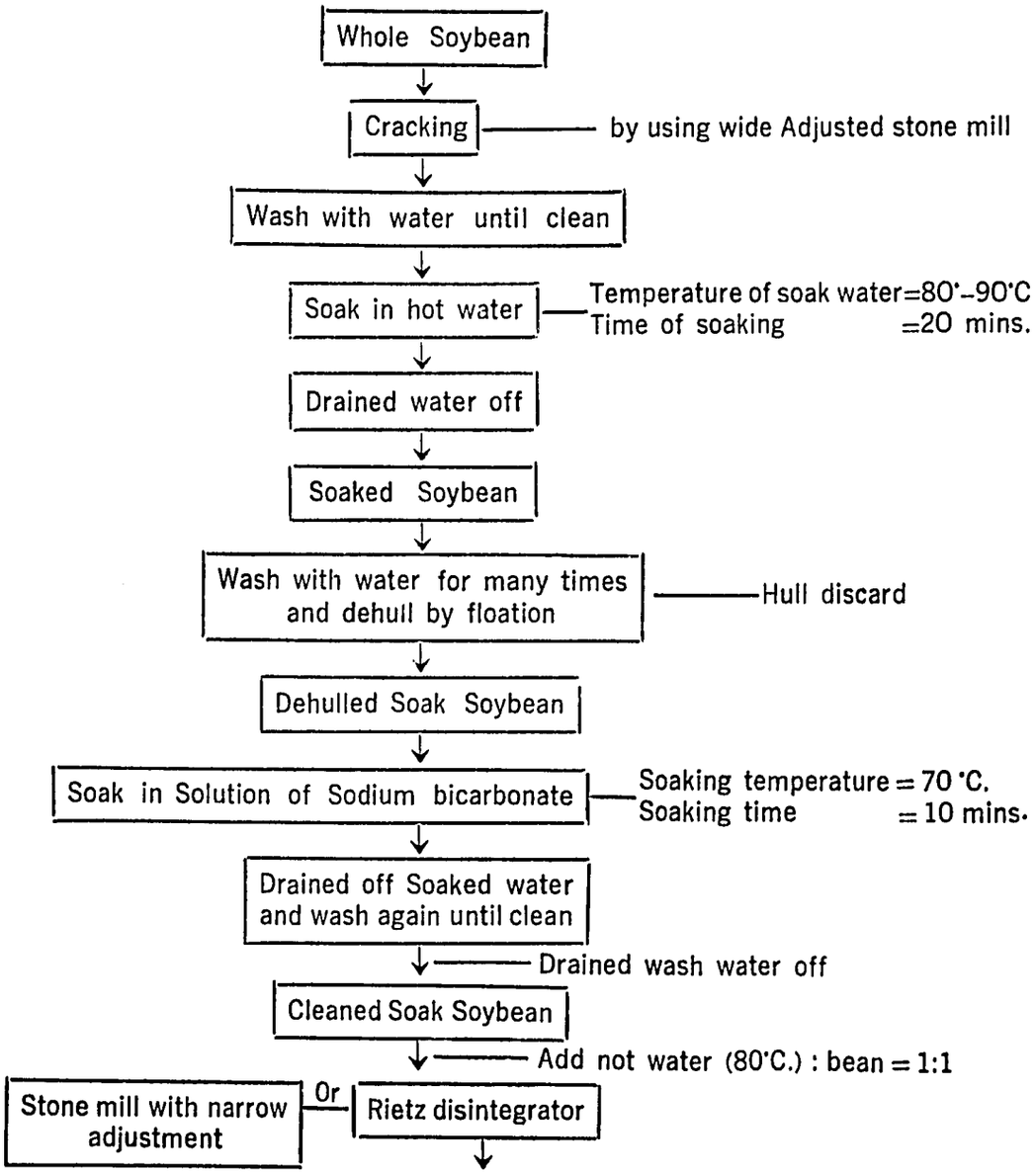
Remarks

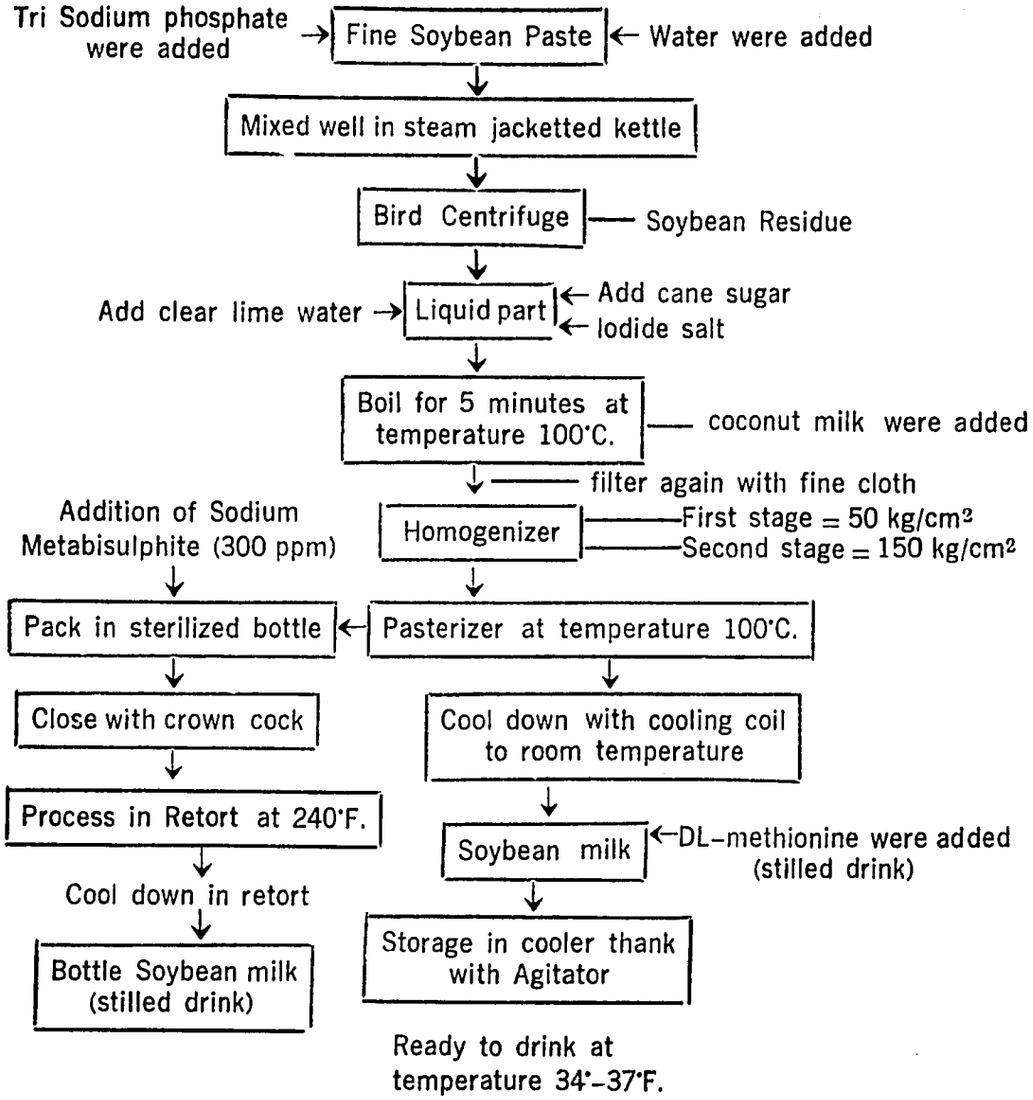
Signed **Eugene Robaidek**
by and for the WARF INSTITUTE. INC.
Date Nov. 6, 1970
WARF Institute No. 0082607-2611

Lesson 2

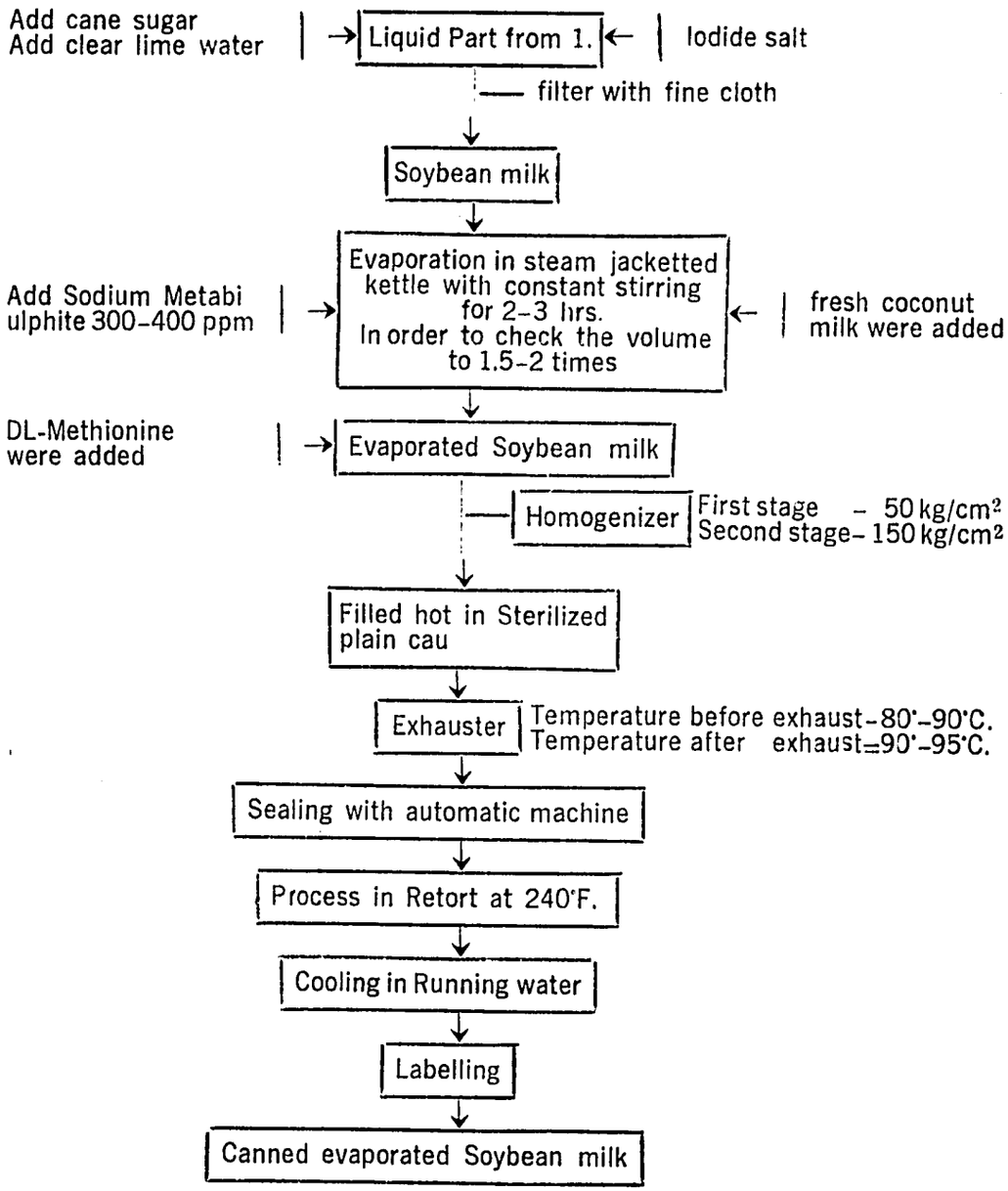
Flow Chart for the Production of Soybean milk (stilled drink) and Canned Evaporated Soymilk

1, Flow Chart for the Production of Soybean milk (stilled drink)




Tri Sodium phosphate were added
Fine Soybean Paste
Water were added
Mixed well in steam jacketted kettle
Bird Centrifuge
Soybean Residue
Add clear lime water
Liquid part
Add cane sugar
Iodide salt
Boil for 5 minutes at temperature 100°C.
coconut milk were added
filter again with fine cloth
Addition of Sodium Metabisulphite (300 ppm)
Homogenizer
First stage = 50 kg/cm2
Second stage = 150 kg/cm2
Pack in sterilized bottle
Pasterizer at temperature 100°C.
Close with crown cock
Cool down with cooling coil to room temperature
Process in Retort at 240°F.
Soybean milk
DL-methionine were added (stilled drink)
Cool down in retort
Bottle Soybean milk (stilled drink)
Storage in cooler thank with Agitator
Ready to drink at temperature 34°-37°F.

2. Flow Chart for the Production of Canned Evaporated Soybean Milk



Proximate Analysis of Kaset Soymilk (stilled drink), Kaset Canned Evaporated Soybean milk, Kaset Soybean Residue determined by Division of Biological Science, Department of Science, Ministry of Industry, Bangkok, Thailand on December 25,1967.

	Kaset Soymilk (stilled drink) FB.595 gm./100 ml.	Kaset Canned Evaporated Soymilk FH.328	Kaset Soybean Residue
Moisture %	87.05	74.5	6.38
Fat %	1.07	4.12	18.20
Protein %	2.7	6.76	40.20
Ash %	0.41	0.80	3.48
Carbohydrate (by difference) %	8.78	13.72	20.70
Crude fibre %	0.00	0.00	11.00
Calorific value (cal./100gm)	55.51	119.0	307.40
Iron mg/100gm	0.43	1.23	4.90
Calcium mg/100gm	19.16	40.05	398.40
Phosphorus	39.20	105.0	491.40
Sodium mg/100gm	–	142.7	–
Potassium mg/100gm	–	136.5	–
Vitamin A	–	not found	–
Vitamin C	–	not found	–
Vitamin B_1 , mg/100gm	–	0.037	–
Vitamin B_2 , mg/100gm	–	0.123	–
Niacin, mg/100gm	–	0.125	–

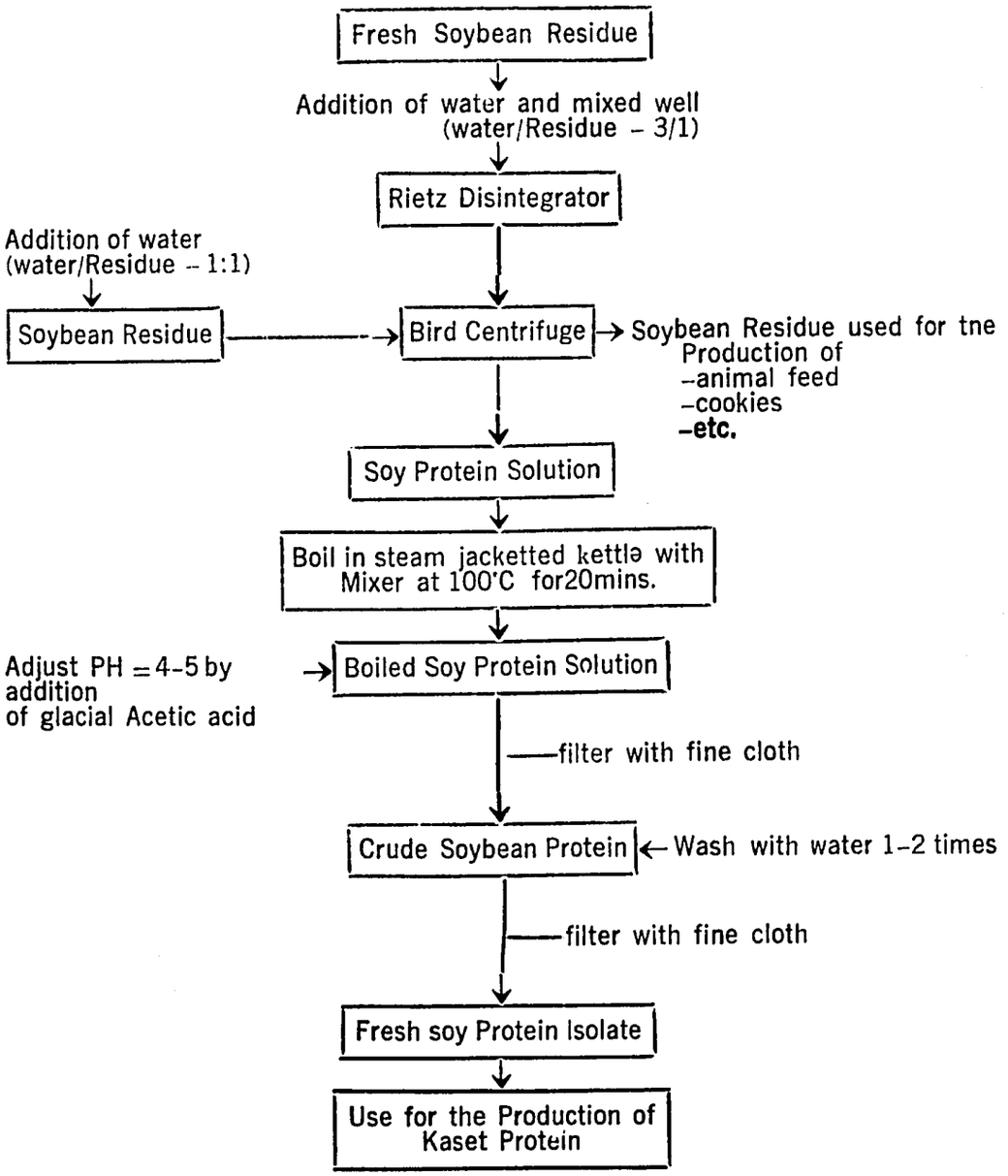
Chemical Analysis of Canned Evaporated Soymilk (100 gm) from WARF Institute Inc., Madison, Wisconsin. **Received on June 17, 1970**

Moisture %	80.3
Fat %	3.1
Protein %	5.8
Ash %	0.5
Fibre %	0.1
Carbohydrate %	10.2
Vitamin B_1 , mg %	10.01
Vitamin B_2 , mg/gm	0.40
Nicotinic acid, mg/gm	3.98
Calcium %	0.026
Phosphorus %	0.08
Methionine (mg/gm)	0.572
Cystine (mg/gm)	0.435
Tryptophan (mg/gm)	0.604
Available lysine %	0.33

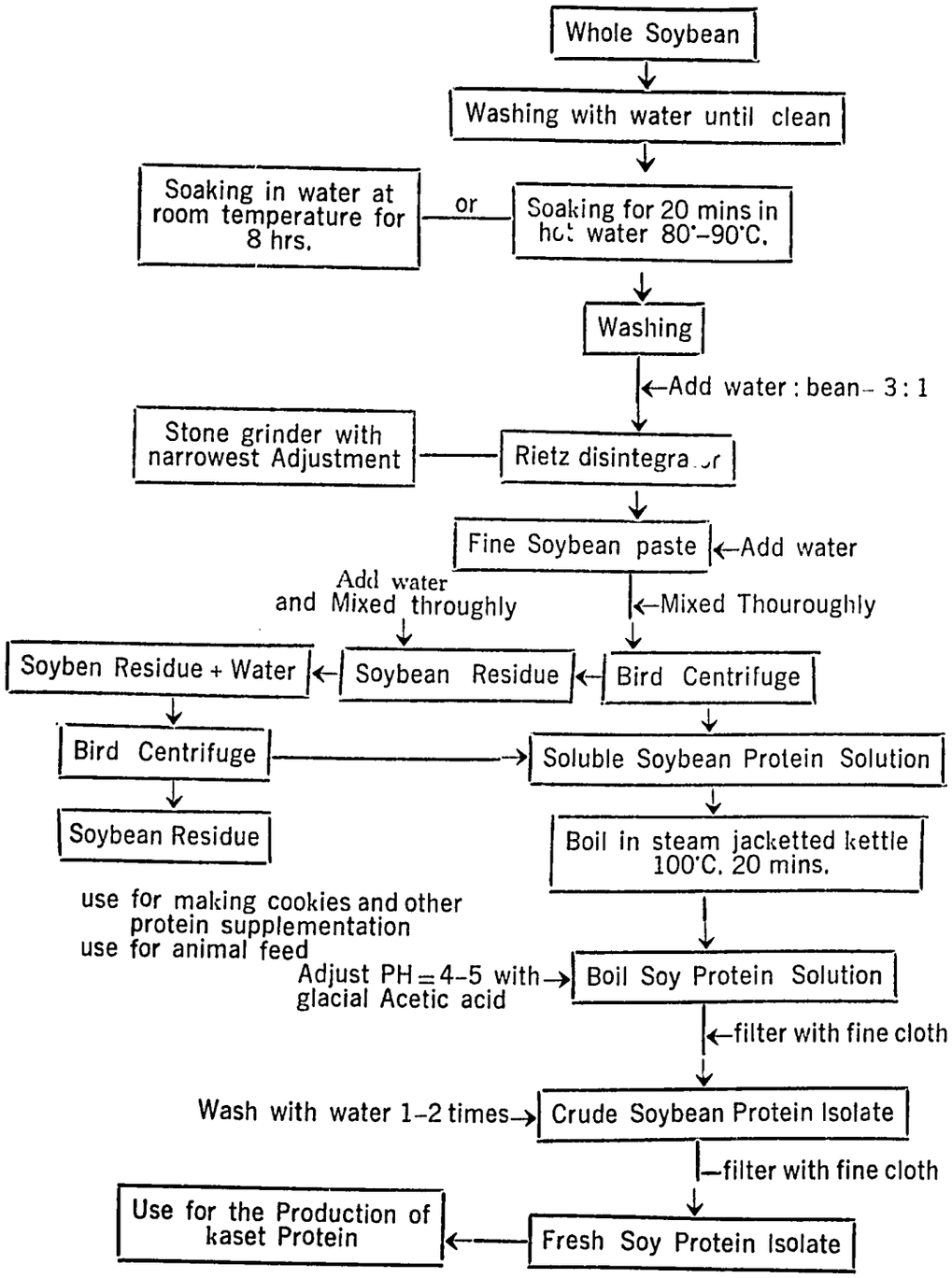
Amino Acid from Amino Acid Analyze for Canned Evaporated Soybean Milk.

Lysine mg/gm	3.33
Histidine mg/gm	1.22
Arginine mg/gm	4.77
Aspartic mg/gm	7.37
Threonine mg/gm	2.47
Serine mg/gm	2.92
Glutamic mg/gm	10.9
Proline mg/gm	3.38
Clycine mg/gm	2.47
Alanine mg/gm	2.57
Cystine mg/gm	0.588
Valine mg/gm	2.49
Methionine mg/gm	0.135
Isoleucine mg/gm	2.55
Leucine mg/gm	4.35
Tyrosine mg/gm	1.99
Phenylalanine (mg/gm)	2.74
Tryptophan mg/gm	0.543
Cysteic acid (mg/gm)	0.303
Canned Evaporated Soymilk PER	1.87
ANRC Casein	2.50

Flow Chart for the Production of Soy Protein from Soybean Residue



Flow Chart for the Production of Soy Protein Isolate from Whole Soybean

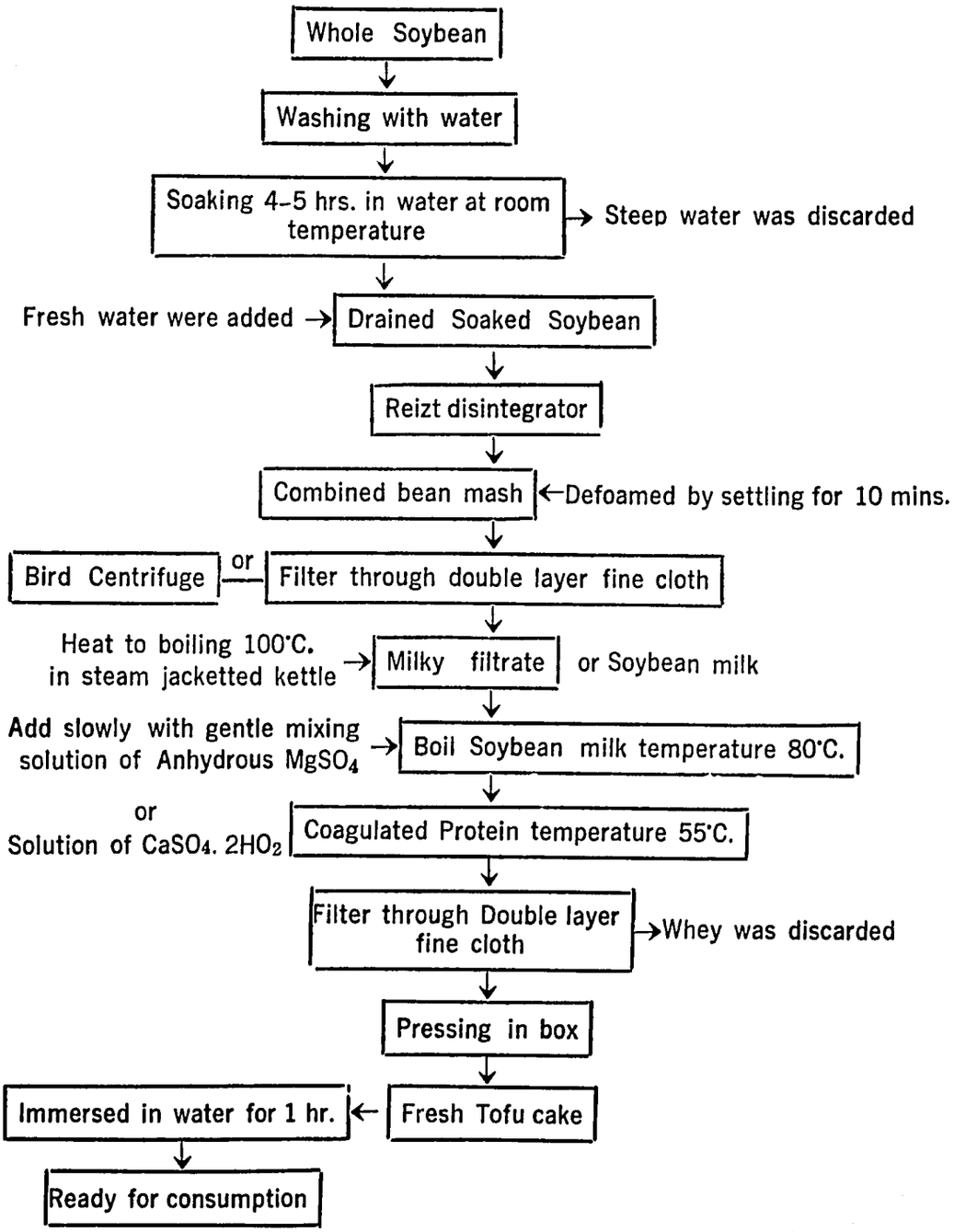


*** Proximate Analysis of Soy Protein Isolate**

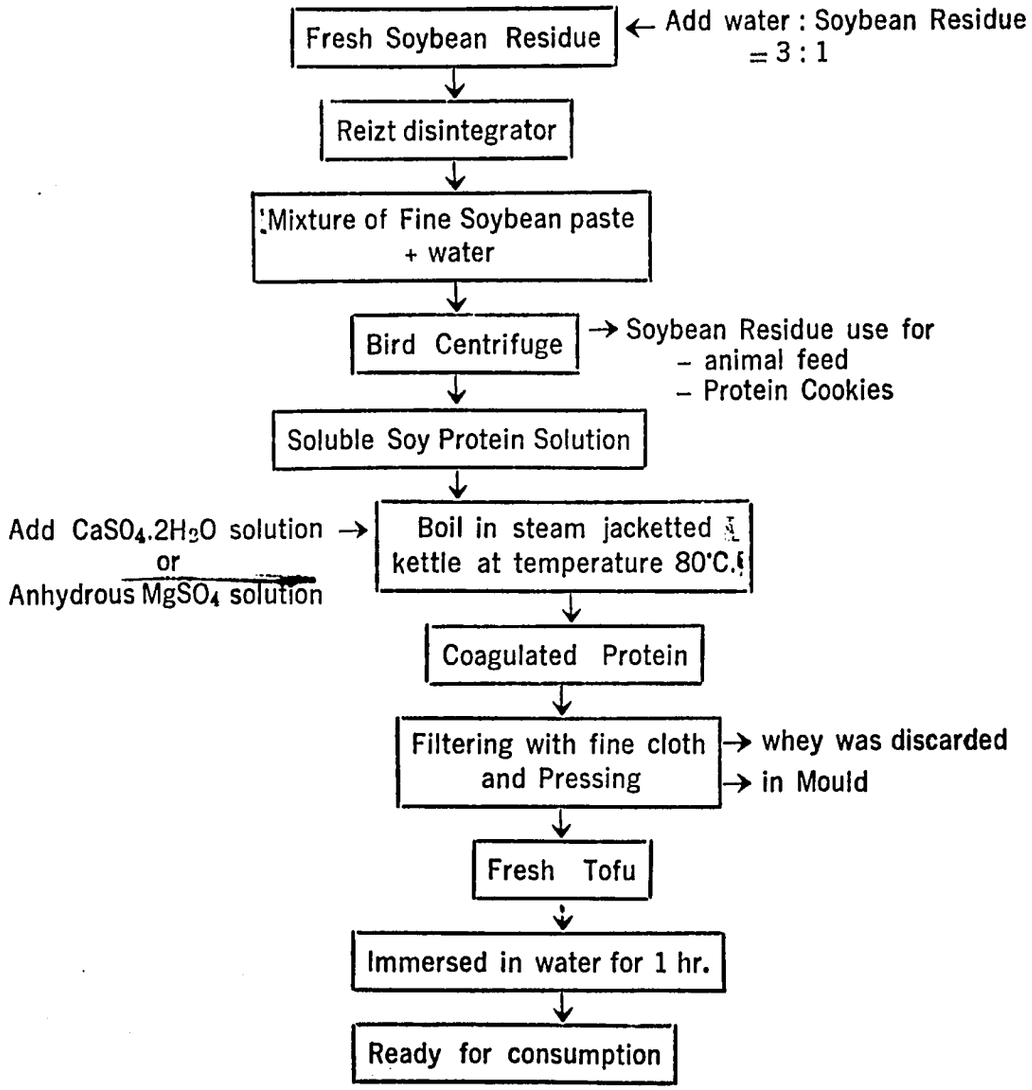
Moisture	7.6
Protein (N 6.25) %	92.9
Crude Fibre %	0.1
Ash %	**2.0**

* From :- Soybean Protein Foods. ARS – 71 – 35
May 1967.

Flow Chart for the Production of Fresh Tofu from Whole Soybean



Flow Chart for the Production of Tofu from Soybean Residue after Extraction of Soybean Milk



Proximate Analysis of Soybean Protein Isolate and Soybean Residue from Department of Science, Ministry of Industry, Bangkok, Thailand on July 3, 1968

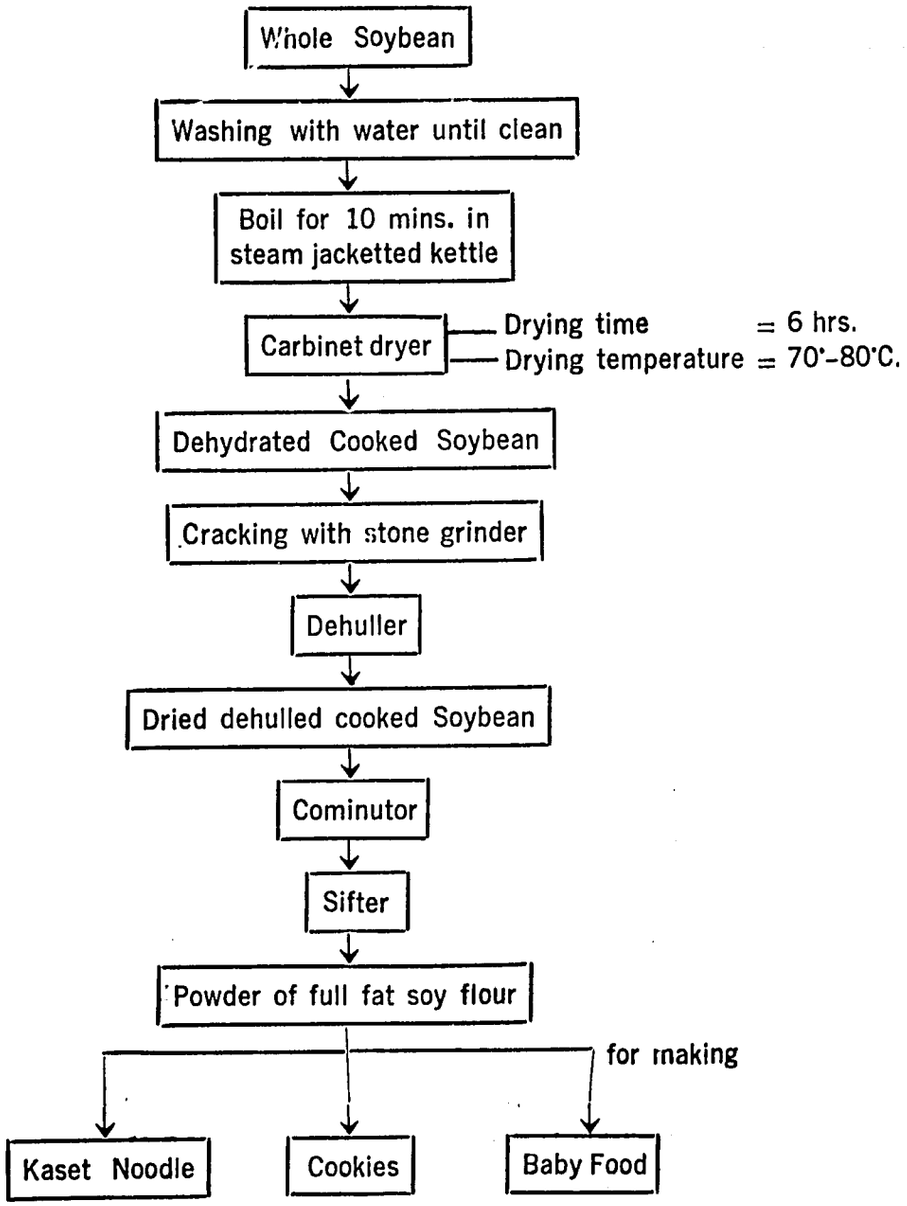
	Soybean Protein Isolate	Soybean Residue
Moisture %	6.18	5.01
Protein %	57.6	41.4

***Amino Acid Composition of Soy Protein Isolate**
Essential Amino Acids, g/16 g N

Lysine	5.8
Methionine	1.0
Cystine	3.9
Tryptophan	1.3
Threonine	3.8
Isoleucine	4.8
Leucine	7.8
Phenylalanine	5.5
Valine	4.6

* From Soybean Protein Foods. ARS-71-35 May 1967 p. 147

Flow Chart for Full Fat Soy Flour Production



Proximate Analysis of Full Fat Soy Flour (100 gm)
(Resulted from the Department ef Science on Febuary 6, 1970)

Moisture, %	4.82
Fat, %	22.80
Crude fibre, %	2.96
Protein (N x 6.25), %	40.4
Ash, %	5.06
Carbohydrate (by diff.), %	24.
Calorific values, cal/100 gm	462.8
Calcium, mg/100 gm	397.2
Iron, mg/100 gm	5.19
Phosphorus, mg/100 gm	641.2

Chemical Analysis ot Full Fat Soy Flour (100 gm)
(Resulted from WARF Institute, Inc., Madison, Wisconsin Received ou June 17, 1970)

Moisture, %	3.2
Fat, %	20.9
Fibre, %	2.2
Protein, %	48.8
Ash, %	4.3
Carbohydrate, %	20.4
Calcium, %	0.34
Phosphorus, %	0.59
Vitamin B_1 mg/100 gm	0.08
Vitamin B_2 mg/gm	1.64
Methionine (mg/gm)	5.45
Cystine (mg/gm)	7.23
Tryptophan (mg/gm)	3.46
Available Lysine, %	2.41
Nicotinic acid (Niacin), mg/gm	18.7

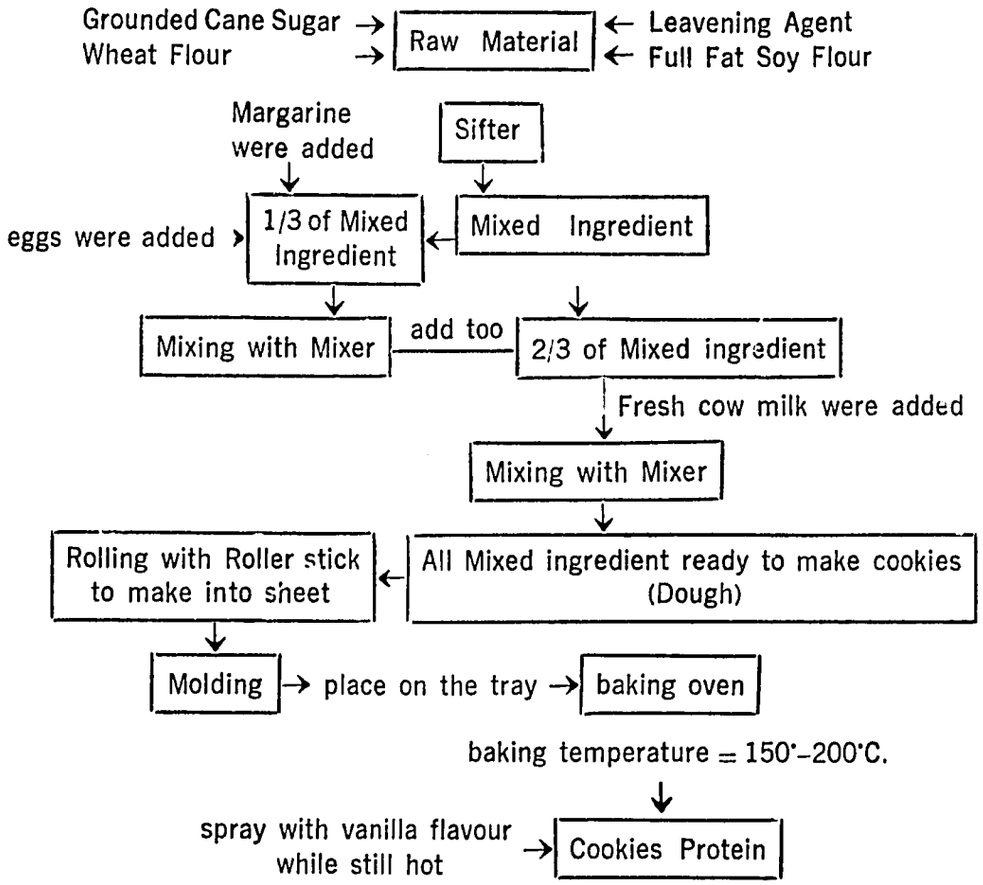
Amino Acid from Amino Acid Analyzer of Kaset Full Fat Soy Flour

Lysine mg/gm	26.3
Histidine mg/gm	12.4
Arginine mg/gm	33.1
Aspartic mg/gm	55.9
Threonine mg/gm	18.7
Serine mg/gm	24.2
Glutamic mg/gm	91.9
Proline mg/gm	28.7
Glycine mg/gm	20.5
Alanine mg/gm	21.1
Cystine mg/gm	9.78
Valine mg/gm	29.7
Methionine mg/gm	6.52
Isoleucine mg/gm	21.5
Leucine mg/gm	37.4
Tyrocine mg/gm	16.6
Phonylalanine mg/gm	23.6
Tryptophan mg/gm	4.53
Cysteic acid mg/gm	0.474

P.E.R.

Full Fat Soy Flour	2.22
ANRC Casein	2.50

Flow Chart for Protein Cookies Production



Proximate Analysis for Portein Cookies from Full Fat Soy Flour by the Department of Science, Ministsy of Public Health an August 5,1960 in 100 gms of Protein Cookies

Moisture	1.5 %
Ash	3.2 %
Protein	16.8 %
Fat (Ether extract)	21.8 %
Crude fibre	0.7 %
Carbohydrate (by diff.)	56.0
Calcium (mg %)	142
Phosphorus (mg %)	510
Iron (mg %)	1.4
Vitamin B_1 (mg %)	0.08
Vitamin B_2 (mg %)	0.11
Vitamin C (mg %)	8.4

Chemical Analysis for Protein Cookies 100 gms from the WARF Institute, Inc., Madison, Wisconsin on June 17, 1971.

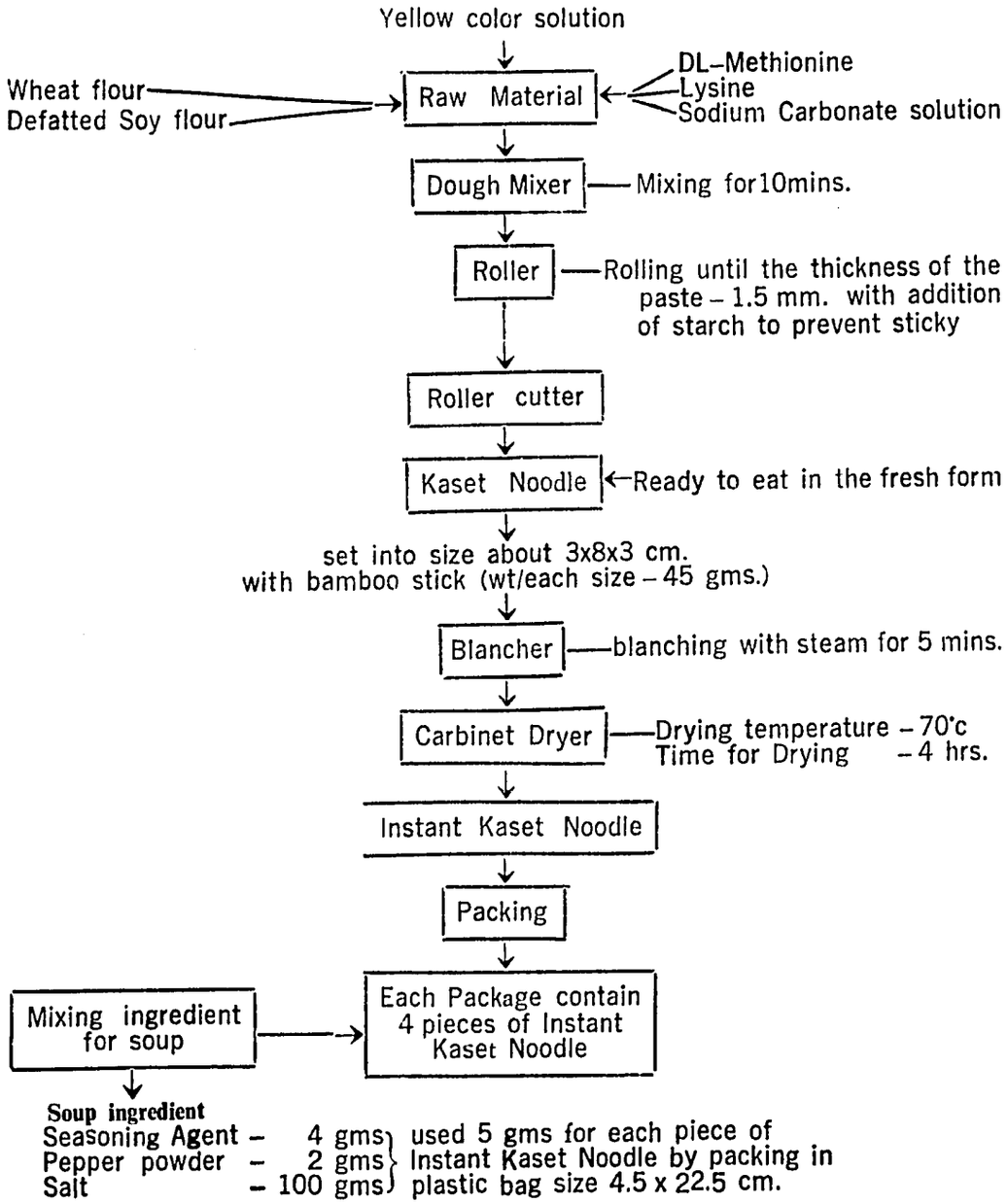
Moisture, %	1.1
Ash, %	2.8
Protein, %	18.2
Fat, (Ether extract), %	22.5
Fibre, %	0.5
Carbohydrate, %	54.9
Calcium, %	0.1
Phosphorus, %	0.52
Methionine (m8/gm)	2.37
Cystine (mg/gm)	3.32
Tryptophan (mg/gm)	1.74
Available lysine, %	0.83
Vitamin B_1 , mg/100gms	0.07
Vitamin B_2 , mg/gm	1.10
Nicotinic acid (Niacin), mg/gm	14.6

Amino Acid from Amino Acid Analyzer af Protein Cookies mg/gm

Lysine	8.96
Histidine	2.99
Arginine	12.0
Aspertic	19.4
Threonine	6.47
Serine	8.75
Glutanic	39.4
Proline	11.4
Glycine	6.72
Alanine	10.1
Cyotine	NC
Valine	7.72
Methionine	1.11
Isoleucine	7.40
Leucine	13.0
Tyrosine	5.43
Phenylalanine	7.92
Tryptophan	1.61
Cysteic acid	0.651

PER = 2.39 (Casein = 2.50)

Flow Chart for Kaset Noodle Production



Proximate Analysis of Instant Kaset Noodle from the Department of Science on April 22, 1969.

Moisture	8.93 %
Fat	2.77 %
Protein (Nx6. 25)	14.7 %

Chemical Analysis of Instant Kaset Noodle from WARF Institute, Inc. on July 27, 1970.

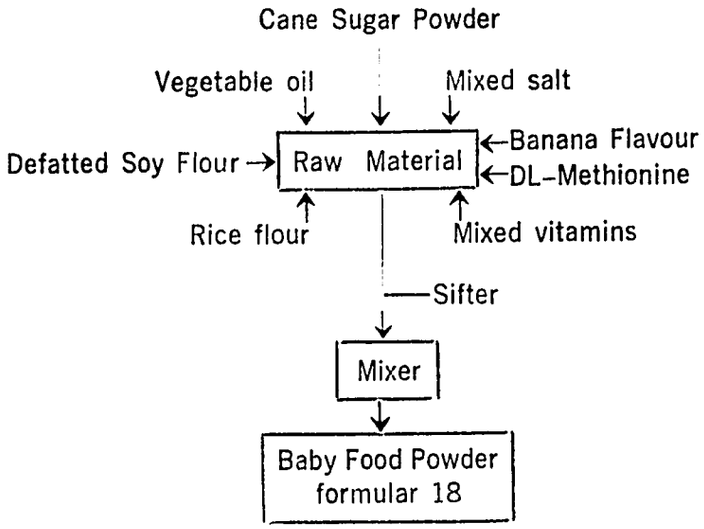
Moisture, %	8.6
Fat (Ether extract), %	2.3
Protein, %	17.7
Ash, %	2.6
Fiber, %	1.4
Carbohydrates (by difference), %	67.4
Nicotinic acid (Niacin) mg/gm)	11.7
Vitamin B_2 or Riboflavin (mg/gm)	0.213
Calcium (%)	0.03
Phosphorus (%)	0.17
Tryptophan (mg/gm)	1.17
Cystine (mg/gm)	2.73
Methionine (mg/gm)	2.99
Vitamin B_1 or Thiamine (mg/gm)	0.03
Available lysine (%)	1.17

Amino Acid from Amino Acid Analyzer of Kaset Noodle Formular 10 (mg/gm)

Lysine	3.27
Histidine	1.97
Arginine	4.84
Aspartic acid	11.3
Threonine	5.14
Serine	7.88
Glutamic acid	43.4
Proline	15.8
Glycine	5.18
Alanine	5.40
Cyotine	NC.
Valine	4.08
Methionine	NC.
Isoleucin	3.36
Leucine	8.03
Tyrosine	3.68
Phenyl alanine	5.19
Tryptophan	0.970

PER = 1.69 (Casein 2.50)

Flow Chart for the Production of Baby Food Powder Formular 18



For feeding children at the age 0–3 years

Mixed Salt Formulation

$Ca_3 (PO_4)_2$	=	36	gms
KCL	=	80	gms
Iodide salt	=	20	gms
NH_4 Ferri citrate	=	4.2	gms
(Ammonium Ferri citrate)			
Total wt of Mixed salt	=	140.2	gms

Mixed Vitamins for Baby Food Powder Formular 18 (100 gms)

Vitamin A		0.0049	gm
Vitamin B_1		0.0008	gm
Vitamin B_2		0.0013	gm
Niacin		0.0074	gm
Vitamin C		0.0431	gm
Vitamin D		0.0006	gm
Total wt of Mixed vitamins	=	0.0682	gm

Proximate Analysis for Baby Food Powder Formular 18, 100 gms from the WARF Institute, Inc. Madison, Wisconsin, on June 17. 1970.

Moisture	4.3	gm
Ash	4.0	gm
Fibre	1.0	gm
Carbohydrate	44.3	gm
Fat	25.8	gm
Protein	20.8	gm
Calories	492	
Calcium	380	mg
Phosphorus	490	mg
Thiamine (vitamin B_1)	1.44	mg
Riboflavine (vitamin B_2)	1.12	mg
Niacin (Nicotinic acid)	9.08	mg
Methionine, mg/gm	2.48	
Cystine, mg/gm	2.85	
Tryptophan, mg/gm	2.40	
Available lysine, %	1,19	

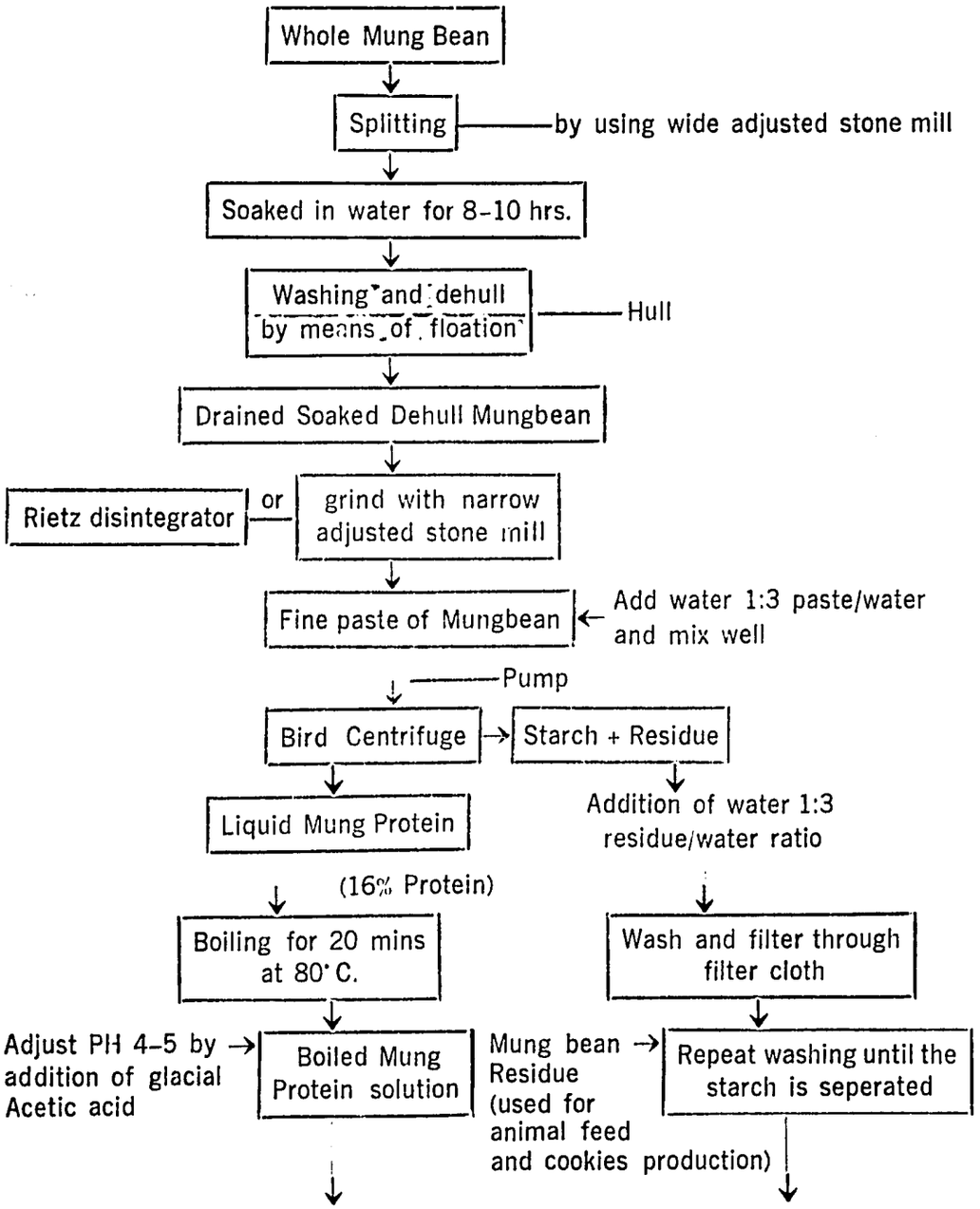
Amino Acids	mg. per gram
Lysine	10.7
Histidine	4.24
Arginine	14.7
Aspartic	20.4
Threonine	6.57
Serine	8.86
Glutanic	33.4
Proline	9.81
Alanine	8.21
Valine	8.75
Methionine	1.88
Isoleucine	7.83
Leucine	13.9
Tyrosine	6.03
Phenylalanine	8.28
Tryptophan	1.96
Glycine	0.89
Cystine	2.98

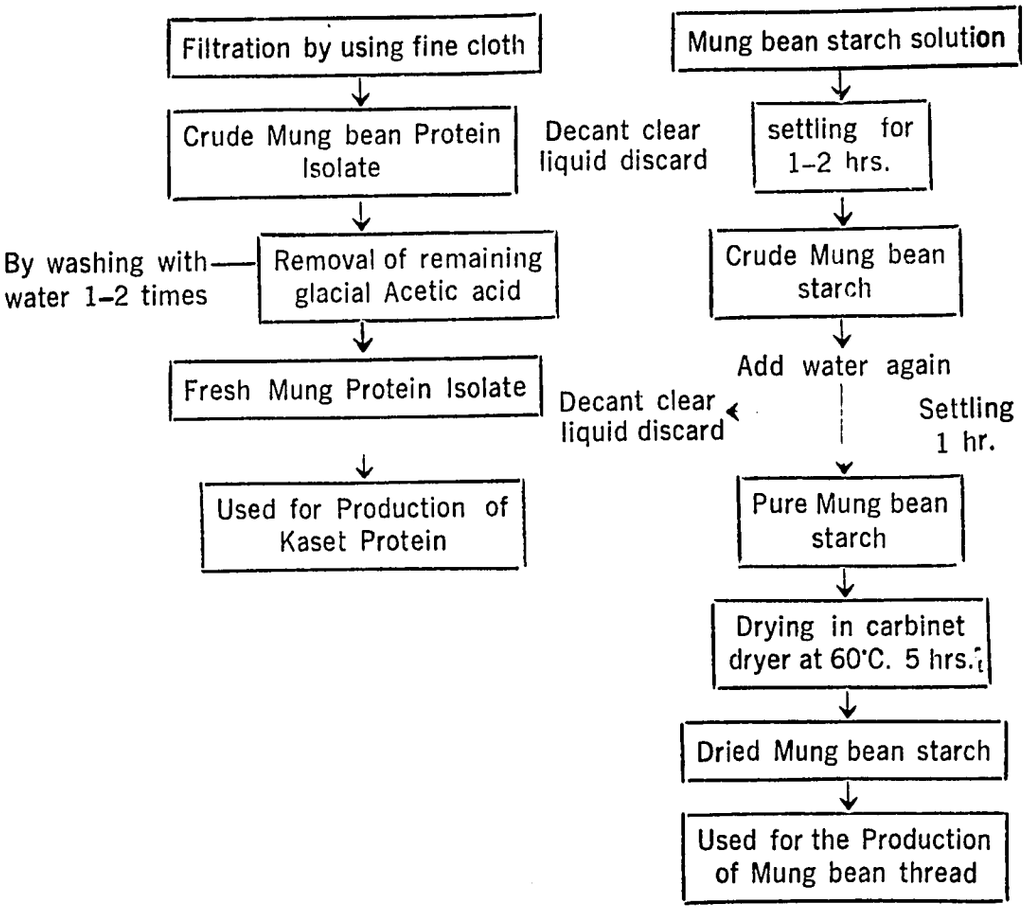
PER = 2.81 (Casein 2.50)

Proximate Analysis for Baby Food Powder Formular 18 (100 gms) from the Medical Science Department, Ministry of Public Health

Moisture, %	3.9
Ash, %	5.2
Protein, %	25.7
Fat (Ether Entracted), %	15.1
Crude fibre, %	0.8
Carbohydrate (by diff.)	49.3
Calcium, mg %	501
Phosphorus, mg %	504
Iron, mg %	17.7
Vitamin B_1 , mg %	0.57
Vitamin B_2 . mg %	1.23
Vitamin C, mg %	69.0

Flow Chart for Protein Isolate and Starch Isolate from Mung Bean




Filtration by using fine cloth
Crude Mung bean Protein Isolate
Decant clear liquid discard
By washing with water 1–2 times
Removal of remaining glacial Acetic acid
Fresh Mung Protein Isolate
Used for Production of Kaset Protein
Mung bean starch solution
settling for 1–2 hrs.
Crude Mung bean starch
Add water again
Decant clear liquid discard
Settling 1 hr.
Pure Mung bean starch
Drying in carbinet dryer at 60°C. 5 hrs.
Dried Mung bean starch
Used for the Production of Mung bean thread

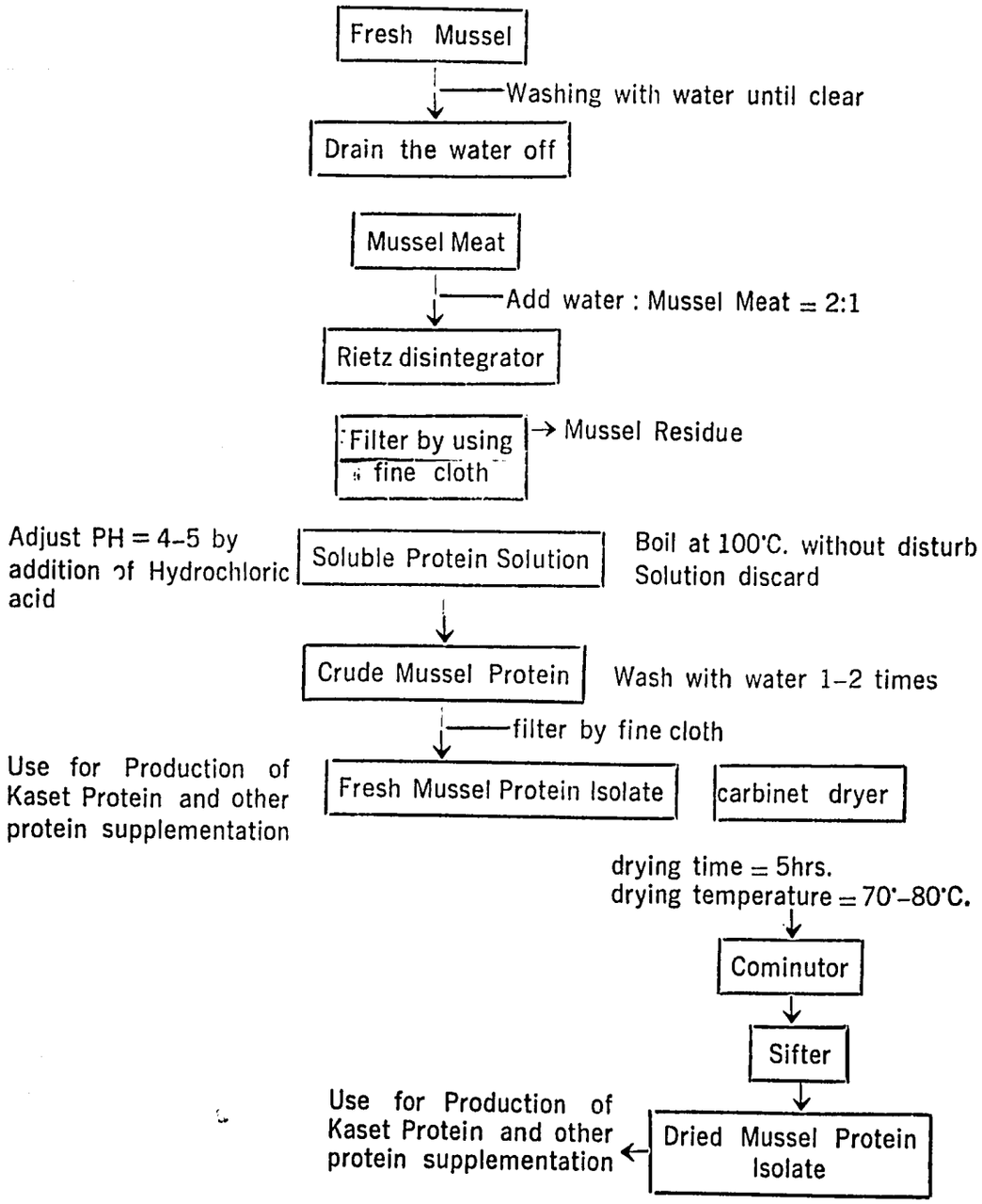
Chemical Composition of Mung Protein Isolate from the Analysis of Department of Science, Ministry of Industry, Bangkok, Thailand, on June 18, 1968.

	Mung bean Protein Isolate (Dehydrate form)	Mung bean Protein Isolate (on wet basis)	Mung bean starch (Dehydrate form)	Mung bean Residue (Dehydrate form)
Moisture, %	2.97	87.6	7.31	8.39
Protein (N x 6.25), %	78.9	8.61	0.67	15.8

Amino Acid Patterns (mg/gm total N_2) of Mung Protein Isolate

	mg/gm total N_2
Isoleucine	278
Leucine	472
Lysine	456
Phenylalanine	388
Tyrosine	156
Threonine	219
Tryptophan	85
Valine	344
Histiodine	147

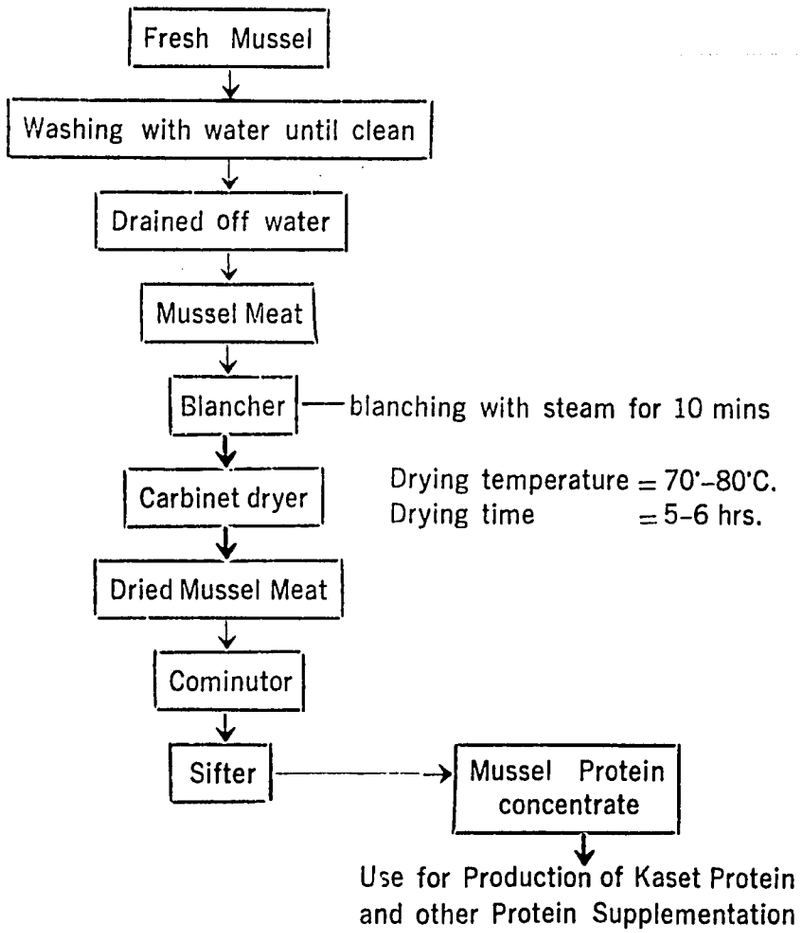
Flow Chart for the Production of Mussel Protein Isolate



Result of Proximate Analysis of Mussel Protein Isolate received from the Department of Science, Ministry of Industry, Rangkok, Thailand, on November 24, 1969.

	Mussel Protein Isolate	
	Odorless type	Odor type
Moisture, %	5.63	9.16
Protein (N = 6.25), %	70.3	62.8
Crude Fat (Ether extract), %	14.3	15.1
Crude fibre, %	0.17	0.10
Ash, %	4.44	5.44
Carbohydrates (by difference), %	5.16	7.40
Calorific value, cal/100 gms.	430.54	416.7
Calcium, mg/100 gms	31.2	35.6
Iron, mg/100 gms	19.5	6.56
Phosphorus, mg/100 gms	723.2	933.8
Sodium, mg/100 gms	178.5	421.8
Potassium, mg/100 gms	82.1	177.8

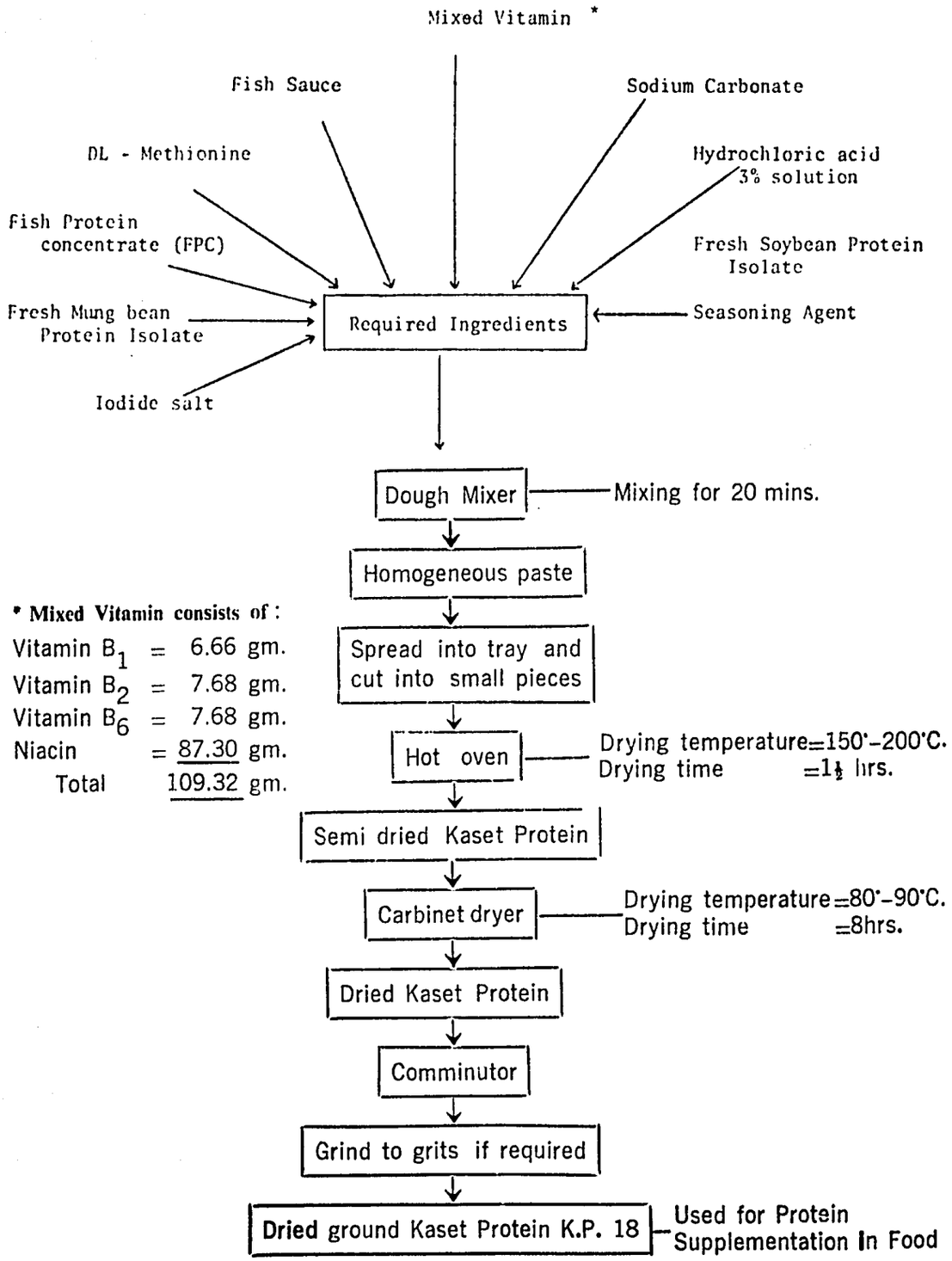
Flow Chart for the Production of Mussel Protein Concentrate



National Evaluation and Chemical Composition of Mussel Protein Concentrate from Mussels : A Potential Source of High – Quality Protein by J.T. and S. John Commercial Fisheries Review, August – September 1969.

Test or Component	Test value or Concentration
PER	3.6 (Casein = 3)
Protein, %	70.0
Ash, %	12.0
Carbohydrate (glycogen), %	15.0
Fluoride	< 5 ppm

Flow Chart for the Production of Kaset Protein



*** Mixed Vitamin consists of :**

Vitamin B_1	=	6.66 gm.
Vitamin B_2	=	7.68 gm.
Vitamin B_6	=	7.68 gm.
Niacin	=	87.30 gm.
Total		109.32 gm.

Formular of K.P 1 – 5

	K.P 1	K.P 2	K.P 3	K.P 4	K.P 5
PFD–O (gm)	100	100	100	100	100 *
Sodium bicarbonate (gm)	3	4	4.5	5	5
Water	200	200	200	200	200
Yeast extract (gm)	2	2	2	2	2
Meat Flavour (gm)	2	2	2	2	2
Mung bean starch (gm)	2	2	2	2	2

* Fresh Mung bean Protein

Composition of PFD–0

Dried Mung bean Protein Powder (gm)	260
Fish Protein Concentrate (gm)	28
DL–Methionine (gm)	3

Protein content in this mixture = 75 %
14.5 15.0 gm of PFD–0 contain Protein 10 gm

Formular of K.P. 8-13

	K.P 8	K.P 9	K.P 10	K.P 11	K.P 12	K.P 13
Wet Mung Protein (kg)	1.0	1.0	1.0	1.0	1.0	1.0
Wet Soy Protein (kg)	–	–	–	–	–	–
Mussel Protein Isolate (gm)	–	–	–	–	–	–
Mussel Protein Concentrate (gm)	–	–	–	–	–	–
Defatted Soy Flour (gm)	–	50.0	75.0	50.0	75.0	75.0
Meat Flavour (gm)	–	2.5	10.0	–	10.0	10.0
Fish Protein Concentrate (gm)	16.0	16.0	–	16.0	–	–
Iodide salt (gm)	2.5	2.5	5.0	2.5	5.0	5.0
Seasoning Agent (gm)	1.5	1.5	1.5	1.5	1.5	1.5
Fish Sauce (cc)	13.0	13.0	–	13.0	–	–
Methionine (gm)	3.0	3.0	3.0	3.0	3.0	3.0
Mixed vitamin (gm)	0.55	0.55	0.55	0.55	0.55	0.55
Sodium carbonate (gm)	6.50	6.50	6.50	6.50	6.50	6.50
Hydrochloric acid 3% (cc)	50.0	50.0	50.0	50.0	50.0	50.0
Potassium Sorbate (gm)	0.20	0.20	0.20	0.20	0.20	0.20
Tryptophan (gm)	–	–	0.75	–	0.75	0.75
Calcium phosphate (gm)	–	–	–	–	–	3.0
Tapioca starch (gm)	50.0	–	–	–	–	–

	K.P 14	K.P 15	K.P 16	K.P 17_A	K.P 17_B	K.P 18
Wet Mung Protein (kg)	–	0.4	0.4	0.5	0.5	0.5
Wet Soy Protein (kg)	1.0	0.6	0.4	0.5	0.5	0.5
Mussel Protein Isolate (gm)	–	–	0.2	–	–	–
Mussel Protein Concentrate (gm)	–	–	–	–	–	–
Defatted Soy flour (gm)	50.0	50.0	50.0	50.0	75.0	–
Meat flavour (gm)	–	–	–	–	10.0	–
Fish Protein Concentrate (gm)	16.0	16.0	16.0	16.0	–	22.3
Iodide salt (gm)	2.5	2.5	2.5	2.5	5.0	2.5
Seasoning Agent (gm)	1.5	1.5	1.5	1.5	1.5	1.5
Fish Sauce (cc)	13.0	13.0	13.0	13.0	–	6.0
Methionine (gm)	3.0	3.0	3.0	3.0	3.0	3.0
Mixed vitamin (gm)	0.55	0.55	0.55	0.55	0.55	0.55
Sodium carbonate (gm)	6.5	6.5	6.5	6.5	6.5	6.5
Hydrochloric acid 3% (cc)	50.0	50.0	50.0	50.0	50.0	50.0
Potassium Sorbate (gm)	0.20	0.20	0.20	0.20	0.20	0.20
Tryptophan (gm)	–	–	–	–	–	–
Calcium phosphate (gm)	–	–	–	–	–	–
Tapioca starch (gm)	–	–	–	–	–	–
Mix 15 mins						
Dry wt. (kg)	0.24	0.24	0.24	0.24	0.24	0.24

	K.P 19	K.P 20	K.P 21	K.P 15_A	K.P 15_B
Wet Mung Protein (kg)	0.5	0.5	0.5	0.4	0.6
Wet Soy Protein (kg)	0.5	0.5	0.5	0.6	0.4
Mussel Protein Isolate (gm)	–	–	–	–	–
Mussel Protein Concentrate (gm)	22.3	11.2	–	–	–
Defatted Soy flour (gm)	–	–	–	–	–
Meat flavour (gm)	–	–	–	–	–
Fish Protein Concentrate (gm)	–	–	11.2	22.3	22.3
Iodide salt (gm)	2.5	2.5	2.5	2.5	2.5
Seasoning Agent (gm)	1.5	1.5	1.5	1.5	1.5
Fish Sauce (cc)	6.0	6.0	6.0	6.0	6.0
Methionine (gm)	3.0	3.0	3.0	3.0	3.0
Mixed vitamin (gm)	0.55	0.55	0.55	0.55	0.55
Sodium carbonate (gm)	6.50	6.50	6.50	6.50	6.50
Hydrochloric acid 3% (cc)	50.0	50.0	50.0	50.0	50.0
Potassium Sorbate (gm)	–	–	–	–	–
Tryptophan (gm)	–	–	–	–	–
Calcium phosphate (gm)	–	–	–	–	–
Tapioca starch (gm)	–	–	–	–	–
Mix 15 mins					
Dry wt. (kg)	0.24	0.24	0.24	0.31	0.24

Proximate Analysis of K.P from the Department of Science, Bangkok, Thailand, on March 13, 1969.

	K.P 1	K.P 2	K.P 3	K.P 4
Moisture, %	9.16	14.8	16.1	16.2
Protein (N × 6.25), %	68.0	45.5	51.3	48.3
Crude Fat (Ether extract), %	1.98	1.07	1.19	0.86
Crude Fibre, %	0.0	0.0	0.0	0.0
Ash, %	8.29	5.22	5.65	5.71
Carbohydrates (by difference), %	12.6	33.4	25.8	28.9
Calorific value, cals/100 gms	340.22	325.23	319.11	316.54
Calcium, mg/100 gms	483.4	284.5	304.7	314.2
Iron, mg/100 gms	25.9	15.3	16.5	18.6
Phosphorus, mg/100 gms	864.5	608.6	652.8	658.5
Vitamin A, IU/100 gms	730.0	596.0	1,680.0	1,369.0
Vitamin B_1, mg/100 gms	1.57	2.43	2.33	1.94
Vitamin B_2, mg/100 gms	6.14	5.03	4.38	3.71
Vitamin C, mg/100 gms	4.40	13.3	12.2	36.0
Niacin, mg/100 gms	29.8	26.7	21.4	22.4

Proximate Analysis of K.P from the Department of Science, Ministry of Industry, Bangkok, Thailand, on

	K.P 5 E (Jan.31,1969)	K.P 6 A (Jan.31,1969)	K.P 7 (Feb,71969)	K.P 8 (Feb.12,1969)
Moisture, %	9.80	8.14	7.54	5.41
Fat, %	4.66	10.50	5.68	8.40
Crude fibre, %	–	–	–	–
Protein (N x 6.25), %	52.7	45.5	55.1	47.1
Ash, %	5.74	4.5	6.43	8.24
Carbohydrate (by diff.) %	27.1	31.3	25.25	30.8
Calorific value, cal/100 gm	361.1	401.7	372.2	387.2
Calcium, mg/100 gm	333.6	297.1	338.9	335.3
Iron, mg/100 gm	15.8	12.2	14.9	9.0
Phosphorus, mg/100gm	616.8	523.0	621.0	566.0
Vitamin A, mg/100 gm	771	863	729	917
Vitamin B_1, mg/100 gm	5.76	1.14	0.3	3.38
Vitamin B_2, mg/100 gm	2.21	6.61	9.70	11.20
Vitamin C, mg/100 gm	28.4	78.7	50.8	50.6
Niacin, mg/100 gm	40.5	35.7	50 0	54.7

Proximate Analysis of K.P from the Department of Science, Ministry of Industry, on Feb. 17, 1969.

	K.P 9 (FN 567)	Kaset Soy bean Residue
Moisture, %	7.36	8.22
Protein (N x 6.25) %	57.0	37.2
Crude Fat (Ether extract), %	13.5	23.7
Ash, %	6.87	3.04
Crude Fibre, %	1.25	6.50
Carbohydrates (by diff.) %	14.0	21.3
Calorific value, cal/100 gm	405.5	447.3
Calcium, mg/100 gm	339.8	368.9
Iron, mg/100 gm	13.0	4.94
Phosphorus, mg/100 gm	678.6	461.4
Vitamin A, IU/100 gm	652	–
Vitamin B_1 . mg/100 gm	0.89	0.39
Vitamin B_2 ' mg/100 gm	4.70	0.14
Vitamin C, mg/100 gm	12.0	1.07
Niacin, mg/100gm	24.1	0.38

Proximate Analysis of Kaset Protein

	K.P 10	K.P 11	K.P 12	K.P 13	K.P 14	K.P 15
Moisture, %	9.8*	7.36**	–	–	5.3***	4.1***
Protein (N × 6.25), %	61.5	57.10	–	–	50.0	39.0
Crude Fat (Ether extract), %	7.73	13.5	–	–	18.5	24.4
Ash, %	5.92	6.87	–	–	7.3	7.1
Crude Fibre, %	1.44	1.25	–	–	0.3	0.1
Carbohydrates (by diff.), %	13.61	14.0	–	–	18.6	25.3
Calorific value, cals/100 gm	370.01	405.5	–	–	–	–
Calcium, mg/100 gm	221.1	339.8	–	–	612.0	329.5
Iron, mg/100 gm	10.3	13.0	–	–	18.7	19.4
Phosphorus, mg/100 gm	611.5	678.6	–	–	616	430
Vitamin B_1, mg/100 gm	1.63	0.89	–	–	8.7	5.6
Vitamin B_2, mg/100 gm	8.33	4.70	–	–	10.4	11.0
Vitamin C, mg/100 gm	18.7	12.0	–	–	trace	7.8
Vitamin A, IU/100 gm	361.0	652.0	–	–	–	–
Niacin mg/100 gm	3.65	24.1	–	–	–	–

*** Result of Analysis from the Department of Medical Science, Ministry of Public Health, Bangkok, Thailand, on September 17, 1970.

* Result of Analysis from the Department of Science, Ministry of Industry, Bangkok, Thailand, on May 15, 1969.

** Result of Analysis from the Department of Science, Ministry of Industry, Bangkok, Thailand, on February 17, 1969.

Proximate Analysis of K.P from Department ot Medical Science, Ministry of Public Health, on September 17, 1970

	K.P 16	K.P 17_A	K.P 17_B
Moisture, %	4.7	4.7	3.8
Protein (N x 6.25), %	54.6	43.3	33.8
Crude Fat (Ether extract), %	18.8	18.0	18.0
Crude Fibre, %	0.5	–	0.4
Ash, %	7.7	6.4	6.8
Carbohydrate (by diff.), %	13.7	27.6	17.2
Calorific value, cal/100 gm	–	–	–
Calcium, mg/100 gm	266.0	141.0	295.0
Iron, mg/100 gm	33.2	11.0	21.8
Phosphorus, mg/100 gm	438.0	333.0	408.0
Vitamin B_1, mg/100 gm	4.9	6.0	6.1
Vitamin B_2, mg/100 gm	8.3	10.1	10.1
Vitamin C, mg/100 gm	5.6	5.4	trace

Result of Chemical Analysis of Kaset Protein from WARF Institute, Inc. Madison, Wisconsin, U.S.A., on February 11, 1970.

	K.P 10	K.P 11
Moisture, %	4.7	2.8
Ash, %	8.5	10.1
Ether extract, %	8.3	5.8
Protein, %	61.5	67.1
Fibre, %	1.3	1.3
Carbohydrates, %	15.7	12.9
PER (Casein 2.50)	1.95	2.21

Result of Chemical Analysis of Kaset Protein from WARF Institute, Inc., Madison, Wisconsin, U.S.A. on November 6, 1970.

	K.P 14	K.P 15	K.P 16	K.P 17_A	K.P 17_B
Moisture. %	3.4	3.2	3.6	3.2	3.1
Protein, %	44.8	44.0	58.6	56.3	54.9
Ash, %	7.6	7.5	7.8	7.1	7.0
Fat (Ether extract), %	15.5	25.6	15.4	17.6	17.3
Fibre, %	1.8	1.7	0.6	1.3	1.3
Carbohydrate, %	16.8	18.1	13.8	14.5	16.4
Amino acid Pattern					
Lysine (mg/gm)	25.8	25.6	39.4	30.7	35.3
Histidine (mg/gm)	11.2	11.4	14.7	13.6	15.7
Arginine (mg/gm)	29.2	29.5	39.0	33.6	38.9
Aspartic acid (mg/g E)	52.2	56.3	74.3	71.8	76.2
Threonine (mg/gm)	16.1	17.8	22.7	19.6	20.4
Serine (mg/gm)	20.7	23.0	29.7	28.7	30.0
Glutamic acid (mg/gm)	82.4	94.5	106.0	110.0	117.0
Proline (mg/gm)	20.9	21.3	23.5	24.7	20.7
Glycine (mg/gm)	18.3	21.0	28.3	23.7	23.1
Alanine (mg/gm)	20.0	23.2	29.4	27.5	27.5
Cystine (mg/gm)	NC	NC	NC	NC	NC
Valine (mg/gm)	20.0	22.8	30.1	28.9	30.7
Methionine (mg/gm)	13.7	15.9	18.6	17.8	17.9
Isolencine (mg/gm)	21.0	23.1	28.1	27.0	28.5
PER (Cesein 2.50)	2.68	3.21	2.68	2.49	2.44
Leucine (mg/gm)	33.5	37.3	47.6	47.0	48.5
Tyrosine (mg/gm)	15.0	17.4	22.4	23.1	21.6
Phenylalanine mg/gm)	20.4	24.4	32.9	33.6	30.0
Tryptophan (mg/gm)	4.41	5.18	6.15	7.26	7.1

Result of Chemical Analysis and Determination of Nutritive Quality of Kaset Protein in General from Central Institute for Nutrition and Food Research TNO, Utrechtseweg, 48, Zeist, on April 25, 1969.

Moisture,%	6.9
Crude Protein (N x 6.25), %	59.1
Crude Fat (Weibull)	18.0
Crude Fibre, %	2.2
Carbohydrates, Calculated as Strach, %	6.5
Ash, %	6.9
Sodium Chloride (NaCl), %	2.8
Calcium, %	0.18
Phosphorus, %	0.34
Vitamin B_1 (Thiamine) mg/gm	16.0
Vitamin B_2 (Riboflavine) mg/gm	40.0
Niacin (Nistinic acid) mg/gm)	285.0

Amino aeid Pattern

	g/100gm Product	g/16gm N.
Isoleucine	3.03	5.3
Leucine	5.02	8.7
Lysine (Total)	4.01	7.0
Lysine (available)	4.36	6.3
Phenylalanine	3.75	6.5
Tyrosine	2.0	3.5
Methionine	1.24	2.1
Cystine	0.33	0.58
Threonine	2.04	3.5
Tryptophan	0.61	1.06
Valine	3.52	6.1
Arginine	4.14	7.2
Histidine	1.57	2.7
Alanine	2.57	4.5
Aspartic acid	7.0	12.1
Glutamic acid	11.12	19.3
Glycine	2.34	4.1
Proline	2.59	4.5
Serine	3.45	6.0

Net Protein Utilization (NPU)	44
True Digestibility (TD)	97
Biological Value (BV)	46
Protein Efficiency Ratio (PER) as obtained	2.14 ± 0.06
PER standardized (1)	1.83

(1) the PER of casein obtained in this assay was 2.93 ± 0.12

Result of Chemical Analysis of KMPC (Kaset Marine Protein Concentrate) from WARF Institute, Inc. Madison, Wisconsin, U.S.A. on June 17, 1970.

Moisture, %	9.6
Ash, %	7.5
Ether extract, %	15.2
Protein, %	56.1
Fibre, %	0.5
Carbohydrates, %	11.0
Calcium, %	0.086
Phosphorus, %	0.76
Available Lysine (%)	4.02
Tryptophan (mg/gm)	7.62
Cystine (mg/gm)	8.30
Methionine (mg/gm)	14.4
Vitamin B_1 (mg/100 gm)	0.03
Vitamin B_2 (mg/gm)	80.0
Niacin (Nicotinic Acid), (mg/gm)	976.0

Amino Acid Pattern	
Lysine (mg/gm)	41.5
Histidine (mg/gm)	12.2
Arginine (mg/gm)	40.0
Aspartic acid (mg/gm)	64.0
Threonine (mg/gm)	27.3
Serine (mg/gm)	24.7
Glutamic (mg/gm)	76.0
Proline (mg/gm)	23.8
Glycine (mg/gm)	32.4
Valine (mg/gm)	25.5
Methionine (mg/gm)	21.0
Isoleucine (mg/gm)	24.5
Leucine (mg/gm)	38.6
Tyrosine (mg/gm)	21.7
Phenylalanine (mg/gm)	24.3
Tryptophan (mg/gm)	6.06
Cysteic acid (mg/gm)	7.64

Composition of PFD-1 (100 person/meal)

Dried Mung bean Protein Powder (gm)	300
Fish Protein Concentrate (FPC) (gm)	1,400
DL-Methionine (gm)	150
Vitamin A (gm)	0.4
Vitamin B_1 (gm)	0.06
Vitamin B_2 (gm)	0.1
Vitamin B_6 (gm)	0.12
Niacin (gm)	0.6
Vitamin C (gm)	3.5
Vitamin D (gm)	0.04

1 person/meal = 14.5 gm of PFD-1 = 10 gm Protein

Amino Acid Pattern in PFD-1 gm/16 gmN. or gm/100 gm of Protein

Isoleucine	5.423
Leucine	8.860
Lysine	6.976
Phenylalanine	4.703
Tyrosine	1.752
Threonine	3.259
Tryptophan	0.763
Valine	5.826
DL-Methionine	1.1305
Cystine	0.0740

FFF-0 and FFF-1 Formular

	FFF-0
Dried Fermented Fish Powder (gm)	300
PFD-0 (gm)	300
KIO_3 (gm)	0.00422
Total wt (gm)	600.00422

	FFF-1
Dried Fermented Fish Powder (gm)	300
PFD-1 (gm)	300
KIO_3	0.00422
Total wt (gm)	600.00422

Proximate Analysis of PFD-1, FFF-1, FFF-2, FFF-3, FFF-4, from Department of Science, Bangkok, Thailand on January 13, 1969

	PFD-1	FFF-1	FFF-2	FFF-3	FFF-4
Protein (N x 6.25), %	71.3	52.7	45.9	40.8	41.6
Calcium, mg/100 g	836.0	904.4	1,250.9	1,301.3	1,362.4
Iron, mg/100 g	27.0	20.6	15.5	13.5	12.3
Phosphorus, mg/100 g	842.3	803.4	855.1	827.4	842.4
Sodium, mg/100 g	315.5	7,266.6	7,080.0	8,417.3	8,611.8
Potassium, mg/100 g	540.2	405.3	423.8	437.5	405.8
Vitamin A, IU/100 g	1,647.0	2,319.0	556.0	143.0	307.0
Vitamin B_1, mg/100 g	3.68	1.93	2.5	1.3	0.47
Vitamin B_2, mg/100 g	9.46	5.52	3.28	3.12	2.63
Vitamin C, mg/100 g	215.0	60.5	58.9	35.3	31.1
Niacin, mg/100 g	43.7	20.5	17.7	13.6	10.6

TFF Formular

	TFF-1	TFF-2
Fresh Mung Protein Isolate (kg)	1	1
Dry Fermented Fish (gm)	20	20
Methionine (gm)	1.8	1.8
Seasoning Agent	1.2	1.2
FPC	13	13
Sodium Carbonate (gm)	6.5	3.25
Hydrochloric acid solution (cc)	50	25
Mixed Vitamin (gm) (3%)	0.55	0.55
Potassium Sorbate (gm)	0.2	0.2

Proximate Analysis of TFF-2 from WARF, Madison, Wisconsin on February 11, 1970.

Moisture, %	5.7
Ash, %	15.5
Ether extract, %	6.9
Protein, %	57.2
Fibre, %	0.7
Carbohydrates, %	14.0
PER (casein 2.5)	1.58

Determination of Chemical Score for K.P. 18

Step 1 – Determination of total essential Amino acid (Include Cystine + Tyrosine)
– Determination of % of each Amino acid to total essential Amino acid.
– The result is Egg pattern.

Step 2 – Do the same way as Food require for determination.

Step 3 – Compare with % of Egg pattern will get chemical score.

Step 4 – The lowest score is the limiting factor of that Food.

Reference : Block, R.J. and Mitchell, H.H. (1946)
Nutr. Abstr. Rev., 16,249

Kind and Quantity of Amino acid in the K.P. 18 100 g.

Essential Amino acid	Mung bean Protein 100 gm.	Dried Mung bean Protein Isolate 45 g. Protein Content 35.5 g.	Soy bean Protein 100 gm	Dried Soy bean Protein Isolate 45 gm. Protein Content 41.7 gm	Fish Protein 100 gm.	Dried Fish Protein Concentrate 10 gm Protein Content 7.5 gm.	Mixture of K.P. 18 100 gm.		Egg 100 gm		Chemical score base on egg Pattern
							Amino acid Content	% of each Amino acid to total Amino acid	Amino acid content	% of each Amino acid to total Amino acid	
Tryptophan	0.738	0.262	1.545	0.645	1.0	0.075	0.982	2.670	0.211	3.205	83
Threonine	3.140	1.115	4.400	1.840	4.6	0.345	3.300	8.950	0.637	9.675	93
Isoleucine	5.540	1.967	6.010	2.510	6.0	0.450	4.927	13.400	0.850	12.912	104
Leucine	9.025	3.209	8.650	3.610	9.3	0.698	7.517	20.400	1.125	17.104	119
Lysine	6.825	2.421	7.075	2.960	9.0	0.675	6.056	16.500	0.819	12.425	133
Methionine	1.086	0.386	1.505	0.628	3.3	0.248	1.262	3.430	0.401	6.091	56.4
Cystine	0.623	0.221	1.990	0.830	1.1	0.083	1.134	3.080	0.299	4.542	68
Phenylalanine	4.775	1.695	5.540	2.315	4.2	0.315	4.325	11.750	0.739	11.225	105
Tyrosine	1.600	0.568	3.570	1.490	3.0	0.225	2.283	6.210	0.551	8.368	74
Valine	5.920	2.100	5.890	2.460	6.2	0.465	5.025	13.650	0.950	14.431	94
Total							36.811		6.583		

Calculation for Supplementation of DL-Methionine (Method 1)

From Table :

Sum of Score of DL -Methionine + Cystine $= 56.4 + 68$
$= 124.4$

Average required score of DL-Methionine + Cystine $= 90 \times 2$
$= 180$

But score of Cystine $= 68$

∴ Score of DL-Methionine should be $= 180-68$
$= 112$

If required score of DL-Methionine = 112 so the required quantity of DL-Methionine to be added should be as the following :

From Table :

Score of DL-Methionine 56.4 quantity of DL-Methionine 1.262

∴ Score of DL-Methionine 112 quantity of DL-Methionine $\frac{1.262 \times 112}{56.4}$

$= 2.510$ gms.

∴ DL-Methionine to be added to 100 gms. of K.P. 18 $= 2.510-1.262$
$= 1.248$ gms.

Calculation for Supplementation of DL-Methionine (Method 2)

From Table :

Sum of score of DL-Methionine + Cystine $= 56.4 + 68$
$= 124.4$

Average required score of DL-Methionine + Cystine $= 90 \times 2$
$= 180$

Buts core of Cystine from table $= 68$

∴ Score of DL-Methionine should be $= 180-68$
$= 112$

If required score of DL-Methionine = 112 so the required quantity of DL-Methionine to be added should be as the following :

From Table :

Score of DL-Methionine = 56.4 so percent of each Amino acid to total Amino acid of DL-Methionine $= 3.43$

∴ Score of DL-Methionine = 112 so percent of each Amino acid to total Amino acid of DL-Methionine $= \frac{3.43 \times 112}{56.4}$
$= 6.811$

∴ Percent of each Amino acid to total Amino acid of DL-Methionine is equal to the quantity of DL-Methionine $= \frac{6.811 \times 36.811}{100}$
$= 2.510$ gms.

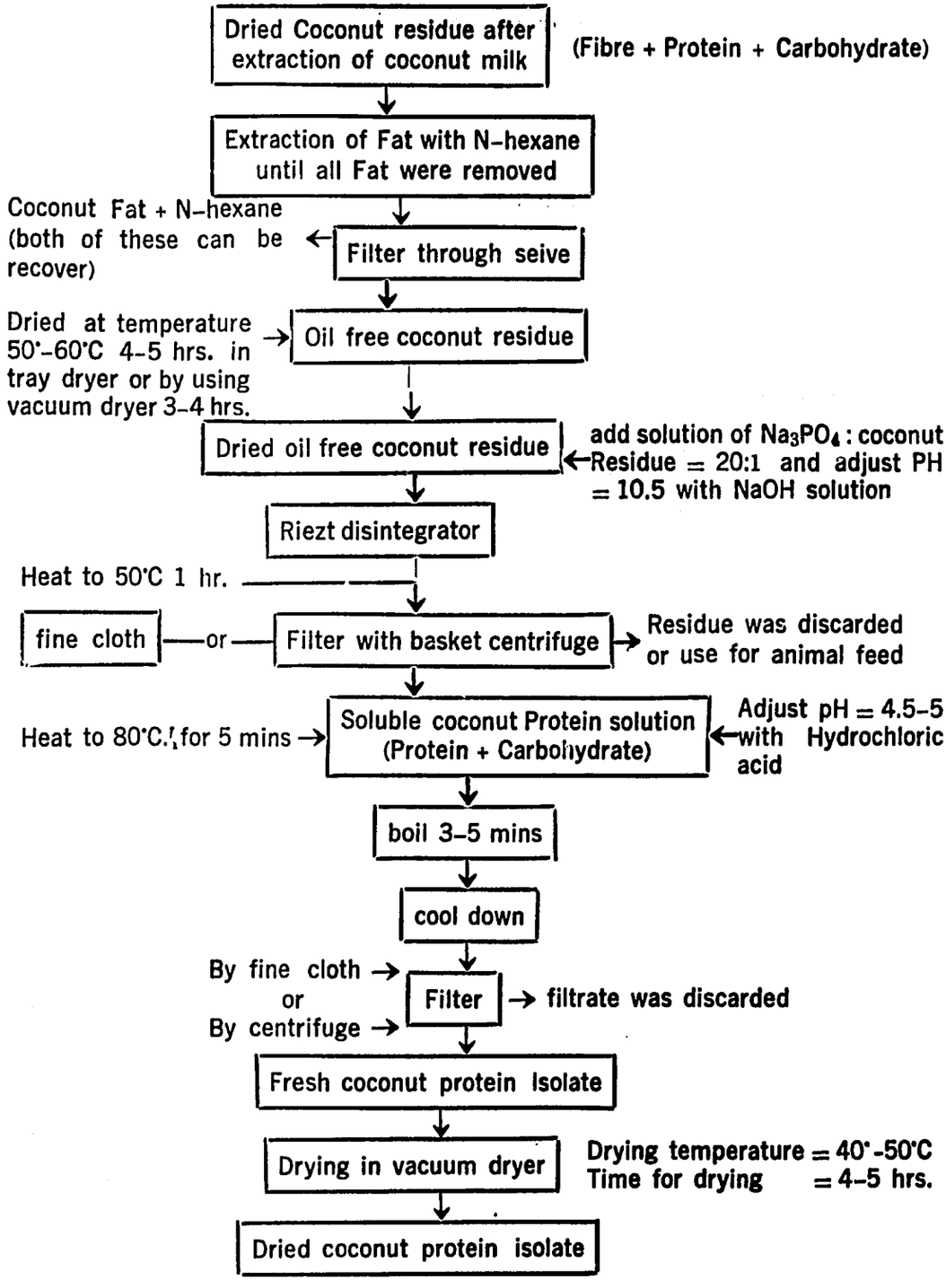
∴ DL-Methionine to be added to 100 gms. of K.P. 18 $= 2.51-1.262$ gms.
$= 1.248$ gms.

Composition of Coconut for Edible Portion 100 gm

Moisture, %	50.0
Calorific Value, cal/100 gm	46.0
Fat, %	35.3
Carbohydrate, %	9.4
Fibre, %	4.0
Protein, %	3.5
Calcium, mg %	13.0
Phosphorus, mg %	95.0
Iron, mg %	1.7
Vitamin B_1, mg %	0.05
Vitamin B_2, mg %	0.02
Niacin, mg %	0.5
Vitamin C, mg %	3.0

Reference : Composition of Foods, Raw, Processed, Prepared.
USDA Agriculture Handbook No. 8, Revised, 1963

Flow Chart for the Production of Coconut Protein Isolate from Dried Coconut Residue



Kind and quantity of Protein in coconut for edible Portion

globulin, %	60
albumin, %	30
prolamine, %	1
Non protein Nitrogen, %	0.1
glutelin, %	4
Residue, %	2

Reference :

1. Report of study and experiment to find out the best method for extraction of coconut milk by Department of Science, Ministry of Industry, Bangkok, Thailand.
2. Report on Protein Food Development.

Lead Leaf Protein Isolate

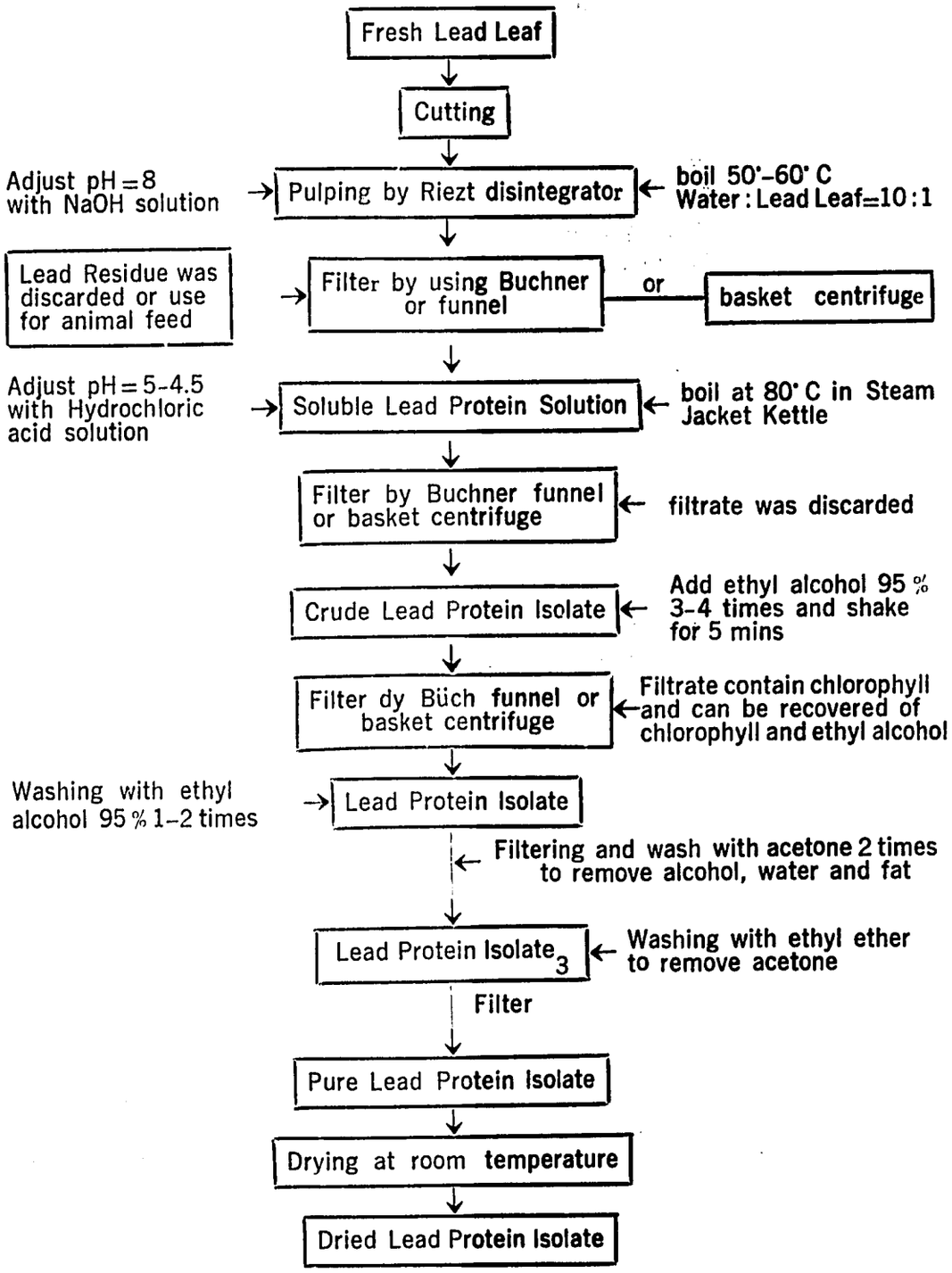
Lead Leaf compoocition

Moisture, %	=	80.7
Protein, %	=	8.4
Fat, %	=	0.9
Carbonydrate, %	=	5.0
Calorific value cal/100gm	=	62
Fibre, %	=	3.8
Vitamin C mg %	=	137
Phosphorus, mg %	=	11
Iron, mg %	=	9.2
Vitamin A, IU	=	7883
B_1 , mg %	=	0.33
B_2 , mg %	=	0.09
Niacin, mg %	=	5.4

Reference :

Result of Analysis of Research Group in the Thai National Nutririon Council

Flow Chart for Lead Leaf Protein Isolafe Production



Compositon of Mung bean, Soy bean and FPC (Fish Protein Concentrate) based on edible portion 100 gms

	* Mung bean (Phaseolus aureus)	** Soy bean (Glycine max)	*** FPC (Fish Protein Concentrate)
Moisture (gm)	6.1	10.0	8.0
Cal (unit)	356	403	–
Fat (gm)	1.0	17.7	1.5
Carbohydrate (gm)	64.6	33.5	0.1–0.4
Fibre (gm)	4.3	4.6	0.5
Protein (gm)	24.4	34.1	73 – 75
Calcium (mg)	125	226.	4,850
Phosphorus (mg)	340	554	3,260
Iron (Fe) (mg)	5.7	8.4	–
Vitamin A (IU)	130	80	–
Vitamin B_1 (mg)	0.66	1.10	0.09
Vitamiu B_2 (mg)	0.22	0.31	1.03
Niacin (mg)	2.4	2.2	3.15
Vitamin C (mg)	10	–	–
Ash	–	–	15 – 18
Vitamin B_{12} (mg)	–	–	0.02 (Mostly Ca+p)

* From Food Composition Table by Food and Nutrition Research Center in Manila, Philippines Handbook 1 (3rd Revision) 1964.

** From Composition of Foods, Raw, Processed, Prepared. USDA Agriculture Handbook No. 8, Revised. 1963.

*** From "Viobin"

	*** Salt Water Mussel (Mytilus Samaragdinus)
Moisture (gm)	85.5
Cal (unit)	52
Fat (gm)	0.9
Carbohydrate (gm)	3.0
Fibre (gm)	0.1
Protein (gm)	8.1
Calcium (mg)	26
Phosphorus (mg)	184
Iron (Fe) (mg)	15.6
Vitamin A (IU)	162
Vitamin B_1 (mg)	0.02
Vitamin B_2 (mg)	0.18
Niacin (mg)	1.9

**** Results of Analysis from Research Group in the Thai Nutrition Council

Protein and type/quantity of Amino Acid in the considered vegetable in 100 gms of edible portion

	Mung bean (Phaseolus aureus)	Soy bean (Glycine Max)
Protein, %	24.4	34.9
Tryptophan	0.18	0.526
Threonine	0.765	1.504
Isoleucine	1.351	2.054
Leucine	2.202	2.946
Lysine	1.667	2.414
Methionine	0.265	0.513
Cystine	0.152	0.678
Phenylalanine	1.167	1.889
Tyrosine	0.390	1.216
Valine	1.444	2.005
Arginine	1.37	2.763
Histidine	0.543	0.911
Alanine	0.730	1.571
Aspartic acid	2.093	4.633
Glutamic acid	2.811	7·010
Glycine	0.449	1.50
Proline	1.070	2.567
Serine	0.734	2.494

Reference :
Journal of Agriculture and Food Chemistry, May–June 1967 (page 440–1)

The FAO had specificed types and quantity of Amino Acid and the Scientists compared types and quantity in Grams of Amino Acid per 16 grams of Nitrogen in Mung bean and Soy bean as follow :

Amino acid	FAO	Mung bean	Thailand Soy bean
Arginine	2.0	6.6	6.3
Histidine	2.4	2.8	2.9
Isoleucine	4.2	4.1	3.8
Leucine	4.8	8.4	7.3
Lysine	4.2	8.0	7.0
Methionine	2.2	1.6	1.6
Methionine Cystine	4.2	2.4	2.4
Phenylalanine	2.8	3.4	3.2
Tryptophan	1.4	1.9	1.9
Valine	4.2	5.3	4.4

Reference :

Journal of Agriculture and Food Chemistry, May–June 1967 (page 440–1)

Amino Acid Patterns (gm/16gm N_2) of Fish Protein Concentrate (FPC)

From "Viobin"

Arginine	6.5
Histidine	2.6
Lysine	9.0
Tyrosine	3.0
Tryptophan	1.0
Phenylalanine	4.2
Cystine	1.1
Methionine	3.3
Serine	4.0
Threonine	4.6
Leucine	9.3
Isoleucine	6.0
Valine	6.2
Glutamic acid	16.9
Aspartic acid	11.9
Glycine	4.7
Alanine	6.8
Proline	3.4

Appendix

Protein Food Promotion

BACKGROUND

Protein Food Promotion is the second stage of the plan to promote the well-eating and well-being of people according to their income, custom and dietary pattern. This project aims at distributing high nutrition low cost foods developed from local raw materials to the people. Details of the first stage of this work is available in the Report on Protein Food Development which is the joint project between the Thai government and USOM, Project No. 493-11-540-179.2

According to the Cabinet's decision on 18 October 1970, Food and Nutrition Project was declared an accelerating national project. The National Economic Development Board (NEDB) has already included this project in the 3rd National Plan.

From the seminar held cooperatively by Health Department, Ministry of Public Health and Institute of Food Research and Product Development (IFRPD), Kasetsart University, during 22 Nov.-1 Dec. 1970, with 23 foreign experts and approximately 100 Thai participants to attend this seminar, the following conclusions and recommendations are presented to the Cabinet:-

The Protein Food Promotion Seminar

I. Aware of the need for the development of the food processing industry in Thailand and the considerable recent advancements made both here and abroad in the fields of food sciences, food technology, and nutrition, and aware of the long range benefits that the people of Thailand could derive from improved, nutritious, protein-rich, yet inexpensive foods fabricated from indigenous food sources,

Recommends

That the Government of Thailand institute the measures needed to stimulate the food processing industry in Thailand to adopt new technologies and fresh approaches in the development and commercial promotion of nutritious, protein-rich foods.

II. Recognizing that opportunity for the expansion of inexpensive, high-protein, processed food products will depend ultimately on the ample availability of suitable food crops and indigenous raw food resources,

Recommends

That the Government of Thailand:

a. Strengthen and clarify national policies pertaining to food and nutrition.

b. Carefully consider the priority needs of food and nutrition in all aspects of national and regional planning.

c. Encourage research and development and increased production of high-protein vegetable food crops with special emphasis given to soy and mung cultivation.

d. Explore ways of increasing the production and harvesting of fish and shell fish, and expand technological utilization leading to convenient and practical preservation, processing and distribution of these foods.

e. Study the problems and obstacles inherent in the raising, transportation and slaughtering of live stock, and the processing and marketing of meat and meat products with the aim of improving the quality of these products and their general availability at reasonable prices.

f. Continue to study and promote methods for increasing the production and availability of marine resources, fowl, eggs, meat, and milk products with due regard to comparative cost relative to other sources of protein.

III. Recognizing that the most serious effects of protein deficiency occur in young children and that these damages may persist into adult life impeding the proper mental and physical growth of the individual and thereby limiting his capacity for development and productivity.

Recommends

That the Government of Thailand and its appropriate agencies emphasize and support programs aimed at increasing the protein consumption of young children, and specifically recommends:

a. The research, development and marketing of high-protein inexpensive nutritionally adequate food suitable for bridging the transitional period between breast feeding and adult traditional unprocessed foods; for want of a better term these are usually known as "baby" or "weaning" foods.

b. Expanded education of the public in the benefits derived from increased consumption of high-protein foods, and in the dangers of protein deprivation in the young child.

c. Support for the development and partial subsidy of mass supplemental feeding programs in school and preschool children, including the programs administered by the Ministry of Interior.

d. Relating nutrition activities with the existing mother and child health program in order that the mother and child will benefit.

e. Expansion of child day care centers with programs for supplementary feeding of high-protein foods for the preschool child and education of the mothers in the benefits of proper diet and good nutrition.

f. Support for programs of voluntary family planning so that each child of a family should have the opportunity for, and the benefits of, a more adequate and nutritious diet as well as the chance for education, self advancement and fulfillment.

g. Studies into the methodology and infrastructure for the preparation and delivery of foods for institutional feeding programs, considering systems such as central kitchen and distribution by catering services.

IV. Believing that the stimulation of greater investment and more innovation in the field of high-protein food processing will require, at least in the early years, a program of education, research, support, and incentives for the food processing industries to stimulate promotion and marketing,

Recommends

That the Government of Thailand:

a. Provide increased funding for relevant research in the fields of food science, food technology and nutrition.

b. Vigorously encourage and support the development of Thai institutions to introduce new knowledge in food sciences and food technology, food economics and marketing, particularly stressing development of those institutions that will extend their application within the Thai food processing industry.

c. Provide incentives to food processing firms to risk investment in the development and marketing of inexpensive protein-rich food products.

d. Support the development of a strong, viable and responsible association of food industries in Thailand to work with appropriate government agencies towards the improvement of food processing and food products, food promotion and marketing in Thailand.

V. Realizing that the proper expansion of the food processing industry will require increased vigilance and perhaps greater regulation by the government in order to protect the responsible investers from the exploiter and in order to ensure proper and economic food value for the consumer, and at the same time appreciating that overrestrictive regulation can stifle legitimate efforts,

Recommends

That the Government of Thailand:

a. Review its existing laws, regulations and standards pertaining to food, food processing, and nutrition.

b. Activate and strengthen a National Coordination Committee of Food and Nutrition and charge the committee with recommending uniform, realistic standards for foods and nutrition.

c. Strengthen the quality control mechanism of the competent services with adequate laboratory facilities and man it with the required number of trained analysts and inspectors.

d. Actively seek the participation and advice of the Association of the Food Industries in the review and establishment of standards and regulations pertaining to processed foods.

e. Establish and enforce regulations and standards for foods and nutrition that are realistic, obtainable and enforcable yet not overrestrictive to the point of interfering with legitimate, responsible expansion of food industrial sector.

VI. Aware that traditional, universal foods, such as rice and other grains, can be substantially improved in terms of protein quality of nutrients,

Recommends

That the Government of Thailand carefully follow ongoing studies in Thailand and elsewhere in reference to lysine fortification of rice in order to evaluate

this method fully as one of the possible strategies for combatting protein malnutrition.

VII. Appreciating that Thailand is making significant progress in the fields of the food sciences, food technology, and nutrition, recognizes at the same time that there is still limited human and physical resources in the country for developing the many aspects of protein food development and promotion and therefore,

Recommends

That the Government of Thailand:

a. Continue to seek technical and material assistance from abroad through the appropriate bilateral, international and voluntary agencies.

b. Continue to send trainees abroad in order to perfect their skills and knowledge.

c. Expand relevant job opportunities and incentives for scientists, technologists and marketing specialists who seek careers in these fields.

VIII. Appreciating the excellent cooperation and coordination that exists in Thailand between the many ministries and government agencies who have collaborated in the organization and presentation of this seminar to develop and promote protein foods,

Wishes

To compliment the Government of Thailand on this achievement and to urge continued and enhanced interagency and international collaboration on the many problems and challenges in the field of protein food promotion and its relationship to the economic development and the welfare of the people of Thailand.

The Cabinet has considered this on 16th February 1971 and made a decision that this matter be further carried on by the government agencies related to the work.

All these facts mentioned are the result of the work whose details are available in

1st Report July–Dec. 1968
2nd Report Jan–Jun. 1969
Special Report
Report on PROTEIN FOOD PROMOTION Vol. 1
Report on PROTEIN FOOD PROMOTION Vol. 2
Summary Report of 3–Year Work.

Summary of Protein Food Development Work

1. Research and development on low cost protein foods has already been carried on for 3 years at the Institute of Food Research and Product Development, Kasetsart University. Several prototypes of protein food have been developed by using mung beans and soybeans as raw materials. These products have been tested in the laboratory and adjusted to the Thai eating pattern.
2. Acceptability and suitability test of the products has been operated in 25 villages in Chiengmai, Prae, Ubol and Roi-et. Twenty-five Child Nutrition Centers were set up and 2,500 children in these villages with ages ranging from 2–5 are taken care of. These children are applied with supplementary protein foods in adequate amount of body's daily requirement. In addition, test on growth of children and comparison between the raw control group and the control group have been done for evaluation work.
3. Documents and reports of this work have been published to distribute to organizations and institutes related to protein food industry and protein food commercialization. Furthermore, a seminar on Protein Food Promotion was held during 22 November–1 December 1970, with local and foreign participants in food industry to attend this seminar.
4. From 1968–1970, several government officers (doctors, food technologists, nutritionists and nurses for the Child Nutrition Centers) have received a study and training both locally and abroad.

Objectives of Protein Food Promotion Project

This is the second stage of protein Food Development Project. Therefore the objectives of Protein Food Promotion Project are mostly the same as those of the Protein Food Development Project, except for some additional objectives to expand the scope of this work as follows:

1. To apply the technology of the products on a larger scale and to exploit the commercial channels and marketing facilities.
2. To stimulate local and foreign food industries in starting commercialization of the products and to support the marketing research.

3. To assist the food industries in the popularization of the products by mass education campaigns.
4. To explore the feasibility of organizing mass feeding programmes as a marketing stimulus.
5. To train and promote small-scale industries in the production of inexpensive high protein foods.
6. To continue research and development of the new products.
7. To stimulate the increase in production of raw materials to meet the demand of the industries.
8. To study the effects of protein supplements on human intellectual, psychological and sociological development.
9. To arrange lunch program for school children

   9.1 with high nutrition foods.
   9.2 with low cost.
   9.3 conforming to the local eating pattern
   9.4 can be prepared easily everywhere.

Target of Operation

1. To provide protein food supplement for approximately 1.6 million preschool children from poor income families in rural areas all over the country (with income lower than 3,000.– baht/year).
2. To introduce low cost protein foods to every age group of people in rural areas by means of industrialization and commercialization.
3. To provide nutritive lunch for school children in municipal schools and government schools. This is to increase the efficiency in learning and to increase physical growth which will effect in the development of man power for the country.
4. To make use of local raw materials and at the same time to raise income level of the farmers since they will have a certain market to sell their products.
5. To promote industrialization of agricultural products so that people can get high nutrition foods. This is to promote rotation of food crop to meet demand of raw materials in food industry. At the moment, National Economic and Development Board (NEDB) has already set up Soybean Project to collaborate with the project of Protein food Promotion.

Procedure and Period of Protein Food Promotion Project

1. To further development of the new products under Protein–Food Development Project to the stage of industry. The producing, distributing and marketing of these products will be in responsibility of the food industries

which will receive promotion from this project by introducing these products to the target groups in rural areas e.g. preschool children and school children.

2. To introduce these new products, Nutrition Division, Department of Health has set up a mass education campaign, as part of nutrition education work, for mothers and housewives in the rural areas, especially the mothers whose children are in Child Nutrition Centers.

   For the operation of this work, Nutrition Division and Institute of Food Research and Product Development with some nutritionists or cooks will take kitchen car to provide education and demonstration on food preparation and child feeding. At the same time we will take this opportunity to introduc low cost protein foods to the people as well.

3. To arrange lunch program for preschool children and for school children by using new protein products as food supplement. We will try to find subsidy either from the government, from charity organizations or from the parents to be the fund for the further operation of this work. The feeding program of 2,500 preschool children in 25 Child-Nutrition Centers in Chiengmai, Prae, Ubol and Roi-et will be of multi-purposes i.e. to study the effects of protein supplements on intellectual, psychological and sociological development of these children; and another purpose is to use these centers as the site of training and of field-activity.

   For the promoting of low cost protein foods, the increasing of growth in school children and to initiate lunch program in schools-the distributing of luuch program in schools will be on trial first. Institute of Food Research and Product Development will be the site of the central kitchen to distribute foods prepared from the new products together with other foods to feed 2,400 school children in 5 schools in marginal areas of Bangkok. Administration of this work will be in responsibility of Ministry of Education.

4. For the training and promoting participation of small industries in the low cost protein food production, Institute of Food Research and Product Development together with Nutrition Division will hold a training course in field of technology twice a year. In each course, there will be approximately 20 trainees (both local and foreign) to attend the course including other interested participants.

5. Institute of Food Research and Product Development will undertake research and development work of new products aiming at utilizing soybeans and marine products as major raw materials. Institute of Food Research and Product Development has developed few products from soybeans e.g. Soymilk and soy flour. Furthermore, we will improve the technique in processing textured protein. Other raw material e.g. groundnut, sesame and cashew etc. will be developed into new products. The processing of high protein from marine will be further considered.

Another type of protein food to be developed is Baby Food which will also be produced from local raw material. The operation in field of technology and the biological test of these products will be performed jointly by Institute of Food Research and Product Development and Nutrition Division. As for the field trial of this product will receive cooperation from Pediatric Department, Faculty of Medical Science, Siriraj Hospital. In addition, the study of the means to apply this product to the babies in rural areas will also be performed.

6. In order to have an adequate supply of raw material to produce protein foods, we will closely cooperate with Department of Agricultural Extension, Ministry of Agriculture in this work. At the moment, one of the staff of Agricultural Extension Department is receiving a training in field of Nutrition at Columbia University with the sponsorship of AID. When he comes back, we hope that he will be of great help to our work.

7. In the field trial for evaluation work, we will study the intellectual, psychological and sociological development of the children who receive the protein food products as food supplement. We have received a very good cooperation from Psychologists and Social workers of Medical Department, Ministry of Public Health.

8. We will cooperate with Institute of Food and Nutrition which is being set up according to the National Food and Nutrition Plan.

Period of Protein Food Promotion Project

3 Years
1 October 1971 – 30 September 1974

BUDGET AND AID

Year	AID					JOINT BUDGET		
	Experts		Study & Training		Equipment	Expert	Trainee	Budget of operation
	No.	Value	No.	Value	Value			
1972	1		11	30,000	70,000			1,500,000
1973	1	2,000	11	30,000	60,000			1,400,000
1974	1	2,000	11	30,000	60,000			1,400,000

Experts

They will be experts of short-term contract to assist in the following work :

1. To study the marketing system for the Protein Food industry
2. To advise on technology of the new products.

Study and Training

Description	1972	1973	1974
Study in Nutrition and Biochemistry	1	1	1
Food Technology	1	1	1
4-month training (U.S.A.)	4	4	4
3-week observation tour (3rd country)	5	5	5

SUPPLIES AND MATERIALS

1972	
Equipment and supplies for protein food processing	US $ 50,000
Vehicle – spare parts for the kitchen car	
Small truck for transporting food	US $ 20,000
3 Willy Jeep (US $ 3,000 each)	
1973	
Equipment and supplies for the Pilot Plant and the Laboratory	US $ 60,000
1974	
Equipment and supplies for the Pilot Plant and the Laboratory	US $ 60,000

ESTIMATED BUDGET OF OPERATION

1972		
Personnel		301,200 baht
75 nurses for Child Nutrition Centre	270,000 baht	
2 officers for the kitchen car	24,000 baht	
1 driver	7,200 baht	
Transportation		20,000 baht
Materials		497,500 baht
Expense on food for feeding 2,500 children, .75 baht per head/day, totally 260 days	487,500 baht	
Packaging	10,000 baht	
Building up and decoration of kitchen car		100,000 baht
TOTAL		918,700 baht
Total expense for the Food Plant		571,300 baht
GRAND TOTAL		1,500,000 baht

1973	
Personnel	301,200 baht
Transportation	20,000 baht
Materials	497,300 baht
Expense for Food Plant	581,300 baht
Total	1,400,000 baht
1974	
Personnel	301,200 baht
Transportation	20,000 baht
Materials	497,500 baht
Expense for Food Plant	581,300 baht
Total	1,400,300 baht

BUDGET 1972

PROTEIN FOOD PROMOTION
FOOD PLANT
INSTITUTE OF FOOD RESEARCH AND PRODUCT DEVELOPMENT

OBJECT CLASS CODE	DESCRIPTION				AMOUNT
01	**PERSONNEL**	**No.**	**Per Month**	**Total**	296,400.–
	Food Tech.	2	1,250	30,000.–	
	Home Economic	3	1,000	36,000.–	
	Mechanic	3	1,000	36,000.–	
	Labours	30	540	194,400.–	
08	**SUPPLIES & MATERIALS**				209,000.–
	Fuel – oil for boiler & Machanic for Catering Service			33,000.–	
	Chemical Substances			50,000.–	
	Raw Material for Experiment (Catering)			30,000.–	
	Lab. Equipment & Spare Part.			70,000.–	
	Stationery for Project			6,000.–	
	Cooking facilities, Pot & Pan for Catering Service			20,000.–	
			Total		505,400.–

REPORT ON TRAVEL TO THAILAND

By **Dr. Aeron Altschul**
Special Assistant to the Secretary of
Agriculture for Nutrition Improvement

Dr. Martin J. Forman
Director, Office of Nutrition
Agency for International Development

Dr. Eugene E. Howe
Director of Experimental Biology
Quinton Research Laboratories
Merck & Company
Member, AID Nutrition Advisory Committee

who came to survey the Protein Food Development work during 16 – 20 November 1970.

The Protein Problem

We conceive of the protein problem as to be multi-faceted and to be tied up with the total food problem. The way in which people get protein determines how much total food must be grown. For example, an economy which depends heavily on animal protein must have an excess of calories from grain to feed the animals. Such an economy has a better chance of minimizing problems of malnutrition sincs there would be adequate meat and animal protein for all including the vulnerable groups. Where there is no excess of cereals for animal production, the chance of getting good protein nutrition are more difficult to attain. Under those conditions the vulnerable groups such as preschool infants and pregnant and nursing women are the first to show of deficiency in protein supply. We do not minimize the requirements for vitamins but these are much cheaper and easier to satisfy than the requirements for protein. The problems of the vulnerable groups, as serious as they are, merely reflect a general inadequacy in the food balance. Therefore, efforts to correct this problem must not stop at simply providing foods for the vulnerable groups but must make a basic improvement in the food balance of the country at the lowest cost.

Protein Strategies

Our experience in dealing with these problems generally all over the world would indicate that improvements in the protein situation in any given country can be found amongst the following interventions :

1. **A cereal policy.** Each country must have a policy of maximizing the food impact of the cereals. This includes, first, having an adequate supply of cereals and, secondly, having an adequate supply of protein foods or additives to maximize the protein impact of the cereals. In Thailand the system primarily consists of rice as the major staple and the major source of calories supplemented by mung bean sprouts and small amounts of animal protein. With the present rate of growth of population at 3.2 % per year, the demands on satisfying the basic requirements for calories will be such as to put a strain on the production of the cereals, primarily rice, at the expense of more expensive foods such as the beans and the animal products. Hence, alternate ways of balancing and maximizing the protein value of the rice must be sought; one of these is the fortification of the rice which is being tested.

2. **New sources of protein.** An additional woy of balancing out the protein in the rice is to find new sources of protein which will satisfy the nutritional needs and be acceptable to the peodle. One such approach is textured vegetable protein either from mung bean protein or from soy protein. Another possible of low cost protein might be new fish sources such as from mussels.

3. **Institutional Programs.** Another approach to eliminating malnutrition is to use institutional programs as a way of controlling food intake so as to supply maximum nutrition at lowest cost. Examples of such approaches are school feeding and day care centers.
Since there is no panacea to the food problem, many approaches will have to be used. The three approaches described above are not mutually exclusive. For every country the lowest cost mix that works will have to be found.

Our Finding

1. . . . . .

2. **Day Care Centers.** We saw several day care centers in operation. Some of these were in villages in which the rice was being fortified. Others involved introduction of textured foods in the noon meals; in one village the textured food was a product of Archer-Daniels-Midland made from soy and in another village the food was made by the Food Research Institute of Kasetsart University out of a mixture of mung bean protein and fish protein concentrate. We were very much impressed with the day care centers as an institution which can be used for many purposes and which represents a good economic investment. These centers are a convenience for the mother and allows her to work during the day without fear of the child not receiving good care. It is educational for the children. It is a means of dispensing health education and care. It is means of dispensing good food habits and it is a means of intervention in the food by supplying foods that can be handled in an institutional setting but in a home setting.
Just the fact that children eat in a social setting seems to prompt the parents to give the children better food than they might ordinarily have gotten and therefore has caused a shifting in the priorities with which the food in the family is divided among the members. It may even have caused the families to spend more of their resources on food and less on other items than they might ordinarily have done.
The day care centers are an excellent example of perfect cooperation between the USAID Mission as represented by Dr. John Kennedy and the Ministry of Health as represented by Dr. Amorn and Mr. Uthai.

3. **New Food Technologies.** The Institute of Food Research at Kasetsart University in Bangkok is one of the best of its kind anywhere in the world. The head of this institute Mr. Amara is pragmatic, has a good grounding in food science, and has a sincere desire to develop new practical approaches to protein foods. His institute has developed a textured food from mung bean using a very simple apparatus for achieving texture, biscuits containing 50% full fat soy flour, a method for extracting protein from mussels which may have a way of introducing a new industry into Thailand a new source of protein, and an evaporated soy milk which is now being made and distributed to schools.

4. **Soy Protein.** At the present time the production of soybeans is very small in comparison with production of mung bean. (This figure is slightly misleading since only a small proportion of the mung bean is processed into starch. It is portion of the mung bean which produces the mung bean protein which is made into texture products.) Yet the production of soy is increasing and soy of all legumes is the largest producer of protein per acre. It is possible that soy can make a serious contribution to the protein supply of Thailand. Its growth should be encouraged and so should be the development of food processing industries based on soy. Archer–Daniels–Midland is interested in the possibility of industrial operations involving soy and so are some other American companies.

5. **Other Protein Food Products.** Certain ideas being tried elsewhere in the world would seem to be applicable to Thailand as well. These include the new 20% protein corn–soy–wheat macaroni now being tried in Brazil and the United States and developed by the General Foods Corporation. Another possibility are the protein drinks based on a soft drink model such as SAMSON and SACI being tested by Coca-Cola in South America and PUMA being tested in Guyana by Monsanto Company.

Recommendations

1. **Fortification**

2. **Day Care Centers**

   These seem to be very effective institutions and should be expanded as rapidly as funds and availability of proper supervisory personnel allows such expansion. We were impressed with the caliber of both the Mission personnel and the Thai authorities who are involved in setting these up.

3. **The Food Research Institute**

   Because this institute has done such good work and is far superior to any others that we have seen, the potential for it doing much better with adequate support, housing and equipment, is all the greater. Investment in the future of this institute ought to pay great dividends. We do not necessarily imply a major increase in the size of the institute; it may even be that its strength lies in the fact that it is a relatively small institution. We are interested more in it having adequate food processing facilities, adequate training facilities, and the kind of status within Thailand and within the international community which it deserves.

4. **Private Sector**

   American private sector should be encouraged to join with counterparts in Thailand to develop new protein food industries. Archer-Daniels-Midland has already been given a grant and could possibly be interested to go on with an investment. So could other companies. One major way of helping

them might be to provide a floor of sales from institutional purchases to help them develop the market and give them a chance to build up production and attain needed production economies to make this a viable business. On our part we agreed to contract several of these compaines in the United States and encourage them to take a hard look at the opportunities in Thailand.

Other Matters

Several additional matters are worthy of nott, and these will be discussed further with Harvard University.

1. **Completeness of Supplement**

2. **Effect of Day Care Centers**
From the content of the lunches seen in one of the Day Care Centers visited, it would seem possible that the lunches may have been greatly improved with respect to high quality protein because these lunches now may come under the scrutiny of others. While this may be desirable from the point of review of benefitting the children as mentioned earlier, it could alter the outcome of the experiment. Since there will be villages without Day Care Centers which receive the complete supplement, this aspect of the project would appear to be sufficiently well controlled—but it will have to be watched closely.

3. **Comparison of One Village with Another**
Because of the possibility of intervention of epidemics of infectius disease, crop failures, etc., this is a dangerous procedure. However, since the expanded plan calls for 5 villages in each treatment, the danger here is greatly reduced. This also will need to be monitored closely.

Comment

It is all well to look at the possibilities for improving nutrition in Thailand and be optimistic because of the competence of the people there and the many things that are under test or being started. But one must not forget that all this can be wiped out if there isn't first success in reducing the rate of growth of population perhaps to zero population growth and concomitant socio-economic development to reduce the level of poverty in the country. Unless progress in these two areas can be made, we see no long term benefits from either improved nutrition or medical care. Under such conditions where real progress in population control and in improving economic status are not attained, nutrition and public health efforts take on an ad hoc character.

Mr. Chairman, Fellow Scientist, Ladies and Gentleman:

I have the honour to present some of the work which have been done here in the institute in colaboration with the better half, Dr. Amorn Nondasuta, and the Department of Health. From the speeches of the Prime Minister, the Deputy Minister of Public Health, the Under-secretary of the Prime Minister's Office, and my superior, Prince Chakrabandhu, you may have learned how the institute and its partner have worked together in bringing up some of the children of Thailand. We are an inexperienced marriage partner and lack appropriate planning. Hence, we have many more children than we can provide for. Furthermore, because of our low financial support, we have not been able to provide for our children as well as we would like to. As you may have heard from previous discussions, our children merely have enough to eat. After the Food Science and Technology and the Nutrition joined together, we have tried to raise the children again. Coincidentally both my partner and I have the same name, i.e. Amorn. He spells his 'Amorn' and I spell mine 'Amara'.

In the past, I have been the follower while Dr. Amorn led. Most of the work you have seen so far have been in existence through the effort of Dr. Amorn and his co-workers. I must emphasize that without my partner, our work could not have gone very far.

Furthermore, as a Thai, I would like to thank my second parents, i.e. my teachers. The Under-secretary of the Ministry of Education who is the chairman here was my physics instructor 30-35 years ago. Without such fundamental, I probably would not be able to continue my study in food science and technology and become a student of Dr. Chichester at a later date. Dr. Chichester has been kind enough to be present here as one of the leading scientists represented in this seminar. I have the opportunity to learn from him for the second time. The first occasion was when I was a student at the University of California at Davis more than ten years ago. Without the knowledge of food science and technology I would not be able to follow the advice of Dr. C.C. Loo while he was the FAO representative in Thailand. You can see now that I have at least three second parents present here. I would like to thank all three of them for their contribution to my work.

My partner and I have received financial aids from the USAID and DTEC when we signed the contract. The aid was 8.6 millions baht or 430,000 dollars for three years. Two years have passed and we still have one more year to go. The expense of this seminar is included in this budget. The USAID paid 20,000 dollars for the seminar and the DTEC paid 59,000 baht or 2,950 dollars for operational work. This amount includes all expenses up to December 1. Hence, we would like to apologize for the inconvenience which occurred during the seminar. In addition, I would like to state in the presence of all of you here that we have no money after next year. I would like to pray and ask the USAID to continue the contract on Protein Food Promotion for three more years. If the USAID gives about

300,000 dollars support and the government of Thailand probably would be able to give about 4-5 millions baht, Dr. Amorn and I would be able to maintain our partnership longer and smoother. My hope depends on the decision and aid of the consultants present here.

Most of you have been in this institute for many days already. I hope you have seen some of the operation and production of the institute. We have progressed to the level of pilot plant or semi-industry, i.e. we have gone beyond lab scale level where operations are done in test tubes and beakers. Furthermore, we have tried to test the acceptance of our product in the market. This is evident in the cases and can labels used similar to other products in the market. You may probably have seen many cases stacked next to the building down stairs. These cases are to be sent to Laos by the USAID truck. We have tried to cope with our production problems. At present we only have 15 employees who have a B.S. degree or higher and 70 non-degree employees. The yearly budget is 800,000-900,000 baht or 40,000 dollars most of which is for salaries, repair of buildings and utility. Analogous to the protein deficiency evident in Thailand, our deficiency is in the areas of employees and finances. Our production may seem small when compared to other institutions which have more support in the initial stages (10 million baht and more). But we have worked hard and quietly to try to compensate for the lack of support. Nevertheless, we are proud of our work. We have had some visitors but our work have not been known to the general public. Our visitors of the last two years are:

Thai visitors other than students	1281 persons
Foreign visitors	30 persons
Visitors from institutions	88 institutions
Outside demonstrations	18 times

In addition, the lab of the institute has been used by students of three universities: Kasetsart, Chulalongkorn, and Mahidol. Graduate courses in Food Science and Technology are conducted for Kasetsart students here also.

Among those of you who have seen our equipment, some probably feel pitiful for our deficiency and wonder how we have managed to work on something at the national scale. The truth is that we cannot wait. Our problem is an immediate one which cannot wait to be solved only when we have proper equipment. We necessarily have to work toward our goal in a small scale. Figures for our daily production are:

Fresh soy milk	1000 litre
Evaporated soy milk	500-600 cans @ 500 ml,
Full fat soy flour cookies	60-70 kilograms
Kaset Protein (60% protein)	100 kilograms
Kaset meat with chilli	2000 cans @ 160 g.

These are all of our daily production. However, Kaset meat can be use in many different ways. Few examples are evident in the snacks available during the breaks of the seminar.

At this point, I would like to state that with respect to the market, the production of Kaset Protein is a worthwhile project. To acquire the same amount of protein the cost of Kaset meat is 1/5 as high as the cost of fresh meat. The whole sale price of both soy bean and mung bean is 1.80 baht/kg. If we promise to buy from the wholesaler for the whole year.

I would like to summarize our work so far:

—Dr. Amorn, my partner, has already stated that the children in all 25 experimental centers accept Kaset Protein.

—The joint experiment with Miss Wanlee and Miss Yuwadee at the Department of Elementary and Adult Education which prepare lunches for children at the price of 1.25–1.50 baht per meal.

—Preparation of snacks by using protein food.

—Supply soy milk to many different schools.

—Supply protein foods to Laos for more than 50,000 cans.

The above figures are enough to show that it is time for the industry to follow our example. In this modern ages, machinery could reduce the cost of production tremendously.

In addition, due to lack of proper machinery, we cannot be sure of the following points:

—We may not be able to sell other by-products, especially starch.

—Percent of yield at this point is quite low due to lack of proper equipment.

—Cost of labor is high when compared to the amount produced. Labors are hired at the civil service basis and not at the industrial basis.

—The calculation of overhead cost is not accurate. We have figured on 40% of direct cost. This figure could be reduced if the production is in a larger scale.

During the last year (October 1969–September 1970) the institute bought mung bean and soy bean from the Navy Welfare Department at Sattaheep at the price of 1.80 baht/kg. on a one year contract. After September, the Navy Welfare Department has discontinued the contract. At that time the prices of the beans went up to 2.50 baht/kg. At present, the institute has agreed to buy from the Kasetsart Co-operation at the compromised price of 2.00 baht/kg. The university promises to plant the beans and provides us at least 100 tons per year for the pilot project. Hence the price of the beans should remain at 2.00 baht/kg.

In extracting protein from mung bean, starch remains by-product material. If the yield of this process is very high, prices of protein would be lower. At the moment, due to lack of machinery, we must separate starch by local method instead of by centrifuge. The Alfa-laval Company is considering the possibility of providing us a centrifuge to separate starch. Without the centrifuge the yield is only 40%. The price of mung bean starch is 10 baht/kg. In the market, pure mung bean starch to sold at 30-40 baht/kg. Mung bean starch mixed with tapioca is sold at 10–20 baht/kg. The price of Kaset Protein is dependent on the price of mung bean. I will illustrate this fact in the following tables and slides:

KASET PROTEIN

Based on 240 kg. of mung bean, the product will be 40 kg. of Kaset Protein (80% yield) and 65 kg. of starch (40% yield). The price of starch to be sold is 7 baht/kg.

PRICE OF MUNG BEAN (baht/kg.)	PRICE OF KASET PROTEIN (baht/kg.) direct cost	direct cost + 40%
1.00	7.00	9.80
1.50	8.00	11.20
2.00	12.80	17.92
2.50	15.90	22.26
3.00	18.801	26.32

Remarks: Protein content 60%
Rate of exchange 1 dollar/20 baht

The use of Kaset Protein to make Kaset meat with chilli without being canned, i.e. to be eaten without being processed, will result in 12% protein (instead of 60%). Figures on cost of cooking and other preparation prior to canning are:

KASET MEAT WITH CHILLI

COST OF KASET PROTEIN (baht/kg.)	PRICE OF KASET MEAT WITH CHILLI (baht/kg.) direct cost	direct cost + 40 %
5.00	4.15	6.90
10.00	5.20	7.30
15.00	6.20	8.70
20.00	7.25	10.15
25.00	8.25	11.16

Price of Kaset with chilli including processing are :

COST OF KASET PROTEIN (baht/kg.)	CAN PRICE =0.65 baht		CAN PRICE =0.35 baht	
	direct cost	direct cost + 40%	direct cost	direct cost + 40%
5.00	1.40	1.96	1.10	1.50
10.00	1.60	2.24	1.30	1.82
15.00	1.74	2.38	1.44	2.00
20.00	1.90	2.66	1.60	2.20
25.00	2.08	2.91	1.78	2.45

SOY MILK

Soy milk is made by the methods of Mysore and Cornell University, 1 kilogram of soy bean will yield 5 litres of soy milk. The followings are details of the production :

COST OF SOY BEAN (baht/kg.)	COST OF SOY MILK (baht/litre) direct cost	direct cost + 40%
1.00	0.87	1.12
1.50	0.97	1·36
2.00	1.07	1.49
2.50	1.17	1.64
3.00	1.27	1.77

Remarks : soy milk produced = 600 litres
labor = 16 hours
average cost of labor + utility + etc. = 0.47 baht/litre.

Cost of evaporated soy milk made by reducing three parts to one part and processed in 20 oz. can (electrolytic 1.00 lb/bb. substance 85 lb./bb.). The cost includes the cost of the can. The figures are :

PRICE OF SOY BEAN (baht/kg.)	COST OF SOY MILK (baht/can) direct cost	direct cost + 40%
1.00	2.35	3.30
1.50	2.60	3.64
2.00	2.75	3.85
2.50	2.90	4.06
3.00	3.20	4.48

Remarks : production = 340 cans
labor = 16 hours

FULL FAT SOY FLOUR

With regard to the making of full fat soy flour, I cannot neglect to thank Dr. Dimler, the director of the North USDA in Peoria, Illinois. He was the person who introduced the method to me at the meeting in November 1969. Without this introduction I would not be able to relay the knowledge to my co-workers and we would not be able to make cookies the way we are making them now. The following table contains figures of the cost of production of full fat soy flour.

PRCIE OF SOY BEAN (baht/kg.)	PRICE OF FULL FAT SOY FLOUR (baht/kg.) direct cost	direct cost + 40%
1.00	1.00	3.93
1.50	3.31	4.63
2.00	3.81	5.33
2.50	4.31	6.02
3.00	4.81	6.73

Remarks: based pm 80 kg. of production
labor = 16 hours
average cost of labor + utility + etc. = 1.81 baht/kg.
1 kg. soy bean/0.8 kg. full fat soy flour

Figures for the cost of cookies are based on 1 : 1 ratio of cost of full fat soy flour and wheat flour. (Lysine and methionine are also added.) The price of wheat flour in the market is quite high, 10 baht/kg.

COST OF FULL FAT SOY FLOUR	PRICE OF COOKIES (baht/kg.)	
(baht/kg.)	direct cost	direct cost + 40%
3.00	9.90	13.86
4.00	10.10	14.14
5.00	10.40	14.56
6.00	10.80	15.12
7.00	11.00	15.40
8.00	11.40	15.96

Remarks: based on 60 kg. of pronuction
labor = 8 hours
average cost of labor + utility + etc. = 2.60 baht/kg.

From the above illustrations it is clear that there is a probability that the production could be extended from pilot scale to industrial scale. I believe that with proper machinery we could obtain higher yield and lower production cost. Labor could be greatly reduced since at the moment the separation of starch by local method needs both labor and time. The filter cloth works only when the starch has been settling in the bottom. Therefore there is a waiting period and a delay. Similarly, in the process of making evaporated milk we use direct heat as means of evaporating milk. If vacuum evaporator is available we could reduce the time and labor and will be able to control the quality of the product better. On the other hand, the whole set of cooker extruder is ideal while we only have parts of the set. These parts will be supplied by the USAID. Many products may be produced form this partial set. For example. we can produce soy beverage as shown by Dr. Dimler as well as other products. We are also lucky to be able to recieve from the German government, a spray dryer to make powder soy milk.

The present limitation is the amount of machinery available. Though our production is quite low, we still hope to operate and use our laboratory as a central kitchen in cooperation with the Ministry of Education, the Department of Health, and other related institutions. The main functions of this central kitchen would be to:

1. to provide protein food,
2. to demonstrate proper methods of food preparation,
3. to advice and try to stimulate new ideas, and
4. etc.

This plan will work only if the USAID and the consultants see the importance of this central kitchen.

Finally, I would like to state that the importance of this central kitchen is undeniable. At present, the government of Thailand has many centers for different categories of people. In these centers food must be provided daily. There are only limited fund for food in each center. The budget is 6 baht/person/day. According to the last count there are 7,569 persons in 27 centers. Thus, the total amount of money spent on food is 16,576,100 baht/year. If 50% of the budget is for supplement protein food, the cost would be 8 millions baht. This figure represents only the need of one type. Another 8 schools where the government must supply food are not included in the above calculation. Lunches are supplied at these schools. I feel that the lunch program should be planned and operated properly. Catering lunches to be demonstrated in different areas should be included in this program. This institute under the administration of Kasetsart University and the Department of Health are willing to cooperate with the Ministry of Education in every way possible. The statement of the Prime Minister that the children of today are adults of tomorrow is very true. It implies that well-built children of today will become healthy and intelligent adults of tomorrow. These adults certainly would be able to contribute in one way or another to the development of our country.

I hope that the experts present here will agree with me that the works of the institute which have started are of value and should be further supported in some way. The development of the programs would certainly enhance the development of the nation as a whole.

Amara Bhumiratana

Protein Food Products developed in Thailand

Protein-calorie malnutrition is recognized as a major nutritional problem in the underprivileged segment of the world population. In Thailand, while the rural diet may provide acceptable level of protein and calories, the fact that protein requirement in certain groups exceeds the actual intake warrants corrective action. The set up of the Protein Food Development Project in 1967 was part of the design to apply corrective measure to this problem. The concept being visualized was that the immprovement of protein intake of the population, both qualitatively and quantitatively, would be possible through the use of protein-rich supplementary foods. Certainly, this is not the only means to cope with the problem, as there are other measures which are used widely, such as those which place emphasis on increasing home food production etc. It is true that each of these measures will have its own advantage and drawback. But, by applying these measures simultaneously, better result could be expected.

Under the Protein Food Development Project, the Institute of Food Research and Product Development, the Department of Health and USAID, as collaborating agencies, undertake to develop protein-rich foods utilizing local materials, then to test the prototypes under laboratory and field conditions, and eventually direct the foods to the target population through various means, principally commercial channel and feeding programs.

These protein foods, in order to be effectively and widely utilized, are produced from a indegenous protein sources. The content of the protein and its amino acid composition are adjusted to satisfactorily supplement what are lacking in the diet.

In the Thai project, both vegetable and animal protein sources are utilized. Decision to use any of these sources, either single or in combination, depends on certain criteria. Principal among which are

- that the protein content and amino acid composition of the source are adequate or lend itself to modification in case of the latter.
- that the level of production of such source is or is expected to be sufficient.
- that the cost is reasonable
- that the products developed from such source have acceptable characteristics
- and that there is a way to utilize the by-products.

Commercial consideration is also important. The prototypes being developed are diversified and each tested for acceptability. The profit margin is wide enough to ensure take-up by the industries. Packaging is attractively designed and hygienic. The products are also designed to retain their keeping quality longer than the expected turnover rate.

The population to benefit from the program is defined from the evidence of inadequate protein intake. Thus the preschool and school children, the pregnant and lactating mothers from the low-income family would be the target group.

The products are laboratory tested for their nutritive quality and field tested in selected group of preschool children in the rural setting. Criteria being used in the evaluation of quality include growth measurements and biochemical findings. Since the food is intended for use as a supplement in the younger age group, the problem of mother's acceptance of the product should be crucial and decide the prospect of promotion. Thus, acceptability test has to be made in both the mother and the child.

To develop a preschool child program, an infrastructure through which the program can be implemented should be examined or developed if necessary. The methodology being used in this country is to organize, in the village, a child nutrition center. This is essentially a day-care center with special emphasis on nutrition. Village people are required to participate in the organization and operation of such center. The preschool child are collected at the place during day-time and one meal into which protein food is incorporated is served. The center is run by attendants who are selected from local girls and trained on the basics of kindergarten, health care, nutrition and home economics. They are under the guidance and control of local health personnel.

Apart from supplementary feeding, the child nutrition center also provides general health care, including immunization, social and educational development opportunities for the children, and an education program for participating mothers.

Some 30 child nutrition centers are selected and used as fieled trial area in connection with the Protein Food Development Project. The number of children under this program is approximately 2,500. They are located in the provinces of Chiengmai and Prae in the north and Ubol and Roi-et in the northeast.

Control area comprises two types of village. One group, called raw control, has none of the project activities while the other group has child nutrition centers in which the same diet as in the experiment area is given except for the added amount of the supplement under trial.

The field trial of our prototypes has recently been completed for the first year. The data collected during this period are now being analyzed.

Because of the definite advantage of the child nutrition center as a mechanism of implementing a preschool child program, the Departments of Health, Education, and Community development are at present preparing a plan to set up

and expand the system in rural areas in all parts of the country. It is expected that the low-cost protein foods will become the core of the supplementary feeding program to be applied in these centers.

As the project enters its second phase in 1971, emphasis will be shifted toward the promotion of protein foods. In order that this is effectively done, commercialization of such foods will be necessary. The interested food industries should be promoted so that they could take up and carry on research and sale in an effective way. One important criterion to be kept in mind is that the product cost must be comparatively low in order to reach the target population and the product quality in terms of nutrition must be adequate.

On the consummer's side, the project will aim at converting and raising the buying value, in terms of nutrition, of the consumer's money already spent on foods. In this connection, catering service programs may be developed in schools and other institutions. Research on the development and promotion of protein food products and training courses will also be initiated or expanded at the Institute of Food Research and Product Development and other appropriate agencies.

Under this project, it is gratifying to note that within the last 3 years, a number of prototypes have been developed and put on trial. A detailed report on these products could be found elsewhere.

Amorn Nondasuta

Lunch Menu

for

School Lunch Program

KASET PROTEIN CURRY

for 600 children

1.	**Rice**	kg.	76.0
2.	**Kaset Protein curry**		
	Kaset Protein	kg.	18.0
	Curry paste	kg.	2.5
	Shredded coconut	kg.	16.0
	Egg-plant	kg.	30.0
	Kaffirlime leaf	kg.	0.2
	Swset basil	kg.	2.0
	Sugar	kg.	0.750
	Fish sauce	litre	1.110
	Vegetablc oil	litre	0.750
	M.S.G. + Ribotide	kg.	0.028
3.	**Red bean in clear syrup**		
	Red bean	kg.	16.0
	Sugar	kg.	16.0
4.	**Soy milk**	litre	120.0
5.	Mixed vitamins	kg.	0.060
6.	N_4 Ferri citrate	kg.	0.026

TOM YAM

for 600 children

1.	**Rice**	kg.	76.0
2.	**Tom yam**		
	Beef	kg.	1.80
	Citric acid	kg.	0.0750
	Fish sauce	litre	3.750
	M.S.G. + Ribotide	kg.	0.0150
	Salt	kg.	0.750
	Coriander	kg.	0.750
	Lemon grass	kg.	0.375
	Kaffirlime leaf	kg.	0.18750
	Kaset Protein	kg.	18.0
3.	**Black Glutinous rice with coconut cream**		
	Black glutionous rice	kg.	16.0
	Suger	kg.	16.0
	Shredded coconut	kg.	1.20
4.	**Soy milk**	litre	120.0
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Ferri citrate	kg.	0.0260

FRIED RICE NOODLE

for 600 children

1.	**Fried rice noodle**		
	Rice noodle	kg.	90.0
	Duck egg	eggs	60
	Kale	kg.	34.0
	Soy sauce (black)	litre	2.670
	Vegetable	litre	3.0
	Fish sauce	litre	2.88
	Sugar	kg.	1.5
	Kaset Protein	kg.	18.0
	Chilli Pickle	kg.	2.0
	Vinegar	bottles	3
2.	**Mung bean in clear syrup**		
	Mung bean	kg.	16.0
	Sugar	kg.	16.0
3.	**Soy milk**	litre	120.0
4.	Mixed vitamins	kg.	0.060
5.	NH_4 Ferri citrate	kg.	0.026

FRIED CABBAGE WITH PORK

for 600 children

1.	**Rice**	kg.	76.0
2.	**Fried cabbage with pork**		
	Pork	kg.	4.0
	Cabbage	kg.	40.0
	Fish sauce	kg.	3.25
	Garlic	kg.	0.45
	Pepper	kg.	0.125
	M.S.G. + Ribotide	kg.	0.03
	Kaset Protein	kg.	18.0
3.	**Tao Suan**		
	Mung bean	kg.	16.0
	Sugar	kg.	16.0
	Tapioca flour	kg.	1.7
	Shredded coconut	kg.	1.25
4.	**Soy milk**	litre	120.0
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Ferri citrate	kg.	0.026

FRIED LONG BEAN WITH CURRY PASTE

for 600 children

1.	**Rice**	kg.	76.0
2.	**Fried long bean with curry paste**		
	Long bean	kg.	30.0
	Pork, medium fat	kg.	4.0
	Curry paste	kg.	2.5
	Palm sugar	kg.	3.9
	Fish sauce	litre	2.15
	Vegetable oil	litre	3.75
	Kaset Protein	kg.	18.0
3.	**Sweet potato in clear syrup**		
	Sweet potato	kg.	40.0
	Sugar	kg.	16.0
	Old ginger	kg.	1.0
4.	**Soy milk**	litre	120.0
5.	Mixed vitamins	kg.	0.060
6,	NH_4 Ferri citrate	kg.	0.026

RICE-NOODLE WITH BEEF SOUP

for 600 children

1.	**Rice-noodle with beef soup**		
	Rice-noodle	kg.	100.0
	Beef	kg.	4.0
	Bean sprout	kg.	25.0
	Garlic	kg.	0.5
	Soy sauce	litre	2.0
	Fish sauce	litre	2.50
	Vegetable oil	litre	2.50
	Sugar	kg.	1.0
	Kaset Protein	kg.	18.0
	Coriander	kg.	0.50
	Chincse celery	kg.	0.50
	Shallot leaves	kg.	1.0
	Chilli pickle	kgs.	2.0
	Vinegar	bottles	3
2.	**Black glutinous rice with coconut cream**		
	Black glutinous rice	kg.	16.0
	Sugar	kg.	16.0
	Shredded coconut	kg.	1.20
3.	**Soy milk**	litre	120.0
4.	Mixed vitamins	kg.	0.060
5.	NH_4 Ferri citrate	kg.	0.026

PALO EGG
for 600 children.

1.	**Rice**	kg.	76.0
2.	**Palo Egg**		
	Duck Eggs		115
	Sugar	kg.	4.0
	Coriander root	kg.	0.3
	Garlic	kg.	0.3
	Pepper	kg.	0.10
	Black soy sauce	litre	1.750
	Vegetable	litre	2.75
	Kaset Protein	kg.	18.0
	Palo Paste	kg.	0.10
3.	**Red bean in clear syrup**		
	Red bean	kg.	16.0
	Sugar	kg.	16.0
4.	**Soy milk**	litre	120
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Farri citrate	kg.	0.026

FRIED KALE WITH BEEF

for 600 children

1.	**Rice**	kg.	76.0
2.	**Fried kale with beef**		
	Beef	kg.	4.0
	Kale	kg.	40
	Fermented bean sauce	kg.	3.0
	Fish sauce	litre	4.050
	Garlic	kg.	1.75
	M.S.G. × Ribotide	kg.	0.2
	Kaset Protein	kg.	0.04
3.	**Sago with coconut cream**		
	Sago (small)	kg.	16.0
	Sugar	kg.	16.0
	Shredded coconut	kg.	1.5
	Tapioca flour	kg.	15.0
4.	**Soy milk**	litre	120.0
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Ferri citrate	kg.	0.026

FRIED BEEF WITH CHILLI PEPPER

for 600 children

1.	**Rice**	kg.	76.0
2.	**Fried beef with chilli pepper**		
	Beef	kg.	4.0
	Egg plant	kg.	30.0
	Chilli pepper	kg.	3.0
	Sweet basil	kg.	2.0
	Fish sauce	litre	3.0
	Salt	kg.	0.125
	M.S.G. + Ribotide	kg.	0.03
	Vegetable oil	litre	2.15
	Garlic	kg.	0.35
	Sugar	kg.	1.0
	Kaset Protein	kg.	18.0
	Shredded coconut	kg.	10
3.	**Banana with Coconut milk**		
	Bananas		620
	Sugar	kg.	16.0
4.	**Soy milk**	litre	120
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Ferri citrate	kg.	0.026

NOODLE WITH TOPS
for 600 children

1.	**Noodle with tops**		
	Egg noodle	kg.	58.0
	Beef	kg.	4.0
	Bamboo shoot	kg.	30.0
	Spring onion	kg.	4.50
	M.S.G. + Ribotide	kg.	0.03
	Carlic	kg.	0.50
	Pepper	kg.	1.0
	Fish sauce	litre	3.20
	Vegetable oil	litre	2.20
	Coriander	kg.	0.55
	Kaset Protein	kg.	18.0
2.	**Red beans in clear syrup**		
	Red bean	kg.	16.0
	Sugar	kg.	16.0
3.	**Soy milk**	litre	120
4.	Mixed vitamins	kg.	0.06
5.	NH_4 Ferri citrate	kg.	0.026

KANG SOM

for 600 children

1.	**Rice**	kg.	76.0
2.	**Kang Som**		
	Kaset Protein	kg.	18.0
	Citric acid	kg.	0.10
	Palm sugar	kg.	2.4
	Fish sauce	litre	3.750
	Curry paste	kg.	2.5
	M.S.G. + Ribotide	kg.	0.03
	Fish	kg.	5.5
	Long bean	kg.	30.0
3.	**Black bean in Clear Syrup**		
	Black bean	kg.	16.0
	Sugar	kg.	16.0
4.	**Soy milk**	litre	120
5.	Mixed vitamins	kg.	0.06
6.	NH_4 Ferri citrate	kg.	0.026

FRIED RICE

for 600 children

1.	**Rice**	kg.	76.0
2.	**Fried rice**		
	Onion	kg.	10.0
	Beef	kg.	4.0
	Black soy sauce	kg.	2.50
	Garlic	kg.	0.45
	Salt	kg.	0.30
	Pepper	kg.	0.10
	Fish sauce	litre	1.50
	Vegetable oil	litre	4.0
	M.S.G.–Ribotide	kg.	0.30
	Kaset Protein	kg.	18.0
	Shallot leaves	kgs.	5.0
3.	**Sweet potato in clear syrup**		
	Sweet potato	kg.	40.0
	Sugar	kg.	16.0
4.	**Soy milk**	litre	120
5.	Mixed vitamins	kg.	0.06
6.	NH_4 Ferri citrate	kg.	0.026

KANG SOB NOG
for 600 children

1.	**Rice**	kgs.	76.0
2.	**Kang Sob Nog**		
	Kaset Protein	kgs.	18.0
	Curry paste	kgs.	2.5
	Shredded coconut	kgs.	16.0
	Egg-plant	kgs.	25.0
	Kaffir-lime leaves	kg.	0.2
	Sweet basil	kgs.	2.0
	Rhizome	kgs.	2.0
	Sugar	kg.	1.0
	Fish sauce	litres	1.5
	Vegetable oil	kgs.	1.25
	MSG-Ribotide	kg.	0.028
	Minced dried fish	kgs.	5.50
3.	**Tao Suan**		
	Mungbean in half	kgs.	16.0
	Sugar	kgs.	16.0
	Tapioca flour	kgs.	5.0
4.	**Soy milk**	litres	120
5.	Mixed vitamins	kg.	0.060
	NH_4 Ferri citrate	kg.	0.026

CHOPPED MEAT NOODLES

for 600 children

1.	**Chopped meat noodles**		
	Rice noodles	kg.	90.0
	Beef	kg.	4.0
	Lettuce	kg.	25.0
	Garlic	kg.	0.475
	Black soy sauce	litre	2.20
	Fish sauce	litre	2.20
	Vegetable oil	kg.	3.25
	Sugar	kg.	1.0
	Kaset Protein	kg.	18.0
	Tapioca flour	kg.	5.0
	Ginger	kgs.	2.0
2.	**Mung bean in clear syruyp**		
	Mung bean	kg.	16.0
	Sugar	kg.	16.0
3.	**Soy milk**	litre	120
4.	Mixed vitamins	kg.	0.060
5.	NH_4 Ferri citrate	kg.	0.026

MORNING GLORY FRIED WITH PORK AND CHINESE CELERY

for 600 children

1.	**Rice**	kg.	76.0
2.	**Morning Glory fried with pork**		
	Morning Glory	kg.	45.0
	Pork, medium fat	kg.	4.0
	Chinese celery	kg.	3.0
	Fermented bean sauce	kg.	3.0
	Fish sauce	litre	2.50
	Vegetable oil	litre	2.60
	M.S.G. + Ribotide	kg.	0.03
	Kaset Protein	kg.	18.0
3.	**Black glutinous rice boiled with coconut cream**		
	Black glutinous rice	kg.	16.0
	Sugar	kg.	16.0
	Shredded coconut	kg.	1.20
4.	**Soy milk**	litre	120
5.	Mixed vitamins	kg.	0.060
6.	NH_4 Ferri citrate	kg.	0.026

MIXED VITAMINS

Vitamin A		4.662	gm.
Viamin B_1		0.5328	gm.
Viamin B_2		0.8658	gm.
Niacin		9.324	gm.
Vitamin C		39.69	gm.
Vitamin D		0.333	gm.
Vitamin B_6		1.332	gm.
	Total	57.0106	gm.
	=	.5702	kg.
NH_4 Ferri citrate		0.02622	kg.