

COMPOSITION OF CERTAIN BEEF CUTS AS AFFECTED BY
GRADE AND METHOD OF COOKING

by

MIRIAM ROGERS

B. A., Coe College, 1934

A THESIS

submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1935

TABLE OF CONTENTS

	<u>Page</u>
INTRODUCTION	2
WORK IN THE FIELD	3
PROCEDURE	8
DISCUSSION OF RESULTS	16
CONCLUSIONS	24
ACKNOWLEDGMENT	26
LITERATURE CITED	27

INTRODUCTION

Recent studies of human nutrition have emphasized the importance of quantitative analysis of food materials. The composition of meat is of particular interest in this connection as it is an important article of food in the American diet. Unfortunately at the present time few analyses are available for cooked meat which is the form in which meat is commonly eaten.

Dietitians and others who must compute food values for special diets feel the need for information on the composition of cooked meat. Today the most reliable source of material on composition of meat in general is probably that compiled by Rose in her Laboratory Handbook for Dietetics (8), although it contains little information on cooked meats. This study was therefore undertaken with the hope that it might be able to contribute some much-needed data on the composition of cooked meat. Top shoulder clod, rib, and top and bottom round of beef were chosen for analysis because these cuts were obtainable from experiments already in progress in the Department of Institutional Economics of Kansas State College.

WORK IN THE FIELD

The earliest work on the chemical composition and nutritive values of food materials was done in European laboratories and on European food products. The first studies were made in England but the majority of the early food analyses were the work of German laboratories. Liebig, a famous organic chemist of nearly a century ago, is credited with first stimulating interest in chemical analysis of food products.

Not until about the year 1880 did food composition become a subject of much study in America. Since then, however, American investigators have accumulated a constantly increasing amount of data on this subject. Woods (11), supervised by Dr. Atwater who was an early American leader in this field, averaged the results of analyses made in this country on different kinds of meat excluding fish. He also indicated points to be considered in cooking meats by various methods. His tables included all the data on composition and caloric value of American meats available at that time and were regarded as the most complete ever published. However, he apparently ignored the changes in composition of meat produced by cooking.

Atwater, working with Bryant (1), one year later is-

sued Bulletin 28 of the United States Department of Agriculture. In it may be found minimum, maximum, and average values for all American food materials for which analyses were obtainable in the year 1895. Meats are included in considerable numbers and both "as purchased" and "edible portion" values are shown. Distinction is also made as to the degree of fatness and most of the usual cuts are included. However at the time this study was made, meats were ungraded so no account was taken of this factor and its effect upon composition of meat. Also, all the analyses are for uncooked meat. The average composition of meats as indicated in this bulletin is identical with that of Woods previously mentioned which suggests the close connection Atwater had with this earlier work.

Chatfield (2) of the Bureau of Home Economics published some thirty years later data on the proximate composition of beef "for the purpose of revising the meat section of Bulletin No. 28." Her work included commercial grades taking into consideration the degree of fatness of the animal and the newer figures on composition of meat. Her data are based on statistical analysis and are believed to supply a close estimate of the composition of many cuts of beef.

Chatfield emphasized the fact that the composition of beef is extremely variable and cited the fact that lean meat from the round of a thin carcass may have only 2 per cent of

fat as determined by ether extract while the visible fat from the loin of a fat carcass may be as high as 89 per cent. Again she noted that the entire edible portion of a wholesale rib cut contained anywhere from 7 to 60 per cent of fat and varied accordingly from 650 to 2590 Calories per pound of edible meat. This suggested the difficulty she found of obtaining accurate values for the composition of beef cuts when they were computed from average figures on meat composition.

Chatfield's analyses were based on a classification of beef carcasses according to fat content, dividing them into thin, medium, fat, and very fat. These divisions correspond to the commercial grades Common, Medium, Good, Choice, and Prime, the latter two being considered as "very fat" under Chatfield's plan. Her estimates included the actual frequency distribution by fatness of beef carcasses in general, the average fatness of each class of beef, the average fatness and class limits of wholesale cuts, and protein, ash, and water content as well as bone.

With Chatfield's method it appears that greater accuracy may be obtained in dietary calculations than when straight averages are used and that errors are minimized in estimating the fat in a cut. Also a relationship is recognized between commercial grade and fat content of meat which permits the estimation of the chemical composition

of any wholesale cut from the percentage of visible fat including protein, ash, and with less accuracy, bone. By this method the chemical composition obtained will be less accurate for retail beef cuts than for wholesale ones.

Loy (6) made extensive analyses of beef blood, adipose tissue, and muscle tissues freed from visible fat. These were studied for protein, fat, and water content, and included calcium, phosphorus, and iron determinations as well as total ash. His analyses were made on uncooked meat and are particularly valuable in connection with this present study for the methods used which are described in detail when they involve new procedures. His values are in good agreement with those of other workers.

Toscani, Rupp, and McClellan (10) analyzed samples of various cuts of meat eaten by two men on an exclusive meat diet. This study included analyses of beef muscle, tongue, liver, kidney, and brain. In addition to the usual determinations for protein, fat, calcium, and phosphorus, carbohydrate was included, averaging 1.36 per cent for well-trimmed muscle and 1.32 per cent for untrimmed muscle. Data for the minimum, maximum, and average values were recorded. The quantity of fat in all cuts of meat varied considerably even when all visible fat had been removed. In well-trimmed beef muscle the percentage of fat ranged from 2.9 to 7.6 per cent according to the amount of fat laid down between the

muscle strands and fibers. No statement was made as to whether the analyses were of cooked or uncooked meat but the values for water content indicate that they were made on raw samples.

A recent study dealing with composition of cooked meat is that of Hanna (4), but the analyses do not deal with meat as it is generally eaten as all juices, gravy, bones, tendons, and visible fat were removed. The remainder was analyzed for protein and fat. Prime ribs, roasted, were found to contain an average of 26.9 per cent of water and boiled beef (cut not stated), 31.1 per cent. The protein content of broiled round steak was 29.8 per cent while the boiled sample of beef round contained 28.0 per cent. Broiled tenderloin cooked well done contained 28.5 per cent of water but only 23.9 per cent if rare. Boiled beef contained more fat than roasted beef, rare steak more than steak cooked well-done; broiled sirloin more than broiled round, and boiled round the same amount as broiled round. Apparently the grade of meat was not considered in these studies.

A still more recent report is that of Fowler and Bazin (3) who analyzed cooked meats freed from visible fat for use by diabetic patients, where a low fat content was desired in a high carbohydrate-low calorie diet. The analyses of these workers included percentage of water, protein

(N x 6.25), fat, and ash in certain beef cuts as well as in other meats and fish. The grades of beef were not indicated for the cuts used. Water averaged 65.4 per cent for beef roasts (cuts not indicated) and 63.2 to 65.5 per cent for steak cuts (fillet and sirloin) and the protein was 27.5 per cent for the roasts and 24.3 to 29.5 per cent for the steaks. Ash varied from 1.22 per cent for the roasts to 1.22 to 1.37 per cent for the steaks. The fat in all cases was low because of its removal before analysis but ran higher in the steak than in the roast cuts.

PROCEDURE

Source of Beef Cuts

All beef cuts used in these analyses were obtained from the Williams Wholesale Meat Company of Kansas City, Missouri. Nothing is known of the history of the meats except that they were U. S. graded and rated as medium, good, or choice in this respect. The cuts were boned and otherwise made ready for cooking by the meat company. All except the braised top clods were rolled. The raw cuts ranged from 10 to 15 pounds in weight. When cooking is indicated, they were prepared by the Department of Institutional Economics of Kansas State College and, in that case, were always either braised or roasted.

In order to insure a clear understanding of the methods of cooking used, the terms braising and roasting have been defined in this study according to a tentative report of the Terminology committee of the Foods and Nutrition Division of the American Home Economics Association (9). According to these authorities to braise is "to brown meat or vegetables in a small amount of fat, then to cook slowly in a covered utensil in a small amount of liquid. The liquid may be meat juices or added water, milk, cream, or meat stock, etc." By the same authority, roasting is "to bake; applied to certain foods as meat, chestnuts, etc." To bake means "to cook by dry heat; now usually done in an oven but occasionally in ashes, under coals, or on heated stones, or metals. When applied to meats it is called roasting."

When the term "braised" is used in these experiments it refers to meats cooked either in a small amount of added water in a steam-jacketed kettle such as is used in institutional kitchens or in a covered aluminum roaster on top of the stove without added water. The latter is considered as "surface burner roasting."

The cuts indicated as "roasted" were cooked in an oven at 150°C. in an uncovered dripping pan to the desired internal temperature which varied from 60 to 68°C. The temperature of the ovens and the final internal temperature attained in the various cuts are indicated in Table 1. Internal

Table 1. General Information Concerning Beef Cuts Used

Sample No.	Cut	Grade	Remarks	Cooking			Weight	
				Method	Time	Temperature	Uncooked	Cooked
						: In- Oven: ternal:		
					min.:	°C. : °C.	gm.	gm.
I	: Top : clod	: medium	: Analyses made on com- : posite sample of two : cuts, (a) and (b)	: Seared 20 min. at : 288°C. Braised : without addition : of water	: *	: * : *	: (a) 7076: : (b) 8021	: (a) 5141 : (b) 5737
III	: Top : round ³	: choice	: Fine texture, abun- : dant marbling, rolled	: Roasted without : previous searing	: 190:	: 150: 60	: 7128:	: 5673
IV	: Rib ³	: choice	: Very fine texture, : abundant marbling, : rolled	: Roasted without : previous searing	: 190:	: 150: 68	: 6348:	: 5344
V	: Top : clod ³	: choice	: Very fine texture, : limited marbling,	: Roasted without : previous searing	: 190:	: 150: 68	: 7374:	: 5815
VI	: Bottom : round ⁵	: good	: Fine texture, lean, no : marbling, moderately : firm. Analyses made : on composite sample of : two cuts, (c) and (d)	: Seared 20 min. at : 288°C. Braised ² : with addition of : small amount of : water	: 330:	: 100: 71	: (c) 6233: : (d) 6147	: (c) 4596 : (d) 4462
VII	: Bottom : round ⁵	: good	: Fine texture, lean, : trace of marbling. : Analyses made on com- : posite sample of two : cuts, (e) and (f)	: Seared 20 min. at : 288°C. Braised ¹ : without addition : of water	: 183:	: 94: 76	: (e) 6341: : (f) 6500	: (e) 4604 : (f) 4804
VIII	: Top : clod ⁴	: good	: Very fine texture, : limited marbling, : rolled	: Not cooked	: --	: -- : --	: 6434:	: --
IX	: Rib ⁴	: good	: Very fine texture, : limited marbling, : rolled	: Not cooked	: --	: -- : --	: 6422:	: --
X	: Top : round : 4, 6	: good	: Fine texture, limited : marbling, rolled	: Not cooked	: --	: -- : --	: 6254:	: --
XI	: Top : round : 4, 6	: good	: Very fine texture, : limited marbling, : rolled	: Roasted without : previous searing	: 340:	: 150: 68	: 6672:	: 5800

1 -- Cooked in a covered roaster.

2 -- Cooked in a steam-jacketed kettle.

3 -- Cuts from same carcass.

4 -- Cuts from same carcass.

5 -- Paired cuts.

6 -- Paired cuts.

temperatures for the braised meats as well as that of the surrounding air in the cooking vessel, also shown in Table 1, were determined by use of thermo-couples made of iron and constantan wire. The actual temperatures attained were registered with a double range portable potentiometer. The accuracy of the thermocouples was tested with a calibrated mercury-glass thermometer.

Method of Sampling

A slice weighing approximately one pound was taken from each cut of meat for analysis. The center of each cut was first located by measure. The slice was then cut halfway between the arm (narrow) end and the center for the clod (Nos. V, VIII); through the center for clod (No. I); 4 inches in from the shank end for the rounds (Nos. III, VI, VII, X, XI); and 4 inches in from the small end (chuck) of the rib pieces (Nos. IV, IX). The slice in all cases represented a complete cross section through the selected portion of meat. Immediately after cutting, the sample was placed in a clean glass jar and sealed tightly to prevent water loss in the interval of one hour or more elapsing before preparation for analysis.

Preparation of Samples for Analysis

The meat was ground twice in a food chopper using the next to the smallest blade and exercising great care to prevent loss. The ground material was then divided into fourths, each individual quarter being repeatedly folded from the outside to the center to insure thorough mixing; two quarters were then combined, and folded, ridged with the hand, and refolded from the outside to the center, the whole process being repeated many times. Finally the two halves were combined and the entire sample thoroughly mixed by repeating the same process of folding, ridging, and refolding. The combined sample was then ground a third time and the quartering, folding, ridging, refolding, and combining repeated many times to insure complete and thorough mixing.

When finally mixed the meat was weighed into individual portions, one for each determination, in order that material for any given analysis could be obtained without disturbing the remainder. Each portion was wrapped in heavy waxed paper and labeled. The small paper-wrapped portions were packed in a cardboard container and all the samples stored together in a large tin can. They were frozen at once and kept frozen until ready for analysis. In this way it was believed changes in composition would be minimized.

Composite samples were made whenever the meats were braised as then two pieces were cooked in the same container and the juices from the two cuts were necessarily intermingled in the process of cooking.

Whenever it was necessary to make a composite sample the slices from the two meats were treated separately by the above method of grinding and mixing. From these individual well-mixed portions a sample was weighed out which was proportional to the original weight of the two samples as determined by the following formula:

$$\frac{\text{Weight of slice in grams} \times \text{grams in 1 pound}}{\text{Total weight of both slices in grams}} =$$

grams to be taken from the particular slice
used in the calculation

The two portions from the two slices were then combined, mixed as described above, so the composite was thoroughly representative of the two cuts from which it was obtained.

Chemical Analyses

Analyses on the different beef cuts sampled included protein (N x 6.25), fat (ether extract), water, total ash, calcium, phosphorus, and iron. Determinations were made at least in triplicate and a known substance was analyzed in each case to prove accuracy of the method used. Nitrogen was determined on approximately 5-gram samples according to the Kjeldahl-Gunning procedure. The Bailey-Walker method

was used for determining fat and the extraction was continued for 72 hours as recommended by Loy (6), approximately 5-gram portions being used here also*. The samples for fat analyses were dried 6 hours in a vacuum oven at 60°C. then the drying continued to constant weight over sulfuric acid in a vacuum desiccator. The drying ordinarily required one week or longer.

Moisture samples weighing approximately 5 grams for cooked and 10 grams for uncooked meat were heated on a water bath until most of the water was expelled and the drying then completed in a Freas oven at 60°C. The low point obtained by this method was taken as the weight of total solids. After the low point was reached the samples would consistently gain in weight which was attributed to the beginning of decomposition. It is customary to use a vacuum oven or vacuum desiccator or both for determining moisture in meat but the laboratory in which these analyses were made lacked such facilities. In order to determine how great an error might be involved by use of this method, No. VIII was analyzed both ways, the Chemical Laboratory of the Kansas Agricultural Experiment Station using vacuum apparatus to check these results with air drying. This laboratory obtained 58.76 per cent of moisture by air drying and their

*The fat and iron determinations were made by the Chemistry Laboratory of the Kansas Agricultural Experiment Station.

laboratory under vacuum conditions obtained 58.73. As these values were so close it is believed that the great care exercised in handling the samples and the low temperature maintained during drying (60°C.) reduced the error to a minimum and that these results may be accepted as reliable.

Total ash was obtained by heating the total solids left from the moisture determinations by a combination of open flame and muffle furnace to a white ash. The heat was never allowed to exceed dull redness in order to prevent loss of chlorides. When difficulty was met in securing a white ash, the material was dissolved in distilled water, filtered on ashless filter paper, and reashed.

Calcium was determined volumetrically on approximately 50-gram samples by a modification of the McCrudden method as given in the Methods of the Association of Official Agricultural Chemists (7). Phosphorus was also determined volumetrically by the Official method (7) which involved ashing 2-gram samples with magnesium nitrate. The colorimetric official method was used to determine iron (7). No attempt was made to prevent contamination with iron in handling the samples but it is believed that the iron added in this way would be no more than would be obtained with the usual methods of preparation so that samples thus contaminated would be typical of meat as ordinarily eaten.

DISCUSSION OF RESULTS

The results obtained are assembled in Tables 1 and 2 and shown graphically in Figures 1 to 5, inclusive.

Data are available (Figure 1) for two cooked top clod (chuck) cuts, No. I which was a composite of two surface burner roasts (braised) and No. V which was roasted. These represent medium and choice grades, respectively. The water content of the roasted clod was 0.7 per cent higher than that of the braised while the protein content was 1.24 per cent lower. While these differences are slight they are consistent with the general tendency of meats for the protein to be inversely proportional to the water content. The braised clod contained 3.06 per cent more fat and 1.53 per cent less total ash than the roasted.

Uncooked clod of good grade (No. VIII) was higher in water and fat, and lower in protein than similar cuts cooked (Figure 1). The differences for ash were less evident. As the grades of meat were not the same it is impossible to say how much of the variation was due to grade and how much to cookery.

The effect of roasting on rib cuts (Figure 2) may be observed in Nos. IV and IX. Unfortunately the grades were not identical as the roast was choice and the uncooked rib of good grade. As was expected the water content was higher

Table 2. Results of Chemical Analyses of Certain Beef Cuts

Sample No.	Cut	Grade	Preparation	Water	Protein (Nx6.25)	Fat (ether extract)	Total ash	Calcium	Phosphorus	Iron
				per cent	per cent	per cent	per cent	per cent	per cent	per cent
I	Top clod	medium	braised ¹	45.66	22.78	29.42	0.819	0.007	0.169	0.00395
III	Top round ⁵	choice	roasted	49.11	28.31	16.55	1.207	0.012	0.213	0.00380
IV	Rib ⁵	choice	roasted	38.88	21.54	37.05	0.766	0.006	0.138	0.00254
V	Top clod ⁵	choice	roasted	46.36	24.59	26.37	0.972	0.017	0.147	0.00292
VI	Bottom round ³	good	braised ²	51.73	30.03	15.90	1.176	0.005	0.234	0.00437
VII	Bottom round ³	good	braised ¹	49.69	31.87	16.75	1.048	0.005	0.207	0.00347
VIII	Top clod ⁶	good	uncooked	58.76	21.13	18.22	0.964	0.012	0.156	0.00232
IX	Ribs ⁶	good	uncooked	48.33	19.79	30.98	0.812	0.009	0.136	0.00182
X	Top round ^{4,6}	good	uncooked	68.14	24.11	6.55	1.162	0.005	0.200	0.00217
XI	Top round ^{4,6}	good	roasted	61.30	30.50	9.01	1.117	0.011	0.214	0.00250

1 -- Cooked in a covered roaster.

2 -- Cooked in a steam-jacketed kettle.

3 -- Paired cuts.

4 -- Paired cuts.

5 -- All cuts from same carcass.

6 -- All cuts from same carcass.

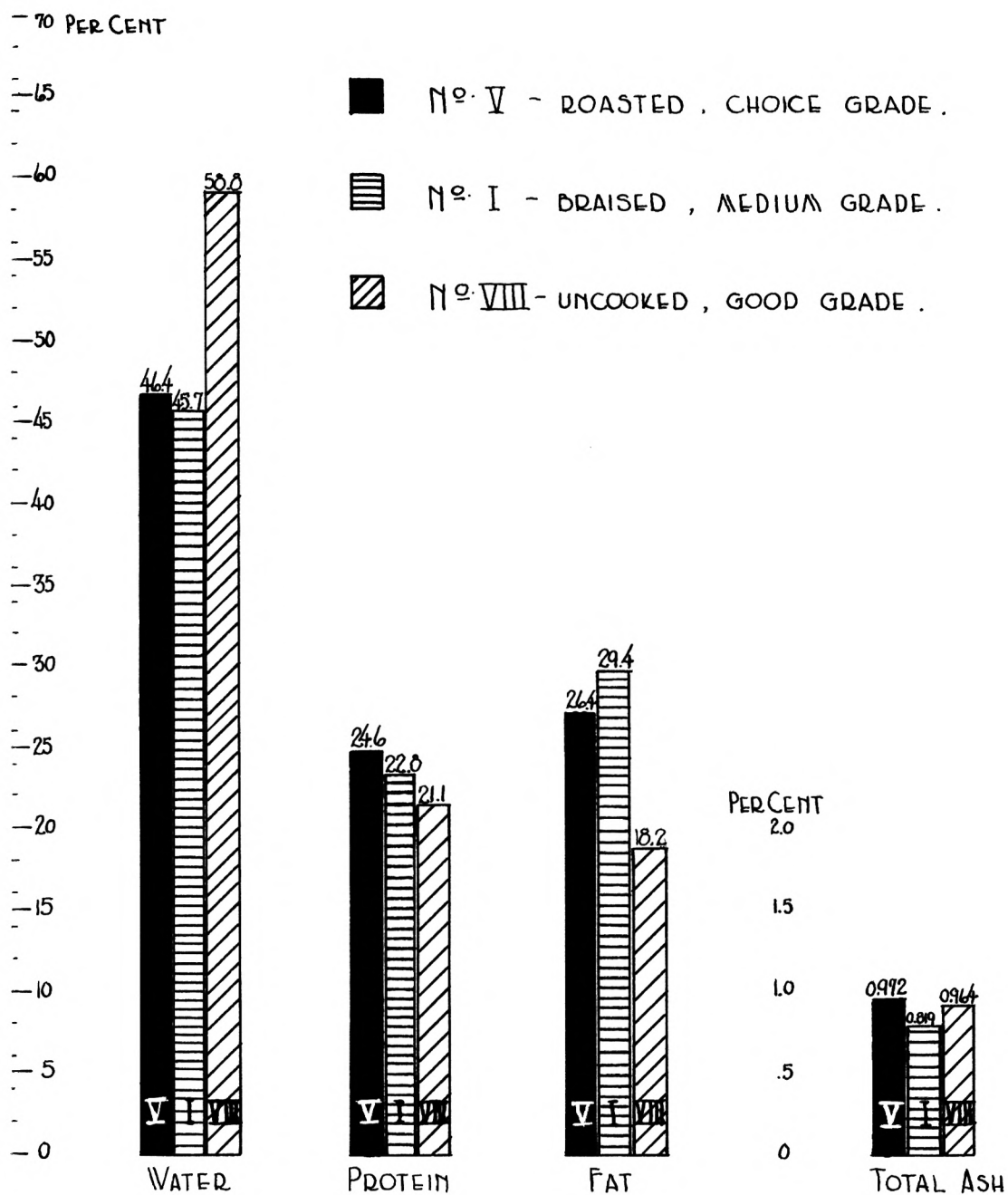


FIG. 1. DRAISED, ROASTED, AND UNCOOKED TOP CLODS COMPARED AS TO COMPOSITION.

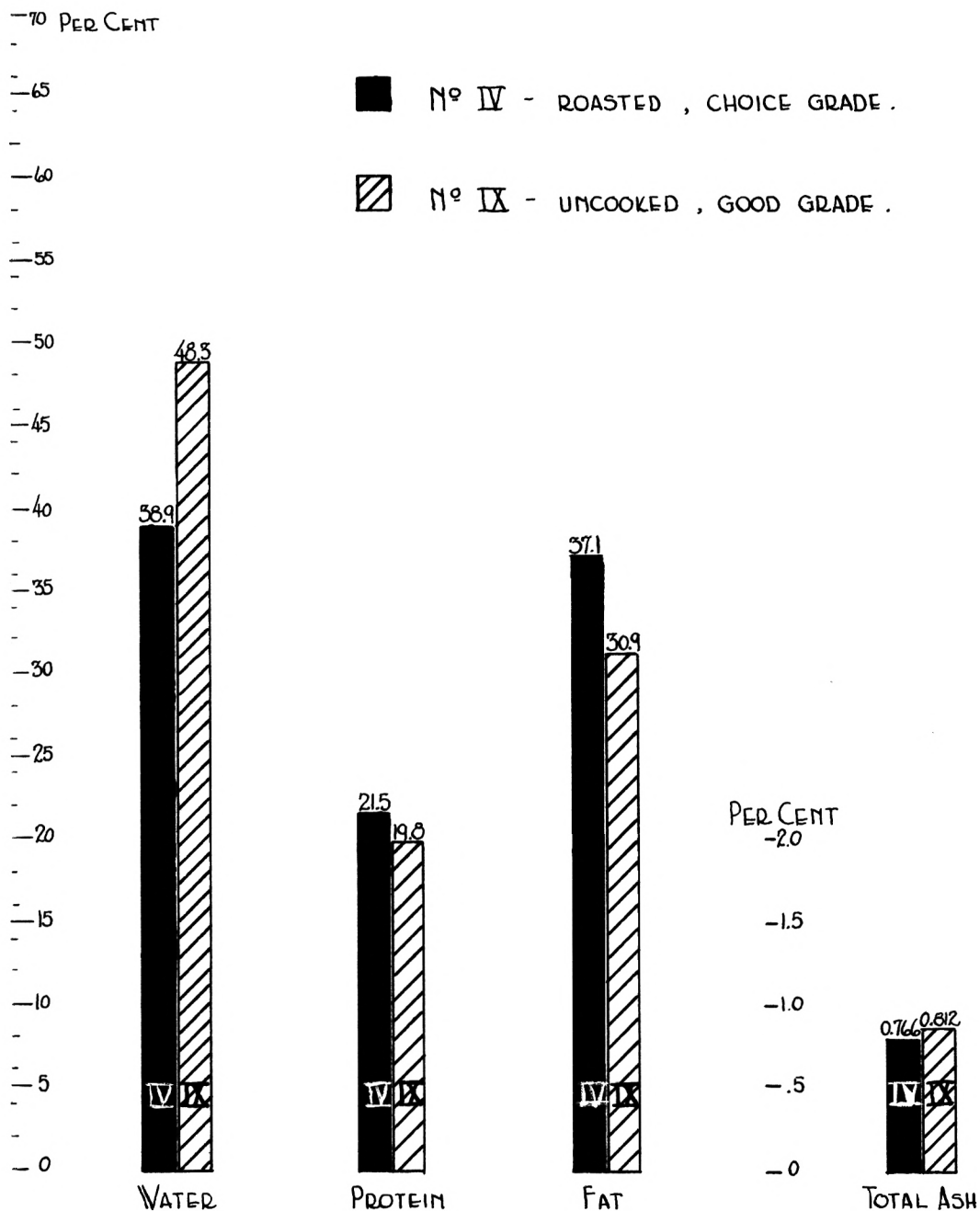


FIG.2. ROASTED AND UNCOOKED RIBS
COMPARED AS TO COMPOSITION.

in the uncooked meat (9.45 per cent) and the protein was slightly lower. The uncooked rib also contained 6.07 per cent less fat while the differences in total ash were negligible. The calcium and phosphorus values were higher in the raw sample while the iron was higher in the cooked meat. Here too, these differences may have been the effect of grade as well as of cooking.

More important and interesting results were obtained on beef round (Figure 3). Comparison of two braised paired bottom round cuts of good grade (Nos. VI and VII) showed but little difference in chemical composition. Such differences as were noted were undoubtedly due to the method of braising used as one was cooked in a steam-jacketed kettle and the other in a covered roaster. No. VI contained slightly more water and ash than sample No. VII and was accordingly lower in protein and fat.

Another group of paired top round cuts of good grade, Nos. X and XI, were compared as to the effect of roasting on the raw meat (Figure 3). The uncooked sample (No. X) was found to contain 6.7 per cent more water and 0.045 per cent more total ash while the protein and fat were lower, 5.39 and 2.46 per cent, respectively. However, the roasted round contained more calcium, phosphorus, and iron even though the uncooked meat was slightly higher in total ash.

Top round cuts, Nos. III and XI, both cooked by roast-

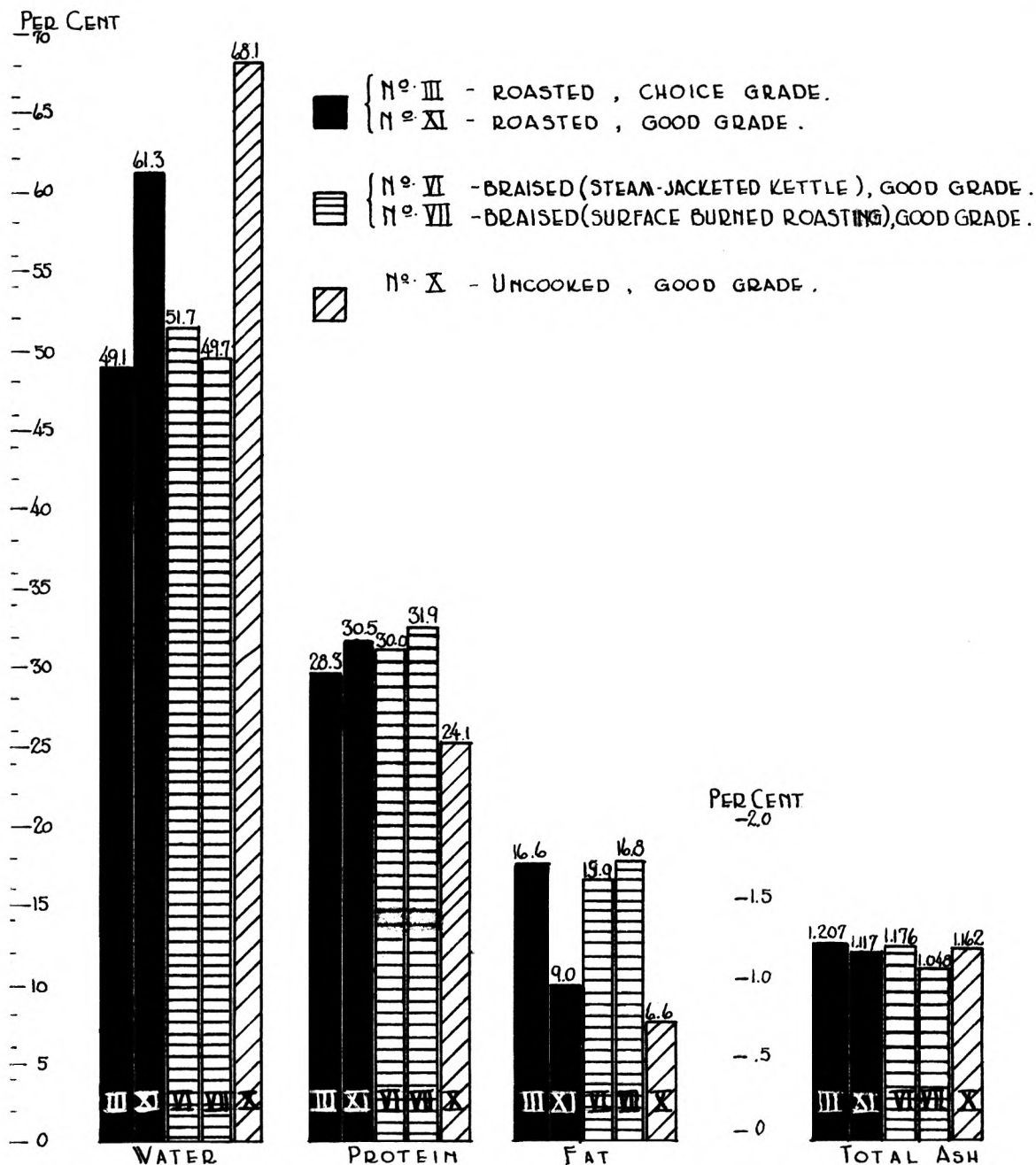


FIG. 3. BRAISED, ROASTED, AND UNCOOKED TOP AND BOTTOM ROUNDS COMPARED AS TO COMPOSITION.

ing, offered an opportunity to contrast the effects of roasting upon meats differing considerably in degree of fatness (Figure 3). No. III which was of choice grade contained nearly double the amount of fat of No. XI, which was graded good. In accordance with other analyses the leaner meat was found to contain more water (12.19 per cent), more protein (1.19 per cent), and less fat (7.54 per cent). Contrary to results of other workers this particular lean cut was slightly lower in total ash. Calcium and phosphorus values were nearly identical in the two meats but the iron was considerably higher in the fat meat (Table 2).

Upon comparing the roasted top round No. XI with bottom round samples, Nos. VI and VII, all of good grade (Figure 3), but cooked by different methods and representing different portions of the round, the protein values were found to be nearly identical whereas in a roasted top round of choice grade (No. III) the protein was slightly lower.

When the average for the cooked top clod, rib, and top and bottom round cuts is compared as to composition (Figure 4) it is seen that round was highest in water, protein, and total ash but lowest in fat. In the same way rib was highest in fat but lowest in water, protein, and total ash. Clod was intermediate in value for each of these constituents. This appears to be in accord with Chatfield's suggestion (2) that a relationship exists between the fat of a

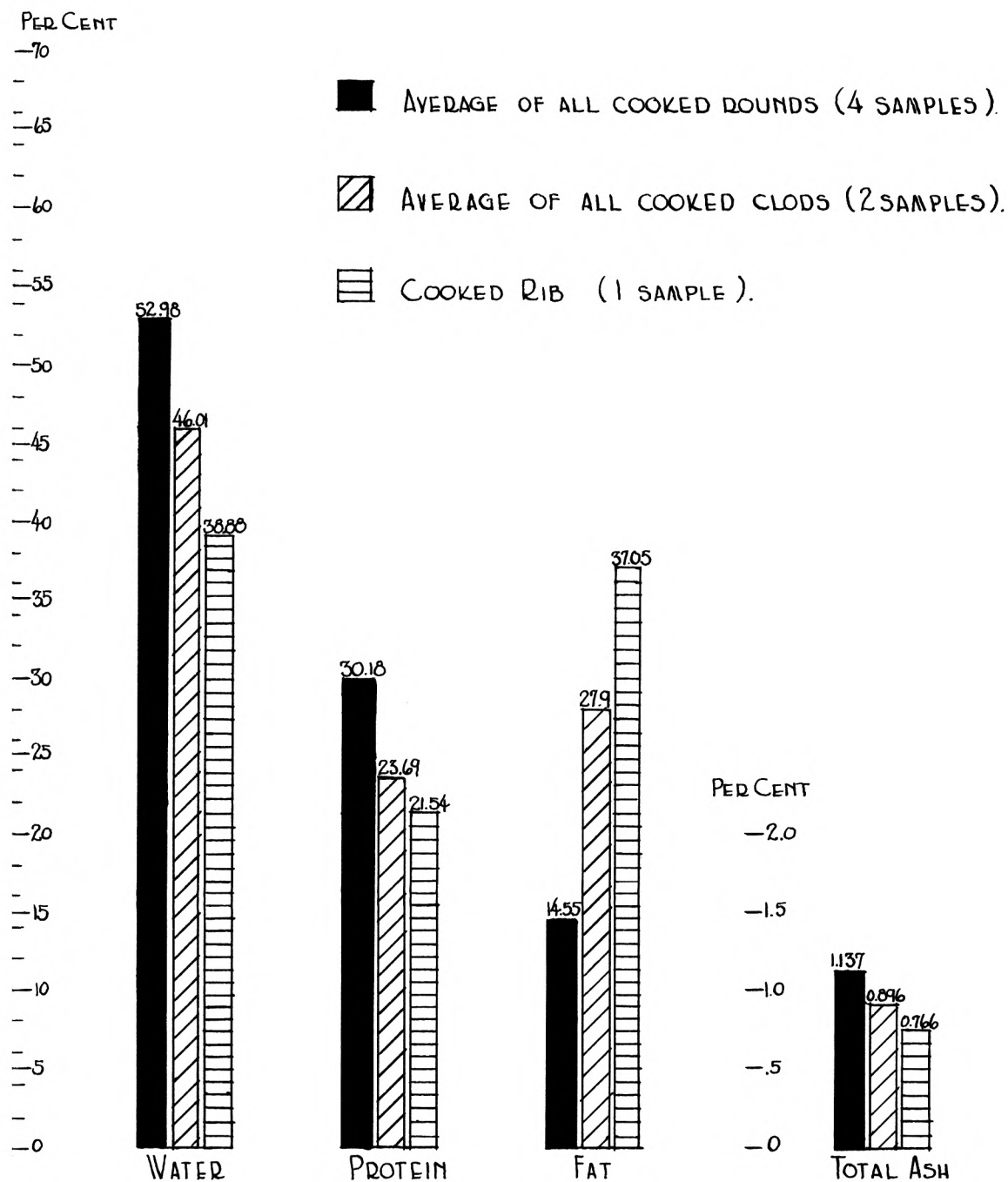


FIG.4. COMPARISON OF COOKED CLOD, RIB, AND ROUND CUTS AS TO COMPOSITION .

given cut and its other constituents. It also emphasizes the well established fact that ribs are a fat cut, while round is a decidedly lean one, and clod falls between these two extremes.

The average composition for all cooked beef cuts used in this study is compared with raw beef in Figure 5. Cooking obviously decreased the water content and concentrated the protein and fat for these cuts in general. The differences for total ash were too slight or too irregular to emphasize.

CONCLUSIONS

1. Beef cuts high in fat tended to be low in water, protein, and total ash, whether cooked or uncooked, with those low in fat the opposite was true. Ribs were highest in fat, clod was intermediate, and round lowest of the cuts studied.
2. All cuts lost water and gained in protein and fat content with cooking.
3. The ash values were not consistent except that cooked cuts were uniformly higher in iron than uncooked ones. In most cases the cuts high in protein, either cooked or uncooked, were also high in phosphorus. Total ash for cooked cuts averaged slightly higher than for uncooked ones, although there were individual exceptions.

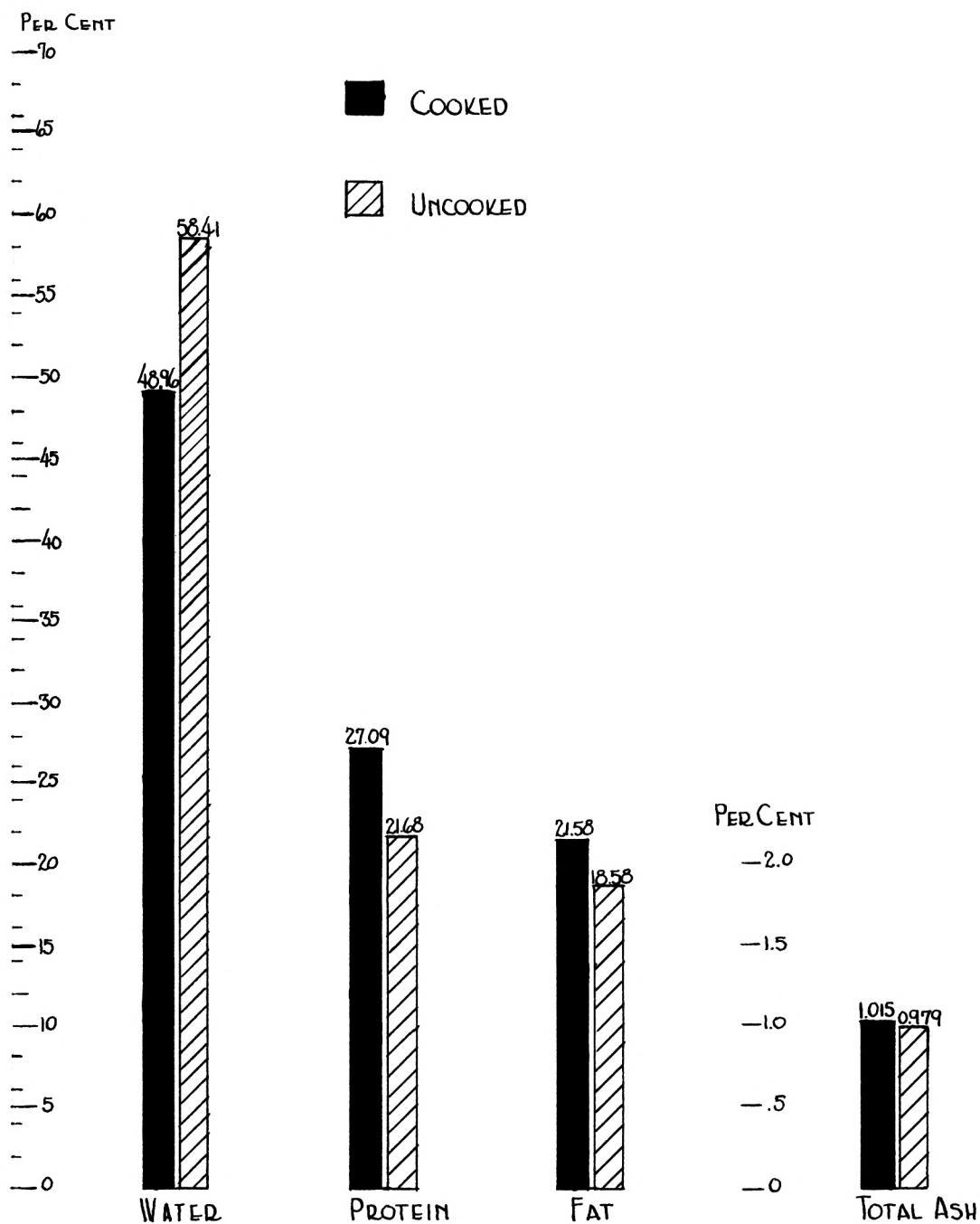


FIG. 5. COMPARISON OF COOKED WITH UNCOOKED BEEF CUTS AS TO COMPOSITION.

4. Paired bottom round cuts were similar as to composition with the two methods of braising used in this study.
5. The average for all braised samples regardless of cut or grade was very close to that for all roasted samples. Apparently cooking was the factor affecting the composition of the meat used in these experiments rather than the method of cooking used.

ACKNOWLEDGMENT

The writer wishes to express her appreciation to Dr. Martha S. Pittman, her major instructor, and to Bernice L. Kunerth and Isabelle Gillum, all of the Department of Food Economics and Nutrition, for their interest and guidance in all matters pertaining to this study; to Henry Wilbert Loy, Jr. of the Chemical Laboratory of the Kansas State Experiment Station for assisting with the fat and iron analyses; and to the Department of Institutional Economics for the cooking of the meat samples.

LITERATURE CITED

- (1) Atwater, W. O., and Bryant, A. P.
The chemical composition of American food materials. U. S. Dept. Agr. Bul. 28, rev. ed., 87 p. 1899.
- (2) Chatfield, Charlotte.
Proximate composition of beef. U. S. Dept. Agr. Cir. 389, 19 p. 1926.
- (3) Fowler, A. F., and Bazin, Eleanor V.
Analysis of meat and fish used in high carbohydrate-low calorie diabetic diets. Jour. Amer. Diet. Assoc. 11: 14-17. May, 1935.
- (4) Hanna, Marion I.
Analyses of cooked meats deprived of visible fat. Jour. Amer. Diet. Assoc. 9: 188-198. Sept., 1933.
- (5) Leach, Albert E., and Winton, Andrew L.
Food inspection and analysis. 4th ed. New York. John Wiley & Sons, Inc., 1090 p. 1920.
- (6) Loy, Jr., Henry Wilbert.
A study of the mineral constituents of blood, muscle tissue, and adipose tissue of beef animals in relation to the shrinkage, palatability, and keeping qualities of meat. Unpublished thesis, Kansas State College, 57 p. 1933.
- (7) Official and tentative methods of analysis of the Association of Official Agricultural Chemists. Committee on Editing Methods of Analysis. Washington, D. C. Association of Official Agricultural Chemists, Washington, D. C., 535 p. 1925.
- (8) Rose, Mary Swartz.
A laboratory handbook for dietetics. 3rd ed. New York. Macmillan, 269 p. 1929.
- (9) The terminology in food preparation. A report of the Terminology Committee of the Foods and Nutrition Division of the American Home Economics Association, 45 p. June, 1935.

- (10) Toscani, V. A., Rupp, V. R., and McClellan, W. S.
Analyses of meats. Jour. Nutrition 7: 475-480.
April, 1934.
- (11) Woods, Charles D.
Meats: composition and cooking. U. S. Dept.
Agr. Bul. 34, 31 p. March, 1915. (reprinted
from 1895 publication).