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A STUDY OF THE USES OF  
DRIPPINGS AND OTHER SURPLUS  
FATS AVAILABLE IN INSTITUTIONS

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A STUDY OF THE USES OF DRIPPINGS AND OTHER SURPLUS FATS  
AVAILABLE IN INSTITUTIONS

by

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A THESIS

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THESIS



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## I. INTRODUCTION

Practically every institution that serves food and which purchases meats in wholesale cuts has a considerable quantity of drippings and other surplus fats\* left after the preparation and utilization of these cuts. Since these fats have been paid for it should be of value to know whether it is economical to save and use them or dispose of them in some other manner. This should be especially important if the food establishment must operate at a low cost.

It is known that some institutions have very definite uses for these fats such as: deep frying, seasoning vegetables, and soap making. Others sell that which they cannot use to tallow companies for commercial soap making. Still others throw the fats away or give them to employees who may be able to use them. But for the most part little is known concerning the extent to which food service institutions use surplus fats or for what purposes they use them.

The lack of knowledge concerning the uses and economic importance of surplus fats in food service institutions led to this study. The purpose of the study was three-fold:

1. To learn what drippings and other surplus fats institutions have and how they use them.

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\*For this study "Drippings" are those surplus fats which have dripped from cooked meat, which have been separated from any liquid and which remain after the meat has been served. "Other surplus fats" are those fats trimmed from the meat and not needed or used in cooking.



2. To determine whether drippings can be used in preparation of foods.

(a) Through a study of their use as shortening in baking powder biscuits.

3. To determine the value of mixtures of surplus fats for deep frying by measuring the chemical changes that follow repeated heating.

## II. REVIEW OF LITERATURE

A study of the literature indicates that up to the present time no material has been written concerning surplus fats and their uses in food service institutions.

In various quantity cookery books recipes are to be found which include surplus fats as an ingredient. However, it is not known how widely these recipes are used nor if they are used with satisfactory results. Recipes for soups, meats, entrees, vegetables, muffins, steamed puddings, and cookies are to be found in quantity cookery books by Treat and Richards (1), Smith (2), Hart (3), Smedley (4), and Fowler and West (5). Smith (6) in a later book "More Recipes for Fifty" describes methods to deodorize and clarify surplus fats. It seems that more recipes using surplus fats as an ingredient were available during the period after World War I than are available in the more recent books.

Howard (7) in a study of the "Left Over Food Problem in Institutions" includes a chart which lists bacon fat as used for frying and other fats as flavoring in main dishes.

Berolzheimer (8) director of Culinary Arts Institute and editor of The American Woman's Cook Book writes that for home use the use of "lard and meat drippings for shortening and cooking dates from the time when all fats were prepared in the home. Fat from chicken and other poultry is highly prized for cake making. Bacon, ham, and sausage fats

are too highly seasoned for any but limited use but are excellent for sautéing any food where their seasonings are desirable. Drippings are not possible for deep fat frying because they burn so easily, unless clarified and combined when they become a good mixed fat. They may be used for sautéing or in seasoning." She writes further that "shortening is a term which includes fat of any kind that is used in pastry, doughs, and batter. Any clear sweet fat may be used. The best known are solid vegetable fats, margarine, salad and cooking oils and drippings. In general they may be used interchangeably for 'shortening' in a recipe, remembering any difference in flavor." Directions on "How to Render Fat" and "How to Clarify Fat" are also found in this book.

Literature on the chemical constants of drippings and other surplus fats is also very limited. Leach and Winton (9) in a "Table of Range of Constants and Variables of Common Edible Fats and Oils" give the Iodine number, Saponification number, and Reichert-Meissel number of beef tallow and mutton tallow. Mathews (10) gives the Iodine number of the above fats while MacLeod and Mason (11) list the melting point and fatty acid content of these fats. Bodansky (12) in a "Table of the Constants of Fats and Oils" gives the Specific Gravity, Solidifying point, Saponification number, Iodine number, and Acid number of beef tallow. McClendon (13) gives the melting point, Iodine number, and Saponification numbers of beef fat and pork fat. Sherman (14) lists the melting point of mutton tallow and bacon fat. Lewkowitsch (15) gives the Saponification value, Iodine value, and Reichert-Meissel value for beef tallow, mutton tallow, and chicken fat. Lowe (16) includes a table which indicates the percentage of unsaturated glycerides found



in chicken fat.

Lewkowitsch discusses beef and mutton tallow from the standpoint of their use in manufacture of oleomargarine, adulteration of butter, and commercial soap making but makes no reference to their use in food preparation. The other authors merely list the constants with no discussion of them or of the fats.

No literature could be found stating the chemical constants of surplus fats determined before or after use in deep frying. There is a definite need for detailed studies of surplus fats either separately or in specified mixtures before and after use in deep frying.

### III. METHOD OF PROCEDURE

The procedure for this study consisted of (A) a survey which included interviews with various food service institutions and analyses of replies to a questionnaire sent to food service institutions throughout the United States; (B) a study of the use of drippings as shortening in baking powder biscuits; (C) the determination of the effect of heat on the chemical constants of two known mixtures of surplus fats.

A. Survey. A survey was made of the following types of institutions to determine what drippings and other surplus fats they had and how they used them:

1. Hotels, hospitals and restaurants in Lansing, East Lansing, and several cities in Ohio were visited and interviews were held with persons directly or indirectly responsible for the food service. The following questions were asked:

a. What kinds of drippings and other surplus fats do you have?

b. How are each of the following surplus fats used? bacon fat? beef fat? chicken fat? lamb fat? fresh pork fat? ham fat? sausage fat?

c. Are the drippings and other surplus fats used for deep frying? If so, how long are they used?

d. Are the surplus fats used separately or combined?



e. Do you have any method for making the surplus fats usable?

If so, what?

2. Questionnaires were sent to commercial cafeterias, hospitals, hotels, high school cafeterias, and college cafeterias in various parts of the United States. One hundred and fifty questionnaires were sent, thirty to each type of institution. Questionnaires were sent to each of the forty-eight states, although those states with the larger cities received more. Information obtained from the interviews aided in formulating the questionnaire which is to be found in the Appendix.

B. Baking Study. As an example of the use of surplus fats in baking, a study of baking powder biscuits was made in which drippings were used as the shortening. The biscuits were made with a standard formula using each of six kinds of drippings as the shortening and were compared with biscuits made with lard. The bacon, beef, chicken, fresh pork, ham, and sausage drippings used were collected from an institution kitchen before the experiment began and were stored in cans in the refrigerator during the course of the experiment. The formula was developed according to the method suggested in Lowes' Experimental Cookery (17). The biscuits were made ten times with each dripping and each time they were also made with lard so that during scoring the judges could compare those made with dripping and those made with lard. Three judges, all institution trained people, scored throughout the entire study. Before beginning the experiment the judges were thoroughly familiarized with all terms on the score sheet. The formula developed was as follows:

## Ingredients:

Pastry Flour .....	100	grams
Bread Flour .....	50	"
Fat .....	37.5	"
Milk .....	102.0	"
Calcium Phosphate Baking Powder.	10.0	"
Salt .....	1.5	"

All ingredients were weighed on a trip balance. The flour was taken from the same bags throughout the study and was thoroughly mixed before weighing. As chicken and bacon drippings had a tendency to liquify at room temperature because of the low melting points, all fats were kept in the refrigerator until just before being weighed and mixed with the flour.

Method: Sift baking powder and salt with flour. Add fat and mix with tips of fingers until flour mixture resembles coarse cornmeal. Form a cavity in center of flour mixture. Pour milk into this cavity and stir vigorously. Stir 20 strokes with a silver fork. Remove dough with a spatula to a lightly floured board. (5 grams of flour was used except with bacon and chicken drippings: 10 grams was used for the former and 15 grams for the latter). Knead 30 times. Place an embroidery hoop over the dough. Roll to desired thickness and cut so that each disbuit weighs 30 grams and is the same thickness. Place in a pan by means of a spatula and bake 12 minutes at 425° F.

The time and procedure was arranged so that the biscuits were not allowed to stand after being cut out and placed in a pan. To do this it was necessary to weigh the dry ingredients for each batch to be used for a specific fat. After weighing, the dry ingredients were sifted into stainless steel bowls. Then the fats were weighed and immediately

mixed with the dry ingredients. All of the milk was weighed, that for each batch in a separate bowl. A silver fork was used for stirring the milk into each mixture. This process was carefully timed so that as soon as the liquid was stirred into the mixture, the dough was kneaded, rolled, and cut. Then the biscuits were placed in a pan and immediately into the oven. Kneading, rolling, and cutting were done on wax paper so that flour and dough would not be lost by sticking and fractional loss could be reduced.

The biscuits were baked in an institution electric oven which was thermostatically controlled. An oven thermometer was used so that the temperature could be watched as closely as possible. An institution electric oven was used in order that conditions would be similar to those in institutions.

The judges scored the biscuits as soon as they were removed from the oven. The score sheet used was developed from a combination of score cards from "Food Preparation Studies" by Clara M. Brown. In compiling, emphasis was placed on those factors which it was thought would probably be affected by the use of drippings in the standard formula. The score sheet as used is listed in the Appendix.

C. Study of Chemical Changes. The following chemical constants were determined on two known mixtures of surplus fats obtained from an institution kitchen before and after use in deep frying: Acid; Saponification number; Iodine number; Reichert-Meissel number.

The determinations were made according to "Methods and Analyses" by the Association of Official Agricultural Chemists (13) and "Food Inspection and Analysis" by Leach and Winton (9).



The constants were determined for each mixture before the fat was used for deep frying and after it had been used or when it was thought that the fat should be discarded. Apparently no scientific method has been devised whereby one can determine when these fats should be discarded or how long they can be used with satisfactory results. The type of food fried determined the length of time the mixtures analyzed in this study were used.

The constants for each mixture were determined two different times. The first time three determinations\* were made for each constant. The second time two determinations\* were made.

The two fat mixtures varied in composition and were used in different cooking procedures. Mixture A consisted of 12 parts beef fat, 10 parts ham fat and 3 parts pork fat. This mixture was used seven days for French fried potatoes and once for fish. Mixture B consisted of 13 parts ham fat and 21 parts beef fat. This mixture was used four days for French fried potatoes and once for croquettes.

Surplus fats in this institution were rendered in a large pot at a low temperature on top of the stove. When the fat was thought to be completely rendered it was strained through cheese cloth and placed in the fryer.

It could not be learned how many times potatoes were French fried or how many times the fat was heated, cooled, and reheated. An electric fryer was used, so it was not necessary to clarify or strain the fat during its use for frying.

This institution as well as many others which utilize surplus fats

\*Each determination consisted of a duplicate sample and blank.

for deep frying used just those fats which accumulated, whatever the proportions were. It was thought determinations of constants of mixtures actually found would be of more practical value than if mixtures were made of fats and in proportions which institutions might not have.

#### IV. DISCUSSION OF RESULTS

A. Survey. 1. Interviews. Of the interviews held with the persons responsible for the food service in twenty institutions, 50% used drippings and other surplus fats in food preparation, while 40% did not (table I). The 50% included those in charge of the food service in all the hospitals and hotels visited, but only two commercial institutions. In two commercial institutions the surplus fats were thrown away, in six the fat was sold for soap grease and in two others interviews could not be arranged as they alleged they were too busy.

TABLE I

##### INTERVIEWS: INSTITUTIONS USING DRIPPINGS

Type of Institution	Number Interviewed	Number Using Drippings	Number Not Using Drippings	Used Drippings Per cent	Did not Use Drippings Per Cent	No Information
Commercial Institutions.	12	2	8	16.6	66.6	2
Hospitals....	5	5	-	100.0	-	-
Hotels.....	3	3	-	100.0	-	-
Totals	20	10		50.0	40.0	10.0

Both drippings and other surplus fats were used and in most cases no differentiation was made between the two types of fat. Foods were prepared with bacon and beef fats in more institutions than with sausage,



lamb, fresh pork, ham, and chicken fats (table II). The kind of fat used varied with the type of institution for bacon, beef, and chicken fats were used in commercial institutions, bacon, beef, and lamb fats in hotels, and all but sausage fat in hospitals. One hotel served no lamb except in the form of chops and no pork or sausage. Chicken was served in all the hotels, but the fat was no considered surplus as it was all used in preparation of gravy or the chicken. Lamb, fresh pork, ham, and sausage were served in commercial institutions, but it was reported that there was no surplus fat from these meats.

TABLE II

INTERVIEWS: KIND OF DRIPPINGS AND OTHER SURPLUS FATS USED

Kind	Commercial Institutions	Hospitals	Hotels	Total	Per Cent
Bacon.....	2	4	3	9	45.0
Beef.....	2	3	3	8	40.0
Chicken.....	1	3	-	4	20.0
Lamb.....	-	1	1	2	10.0
Fresh Pork...	-	2	-	2	10.0
Ham.....	-	2	-	2	10.0
Sausage.....	-	-	-	-	-

The uses that were made of the various fats depended upon the kind of fat as well as on the type of institution. Bacon drippings had a total of ten different uses (table III). Eggs were fried in this fat in more than half of the institutions and in more than a third it was used in preparation of such "made dishes" as Spanish rice, Italian ma-

TABLE III  
INTERVIEWS: USES OF BACON DRIPPINGS

Use	Commercial Institutions	Hospitals	Hotels	Totals	Per Cent
Baked Beans.....	2	4	-	6	30.0
Deep Frying.....	-	1	-	1	5.0
Fry Eggs.....	2	5	3	10	50.0
Fry Potatoes.....	-	1	2	3	15.0
Gravy.....	-	-	-	-	-
Made Dishes.....	2	5	-	7	35.0
Muffins (Bacon)...	-	2	-	2	10.0
Season Vegetables..	-	1	-	1	5.0
Semi-deep Frying..	-	-	1	1	5.0
Soup (Navy Bean)...	-	1	-	1	5.0
Wilted Lettuce....	-	5	-	5	25.0

caroni and spaghetti. It was reported in several hotels that except on request bacon drippings could not be used for food served in the main dining room because of the type of clientele to which they catered and because of this fact this fat was used mostly in preparation of food for their help. One hospital gave some bacon drippings to its help to take home.

Apparently it was thought that beef drippings were less satisfactory than bacon drippings for food preparation for this fat had only eight uses (table IV). Gravy was prepared with beef drippings in a fourth of the institutions and in a fifth this fat was used for deep frying, frying, and suet pudding. By "frying" they meant such foods

as home style fried potatoes, fried onions, and browning meats before baking as swiss steak, braised liver and pork chops, in other words, sautéing. In soup preparation these drippings were added to the stock and in seasoning vegetables they were added to the other seasonings used.

TABLE IV  
INTERVIEWS: USES OF BEEF DRIPPINGS

Use	Commercial Institutions	Hospitals	Hotels	Totals	Per Cent
Deep Frying.....	1	1	2	4	20.0
Dumplings.....	1	-	1	2	10.0
Frying.....	2	1	1	4	20.0
Seasoning Vege- tables.....	-	1	-	1	5.0
Soup.....	-	1	-	1	5.0
Yorkshire Suet Pudding.....	-	3	1	4	20.0
Gravy.....	2	2	1	5	25.0

Perhaps less chicken than other meats was served in these institutions for the drippings from this meat had only three uses (table V). In two hospitals this fat was found very satisfactory for shortening in light and dark cakes. Biscuits made with this fat and served with creamed chicken and chicken pie were very popular in two other hospitals. Gravy was the only use found for this fat in commercial institutions. In one hotel it was reported that if requested eggs would be fried in chicken drippings or fat. It was found that one of the commercial institutions which was too busy to arrange for an interview and

TABLE V  
INTERVIEWS: USES OF CHICKEN DRIPPINGS

Use	Commercial Institutions	Hospitals	Hotels	Totals	Per Cent
Biscuits.....	-	2	-	2	10.0
Cakes.....	-	2	-	2	10.0
Gravy.....	1	3	-	4	20.0

which served a great deal of chicken, sold all chicken drippings and fat to the Jewish trade, and that the demand for this fat was greater than the supply. The price received was such that it would seem profitable for any institution which served a great deal of chicken to sell the surplus fat, providing a trade could be developed.

Evidently lamb drippings were less popular than the other drippings mentioned, for this fat was used for gravy in only two institutions and in one of these it was mixed with other fats for deep frying. As far as could be learned, lamb was not served in the other institutions or, if so, the drippings were not used (table VI).

TABLE VI  
INTERVIEWS: USES OF LAMB DRIPPINGS

Use	Commercial Institutions	Hospitals	Hotels	Totals	Per Cent
Gravy.....	-	1	1	2	10.0
Mixed for Deep Frying.....	-	-	1	1	5.0



The fact that fresh pork and ham were not served in several of the institutions, and that in several where these meats were served there was no surplus fat probably accounts for the limited use of these drippings. Split pea soup and green beans were the only foods prepared with these fats, (table VII).

TABLE VII

## INTERVIEWS: USES OF FRESH PORK AND HAM DRIPPINGS

Use	Commercial Institutions	Hospitals	Hotels	Totals	Per cent
Split Pea Soup...	-	2	-	2	10.0
Season Green Beans.....	-	2	-	2	10.0

Lard and hydrogenated fats were more popular than surplus fats for deep frying in the institutions interviewed. In the hospital where these fats were used for deep frying, bacon was combined with beef fat and trimmings and if this was not enough, lard or a hydrogenated fat was added. In one hotel lamb was sometimes mixed with beef and other fats but usually only beef drippings were added to the trimmings from beef for deep frying. In all institutions the fats were rendered and strained.

In the hospital the fat was used until it became dark and smelled strong, while in the hotels it was used until it started to foam, and in the commercial cafeterias it was used two days. The type of food fried or the number of times the fat was reheated was not considered in determining when it should be discarded.

2. Questionnaires. Of the questionnaires sent to the various institutions, 52.6 % were returned with replies. A larger percentage of hospitals replied than other institutions, college cafeterias were second in number of responses, high school cafeterias third and commercial cafeterias and hotels fourth. Commercial cafeterias and hotels replied in equal numbers (table VIII).

TABLE VIII  
SUMMARY OF QUESTIONNAIRES

Type of Institution	Number Questionnaires Sent	Number Replied	Replied Per Cent
Commercial Cafeterias...	30	12	40.0
Hospitals.....	30	26	86.6
Hotels.....	30	12	40.0
High School Cafeterias..	30	14	46.6
College Cafeterias.....	30	15	50.0
Totals.....	150	79	52.6

Drippings were used in all of the institutions, the use depending upon the kind and type of institution. In over 75% of the institutions, foods were prepared with bacon and beef drippings and in over 66 2/3% with chicken, fresh pork, and ham drippings. Sausage drippings were used in over one half and lamb drippings in less than one half of the food service establishments. The following meats, fresh pork, ham, sausage, and lamb, were not served in some of the hotels and in others lamb was featured only in the form of chops. Consequently, the amount of surplus fats from these meats was very limited. The majority of

high school cafeterias served only one meal daily and offered the students vegetables, fruits, and milk rather than much meat. When meat was served, there was little variety and the portions were small, so that both the quantity and kinds of drippings were limited (table IX).

TABLE IX  
QUESTIONNAIRES: KINDS OF DRIPPINGS USED

Kind of Dripping	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Bacon.....	11	26	8	9	11	65	82.2
Beef.....	9	22	11	11	11	64	81.0
Chicken.....	10	14	7	8	12	51	64.5
Lamb.....	7	12	6	7	5	37	46.8
Fresh Pork....	10	19	5	6	11	51	64.5
Ham.....	10	19	4	8	10	51	64.5
Sausage.....	10	18	6	4	9	46	58.2

The uses reported for bacon drippings were numerous and varied (table X). In over one fourth of the institutions vegetables were seasoned with this fat, in over one tenth, eggs were fried and scrambled, potatoes were fried, and other foods were sauteed or fried. The term "frying" was given as a use for bacon drippings and some of the other drippings but the replies did not indicate what foods were "fried."

In preparation of salad dressings, such hot salads as wilted lettuce, hot potato salad, and hot cole slaw were mentioned as prepared with bacon drippings and such main dishes as Spanish rice, Italian spaghetti, Spanish noodles, and macaroni. The vegetables seasoned with this fat were spinach, green beans, navy and lima beans, parsnips, and

TABLE X

QUESTIONNAIRES: USES OF DRIPPINGS  
USES OF BACON DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Baked Beans...	-	-	-	1	-	1	1.2
Cornbread.....	-	1	-	-	-	1	1.2
Deep Frying...	-	-	1	-	-	1	1.2
Fry Potatoes..	1	4	-	1	3	9	11.3
Fry Meat.....	-	1	1	-	-	2	2.5
Frying.....	2	5	2	-	-	9	11.3
Fry and Scramble Eggs.	-	7	-	-	3	10	12.6
French Toast..	-	-	-	-	1	1	1.2
Gingerbread...	-	-	-	-	1	1	1.2
Grease Pans...	-	1	-	2	-	3	3.7
Gravy.....	-	-	-	1	-	1	1.2
Made Dishes...	2	-	-	3	2	7	8.8
Muffins.....	-	-	-	-	1	1	1.2
Season Veg....	2	8	2	2	7	21	26.5
Sauces.....	-	-	1	-	-	1	1.2
Sauté.....	2	5	-	-	2	9	11.6
Soups.....	1	-	-	-	1	2	2.5
Salad Dressings.....	2	-	-	-	-	2	2.5
Potato Pancakes	1	1	1	-	1	4	5.0

cabbage, and the soups included navy bean, puree of lima bean, split pea, puree of pea, tomato bouillon, and corn chowder. Many replies did not specify what foods were prepared with this fat.

In some institutions, it was reported that bacon drippings were



not used because the taste of smoked fat was noticeable and objectionable. In others it was reported that this fat was satisfactory only in those foods where the flavor could not be detected or would not be undesirable. Several reported budgets so limited that it was found necessary to use this fat even though the flavor was noticeable and more or less objectionable.

While beef drippings were used in nearly as many institutions as bacon, the total different uses were only thirteen. Gravy was prepared with this fat in more institutions than were other foods. Gravy and deep frying were the more important uses for this fat (table XI).

TABLE XI

QUESTIONNAIRES: USES OF DRIPPINGS  
USES OF BEEF DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per cent
Baking Powder Biscuits.....	-	-	-	2	2	4	5.0
Deep Frying...	3	7	3	1	-	14	17.7
Dressing.....	1	1	-	1	2	5	6.3
Frying.....	4	-	2	-	1	7	8.8
Grid Frying...	1	-	-	-	-	1	1.2
Gravy.....	3	6	-	6	3	18	22.7
Grease Pans...	-	-	-	1	-	1	1.2
Sauces.....	-	-	-	-	1	1	1.2
Sauté.....	-	-	-	4	-	4	5.0
Seasoning.....	-	-	-	-	2	2	2.5
Soup.....	-	2	-	1	3	6	7.5
Suet Pudding..	1	-	-	-	-	1	1.2
Yorkshire Pudding.....	-	-	2	-	-	2	2.5

In soup preparation the drippings were added to the stock. Some reported using this fat for greasing pans, but the only pans greased with beef fat were those in which meats or dressings were to be baked. In one institution it was reported that this fat could not be used because of the complaint of "fishy taste." Davies (19) found that some fats tend to have a "fishy taste" when they become rancid, which may have been the case with the beef drippings in this particular institution.

Chicken drippings had twenty-four different uses, the greatest variety for any of the drippings. In one-third of the institutions gravy was prepared with this fat and in one tenth, sauces and soups were prepared. A considerable number indicated that this fat was found satisfactory for shortening in cakes, cookies, pastry dough, and biscuits (table XII). In one institution, where dark cakes were made with this fat it was reported that the product was thought superior to those made with any other fat except butter. It could not be learned how ice cream was prepared with chicken drippings, although no doubt it would have been interesting. In several institutions this fat was substituted for butter in white sauces, soups, and seasonings. When used in dumpling dough one institution mentioned that the dumplings were served with fricassee of chicken.

The replies to the questionnaires indicated that lamb drippings were less popular than other drippings in food preparation. In some of the institutions gravy was prepared with this fat, but in the majority of cases this fat was not used even for that (table XIII). Lamb was not served in some institutions, in others only chops were served

TABLE XII

QUESTIONNAIRE: USES OF DRIPPINGS  
USES OF CHICKEN DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Baking Powder Biscuits.....	-	1	-	2	2	5	6.3
Chicken Pie Crust.....	-	-	-	1	2	3	3.7
Cookies.....	-	1	-	1	1	3	3.7
Creamed Chicken.....	-	-	-	1	-	1	1.2
Croquettes....	-	1	-	-	-	1	1.2
Dressings.....	-	1	-	1	-	2	2.5
Deep Frying...	-	1	-	-	1	2	2.5
Dumpling Dough	-	-	-	1	-	1	1.0
Frying.....	3	1	1	-	-	5	6.3
Fry Eggs.....	-	-	1	-	1	2	2.5
Fricassee.....	-	1	-	-	1	2	2.5
Gravy.....	7	8	-	3	6	24	33.3
Made Dishes...	-	-	-	-	1	1	1.2
Noodles.....	-	1	-	-	-	1	1.2
Pancakes.....	-	-	-	1	-	1	1.2
Pastry Dough..	-	-	-	1	1	2	2.5
Potato Salad..	-	-	-	1	-	1	1.2
Roux.....	3	-	1	-	1	5	6.3
Sauces.....	3	2	2	-	1	8	10.1
Sautéing.....	-	-	-	-	5	5	6.3
Seasoning.....	-	2	2	-	-	4	5.0
Soup.....	2	6	1	-	3	12	15.1
Cake.....	-	-	-	-	1	1	1.2
Ice Cream.....	1	-	-	-	-	1	1.2

and in still others this meat was served but the fat was discarded. If gravy was served with this meat it must have been made with other fat. In one institution lamb drippings could not be used because of the strong flavor, while in another this flavor was found of value in strengthening soup stock.

TABLE XIII

QUESTIONNAIRES: USES OF DRIPPINGS  
USES OF LAMB DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Dumplings.....	-	-	1	-	-	1	1.2
Deep Frying....	1	-	-	-	-	1	1.2
Fricassee Sauce	-	1	-	-	-	1	1.2
French Fried Potatoes.....	-	-	1	-	-	1	1.2
Frying.....	-	-	1	-	1	2	2.5
Gravy.....	3	4	-	3	3	13	16.4
Mixed Beef Fat,	-	-	-	-	1	1	1.2
Roux.....	-	-	-	-	2	2	2.5
Scotch Broth...	-	1	-	1	-	2	2.5
To Strengthen Flavor.....	-	-	1	-	-	1	1.0

Since some institutions did not serve fresh pork it was expected that the variety in uses for the drippings from this meat would not be as great as for some of the other fats. In over one fifth of the institutions gravy was made with this fat and in over one tenth various foods were sautéed, deep fried, fried, and seasoned (table XIV). Three institutions reported that they did not have sufficient pork drippings

TABLE XIV

QUESTIONNAIRES: USES OF DRIPPINGS  
USES OF FRESH PORK DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Broiling.....	-	-	1	-	-	1	1.2
Dressing.....	-	1	-	-	-	1	1.2
Deep Frying....	1	3	-	1	1	6	7.5
Frying.....	2	1	1	1	-	5	6.3
Gravy.....	5	5	-	4	4	18	22.7
Grid Frying....	1	-	-	-	-	1	1.2
Grease Pans....	-	-	-	1	-	1	1.2
In Place of Lard.....	-	-	-	-	1	1	1.2
Prepare Food for Help.....	-	-	1	-	-	1	1.2
Roasting.....	-	-	1	-	-	1	1.2
Sautéing.....	1	-	-	1	5	7	8.8
Seasoning.....	-	1	-	1	3	5	6.3
Shortening.....	-	-	-	-	1	1	1.2
Soup.....	-	-	-	-	1	1	1.2

to establish a policy concerning them. In some institutions the same foods that were seasoned with bacon drippings were sometimes seasoned with pork and other drippings. One hotel person stated that French fried potatoes should always be fried in fresh pork drippings but since pork was not served in this hotel, lard was used for this purpose.

Ham drippings resemble bacon in flavor and therefore one might expect these two fats to have some similar uses. As was observed in the case of bacon drippings, in one fourth of the institutions vege-



tables were also seasoned with ham drippings. In over one tenth, gravy and soups were prepared with this fat (table XV). The vegetables seasoned with this fat were the same as the ones seasoned with bacon and fresh pork with the addition of spinach and sauerkraut. The soups mentioned were also the same as those seasoned with bacon drippings. One institution stated that this fat could not be used because of the sugar and spice flavor. In another, this fat was discarded because it smelled of smoke.

TABLE XV

QUESTIONNAIRES: USE OF DRIPPINGS  
USE OF HAM DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Baked Beans....	-	-	-	-	-	1	1.2
Braised Veg....	-	-	1	-	-	1	1.2
Casserole Dishes.....	-	-	-	-	1	1	1.2
Dressing.....	1	-	-	-	1	2	2.5
Frying.....	1	1	-	-	-	2	2.5
Gravy.....	4	3	-	1	2	10	12.6
Grease Pans....	-	-	-	1	-	1	1.2
Roasting.....	-	-	1	-	-	1	1.2
Sautéing.....	-	1	-	2	2	5	6.3
Season Vegetables.....	4	6	2	2	5	19	24.0
Shortening.....	-	-	-	-	1	1	1.2
Soups.....	1	4	-	3	3	11	13.9
Tomato Sauce...	-	1	-	-	-	1	1.2

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Sausage drippings which had a total of twelve uses were only slightly more popular than lamb drippings. In about one tenth of the institutions the same vegetables that were seasoned with ham drippings were also mentioned as being seasoned with this fat (table XVI). In several institutions this fat was not used because it was too highly seasoned and had a flavor too strong for use in cooking.

TABLE XVI

QUESTIONNAIRES: USES OF DRIPPINGS  
USES OF SAUSAGE DRIPPINGS

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Cornbread.....	-	-	-	-	2	2	2.5
Cream Gravy....	1	-	-	-	-	1	1.2
Deep Frying....	1	-	-	-	-	1	1.2
Dressing.....	2	-	2	-	1	5	6.3
Esc. Corn and Sausage.....	-	-	-	1	-	1	1.2
Esc. Potatoes and Sausage....	-	1	-	-	-	1	1.2
Frying.....	-	2	2	-	-	4	4.0
Fry Potatoes...	2	-	-	-	-	2	2.5
Gravy.....	2	2	-	1	1	6	7.5
Roasting.....	-	-	1	-	-	1	1.2
Sautéing.....	-	-	-	1	3	4	5.0
Seasoning.....	-	2	2	2	4	10	12.6

The fact that of the replies received 44.3% did not answer the question concerning the use of beef and chicken fat indicates that possibly this question might have been misunderstood. In several replies,

reference to the uses of drippings was made as an answer to this question. It was concluded that in these institutions beef and chicken fats were used in the same manner as the drippings or that no differentiation was made between the drippings and the trimmings. In the majority of institutions which did reply, beef fat was used for deep frying and sautéing, two institutions reporting that the fat was rendered. In six institutions chicken fat was substituted for butter, three stating that the fat was rendered and clarified first. The other three did not say but it is probable that they did likewise. In eight institutions this fat was used for "frying" and in three, as the fat in pastry dough (tables XVII and XVIII). Since the information received concerning the above question was not as extensive as desired, perhaps the question should have been explained.

Approximately 50% of the institutions had no method for making surplus fats usable, only 22.7% had any method at all while 27.3% did not answer this question. Three institutions reported that "ordinary methods" were used but it is not known what was meant by the word "ordinary" (table XIX).

No recipes for surplus fats had been developed in over one half of the institutions. Recipes had been developed in only one twelfth and part of this number merely modified certain recipes (table XX). One institution reported that in substituting chicken fat for butter or other shortening, one fourth less was used. Another in substituting bacon fat for other shortening in cornbread suggested that one half the shortening specified in the recipe might be replaced with the bacon fat. It would be of interest to know how other institutions used these

TABLE XVII  
USES OF BEEF FAT

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Base for Gravy.	1	3	-	-	-	4	5.0
Brown Potatoes.	-	-	-	-	1	1	1.2
Dressing.....	-	-	-	-	2	2	2.5
Deep Frying....	-	3	5	1	-	9	11.3
Frying Meats...	-	2	1	1	1	5	6.3
Grease Pans for Meats.....	-	-	-	1	-	1	1.2
Gravies.....	1	1	-	1	-	3	3.7
Grid Frying....	1	-	-	-	-	1	1.2
Hamburgers.....	-	-	-	1	-	1	1.2
Render.....	-	-	-	-	2	2	2.5
Render and Clarify.....	-	1	-	-	-	1	1.2
Render for Deep Frying....	1	1	-	-	-	2	2.5
Rendered and Put with Drippings.....	-	1	-	-	-	1	1.2
Rendered and Sold.....	1	-	-	-	-	1	1.2
Roux.....	-	-	-	-	1	1	1.2
Sautéing.....	-	-	-	1	1	2	2.5
Seasoning.....	-	-	-	1	-	1	1.2
Soap.....	-	1	-	-	-	1	1.2
Stock Soup.....	-	1	1	-	2	4	5.0
With Roasts....	-	1	-	-	-	1	1.2
No Answer.....	6	11	5	8	5	35	44.3



TABLE XVIII  
USES OF CHICKEN FAT

Use	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Base for Gravy.	1	-	-	-	-	1	1.2
Cream Sauce....	-	-	-	1	1	2	2.5
Dressing.....	-	-	-	-	2	2	2.5
Frying.....	-	-	3	-	2	5	6.3
Fry Chicken....	-	-	1	-	-	1	1.2
Fry Potatoes...	-	1	-	-	-	1	1.2
Gravies.....	1	2	-	-	2	5	6.3
In Place of Butter.....	-	1	-	1	1	3	3.7
Pastry Dough...	-	-	-	1	2	3	3.7
Render.....	-	1	-	-	2	3	3.7
Render and Clarify.....	-	1	-	-	-	1	1.2
Render for Roux.....	1	-	1	-	1	3	3.7
Render, Clarify and use in place of Butter	-	1	-	2	-	3	3.7
Sauces.....	-	-	1	1	-	2	2.5
Soup.....	-	2	1	-	2	5	6.3
Seasoning.....	1	2	-	-	-	3	3.7
Render and use for Frying....	1	-	-	-	-	1	1.2
No Answer.....	6	11	5	3	5	35	44.3

TABLE XIX

## QUESTIONNAIRE: METHODS FOR MAKING DRIPPINGS USABLE

Method	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Allow to Stand and Remove Fat.	-	1	-	-	-	1	1.2
Boil in Water and Strain.....	1	-	1	-	-	2	2.5
Grind and Use in Dressing....	-	-	-	1	-	1	1.2
Ordinary Methods.....	-	-	1	-	2	3	3.7
Strained.....	3	2	-	-	2	7	8.8
Strained and Clarified.....	1	1	-	1	-	3	3.7
Strained and Filtered.....	-	-	1	-	-	1	1.2
No Method Used.	4	17	3	7	8	39	49.3

Used Some Method	13	22.7
Used No Method	39	49.3
No Answer	22	27.8

TABLE XX

## QUESTIONNAIRE: RECIPES DEVELOPED FOR USE OF DRIPPINGS

	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Yes.....	2	3	-	3	2	10	12.6
No.....	3	21	5	7	8	44	55.6

No Answer	25
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fats. Only four institutions enclosed recipes with their replies.

Deep frying with surplus fats was not as common as had been expected, for only slightly more than one fourth did any deep frying with these fats, hospitals constituting one half of this number. About one fifth of the institutions did not answer this question (table XXI).

TABLE XXI

## QUESTIONNAIRE: WHETHER USED FOR DEEP FRYING

	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Yes.....	3	10	5	2	1	21	26.5
No.....	7	15	3	8	10	41	51.9

No Answer 17 21.5

Drippings and surplus fats were used both separately and combined. However, over one half of the institutions used them separately, one sixth combined and one twentieth both. Over one fifth did not answer this question (table XXII).

TABLE XXII

## QUESTIONNAIRE: METHOD OF USING DRIPPINGS AND OTHER SURPLUS FATS

Method	Commercial Cafeterias	Hospitals	Hotels	High School Cafeterias	College Cafeterias	Totals	Per Cent
Separately.....	7	16	3	7	11	44	55.6
Combined.....	2	5	2	1	3	13	16.4
Both.....	1	2	-	1	-	4	5.0

No Answer 18 22.7

It was interesting to find out the methods of determining when the surplus fats used for deep frying were discarded, and they are listed below:

1. When the fat boiled.
2. When the fat became foamy.
3. When the fat became dark.
4. When the fat became dark and would not congeal or solidify.
5. When the fat became dark enough to prevent seeing the bottom of the pan.
6. When the fat lost color and body.
7. When the color and odor of the fat were unsatisfactory.
8. When used a second time.
9. When used 24 hours and it began to smoke.
10. When used three times, if any was left for a third time.
11. Depended upon the food fried.
12. As long as the finished product was satisfactory.
13. Changed twice weekly.
14. When used 48 hours.
15. When used two weeks.

Many of these methods depended entirely upon the opinion of individuals, probably those individuals doing the deep frying Others depended upon a specific period of time with no reference to the condition of the fat.

It is very possible that opinions of individuals would differ as to when a fat was too dark to use, when the fat lost color and body and when the color and odor were unsatisfactory. One individual might consider the fat unfit for further use and another might consider the same fat still satisfactory. An experienced person, no doubt, could judge more accurately as to the fitness of a fat for further use, but many times an institution might not have such a person responsible for the deep fat frying.

Investigators at Iowa State College (16) found that absorption of fat by doughnuts was influenced to a greater degree by the smoking point

than any other factors investigated. This suggests that while other factors also affect the amount of fat absorbed by fried foods, if surplus fats were used until they began to smoke there would be more absorption by the food fried than if they were discarded before the smoking point was reached.

Woodruff and Blunt (20) have reported that the fat absorbed by fried food undergoes greater changes than the fat in which the food is cooked, that long cooking or use increases the amount of decomposition of the fat. If fats were used for one week or two weeks there would undoubtedly be some decomposition of the fat, with a greater change in the fat absorbed by the food fried.

More reliable and scientific methods would be of value in determining when surplus fats used for deep frying should be discarded.

The survey indicated that practically all kinds of drippings and other surplus fats are used in institutions. Some are used in more institutions and to a greater extent than others. Evidently some food service institutions managers feel that surplus fats from some meats are more desirable than others. The information obtained as to why they considered those from other meats less desirable was not extensive. The fact that so few institution persons had developed recipes for the uses of surplus fats, or, if so, did not say so, leads one to believe that further studies should be made along this line. Further studies should also be made concerning the desirability of the various methods for making surplus fats usable. Perhaps more information might be obtained from a more detailed questionnaire.

B. Discussion of Results of Experimental Baking. Baking Powder Biscuits in Which Drippings Were Used as the Shortening. A preliminary analysis of the judges' scores of the baking powder biscuits indicated that probably appearance and flavor would be the only two factors showing significant differences. Therefore, a statistical analysis\* was made of the judges' scores of appearance and flavor but not of the other factors, exterior color, crust, interior color, texture, and flake. The results (table XXIII) showed that there were no significant differences between the means of the scores pertaining to appearance of the biscuits. In other words, with this system of scoring, there was no difference in the appearance of the biscuits. Compared with the standard, in appearance, the products made with one kind of drippings were as good as those made with another.

The results of the statistical analysis also showed that the mean of the flavor scores when the biscuits contained beef fat was significantly less than when they contained the other surplus fats (table XXIII). However, there were no significant differences between the means of the flavor scores when the biscuits contained bacon, chicken, fresh pork, ham, and sausage fats. Compared with the standard, in flavor biscuits made with one kind of drippings were as good as those made with another with the exception of those made with beef drippings.

Since the differences between the means of the scores pertaining to each of the factors, exterior color, crust, interior color, texture and flake were no greater in any case than the differences between the

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\*The statistical analysis was made with the assistance of Dr. W. D. Baten of the Mathematics Department, Michigan State College.

TABLE XXIII  
AVERAGE SCORES OF BAKING POWDER BISCUITS MADE  
WITH SIX KINDS OF DRIPPINGS\*

Factor	Possible Score	Bacon	Beef	Chicken	Fresh Pork	Ham	Sausage
Appearance..	14	12.66	12.86	12.63	12.86	13.10	12.83
Exterior Color.....	14	12.26	11.66	11.63	12.10	12.80	12.50
Crust.....	14	12.30	12.16	12.46	12.36	12.33	12.90
Interior Color.....	14	13.30	12.90	11.53	13.43	13.70	13.43
Texture.....	14	11.50	11.46	11.56	11.30	12.10	11.53
Flake.....	14	12.36	12.10	12.63	12.53	12.66	12.06
Flavor.....	16	12.70	11.40	12.96	12.83	13.66	13.46
Total.....	100	87.08	84.54	85.40	87.41	90.35	88.71

\*The biscuits were made ten times with each kind of drippings

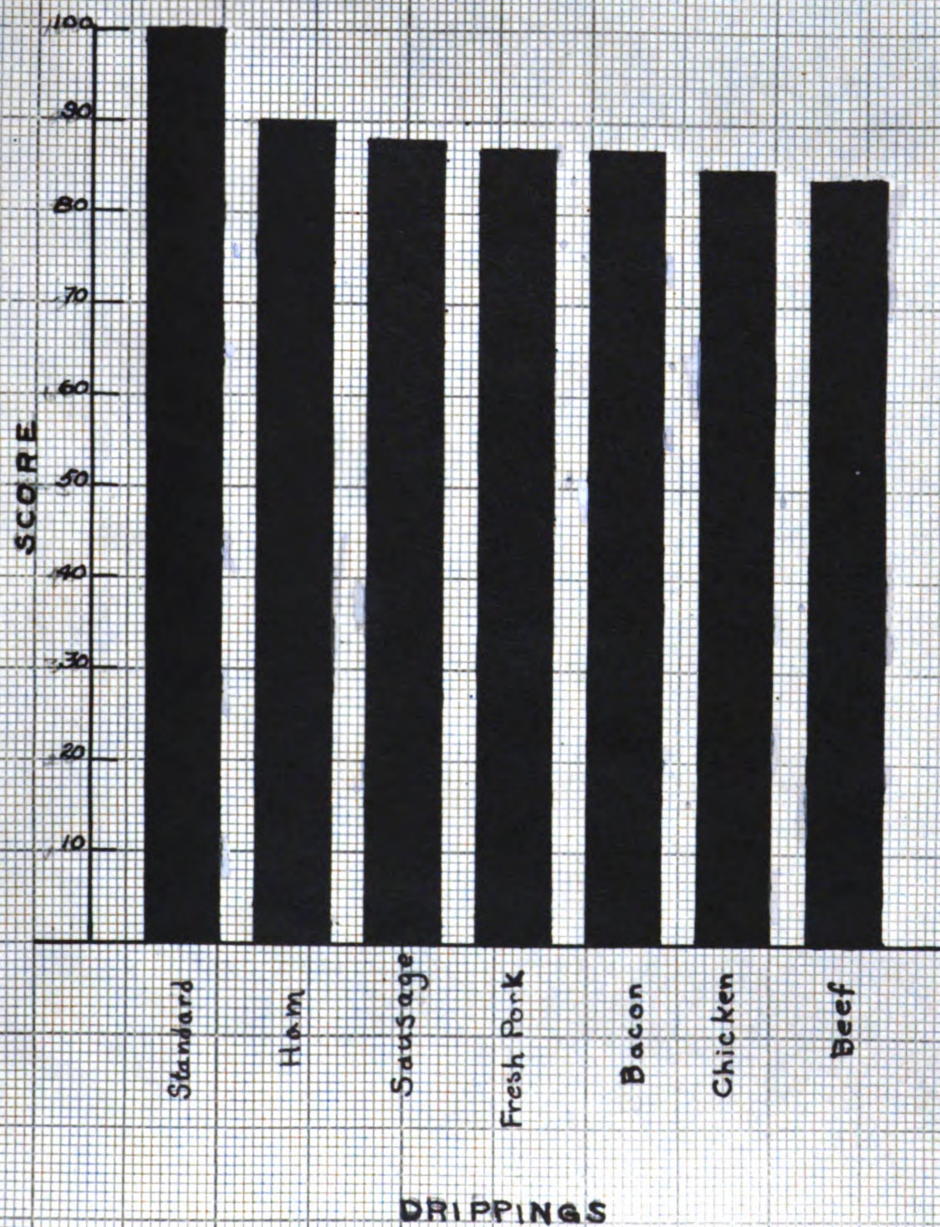
means of the scores pertaining to appearance, it was concluded that in respect to these factors compared with the standard, biscuits made with one kind of drippings were as good as those made with another kind.

The data in table XXIII and charts II-VIII indicated that there were very few differences between the biscuits in any of the factors except flavor. The products made with ham drippings scored slightly higher in comparison with the standard in all factors except crust. In crust those made with sausage drippings scored slightly higher. The greatest differences were observed in the factor, flavor, thus indicating that that was most important. The flavors of ham and bacon drippings were very noticeable in the biscuits but they were not considered undesirable. The biscuits made with beef drippings scored lower in



## CHART I

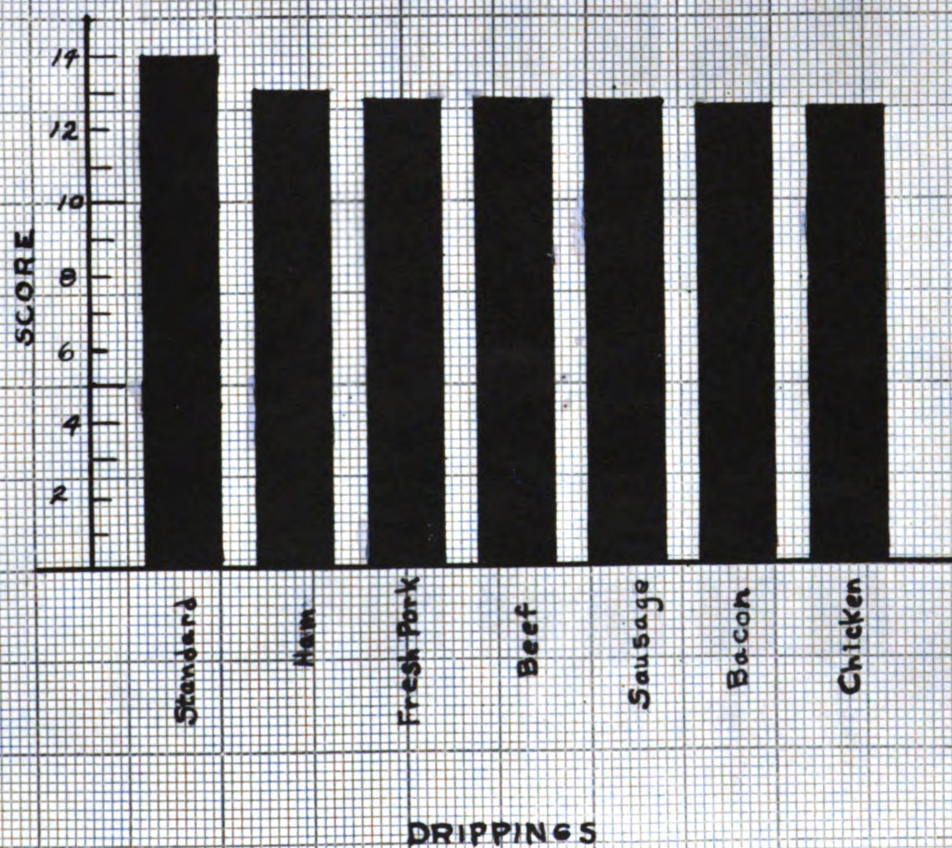
AVERAGE SCORES OF BAKING POWDER  
BISCUITS MADE WITH VARIOUS DRIPPINGS





## CHART II

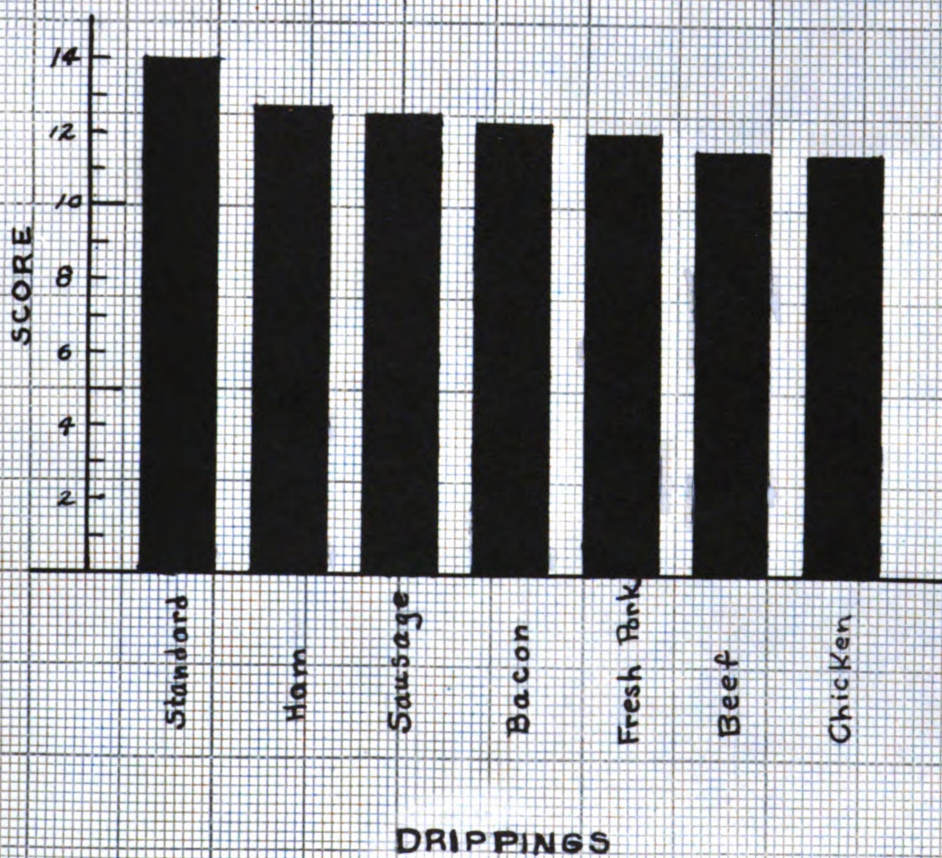
APPEARANCE OF BAKING POWDER BISCUITS  
MADE WITH VARIOUS DRIPPINGS





## CHART III

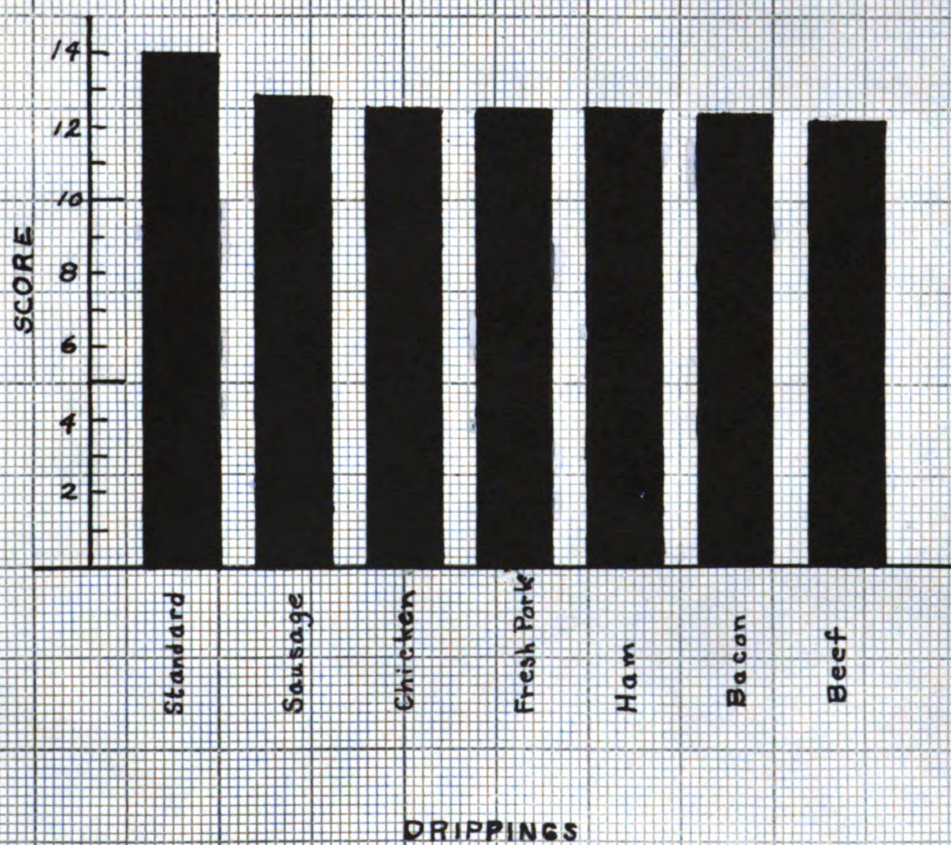
EXTERIOR COLOR OF BAKING POWDER  
BISCUITS MADE WITH VARIOUS DRIPPINGS





## CHART IV

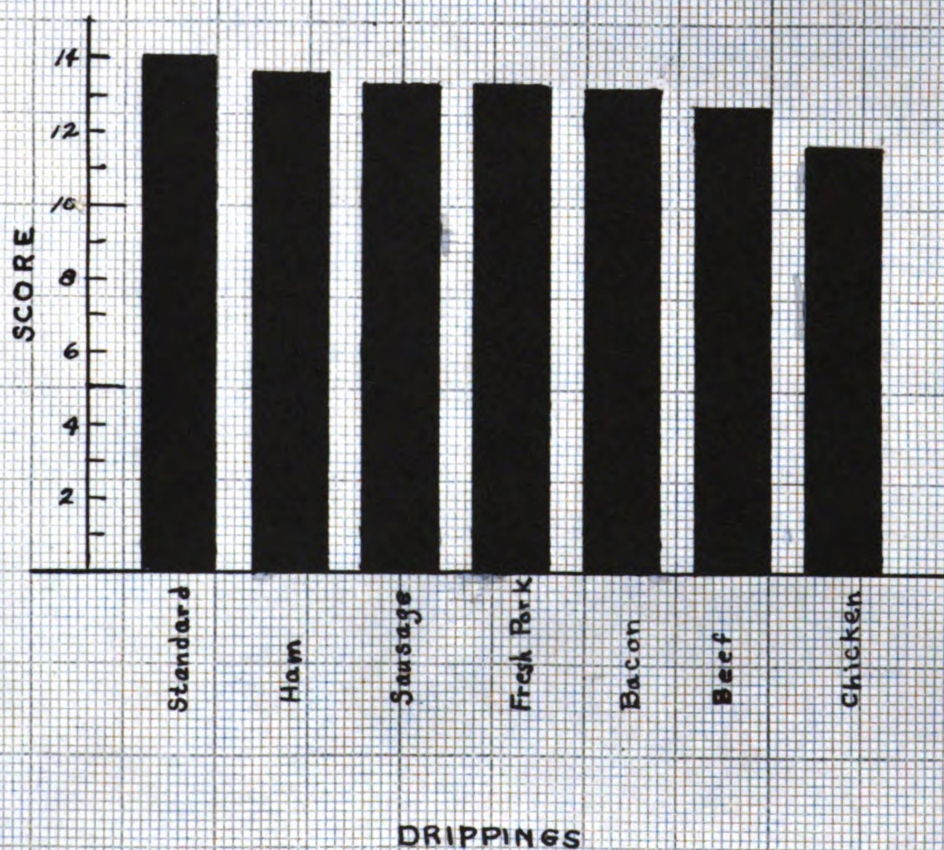
CRUST OF BAKING POWDER BISCUITS  
MADE WITH VARIOUS DRIPPINGS





## CHART V

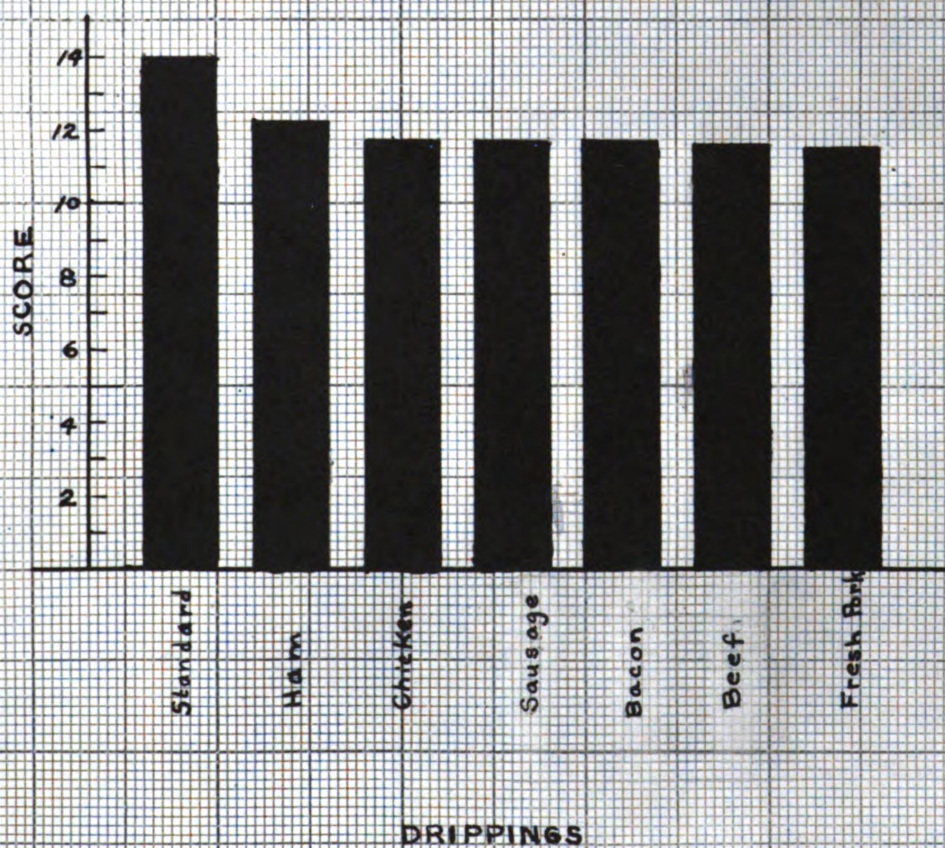
INTERIOR COLOR OF BAKING POWDER  
BISCUITS MADE WITH VARIOUS DRIPPINGS





## CHART VI

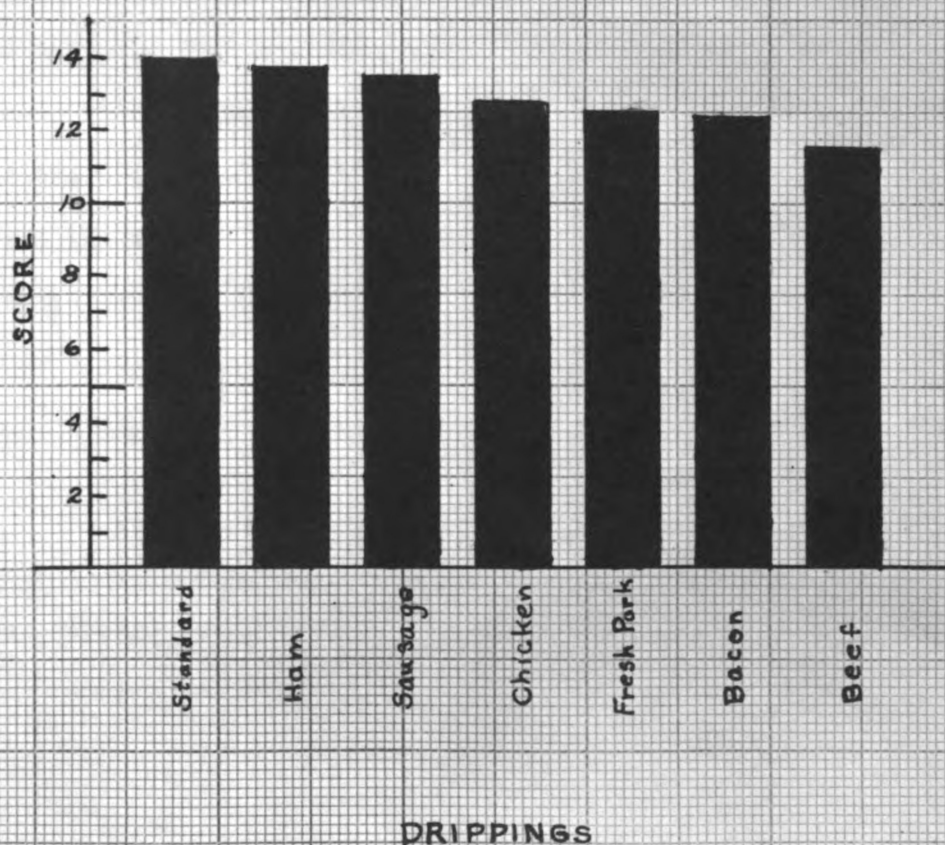
TEXTURE OF BAKING POWDER BISCUITS  
MADE WITH VARIOUS DRIPPINGS





## CHART VIII

FLAVOR OF BAKING POWDER BISCUITS  
MADE WITH VARIOUS DRIPPINGS





flavor than those made with the other fats. One judge thought this flavor was decidedly inferior and undesirable. These biscuits scored an average of 2.26 points lower than those made with ham drippings.

The average of the judges' scores in table XXIV showed in general that the judges were quite consistent with each other in all factors except flavor, again emphasizing the importance of this factor. One judge scored an average of 2.15 points lower in flavor than the one who scored highest. All of these judges thought that the flavor of the biscuits made with ham and bacon drippings was very desirable. However, some people might object to such noticeable flavors. One institution trained person, who was not a judge, thought that the flavor of the biscuits made with chicken drippings was decidedly superior. The writer sampled the products each time that they were made and consistently preferred the flavor of those made with chicken drippings to the others. Undoubtedly personal preference would enter into a decision as to the flavor of baking powder biscuits.

TABLE XXIV  
AVERAGE SCORES OF EACH JUDGE FOR EACH FACTOR

Factors	Appearance	Exterior Color	Crust	Interior Color	Texture	Flake	Flavor
Judge							
A	12.75	12.00	12.48	13.18	11.23	12.21	11.85
B	12.68	12.53	12.16	13.10	11.58	12.65	14.00
C	13.05	12.75	12.53	13.86	11.91	12.31	12.66



The judges were of the opinion that all of the products were very acceptable. Even those with the lower scores were considered excellent in all factors compared with those served in many institutions. After the biscuits had been made three or four times the judges in most cases were able to distinguish those made with each fat. Those made with chicken drippings were identified by the yellow color which appeared both inside and outside the biscuits. Those made with bacon and ham drippings had the characteristic flavor of bacon and ham. Those made with beef drippings were identified by the flavor which was usually less desirable than the standard. The judges were not always able to distinguish between the biscuits made with fresh pork drippings and those made with sausage. Sometimes the flavor of those made with sausage fat seemed more desirable than those made with fresh pork fat, while at other times the reverse was true.

The average score of the biscuits made with beef drippings was 84.54, that of those made with chicken drippings was 85.40 while that of those made with ham drippings was 90.35 (table XXIII and chart I). This would seem to class the products made with chicken fat with the poorer group, but since the analysis showed that in all factors these products were as good as those made with ham fat, perhaps the total score should not be considered significant.

There are several factors which might influence the results obtained with these fats. The quality or condition of the fats when used might be one factor. If the chemical condition of the fats could be determined before use, this might aid in interpreting the results. Woodruff and Blunt (20) found that the higher the temperature to which a

fat is heated the greater the number and quantity of decomposition products formed. It was not known whether any of the fats used for this experiment had been subjected to a temperature sufficient to cause decomposition, but this seems a possibility.

It is believed that if the standard formula were adjusted according to the particular type of fat used, better products might be obtained. This opinion was formulated when ten grams of flour in the case of bacon drippings, and fifteen grams in the case of chicken drippings were necessary in kneading to keep the dough from sticking. Even with this additional flour these fats produced biscuits with tender crusts as was observed in the scores of this factor (table XXIII, chart IV). If these softer fats, as bacon and chicken, were to be used in institutions for baking powder biscuits, less liquid, less fat, or more flour than was used in the formula for this study might be more satisfactory; whereas, with harder fats, as beef, the reverse might be true.

Further study of the various factors which affect the fats and the biscuits seems to be necessary before one can say that drippings are satisfactory or unsatisfactory as shortening in baking powder biscuits. Studies of the physical and chemical condition of drippings before use and the different temperatures to which they were subjected in cooking meat might furnish information which would be of value in deciding the above point. Further studies with the system of scoring and method used in this study might be of importance to substantiate the results obtained.

It appears that within the limits of the method used for this study, satisfactory baking powder biscuits can be made with bacon, beef, chicken, fresh pork, ham, and sausage drippings.

C. Chemical Tests. A study of the chemical constants determined on the two surplus fat mixtures before and after use for deep frying indicated that certain changes occurred, these changes being greater in mixture A than B (tables XXV and XXVI). There was an increase in the free fatty acid content, a decrease in the Iodine number, and an increase in both the Saponification and Reichert-Meissel numbers. Reports of studies with other fats used in deep frying and certain reactions, as oxidative and hydrolytic types of rancidity which are characteristic of fats when in the presence of heat and moisture might be used to interpret these results. In the case of both fat mixtures, there was an increase in the free fatty acid content after use. This was evidence of decomposition to a certain extent. According to the conclusion of Porter et al (21) after testing various fats in frying doughnuts, the decomposition of a fat, which involved the formation of acid "was a direct result of reaction with moisture at elevated temperature." These workers also stated that the rate of the reaction increased after a content of 0.75 per cent was reached with "the acid probably acting as a catalyst." It was further reported in this study "that the per cent of free acid present in a fat was a fairly reliable measure of the extent of its breaking down." In view of these conclusions and the fact that more foods were probably fried in mixture A, the greater increase observed, after use, in the free acid content of this mixture was to be expected. It was also found in the above mentioned study that an objectionable flavor in fried food was detected when the free fatty acid content of the fat reached 2.0 per cent and a distinctly objectionable flavor was noticeable when the acid content reached 4.4 per cent. The initial acid

TABLE XXV  
AVERAGES OF DETERMINATIONS OF CHEMICAL CONSTANTS  
OF MIXTURE A

Fat	Acid Degree		Iodine No. (Hanus)		Reichert- Meissel No.		Saponi- fication No.	
	Before Use	After Use 7 da.	Before Use	After Use 7 da.	Before Use	After Use 7 da.	Before Use	After Use 7 da.
Sample 1	2.64	6.33	53.4	46.6	2.2	6.8	190.9	203.8
Sample 2	2.84	6.56	53.4	46.8	2.7	6.9	190.9	203.4

TABLE XXVI  
AVERAGES OF DETERMINATIONS OF CHEMICAL CONSTANTS  
OF MIXTURE B

Fat	Acid Degree		Iodine No. (Hanus)		Reichert- Meissel No.		Saponi- fication No.	
	Before Use	After Use 7 da.	Before Use	After Use 7 da.	Before Use	After Use 7 da.	Before Use	After Use 7 da.
Sample 1	2.58	3.87	54.3	51.3	5.0	6.9	194.3	195.4
Sample 2	2.83	3.94	54.0	51.5	4.9	6.1	193.9	195.5

value of both mixtures A and B was higher than the 2.0 per cent at which this objectionable flavor was noticed. This might have been partially due to the temperature at which the fats were rendered and some hydrolytic changes might have taken place, in which case glycerol and fatty acids would have resulted, the latter catalyzing further changes (19).

It was not possible to sample any of the products fried in these



fats; therefore, no correlation could be made between the acid content and the flavor of the products. At various times in other institutions the writer sampled products, other than doughnuts, which had been fried in similar mixtures of surplus fats, but could not detect any objectionable flavors when the fats had been used several times a day for several days. Perhaps this might have been due to the type of food fried.

The results also showed that after use there was a decrease in the Iodine number of both mixtures (tables XXV and XXVI). Bodansky (12) indicates that in an oxidative type of rancidity an increase in the acid content may be followed by a lowering of the Iodine number. As a result of this type of reaction, the number of double bonds with which Iodine could combine, might be decreased and the number of short chain or volatile fatty acids increased (12). The greater decrease noted in the Iodine value for mixture A was to be expected since the acid content of this mixture was also greater. In a recent study Lowe et al (22) found a consistent lowering of this number when various fats were used for frying doughnuts and potato chips. There was no evidence that the decrease in Iodine value of the fats had affected the palatability of the products fried therein. If there is any relationship between this constant and the palatability of the products fried in mixtures of surplus fats this fact might be determined by further studies.

In addition to the changes in acid content and Iodine value the results of the determinations indicated an increase in the Reichert-Meissel number of the two mixtures (table XXV and XXVI). This number measures the amount of volatile fatty acids present in a fat (23), and if there were an increase in the free acid content, there would also be



an increase in this value. The changes in acid and Iodine value of mixture A were followed by corresponding changes in the Reichert-Meissel value.

Lastly, the results showed an increase in the Saponification number of both mixtures (tables XXV and XXVI). In oxidative changes of a fat there may be an increase in this number in the late stages of the reaction or when a considerable number of free fatty acids have been formed (12). The fact that only a small increase in this chemical value was observed after mixture B had been used, while a noticeable increase was observed in mixture A after use, indicated that probably the late stages of oxidation had not been reached in the former fat, but it might have been reached in the latter.

Since the condition of the foods fried in these surplus fats could not be learned, perhaps a more extensive study might reveal correlations between the changes in the chemical constants and such factors as flavor and fat absorption. A knowledge of the temperatures to which the fats were heated and the number of times they were reheated might be of value in determining the length of time the fats could be used satisfactorily for deep frying. It seems possible that some practical method might even be developed whereby institutions could test the free acid content of surplus fats and in this manner decide whether they could be used further or at all.

The results of this study indicate that the extent to which these fats were used was sufficient to cause considerable changes in the chemical constants. In all cases mixture A underwent greater changes with use than B. Since the initial acid value was high, it seems that

one might question the flavor of foods fried in surplus fats, except in the case of stronger flavored foods.

## V. SUMMARY AND CONCLUSION

The uses of drippings and other surplus fats available in food service institutions were studied by means of (A) a survey in which the kinds of surplus fats and manner in which they were used in food service institutions were determined through interviews and replies to a questionnaire, (B) a baking study in which baking powder biscuits made with various drippings as the shortening were compared with biscuits made with lard, (C) chemical tests in which the effect of repeated heating of known mixtures of surplus fats was measured by changes in the chemical constants. The results of this study indicate that,

1. Practically all kinds of drippings and other surplus fats were used in food service institutions.
2. The uses varied not only with the kind and amount of fat but also with the type of institution.
3. Recipes had been developed in only a few institutions.
4. Various methods were used to determine when surplus fats used in deep frying should be discarded, but no scientific method had been developed.
5. Apparently satisfactory baking powder biscuits can be made with bacon, beef, chicken, fresh pork, ham and sausage drippings. Compared with biscuits made with lard there were few differences between the biscuits made with the six fats in any factor studied, except flavor in which those made with beef fat scored significantly lower than the others. With the system of scoring used,

flavor was the most important factor.

6. With repeated heating of two known mixtures of surplus fats certain chemical changes occurred. The acid, Reichert-Meissel and Saponification values were increased, while the Iodine value was decreased. The changes in all cases were greater in mixture A in which more foods had probably been fried. This mixture consisted of 12 parts beef fat, 10 parts ham fat and 3 parts fresh pork fat. The changes which occurred in the fats with use were characteristic of oxidative and hydrolytic types of reactions. The high initial acid value of both mixtures would seem to make the use of surplus fats in deep frying questionable, except in the case of stronger flavored foods.
7. Probably more recipes should be developed for the use of surplus fats. Some scientific method which would also be practical should be devised to determine how long surplus fats could be used satisfactorily for deep frying. More experimental work ought to be done in the use of surplus fats in products other than biscuits.

## A P P E N D I X

QUESTIONNAIRE

Name of Institution \_\_\_\_\_

Kind of institution. Hotel? Hospital? Restaurant?

What kinds of fat drippings do you have? Bacon Beef

Chicken Lamb Fresh Pork Ham Sausage (Please check ones you have.)

In what manner are beef and chicken fat used?

In what manner are each of these drippings used?

Bacon Fat \_\_\_\_\_

Beef Fat \_\_\_\_\_

Chicken Fat \_\_\_\_\_

Lamb Fat \_\_\_\_\_

Fresh Pork Fat \_\_\_\_\_

Ham Fat \_\_\_\_\_

Sausage Fat \_\_\_\_\_

Do you have any special methods for making these drippings and fats usable? If so what? \_\_\_\_\_

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Have you devised any special recipes for the use of any of these fats and drippings?

Would you object to our trying these recipes? If not, please enclose in your reply.

If any of the fat and drippings are used for deep frying, how long are they used? What method is used to determine when the fat is unfit for use?

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Do you use the drippings from each kind of meat separately or do you combine them?

## BAKING POWDER BISCUIT SCORE SHEET

The Standard is given in the first line under qualities for each factor and the subsequent lines are given to indicate how the product may differ from the Standard.

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F A C T O R S	Q U A L I T I E S	R A T I N G
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## Exterior

1. Appearance	a. Fairly smooth and level top	12-14
	b. Somewhat rough or somewhat smooth	9-11
	c. Fairly rough or quite smooth	6-8
	d. Rough or smooth	3-5
	e. Very rough or very smooth	0-2
2. Color	A.	
	a. Golden brown	6-7
	b. Light brown or slightly dark brown	4-5
	c. Pale brown or dark brown	2-3
	d. Very light brown or very dark brown	0-1
	B.	
	a. Even color	6-7
	b. Fairly even color	4-5
	c. Somewhat uneven or Somewhat uneven and spotted or Somewhat spotted	2-3
	d. Uneven color or Uneven and spotted or Spotted	0-1
3. Crust	a. Crisp and tender	12-14
	b. Fairly crisp and tender or Somewhat too tender	9-11
	c. Slightly brittle and hard or considerably too tender	6-8
	d. Brittle and hard or too tender	3-5
	e. Very brittle and hard or much too tender	0-2

## Interior - Crumb

1. Color	A.	
	a. Creamy white	3
	b. Cream or gray white or yellow	2
	c. Gray	0-1
	B.	
	a. Even color	9-11
	b. Fairly even color	6-8

F A C T O R S	Q U A L I T I E S	R A T I N G
	c. Somewhat uneven or Somewhat uneven and spotted or Somewhat spotted	3-5
	d. Uneven color or Uneven and spotted or Spotted	0-2
2. Texture	A. a. Fine	6-8
	b. Somewhat coarse or Somewhat too fine	4-5
	c. Coarse or too fine	2-3
	d. Very coarse or much too fine	0-1
	B. a. Even	5-6
	b. Somewhat uneven	3-4
	c. Uneven	1-2
	d. Very uneven	0
3. Flake	a. Flaky with long thin pile	12-14
	b. Fairly flaky with less pile	8-11
	c. Slightly bready	4-7
	d. Bready	0-3
4. Flavor	a. Pleasing flavor	13-16
	b. Fairly pleasing	9-12
	c. Slightly undesirable (perceptible fat taste or ( " Baking Powder taste (or flat taste	5-8
	d. Undesirable taste (Pronounced fat taste ( " Baking Powder taste ( " flat taste	0-4



# BAKING POWDER BISCUIT RATING SHEET

Judge \_\_\_\_\_

Date \_\_\_\_\_

	SAMPLES					
	A	B	C	D	E	F
Exterior						
I. Appearance ----- 14						
II. Color ----- 14						
A. --- 7						
B. --- 7						
III. Crust ----- 14						
Interior						
IV. Color ----- 14						
A. -- 3						
B. -- 11						
V. Texture ----- 14						
A. -- 8						
B. -- 6						
VI. Flake ----- 14						
VII. Flavor ----- 16						
Total ----- 100						

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