WHEAT AND COCONUT FLOUR PROTEIN UTILIZATION BY SIX YOUNG COLLEGE WOMEN

by

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INTRODUCTION

It is generally recognized that the diets consumed by a large segment of the population in most of the developing countries of the world, as in Latin America, Africa, the Middle East, and Southeast Asia, consist predominantly of cereals and include negligible amounts of animal proteins. The consequences of this dietary deficiency are clearly seen among infants, children, and expectant and nursing mothers. Protein malnutrition is prevalent especially among the rural and urban poor. The Food and Agriculture Organization of the United Nations estimated that about 20 percent of the population of the less developed nations do not meet their calorie requirements, and that about 60 percent lack the proper balance of calories, proteins, minerals, and vitamins (1). The incidence of malnutrition is high and costly in terms of the general adverse effect it exercises on the economic and social development of nations.

While cereals are still the main source of protein, the pulse, oilseeds, and nuts are of great value in achieving a good pattern of amino acids. Oilseed meals, a potentially rich source of protein are mainly used as basic material for fertilizer and feed for livestock. Research in India, Africa, the Philippines, and Latin America has demonstrated that protein residue from oilseeds can be converted to foods of high nutritional value which are safe and fit for human consumption.

The meal left after oil extraction of coconut, peanut, sesame, and cottonseed can with proper processing contain from 40 to 50 percent good quality protein (2). Because the extracted oil pays partly for the cost, these meals could be a cheap source of protein.

Since technology is not advanced in many of the developing countries, the problem of protein malnutrition may remain a difficult one for a long time. Major social programs are necessary, including measures to develop a highly nutritious food utilizing local plant protein resources that can be manufactured and sold at low cost in the country and used as supplementary foods for children.

One approach and maybe an efficient solution is to replace some of the cereals by varieties of higher protein foods such as coconut flour, bean flour, or cottonseed flour. The addition of oilseed protein to cereal flour or meal used for one or any type of bread can be a good outlet for oilseed proteins. The nutritive value of cereals may also be enhanced by supplementation with another vegetable and the addition of a very small amount of skimmed milk. In this way the contribution of donated milk to the community may be extended by vegetable combinations.

In the Philippines, interest has been focussed on the possibility of using coconut protein to make up for the protein deficient diet of the majority of the population. Different methods have been developed to convert the coconut meal into purified products that are acceptable, high in nutritive value, and fit for human consumption. The coconut oilseed appears to be a good source of processed protein because of the high nutritive value of the undamaged coconut meat and its availability to the area. The Philippines is the largest single producer of coconut in the world.

Since processing of coconut proteins had been a source of many problems in the past, there is a need for more studies on the effect of heat damage on protein recovery and utilization (3). The amino acids as affected by processing may not be liberated in their chemical forms so that they can be absorbed or, if they are absorbed, may not be utilized in the usual fashion.

In an attempt to combat protein calorie malnutrition through a large-scale feeding program in the country, Nutribun, a special milk bread, has been developed. Its formulation is given in Appendix A.

Most recently, the feasibility of combining wheat flour and coconut flour in the Nutribun was tested. Although it is possible to supplement the bread with coconut flour, there is the inevitable effect of taste, color, and physical characteristics which limits the amount that can be incorporated into the product. Tests have shown that 10 to 15 percent coconut flour can replace proportionate fractions of wheat flour and milk powder without adversely affecting the baking quality or the acceptability of the product.[1] In this study 11 percent coconut flour was used in the formulation of a special coconut Nutribun (Nutribun C).

This investigation was undertaken to compare the utilization of wheat flour Nutribun protein with the utilization of coconut flour Nutribun protein when consumed by young women using a low protein, high fruit and vegetable diet.

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[1] Engel, R. and A. Fraleigh 1972 Nutribun - a ready-to-eat complete meal. League for International Food Education Newsletter. (March) p. 3.

REVIEW OF LITERATURE

The development of suitable combinations of plant protein sources to supply both essential and nonessential amino acids in their correct proportion is a practical approach to supplying the needed dietary protein in areas where milk and animal proteins are limited and expensive. Extensive investigations have been done on the use of foods rich in protein that are available and are low in cost in many of the developing countries today (2,4,5,6). Considerable interest has been directed in the utilization of specially processed low fat oilseed meals as sources of protein for supplementing human diets.

Upon analysis of the different plant resources, several workers (7,8,9,10,11) have revealed that coconut meal was a potential source of good quality protein.

A study on the essential amino acid content of coconut meal, peanut flour, and Bengal gram flour showed that coconut meal contains an appreciable amount of all the essential amino acids, while proteins of peanut and Bengal gram flour were deficient in methionine, lysine, tryptophane, and threonine. The qualitative analysis of amino acids present in coconut meal done by Krisnamurthy *et al.* (12) showed that coconut protein contains a relatively good amount of lysine. Concepcion and Cruz (10) and Miranda *et al.* (9) in their amino acid determination on coconut flour found the same result.

In comparing the amino acids in the various coconut products to the Food and Agriculture Organization (FAO) reference pattern, it appeared that tryptophane was the most limiting factor. This did not affect the ability of the coconut protein to promote growth in rats, nor did it affect the protein's biological value.

The supplementary value of coconut meal, a by-product of coconut oil extraction, has been found useful in the diets of livestock, chicks, hogs, and rats as reported by several authors (13,14,15,16,17).

One of the earliest studies done in 1919 by Johns, Finks, and Paul (11) on the effect of feeding coconut globulin to rats revealed normal growth response when coconut globulin was used as a single source of protein in the diet. Mitchell and Villegas (13) in 1923 reported that at 5 percent protein level in the diet, the average utilization of coconut protein was 77 percent, corn 72 percent, and soybean 78 percent. The commercial coconut protein gave an average biological value of 58 which is similar to that of corn. Smuts and Malan in 1938, on the other hand, found the average biological value of coconut meal to be 69 and the true digestibility to be 89 percent (14). Similar results were obtained by Mitchell, Hamilton, and Beadles in 1945 using 10 percent protein from copra meal in rat diets which gave a biological value of 71 and the digestibility of 86.1 percent (15).

Schmidt and Vogel (16) observed that copra meal, when included in the feed, increased butterfat from dairy cows. The use of fresh coconut meat as a feed for hogs was investigated by Alfalla in 1938 (17). Results from their studies showed that using two parts of coconut meal instead of one part corn in the feed increased the weight of the animals significantly.

The works of Crawford (18) demonstrated the effect of the method of oil extraction of coconut meat on its supplementary value in different kinds of livestock. The presence of a large quantity of oil in the coconut meal was found to limit the amount which can be used in the food. It was also noted that coconut meal became rancid in a warm and moist environment.

Rats have been used to determine the supplementary value of coconut protein with other plant proteins in the diet and if toxicity exists (9,12,19,20). Bhatia and Swaminathan (19) tried a combination of coconut meal fortified with calcium salts, vitamins A and D, thiamine, and riboflavin. At 10 percent level in the diet, the PER obtained in the study was 1.87. Takar, et al. (20) observed that coconut meal, when added to a poor rice diet at 12 percent level of protein, increased rat growth. Other low fat flour of peanut, coconut meal, and chickpea flour at 48: 25: 25 ratio, when used to supplement a poor rice diet, caused also a marked increase in growth. The study of Krisnamurthy as reviewed by Melo (21) reported the protein efficiency ratio of coconut meal at 10 percent level in the diet of growing rats at 8 weeks to be 2.04. This was comparable with milk powder protein which had a value of 2.29.

Considerable work has been done to evaluate the quality of coconut protein in animal studies. Very little is known about its supplementary value when used with other proteins in the human diet. Different methods have been developed to convert coconut meal into purified products that are of higher nutritive value and are fit for human consumption (4,9,21).

A study by Miranda et al. (9) evaluated the two types of flour produced by a new method of processing. The flour from the Philippine Industrial Research Center was found to have a lower fat content which was 2.5 percent while the other kind from Franklin Baker contained 19.6 percent. Both the Industrial Research Center and the Franklin Baker processed flours have similar crude fiber and protein content: 9.7 and 8.6; and 19.3 and 18.6 percent respectively. Experiments carried out on rats showed that Franklin Baker's flour was the more digestible of the two samples. Both flours gave almost identical results on their biological values, suggesting that they have similar amino acid patterns.

Additional work done by Miranda et al. (22) on the utilization of various levels of coconut flour, using albino rats, demonstrated that replacement of 50 percent of the casein as a protein source in the diet with coconut flour gave no appreciable difference in growth rate. It was also noted that at 20 percent casein level in the diet a combination with 8, 16, 32, and 50 percent protein from coconut flour respectively promoted growth almost equal to that elicited by casein alone. Similar results were obtained by Concepcion et al. (23) when coconut protein gave comparable values with rat diets containing 12 percent casein.

In a comparative study of the nutritive value of protein done by Hegstead et al. (24) on dogs, rats, and humans, they observed that in a mixed diet man closely resembled the growing rat in his metabolic utilization of food protein. This indicated that the result of rat growth tests may be used to evaluate protein quality for human consumption.

Subrahmanyan <u>et</u> <u>al</u>.(25) carried a feeding trial for eight months with 40 boys from 7 to 12 years old, giving them protein mixture of 25 percent coconut meal, 25 percent chickpea, and 50 percent peanut flour fortified with vitamins and minerals. Results from their study indicated significant increase in height, weight, and hemoglobin in the blood.

Snyderman <u>et</u> <u>al</u>. (26) evaluated two coconut protein isolate samples with 48 healthy premature infants using the nitrogen balance method. The two protein samples tested were C-I-I_o, which was oil soluble, and the C-I-I_w, a water soluble product. Of the two samples, C-I-I_o was found to be superior. It promoted a normal growth curve, however, it was marginal in nature. It was also observed that the digestibility of the protein was not affected by intake at the range of 3.5, 5, and 7 grams per kilogram of body weight. On the other hand, the biological value and the net protein utilization were considerably lower than values obtained from milk. This was explained partly by the peculiarity of the premature infants whose digestive and absorptive functions may be inferior to older children or by the inherent chemical and physical characteristics of the food itself. Increase in stool volume was also noted when infants received the coconut protein.

With more studies done on the extraction and recovery of coconut protein, and edible protein isolate, free from indigestible carbohydrates, adverse odor, and bitter taste is now being used in the Philippines in a variety of food preparations. The coconut protein isolate was found to have a PER of 2.05, biological value of 71, and net protein utilization of 66 (27).

Very recently a product resembling canned meat spread was developed using protein isolate from coconut. Other studies were done on the preparation of noodle type products using mixtures of 30: 60: 10, semolina, coconut flour and mung flour. This product was considered acceptable and has an excellent shelf life of six months (5).

A high protein mixture containing 35 percent coconut flour, 60 percent mung flour, and 5 percent non-fat dry skim milk has been prepared by the Food and Nutrition Research Center in the Philippines (27). This formulation has been successfully incorporated into the native recipes as porridge and was found to be acceptable with children in schools. The coconut, mung, milk mixture is a good source of protein, with two ounces supplying about one-fifth of the daily minimum requirement for calories and one-third of the protein requirement for a one- to three-year-old child (5).

Crunchies of "Kroepeck" made from a combination of coconut flour, high protein wheat flour, shrimp powder, and condiments is also being tested. A new infant food in the form of cereal flakes using one part coconut flour and three parts of high protein flour is also being tried in some feeding centers (27). Cereal flakes made from homogenized blends of cereal flour, peanut protein isolate, coconut proteins, with vitamins and minerals have been used to feed some children in India (28). This food flake is given in the form of porridge. An infant food made from the combination of coconut honey, peanut protein, skim milk powder, buffer salts, and glucose sugar was also developed in the same country (19).

Nutribun, a special milk bread is now used to supplement the diet of under-nourished children in the Philippines. The formula uses two parts plant protein and one part animal protein with the following ingredient pattern: wheat 100, non-fat dry milk solids 14, sugar 12, vegetable oil 5, salt 1.5, and yeast 1. The Nutribun weighs 133 grams, contains 17 grams of protein and 500 kilocalories. It supplies protein which provides over 25 percent of the recommended daily protein and calories for a twelve-year-old Filipino. Vitamin A, niacin, riboflavin, thiamine, calcium, and iron supply more than 30 percent of the recommended daily requirement.[2]

Attempts have been made to replace proportionate fractions of Food for Peace wheat flour and milk powder with coconut flour which is available and cheap. Tests show that at 10 to 15 percent level, coconut flour can be used effectively without any adverse effect on the acceptability and the baking qualities of the product.

Since coconut flour has shown great potential as a source of dietary protein, further studies are deemed necessary, especially in the effect of processing on the recovery of protein. Investigators have indicated that in the processing of oilseed proteins, lysine may be made unavailable (3, 23). Lysine is reduced from

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[2]Engel, R. and A. Fraleigh 1972 Nutribun - a ready-to-eat complete meal. League for International Food Education Newsletter. (March) p. 2.

3.1 percent to 1.1 percent when heated to 130° C. for 30 minutes (29). Evans and Butts (30) also reported that lysine and to a lesser extent methionine and tryptophane are made unavailable when protein is submitted to severe heat. Heating or drying coconut protein to 100° C. is not advisable because denaturation occurs (21). Improved methods of coconut protein extraction to increase percentage of recovery still remain a challenge for researchers. More studies should also be done to determine the effect of high fiber content and of processing on the protein utilization when used at high levels in the diet.

METHODS AND PROCEDURE

Subjects

Six female undergraduate students from the College of Home Economics served as subjects. They ranged from 19 to 21 years of age, 50.0 to 60.3 kilograms in weight and 155 to 170 centimeters in height. The subjects were divided into two weight groups. Subjects I, III, V, and VI belonged to the 60 kilogram or the larger group, and Subjects II and IV belonged to the 50 kilogram or the smaller group.

During the study all subjects maintained their usual daily activities and continued to stay in their respective dormitories and apartment homes. The duties and responsibilities of participants in the study were discussed in a meeting one week before the start of the experiment. It was further emphasized that the success of the study would be greatly dependent on how accurately they followed instructions and gave their full-hearted cooperation.

Five of the subjects were Foods and Nutrition majors. This made it easier for them to perform their work project in weighing, preparing, and serving meals. Before the beginning of the experiment, all subjects had a physical examination by the Infirmary physician to ensure that they were in normal health. A complete blood count, hematocrit, and hemoglobin levels were also taken to rule out the presence of any infection or anemia. Subjects recorded their weights on the daily record sheet during the study. The mean weight of each subject at the end of the experimental period is given in Appendix B. Daily activities were also checked on the activity form which was provided for the whole experimental period.

Experimental Design

The 22-day experiment was divided into four periods. The subjects were given a basal diet plus one of the following supplements in each period:

A. Nutribun C

B. Nutribun W

C. Combination of equal amounts of Nutribun C and Nutribun W.

(See Appendix A for formulation of Nutribun C and Nutribun W).

The first six days (Period I) was the adjustment period. All subjects were given the basal diet plus the combination in equal amounts of Nutribun C and Nutribun W. The next six days were Period II. Half of the subjects (I, II, III) were placed on the basal diet plus Nutribun C supplement and the other half (Subjects IV, V, and VI) were placed on the basal diet plus Nutribun W. Period III was the second adjustment period which lasted for four days. All subjects were again given the same diet as during the first adjustment period. The last six days (Period IV) the subjects were given the basal plus the reverse supplement of Period II as shown in Table I.

TABLE I

EXPERIMENTAL DESIGN FOR DIET SUPPLEMENT

Subjects[1]	I II III	IV V VI
Period I	Basal + (Nutribun C (Nutribun W	Basal + (Nutribun C (Nutribun W
Period II	Basal + Nutribun C	Basal + Nutribun W
Period III	Basal + (Nutribun C (Nutribun W	Basal + (Nutribun C (Nutribun W
Period IV	Basal + Nutribun W	Basal + Nutribun C

[1]Each subject served as her own control in comparing the response to each supplement.

Diet

Two basal diets composed mainly of fruits and vegetables were used. Both diets were the same except that they differed in the amount given to the two weight groups of subjects. The high level basal diet which contained approximately 9 grams of protein was given to the larger group of subjects, and 83.33 percent of the food from the high level basal diet was given to the smaller group of subjects.

There were six basal menus prepared to avoid monotony and to provide more variety (Appendix C). A combination of mixed foods was used in menus to give similar nutrient content from day to day (Appendix D). One serving of rice was included daily to simulate the rice diet consumed in the Philippines. A small amount of animal protein in the form of cold meat (Salami and Bologna) was also used. The basal protein was kept constant, ranging from 9 to 10.14 grams daily. The six-day menu cycle was used in the same order for each study period.

Slight changes were made on Menus IV and VI at the start of the second period. Grapes were replaced by blueberries of equal weight with the same protein content in Menu I. This was done because it was difficult to get the same variety of grapes from time to time during the study. Since most subjects objected to eating asparagus, one serving was replaced in Menu VI by broccoli, the weight of which was adjusted to give an equivalent amount of protein.

The protein intake for all subjects during the study was 0.725 grams/kilogram of body weight. Daily protein intake was approximately 45 grams for the high level diet and 35 grams for the lower level

(Appendix E). The energy intake was started at 34 kilocalories/kilogram of body weight and was gradually adjusted to meet each individual's weight maintenance requirement by giving extra energy foods in the form of lifesavers, jams, jellies, and sugar. Daily kilocalorie intake for the high level diet was 2,000 ± 100 and the low level diet contained 1,700 ± 100 kilocalories. Kilocalorie adjustment needed to maintain energy requirement of subjects ranged from 33 to 38 kilocalories/kilogram of body weight (Appendix F).

Supplements

Two kinds of Nutribuns (Nutribun C and Nutribun W) were used to supplement the basal diet in the study. The Nutribun contributed approximately 80 percent of the protein and 50 percent of the kilocalories of the day's total intake (Appendix G).

The diet met the recommended daily allowance[3] of thiamine, riboflavin, vitamin C, and niacin and supplied approximately more than two-thirds of vitamin A, calcium, and iron (See Appendix E). Only iron supplements were given in the form of ferrous gluconate. Each subject was given one tablet which was equivalent to 35 milligrams of ferrous iron every sixth day, beginning with Period II.

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[3]Food and Nutrition Board: Recommended Dietary Allowances. Revised 1968. Washington, D. C., National Academy of Sciences, Publication 1146, National Research Council.

Food Preparation and Serving

All fruits and vegetables that were not served fresh were pre-prepared, weighed, placed in individual containers, and kept in the freezer until ready to serve. Nutribuns were pre-weighed to give 29 and 35 grams of protein respectively for the smaller and the larger group of subjects. These were stored in plastic bags and frozen until ready for use.

Special recipes (31) were also pre-prepared, weighed, placed in individual containers, and kept in storage until ready to use. Soups were blended thoroughly in the Waring blender and served hot. Dietetic dressing was used in salads to reduce the total fat and calorie content. Deionized water was used to prepare beverages, Kool Ade, and for drinking. Tea and coffee were taken in a constant amount daily.

Foods that were served hot were heated at 250° F. for 15 minutes before meal time. This was done to minimize the effect of heat on the possible destruction of lysine in the Nutribuns and to eliminate the variable due to the change in protein by heat or moisture loss at varying temperatures.

Meals were served in the food laboratory of the Department of Human Nutrition and Foods, at a scheduled time convenient to all subjects. Breakfast was served from 7:30 to 8:30 A.M., lunch from 12:00 to 12:30 P.M., and dinner from 6:00 to 6:30 P.M., Monday through Saturday. On Sundays breakfast was served at 9:00 A.M. and lunch at 1:00 P.M. Dinner was served at the same time as on the other days. The girls were allowed to take breakfast home if they so desired. Most of the girls, however preferred having breakfast in the food laboratory.

Food Composite

Each day during the adjustment period, an extra serving of all foods included for both the upper and the lower level diets was prepared for the food composite. Foods were placed in labelled containers and deionized water was used to transfer small particles of food that were left in the serving dishes and were brought to a consistent weight.

At the end of the day's meals, the composite was transferred to the Waring blender and mixed thoroughly for three minutes. An aliquot portion of 100 grams was immediately taken and kept in the freezer for nitrogen analysis.

The Nutribuns were not included in the food composite, but were analyzed separately for nitrogen and moisture content prior to the beginning of the study. Values obtained are shown in Table II.

Urine and Fecal Collection

Daily twenty-four hour urine and fecal samples were collected. Urine samples were placed in plastic bottles containing toluene as a preservative. The twenty-four hour urine collection started at 8:00 A.M. and was completed at 8:00 A.M. the following day.

The daily urine composite was kept in the refrigerator until the collection was completed. Every morning this was diluted to the nearest hundred milliliters with deionized water, and mixed thoroughly with a magnetic stirrer. An aliquot sample of 100 milliliters

TABLE II

ANALYZED NITROGEN CONTENT OF BASAL DIET AND NUTRIBUNS

Basal Diet					Nutribun				
	Calculated Values		Analyzed Values			Nutribun C		Nutribun W	
Day	High Level	Low Level	High Level	Low Level	Trials	Nitrogen	Moisture	Nitrogen	Moisture
I[1]	1.622	1.230	1.740	1.372	I[2]	0.0174	28.75	0.0177	27.56
II	1.441	1.200	1.673	1.304	II	0.0175	28.80	0.0177	27.05
III	1.476	1.229	1.675	1.338	III	0.0176	28.25	0.0178	27.60
IV	1.448	1.206	1.885	1.508	IV	0.0174	28.10	0.0179	27.25
V	1.465	1.218	1.751	1.433	Ave.	0.0175	28.47	0.0177	27.36
VI	1.465	1.220	1.645	1.371					

[1]Data are computed as gram nitrogen from basal diet.

[2]Data are computed as gram nitrogen per gram of Nutribun.

each was placed in two bottles. Creatinine and nitrogen analyses were done daily from one sample bottle, while the duplicate was kept in storage for reserve.

Gelatin capsules containing 50 milligrams brilliant blue diluted with 350 milligrams of methyl cellulose were used to mark the feces for each period. This was taken by all subjects at the beginning of Periods I, II, III, and IV, and at the end of Period IV.

Feces were collected in waxed paper cartons, labelled, and stored in the freezer. All feces for one period was composited, diluted with deionized water to a workable volume, and blended thoroughly in a Waring blender. An aliquot of 250 grams was stored in the freezer and analyzed for nitrogen content at the end of the study.

Chemical Analysis

Nitrogen determinations were done on the Nutribuns, the food composite, the urine, and the feces samples by the modification of Kjeldahl-Gunning-Arnold method as described by Spence (32). Creatinine analysis was made daily to check complete collection of urine sample using method used for the Technicon Auto Analyzer (33).

RESULTS AND DISCUSSION

All subjects remained in good physical condition throughout the study. No subjects experienced any illness and all maintained their weight within ± 0.50 kilogram of their beginning weights.

Daily nitrogen balances of the six subjects are given in Table III. Nitrogen balance was not calculated for Day 1. Five of the girls were in negative balance during the early part of the adjustment period, however, all but one subject were in positive balance by the end of the period. Nitrogen balances of the six subjects on Day 6 of the adjustment period ranged from -0.856 to 2.519. This variation may be a reflection of variability of nitrogen stores and of differences in requirement of energy and protein. Subjects may have accumulated nitrogen while consuming their usual meal pattern as shown by their dietary record taken for a three-day period prior to the study. They consumed more than an adequate amount of animal protein. Another reason for variation, perhaps, is the knowledge of the approaching low protein diet that may have encouraged some subjects to add one or more servings of meat in their meals prior to the beginning of the experiment.

Previous studies have reported that the body tends to lose the reserve protein until a minimum is reached. Nitrogen retention is most often associated with depletion and repletion of stored proteins, when the body adjusts to a lower protein intake (24, 34, 35, 36). A

TABLE III

DAILY NITROGEN BALANCES OF SIX SUBJECTS

	Day	Subjects I	II	III	IV	V	VI
Period	I	C + W[1]	C + W	C + W	C + W	C + W	C + W
	1	Nitrogen balances not taken.					
	2	0.096[2]	-0.754	-0.607	-0.593	0.806	-0.544
	3	-0.166	-0.805	-0.267	0.156	1.501	-0.274
	4	1.577	0.388	0.106	-0.380	0.816	-0.357
	5	2.699	-0.436	0.588	-1.243	1.716	0.507
	6	2.519	0.419	0.376	-0.856	1.589	0.349
Period	II	C[3]	C	C	W[4]	W	W
	7	0.231	0.793	0.502	-0.062	1.156	1.052
	8	0.616	0.214	0.680	-0.023	1.194	1.339
	9	0.525	0.678	0.707	0.340	0.855	0.921
	10	0.695	0.080	0.772	0.240	1.129	0.128
	11	-0.288	0.535	0.434	0.539	1.730	-0.243
	12	-0.442	0.294	0.335	-0.474	1.011	0.695[5]
Period	III	C + W	C + W	C + W	C + W	C + W	C + W
	13	0.373	0.485	0.911	0.617	2.416	-0.297
	14	1.859	0.571	0.486	0.097	1.673	0.504
	15	1.558	0.251	0.816	-0.495	1.364	0.130
	16	0.616	0.061	0.262	0.327	1.076	0.567
Period	IV	W	W	W	C	C	C
	17	0.193	-0.425	0.154	-0.243	1.414	-0.323
	18	1.245	0.118	0.321	-0.472	0.693	-0.235
	19	0.417	0.100	0.302	0.018	1.950	0.178
	20	1.038	0.305	-0.049	-0.481	1.096	0.467
	21	1.112	0.625	0.712	0.423	1.243	0.669
	22	1.172	0.442	0.412	0.047	0.710	0.494

[1] Subjects were given basal diet plus Supplement C (Nutribun C + Nutribun W).

[2] Data are expressed in grams of nitrogen.

[3] Subjects were given basal diet plus Supplement A (Nutribun C).

[4] Subjects were given basal diet plus Supplement B (Nutribun W).

[5] Value was dropped because of incomplete urine collection on this day.

daily variation of $\pm$ 0.50 grams of nitrogen was considered compatible to nitrogen balance by Leverton and Steel (37).

A summary of the mean nitrogen intake, excretion, and retention of six subjects receiving the two supplements in the diet, Nutribun C and Nutribun W, is given in Table IV. The mean nitrogen retention of subjects receiving Nutribun C was 0.408 and ranged from 0.222 to 0.571, and for subjects receiving Nutribun W it was 0.633 which ranged from 0.093 to 1.179 grams of nitrogen during Period II.

All six subjects were in positive balance at the end of the second adjustment period, Period III, with apparent nitrogen retention of subjects ranging from 0.061 to 1.076 grams of nitrogen (Table III). On Period IV, subjects (IV, V, VI) receiving Nutribun C supplement in the diet had a mean nitrogen retention of 0.424 and subjects (I, II, III) receiving Nutribun W had a mean nitrogen retention of 0.455 grams of nitrogen.

All subjects were in nitrogen balance except for one during the two diet supplements. Three subjects (I,IV, VI) retained more nitrogen during Nutribun W diet, and the other three subjects (II, III, V) retained more nitrogen when consuming Nutribun C (Table IV). The average mean retention of six subjects on Nutribun C diet was 0.416, and on Nutribun W was 0.544 grams of nitrogen. Mean urinary nitrogen excretion of six subjects consuming Nutribun C was 5.303 grams of nitrogen, which was slightly less than 5.554 grams of nitrogen when they received Nutribun W. The reverse was true for fecal nitrogen excretion, the loss being 1.238 and 0.847 grams for Nutribun C and Nutribun W respectively. Values for fecal nitrogen excretion for

TABLE IV

SUMMARY OF MEAN NITROGEN INTAKE, EXCRETION, AND RETENTION
OF SIX SUBJECTS GIVEN NUTRIBUN C AND NUTRIBUN W

Diet Supplement		Subjects I[1]	II	III	Ave.[4]	IV	V	VI	Ave.	Mean Average
			Period II				Period IV			
	Intake[2]	7.405	6.065	7.405		6.065	7.405	7.405		6.840
Supplement A	Urine	5.650	4.908	5.664		4.605	5.018	5.975		5.303
(Nutribun C)	Feces[3]	1.533	0.725	1.170		1.576	1.203	1.224		1.238
	Nitrogen Retention	0.222	0.432	0.571	0.408	-0.116	1.184	0.206	0.424	0.416
			Period IV				Period II			
	Intake	7.405	6.065	7.405		6.065	7.405	7.405		6.840
Supplement B	Urine	5.721	4.978	5.908		5.164	5.442	6.157		5.554
(Nutribun W)	Feces	0.822	0.893	1.189		0.808	0.784	0.591		0.847
	Nitrogen Retention	0.862	0.194	0.308	0.455	0.093	1.179	0.639	0.633	0.544

[1]Data are expressed in grams of nitrogen.

[2]Data are computed from basal diet and Nutribun.

[3]Data are taken from a six-day composite.

[4]Average of the mean nitrogen retention of the subjects in each period.

each subject were estimated from a six-day composite which came out to be approximately 10 to 23 percent of the nitrogen intake. The difference in mean urinary nitrogen excretion was not significant at 0.05 level, however, the difference in fecal nitrogen excretion was significant at the 0.05 but not at the 0.01 level of probability. No significant difference was found in the mean nitrogen retention of subjects on the two diet supplements.

Time required for adjustment to the low protein diet was not related to body weight. Subject V required the shortest time to attain positive nitrogen balance and Subject IV needed the longest. Subject V, who belonged to the 60 kilogram weight group, retained the largest amount of nitrogen, and Subject IV, who was with the 50 kilogram group, retained the least. These two subjects were consistent in their specific response to the two supplements. Subject IV showed an average loss of 0.023 grams of nitrogen while Subject V showed an average gain of 1.182 grams.

The diet history of Subject V revealed that she was accustomed to a relatively higher fruit and vegetable diet when compared to the rest of the group. This may have conditioned her body to adjust rapidly to a high plant protein source. Several workers, in comparing the utilization of vegetable and animal proteins in humans, have observed that there is relatively higher nitrogen retention by humans on a predominantly vegetable diet than on an animal diet (34). Phansalkar and Patwardhan, in studying the maintenance requirements of protein in young Indian adults, observed that their subjects increase in weight more consistently from animal protein, whereas those on vegetable diets gained little weight or even had a slight weight loss even if they retained more nitrogen (35).

Subject I lost 0.288 and 0.442 grams of nitrogen on Days 11 and 12 respectively. Her daily activity record indicated that she took two aspirin tablets on Day 10 because she had a headache and felt very tired. This may have affected her poor apparent nitrogen retention for these two days.

Subject VI noted that she began taking "Ovral" (oral contraceptives) on Day 12, but she showed poor nitrogen retention on the day before this. Minor psychological tension may have explained her poor retention on Day 11. An incomplete urine collection was also reported on Day 12 when she had her first pre-marital examination. This upset her very much because of scheduling complications. This could be a partial explanation for her negative response on the following day. Minor illness or psychological stress increases the level of nitrogen excretion in the urine (4). Some account must be given, also to some extraneous factors that may be a part of every day living. The positive balance on Day 12, when incomplete urine collection was made, was discarded and not included for interpretation. On Days 17 and 18, Subject VI developed a headache, a cause for slight distress which may have explained her nitrogen loss on these two days.

Subjects II and III showed a fairly stable nitrogen retention after the first adjustment period. No explanation could be found for the slight loss of nitrogen by Subject II on Day 17 except that she felt tired as noted on her daily activity form. Subject III had a burning sensation in her eyes on Day 20, a possible explanation for her negative nitrogen retention on this day which was followed by a good positive balance the following day. Depletion due to stress, infection, or trauma will result in a higher retention immediately in subsequent days even with a diet of relatively inferior protein quality (35).

Subject IV demonstrated poor tolerance to the high roughage diet. This was indicated by an increase in fecal weight and her stool had a softer consistency. This could be one reason for her low nitrogen retention and large fecal nitrogen loss when compared with the rest of the group. Table V shows the variations of fecal weight and fecal nitrogen for the six subjects receiving the two diet supplements during the study.

When comparing the two diet variations, it appeared that five subjects had higher fecal nitrogen loss when consuming Nutribun C than when they were receiving Nutribun W. There was also a marked increase in fecal weight (Table V). The higher fiber content of the coconut flour may have lowered the digestibility of the protein and the availability of the amino acids for absorption rather than the efficiency for utilization. It has been reported by several investigators that the removal of indigestible carbohydrates and other interfering materials improves the digestibility of the proteins (9,15,20,21,27).

Diets containing supplements of groundnut protein isolate demonstrated a higher apparent digestibility coefficient than that containing groundnut flour, which may be due to the fact that isolates are free from fiber and other unavailable carbohydrates present in

TABLE V

THE RELATIONSHIP OF FECAL WEIGHT AND MEAN FECAL NITROGEN ON SIX SUBJECTS GIVEN NUTRIBUN C AND NUTRIBUN W

Diet Supplement		Subjects I[1]	II	III	IV	V	VI	Mean Average
Supplement A (Nutribun C)	Fecal Weight[2]	664	475	664	1067	474	640	664
	Fecal Nitrogen	1.533	0.725	1.170	1.796	1.203	1.224	1.238
Supplement B (Nutribun W)	Fecal Weight	327	513	534	572	187	210	390
	Fecal Nitrogen	0.882	0.893	1.189	0.822	0.784	0.591	0.847

[1]Data are expressed in grams.

[2]Data are taken from six-day pooled composite.

flour (27). Coconut isolate, heat coagulated, has a digestibility coefficient of 94 while coconut flour has one of 87 (5,27). Refined white flour is reported to have a digestibility coefficient of 91 (2). The presence of indigestible material in food also hastens its passage in the gut and affects the absorption of nutrients.

If the net nitrogen retention values (Table IV) are compared with the quantities of nitrogen intake from the two supplements to the diet, it appears that the quantity retained is proportionate to the quantity absorbed. The urinary excretion of five subjects averaged slightly, but not significantly, less when they were given Nutribun C than when given Nutribun W diet. Subjects II and IV, who were on the lower level diet, had less nitrogen loss in the urine. It appeared, also, that the subjects showed consistent response in their nitrogen excretion during the two diet variations. Subject VI who had the highest urinary nitrogen excretion (6.157 grams of nitrogen) when receiving Nutribun W also had the highest loss (5.975 grams of nitrogen) with Nutribun C. Subjects II and IV who had the least in urinary nitrogen excretion (4.978 and 5.164) when given Nutribun W had followed the same pattern on Nutribun C, with urinary nitrogen excretion of 4.908 and 4.605 grams of nitrogen respectively. Subject VI who had the largest urinary nitrogen loss had the least fecal nitrogen excretion on both supplements. Creatinine values were relatively constant from day to day with the four subjects. Two subjects showed slight variations on some days which may be an indication of an overlapping urine collection. An incomplete urine collection was noted by Subject VI on Day 12.

There has been a slight difference in nitrogen retention of the six subjects when coconut flour was used at an 11 percent level to replace a proportionate amount of wheat flour and dry skim milk powder in the original Nutribun formulation; however, this difference was not statistically significant.

All subjects, except for one, were in positive nitrogen balance during the two supplemented diets in the study. It would appear, therefore, that adding high protein food of plant origin to a cereal based food mixture may effectively supplement its nutritive value. Coconut protein, in replacing a proportionate fraction of wheat flour and dry skimmed milk powder, did not adversely affect the acceptability and the protein quality of the Nutribun.

SUMMARY AND CONCLUSIONS

Six young women served as subjects in a nitrogen balance study to determine the utilization of coconut flour protein when used to replace a proportionate amount of wheat flour protein and dry skimmed milk powder in the Nutribun formulation. All subjects were given an isonitrogenous diet containing approximately 0.725 grams of protein/kilogram of body weight throughout all study periods.

After a six-day adjustment period, half of the subjects in each weight group were placed on the wheat Nutribun supplement and the other half were placed on the coconut Nutribun supplement. This first experimental period was carried out for six days. Then, the subjects were placed again on the adjustment diet for four days. During the second experimental period of six days, the diet supplements were reversed for the two groups.

Food composite, the two types of Nutribuns, urine, and feces were analyzed for nitrogen content. Creatinine analysis was carried out daily for each subject.

The following results and conclusions were made from this study:

1. Subjects showed a gradual adaptation to the low protein diet during the adjustment period, and five were in positive nitrogen balance after six days. One subject came into positive balance after eight days. The sub-

ject who required the shortest time to attain positive balance retained the most nitrogen, and the subject who required the longest time retained the least.

2. Subjects appeared to follow the same pattern in response to urinary nitrogen excretion when they consumed both sources of protein. The subjects who had the highest and the lowest nitrogen excretion when given the coconut Nutribun supplement also had followed the same pattern when they consumed the wheat Nutribun supplement.
3. Fecal nitrogen excretion was found to be 10 to 23 percent of the dietary nitrogen intake. Fecal weight was observed to be directly proportional to fecal nitrogen. The fecal nitrogen excretion of subjects when given coconut Nutribun supplement was significantly higher than when they were given the wheat Nutribun.
4. The nitrogen content of wheat Nutribun and coconut Nutribun, by analysis, was approximately the same and was close to the calculated values.
5. No significant difference was found between the mean nitrogen retention of subjects when given the two supplements.
6. The use of coconut flour protein to replace a proportionate fraction of wheat flour and powdered skim milk protein did not adversely affect the acceptability and the protein utilization of the Nutribun when consumed by young women on a low protein, high fruit and vegetable diet.

7. Additional studies are needed to determine the utilization and the supplementary value of coconut flour protein when used with other protein sources in the diet.

LITERATURE CITED

1. Lewis, R. 1971 Prospects for meeting protein needs from conventional food sources. Proceedings, Western Hemisphere Nutrition Congress III, Chicago, Illinois. p. 33.
2. International Action to Avert Impending Protein Crisis. 1968 United Nations Publication. New York. p. 54.
3. Bjarnason, J. and K. Carpenter 1970 Mechanism of heat damage in protein. Brit. J. Nutrition, 24: 313.
4. Hansen, I., H. Schendel, J. Wilkins and J. Breck 1960 Nitrogen metabolism of children with kwashiorkor receiving milk and vegetable diets. Pediatrics, 25: 258.
5. Abdon, I. 1969 Coconut as a source of protein. Phil. J. Nutrition, 22: 103.
6. Altschul, A. 1961 Present status of oilseeds. Meeting Protein Needs of Infants and Children. Washington, D. C., National Academy of Science, Publication 843, National Research Council. p. 517.
7. Kim, J. and D. DeRenter 1968 Bread from non-wheat flours. Food Tech., 22: 867.
8. Shaw, R. 1966 Incarparina, low cost protein rich food. Nutrition Document R. 10/add 92. WHO/FAO/UNICEF P. A. G. Meeting, Geneva. p. 2.
9. Miranda, C., J. Gonzales, M. Santos and L. Dumadang 1968 A

biological evaluation of coconut flour. Phil. J. Nutrition, 21: 59.

10. Concepcion, I. and I. Cruz 1961 Amino acid composition of some Philippine plant foods. Phil. J. Sci., 90: 497.

11. Johns, C., A. Finks and M. Paul 1919 Studies in Nutrition - the nutritive value of coconut globulin and coconut presscake. J. Biol. Chem., 37: 497.

12. Krisnamurthy, K. 1958 Nutritive value of coconut meal and low cost protein food containing coconut and peanut meals and Bengal gram. Food Sci. (Mysore), 7: 363.

13. Mitchell, H. and V. Villegas 1923 The nutritive value of proteins of coconut meal, soybeans, rice bran, and corn. J. Dairy Sci., 6: 222.

14. Smuts, D. and V. Malan 1938 Plant proteins, XI - the biological value of lucerne leaf meal, sesame meal, peanut meal, copra meal, cottonseed meal and oatmeal. Onderstepoort J. V. Sci., 10:207.

15. Mitchell, H., T. Hamilton and J. Beadles 1945 The importance of commercial processing for protein value of food products. J. Nutrition, 29: 13.

16. Schmidt, J. and H. Vogel 1932 Feeding trials with milk cows on palm kernels and coconut cakes and mixtures of these. Biedermaumns. Zeuts. B. Lierernshr., 3: 520. (Abstracted in CA Vol. 26: 41107, 1932).

17. Alfalla, A. 1938 A study of fresh coconut meat as a feed for growing and fattening pigs. The Philippine Agriculturist, 26: 680.

18. Crawford, M. 1940 Coconut poonac as food for livestock.

Tropical Agriculture (Ceylon), 94: 168.

19. Bhatia, B. and M. Swaminathan 1963 Indian Multipurpose Food. Recent Advances in Food Science, 3: 105.

20. Takar, A., M. Narayana Rao, M. Swaminathan and V. Subrahmanyan 1959 The effect of supplementary food containing coconut meal, groundnut and Bengal gram flour on the metabolism of nitrogen, calcium and phosphorous in children subsisting on a poor rice diet. Ann. Biochem. and Exptl. Med., 19: 152.

21. Melo, T. 1969 Purification, isolation and characterization of protein from coconut meat. M.S. thesis. University of the Philippines, College of Agriculture. p. 8. (Unpublished).

22. Miranda, C., J. Gonzales, I. del Rosario and M. Santos 1969 Studies on the utilization of various levels of coconut flour by the albino rats. Phil. J. Nutrition, 22: 156.

23. Concepcion, I., J. Gonzales and C. Intengan 1958 Preliminary studies on the quality of coconut proteins. Nutr. News, 11: 6.

24. Hegstead, D., V. Kent, A. Tsongas and I. Stare 1947 A comparison of the nutritive value of proteins in a mixed diet for rats, dogs, and humans. Jour. Lab. Clin. Med., 32: 403.

25. Subrahmanyan, V., T. Doraiswamy, R. Bhagaran and M. Swaminathan 1959 Supplementary value of a protein food in a blend of coconut meal, groundnut flour and chickpea flour on the diet of children. Ann. Biochem. and Exptl. Med., 19: 147.

26. Snyderman, S. and L. Holt 1961 Evaluation of protein in premature infants. Meeting Protein Needs of Infants and Children. Washington, D. C., National Academy of Science, Publication 843,

National Research Council. p. 331.

27. Payumo, E., P. Briones and E. Banzon 1971 The use of coconut protein isolate for all vegetable snack items. Phil. J. Nutrition, 24: 65.

28. Rajasekharan, N. 1967 The use of coconut protein preparation as a protein supplement in child feeding. Jour. Food Sci. and Tech., 4: 2.

29. Pirie, N. 1963 Non-conventional protein sources. Recent Advances in Food Science, 3: 87.

30. Evans, R. and H. Butts 1949 Inactivation of amino acids by autoclaving. Science, 109: 569.

31. Arnold, T. 1965 A comparison of the utilization of beef and turkey meat proteins in the human body. M.S. thesis. Virginia Polytechnic Institute, College of Home Economics. p. 64. (Unpublished)

32. Spence, N. 1971 The Excretion of Nitrogen in Sweat by Pre-adolescent Girls Consuming Low Protein Diets. M.S. thesis. Virginia Polytechnic Institute and State University, College of Home Economics. p. 33.

33. Technical Industrial System Manual 1970 Technicon Auto Analyzer. Terry Town, N. Y. p. 1.

34. Karanbelkar, P., V. Patwardhan and A. Sreenivaran 1950 Studies in protein metabolism. Further observations on the influence of dietary protein on urinary nitrogen excretion. Indian J. Med. Research, 38: 241.

35. Phansalkar, S. and V. Patwardhan 1955 Maintenance requirements of protein in young Indian adults. Annual Report, Nutrition

Research Laboratories, Coonoor, India. p. 10.

36. Kies, C., E. Williams and H. Metz Fox 1965 Effect of "non-specific" nitrogen intake on adequacy of cereal proteins for nitrogen retention in human adults. J. Nutrition, 86: 357.

37. Leverton, R. and D. Steel 1962 Nitrogen balances of young women fed FAO reference pattern of amino acids and the oat pattern. J. Nutrition, 78: 10.

APPENDIX A

Nutribun Formulation[1]

Ingredients:	NUTRIBUN W Weight:	NUTRIBUN C Weight:
Flour, all purpose	70 lbs.	61 lbs., 10 oz.
Water	39 lbs., 15 oz.	42 lbs.
Yeast	48 oz.	48 oz.
Salt	1 lb.	1 lb.
Liquid Shortening	3 lbs., 8 oz.	2 lbs., 12 oz.
Milk Powder, non-fat	9 lbs., 13 oz.	8 lbs., 6 oz.
Coconut Flour	0	10 lbs., 8 oz.

Mix (conventional mechanical mixer): 20 to 30 minutes.

First fermentation: 35 minutes.

Punch.

Second fermentation: 15 to 20 minutes.

Scaling weight: 175

Final proof: 35 to 40 minutes.

Bake: 15 to 20 minutes at 385° F.

Average baked weight per bun: 150 grams.

Average yield: 308 Nutribuns.

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[1]Received from Nutrition Office, U. S. AID, Manila, the Philippines, November, 1971.

APPENDIX B

Subjects' Data Sheet

Subjects Name	Exptl. Study Number	Age (years)	Height (centimeters)	Initial[1] Weight (kilograms)	Final[2] Weight (kilograms)
Sharon Moore	I	21	170	60.3	60.6
Janet Childress	II	19	155	50.3	50.0
Kathy Shear	III	20	165	59.6	59.1
Bobbie Peterson	IV	21	158	50.0	49.5
June Stevens	V	21	161	58.2	58.3
Frances Somervell	VI	20	170	56.2	56.0

[1]Weight at beginning of study.

[2]Mean weight of subjects at end of study.

APPENDIX C

Menus for Basal Diet

DAY I:

	Upper Level[4] (wt. in gms.)	Lower Level[5] (wt. in gms.)
Breakfast:		
Grape Juice	125	104
Jam	20	17
Margarine[1]	14	12
Sugar	6	5
Tea or Coffee		
Lunch:		
Clam Chowder Soup	123	102
Asparagus Spears	100	83
Canned Beets	85	17
Margarine	14	12
Sherbet	97	81
Beverage		
Dinner:		
Cream of Mushroom Soup	123	102
Cooked Cabbage	50	42
Margarine	7	6
Rice	70	58
Grapes	70	58
*Strawberry Torte[2]		
Beverage[3]		

*Individual Servings.

[1]Margarine was weighed for the entire day and was served at all meals.

[2]Strawberry Torte was made from special recipe (31).

[3]Choice of Kool ade, coffee, or tea with the two latter not exceeding two cups per cay.

[4]Given to 60 kilogram weight group.

[5]Given to 50 kilogram weight group.

APPENDIX C (Continued)

Menus for Basal Diet

DAY II:

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Frozen Orange Juice	100	83
Margarine	14	12
Jelly	20	17
Sugar	17	15
Coffee or Tea		
Lunch:		
Applesauce	123	102
Shredded Cabbage	50	42
Thousand Island Dressing	15	12
Canned Peaches	123	102
Margarine	14	12
Whipping Cream	15	12
Beverage		
Dinner:		
Cream of Chicken Soup	133	111
Chopped Lettuce	50	42
French Dressing	15	12
Radish	10	8
Margarine	7	6
Rice	70	58
Fruit Cocktail	128	107
Beverage		

APPENDIX C (Continued)

Menus for Basal Diet

DAY III:

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Pineapple Juice	124	103
Lemon Juice	10	8
Jelly	20	17
Margarine	14	12
Sugar	17	15
Tea or Coffee		
Lunch:		
Pork and Beans	60	50
Pear	80	67
Carrots	45	37
Chocolate Cornstarch Pudding[1]	140	117
Beverage		
Dinner:		
Cauliflower	72	60
Bologna	26	22
Rice	70	58
Margarine	14	12
Fruit Cocktail	128	107
Beverage		

[1]Chocolate cornstarch pudding was made from special recipe (31).

APPENDIX C (Continued)

Menus for Basal Diet

DAY IV:

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Frozen Strawberries	71	59
Margarine	14	12
Jam	20	17
Sugar	22	9
Coffee or Tea		
Lunch:		
Baked Apples	100	83
Salami	14	12
Lettuce	30	25
Snap Beans, canned	42	35
French Dressing	15	13
Margarine	12	11
Jam	20	17
Beverage		
Dinner:		
Beef Vegetable Soup	112	93
Summer Squash	105	87
Margarine	14	12
Tomatoes, raw	100	83
Rice	70	58
Pineapple Tapioca[1]	100	83
Beverage		

[1]Pineapple Tapioca was made from special recipe (31).

APPENDIX C (Continued)

Menus for Basal Diet

DAY V:

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Apple Juice	200	167
Margarine	14	12
Jam	20	17
Sugar	14	12
Coffee or Tea		
Lunch:		
Beef Noodle Soup	100	83
Green Snap Beans	63	53
Lettuce	50	42
Margarine	14	12
Plums in Syrup	126	105
French Dressing	15	13
Whipping Cream	30	23
Beverages		
Dinner:		
Chicken Gumbo Soup	135	114
Peaches, canned	90	75
Raisins	14	12
Rice	70	58
Sweet Pepper	24	21
Radish	40	34
Ice Cream	33	28
Margarine	7	6
Beverage		

APPENDIX C (Continued)

Menus for Basal Diet

DAY VI:

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Tangerine Juice	125	104
Jam	20	17
Margarine	14	12
Sugar	18	15
Coffee or Tea		
Lunch:		
Broccoli, cooked	104	84
Margarine	14	12
Chopped Lettuce	50	42
Apple	75	57
Pears	128	106
Jelly	20	17
Cranberry Juice	125	104
Dinner:		
Vegetarian Soup	100	83
Asparagus Spears, canned	60	50
Margarine	14	12
Canned Beets	43	35
Rice	70	58
Tapioca Pudding	100	83
Beverage		

APPENDIX C (Continued)

Modified Basal Menu I

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Grape Juice	125	104
Jam	20	17
Margarine	14	12
Sugar	6.	5
Tea or Coffee		
Lunch:		
Clam Chowder	63	52
Asparagus Spears	100	83
Canned Beets	85	71
Margarine	14	12
Sherbet	97	81
Beverage		
Dinner:		
Cream of Mushroom Soup	123	102
Cooked Cabbage	50	42
Margarine	7	6
Rice	70	58
Blueberries	70	58
*Strawberry Torte		
Beverage		

*Made from special recipe (31).

APPENDIX C (Continued)

Modified Basal Menu IV

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Frozen Strawberries	71	59
Margarine	14	12
Jam	20	17
Sugar	22	19
Coffee or Tea		
Lunch:		
Baked Apples	100	83
Bologna	22	18
Lettuce	30	25
Snap Beans, canned	42	35
French Dressing	15	13
Margarine	12	11
Jam	20	17
Beverage		
Dinner:		
Beef Vegetable Soup	112	93
Summer Squash, boiled	105	87
Margarine	14	12
Tomatoes, raw	100	83
Rice	70	58
*Pineapple Tapioca	100	83
Beverage		

*Made from special recipe (31).

APPENDIX C (Continued)

Modified Basal Menu VI

	Upper Level (wt. in gms.)	Lower Level (wt. in gms.)
Breakfast:		
Tangerine Juice	125	104
Jam	20	17
Margarine	14	12
Sugar	18	15
Coffee or Tea		
Lunch:		
Broccoli, cooked	104	84
Margarine	14	12
Chopped Lettuce	50	42
Apple	75	57
Pears in Syrup	128	106
Jelly	20	17
Cranberry Juice	125	104
Dinner:		
Vegetarian Soup	100	83
Broccoli, boiled	30	25
Margarine	14	12
Canned Beets	43	35
Rice	70	58
*Tapioca Pudding	100	83
Beverage		

*Made from special recipe (31).

APPENDIX D

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day I	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit.[1] B_1 mg.	Vit.[2] B_2 mg.	Nia. mg.	Vit.[3] C mg.
Jam	20	55	---	---	14.00	4.0	0.2	---	---	0.01	---	---
Margarine	35	250	---	30.00	---	8.0	---	1,175	---	---	---	---
Sugar	6	22	---	---	6.00	---	---	---	---	---	---	---
Grape Juice	125	82	0.50	0.50	21.00	14.0	0.4	---	0.10	0.05	0.50	---
Asparagus	100	16	1.66	---	3.50	21.0	0.6	800	0.16	0.20	1.40	26.0
Beets	85	28	1.00	---	6.00	12.0	0.4	15	0.02	0.03	0.30	5.0
Clam Chowder	123	115	2.00	4.00	6.00	46.0	0.5	25	0.01	0.01	0.50	---
Cream of Mushroom	123	69	1.00	5.00	5.00	21.0	0.3	36	0.01	0.06	0.40	---
Cabbage	50	7	0.70	---	1.00	21.0	0.3	73	0.03	0.02	0.30	13.0
Rice	70	77	1.30	---	17.00	7.0	0.6	---	0.08	0.01	0.70	---
Grapes	76	32	0.50	---	7.00	7.0	0.2	50	0.02	0.01	0.10	1.0
Strawberry Torte		174	0.48	13.40	45.00	17.6	0.48	570	0.02	0.04	0.16	32.8
Sherbet	97	130	1.00	1.00	29.50	15.0	---	60	0.01	0.03	0---	2.0
Total (U.L.)*		1057	10.14	53.90	161.00	193.6	3.98	2,804	0.46	0.47	4.36	79.8
Total (L.L.)**		880.79	8.44	44.91	134.20	161.33	3.31	2,336	0.38	0.39	3.63	66.5

*Basal for upper level diet.

**Basal for lower level diet.

[1] B_1 - thiamine.

[2] B_2 - riboflavin.

[3] C - ascorbic acid.

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day II	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Orange Juice	100	48	0.8	---	12	10	0.1	220	0.10	0.01	0.40	55
Margarine	35	250	---	30	---	---	---	---	---	---	---	---
Jelly	20	56	---	---	14	4	0.3	---	---	0.01	---	---
Sugar	11	40	---	---	11	---	---	---	---	---	---	---
Applesauce	123	111	0.5	---	29	5	---	48	0.02	0.01	---	1
Cabbage	50	7	0.7	---	1	21	0.3	73	0.03	0.02	0.30	13
Thousand Island Dressing	15	75	---	8	3	2	0.1	47	---	---	---	---
Canned Peaches	123	64	0.5	---	17	7	0.7	928	0.02	0.02	0.30	1
Whipping Cream	15	45	---	5	1	13	---	190	---	0.02	---	---
Cream of Chicken	96	70	3.7	4	6	70	0.2	249	0.02	0.10	0.30	1
Lettuce	50	10	1.0	---	2	34	0.7	950	0.03	0.04	0.20	9
French Dressing	15	---	---	---	---	2	0.1	---	---	---	---	---
Radish	10	1	---	---	---	3	0.1	---	---	---	---	3
Rice	70	77	1.30	---	17	7	0.6	---	0.08	0.01	0.70	---
Fruit Cocktail	128	98	0.50	---	25	12	0.5	180	0.02	0.01	0.60	3
Total (U.L.)*		952	9.00	47	138	190	3.7	2,885	0.32	0.25	2.80	86
Total (L.L.)**		793.3	7.50	39.16	114.9	158.3	3.08	2,404	0.26	0.20	2.33	71.6

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day III	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Pineapple Juice	124	67	---	---	17.0	18.0	0.30	60	0.06	0.02	0.20	11.0
Lemon Juice	10	11	0.20	0.09	---	3.0	0.10	8	0.01	---	0.03	23.0
Jelly	20	55	---	---	14.0	4.0	0.20	---	---	0.01	---	----
Margarine	28	200	---	24.00	---	6.0	---	940	---	---	---	---
Sugar	17	64	---	---	16.0	---	---	---	---	---	---	---
Cauliflower	72	14	1.80	---	3.5	13.0	1.00	32	0.07	0.05	0.33	25.0
Bologna Sausage	26	80	3.00	7.00	---	2.0	0.50	---	0.04	0.06	0.70	---
Rice	70	77	1.30	---	17.0	7.0	0.60	---	0.08	0.01	0.70	---
Fruit Cocktail	128	98	0.50	---	25.0	12.0	0.50	180	0.02	0.01	0.60	3.0
Pork and Beans	60	34	1.60	1.60	---	12.0	0.45	130	0.02	0.01	0.20	0.5
Pears	80	61	0.25	---	16.0	4.0	0.20	---	0.01	0.02	0.10	1.0
Carrots	45	14	0.35	---	3.0	15.0	0.30	4,723	0.02	0.02	0.20	3.0
Chocolate Pudding	140	166	0.23	5.80	28.2	3.6	0.28	---	---	---	0.06	---
Total (U.L.)*		941	9.23	38.49	139.7	99.6	4.43	6,073	0.33	0.21	3.12	66.5
Total (L.L.)**		784	7.69	32.07	116.41	82.99	3.69	5,061	0.27	0.17	2.59	55.41

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day IV	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Frozen Strawberries	71	78	0.25	---	20.0	10	0.5	23	0.01	0.04	0.4	38
Margarine	40	286	---	34	---	9	---	1,343	---	---	---	---
Jam	40	112	---	---	28.0	8	0.6	---	---	0.02	---	2
Sugar	22	80	---	---	---	---	---	---	---	---	---	---
Baked Apples	100	47	0.30	---	12.0	5	0.3	33	0.03	0.01	0.1	2
Salami	14	45	2.50	4	---	2	0.3	---	0.03	0.03	0.6	---
Lettuce	30	6	0.60	---	1.0	20	0.4	570	0.02	0.02	0.1	5
Snap Beans	42	10	0.70	---	2.0	21	0.3	228	0.03	0.04	0.2	5
French Dressing	15	---	---	---	---	2	0.1	---	---	---	---	---
Beef Vegetable Soup	112	36	2.30	1	---	5	0.3	1,237	0.03	0.04	0.9	---
Summer Squash	105	15	1.00	---	4.0	26	0.4	410	0.05	0.08	0.8	11
Tomatoes	100	20	---	---	5.0	12	0.4	820	0.05	0.03	0.6	21
Rice	70	77	1.30	---	17.0	7	0.6	---	0.08	0.01	0.7	---
Pineapple Tapioca Pudding	100	71	0.10	---	18.3	15	0.4	16	0.02	---	---	3
Total (U.L.)*		883	9.05	39	107.3	142	4.60	4,680	0.35	0.32	4.4	87
Total (L.L.)**		735.8	7.54	32.49	89.41	118.32	3.83	3,899	0.29	0.26	3.6	72.5

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day V	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Apple Juice	200	98	0.20	---	22	12	1.2	---	0.02	0.04	0.20	2
Margarine	42	300	---	36.0	---	9	---	1,410	---	---	---	---
Jam	20	56	---	---	14	4	0.3	---	---	0.01	---	---
Sugar	11	40	---	---	11	---	---	---	---	---	---	---
Beef Noodle Soup	100	28	1.60	1.0	3	3	0.4	20	0.02	0.03	0.40	---
Green Snap Beans	63	15	1.00	---	4	32	0.4	343	0.05	0.06	0.30	8
Lettuce	50	10	1.00	---	2	34	0.7	950	0.03	0.04	0.20	9
Plums	126	100	0.50	---	17	---	0.7	928	0.02	0.02	0.30	1
French Dressing	15	---	---	---	---	2	0.1	---	---	---	---	---
Whipping Cream	30	90	---	10.0	2	26	---	380	---	0.04	---	---
Chicken Gumbo Soup	135	34	1.60	0.5	4	10	0.2	100	0.02	0.03	0.75	3
Peaches	90	28	0.50	---	6	30	0.6	9,447	0.05	0.04	0.40	6
Raisins	14	40	---	---	11	9	0.5	---	0.02	0.01	0.10	---
Rice	70	77	1.33	---	17	7	0.6	---	0.08	0.01	0.70	---
Sweet Pepper	24	5	0.33	---	1	2	0.1	103	0.02	0.02	0.10	31
Radish	40	5	---	---	1	12	0.4	---	0.01	0.01	0.10	10
Ice Cream	33	64	1.33	3.0	7	50	---	146	0.01	0.06	0.07	---
Total (U.L.)*		990	9.39	50.5	122	242	6.2	13,827	0.35	0.42	3.62	70
Total (L.L.)**		824.9	8.82	42.1	101.7	201.6	5.2	11,522	0.29	0.34	3.01	58.3

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Day VI	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Tangerine Juice	125	62	0.50	0.5	15.0	22	0.25	525	0.07	0.02	0.10	27
Jam	20	55	---	---	14.0	4	0.20	---	0.01	---	---	---
Margarine	42	300	---	36.0	---	9	---	1,410	---	---	---	---
Sugar	17	64	---	---	16.0	---	---	---	---	---	---	---
Broccoli	104	26	3.33	0.6	4.6	90	0.80	2,586	0.09	0.20	0.80	90
Lettuce	50	10	1.00	---	2.0	34	0.70	950	0.03	0.04	0.20	9
Apple	75	35	---	---	9.0	4	0.20	25	0.02	0.01	0.05	1
Pears	128	97	0.50	0.5	25.0	6	0.20	7	0.01	0.01	0.15	2
Jelly	20	55	---	---	14.0	---	---	---	---	---	---	---
Cranberry Juice	125	82	---	---	21.0	7	0.40	---	0.01	0.01	0.05	20
Vegetable Soup	100	32	0.90	0.8	5.4	8	0.40	1,200	0.02	0.02	0.40	---
Asparagus	60	10	1.00	---	2.0	13	0.40	540	0.10	0.11	0.80	16
Beets	43	14	0.50	---	3.0	6	0.20	7	0.01	0.01	0.15	2
Rice	70	77	1.33	---	17.0	7	0.60	---	0.08	0.01	0.70	---
Tapioca Pudding	100	71	0.10	---	18.0	15	0.40	16	0.02	---	---	3
Total (U.L.)*		990	9.16	38.4	166.0	225	4.75	7,266	0.47	0.44	3.40	170
Total (L.L.)**		825.8	7.63	32.0	138.3	181.5	3.96	6,055	0.39	0.37	2.83	141

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Modified Day I	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Jam	20	55	---	---	14.00	4.0	0.20	---	---	0.01	---	---
Margarine	35	250	---	30.00	---	8.0	---	1,175	---	---	---	---
Sugar	6	22	---	---	6.00	---	---	---	---	---	---	---
Grape Juice	125	82	0.50	0.50	21.00	14.0	0.40	---	0.10	0.05	0.50	---
Asparagus	100	16	1.66	---	3.50	21.0	0.60	800	0.16	0.20	1.40	26.0
Beets	85	28	1.00	---	6.00	12.0	0.40	15	0.02	0.03	0.30	5.0
Clam Chowder	63	34	1.04	3.00	3.00	24.0	0.26	13	0.01	0.02	0.13	---
Cream of Mushroom	123	69	1.00	5.00	5.00	21.0	0.30	36	0.01	0.06	0.40	---
Cabbage	50	7	0.70	---	1.00	21.0	0.30	73	0.03	0.02	0.30	13.0
Rice	70	77	1.30	---	17.00	7.0	0.60	---	0.08	0.01	0.70	---
Blueberries	70	42	0.50	0.50	1.00	10.0	0.70	70	0.02	0.04	0.30	10.0
Strawberry Torte		174	0.48	13.40	45.00	17.6	0.48	570	0.02	0.04	0.16	32.8
Sherbet	97	130	1.00	1.0	29.50	15.0	---	60	0.01	0.03	---	2.0
Modified Total (U.L.)*		986	9.18	53.40	152.00	174.6	4.24	2,812	0.46	0.51	4.19	89.7
Modified Total (L.L.)**		822	7.64	44.49	126.60	144.9	3.54	2,343	0.38	0.42	3.49	74.7

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Modified Day IV	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Frozen Strawberries	71	78	0.25	---	20.0	10	0.50	23	0.01	0.04	0.40	38
Margarine	40	286	---	34	---	9	---	1,343	---	---	---	---
Jam	40	112	---	---	28.0	8	0.60	---	---	0.02	---	2
Sugar	22	80	---	---	---	---	---	---	---	---	---	---
Baked Apples	100	47	0.30	---	12.0	5	0.30	33	0.03	0.01	0.10	2
Bologna	22	63	2.37	6	---	2	0.39	---	0.03	0.04	0.55	---
Lettuce	30	6	0.60	---	1.0	20	0.40	570	0.02	0.02	0.10	5
Snap Beans	42	10	0.70	---	2.0	21	0.30	228	0.03	0.04	0.20	5
French Dressing	15	---	---	---	---	2	0.10	---	---	---	---	---
Beef Vegetable Soup	112	36	2.30	1	---	5	0.30	1,237	0.03	0.04	0.90	---
Summer Squash	105	15	1.00	---	4.0	26	0.40	410	0.05	0.08	0.80	11
Tomatoes	100	20	---	---	5.0	12	0.40	820	0.05	0.03	0.60	21
Rice	70	77	1.30	---	17.0	7	0.60	---	0.08	0.01	0.70	---
Pineapple Tapioca Pudding	100	71	0.10	---	18.3	15	0.40	16	0.02	---	---	3
Modified Total (U.L.)*		901	8.92	41	107.3	142.0	4.69	4,680	0.35	0.33	4.35	87
Modified Total (L.L.)**		751	7.43	34	89.4	118.3	3.90	3,899	0.29	0.27	3.62	72

APPENDIX D (Continued)

CALCULATED NUTRIENT CONTENT OF BASAL DIET

Modified Day VI	Wt. gms.	Cal.	Prot. gms.	Fat gms.	CHO gms.	Ca. mg.	Fe. mg.	Vit. A I.U.	Vit. B_1 mg.	Vit. B_2 mg.	Nia. mg.	Vit. C mg.
Tangerine Juice	125	62	0.50	0.50	15.0	22	0.25	525	0.07	0.02	0.10	27
Jam	20	55	---	---	14.0	4	0.20	---	0.01	---	---	---
Margarine	42	300	---	36.00	---	9	---	1,410	---	---	---	---
Sugar	17	64	---	---	16.0	---	---	---	---	---	---	---
Broccoli	104	26	3.33	0.60	4.6	90	0.80	2,586	0.09	0.20	0.80	90
Lettuce	50	10	1.00	---	2.0	34	0.70	950	0.03	0.04	0.20	9
Apple	75	35	---	---	9.0	4	0.20	25	0.02	0.01	0.05	1
Jelly	20	55	---	---	14.0	---	---	---	---	---	---	---
Pears	128	97	0.50	0.50	25.0	6	0.20	7	0.01	0.01	0.15	2
Cranberry Juice	125	82	---	---	21.0	7	0.40	---	0.01	0.01	0.05	20
Vegetable Soup	100	32	0.90	0.80	5.4	8	0.40	1,200	0.02	0.02	0.40	---
Broccoli	30	8	1.00	0.20	1.6	13	0.24	776	0.03	0.06	0.24	29
Beets	43	14	0.50	---	3.0	6	0.20	7	0.01	0.01	0.15	2
Rice	70	77	1.33	---	17.0	7	0.60	---	0.08	0.01	0.70	---
Tapioca Pudding	100	71	.10	---	18.0	15	0.40	16	0.02	---	---	3
Modified Total (U.L.)*		988	9.16	38.60	165.6	244	4.59	7,502	0.40	0.39	2.84	183
Modified Total (L.L.)**		823	7.63	32.16	137.4	203	3.82	6,251	0.33	0.32	2.36	152

APPENDIX E

NUTRIENT CONTENT OF BASAL DIET PLUS NUTRIBUNS

Day			Cal.	Prot.	Fat	CHO	Ca.	Fe.	Vit. A	Vit.[1] B_1	Vit.[2] B_2	Nia.	Vit.[3] C
				gms.	gms.	gms.	mg.	mg.	I.U.	mg.	mg.	mg.	mg.
I	Basal		1057.0	9.28	53.50	160.50	172.00	3.98	2,804	0.46	0.47	4.36	79.80
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		*H.L.	2109.0	44.91	66.48	316.70	583.00	10.73	2,812	1.57	1.74	13.21	81.80
		**L.L.	1757.4	37.42	55.40	263.91	485.81	8.94	2,343	1.31	1.45	11.01	68.16
II	Basal		977.0	9.00	47.00	138.00	190.00	3.00	2,884	0.32	0.25	2.08	86.00
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		H.L.	2029.0	44.63	59.98	294.20	601.00	9.75	2,892	1.43	1.52	10.93	88.00
		L.L.	1690.0	37.19	49.98	244.99	500.81	8.32	2,410	1.19	1.27	9.11	73.33
III	Basal		941.0	9.23	38.40	139.70	99.60	4.43	6,073	0.33	0.25	3.12	66.50
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		H.L.	1993.0	44.86	51.38	295.90	510.60	11.18	6,081	1.44	1.52	11.97	68.50
		L.L.	1660.0	37.38	42.81	246.57	424.98	9.32	5,067	0.92	1.27	9.97	55.83
IV	Basal		883.0	9.05	39.00	107.30	142.00	4.60	4,680	0.35	0.32	4.40	87.00
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		H.L.	1935.0	44.68	51.98	263.50	553.00	11.35	4,688	1.46	1.59	13.25	89.00
		L.L.	1612.4	37.23	43.31	219.57	460.81	9.46	3,907	1.22	1.32	11.04	74.16
V	Basal		990.0	9.35	50.50	122.00	242.00	6.20	13,681	0.35	0.42	3.62	70.00
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		H.L.	2042.0	44.98	63.48	278.20	653.00	12.95	13,689	1.46	1.69	12.47	72.00
		L.L.	1701.6	37.48	52.90	231.82	544.14	10.79	11,407	1.22	1.41	10.39	60.00
VI	Basal		991.0	9.16	38.40	166.00	225.00	3.95	6,054	0.32	0.30	2.35	117.00
	Bun		1052.0	35.63	12.98	156.20	411.00	6.75	8	1.11	1.27	8.85	2.00
		H.L.	2043.0	44.79	51.38	322.20	636.00	10.70	6,062	1.43	1.57	11.20	119.00
		L.L.	1702.4	37.32	42.81	268.49	529.98	8.92	5,051	1.19	1.31	9.33	99.00

* High Level Diet
** Low Level Diet

[1] B_1 - thiamine.
[2] B_2 - riboflavin.
[3] C - ascorbic acid.

APPENDIX F

DAILY CALORIE INTAKE OF SUBJECTS[1]

Days in Study	Subjects I	II	III	IV	V	VI
1	34	34	34	34	34	34
2	34	34	34	34	34	34
3	33	33	33	37	33	33
4	33	33	33	37	33	33
5	34	34	34	38	34	34
6	34	34	34	38	34	34
7	33	33	36	38	33	33
8	34	34	36	38	34	35
9	33	33	35	38	33	35
10	33	33	35	38	33	35
11	34	34	35	38	34	35
12	34	34	35	38	34	36
13	33	33	33	33	33	33
14	34	34	34	34	34	34
15	33	33	35	37	33	35
16	33	33	35	37	33	35
17	33	33	35	37	35	35
18	34	34	35	38	35	37
19	33	35	35	38	35	37
20	33	33	35	38	35	37
21	34	34	34	38	35	37
22	34	34	34	38	35	37

[1]Data are expressed in kilocalories/kilogram of body weight.

APPENDIX G

NUTRIBUN - FOOD COMPOSITION (Per Bun)

Commodity -	Grams -	Calories -	Protein (mg)	Calcium (mg)	Iron (mg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Vitamin A I.U.	Ascorbic Acid (mg)
Flour	100	364	11.6	16	2.90	0.44	0.26	3.5	0	0
Milk	14	51	5.0	183	0.08	0.05	(0.25)	0.1	4	1
Oil	5	44	-	-	-	-	-	-	-	-
Sugar	12	46	-	-	-	-	-	-	-	-
Yeast	2	6	(0.7)*	(0.9)	(0.3)	(0.05)	(0.11)	(0.7)	Tr	Tr
Totals	133	511	17.3	199.9	3.28	0.54	0.62	4.3	4	1

* - Numbers in parenthesis denote values imputed - from another form of the food or from a similar food.

I.U. - International Unit.

Tr - Trace.

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WHEAT AND COCONUT FLOUR PROTEIN UTILIZATION

BY SIX YOUNG COLLEGE WOMEN

by

Candelaria S. Formacion

(ABSTRACT)

A balance study was carried out to determine the utilization of coconut flour protein when used to replace a proportionate amount of wheat flour and dry skimmed milk protein in the formulation of a special milk bread called the Nutribun. This bread is used in the Philippines to supplement the protein-deficient diet of children.

Six young women were placed on a low protein, high fruit and vegetable diet supplemented with two types of Nutribun. One type used wheat flour and the other type contained coconut flour at an 11 percent level in its formulation.

Each subject acted as her own control to compare specific response to each Nutribun supplement. Both diets were isonitrogenous. Nitrogen determinations were made on the Nutribuns, the food composite, the feces, and the urine. Daily urinary creatinine analysis was also carried out.

Observations were made on the nitrogen retention of the subjects given the two diet supplements during the study. No significant difference was found on the mean nitrogen retention of subjects fed the

two diets.

The use of coconut flour at 11 percent level in the Nutribun formulation did not adversely affect the acceptability or the protein utilization of the product as supplied in this experimental diet.