THE NUTRITIVE VALUE AND COST DISTRIBUTION OF FOOD OF ARMY STUDENTS

by

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INTRODUCTION

Ancient methods of feeding troops were crude. Often raiding armies were expected to live upon the country. Or certain rations might be issued with the idea that individual soldiers would manage to find supplements. However, during recent years, the rapid development of knowledge of nutrition has stimulated interest and careful thought on the part of those responsible for Army food.

Studies have been made of the food habits of organized groups of college men, but little information is to be found in the literature concerning the food served to groups of Army students, as now trained on college campuses. The purpose of the present study was to determine, for a period of two weeks, the nutritive value and cost of food purchased for and consumed by the Army students at Kansas State College of Agriculture and Applied Science.

REVIEW OF LITERATURE

In 1901, investigators had an understanding of the nutrition of the day, and of the ways in which they could study the diets of people in institutions. Atwater (1901) stated that the problem of properly feeding the Army had received attention for many years, and it may be said that an attempt was made to do this in accordance with the best known principles of nutrition.

It is of interest to note, however, that the pioneer work in dietary studies in institutions was done in 1886 by Atwater

(1901). This work included investigations of food consumed by 39 college feeding units for men students. The food waste was analyzed and results were subtracted from the amount of food purchased. Average calories per man per day were found to be 3,420. The author concluded that dietary studies are valuable because "they have to do with the physiological, pecuniary, and humanitarian aspects of living."

Later, many other investigations of food for men of college age were made. Mallinckrodt (1905), at Harvard University, made a dietary study as it seemed probable that some of the students were working and living on rations below the accepted standards. He found the available energy to be 2,720 calories, while the standards at that time gave 2,700. Protein furnished 88 g per man per day, seven per cent less than accepted standards.

Hawley (1929) collected data concerning food habits of college students, including 260 institutions or groups. As compared with standards of that time, the average of the diets yielded slightly more energy, one third more protein, and somewhat more calcium, phosphorus, and iron than were actually needed. Her conclusions were that, on the whole, meat, fish, eggs, fatty foods and sweets were used in ample quantities for a well-balanced diet, but milk, cream, cheese, fruits and vegetables played too small a part in the diet.

In a study made by Fowler (1933), the food consumed by a group of college men living in a fraternity house, was found to supply 2,915 calories, 82.8 g protein, 0.65 g calcium, 1.28 g phosphorus, and .007 g iron. When compared with accepted stand-

ards, the diet was found to be slightly higher in energy value, 20 g higher in protein, adequate in calcium and phosphorus, but low in iron. As evaluated at that time, the diet was apparently adequate in vitamins A, B, and G but was questionable for vitamin C.

Similar studies were made by Trump (1930), Shirley (1932), and Brown (1942) whose findings are valuable for comparison.

The food situation among American soldiers in previous wars has been ably described by Murlin (1920). From the nutritional standpoint, in every war, the Army has been subjected to some form of privation. In the Revolutionary War there was not enough food to go around. In the War of 1812, the food that the Army was able to secure, was not fresh enough, or of enough variety to promote good health. Scurvy was common among the soldiers. During the Mexican War the Army was able to live mainly upon the country in which it was stationed. A large supply of fresh fruit helped to prevent scurvy at this time. But sanitary care of foods and camps was poor, and as a result, there was much dysentery. At the beginning of the Civil War, there was much scurvy and sickness resulting from poor food. For the first time the Medical Department of the Army was given some of the responsibility for the proper feeding of troops. Surgeon John Letterman, one of the greatest sanitarians the Army has ever had, immediately made plans to improve the deficiencies of the ration according to the best knowledge of the day. During the Spanish-American War of 1898, the need of adequate inspection of foods, not only as purchased, but also as used by the cook, aroused interest. To

avoid a repetition of conditions as in the Spanish-American War, General Gorgas organized the Division of Food and Nutrition in July 1918. The purpose of this organization was to make frequent inspections of food conditions in the camps and in the field, to improve the preparation and serving of the food, and to study the suitability of the ration. After December, 1918, the Division became a section of the Division of Sanitation, for convenience in administration.

After studying the diets of the soldiers during World War I the following points were outstanding: (1) For the first time the average food requirement of the soldier in training was calculated, (2) the average daily consumption was studied so that an average ration could be determined from the information collected, (3) a possible relationship of diet and susceptibility to infection was noted as needing further study.

Also, after studying the diets, the following conclusions were reached: (1) the soldier will eat outside the mess hall, no matter how good the food may be, (2) the food consumption varies in different seasons, (3) the food consumption of the same company would vary from week to week, other factors remaining the same.

According to Murlin (1920), the basal ration of World War I was slow to change. The principal modifications, which are given in Table 1, show that the ration of World War I dated from 1794.

Table 1. Changes made in the basal Army ration from 1794 to 1908.

Date	Ration	Amount	Comment
1794	Bread	18 ounces	
	Beef	20 ounces	
	Whiskey		Used for energy
	Salt		
	Vinegar		
1818	Beans	0.5 pint	Added
1832	Liquors		Eliminated
	Coffee		Substituted
	Sugar		Substituted
1861	Beans		Added
	Potatoes		Added
1864	Pepper		Added
1898	Tomatoes		Added
1901	Prunes		Added
1908	Jam		Added
	Evaporated milk		Added
	Butter		Added
	Lard		Added
	Extracts		Added

Actually, the soldiers of World War I did not consume all of the above ration. They were given free choice of foods in the camps and they consumed in addition quantities of fruit, milk, butter, sugar and coffee.

Murlin's conclusions (1920), about the food served in World War I, were that the men had enough to eat and of such quality that no deficiency disease was reported, and almost without exception, no cases of other disease in any way traceable to food.

When the United States entered the World War in 1917, the importance of food was emphasized in connection with winning the

war. Because so little was known about the food habits of the American people, and it was impossible to make plans for the use of foods without such knowledge, investigations were started to gather information about this subject.

Nutritional surveys were made by Murlin and Hildebrandt (1919) in 67 different camps of World War I. The total individual messes included were 427. Average food consumption was 3,633 calories, giving an average of 24.6 calories per pound of body weight or 52.1 calories per kilogram per day. The average of all the Army messes was between 3,000 and 4,500 calories. Total consumption of nutrients for the average soldier was 122 g protein, 123 g fat and 485 g carbohydrate, 14 per cent of the calories were derived from protein, 31 per cent from fat and 55 per cent from carbohydrate. Average cost was $0.44 per day. Edible waste per man per day was 0.38 pound.

The present military situation has brought the best modern knowledge of nutrition into Army feeding problems. As explained by Berryman and Chatfield (1943), those responsible for feeding soldiers have recognized that the outstanding nutritional problems of today are the subclinical more than the obvious or extreme deficiency states. Workers in military preventive medicine have become aware of the importance of optimal nutrition, and have become vitally interested in an adequate diet for the soldier. More recently Berryman and Howe (1944) have concluded "a short method of calculating the nutritive value of diet", prepared for Army use. They stated that in connection with the nutritional evaluation of food, provided for the soldier, an

opportunity has been given to obtain an indication of military food habits. From the food pattern derived from these quantities of food, the basis for a short method of nutritional evaluation of food as purchased has been formed. This has made prompt evaluation of the nutritive value of Army rations possible everywhere.

Articles like that of McAuley (1944) have presented problems of feeding Army and Navy students but have given few details of nutritive values of the diet.

PROCEDURE

Permission to conduct this study was obtained from Colonel J. K. Campbell, commandant of the Army Specialized Training Command and the Air Forces Technical Training Command, who was responsible for Army students in training at Kansas State College of Agriculture and Applied Science. The Army students received their meals in a mess hall, operated for them alone. At the time the two-week experiment was begun, February 19, 1944, more than 1300 students were fed daily.

The civilian staff (dietitians and a bookkeeper), responsible for the entire food unit, co-operated in every way. The Army officers supervising the dining room were also helpful.

Regular meals of the type used for some months, were served to the students. Food selection and menu planning were responsibilities of the staff dietitians. The number of people served at each meal was recorded for the 14 days. This included dietitians and kitchen employees, who received meals as part of their

compensation and volunteer helpers who served on the counter at meal time and were given their meals. The meal record, therefore, included volunteer helpers, employees, and dietitians because of the impossibility of separating their food intake from that of the Army students.

A physical inventory of all foods on hand was taken at the beginning and again at the close of the period. Quantities were recorded in terms of weight. The amounts of food used during the study were determined by adding the numbers representing the amount of food on hand at the beginning of the period to those for the food purchased and subtracting from this sum the total amount of food on hand at the close of the study. Food prices were obtained from the sales slips of the foods purchased daily. Other prices were obtained from the bookkeeper, who kept a complete inventory of all foods on hand, with the purchase prices. The inventory units included were name, brand, size, weight, amount on hand, amount received, weight used, unit cost, and total cost.

Figures for waste were obtained from several sources. Preparation of food was observed several times daily, to note any waste differing markedly from the average. In a few instances individual weighings were made. On the whole, it seemed satisfactory to use the accepted figures for the waste in vegetables and fresh fruits. Therefore, calculations for the amount of E. P. (edible portion) from A. P. (as purchased) were made, using the percentages as given by Chatfield and Adams (1940).

At every meal careful records were made of food discarded in

the dining rooms. Fortunately, the Army had been working on the problem of table waste. The students had been instructed to refuse any food they did not desire, as they went through the line. Students were allowed second servings of most food, except desserts, provided that they had eaten everything on their first tray. Shortly before this project started, Army regulations provided that edible and inedible waste be separated by the students leaving any food on their trays. For this purpose number 10 cans were placed on a table in the center of each dining hall, with a label on each can. Labels used were (1) meat, (2) vegetables, (3) salads, (4) bread, (5) desserts, (6) liquids. It was the contents of these containers that were weighed at the end of each meal. When meat was served that contained a large amount of fat and bone, the discarded weight was subtracted from the total amount purchased to give the amount calculated as edible.

The dietitians, following Army regulations, were sometimes obliged to discard food. These discards were weighed and recorded. This waste, by careful management, was kept at a minimum.

To determine the percentage of cost and distribution of nutrients, the foods were divided into the following groups, according to the plan of the Army, as given by Howe and associates (1942): (1) meats, fish and poultry, (2) eggs, (3) butter, (4) milk and milk products, (5) other fats, (6) cereals and grain products, (7) beans, other legumes, nuts, (8) sugars and sirups, (9) vegetables, leafy green or yellow, (10) tomatoes, (11) potatoes, (12) citrus fruits, (13) dried fruits, (14) other vegetables, (15) other fruits, (16) miscellaneous.

The item by item method of calculation was used to determine the energy, protein, carbohydrate, fat, calcium, phosphorus and iron content of the food. Tables of Chatfield and Adams (1940) were supplemented with figures from Chaney and Ahlborn (1943) and Taylor (1942) for the first four items. In selecting figures to use for calculating values for meat, it was difficult to know what grades to choose from the tables. "Medium fat" grades seemed most suitable and were selected throughout. However, some of the very considerable amount of pork was quite fat, so that there were drippings in excess of those possible to use in food preparation, and therefore never offered the Army students. As a check on the amount of fat, protein and carbohydrate the students might have been expected to obtain from the meat purchased, the factors of the short-cut method of Berryman and Howe (1944) were applied. Results so obtained were similar to those from the item by item method, as shown in Table 2.

Table 2. Contributions of meat, fish and poultry per man per day.

Method	Protein, g	Fat, g	Carbohydrate, g
Berryman and Howe method	46.5	66.7	1.4
Item by item method	45.4	69.5	0.4

The item by item figures were used for all the tables. Tables as given by Sherman (1941) were used to determine the mineral values, supplemented by those of Chaney and Ahlborn (1943). With accepted and reliable figures at hand, it did not seem advisable to use

the Army short-cut method. However, for the vitamin calculations, the short method as recommended by Berryman and Howe (1944) was used. It was felt that, in view of the mass of new vitamin values, this table was more recently prepared and more acceptable than others available. These authors had given figures for summer and also for winter, the latter being the most suitable for this investigation. Individual calculations for vitamin values for dried fruits and cream were made. The dried fruits used in this study were not in the same proportion as those given in tables by Berryman and Howe (1944). As the regulation Army menu does not include cream, individual calculations for the cream consumed were necessary.

Food values for the carbohydrate, fat, protein, calcium, phosphorus, and iron were calculated on the E. P. basis. Calculations for the vitamin values were made on an A. P. basis as recommended by the Army (Berryman and Howe, 1944).

Data for the food expenditure of each class were summarized for comparison. Percentage distributions are shown in figures and tables. Also included are the average nutrients per capita per day in comparison with accepted standards.

FINDINGS AND DISCUSSION

Sherman (1943) always emphasizing adequate food for the individual called attention to a statement made by Howe. He said that both our Army and our civilian population have the right to be well fed, and we should be able to provide them with adequate dietaries with little variation from accustomed food habits.

Planning the menus is an important responsibility of the dietitian. Not only must she give attention to the usual considerations, but also she must watch variety particularly for it is one of the most significant factors in the diet for maintenance of morale in the Army. From this study, it may safely be said that Army rations can be much better than many household dietaries.

The National Research Council (1943) has stated that the safest way to insure meeting dietary allowances is to include certain foods in the diet daily in specified amounts. In checking the menus for the recommended amounts, it was found that the Army student food compared favorably with household dietaries (Table 3).

The menus during the period provided a liberal supply of fresh fruits and vegetables. Raw vegetables such as lettuce, cabbage, carrots, and tomatoes, in the form of salads, were served daily. Relishes, such as celery and olives, were offered for variety. Olives are sometimes considered expensive in the diet, but those planning the menus felt justified in using these foods to tempt the appetite. Ice cream, ordered in different flavors, seemed to be the most popular dessert, being used six times during the period. Due to the amount of labor involved, pie was served only three times.

Ration points were more liberal for the students than for the civilians at that time. However, chicken and turkey, which

Table 3. Servings of recommended foods per man per day.

Food	Diet plans (1943) National Research Council	Average servings this study
Milk	1 pint	1.6 pints
Egg	1, if possible	1.2
Meat, fish, fowl	1 or more servings	1 serving of meat, fish, poultry 1 serving of meat dishes (stews, meat loaf)
Potato	1 or more servings	1 serving
Vegetables	2 or more servings, 1 green or yellow	1 raw vegetable 1.5 other cooked vegetables (These included 1.4 servings yellow or green vegetable.)
All fruits	2 or more 1 citrus or tomato or other good source of ascorbic acid	1.5 servings citrus fruits or tomatoes 1 serving other fruit
Cereals and bread	Whole grain or enriched	Most breakfast cereals used were whole grain products. Bread made with enriched flour.

M E N U S

Saturday, Feb. 19

Breakfast

Grapefruit
Dry Cereals
Milk
Eggs (poached)
Toast
Butter
Honey
Coffee

Lunch

Roast Beef
Brown Gravy
Mashed Potatoes
Succotash
Sliced Tomatoes
Bread
Butter
Cottage Pudding
Butterscotch Sauce
Milk - ½ pt.

Dinner

Cold Cuts
Mustard
Baked Potatoes
Pickles and Celery
Bread
Butter
Ice Box Pudding
Cocoa

Sunday, Feb. 20

Breakfast

Tomato Juice
Dry Cereals
Milk
Canadian Bacon
Fried Eggs
Toast
Butter
Jelly
Coffee

Lunch

Roast Turkey - Dressing
Mashed Potatoes
Gravy
Buttered Lima Beans (frozen)
Pineapple and Cheese Salad
Rolls
Butter
Strawberry Ice Cream
Hard Candies
Milk - ½ pt.

Dinner

Cold Cuts
Fried Potatoes
Lettuce Salad w/ French Dressing
Bread
Butter
Canned Apricots
Ginger Cookies (1)
Hot Tea

Monday, Feb. 21

Breakfast

Oranges
Grapenut Wheat Meal
Milk
Scrambled Eggs
Toast
Butter
Grape Jam
Coffee

Lunch

Beef Stew w/ Vegetables
Buttered Broccoli
Macaroni Salad
Bread, Rye
Butter
Raisin Pudding
Milk - ½ pt.

Dinner

Swiss Steak
Parsley Buttered Potatoes
Broccoli
Sliced Tomatoes
Bread
Butter
Peach Nut Jello
Coffee

Tuesday, Feb. 22

Breakfast

Winesap Apples
Dry Cereals
Milk
Bacon
Bread
Butter
Doughnuts
Coffee

Lunch

Tomato Rice Soup
Crackers
Wieners
Mustard
Tossed Salad
Buns
Butter
Vanilla Ice Cream
Hershey Bars
Milk - ½ pt.

Dinner

Baked Ham w/ Raisin Sauce
Creamed Potatoes
String Beans
Olives and Celery
Bread
Butter
Cherry Cobbler
Coffee

Wednesday, Feb. 23

Breakfast

Grapefruit
Dry Cereals
Milk
Poached Eggs
Toast
Butter
Pineapple Preserves
Coffee

Lunch

Braised Spiced Ham
Baked Beans
Head Lettuce - 1000 Island Dressing
Bread, Raisin
Butter
Ice Box Pudding
Milk - ½ pt.

Dinner

Barbecued Short Ribs of Beef
Mashed Potatoes
Sauerkraut
Waldorf Salad
Bread
Butter
Mince Pie
Coffee

Thursday, Feb. 24

Breakfast

Grapefruit Juice
Oatmeal
Milk
Link Sausage
Cinnamon Rolls
Bread
Butter
Coffee

Lunch

Tamale Pie
Buttered Peas
Sliced Orange Salad
Bread
Butter
Pecan Nut Ice Cream
Milk - ½ pt.

Dinner

Roast Beef
Browned Potatoes
Gravy
Buttered Cabbage
Sliced Tomatoes
Bread
Butter
Baked Rice Pudding
Coffee

Friday, Feb. 25

Breakfast

Stewed Prunes
Dry Cereals
Milk
Soft Boiled Eggs
Toast
Butter
Honey
Coffee

Lunch

Meat Loaf
Creamed Carrots
Cabbage and Peanut Salad
Bread
Butter
Dutch Apple Cake
Milk - ½ pt.

Dinner

Club Steaks
Gravy
Mashed Potatoes
Buttered Spinach
Celery and Radishes
Bread
Butter
Chocolate Pie
Coffee

Saturday, Feb. 26

Breakfast

Oranges
Farina
Milk
Bacon
Fruit Rolls
Bread
Butter
Coffee

Lunch

Pork Chops
Gravy
Steamed Potatoes
Escalloped Tomatoes
Carrot and Raisin Salad
Bread
Butter
Cocoanut Cake
Milk - ½ pt.

Dinner

Roast Beef
Baked Potatoes
Head Lettuce w/ Dressing
Bread
Butter
Sugar Cookies
Cocoa

Sunday, Feb. 27

Breakfast

Grapefruit
Dry Cereals
Milk
Sausage Patties
Hot Cakes
Syrup
Butter
Coffee

Lunch

Stewed Chicken w/ Noodles
Mashed Potatoes
Cauliflower w/ Cheese
Molded Fruit Salad
Hot Rolls
Butter
Chocolate Ice Cream
Milk - ½ pt.

Dinner

Potato Soup - Crackers
Toasted Cheese Sandwiches
String Beans
Pickles and Celery
Baked Apples
Coffee

Monday, Feb. 28

Breakfast

Tomato Juice
Oatmeal
Milk
Fried Eggs
Bread
Butter
Doughnuts
Coffee

Lunch

Hamburgers - mustard
Whole Grain Corn
Sliced Tomatoes
Buns
Butter
Prune Cake
Milk - ½ pt.

Dinner

Roast Beef
Steamed Potatoes
Gravy
Sauerkraut
Pineapple and Cheese Salad
Bread
Butter
Butterscotch Pudding
Coffee

Tuesday, Feb. 29

Breakfast

Oranges
Dry Cereals
Milk
Bacon
Toast
Butter
Apple Butter
Coffee

Lunch

Chili Con Carne
Crackers
Creamed Asparagus
Pickled Beets
Bread
Butter
Fresh Pears
Ginger Cookies
Milk - ½ pt.

Dinner

Pork Chops
Mashed Potatoes
Gravy
Fried Apples
Head Lettuce w/ 1000 Island Dressing
Bread
Butter
Steamed Chocolate Pudding w/ Vanilla Sauce
Coffee

Wednesday, March 1

Breakfast

Grapefruit
G. D. M. Cereal
Milk
Link Sausage
Cinnamon Rolls
Bread
Butter
Coffee

Lunch

Braised Liver
Spaghetti w/ Tomato Sauce
Celery and Carrot Strips
Hot Rolls
Butter
Marmalade
Brown Bread Ice Cream
Milk - ½ pt.

Dinner

Roast Beef
Glaced Sweet Potatoes
Buttered Cabbage
Tossed Salad
Bread
Butter
Washington Cream Pie
Coffee

Thursday, March 2

Breakfast

Stewed Prunes
Dry Cereals
Milk
Soft Cooked Eggs
Toast
Butter
Pineapple Jam
Coffee

Lunch

Vegetable Soup - Crackers
Cold Cuts
Mustard
Buttered String Beans
Bread
Butter
Apricot Upside Down Cake
Milk - ½ pt.

Dinner

Breaded Veal Chops
Parsley Potatoes
Buttered Spinach
Grapefruit and Orange Salad
Bread
Butter
Bread Pudding w/ Custard Sauce
Coffee

Friday, March 3

Breakfast

Oranges
Cream of Wheat
Milk
Bacon
Fruit Rolls
Bread
Butter
Coffee

Lunch

Chop Suey
Steamed Rice
Cabbage and Carrot Salad
Bread
Butter
Cherry Ice Cream
Milk - ½ pt.

Dinner

Roast Lamb
Browned Potatoes
Gravy
Buttered Broccoli
Head Lettuce w/ Dressing
Bread
Butter
Apple Pie
Coffee

Saturday, March 4

Breakfast

Bananas
Dry Cereals
Milk
Poached Eggs
Toast
Butter
Marmalade
Coffee

Lunch

Club Steaks
Mashed Potatoes
Glaced Carrots
Lettuce and Tomato Salad
French Dressing
Bread
Butter
Cake w/ Youngberries
(frozen)
Milk - ½ pt.

Dinner

Breaded Pork Chops
Sweet Potatoes
Mixed Vegetable Salad
Bread
Butter
Apples
Peanut Butter Cookies
Cocoa

were ration free, were used twice to supplement the meats that required ration points. The high points allocated to cheese, discouraged its use on the menu. Also, butter was a rationed item but students were allowed one pat (cut 60 to one pound) per meal. Canned fruits and vegetables required ration points, thus making it necessary to use more fresh fruits and vegetables.

Commanding officers were strict in efforts to control food waste. The policy was to give students an abundance of food, but the food was to be eaten, not wasted. Edible waste for this study averaged 0.06 pound per person per day. This good record was due to careful planning and ordering by the dietitian, to the willingness of the entire group to eat food served to them, to the use of left-overs allowed by Army regulations, and to the attitude of the commanding officers. For instance, census reports sent by officers in charge, to the Mess Hall for the week-end period were a great aid in reducing waste by helping to prevent overproduction.

Army regulations (War Dep't Circ. 1942) stipulate that certain protein foods and salads, such as potato and egg, should never be served as left-overs. Foods containing salad dressing, sauces made with egg or milk, and the like, must be served within four hours after combining ingredients. Sliced cooked meat, ground meat, hash, ground cheese and ground hard-cooked eggs, should be served immediately after preparation. Any foods served as left-overs must be thoroughly cooked.

Dietitians followed those instructions carefully. However, with good cold storage facilities available, left-overs were usually in first-class condition. Therefore left-overs not allowed the Army students were often eaten and enjoyed by the kitchen employees. With this careful management the Army regulations were observed, but food discard was kept at a minimum.

On the average 1,095 Army students were fed each meal, with a maximum of 1,340 and a minimum of 179. This last was due to week-end pass privileges.

Results of this study in terms of average nutrients are shown in Table 4 with amounts reported for the Army and standards suggested by the National Research Council (1943). In this study calcium, phosphorus, iron and riboflavin were found present in amounts at least as high as for the Army. Energy intake of the Army students was by choice lower than reported for the Army, no doubt due to less active life on the campus than in the field. Army rations provided for about 12 per cent of the calories in the form of protein. In this study, 14.2 per cent of the total calories were furnished by protein, 41.9 per cent by carbohydrates and 43.8 per cent by fat. Similarly, vitamin intakes of the Army students were lower than those of the Army ration, but still in satisfactory proportion to the calorie intake. All nutrients, except riboflavin, met the suggested standards of the National Research Council (1943) for intakes of 4,500 calories. The suggested standards for intakes of 3,000 calories, similar to this study, were met with generous margins in most cases as indicated in the table.

Table 4. Nutritive value of the diet compared with accepted standards.

Food nutrient	Unit	National Research Council (1943) Moderately active	National Research Council (1943) Very active	Berryman and Howe Army ration (1942)	This study Per man per day	This study Percentage of 3,000 N. R. C. recommendations
Calories		3,000	4,500	4,200	3,318	111
Protein	g	70	70	128	117.5	168
Fat	g			192	161.8	
Carbohydrate	g			490	347.5	
Calcium	g	0.8	0.8	.98	1.32	165
Phosphorus	g			1.98	2.08	
Iron	g	0.012	0.012	.024	.024	200
Vitamin A	I.U.	5,000	5,000	13,500	11,203	224
Thiamine	mgm	1.8	2.3	3.3	2.76	153
Riboflavin	mgm	2.7	3.3	2.6	3.14	116
Nicotinic acid	mgm	18.0	23.0	29.5	25.7	143
Ascorbic acid	mgm	75.0	75.0	129.0	121.06	161

The daily protein intake, averaging 117.5 g per capita, was well above the standard set by the National Research Council, which allows an average of one gram per kilogram of body weight. Few of the students weighed more than 80 kilograms, which means

that most of them received at least 50 per cent more protein than was considered absolutely necessary. The quality of the protein was good, 70.1 per cent being from animal sources.

The recommended allowances for calcium and phosphorus were more than met, with a margin of 65 per cent calcium and 57 per cent phosphorus. This was due to the large amount of milk consumed, 0.8 quart, along with 1.5 ounces coffee cream per man per day. No Army student refused individual bottles of milk, but a few used the milk as a medium of exchange.

Iron was decidedly high in this dietary--twice the amount recommended by the National Research Council. The large amount of meat used contributed to the high iron intake.

Low vitamin A in the American diet has been feared with present-day food choices and with the rationing of butter. This study showed that the recommended allowance was more than doubled. It is interesting to note, that with the use of liver only once during the 14-day period, meat contributed 17.1 per cent of the total amount of vitamin A. Also, leafy vegetables made a large contribution.

Thiamine is rather widely distributed in natural foods, but few foods are rich sources. Among the most important are pork and whole grain cereals. Pork was used liberally during the study. Whole grain products and enriched flour also furnished thiamine.

Because many foods contain riboflavin there is little danger of shortage in well-balanced diets. Meat and milk insured adequate amounts of riboflavin.

The need for nicotinic acid was more than met with the meat, grain products and potatoes in the diet.

Most of the ascorbic acid of the diet was furnished by vegetables and fruits. Potatoes, leafy vegetables, and citrus fruits were the best sources. Eating raw fruit or a raw vegetable every day insured an adequate intake.

Table 5 shows comparisons of results of this study with findings of Trump (1930), Shirley (1932) and Fowler (1933), who investigated diets of college fraternity groups, of Brown (1942) who studied diets of Army and Navy men prior to the entrance of the United States into the war, and of Berryman and Howe (1943) who worked with more recent Army diets.

The present study shows lower energy intake than found by either Brown or Berryman and Howe, but does compare favorably with results found by the investigations made on college fraternities for men. Protein intake of this study is not as high as Army findings, but, compared with present-day standards, is at least 50 per cent higher than actually needed. Calcium and phosphorus were higher in this study than in any other listed, due to the larger intake of milk. Iron, in all investigations, was high, except one deficiency reported by Fowler (1933).

The raw food cost per man per day for this study was $0.632. At Indiana University (McAuley, 1944) raw food cost averaged $0.52. However, in checking food costs (McAuley, 1944) certain pertinent facts appear. A breakfast of fruit, toast with butter, and cereals with milk cost approximately $0.10. Adding jelly for breakfast raised this $0.02. By adding any breakfast item, such

as bacon or eggs, the cost was raised from $0.02 to $0.05. Prepared breakfast cereals cost approximately $0.016 per serving, while the cooked cereals cost $0.0044. During the period of the present study, jelly and breakfast items were served each morning. Also, more prepared than cooked cereals were consumed. Milk, purchased by the quart, and served in unlimited amounts for breakfast, accounted for 41.7 per cent of the total amount spent for milk. For lunches, when each student was only allowed one half pint, there were 4,152 quarts milk used during the 14-day period. For breakfast, when milk could be used in unlimited amount, 7,495 quarts were consumed.

Data on the distribution of the food dollar from various sources are presented in Table 6. Findings of this study were assembled into the five food groups for ease in comparison with data from the literature. Along with the results from studies of college men, probably comparable with the Army students, are figures for some family groups. The first, Sherman (1941), was extensive and had been so widely quoted that it seemed desirable for reference. His study represents a wide range of American conditions, urban and rural, well distributed over different parts of the country, over a number of years, all seasons, and includes families having different levels of income and expenditure for food.

The next, Steibeling and Phiphard (1939), diets of 26 families of employed wage earners and clerical workers in cities, is of interest because it is thorough and recent.

Table 6 shows that in the present study more than 40 per

Table 5. Nutritive value of the diet compared with results of other studies.

Investigator	Year	Findings				
		Calories	Protein g	Calcium g	Phosphorus g	Iron g
Trump	1930	3415	99.4	0.838	1.70	.020
Shirley	1932	3816	118.5	0.910	1.70	.020
Fowler	1933	2915	82.5	0.650	1.28	.007
Brown	1941	4150	132.0	0.970		.025
Berryman and Howe	1942	4200	128.0	0.980	1.98	.024
This study	1944	3318	117.5	1.320	2.08	.024

cent of the food dollar went for meat, fish, poultry and eggs, distinctly higher than for other groups of college men. Moreover, it is higher than the expenditure of the 244 families. This proportion spent for meat may appear unwise, but at the time (February and March, 1944) meat was selling at relatively high prices, due to war conditions. In making checks of Army and Navy student menu costs at Indiana University (McAuley, 1944), presented in October, 1943, it was found, with prices prevailing at that time, that meat usually constituted well over 50 per cent of the food cost, and in some cases it accounted for 70 per cent of the total cost.

Almost one-fourth of the money went for milk, cream, cheese, and ice cream, which was much the highest item on the list for milk products. This was due to the unlimited use of milk for breakfast, along with frequent serving of ice cream and one-half

Table 6. Comparison of the distribution of expenditures as shown by various investigators.

Study	Year	No. of studies	Meat and eggs	Milk and products	Fruits and vegetables	Cereals	Fats, sweets, misc.
Hawley	1918	192 groups	29.00	15.00	26.00	13.00	18.00
Shirley	1932	7 fraternities - college men	25.81	12.10	28.23	13.00	20.86
Fowler	1933	1 fraternities - college men	28.33	8.22	25.27	11.22	26.96
Sherman		244 families	37.66	10.59	15.86	18.29	17.60
Steibeling and Phiphard	1939	26 families	29.6	12.10	19.90	18.1	20.3
Gillette (Sherman)	1943		20.0-	20.0-	20.0-	20.0-	20.0-
This study	1944	1,095 students	41.9	23.4	16.0	9.7	9.0

pint milk per person at lunch. Also cream was always served with coffee, not customary in Army food service.

This study shows a low percentage spent for fruits and vegetables. Actually, the total sum spent for fruits and vegetables was good because the total food budget was generous. Many fresh fruits and vegetables were used, a necessity because of the rationing of canned fruits and vegetables. Cauliflower, broccoli, fresh tomatoes, and radishes, out of season during this study, were in-

cluded to increase the palatability of the diet. As explained elsewhere there is every reason to believe that sufficient fruits and vegetables were provided in the diet.

Because of the small percentage spent for grains and cereal products, it is obvious that the students did not depend upon these foods for their calories. So many palatable dishes were served, including protective foods, that the Army students did not eat much bread in proportion to other items.

Nine per cent of the food dollar was spent for fats, sweets and miscellaneous items, less than in any previous study. Fat and sugar rationing, no doubt kept expenditures low for this group.

The miscellaneous group included coffee, cocoa, condiments, extracts, gelatin, spices, salt, and pickles. Coffee was served twice daily and accounted for one-half of the cost of the miscellaneous foods.

Comparisons with the practical suggestions of Gillette are worth while. As indicated in Table 6, the expenditure for meat in the present study, seems high and for cereals and miscellaneous foods too low. However, of the studies available for comparison, the present one alone, meets the Gillette recommendation for purchase of milk and milk products.

Individual contributions of the various classes of food in terms of percentage, for both the present study and the study made by Berryman and Howe (1943), are shown in Tables 7 and 8. The two tables show similar percentage distribution of various factors investigated. The Army students of the present study used fewer dry legumes and potatoes, less sugar and less of the "other

Table 7. Percentage of nutritional contribution of various classes of foods based on food consumed by the Army students.

Food group	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic acid	Ascorbic acid
Meats, poultry and fish	24.3	38.7	42.9	.1	2.2	25.8	36.8	17.1[1]	48.9	24.5	54.3	2.3
Eggs	2.9	6.5	4.3	--	2.6	6.4	7.7	5.3	3.0	6.9	.1	--
Milk	18.3	24.8	22.4	11.5	71.5	37.4	7.0	17.2	7.1	42.4	2.7	6.0
Butter	6.8	.1	15.4	--	.4	.2	2.6	9.1	--	.1	.1	--
Other fats	2.4	--	5.5	--	--	--	--	--	--	--	--	--
Grain products	26.1	21.1	7.1	47.6	11.4	17.8	23.5	.1	25.4	16.6	27.2	--
Dry legumes	1.1	2.1	.5	1.9	1.2	2.4	4.0	--	1.9	1.0	1.1	--
Sugars	8.7	.5	1.0[2]	19.7	.8	.1	1.5	--	--	--	--	--
Leafy vegetables	1.3	1.6	.2	2.4	4.1	2.6	5.8	43.1	3.4	2.4	3.1	28.7
Tomatoes	0.5	.6	.1	1.0	.6	1.1	1.5	4.1	1.9	.9	1.1	8.0
Citrus fruits	1.4	1.6	.1	2.9	1.4	.8	1.1	.7	2.7	.7	1.8	28.7
Potatoes	2.6	1.7	.1	5.5	.9	2.6	4.6	.4	3.5	1.7	4.9	10.7
Other vegetables	0.8	.9	.1	1.5	1.9	1.8	1.6	.5	1.3	1.8	1.0	13.6
Other fruits	1.9	.6	.2	4.0	.5	.6	1.1	1.2	.5	.8	1.0	2.0
Dried fruits	0.8	.2	--	1.8	.4	.4	1.2	1.2	.4	.2	1.6	--
Miscellaneous	.1	--	.1	.1	.1	--	--	--	--	--	--	--

[1] Contributed almost entirely by liver.

[2] Contributed by chocolate bars.

Table 8. Percentage of nutritional contribution of various classes of foods based on food prescribed for the U. S. Army (May 1941-April 1942. Field Ration A). (Berryman and Howe, 1943).

Food group	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin A	Thiamine	Riboflavin	Nicotinic acid	Ascorbic acid
Meats, poultry and fish	22.7	43.3	42.1	.3	3.5	30.9	35.0	17.1[1]	48.5	33.4	66.0	2.0
Eggs	2.5	6.7	3.9	.1	3.6	7.0	7.5	4.9	4.2	9.0	.1	--
Milk	9.1	13.2	11.6	5.4	59.9	22.8	4.0	8.0	3.6	29.6	1.4	3.3
Butter	7.3	.2	17.6	--	.7	.3	.3	10.2	--	.2	.2	--
Other fats	7.6	.1	18.4	.1	--	--	--	.1	--	--	.1	--
Grain products	22.9	21.9	5.1	38.8	11.4	17.0	16.2	.1	23.0	7.7	10.0	--
Dry legumes	2.3	4.6	.5	3.4	3.3	6.0	10.3	--	4.4	3.0	2.5	--
Sugars	12.9	.3	--	27.6	1.2	.3	--	--	--	--	--	--
Leafy vegetables	1.6	2.4	.2	2.6	6.4	3.3	6.4	46.9	3.8	3.9	3.9	30.3
Tomatoes	.5	.6	.1	.8	.9	1.2	1.6	4.2	1.6	1.1	1.1	8.8
Citrus fruits	.7	.3	.1	1.3	1.9	.7	1.0	.1	1.4	0.5	1.0	18.2
Potatoes	5.3	4.2	--	10.1	2.1	6.3	7.9	.7	7.0	4.9	10.3	19.8
Other vegetables	1.2	1.3	.2	2.2	3.0	2.5	2.3	.4	1.0	2.4	0.9	10.8
Other fruits	2.5	0.6	.2	5.2	1.3	.9	2.0	5.2	1.0	2.3	1.7	6.8
Dried fruits	1.0	0.3	--	2.1	.8	.8	2.5	2.1	0.5	2.0	0.8	--

[1] Contributed almost entirely by liver.

fruits" with consistently smaller contributions of nutrients. On the other hand, they used more citrus fruits, and about twice as much milk, with correspondingly greater contributions of nutrients.

Figures 1 to 8 show the contribution of each class of food in proportion to the distribution of the food dollar, and to the average daily diet of the student. Some foods are important in the diet because of the large quantities in which they are used. Others give excellent return because of high nutritive content. If a food furnishes a larger share of any nutrient than the share it takes of the money spent, it may be considered a comparatively cheap source of that factor. Any food that furnishes several nutrients cheaply could be considered an economical food.

Dairy products accounted for 23.4 per cent of the money spent and in return furnished more than their share of protein, calcium, phosphorus, and riboflavin. For these nutrients, milk was an important and cheap source. Milk and milk products furnished 71.5 per cent of the total amount of calcium received by the average student. If milk products had been omitted, he would have received only 0.39 g calcium which is about half of the estimated requirement.

The generally accepted idea that meat is a relatively expensive food seemed to hold in this study. However, meat appeared to carry its full share of the load in providing protein, fat, iron, thiamine, and nicotinic acid. The average consumption amounted to 0.7 pound per day.

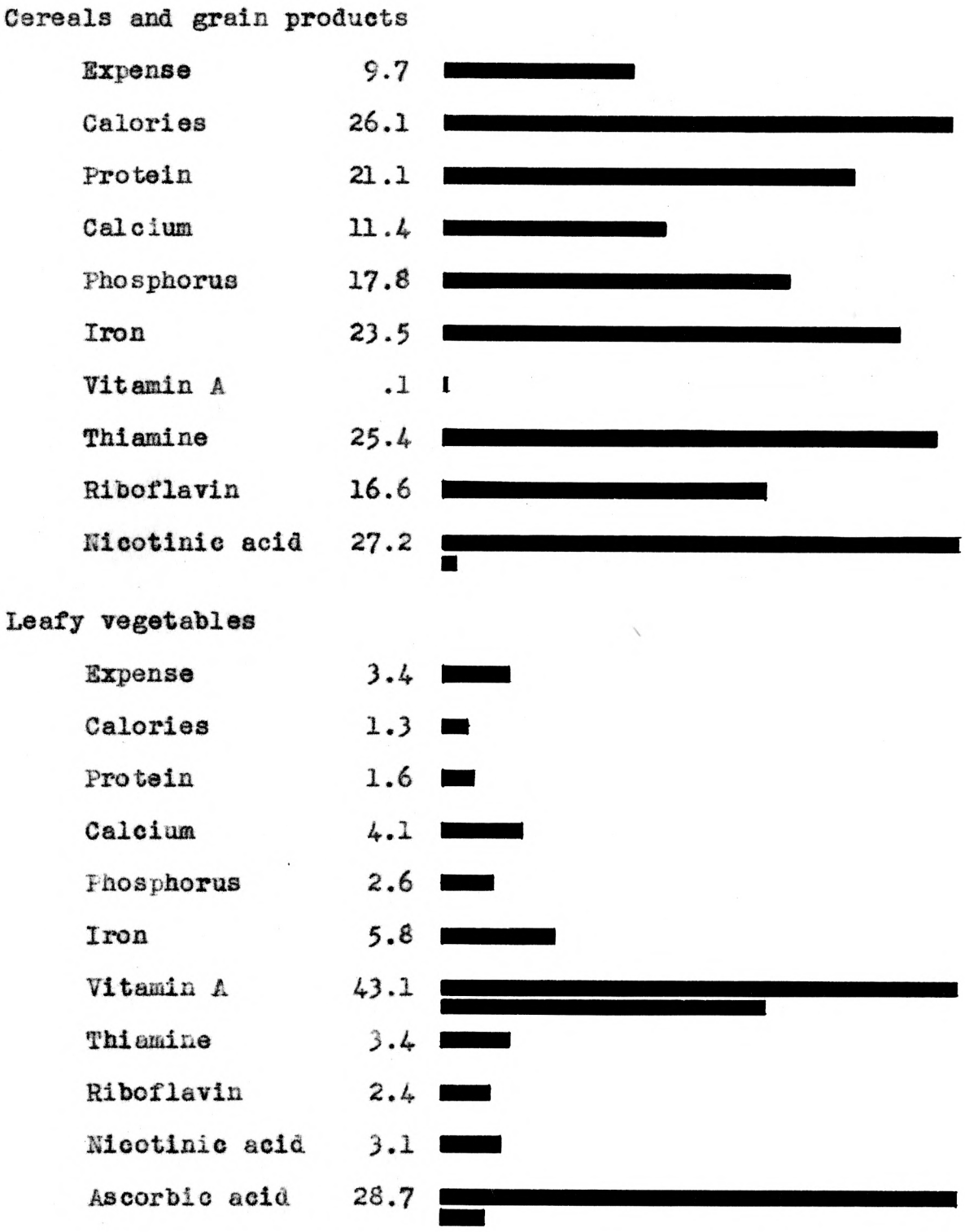


Fig. 1. Percentage of total of specified nutrients contributed to the diet by cereals and leafy vegetables, with percentage of food dollar allocated to each.

Beans and legumes

Expense	.3
Calories	1.1
Protein	2.1
Calcium	1.2
Phosphorus	2.4
Iron	4.0
Thiamine	1.9
Riboflavin	1.0
Nicotinic acid	1.1

Citrus fruits

Expense	3.1
Calories	1.4
Protein	.6
Calcium	1.4
Phosphorus	.8
Iron	1.1
Vitamin A	.7
Thiamine	2.7
Riboflavin	.7
Nicotinic acid	1.8
Ascorbic acid	28.7

Fig. 2. Percentage of total of specified nutrients contributed to the diet by beans and citrus fruits, with percentage of food dollar allocated to each.

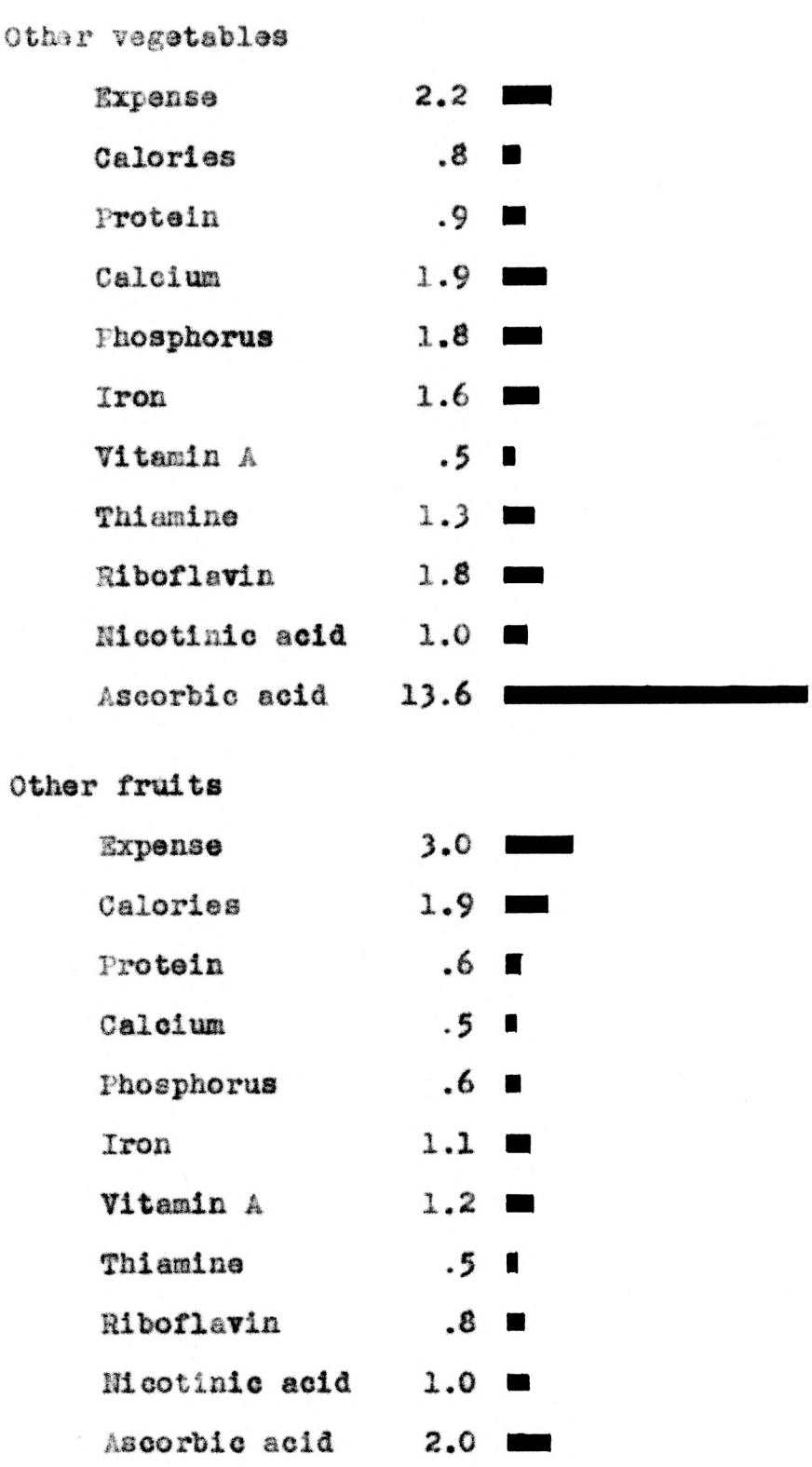
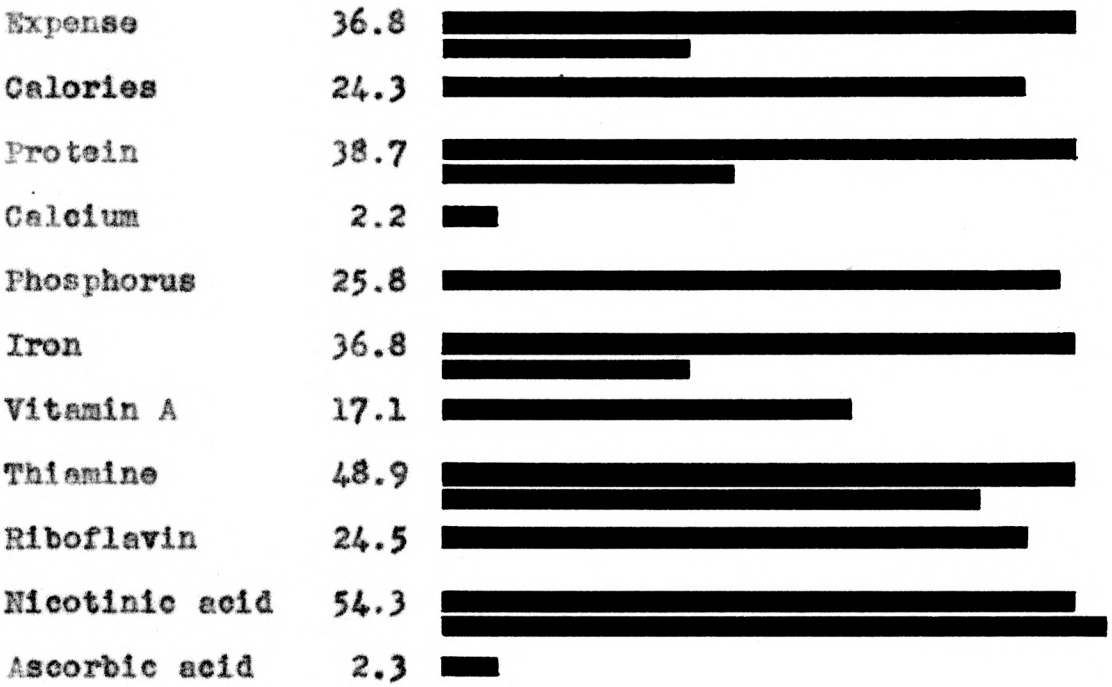


Fig. 3. Percentage of total of specified nutrients contributed to the diet by other vegetables and other fruits, with percentage of food dollar allocated to each.

Meat



Eggs

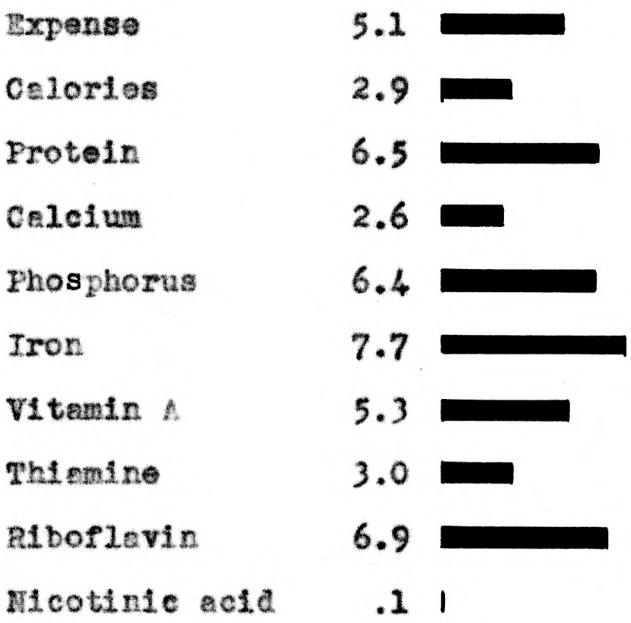


Fig. 4. Percentage of total of specified nutrients contributed to the diet by meat and eggs, with percentage of food dollar allocated to each.

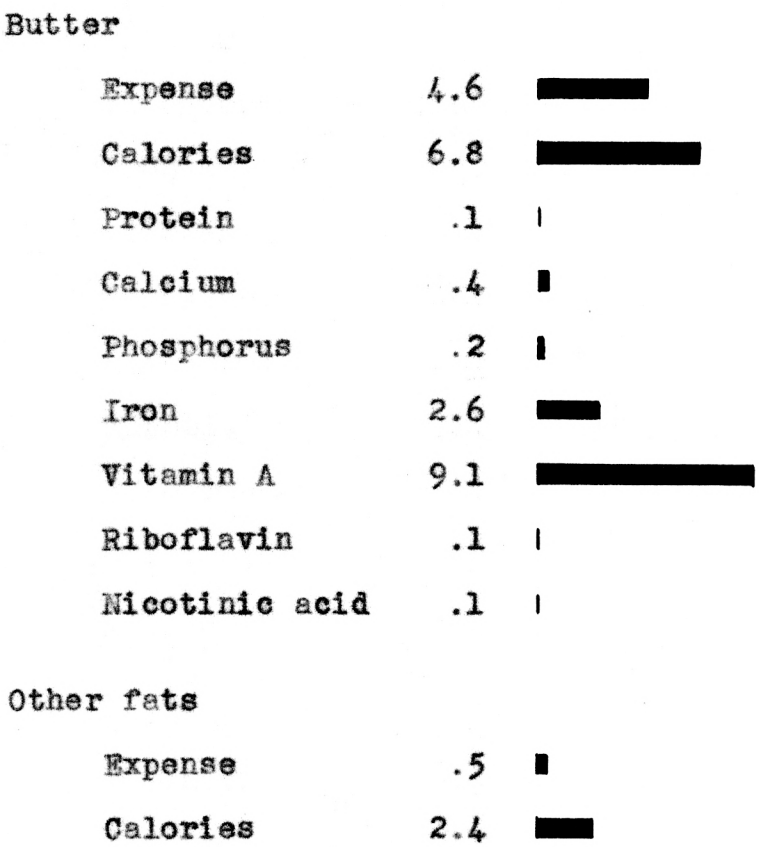


Fig. 5. Percentage of total of specified nutrients contributed to the diet by butter and other fats, with percentage of food dollar allocated to each.

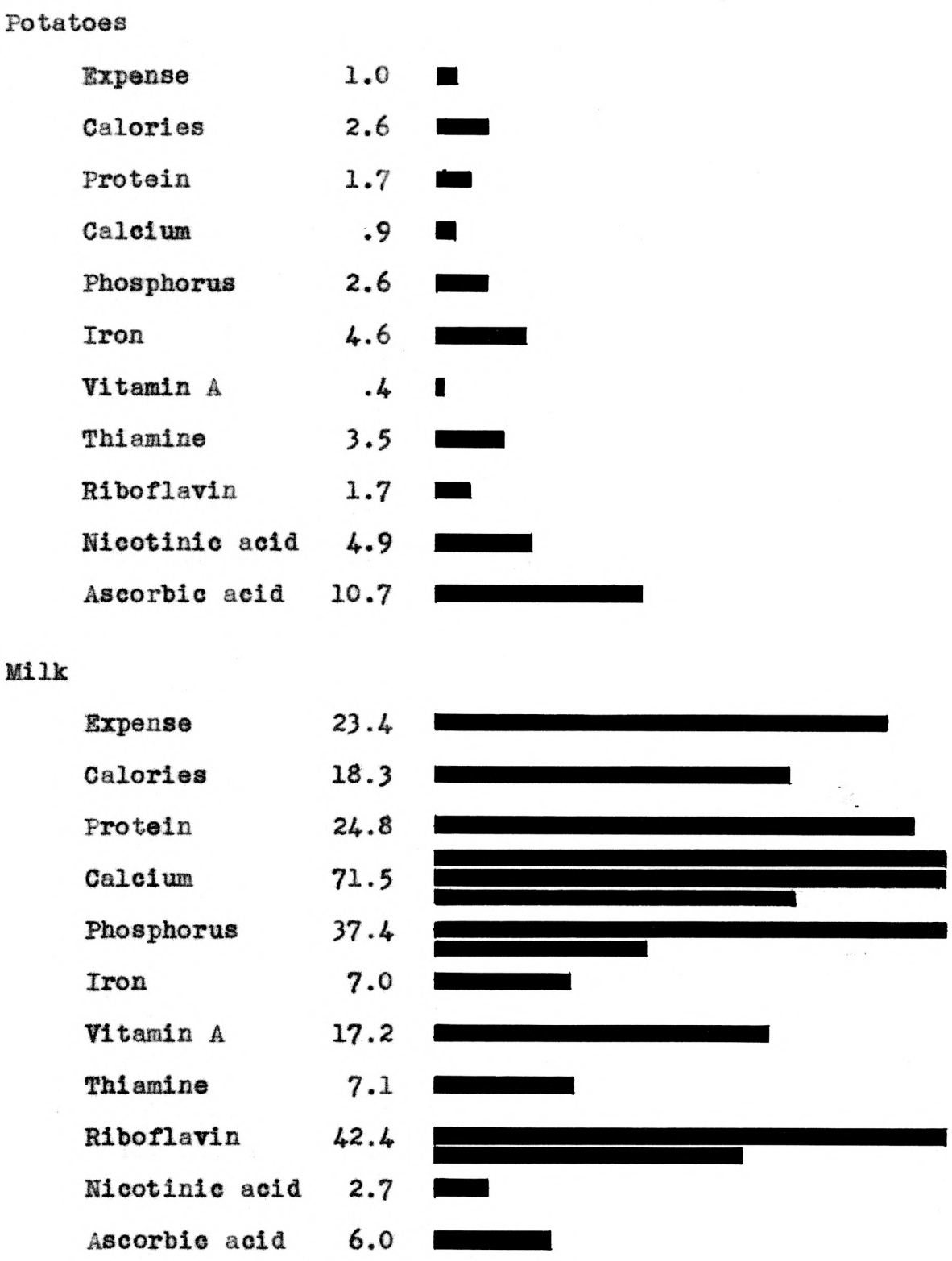


Fig. 6. Percentage of total of specified nutrients contributed to the diet by potatoes and milk, with percentage of food dollar allocated to each.

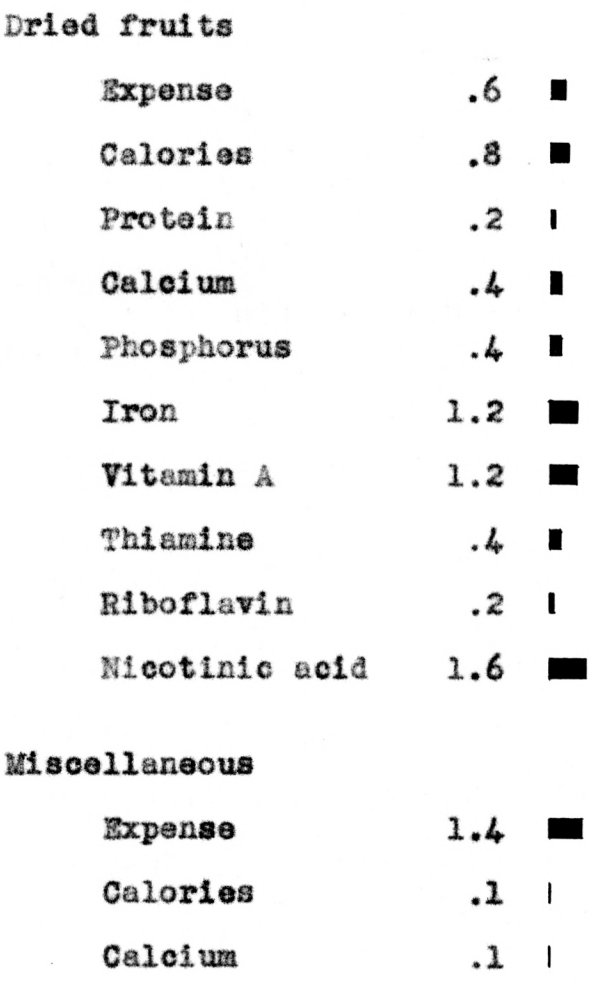


Fig. 7. Percentage of total of specified nutrients contributed to the diet by dried fruits and miscellaneous foods, with percentage of food dollar allocated to each.

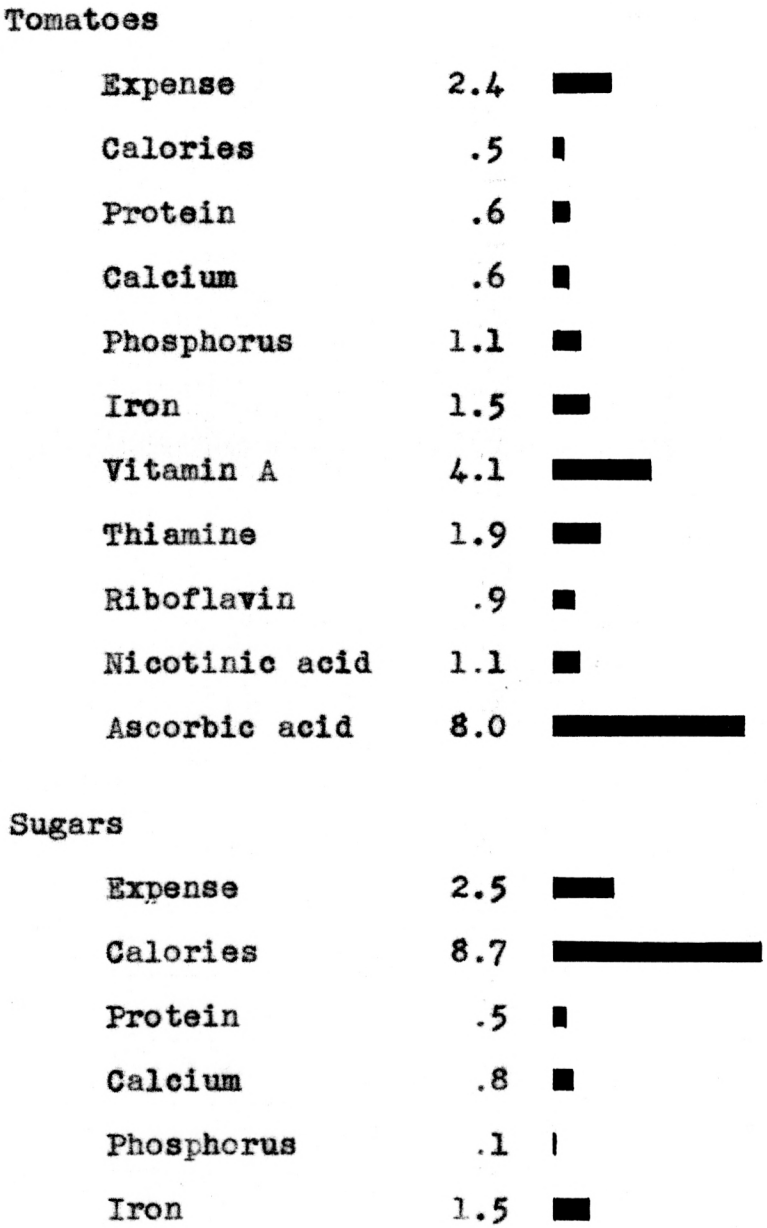


Fig. 8. Percentage of total of specified nutrients contributed to the diet by tomatoes and sugars, with percentage of food dollar allocated to each.

Eggs, contributing small amounts of all the nutrients, furnished more than their share of protein, phosphorus, iron, vitamin A and riboflavin.

Fats and sugars were inexpensive sources of calories and helpful in adding flavor and variety. Except for vitamin A from butter, other contributions were negligible.

Grain products and legumes were cheap sources of calories, protein, phosphorus, iron, thiamine, riboflavin, and nicotinic acid. This is consistent with the customary advice to buy largely of inexpensive legumes and whole grain products for the low cost diet.

As a class, fruits and vegetables were excellent sources of several vitamins. Tomatoes, citrus fruits, and other fruits and vegetables were inexpensive sources of ascorbic acid. Fruits, other than citrus, while not contributing to the nutrients in large amounts, helped the diet, increasing its variety and palatability. Potatoes were important, not only for the ascorbic acid, but also for calories, phosphorus, iron, thiamine, riboflavin, and nicotinic acid. For 3.4 per cent of the expenditure, leafy vegetables provided 41.3 per cent of the vitamin A and 28.7 per cent of the ascorbic acid, contributing more of these factors than any other class of food.

SUMMARY

The food of 1,095 Army students was studied for a two-week period, to determine the nutritive value and cost of food purchased for and consumed by them. The amounts of food used were

obtained by the inventory method. Calculations for waste and food nutrients were made by the usual procedures.

Specified servings of food, as recommended by the National Research Council per man per day, were provided with liberal margins. Edible waste was 0.06 pound per person per day.

The nutrients supplied in the food consumed by the Army students at Kansas State College were:

Calories	3,318		Iron	.024	g
Protein	117.5	g	Vitamin A	11,203	I.U.
Fat	161.7	g	Thiamine	2.76	mgm
Carbohydrate	347.5	g	Riboflavin	3.14	mgm
Calcium	1.32	g	Nicotinic acid	25.70	mgm
Phosphorus	2.08	g	Ascorbic acid	121.06	mgm

On the basis of present accepted nutritive standards for the individual, this dietary supplied all nutrients in sufficient amounts. The suggested standards of the National Research Council for intakes of 3,000 calories, similar to this study, were met, with generous margins in most cases.

The food cost averaged $0.632 per man per day. Following is the percentage distribution of food expenditure, arranged according to Army groupings.

Meats, fish and poultry	36.8	Eggs	5.1
Milk and milk products	23.4	Butter	4.6
Other fats	.5	Grain products	9.7
Legumes and nuts	.3	Sugars and sirups	2.5
Vegetables, leafy green and yellow	3.4	Tomatoes	2.4
White potatoes	1.0	Citrus fruits	3.1
Other fruits	3.0	Other vegetables	2.2
Dried fruits	.6	Miscellaneous	1.4

The nutritive return as judged by the expenditure for the following foods and nutrients was,

Foods	Nutrients
Milk (0.8 quart per man per day)	Protein, calcium, phosphorus, riboflavin.
Meat (0.7 pound per man per day)	Protein, iron, thiamine, nicotinic acid.
Eggs (1.2 eggs per man per day)	Protein, phosphorus, iron, vitamin A, riboflavin.
Fruits, vegetables	Minerals and vitamins, including 50 per cent of the vitamin A, more than 90 per cent of the ascorbic acid.
Grain products, legumes	Economical sources of several nutrients, but not prominent in the diet because the generous budget provided for liberal amounts of other foods.

The specified servings of food and the daily requirements, as recommended by the National Research Council per man per day, were met in more than adequate amounts.

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