NUTRITIVE VALUE OF THE DIETS OF THE INDIVIDUAL MEMBERS OF A NEGRO COOPERATIVE GROUP AT KANSAS STATE COLLEGE OF AGRICULTURE AND APPLIED SCIENCE

by

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B. S., Houston College for Negroes, 1938

A THESIS

submitted in partial fulfillment of the

requirements for the degree of

MASTER OF SCIENCE

Department of Food Economics and Nutrition

Kansas State College
of Agriculture and Applied Science

1939

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INTRODUCTION

The nutritive value of the diets of college students has been studied widely by many workers in various parts of the country. According to the information available nothing has been reported on the food intakes of Negro college women. It therefore seemed advisable to take advantage of an opportunity to study the diets of a cooperative group, consisting of six Negro women, five of whom were attending Kansas State College of Agriculture and Applied Science. The other member was an older person who served as house mother.

The purpose of this study was to determine what each subject ate and to calculate the number of calories, the grams of protein, fat, carbohydrate, calcium, phosphorus, and iron, and the units of vitamins A, B_1 (thiamin), C (ascorbic acid), D, and G (riboflavin) supplied in the individual diets when appetite governed the food intake. It was also desired to compare the amounts of nutrients received by these subjects with accepted standards and with the results of other studies.

REVIEW OF LITERATURE

Dietary Studies

Atwater (1902) was the first to collect data on dietaries from various American institutions including the physiological, economic, and social aspects of the diet. His purpose was to establish a dietary standard based upon the physiological needs of the individuals in these institutions. As a result of 56 such studies he concluded that this standard be 85 gm. of protein and 2450 Calories of energy per capita per day.

Investigating the economic aspects in these institutions, Atwater (1902) found great waste in food preparation and in an effort to lessen it, he recommended that food be prepared which would appeal to the individual. His conclusions were that improvements in dietaries of institutions must be gradual and that it would require long continued experiments and observations to change their dietary habits.

The average daily per capita food intake for women students at Montana State College over an eight-day period was determined by Borthwick (1917) to be 2549 Calories, 73 gm. of protein, 0.76 gm. of calcium, 1.29 gm. of phosphorus,

and 0.014 gm. of iron.

MacLeod and Griggs (1918) studied the diet of 115 subjects at Vassar College including seven faculty members, 17 servants (two were men) and 91 women students. The young women averaged 19.4 years of age, 5 feet, 4 inches in height, and 123.9 pounds in weight. These workers found the diets supplied for each person daily 2698 Calories, 398 of which came from protein, 1,252 from fat and 1,048 from carbohydrate. The average cost was 14 cents per meal.

From a seven-day dietary study on 300 college women living in sorority, church, and cooperative houses at the University of Illinois, Bevier (1920) determined that the average daily cost of the food for this group was 40.3 cents per person. The mean energy value was 2419 Calories per capita while the protein averaged 69.5 gm. This investigator believed that the quantity of food was fairly satisfactory and the cost moderate.

Raitt in 1926 (Ryder, 1932) reported a similar study made at the University of Washington on 12 organized houses for college women students consuming an average of 2667 Calories daily. The protein was adequate to meet the needs of the residents of each house but the calcium was insufficient for half of the group. Phosphorus fell below the standard for three of the houses while all were deficient in iron.

At Kansas State College of Agriculture and Applied Science a dietary study was made by Kramer and Grundmeier (1926) of 20 groups including both men and women students. The data were secured from records of food purchased and otherwise obtained during the period of the study. These authors concluded that the protein intake was sufficient and the energy probably adequate, but that calcium, phosphorus, and iron were too low. Doubt also existed as to the adequacy of the vitamins and cellulose supplied by these diets. It appeared that the deficiencies could have been met without increasing the cost of the diet, had a wiser selection of food been made.

Grace (1929) considered the consumption and cost of food for college women living in nine sorority houses, one dormitory, and two home management houses at Oregon State College. She found the intake varied from an average of 2156 to 2765 Calories per person per day at a cost range of 34 to 49 cents. The protein supplied ten per cent or more of the total calories. Calcium was adequate for all the houses except one, phosphorus was equal to or above the standard allowance for all, but iron was sufficient in the diets of only three houses.

Adequacy of the dietaries of 923 students living in sorority and fraternity houses at Kansas State College of Agriculture and Applied Science was investigated by West (1931). Her data showed the average per capita daily intake for men and women students was 2827 Calories, 83.1 gm. of protein, 0.79 gm. of calcium, 1.42 gm. of phosphorus, 0.0186 gm. of iron and the average cost was 46.1 cents. She concluded that it was possible for a college to meet its obligation for maintaining healthful dietaries in organized houses without an increase in cost by providing an adequately trained person to direct the purchasing, planning, and preparation of the food.

The nutritive value of foods served to 125 women students living in a residence hall at Kansas State College of Agriculture and Applied Science was investigated by Ryder (1932). The average daily per capita intake was determined to be 1821 Calories, 56.1 gm. of protein, 0.792 gm. of calcium, 1.32 gm. of phosphorus, and 0.01236 gm. of iron. Four years later Schermerhorn (1936) investigating the nutritive value of the dietaries in this same residence hall concluded that the food consumed was satisfactory for protein, phosphorus, vitamins A and C but unsatisfactory for calories, iron, and vitamin G. She found the food intake was higher

in energy and protein than Ryder's study had showed. The average daily per capita consumption in this case was 2088 Calories, 65 gm. protein, 0.75 gm. calcium, 1.13 gm. of phosphorus, and 0.0095 gm. iron. Wheeler and Mallay (1935) studied the food of a cooperative housekeeping group at Vassar College consisting of 28 students. The diet averaged 2397 Calories, 70 gm. of protein, 0.92 gm. of calcium, 1.32 gm. of phosphorus, 11.8 mg. of iron, 6616 Sherman Munsell units of vitamin A, and 227 Sherman units of vitamin C. The diets selected by students from a college cafeteria in North Dakota were examined by Latzke (1934). She discovered that women drank less milk than men, used more fruits and desserts, ate less bread, and fewer vegetables. Women chose meat on the average slightly more than once a day. The daily expenditure for food averaged 71.3 cents for women and 80.9 cents for men.

Ross (1939) investigated the dietaries of six Negro women living in a cooperative house in Manhattan, Kansas, and found the average nutritive value of the food consumed per person to be 2325 Calories, 72.9 gm. of protein, 0.74 gm. of calcium, 1.88 gm. of phosphorus, 0.012 gm. of iron, 10,287 Sherman-Munsell units of vitamin A, 413 Sherman-Chase units of vitamin B_1, 95 Sherman units of vitamin C, and

559 Sherman-Bourquin units of vitamin G. She concluded that the calories and vitamin B_1 intakes were low but that the other nutrients were above the requirement calculated on the basis of the adult male unit.

Food Requirements

According to Widdowson (1936) the pioneer investigators in the field of food requirements were Voit of Germany, Atwater of America, and Rubner, also of Germany. The daily energy requirement of a man doing moderate work was determined by means of dietary studies, by these workers to be 3055, 3400, and 3093 Calories respectively. The variations in allowances suggested were attributed to differences in manner of living and types of diets used in the two countries.

Widdowson also reported that the League of Nations recommended 2400 Calories per day per person, male or female, living an ordinary every-day life in a temperate climate and engaged in sedentary work. To this basic requirement were added supplements for muscular activity varying from 50 to 266 Calories per hour of work, according to its severity.

Sherman (1937) concluded from results obtained by different methods of studying energy requirements, chiefly by means of dietary studies, calorimetry, and carbon and

nitrogen balance experiments, that the energy requirement of a young to middle-aged man of average size (70 kg.) living in one room was 2200 Calories per day. An allowance for moderate activity raised this suggested daily standard to 3000 Calories.

Atwater (1902) suggested as a protein standard 100 to 128 gm. per day for a man weighing 70 kg. Chittenden (1907) recommended a low protein standard of 60 gm. daily for the same weight as he believed a low protein intake was conducive to health.

According to Widdowson (1936), The Royal Society Committee in 1919 suggested a daily allowance of 70 to 80 gm. of protein for the adult male unit. In contrast to this, Stiebeling and Ward (1933) set 67 gm. daily as a desirable amount of protein for Americans while the English Ministry of Health (Widdowson, 1936) recommended 80 to 100 gm. per capita. Sherman (1932) proposed one gm. of protein per kg. of body weight and the League of Nations Committee in 1935 (Widdowson, 1936) adopted this latter standard. At the present time the Sherman recommendation is widely used.

Comparatively few studies have been conducted for the purpose of determining the individual minimum requirements of calcium, phosphorus, and iron.

Sherman (1937) reviewed the literature and added new data concerning calcium and phosphorus output of adult subjects. In 97 balance experiments of three to eight days each, he determined the average requirement of calcium for the man of 70 kg. to be 0.45 gm. daily while the mean for 95 satisfactory phosphorus balance experiments was 0.88 gm. per person per day. To these minimum requirements he added 50 per cent as a "margin of safety" and advised an intake of 0.68 gm. of calcium and 1.32 gm. of phosphorus for a 70 kg. man each day.

Sherman (1932) concluded, from 12 iron balance studies on adults reported in the literature, that the daily minimum requirement for iron was 10 mg. per 70 kg. of body weight. With the addition of the customary 50 per cent safety factor the standard was set at 15 mg. per person per day.

According to Sherman (1937) Farrar and Goldhamer in 1935, basing their judgment both upon new experimental work of their own and upon a reexamination of the literature, reached a materially lower estimate of the iron requirement of the normal human adult. Sherman, considering these lower estimates and reevaluating the available material, set the requirement at eight mg. of iron per day as the minimum for normal men and women. To this estimate he added the

customary 50 per cent to insure adequacy and arrived at a dietary standard of 12 mg. per capita per day.

A good many workers, however, believe that a higher standard for iron is desirable for women. Minot (1937) suggested that women may require four times as much iron as men up to the menopause. Duckles, et al. (1937) found from hemoglobin determinations on 40 college women at the University of Wisconsin that 30 per cent had hemoglobin below 13 gm. per 100 c.c. which were regarded as low. They concluded that women required more iron in their diets than men. Such conflicting opinions as those expressed by Sherman and these workers give a feeling of uncertainty as to what standard for iron to accept.

About 1906 (Chaney and Ahlborn, 1934) it was "discovered that a diet of pure protein, fat, carbohydrate, and minerals did not permit life in animals and that the addition of small amounts of milk to the purified ration resulted in growth." This led to the belief that there are very small quantities of substance which are necessary to health. By 1910 these substances had been named vitamins. Today the existence of vitamins and their importance to growth and maintenance have been definitely established. The Vitamin Standardization

Committee of the League of Nations has adopted units of activity for the various vitamins (Widdowson, 1936).

The estimated daily human vitamin needs for the adult unit (70 kg.) as recommended by Daniel and Munsell (1937) are: vitamin A, 4500 Sherman-Munsell units; vitamin B, or thiamin, 600 Sherman-Chase units; vitamin C or ascorbic acid, 30-100 Sherman units; vitamin D, 400 International units for children (there is no standard for adults) and vitamin G or riboflavin, 600 Sherman-Bourquin units.

Food Cost

Various recommendations have been made as to the amount of money to spend on the different groups of foods. The United States Bureau of Labor, the New York Association for Improving the Condition of the Poor, and the Bureau of Home Economics of the United States Department of Agriculture have conducted studies to determine the best distribution of the food money when making food purchases.

Sherman (1937) summarized these studies as to distribution of the total food allowance for various items made by 225 American families. He found they spend 30 to 35 per cent of their food money for meat and fish; 5 to 6 per cent for eggs; 8 to 12 per cent for milk; 7 to 12 per cent for butter and other fats; 10 to 12 per cent for bread and cereals; 3 to

7 per cent for sugar and other sweets, and less than 2 per cent for cheese and nuts. He recommended spending as much for milk including cream and cheese as for meats, poultry, and fish and at least as much for fruits, and vegetables as for meats, poultry, and fish.

According to Chaney and Ahlborn (1934), Gillett in 1931 advised the division of the money spent for food into fifths as follows:

"One fifth, more or less, for vegetables and fruits;
One fifth, or more, for milk and cheese;
One fifth, or less, for meat, fish and eggs;
One fifth, or more, for bread and cereals;
One fifth, or less, for fats, sugar, and other groceries and food adjuncts."

The Bureau of Home Economics (1931) has recommended a slight modification of the Gillett division of the food dollars as follows:

Fruits and vegetables, one-fourth or more;
Milk and cheese, one-fourth or more;
Meat, poultry, fish and eggs, about one-sixth;
Bread and cereals, about one-eighth;
Fats, sugar, and accessories, about one-sixth.

PROCEDURE

Permission to make this study was secured from the director of the Negro cooperative house, after which those participating were made acquainted with the plan and their cooperation obtained. Such personal data as would aid in evaluating the results were secured for each member of the group (Table 1).

Each subject weighed herself every morning before dressing on ordinary spring bathroom scales. The variations in weight from day to day are shown in Table 2.

The study began with breakfast on February 26 and ended just before breakfast on March 5, 1939. During this time 126 meals were served to the group.

The menus for the meals served during the seven-day period and the foods eaten between meals by each subject are indicated in Table 3. The menus were planned a week in advance according to the custom of the house. The food was purchased by the writer. She was assisted throughout the study by one of the subjects who had conducted a similar research the preceding week in which the writer served as assistant. Because the group was familiar with the nature of the experiment no preliminary period was necessary.

Table 1. Personal data.

Item	Subject					
	R	O	A	C	M	Ro
Home residence	Bryan, Texas	Kansas City, Kans.	Cleveland, Ohio	Manhattan, Kans.	Kansas City, Kans.	Houston, Texas
Country						
Small town	X			X		
City		X	X		X	X
Classification in college	Graduate	Junior	Special	House mother	Senior	Graduate
Major course	Foods and nutrition	Home economics	Home economics		Home economics	Foods and nutrition
Minor course	Child welfare	Biology			English	Chemistry and education
Age in years to nearest birthday	28	20	30	61	22	24
Height in inches (without shoes)	61	66	64	65.5	62	66
Weight in kg. (beginning of study)	56.4	54.5	66.3	63.6	44.5	52.7
Weight in kg.(end of study)	56.5	54.7	66.5	64.0	44.9	52.9
Activity	Moderate	Moderate	Moderate	Light	Moderate	Moderate
Chief form of exercise	Walking	Walking	Walking	Sewing	Walking	Walking
Average number of hours of sleep per day	7.5	7	7	7	7	6
Smoking	None	None	None	None	None	None

Table 2. Daily weight record of subjects.*

Date	Day	Subject					
		R	O	A	C	M	Ro
		lb.	lb.	lb.	lb.	lb.	lb.
2/26/39	Sunday	124	120	146	139.8	98	116
2/27/39	Monday	124	120	146	140	98	116
2/28/39	Tuesday	124	120	146	140.5	99	116
3/1/39	Wednesday	124	120	147	141	99	116
3/2/39	Thursday	124	120.5	147	141	99	116.5
3/3/39	Friday	124.5	120.5	146	141	99	117
3/4/39	Saturday	124	121	146	141	99	117
Mean		124.1	120.3	146.3	140.6	98.7	116.4
		kg.	kg.	kg.	kg.	kg.	kg.
Mean		56.4	54.7	66.5	64.0	44.9	52.9

* Without clothing.

Table 3. Food served during week of experiment.

Day and date	Breakfast	Lunch	Dinner	Extra foods	
				Item	Subject using
Sunday 2/26/39	Grapefruit Hot cakes Butter Sirup Milk Coffee	Peanut butter sandwiches Chocolate cake Cocoa	Roast beef Gravy Candied yams Buttered string beans Perfection salad Bread, w.w. Butter Chocolate cake	Chicken	C
Monday 2/27/39	Orange Banana Corn flakes Sugar Cream Bacon and eggs Toast, w.w. Butter Cocoa Coffee	Hash Carrot strips Pickle Bread, w.w. Butter	Cheese fondue Buttered cabbage Apple rings Perfection salad Bread, w.w. Butter Chocolate cake Cocoa	Boiled egg Candied yams Bread, w.w.	R,O A,Ro A,Ro
Tuesday 2/28/39	Tomato juice Malt-o-meal Cream Toast, w.w. Butter Apple butter Milk Coffee	Salmon croquettes Cheese fondue Creamed carrots Sliced onions Bread, w.w. Butter	Liver Tomato sauce Mashed potatoes Buttered string beans Fruit salad Bread, w.w. Butter Chocolate cake	Cheese fondue Chicken	R C
Wednesday 3/1/39	Grapefruit Corn flakes Sugar Cream Bacon Toast, w.w. Butter Apple butter Cocoa Milk Coffee	Cream of tomato soup Crackers Deviled eggs Cheese Chocolate cake	Meat balls Egg omelet Gravy Candied potatoes Buttered green peas Bread, w.w. Butter	Egg omelet Fruit salad	R C
Thursday 3/2/39	Shredded wheat biscuit Sugar Cream Cheese toast Cinnamon toast Cocoa Coffee	Corn pudding Baked apple Bread, w.w. Butter Milk	Meat loaf Gravy Mashed potatoes Buttered spinach Harvard beets Corn meal muffins Butter Chocolate cake		
Friday 3/3/39	Stewed prunes Post toasties Sugar Cream Bacon Toast, w.w. Butter Cocoa Coffee	Navy bean soup Crackers Fruit salad	Pork sausage Corn meal dressing Mashed potatoes Creamed onions Bread, w.w. Butter Bread pudding	Orange Grapes	R C
Saturday 3/4/39	Tomato juice Malt-o-meal Sugar Cream Bacon and eggs Toast, w.w. Butter Cocoa Coffee	Creamed beef on toast Bread pudding with chocolate sauce	Fried fish Potato salad on lettuce Bread pudding with chocolate sauce	Grapes	C

Small articles of food were weighed on one of two Hanson scales of 500 and 1000 gram capacity, respectively. A larger scale capable of weighing 12 pounds with reasonable accuracy was employed for heavy articles.

Each ingredient used in a recipe was weighed and the cooked weight of the finished product obtained. The food value of these prepared dishes was calculated on the basis of the cooked weight.

Tables of food composition from Rose (1937) were used for the calculations whenever possible. In a few cases where the foods were not listed by Rose the tables of Chaney and Ahlborn (1934) were used. Information concerning certain commercial foods not included in the tables was secured from the manufacturer as a rule. When this was impossible calculations were made of foods similar in nature for which data were available.

At meal time the writer weighed the individual servings of food and the assistant recorded the amounts. Additional servings of any food were furnished as requested. Rubber scrapers were used to remove uneaten food from the dishes returned from the dining room. This table refuse for each subject was weighed and the amount subtracted from that of the total food served to obtain the quantity eaten. Any

eating between meals was noted and the weights of the food recorded.

The drinking water was weighed, a definite amount for each subject being bottled daily and stored in a cold place. Additional water was provided as needed. The weight of that left at the end of the 24-hour period was subtracted from the amount served to determine the quantity used each day by each individual. Extra water obtained from drinking fountains was measured in a drinking cup and the amount computed from the known weight of a like measure of water.

The following methods were found to increase the speed of service: A day's supply of butter for a subject was weighed in advance and placed on a marked plate ready to serve. Weighed amounts of sugar, cream, and jelly for each individual were placed in small cups each morning. The subjects used from these during the day and any remaining food was weighed back at the end of the 24-hour period. Individual servings of bread were weighed before each meal and placed on bread-and-butter plates.

The total calories and grams of protein, carbohydrate, fat, calcium, phosphorus, and iron supplied by the diets were determined for each subject (Rose, 1937; Chaney and Ahlborn, 1934). The vitamin values were computed by means

of the Daniel and Munsell tables (1937). At best, the vitamin intakes were only an approximation as data were not available for calculating the vitamin content of all the foods used by this group. Neither could losses in preparation be accurately determined. The loss of vitamin C for cooked foods was estimated at 50 per cent and this amount deducted in each case.

The cost of the diet per individual per day was determined and the distribution of the cost among the various food groups suggested to secure a well balanced diet compared with the recommendations of Gillett (Chaney and Ahlborn, 1934) and the Bureau of Home Economics (1931).

RESULTS AND DISCUSSION

The standards used to determine the nutritive value of the diets per adult male unit were those recommended by Sherman (1937) and Daniel and Munsell (1937). The amounts of the food constituents needed by the individual subjects were determined on the commonly used basis of weight. Iron was not so scaled because it was believed that women have a greater need for iron than men becauses of losses in menstruation.

The weights of the group (Tables 1 and 2) varied from 44.9 to 66.5 kg. and averaged 56.6 kg. The age ranged from

20 to 61 years, the latter being that of the housemother. The mean age for the five students was 25 years, the youngest being 20 and the oldest 30 years of age. The height varied from 5 feet 1 inch to 5 feet 6 inches, and averaged 5 feet 4 inches for the group.

The individual daily per capita food intakes are shown in Tables 4, 5, 6, 7, 8, and 9. These amounts were also calculated per 70 kg. and per 3,000 Calories for purposes of comparison.

Even though the food of half the group was below the individual standard in some respects as indicated in Tables 4, 6, and 9, the other half received amounts considerably in excess of their individual needs (Tables 5, 8, and 9) making the average intake of the six subjects (Table 10) above the standard computed on the mean weight of the group.

Subjects R, A, and C were below their requirements for energy and vitamin B_1 (Tables 4, 6, and 7) being deficient to the extent of 165, 424, and 325 Calories and 76, 68, and 121 Sherman-Chase units respectively. The other constituents of these diets were above their calculated needs. Even though the caloric intakes of these three subjects were supposedly low they gained in weight. The mean gain during this period was 0.23 kg. per capita. It

Table 4. Food consumed by Subject R.

Date	Day	Calories	Protein	Fat	Carbo-hydrate	Calcium	Phos-phorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D Inter-national	G Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	2536	68.2	125.5	283.4	0.77	1.24	0.016	8996	365	56	39	321
2/27/39	Monday	2412	72.2	138.2	228.1	1.13	1.48	0.015	3902	314	41	33	679
2/28/39	Tuesday	2025	79.0	112.9	173.2	1.07	1.58	0.015	7821	306	39	79	1674
3/1/39	Wednesday	1972	79.8	90.9	201.4	0.69	1.19	0.011	6338	274	76	26	453
3/2/39	Thursday	2507	76.7	116.4	289.0	1.42	1.50	0.011	5180	348	81	27	686
3/3/39	Friday	2042	50.3	122.7	184.0	0.87	1.12	0.009	4497	985	76	20	283
3/4/39	Saturday	2181	89.8	129.8	149.4	0.88	1.49	0.011	2070	245	30	10	243
Mean		2239	73.7	119.5	215.5	0.98	1.37	0.013	5544	405	58	33	620
Standard (56.4 kg.)		2421	56.4			0.55	1.07	0.012	3632	484	48		484
Per 70 kg.		2768	91.0			1.22	1.66	0.016	6881	503	72		770
Per 3000 Calories		3000	98.7			1.30	1.82	0.017	7372	539	77		824

Table 5. Food consumed by Subject O.

Date	Day	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D International	G Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	2753	63.7	150.8	285.4	0.56	1.18	0.018	8797	419	65	33	488
2/27/39	Monday	2891	88.6	154.0	287.5	1.31	1.87	0.019	15153	1183	119	39	878
2/28/39	Tuesday	3148	65.9	197.8	275.9	0.80	1.44	0.018	6603	564	127	92	1835
3/1/39	Wednesday	2624	99.0	114.4	299.8	0.70	1.42	0.013	8100	517	113	82	1603
3/2/39	Thursday	2778	92.9	137.5	292.3	1.62	2.00	0.013	7009	532	126	17	1015
3/3/39	Friday	3024	70.2	154.9	336.7	0.96	2.20	0.014	3387	1224	16	5	531
3/4/39	Saturday	2634	99.0	136.8	252.0	0.95	1.43	0.013	3213	439	48	32	414
Mean		2836	82.8	149.5	289.9	0.99	1.65	0.015	7466	697	88	43	966
Standard (54.7 kg.)		2336	54.7			0.53	1.03	0.012	3516	469	47		469
Per 70 kg.		3629	106.0			2.27	2.11	0.019	9554	892	113		1236
Per 3000 Calories		3000	88.7			1.06	1.77	0.016	7799	747	94		1035

Table 6. Food consumed by Subject A.

Date	Day	Calories	Protein	Fat	Carbo-hydrate	Calcium	Phos-phorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D Inter-national	G Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	2482	49.5	158.9	213.3	0.52	0.93	0.014	13084	470	90	16	581
2/27/39	Monday	2612	76.3	119.2	304.5	0.64	1.11	0.015	13995	561	107	6	819
2/28/39	Tuesday	2526	69.9	130.3	268.1	0.54	1.26	0.016	5788	491	98	64	1689
3/1/39	Wednesday	2582	116.8	106.4	290.2	0.69	1.57	0.009	10978	449	123	79	1730
3/2/39	Thursday	2420	76.0	109.7	280.6	1.41	1.67	0.014	48536	342	54	8	884
3/3/39	Friday	1953	56.7	100.6	209.9	0.74	1.45	0.010	848	891	4	8	172
3/4/39	Saturday	2405	95.7	165.2	162.0	0.65	1.38	0.011	1731	316	47	3	254
Mean		2426	77.3	127.2	246.9	0.74	1.34	0.015	13352	503	75	26	826
Standard (66.5 kg.)		2850	66.5			0.65	1.25	0.012	4275	570	57		570
Per 70 kg.		2554	81.3			0.78	1.41	0.016	14055	529	79		922
Per 3000 Calories		3000	95.0			0.92	1.66	0.019	16511	622	93		1083

Table 7. Food consumed by Subject C.

Date	Day	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
									Sherman-Munsell	Sherman-Chase	Sherman	International	Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	3103	74.3	198.9	252.7	0.65	1.31	0.016	14268	408	117	42	450
2/27/39	Monday	2286	68.0	131.4	207.7	0.67	0.98	0.010	6674	369	108	19	725
2/28/39	Tuesday	2350	77.3	118.3	244.9	0.52	1.15	0.016	5546	389	97	55	1176
3/1/39	Wednesday	1853	70.7	75.8	215.0	0.48	1.06	0.008	4696	340	117	19	479
3/2/39	Thursday	2259	74.1	112.8	235.5	1.24	1.48	0.012	5097	292	133	28	832
3/3/39	Friday	2393	58.0	111.5	289.4	0.74	1.77	0.014	1147	968	20	14	414
3/4/39	Saturday	2605	90.6	181.5	152.3	0.85	1.54	0.013	1873	225	46	--	127
Mean		2407	73.3	133.0	228.2	0.74	1.33	0.013	5615	427	91	25	600
Standard (64.0 kg.)		2739	64.0			0.62	1.21	0.012	4107	548	55		548
Per 70 kg.		2633	80.2			0.81	1.45	0.014	6141	467	100		656
Per 3000 Calories		3000	91.0			0.92	1.65	0.016	6978	531	113		746

Table 8. Food consumed by Subject M.

Date	Day	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D International	G Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	2798	50.4	145.8	321.0	0.38	0.82	0.013	8745	295	79	36	304
2/27/39	Monday	2789	83.3	155.9	263.1	1.18	1.39	0.018	10987	512	127	38	832
2/28/39	Tuesday	2530	78.4	118.4	287.8	0.74	1.42	0.016	4778	557	85	84	1691
3/1/39	Wednesday	2899	97.4	124.0	348.5	0.72	1.45	0.012	14776	633	152	73	2261
3/2/39	Thursday	2743	81.7	131.4	308.4	1.21	1.59	0.013	28986	482	97	38	897
3/3/39	Friday	1946	43.3	102.3	213.0	0.81	1.11	0.010	5143	886	22	29	568
3/4/39	Saturday	1841	81.1	69.2	223.4	0.64	1.40	0.014	13910	681	341	20	589
Mean		2506	73.7	121.0	280.7	0.81	1.31	0.014	12475	578	129	45	1020
Standard (44.9 kg.)		1924	44.9			0.44	0.85	0.012	2886	385	39		385
Per 70 kg.		3907	114.9			1.26	2.04	0.022	19449	901	201		1590
Per 3000 Calories		3000	88.0			0.97	1.56	0.017	14893	690	154		1218

Table 9. Food consumed by Subject Ro.

Date	Day	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D International	G Sherman-Bourquin
			gm.	gm.	gm.	gm.	gm.	gm.					
2/26/39	Sunday	2908	57.2	150.9	330.2	0.64	1.12	0.015	9221	354	66	42	448
2/27/39	Monday	2467	63.9	138.8	240.6	0.58	0.88	0.015	10316	569	111	57	639
2/28/39	Tuesday	2383	75.7	94.4	307.7	0.80	1.41	0.014	6176	525	76	73	1412
3/1/39	Wednesday	2868	111.1	117.9	340.5	0.68	1.50	0.011	9436	461	66	28	588
3/2/39	Thursday	2463	84.2	104.0	297.5	0.94	1.42	0.012	13601	390	59	37	692
3/3/39	Friday	2618	57.7	131.1	301.7	0.73	1.19	0.010	3966	779	14	19	465
3/4/39	Saturday	2726	106.3	174.3	183.1	1.14	1.90	0.015	5022	453	46	14	279
Mean		2633	79.5	131.6	285.9	0.79	1.34	0.013	8248	504	63	39	646
Standard (52.9 kg.)		2267	52.9			0.51	0.98	0.012	3401	453	45		453
Per 70 kg.		3484	105.2			1.04	1.77	0.017	10914	667	83		855
Per 3000 Calories		3000	90.0			0.89	1.52	0.015	9330	570	71		731

Table 10. Summary of mean nutritive value of diets compared with Sherman Standard.

Subject	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
								A Sherman-Munsell	B Sherman-Chase	C Sherman	D International	G Sherman-Bourquin
		gm.	gm.	gm.	gm.	gm.	gm.					
R	2239	73.7	119.5	215.5	0.98	1.37	0.013	5544	405	58	33	620
O	2836	82.8	149.5	289.9	0.99	1.65	0.015	7466	697	88	43	966
A	2426	77.2	127.2	246.9	0.74	1.34	0.015	13352	5031	75	26	876
C	2407	73.3	133.0	228.2	0.74	1.33	0.013	5615	424	91	25	600
M	2506	73.7	121.0	280.7	0.81	1.31	0.014	12475	578	129	45	1020
Ro	2633	79.5	131.6	285.9	0.79	1.34	0.013	8248	504	63	39	646
Mean	2508	76.0	130.3	257.8	0.84	1.39	0.014	8783	519	84	35	788
Per 70 kg.	3100	94.0			1.04	1.72	0.017	10687	642	104		957
Per 3000 Calories	3000	92.0			1.00	1.66	0.017	10498	620	100		942
Standard (56.6 kg.)	2426	56.6			0.55	1.07	0.012	3639	485	49		485
Sherman standard	3000	70.0			0.68	1.32	0.012	4500	600	60		600

was possible that their activity was less than they had supposed when their requirements were calculated.

The nutritive value of the diets consumed by subjects O, M, and Ro was above their calculated requirements (Tables 6, 9, and 10) in all the essentials studied. Each of these subjects gained in weight also (Tables 2 and 12). The total gain for the week was 0.2, 0.4, and 0.2 kg. respectively for the three subjects or a mean of 0.27 kg. This group with a somewhat higher food intake had a slightly higher mean gain than those whose diets were deficient in calories and vitamin B_1.

The average amount of food nutrients believed to be needed per capita per day by the members of this group was calculated on the basis of 56.6 kg. which was the average weight of the subjects for the week of this study. The amounts required for this theoretical person (Table 10) were 2426 Calories, 56.6 gm. of protein, 0.55 gm. of calcium, 1.07 gm. of phosphorus, 0.012 gm. of iron, 3639 Sherman-Munsell units of vitamin A, 485 Sherman-Chase units of vitamin B_1, (thiamin), 49 Sherman units of vitamin C (ascorbic acid) using 60 units as the standard, and 485 Sherman-Bourquin units of vitamin G (riboflavin).

The caloric intake per kg. of body weight ranged from 36 to 56 Calories with a mean of 44 per capita. Subject R, A, and C were below the standard of 43 Calories. Subjects O, M, and Ro received more than 43 Calories per kg. of body weight (Table 11). The energy value of the food consumed by subject M was higher per kg. (56 Calories) than any of the others which was in agreement with her total gain in weight which was also high (0.4 kg.). It may also be noted (Table 12) that subject C's gain was equal to M's although her intake was considerably lower (38 Calories per kg.). She, however, was an older and less active woman.

The so-called protective foods were used frequently in these diets (Table 13). Subject R consumed a somewhat larger amount of milk than the others. Whole grain cereals appeared frequently in the diets due to the use of whole wheat instead of white bread and occasional servings of whole grain breakfast foods. White bread was not served at any time during this study. The subjects consumed more servings than the recommended number of vegetables and fruits. Citrus fruits appeared more than once daily.

The mean daily water intake for this group showed considerable variation, the lowest being 1,144 and the highest 1,913 gm. (Table 14). The average per capita per day was

Table 11. Mean nutritive value of diets per kilogram of body weight.

Subject	Weight	Calories	Protein	Fat	Carbohydrate	Calcium	Phosphorus	Iron	Vitamin units				
									A Sherman-Munsell	B Sherman-Chase	C Sherman	D International	G Sherman-Bourquin
	kg.		gm.	gm.	gm.	gm.	gm.	gm.					
R	56.5	40	1.3	2.1	3.8	0.018	0.024	0.0002	98	7	1.0	0.6	11
O	54.7	52	1.5	2.7	5.3	0.018	0.030	0.0003	136	13	1.6	0.8	17
A	66.5	36	1.1	1.9	3.7	0.011	0.020	0.0002	201	7	1.1	0.4	13
C	64.0	38	1.1	2.0	3.6	0.012	0.021	0.0002	88	7	1.4	0.4	9
M	44.9	56	1.6	2.7	6.3	0.018	0.029	0.0003	278	13	2.9	1.0	23
Ro	52.9	49	1.5	2.5	5.4	0.015	0.025	0.0002	156	10	1.2	0.7	12
Mean	56.6	44	1.3	2.3	4.6	0.015	0.025	0.0002	155	9	1.5	0.6	14

Table 12. State of nutrition related to individual caloric intake.

Subject	Age	Height	Weight	State of nutrition	Calories per kg.	Total gain during study
	yr.	cm.	kg.			kg.
R	28	154.9	56.4	Normal	40	∕0.1
O	20	167.6	54.5	Underweight	51	∕0.2
A	30	162.6	66.3	Overweight	36	∕0.2
C	61	166.4	63.6	Normal	38	∕0.4
M	22	157.5	44.5	Underweight	56	∕0.4
Ro	24	167.6	52.7	Underweight	50	∕0.2

Table 13. Frequency of occurence of certain foods* in the diets.

Food	Required number of servings	Number of servings received by subject					
		R	O	A	C	M	Ro
Eggs	7	5	5	2	3	5	4
Fruits	7						
Citrus		7	6	6	6	6	6
Cooked		5	5	5	5	5	5
Raw		2	4	4	6	4	4
Meat, cheese	14	14	14	14	14	14	14
Milk	14	8	7	7	4	7	7
Vegetables							
Potatoes	7	7	7	7	7	7	7
Others, cooked	7	10	10	10	10	10	10
Raw	7	6	6	6	6	6	6
Whole grain cereals	14	18	18	19	18	18	19

* Milk measured in cups; eggs by number; other foods in servings.

Table 14. Mean individual daily intakes of water and other liquid.

Date	Day	Subject																		
		R			O			A			C			M			Ro		
		Water	Other liquid	Total	Water	Other liquid	Total	Water	Other liquid	Total	Water	Other liquid	Total	Water	Other liquid	Total	Water	Other liquid	Total
		gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.	gm.
2/26/39	Sunday	770	409	1479	1021	307	1328	591	372	963	771	472	1243	950	139	1089	1904	360	2204
2/27/39	Monday	2168	462	2630	1846	433	2279	1032	282	1314	1329	524	1853	803	370	1173	1714	397	2111
2/28/39	Tuesday	1084	45	1129	933	250	1173	943	196	1139	1761	209	1970	1690	244	1934	1904	264	2168
3/1/39	Wednesday	1084	385	2469	1846	266	2112	945	467	1412	881	456	1337	1900	452	2352	1904	465	2369
3/2/39	Thursday	1084	508	1592	1806	414	2220	1634	468	2102	1516	490	2006	1900	493	2393	1904	507	2411
3/3/39	Friday	1942	275	2217	1846	520	2366	1694	227	1921	1332	263	1595	1583	316	1899	1904	299	2203
3/4/39	Saturday	1084	249	1333	1846	316	2152	1167	188	1355	1762	201	1963	860	450	1310	2150	278	2428
Total / week		9216	2333	12849	11134	2506	13624	8006	2200	10206	9352	2615	11967	9686	2464	12150	13384	2570	15894
Mean / day		1317	333	1836	1591	358	1946	1144	314	1458	1336	374	1710	1384	352	1736	1912	359	2271

Mean water 1447 gm., other liquids 2448 gm.

Mean total liquid intake 3895 gm.

1,447 gm. This did not include the water obtained from beverages and soups. These other liquids averaged 2,448 gm. per capita per day making the total mean liquid intake for the group 3,895 gm. or approximately four liters. This may be considered a generous amount of liquid.

Results of this study compared with a similar one on the same group made the proceding week by Ross (1939) showed the nutritive value of these diets to be higher in all respects except for vitamins A and C. Compared with similar studies on other groups, the food intakes were about equal to some of the early investigations but above those of later ones (Table 15).

All subjects gained in weight during the week of the experiment (Tables 2 and 12). This may possibly be accounted for by the fact that all meals were eaten on a very regular schedule at the cooperative house during the time of the study while at other times, lunch was eaten in the college cafeteria and only breakfast and dinner were prepared and served in the house. The more regular schedule and perhaps more carefully planned meals may have been conducive to a gain in weight. In particular Subject Ro, who was underweight and on a high caloric diet at the time the study was begun, reported a steady gain in weight previous to this

Table 15. Comparison of nutritive value of diets of college groups.[1]

Study	Year	Institution	Weight	Calories	Protein	Calcium	Phosphorus	Iron	Vitamin units				
									Sherman Munsell	Sherman Chase	Sherman	International	Sherman Bourquin
			kg.		gm.	gm.	gm.	gm.					
Borthwick	1917	Women's Residence Hall Montana State College		2549	73.0	0.76	1.92	0.014					
MacLeod and Grigg	1920	Women's Residence Hall Vassar College	56.3	2698	99.0								
Bevier	1920	Women's organizations University of Illinois		2419	69.5								
Raitt	1926	University of Washington		2667	adequate	inadequate	inadequate	inadequate					
Kramer and Grundmeier	1926	Kansas State College		2889		inadequate	inadequate	inadequate					
Grace	1929	Women's organizations Oregon State College		2411	adequate	adequate	adequate	inadequate					
West	1931	Kansas State College		2827	83.1	0.79	1.42	0.0186					
Ryder	1932	Women's Residence Hall Kansas State College	58.2	1821	56.1	0.792	1.197	0.01236					
Wheeler and Mallay	1933-34	Cooperative group Vassar College		2397	70.0	0.92	1.32	0.0118	6616		227		
Schermerhorn	1936	Women's Residence Hall Kansas State College		2088	65.0	0.75	1.13	0.095					
Ross	1939	Negro cooperative group Kansas State College	56.3	2325	72.9	0.74	1.11	0.012	10287	413	95		559
This study	1939	Negro cooperative group Kansas State College	56.6	2508	76.0	0.84	1.39	0.014	8783	519	84	35	788

1. Expressed as means.

time. As was to be expected she had a particularly high intake of food as indicated in Table 9.

The cost of food per person per day varied from 22.6 to 28.0 and averaged 24.7 cents (Table 16).

The food purchases were grouped (Table 17) according to the recommendation of Gillett (Chaney and Ahlborn, 1934) and the Bureau of Home Economics (1931). The distribution of the cost was compared with these standards (Table 18). In this study more than the recommended amount was spent for fruits, vegetables, meats, fish, and eggs. The expenditure for dairy products equalled the Gillett standard but fell below the recommendations of the Bureau of Home Economics. The proportion spent for bread and cereals was low according to both standards while that spent for fats, sugars, and other groceries and food adjuncts was equal to the recommendations of the Bureau of Home Economics but below those of Gillett.

CONCLUSIONS

1. The food eaten by the Negro cooperative group during the experimental period was typical of the food consumed by this group throughout the year.

Table 16. Cost of food served.

Date	Day	Subject					
		R	O	A	C	M	Ro
		cents	cents	cents	cents	cents	cents
2/26/39	Sunday	25.3	25.4	23.8	22.9	23.7	27.2
2/27/39	Monday	25.5	33.1	24.0	23.5	24.6	22.8
2/28/39	Tuesday	23.6	31.7	24.7	23.6	26.2	28.2
3/1/39	Wednesday	19.0	25.3	25.8	19.9	28.1	26.8
3/2/39	Thursday	23.9	30.5	27.9	27.2	29.9	27.2
3/3/39	Friday	19.1	22.2	18.8	23.3	16.3	20.1
3/4/39	Saturday	21.5	27.6	24.6	25.4	19.9	29.1
Mean		22.6	28.0	24.0	23.7	24.1	25.9
Mean per capita cost per day - 24.7 cents							

Table 17. Percentage distribution of food cost.

Food group	Distribution	
		per cent
Fruits and vegetables	$ 3.82	31
Meat, fish, and eggs	3.15	25
Dairy products	2.54	20
Bread and cereals	1.06	8
Fats, sugars, other groceries, and food adjuncts	1.94	16
Total	12.51	100

Table 18. Comparison of percentage distribution of cost with recommended expenditure.

Food group	This study	Recommended expenditure	
		Gillett	Bureau of Home Economics
Fruits and vegetables	31	20	25
Meat, fish, and eggs	25	20	16
Dairy products	20	20	25
Bread and cereals	8	20	12
Fats, sugars, other groceries, and food adjuncts	16	20	16

2. The mean nutritive value of the diet of this group of Negro college women was adequate according to Sherman and Daniel and Munsell for the adult male unit.

3. An adequate diet may be supplied at a cost of 24.7 cents per day per 56.6 kg. of body weight in Manhattan, Kansas, at prices prevailing at the time this study was made.

4. The nutritive value of the food consumed by this group was equal to that of early investigations and above the more recent ones.

5. The fact that this cooperative group received considerable supervision from a member of the Department of Household Economics of the college may have been a factor which determined to some degree the quality of the diet.

6. It is desirable to make similar studies on other Negro groups to compare with this one in order to ascertain whether this dietary is typical of that of the average Negro college woman here and in other sections of the country.

ACKNOWLEDGMENTS

The writer wishes to acknowledge her indebtedness to Dr. Martha S. Pittman, head of the Department of Food Economics and Nutrition, under whose guidance the study was made; to Miss Florence McKinney for assistance during this study, and to the individual members of the cooperative group who made this study possible.

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