A STUDY OF METHODS OF TESTING AND SAMPLING TECHNIQUE IN THE DETERMINATION OF FAT CONTENT OF GROUND MEAT

by

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INTRODUCTION

The determination of the fat content of ground meat has always been of utmost importance to the meat packers as well as the consumer. The fat content is of importance to the packer for he is desirous of producing a suitable product, but still, from an economic standpoint, anxious to use as much fat as possible in the product and still be within requirements of the specifications set forth for the item. The consumer wants the ground meat component of his ration to be palatable, and not unduly wasteful. The fat content of the meat is one of the most important constitutents which will determine this factor.

The determination of the fat content of ground meat while it is under the control of the meat packer will be handled normally by the plant laboratory facilities. As far as the consumer is concerned the determination of fat content is the responsibility of regulatory officials. The fat content of ground meat is of specific importance to inspectors of products wherein specifications have been set up for each item.

The methods of determination of the fat content of meats involved must incorporate the following factors in order to be feasible both to the packer and the inspector:

1. The method of sampling must be such as to be representative of the product as a whole.
2. The method of determination must be accurate.
3. The results of the tests must be determined rapidly.

4. The tests should involve as simple a procedure as possible.

The method of collection of samples varies somewhat, however some method must be used which will be representative of the lot as a whole. In the case of ground beef and pork, care must be exercised to be sure that the sample includes meat of one grade and lot. Small portions should be collected at regular intervals during the grinding operation, then mixed together, and the entire pooled sample run through a meat grinder.

The accuracy of the test is of utmost importance, particularly to the meat packer, for if the meat packer has placed a bid for a contract to furnish a certain amount of ground beef or pork at a certain price, that price has been figured on the basis of allowing a maximum amount of fat in the product, according to the specifications under which it is being furnished.

The time consumed in conducting the fat determination of ground meat is of importance for the following reasons:

1. The meat packer is anxious to ship the ground meat to its destination as soon as possible. If the product is fresh (not frozen) the keeping quality of the product is a factor to be considered. In cases where the product is frozen by the packer, the space required to store the frozen product is many times limited. Also the meat packer may have a very limited time after producing the product, to get the product

to its destination within the time limit set by the contract. If the product is not delivered on time the contractor will be considered delinquent and it may be necessary to make a purchase of the product in question from another meat packer.

2. The inspector of the product, being a representative of the consumer is anxious to obtain the results of fat analysis rapidly in order that the product may be shipped to the consumer in the best condition possible. When the results are obtained rapidly the inspector can complete the inspection procedure, by either accepting or rejecting the product, and be free to carry on with other inspection activities in other locations. Obtaining rapid results from a test which would not require submission of a sample to a central laboratory except for check purposes, will allow the inspector to keep in close touch with the trend of production. By conducting a fat analysis on the ground meat at regular intervals with rapid results, a change can be made in the amount of fat being added to the product if necessary.

3. A rapid method of fat determination is of value to the laboratory in that only limited equipment is needed, and less time is consumed on the part of the laboratory technician.

It is important that as simple a procedure as possible be used in order to permit inspectors in the field who are not highly trained laboratory technicians to conduct the fat analysis tests.

REVIEW OF LITERATURE

The determination of the fat content of meat and meat products by ether extraction was first recorded by the Association of Official Agricultural Chemists (1) in 1901. In this recording it was considered that complete extraction could only be obtained after digesting the particles and muscular tissues with pepsin and extracting again with an organic solvent. It was considered necessary to extract first with alcohol, to remove the last traces of water, and then with ether in a continuous extractor.

Wiley (2) states there are some fats both in animal and vegetable substances insoluble in ether, but they exist in minute quantities and therefore are not separated from the extracts. There are also minute quantities of bodies not fat in foods soluble in ether and these are included in the ether extract. These facts have some bearing on the accuracy of the ether extraction method of fat determination as set forth by the Association of Official Agricultural Chemists. The present method used by the Association of Official Agricultural Chemists (3) for the determination of the amount of fat in ground meat is the utilization of a 3 to 4 gram sample, spread out in a thin layer over sides and bottom of weighing bottle. The sample is dried for 16 to 18 hours at 101 - 102° C. or 2 to 3 hours at 125° C. The dried sample is ground with asbestos,

or similar substance. Approximately a 2 gram sample is extracted with anhydrous ether for a period of 16 hours. The extract is dried at a temperature of boiling water for 30 minutes, cooled in desiccator and weighed. The weighings are continued at 30 minute intervals, alternated by drying for like length of time until the weight is constant. Then the amount of fat present in the sample is calculated.

This method of testing for the amount of fat in ground meat by the armed forces as set forth in TB Med 233 (AFM 160-41) (4) has modified the method of the Official Agricultural Chemists in the following ways:

1. A 6 to 8 gram sample is weighed directly into the thimble. The thimble is placed within the extractor and dried at 101° C. for approximately 6 hours.

2. The apparatus is then placed on a Soxhlet extractor, using petroleum ether (30 - 60° C. boiling point) and extracted for 16 to 18 hours.

3. Grinding of the sample as outlined in the test conducted by the Association of Official Agricultural Chemists is omitted.

The army modified method of ether extraction of fat is the test used to compare the results of the ether extraction method with the rapid methods of fat analysis in this work.

In order to meet the need for a rapid method of fat analysis the laboratories of the meat packing plants, and other

personnel in laboratories interested in food inspection and research, set out to derive methods to accomplish this test. Oesting and Kaufman (5) described a method of rapid determination of fat which they considered gave sufficiently accurate results for the control of manufacturing operations. The procedure of the test was to weigh out a 25 gram finely ground sample and place in a Waring mixer. Then 100 grams of cracked ice or water at 1° to 3° C. and 2 grams of household oakite was added to the sample. The mixer was run for 10 minutes, then 10 grams of the emulsion was weighed to the nearest 0.1 of a gram and placed into a Babcock bottle. Glacial acetic acid, 5 ml, was added, followed by the addition of a total of 15 ml of concentrated sulphuric acid (specific gravity 1.84) a little at a time. Hot water was added to the test bottles to bring the level of the fluid to the neck of the bottle, after centrifuging for 5 minutes at approximately 1,000 r.p.m. Finally hot water was added to within 1 to 2 cm of the top of the neck and centrifuged for one minute. The bottles were immersed in water at 70° C. and read after 2 minutes on a descending fat column. The column of fat was read from the top of the upper meniscus to the bottom of the lower meniscus. The figure obtained from the reading was multiplied by 9.2 for the purpose of correcting the per cent of fat. The author considered the test gave satisfactory results with all types of fresh and cooked meat items, with the exception of foods of

high cereal content. In general only single tests were conducted on each meat item tested.

Swift and Company Research Laboratories devised a method of rapid determination of fat in meat and meat products.[1] In this case 9.0 ± 0.1 grams of a well mixed ground meat sample was placed in a beaker to which was added 25 ml of acid digestion reagent (acid digestion reagent prepared by placing one volume of C. P. hydrochloric acid (specific gravity 1.19) and seven volumes of C. P. nitric acid (specific gravity 1.42) into 32 volumes of distilled water). The mixture was allowed to boil for 12 to 20 minutes or until the meat was completely digested. While the mixture was hot it was poured into Babcock bottles (Babcock test bottle, height 6½ inches, 18 gram capacity, graduated 0 to 20 per cent, or 18 gram capacity, graduated 0 to 30 per cent). The beaker and stirring rod used in preparation of sample was washed with hot water, and washing added to Babcock bottle. The sample was centrifuged for one minute at specified speed. The fat column was read from bottom of lower meniscus to bottom of upper meniscus. The following calculations were used to determine results:

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[1]Swift and Company Research Laboratories. Fat Meat and Meat Products, Using Babcock Bottles - Method Ca 4C-49. Unpublished. Obtained by communication with V.C. Mehlenbacker, Chemist, Swift and Company, Union Stock Yards, Chicago, Illinois, January, 1952.

1. Fat, per cent = average of duplicate reading x 2.

2. If 4.5 gram sample was used, it was calculated as follows: Fat, per cent = average of duplicate reading x 4.

Armour and Company Laboratories described a method of fat determination used on a tentative basis as a control method in their processing operations.[2] In this method the following procedure was given:

1. Nine grams of meat were weighed into Paley bottle (Babcock test bottle - 50 per cent - 9 grams - Paley), if high percentage of fat, used 6 or 4.5 grams. Added 10 ml of boiling water. Agitated to break up meat into fine particles so that it would readily dissolve in the acid.

2. Added a total of 18 ml Babcock sulphuric acid (455 ml concentrated to 20 ml water) in three portions: about 10 ml, 4 ml, and 4 ml. Mixed thoroughly after each addition. Let stand about one minute after each addition.

3. Placed on hot plate 10 minutes or until digestion was complete.

4. Added hot sulphuric acid to bring fat well up into neck of flask.

5. Placed in water bath at 140° F., immerse to top of fat column.

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[2]Armour and Company Laboratories. Rapid Control Method for the Determination of Fat in Cooked and Uncooked Sausage and Ground Meat Such as Hamburger (Tentative). Unpublished. Obtained by communication with L. A. Michael, Armour and Company Laboratory, Armour and Company, Kansas City, Kansas, February 6, 1951.

6. After about a minute removed from bath, measured fat, using dividers, from lowest point to top of upper meniscus.

7. If 6 gram sample was used, reading x 1⅓ equals fat; if 4.5 gram sample, reading x 2 equals fat.

In research work conducted by Hall, a rapid method of fat determination of ground meat was used wherein the sample was digested in a beaker by the use of glacial acetic acid and concentrated sulphuric acid.[3] The contents of the beaker was then transferred to a Babcock milk or cream bottle. Five milliliters of concentrated sulphuric acid was added, and bottle with contents centrifuged for five minutes at 1,000 r.p.m. Water (70° C.) was added to bring liquid to middle of scale of bottle, after which it was centrifuged again for three minutes, after being held in the water bath for two minutes. The bottle was removed from centrifuge and held in water bath at 70° C. for two minutes, and the column of fat then read. The column being read by checking the descending column from bottom of upper meniscus to bottom of lower meniscus.

The Army Medical Service Graduate School used a method of rapid determination of fat content of meat utilizing a Paley Cheese Babcock bottle, 50%.[4] The nine gram sample of ground

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[3]Hall, J. Lowe. Babcock Method for Determining Fat in Meat Products. Unpublished. Obtained by communication with J. Lowe Hall, Meat Research, Chemistry Department, Kansas State College, Manhattan, Kansas, October 1951.

[4]Army Medical Service Graduate School, Army Medical Center. Rapid Method for Fat in Ground Meat. Unpublished. Obtained from Director, Veterinary Division, Army Medical Service Graduate School, Army Medical Center, Washington, D.C., October 1951.

meat was digested with sulphuric acid (commercial sp. gr. 1.82-1.83) added in three portions of ⅓, ⅓, and ⅓ portions. After digestion had occurred, hot water (140° F, 60° C.) was added filling the bulb of the bottle. The bottle was centrifuged for two minutes, water added (140° F., 60° C.) to bring level of liquid up near the top graduation. The bottles were again centrifuged for one minute and tempered in water bath (140° F., 60° C.) for five minutes. A few drops of glymol was added to top of fat column and descending column of fat was read from junction with glymol to the bottom of the column. As a result of twenty-five tests conducted they say the findings vary with the official method only about one per cent.

The Depot Veterinarian, Chicago Quartermaster Depot, brought forth a new method for fat determination of ground meat in which case the ground meat was digested in a pyrex Erlenmeyer flask and the fat content measured on a 15 cc tube attached to the flask, without centrifuging.[5]

In this case 10 grams of ground beef was placed in an Erlenmeyer flask and broken up with 5 to 10 cc of water, then 25 cc of concentrated sulphuric acid was added for digestion of meat, with additional heat. Hot water was added to bring the fat column up into the graduated portion of the tube. A few drops of acetic acid was added to the fat column if bubbles occurred.

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[5]Depot Veterinarian Office, Chicago Quartermaster Depot. New Method for Fat Determination of Ground Meat. Unpublished. Obtained from Depot Veterinarian, Chicago Quartermaster Depot, Chicago, Illinois. November 1951.

The fat column was read as number of cc's and multiplied by a conversion factor of 8.95. They reported that the results ran consistently, approximately two per cent less than the army modified method of ether extraction for fat content of ground meat.

In that in the study of rapid fat determination various modifications of the Babcock method of determination was utilized, it was considered appropriate to look briefly into the history of the use of the Babcock method of analysis of milk and milk products and some of its applications. As recorded by Farrington and Woll (6) the test was reported by Dr. S. M. Babcock of the Wisconsin Agricultural Experiment Station and published in July, 1890. The test is now known and adopted in all parts of the world where dairying is an important industry. The sulphuric acid when added to the milk, first coagulates the casein and then dissolves it according to Wilster (7). This author further states that when the butterfat globules, of which there are two to three billion per ml of milk, when freed of the film of casein, unit readily and form a layer on the surface of the sulphuric acid-milk mixture.

The acid when added in the proper amount to the milk does not react with the fat but reacts with the other milk solids. The mixture that results from the combination of the serum and the acid has a specific gravity of about 1.4. Since the specific gravity of the fat is only about 0.9, this great difference in

specific gravity favors the separation of the fat from the serum acid mixture during centrifuging.

As further described by Farrington and Woll (6) the scale on the neck of the Babcock test bottle will show directly the per cent of fat found in the milk. In the case of a fluid, like milk to be tested, a 17.6 ml pipette which will deliver 17.5 ml of milk, is used considering that the specific gravity of milk is 1.032, the weight of the milk delivered is 18 grams. The scale of the test bottle will vary but for example, if it is calibrated from 0 to 10 per cent, then 10 per cent of 18 grams is 1.8 grams. As the specific gravity of pure butterfat compared at the temperature at which the readings are made (about 140° F.) is 0.9, then 1.8 grams of fat will occupy a volume of $\frac{1.8}{.9} = 2$ cubic centimeters. The spaces between the 0 and 10 per cent marks on the necks of the test bottles must therefore hold exactly 2 cubic centimeters. It is also important that the temperature of water used in connection with conducting the test be carefully checked for the coefficient of expansion of butterfat is 0.00064.

As indicated by Wilster (7) in the measurement of the fat column in the Babcock test bottle in the case of dairy products it should be measured from its lowest point to the highest point of the upper meniscus.

In considering the points in conducting the tests in dairy products, some variations in procedure will be noted in the adaptation of the test to use with meats.

METHODS AND PROCEDURES

The tests conducted were arranged into four different groups. The methods of obtaining and handling the samples to be tested as well as procedures used in conducting the tests varied in some respects in each of the groups. Also experience gained in conducting the tests in the first group, it is felt, brought about an increase of accuracy in the results obtained in the last three groups of tests conducted.

The methods of sampling and procedures used are reported separately in each of the four groups. A cross reference is made where the procedure of testing is the same as the proceeding groups.

Group I

1. Method of sampling.

   The samples used in conducting the tests in this phase were prepared by using ground beef to which was added a different amount of fat to each series. After the fat was added to the ground component, the product was ground three times. Each series of samples were prepared in duplicate, and put into approximately one quarter pound quantities. The one quarter pound samples were wrapped in wet wax paper, and the packages frozen at 0° F. until used for the test.

2. Methods of testing.

a. Ether extraction (Method of Official Analysis of the Association of Agricultural Chemists)

(1) Apparatus

Soxhlet extraction equipment

Electric heater or steam bath

Air oven maintained at 101° ± 1° C.

Filter paper, Whatman No. 2

Spatula

Desiccator

Analytical scale

Metal pan Ca 2 inches in diameter

(2) Reagent

Anhydrous ethyl ether

(3) Procedure

Thoroughly mixed sample and drew sample from at least three different areas of sample.

Weighed out 6 to 9 grams of the sample, and spread out thinly over the bottom of the pan.

Dried sample for 16 to 18 hours at 100 to 101° C.

Placed all of the dried sample into thimble of the Soxhlet apparatus,

and added loose plug of clean cotton to prevent loss of the sample later.

Put 150-200 ml of anhydrous ether in the flask of the Soxhlet apparatus, and assembled with the thimble in place. The actual amount of ether used varied with the size of the flask. Sufficient ether must be added that when the thimble fills during the extraction, there is still enough ether in the flask to cover the sample, and allow for evaporation.

Placed the Soxhlet apparatus on the heater with sufficient heat to cause the extraction to proceed at a steady rate for 16 to 18 hours.

Removed flask from Soxhlet apparatus and evaporated the ether-fat solution to complete dryness. This was accomplished by placing the flask over a steam bath. The flask was then placed in an oven at 100 to 101° C. until dry, approximately 30 minutes. The flask was removed from the oven and cooled to room temperature in a desiccator. The sample was weighed to

the nearest 0.0005 gram. The heating, cooling and reweighing was continued until constant weight was obtained. The percentage of fat in the sample was calculated by determining the weight of residue, multiplying by 100, and dividing by the weight of the sample.

b. Method for rapid fat determination of ground meat <u>without</u> centrifuging, using sulphuric acid.

(1) Apparatus (Plate I)

"Torsion" cream balance with 10 gram weight

Pyrex Erlenmeyer extraction flask, 200 ml (ground glass neck)

Measuring tube, 15 ml

Graduate, 25 ml, for measuring acid

Metal spatulas - 2

Bunsen burner

Beaker, 250 ml

Glass rod, 1/8 inch in diameter and 6 to 8 inches long

(2) Reagents

Sulphuric acid, concentrated (commercial, specific gravity 1.82-1.83)

Acetic acid, concentrated

(3) Procedure

Thoroughly mixed sample and drew sample from at least three different areas of sample.

Weighed exactly 10 grams of sample and placed sample in Erlenmeyer flask with 10 ml of water (70° C.).

Sample was thoroughly dispersed in water with aid of glass stirring rod. Concentrated acetic acid (5 ml) was added to sample pouring acid over glass stirring rod to remove any fat that may have been adhering to the rod.

Measured out concentrated sulphuric acid (25 ml) and poured into Erlenmeyer flask with sample. The Erlenmeyer flask was gently rotated and shaken to aid in digestion of the ground meat. Complete digestion occurred in 2 to 3 minutes after addition of concentrated sulphuric acid. Warm water (70° C.) was added to the Erlenmeyer flask, bringing the level of the contents up even with the lower edge of the ground glass neck. The measuring tube was placed

into position and the contents brought up to the top of the measurements marked on the tube, by further addition of warm water (70° C.).

The fat column which moved up into the measuring tube was measured by reading from lower level of top meniscus to lower level of bottom meniscus.

The percentage of fat present in the sample was calculated by reading the number of milliliters occupied by the fat and multiplying that factor by a conversion factor of 8.95.

c. Method for rapid fat determination of ground meat without centrifuging using Minnesota reagent.[6]

(1) Apparatus (Plate I)

Apparatus was the same as was previously described for method for rapid fat determination of ground meat without centrifuging using sulphuric acid except an electric heater or steam bath

[6]Standard Methods for the Examination of Dairy Products. Washington, D. C. American Public Health Association. 1948.

EXPLANATION OF PLATE I

Apparatus used in the rapid method of fat determination without centrifuging.

PLATE I

was added to the list of equipment.

(2) Reagents

Acetic acid, concentrated

Minnesota test reagent. The stock reagent prepared by dissolving 645 grams of sodium salicylate, 355 grams of potassium carbonate and 16.5 grams of sodium hydroxide. Made up to 3 liters and then added one liter of isopropyl alcohol. The reagent stored in cork or rubber stoppered glass bottles.

Optionally used in a portion of samples tested was a commercially prepared mixture of the reagent, as described above.

(3) Procedure

Procedure was the same as was previously described for method for rapid fat determination of ground meat without centrifuging using sulphuric acid with the following exceptions.

Measured out Minnesota reagent (25 ml) and poured into Erlenmeyer flask with sample.

The Erlenmeyer flask was gently rotated and shaken to thoroughly mix

the ingredients. It was then necessary to place the flask on a heater, and heat to approximately 100° C. for 15 to 20 minutes to bring about as much digestion as possible.

d. Modified Babcock method of fat determination with centrifuging using sulphuric acid.

(1) Apparatus (Plate II)

"Torsion" cream balance with 9 gram weight.

Paley cheese Babcock bottles, 50%

Metal spatulas, 2

Graduate for measuring acids

Thermometer

Calipers (Babcock)

Glass stirring rod, 1/8 inch in diameter and 4 to 5 inches long.

Bunsen burner

Beaker, 250 ml

Centrifuge or Babcock tester

(2) Reagents

Sulphuric acid, concentrated (Commercial, specific gravity 182-183)

Acetic acid, aconcentrated

Sudan III

(3) Procedure

Thoroughly mixed sample and drew sample from at least three different areas of sample.

Weighed exactly 9 grams of sample and placed ground meat into Paley bottle. To the sample was added 5 ml of water (70° C.). Sample was thoroughly dispersed in water with aid of glass stirring rod. Concentrated acetic acid (5 ml) was added to sample, pouring acid over glass stirring rod to remove any fat that may have been adhering to the rod.

Measured out concentrated sulphuric acid (15 ml) and poured into Paley tube with sample.

Immediately after the acid was added, the Paley bottle was rotated. The contents of the bottle was again mixed and stirred with the glass rod. Complete digestion occurred in about 2 to 3 minutes.

The stopper was put in the bottle and secured with a small wire placed

over the stopper and around the bulb of the bottle. The Paley bottle was then placed in a centrifuge for five minutes, having a 10 inch diameter wheel and centrifuged at approximately 1000 r.p.m.

The bottle was removed from the centrifuge and placed in a water bath (70° C.) for two minutes, after which hot water (70° C.) was added to bring the level of the contents up near the top of the graduation in the stem of the bottle.

The bottle was again centrifuged for two minutes at approximately 800 r.p.m., and again tempered in water bath (70° C.) for two minutes.

The Babcock calipers were immediately placed on the column of fat, from the bottom of the top meniscus, to the bottom of the lower meniscus of the fat column. The dividers were placed on the graduations of the bottle and the percentage of fat read off the column directly. Also the column of fat was measured from the top of the upper

meniscus, to the bottom of the lower meniscus, and record made of the reading.

Sudan III, approximately 2 grains, was added to the solution in the Babcock bottle in a portion of the samples tested. The Sudan III was added after the bottles had been centrifuged for five minutes. This addition was made in the test in order to facilitate reading the fat column, for Sudan III is fat soluble, coloring the column of fat a pink color.

e. Modified Babcock method of fat determination with centrifuging using Minnesota Reagent.

(1) Apparatus (Plate II)

Apparatus was the same as was previously described for modified Babcock method of fat determination with centrifuging using sulphuric acid, under group I,2, d,(1), except an electric heater or steam bath was added to list of apparatus needed.

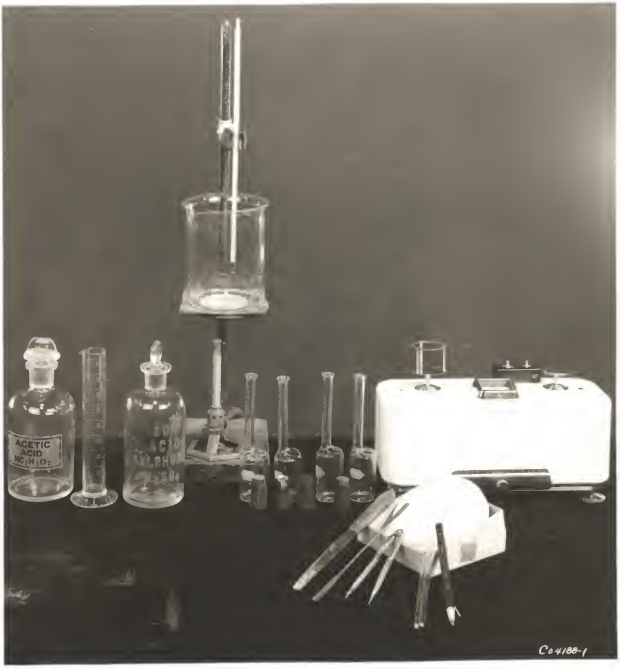
(2) Reagents

Acetic acid, concentrated

EXPLANATION OF PLATE II

Apparatus used in Modified Babcock Method of fat determination.

PLATE II



Minnesota test reagent

(3) Procedure

Procedure was the same as was previously described for modified Babcock method of fat determination with centrifuging using sulphuric acid with the following exceptions.

Measured out Minnesota reagent (15 ml) and poured into Paley test tube with sample to be tested. After rotating the bottle and mixing the contents with a glass rod it was necessary to place the bottle on an electric or steam bath for 15 to 20 minutes to bring about as complete digestion as possible.

Group II

1. Method of sampling.

The samples used in conducting the tests in this group were obtained in part from the Army Veterinary Officer-in-Charge at Kansas City, Missouri. Other samples were obtained from the Meat Laboratory, Department of Animal Husbandry, Kansas State College. The samples obtained from the Army Veterinary Officer-in-Charge were duplicate samples to those submitted to an Army Laboratory for analysis. In case of the beef

samples, the Army submitted the samples from the ground beef component of 4 way boneless beef.[7] The pork samples received from the army inspectors were duplicate samples of those submitted to army laboratories for analysis, taken during the processing of pork sausage under contract.[8] The remainder of the samples obtained from the Meat Laboratory, Kansas State College, were prepared by using ground meat to which was added a variable amount of fat to each series. The samples were wrapped in wet wax paper and the packages frozen at 0° F. until used for the test. Some of the samples tested were ground and mixed three times, and others ground and mixed five times. The designation of samples as to the different methods of grinding and mixing is shown in the section of this thesis under observation and discussion.

2. Methods of testing.

   a. Ether extraction (A.O.A.C.), Method of Official Analysis of Association of Agricul tural Chemists - Modified Army Laboratory Method.

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[7] Military Specification, Beef, Boneless, Frozen (4 way) Department of the Army, Navy and Air Force. 1950.

[8] Military Specification, Sausage, Pork, Canned. Department of the Army, Navy and Air Force. 1950.

(1) Apparatus

The apparatus used in this test is the same as that outlined under Group I,2,a,(1), ether extraction (A.O.A.C.) except that a metal pan Ca 2 inches in diameter was not required.

(2) Reagent

Petroleum ether (30° to 60° C.)

(3) Procedure

Thoroughly mixed sample and drew sample from at least three different areas of the sample.

Weighed out 6 to 8 gram sample which was placed directly into the thimble of extraction equipment, and added loose plug of clean cotton to prevent loss of the sample later.

The thimble was placed within the extractor and dried at 101° C. for 6 hours.

Put 150-200 ml of petroleum ether in the flask of the Soxhlet apparatus, and assembled the equipment.

The remainder of the procedure was the same as that set forth under Group I,2,a,(3) ether extraction (A.O.A.C.).

b. Method for rapid fat determination of ground meat without centrifuging using sulphuric acid.

The apparatus (Plate I), reagent and procedure was the same as explained under Group I,2,b,(1),(2), and (3) for the same test.

c. Modified Babcock method of fat determination with centrifuging using sulphuric acid.

The apparatus (Plate II), reagents, and procedure were the same as described under Group I,2,d,(1), (2) and (3) for the same test.

Group III

1. Method of sampling.

The samples used in conducting the tests in this group were obtained again in part from the Army Veterinary Officer-in-Charge at Kansas City, Missouri, and the remainder of the samples used from the Meat Laboratory, Department of Animal Husbandry, Kansas State College. In the case of the samples obtained from the Army Veterinary Corps, all were beef samples, obtained from those samples submitted on 4 way boneless beef contracts.

The remainder of the beef samples and pork were obtained and prepared from the Meat Laboratory, Kansas State College. All samples were wrapped in wet wax paper and the packages frozen at 0° F. until used for the test. The method of grinding and mixing is again shown in the section of this work under observation and discussion.

2. Method of testing.

The methods of testing were identical to those used for Group II.

Group IV

1. Method of sampling.

All of the samples used in this group of tests were pork sausage, which were prepared in the Meat Laboratory, Department of Animal Husbandry, Kansas State College. The samples had been mixed, ground and seasoned in the laboratory, and used for test purposes in the fresh state.

2. Method of testing.

The ether extraction (A.O.A.C.), Method of Official Analysis of the Association of Agricultural Chemists, modified army laboratory method and the modified Babcock method with centrifuging (using sulphuric acid), as used for the Group II series of tests were conducted.

The only exception being that in this group of samples, there was not a second reading taken of the fat column from the top of the upper meniscus to the bottom of the lower meniscus, on the graduated portion of the Paley test tube.

OBSERVATION AND DISCUSSION

In conducting the fat determination tests on samples of ground meat, the samples were tested in duplicate. Correlation tests were conducted in duplicate on the samples of meat, the second or correlation test of the sample was conducted separately from the first.

The results of the tests conducted on Group I series of five samples are shown in Tables 1, 2, 3, and 4. The differences between the results obtained by the ether extraction (A.O.A.C.) method and the rapid methods of fat determination (Plates III and IV) are variable in this group. The differences in part may have been due in part to improper mixing of the samples, and also lack of experience in conducting the tests.

The results of the tests conducted on Group II series of eighteen samples are shown in Tables 5, 6, 7, 8 and 9. As indicated formalin was added to some of the samples on which the rapid method of analysis was used. The addition of the formalin slowed down the action of the sulphuric acid in the

Table 1. Results of tests conducted on group I series of samples.

Sample series	Test number 1 ether extraction (AOAC)	Test number 2A rapid method for fat determination of ground meat without centrifuging using sulphuric acid	Test number 2B correlation test with test number 2A
A	37.35% Fat	31.32% Fat	33.11% Fat
A_1	35.35 Fat	31.77 Fat	32.56 Fat
B	35.23 Fat	30.83 Fat	30.43 Fat
B_1	35.71 Fat	30.83 Fat	30.43 Fat
C	27.15 Fat	22.37 Fat	25.06 Fat
C_1	26.45 Fat	24.16 Fat	25.06 Fat
D	37.32 Fat	33.56 Fat	29.53 Fat
D_1	35.01 Fat	32.39 Fat	30.34 Fat
E	33.75 Fat	29.53 Fat	27.74 Fat
E_1	33.70 Fat	29.53 Fat	27.74 Fat

Table 1. (cont.).

Sample series	Test number 3A method for fat determination of ground meat w/o centrifuging modified by the use of Minnesota reagent	Test number 3B correlation test with test number 3A
A	32.22% Fat	32.22% Fat
A_1	32.22 Fat	32.22 Fat
B	20.58 Fat	24.16 Fat
B_1	20.58 Fat	22.37 Fat
C	19.67 Fat	22.37 Fat
C_1	20.58 Fat	22.37 Fat
D	26.85 Fat	28.64 Fat
D_1	27.74 Fat	28.64 Fat
E	20.58 Fat	21.48 Fat
E_1	20.58 Fat	21.48 Fat

Table 1. (concl.).

Sample series	Test number 4 modified Babcock method	Test number 5 modified Babcock method using Minnesota reagent
A	31.4% Fat	Broken
A_1	31.2 Fat	20% Fat
B	36.5 Fat	27.0% Fat
B_1	28.0 Fat	27.5% Fat
C	26.5 Fat	27% Fat
C_1	26.5 Fat	27% Fat
D	34.9 Fat	31.5% Fat
D_1	35.4 Fat	31.5% Fat
E	32.0 Fat	22% Fat
E_1	32.0 Fat	22% Fat

Table 2. Difference between duplicate samples in each of tests conducted on group I series of samples.

Sample series	Test number 1 ether extraction (AOAC)	Test number 2A rapid method for fat determination of ground meat w/o centrifuging using sulphuric acid	Test number 2B correlation test with test number 2A	Test number 3A rapid method for fat determination of ground meat w/o centrifuging modified by the use of Minnesota reagent
A and A_1	2 per cent	.45 per cent	.45 per cent	No difference
B and B_1	.48 per cent	No difference	No difference	No difference
C and C_1	.70 per cent	1.79 per cent	No difference	.91 per cent
D and D_1	2.31 per cent	1.17 per cent	.81 per cent	.89 per cent
E and E_1	.05 per cent	No difference	No difference	No difference

Table 2. (concl.).

Sample series	Test number 3B correlation test with 3A	Test number 4 modified Babcock method	Test number 5 modified Babcock method using Minnesota reagent
A and A_1	No difference	.2 per cent	Incomplete results
B and B_1	1.79 per cent	8.5 per cent	No difference
C and C_1	No difference	No difference	No difference
D and D_1	No difference	.5 per cent	No difference
E and E_1	No difference	No difference	No difference

Table 3. Difference between correlation tests conducted on group I series of samples.

Sample series	Test number 2A and correlation test 2B rapid method for fat determination of ground meat w/o centrifuging using sulphuric acid	Test number 3A and correlation test 3B rapid method for fat determination of ground meat w/o centrifuging modified by the use of Minnesota reagent
A	1.79%	No difference
A_1	.79	No difference
B	.40	3.58%
B_1	.40	1.79
C	2.69	2.70
C_1	.80	1.79
D	4.03	1.79
D_1	2.05	.90
E	1.79	.90
E_1	1.79	.90

Table 4. Difference in results between ether extraction (AOAC) method and rapid methods of fat determination in group I.

Sample series	Test number 2A and 2B (average) rapid method for fat determination of ground meat w/o centrifuging using sulphuric acid	Test number 3A and 3B (average) rapid method for fat determination of ground meat w/o centrifuging modified by the use of Minnesota reagent	Test number 4 modified Babcock method	Test number 5 rapid fat determination method using Minnesota reagent
A	5.12% + (AOAC)[1]	5.13% + (AOAC)	6.95% + (AOAC)	Incomplete results
A_1	3.39 + (AOAC)	3.13 + (AOAC)	4.15 + (AOAC)	15.35% + (AOAC)
B	4.60 + (AOAC)	12.86 + (AOAC)	1.27 - (AOAC)[2]	8.23 + (AOAC)
B_1	5.08 + (AOAC)	14.24 + (AOAC)	7.71 + (AOAC)	8.21 + (AOAC)
C	3.44 + (AOAC)	6.13 + (AOAC)	.65 + (AOAC)	.15 + (AOAC)
C_1	3.54 + (AOAC)	4.98 + (AOAC)	.05 - (AOAC)	.55 - (AOAC)
D	6.28 + (AOAC)	10.58 + (AOAC)	2.42 + (AOAC)	5.82 + (AOAC)
D_1	3.65 + (AOAC)	6.82 + (AOAC)	.39 - (AOAC)	3.51 + (AOAC)
E	5.10 + (AOAC)	12.72 + (AOAC)	1.75 + (AOAC)	11.75 + (AOAC)
E_1	5.05 + (AOAC)	12.67 + (AOAC)	1.70 + (AOAC)	11.70 + (AOAC)

[1] + AOAC - Indicates greater amount of fat found in ether extraction (AOAC) method.
[2] - AOAC - Indicates less amount of fat found in ether extraction (AOAC) method.

process of digestion. The following points are noted from results shown on Table 6:

1. Little difference occurred between duplicate samples in the ether extraction (AOAC) army modified method. The greatest difference being 1.01 per cent.

2. Considerable difference occurred between duplicate samples in the rapid fat determination of ground meat without centrifuging using sulphuric acid. The greatest difference being 4.02 per cent, with the results of over thirteen tests being over one per cent in difference.

3. Little difference occurred between duplicate samples in the modified Babcock method of fat determination with centrifuging using sulphuric acid. There were only three samples with over one per cent difference in results.

The results shown on Table 7 show the following:

1. Considerable difference occurred between correlation tests in the ether extraction (AOAC) army modified method. The difference may have been due to the fact that samples were mixed and ground only three times.

2. Less difference occurred between correlation test of the modified Babcock method than occurred between the correlation test of the rapid method of fat determination without centrifuging.

Table 8 demonstrated the following:

1. A large difference in results were obtained between

the ether extraction (AOAC) army modified method and rapid method of fat determination of ground meat without centrifuging. Only three tests showed less than one per cent difference and ranging up to 11.77 per cent.

2. A close relationship in results were obtained between the ether extraction (AOAC) army modified method and the modified Babcock method of fat determination. This close relationship between results occurred when the samples were well mixed. In only two instances when the samples were well mixed were the differences greater than one per cent. When the samples were not well mixed, the difference in results were made wider, up to 11.5 per cent.

In reference to Table 9 it was found that the relationship between the reading taken by placing the calipers at the top of the upper meniscus to the bottom of the lower meniscus on the graduated neck of the Paley test tube was quite constant with the readings taken from the bottom of the upper meniscus to the bottom of the lower meniscus. The results of the modified Babcock method and the ether extraction (AOAC) army modified however are closer when the reading is taken from the bottom of the upper meniscus to the bottom of the lower meniscus.

Tables 10, 11, 12, 13 and 14 give the results of the tests conducted on group III series of twelve samples. An average of the differences were taken from the results shown in the tables

Table 5. Results of tests conducted on group II series of samples

Sample series	Test number 1A: ether extraction (AOAC) modified army laboratory method		Test number 1B: correlation test with test IA		Test number 2A: rapid method of ground meat without centrifuging		Test number 2B: correlation test with test number 2A	
F	25.20%	Fat[1]	--		22.37%	Fat	22.37%	Fat
F_1	24.90	Fat	--		23.27	Fat	22.82	Fat
G	34.10	Fat[1]	--		33.11	Fat	34.01	Fat
G_1	34.30	Fat	--		33.11	Fat	31.32	Fat
H	36.80	Fat[1]	--		33.11	Fat	35.80	Fat
H_1	36.60	Fat	--		31.52	Fat	37.14	Fat
I	29.90	Fat[2]	--		27.74	Fat[3]	28.64	Fat[3]
I_1	30.20	Fat	--		27.74	Fat	28.64	Fat
J	27.10	Fat[1]	--		25.06	Fat[3]	24.16	Fat[3]
J_1	26.90	Fat	--		25.50	Fat	25.50	Fat
Pork No. 1	39.30	Fat[4]	--		41.27	Fat	41.27	Fat
Pork No. 1_1	38.70	Fat	--		42.17	Fat	39.38	Fat
K	21.70	Fat[3]	--		24.61	Fat[3]	27.74	Fat[3]
K_1	21.70	Fat	--		---		29.53	Fat
L	25.50	Fat[1]	--		22.82	Fat[3]	22.37	Fat[3]
L_1	25.50	Fat	--		23.27	Fat	23.27	Fat
Pork No. 2	41.70	Fat[4]	--		40.27	Fat	41.17	Fat
Pork No. 2_1	41.70	Fat	--		42.06	Fat	41.79	Fat
M	40.50	Fat[2]	45.10%	Fat	41.17	Fat	42.96	Fat
M_1	40.50	Fat	45.10	Fat	41.17	Fat	42.50	Fat
N	38.20	Fat[2]	43.00	Fat	38.48	Fat	39.38	Fat
N_1	37.40	Fat	43.00	Fat	38.48	Fat	39.38	Fat
O	43.70	Fat[2]	44.70	Fat	46.54	Fat	---	
O_1	44.00	Fat	44.70	Fat	42.51	Fat	---	
P	38.40	Fat[2]	48.00	Fat	41.17	Fat	42.50	Fat
P_1	38.40	Fat	48.00	Fat	42.51	Fat	41.17	Fat

Table 5. (cont.).

Sample series	Test number 1A: ether extraction (AOAC) modified army laboratory method		Test number 1B correlation test with test 1A		Test number 2A: rapid method for fat determination of ground meat without centrifuging		Test number 2B correlation test with test number 2A	
Q	37.70%	Fat[2]	41.60%	Fat	38.03%	Fat	42.06%	Fat
Q_1	37.70	Fat	41.60	Fat	38.48	Fat	42.06	Fat
R	37.00	Fat[2]	46.20	Fat	46.54	Fat	46.54	Fat
R_1	37.00	Fat	46.20	Fat	46.98	Fat	50.56	Fat
4A	38.96	Fat[1]	42.60	Fat	33.01	Fat	38.93	Fat
$4A_1$	38.96	Fat	42.20	Fat	33.01	Fat	37.59↓	Fat
4B	38.96	Fat[1]	41.80	Fat	34.90	Fat	---	
$4B_1$	39.97	Fat	42.50	Fat	37.59	Fat	---	
5A	43.33	Fat[1]	44.80	Fat	41.17↓	Fat	---	
$5A_1$	43.33↓	Fat	43.60↓	Fat	---		---	

Table 5. (cont.).

Sample series	Test number 3A modified Babcock method	Test number 3B correlation test with 3A
F	25.4% Fat	24.9% Fat
F_1	25.1 Fat	25.5 Fat
G	34.5 Fat	34.0 Fat
G_1	34.5 Fat	34.1 Fat
H	36.6 Fat	34.5 Fat
H_1	36.9 Fat	36.0 Fat
I	25.5 Fat[3]	25.1 Fat[3]
I_1	25.8 Fat	--
J	26.9 Fat[3]	28.4 Fat[3]
J_1	26.9 Fat	28.0 Fat
Pork No. 1	36.7 Fat	36.5 Fat
Pork No. 1_1	36.5 Fat	Unknown
K	26.4 Fat[3]	24.8% Fat[3]
K_1	25.9 Fat	25.6 Fat
L	25.0 Fat[3]	27.5 Fat[3]
L_1	--	27.5 Fat
Pork No. 2	38.6 Fat	41.5 Fat
Pork No. 2_1	39.5 Fat	--
M	44.0 Fat	43.4 Fat
M_1	42.57% Fat	43.0 Fat
N	38.4% Fat	39.5 Fat
N_1	38.4 Fat	40.4 Fat
O	49.4 Fat	48.0 Fat
O_1	46.6 Fat	48.0 Fat
P	42.0 Fat	42.8 Fat
P_1	42.17% Fat	42.7 Fat
Q	39.1% Fat	43.5 Fat
Q_1	39.1 Fat	43.5 Fat

Table 5. (concl.).

Sample series	Test number 3A modified Babcock method		Test number 3B correlation test with 3A	
R	47.4%	Fat	48.0%	Fat
R_1	--		48.5	Fat
4A	38.9	Fat	38.5	Fat
$4A_1$	38.6	Fat	38.5	Fat
4B	38.8	Fat	38.5	Fat
$4B_1$	39.9	Fat	38.5	Fat
5A	42.5	Fat	43.0	Fat
$5A_1$	42.8	Fat	43.0	Fat

[1]All samples so marked were fine ground or well mixed, by grinding sample five times.
[2]All samples so marked were coarse ground for they have been ground three times and were not completely mixed.
[3]All samples so marked had formalin added as a preservative. The sulphuric acid failed to digest the meat as rapidly as when not added.
[4]Pork samples digested very rapidly when sulphuric acid was added to the product.

Table 6. Difference between duplicate samples in each of tests conducted on group II series of samples.

Sample series	Test number 1A ether extraction (AOAC) army modification method	Test number 1B correlation test with 1A	Test number 2A rapid method for fat determination of ground meat w/o centrifuging
F and F_1	.3 per cent	--	.9 per cent
G and G_1	.2 per cent	--	No difference
H and H_1	.2 per cent	--	1.79 per cent
I and I_1	.3 per cent	--	No difference
J and J_1	.2 per cent	--	.44 per cent
Pork Nos. 1 and 1_1	.6 per cent	--	.90 per cent
K and K_1	No difference	--	No duplicate
L and L_1	No difference	--	.45 per cent
Pork Nos. 2 and 2_1	No difference	--	1.79 per cent
M and M_1	No difference	No difference	No difference
N and N_1	.8 per cent	No difference	No difference
O and O_1	.3 per cent	No difference	2.03 per cent
P and P_1	No difference	No difference	1.34 per cent
Q and Q_1	No difference	No difference	.45 per cent
R and R_1	No difference	No difference	.44 per cent
4A and $4A_1$	No difference	.4 per cent	No difference
4B and $4B_1$	1.01 per cent	.7 per cent	2.69 per cent
5A and $5A_1$	No difference	1.2 per cent	--

Table 6. (concl.).

Sample series	Test number 2B correlation test with test number 2A	Test number 3A modified Babcock method	Test number 3B correlation test with test number 3A
F and F_1	.45 per cent	.3 per cent	.6 per cent
G and G_1	2.69 per cent	No difference	.1 per cent
H and H_1	1.34 per cent	.3 per cent	1.5 per cent
I and I_1	No difference	.3 per cent	No duplicate
J and J_1	1.34 per cent	No difference	.4 per cent
Pork Nos. 1 and 1_1	1.89 per cent	.2 per cent	No duplicate
K and K_1	1.79 per cent	.5 per cent	.8 per cent
L and L_1	.90 per cent	No duplicate	No difference
Pork Nos. 2 and 2_1	.62 per cent	.9 per cent	No duplicate
M and M_1	.46 per cent	1.43 per cent	.4 per cent
N and N_1	No difference	No difference	.9 per cent
O and O_1	--	2.8 per cent	No difference
P and P_1	1.33 per cent	.17 per cent	.1 per cent
Q and Q_1	No difference	No difference	No difference
R and R_1	4.02 per cent	Unknown	.5 per cent
4A and $4A_1$	1.34 per cent	.3 per cent	No difference
4B and $4B_1$	--	1.1 per cent	No difference
5A and $5A_1$	--	.3 per cent	No difference

Table 7. Difference between correlation tests conducted on group II series of samples.

Sample series	Test number 1A and correlation test 1B ether extraction (AOAC) modified army laboratory method	Test number 2A and correlation test 2B rapid method for fat determination of ground meat w/o centrifuging	Test number 3A and correlation test 3B modified Babcock method
F	--	No difference	.6 per cent
F_1	--	.45 per cent	.4 per cent
G	--	.90 per cent	.5 per cent
G_1	--	1.79 per cent	.4 per cent
H	--	1.69 per cent	2.1 per cent
H_1	--	5.81 per cent	.9 per cent
I	--	.90 per cent	.4 per cent
I_1	--	.90 per cent	--
J	--	.90 per cent	1.5 per cent
J_1	--	No difference	1.1 per cent
Pork No. 1	--	No difference	.2 per cent
Pork No. 1_1	--	2.79 per cent	Unknown
K	--	3.13 per cent	1.6 per cent
K_1	--	--	.3 per cent
L	--	.45 per cent	2.5 per cent
L_1	--	No difference	--
Pork No. 2	--	.90 per cent	2.9 per cent
Pork No. 2_1	--	.27 per cent	--
M	4.6 per cent	1.79 per cent	.6 per cent
M_1	4.6 per cent	1.33 per cent	.43 per cent
N	4.8 per cent	.90 per cent	1.1 per cent
N_1	5.6 per cent	.90 per cent	2.0 per cent
O	1.0 per cent	--	1.4 per cent
O_1	.7 per cent	--	1.4 per cent
P	9.6 per cent	1.33 per cent	.8 per cent
P_1	9.6 per cent	1.34 per cent	.47 per cent

Table 7. (concl.).

Sample series	Test number 1A and correlation test 1B ether extraction (AOAC) modified army laboratory method	Test number 2A and correlation test 2B rapid determination of fat ground meat w/o centrifuging	Test number 3A and correlation test 3B modified Babcock method
Q	3.9 per cent	4.03 per cent	4.4 per cent
Q_1	3.9 per cent	3.58 per cent	4.4 per cent
R	9.2 per cent	No difference	.6 per cent
R_1	9.2 per cent	3.58 per cent	Unknown
4A	3.6 per cent	5.92 per cent	.4 per cent
$4A_1$	3.6 per cent	4.58 per cent	.1 per cent
4B	2.84 per cent	--	.3 per cent
$4B_1$	2.53 per cent	--	1.4 per cent
5A	1.47 per cent	--	.5 per cent
$5A_1$	.27 per cent	--	.2 per cent

Table 8. Difference in results between ether extraction (AOAC) (army modified laboratory method) and rapid methods of fat determination in group II series of samples.

Sample series	Test number 2A and 2B (average) rapid method for fat determination of ground meat without centrifuging		Test number 3A and 3B (average) modified Babcock method	
F	2.23%	+ (AOAC)[1]	.1%	+ (AOAC)[3]
F_1	1.86	+ (AOAC)	.4	- (AOAC)[2]
G	.54	+ (AOAC)	.1	- (AOAC)[3]
G_1	1.09	+ (AOAC)	No difference	
H	2.35	+ (AOAC)	1.3%	+ (AOAC)[3]
H_1	2.37	+ (AOAC)	.2	+ (AOAC)
I	1.71	+ (AOAC)	4.6	+ (AOAC)[4]
I_1	1.3	+ (AOAC)	4.4	+ (AOAC)
J	2.49	+ (AOAC)	.5	- (AOAC)[3]
J_1	1.4	+ (AOAC)	.5	- (AOAC)
Pork No. 1	1.97	- (AOAC)	2.7	+ (AOAC)
Pork No. 1_1	2.07	- (AOAC)	2.2	+ (AOAC)
K	4.47	- (AOAC)	3.9	- (AOAC)[4]
K_1	7.83	- (AOAC)	4.0	- (AOAC)
L	2.91	+ (AOAC)	.7	- (AOAC)[3]
L_1	2.23	+ (AOAC)	2.0	- (AOAC)
Pork No. 2	.98	+ (AOAC)	1.7	+ (AOAC)
Pork No. 2_1	.22	- (AOAC)	2.2	+ (AOAC)
M	1.56	- (AOAC)	3.2	- (AOAC)[4]
M_1	1.33	- (AOAC)	2.28%	- (AOAC)
N	.73	- (AOAC)	.7%	- (AOAC)[4]
N_1	1.53	- (AOAC)	2.0	- (AOAC)
O	2.84	- (AOAC)	.5	- (AOAC)[4]
O_1	1.49	+ (AOAC)	3.3	- (AOAC)
P	3.43	- (AOAC)	4.0	- (AOAC)[4]
P_1	3.44	- (AOAC)	4.03%	- (AOAC)

Table 8. (concl.).

Sample series	Test number 2A and 2B (average) rapid method for fat determination of ground meat without centrifuging	Test number 3A and 3B (average) modified Babcock method
Q	2.34% - (AOAC)	3.6% - (AOAC)[4]
Q_1	2.57 - (AOAC)	3.6 - (AOAC)
R	9.54 - (AOAC)	10.7 - (AOAC)[4]
R_1	11.77 - (AOAC)	11.5 - (AOAC)
4A	2.99 + (AOAC)	.26% + (AOAC)[3]
$4A_1$	3.66 + (AOAC)	.46 + (AOAC)
4B	4.06 + (AOAC)	.46 + (AOAC)[3]
$4B_1$	2.38 + (AOAC)	.77 + (AOAC)
5A	2.16 + (AOAC)	.63 + (AOAC)[3]
$5A_1$	Unknown	.43 + (AOAC)

[1] + AOAC - Indicates greater amount of fat found in ether extraction (AOAC) army modified laboratory method.

[2] - AOAC - Indicates less amount of fat found in ether extraction (AOAC) army modified laboratory method.

[3] All samples so marked were fine ground or well mixed, by grinding sample five times.

[4] All samples so marked were coarse ground for they had been ground three times and not completely mixed.

Table 9. Difference in reading of fat column in modified Babcock method from upper level of top meniscus to lower level of bottom meniscus, as compared to standard method (in milk) of reading from lower level of top meniscus to lower level of bottom meniscus in group II series of samples.[1]

Sample series	Test 3A modified Babcock method	Test 3B modified Babcock method (correlation test)
F	.6 per cent	.6 per cent
F_1	.4 per cent	.5 per cent
G	.5 per cent	.9 per cent
G_1	.5 per cent	.7 per cent
H	.5 per cent	.4 per cent
H_1	.6 per cent	.5 per cent
I	1.5 per cent	.9 per cent
I_1	.7 per cent	--
J	1.0 per cent	.6 per cent
J_1	.6 per cent	.8 per cent
Pork No. 1	1.2 per cent	1.0 per cent
Pork No. 1_1	.5 per cent	--
K	.6 per cent	.6 per cent
K_1	1.1 per cent	.6 per cent
L	.5 per cent	.5 per cent
L_1	--	.5 per cent
Pork No. 2	.4 per cent	.5 per cent
Pork No. 2_1	.5 per cent	--
M	.5 per cent	.6 per cent
M_1	.5 per cent	.5 per cent
N	1.6 per cent	1.0 per cent
N_1	.8 per cent	.6 per cent
O	.6 per cent	1.0 per cent
O_1	1.0 per cent	1.0 per cent
P	1.3 per cent	.7 per cent
P_1	1.4 per cent	.8 per cent

Table 9. (concl.).

Sample series	Test 3A modified Babcock method	Test 3B modified Babcock method (correlation test)
Q	.5 per cent	1.0 per cent
Q_1	.5 per cent	1.0 per cent
R	.6 per cent	1.0 per cent
R_1	--	1.0 per cent
4A	.6 per cent	1.0 per cent
$4A_1$	.4 per cent	1.0 per cent
4B	1.0 per cent	.5 per cent
$4B_1$	.6 per cent	.5 per cent
5A	1.1 per cent	.5 per cent
$5A_1$	.4 per cent	.5 per cent

[1]In each case the figure shown was the amount in favor of the reading from the top level of upper meniscus to lower level of bottom meniscus.

in this group of samples. The results obtained from tests conducted on beef samples and pork samples were considered separately.

The findings as shown in Table 11 are as follows:

1. The average of the differences between duplicate samples conducted on beef samples was 0.7 per cent for the ether extraction (AOAC) army modified method and 0.8 per cent for the modified Babcock method (using sulphuric acid). The average of the differences between duplicate samples in the case of the rapid method of fat determination without centrifuging (using sulphuric acid) was 1.3 per cent.

2. The average of the differences between duplicate samples conducted on pork samples was 0.6 per cent for the ether extraction (AOAC) army modified method and 0.4 per cent for the modified Babcock method (using sulphuric acid). The average of the differences between duplicate samples in the case of the rapid fat determination method without centrifuging (using sulphuric acid) was 0.8 per cent.

In Table 12 the following was found:

1. The average of the difference between the correlation tests conducted on beef samples showed the greatest difference to exist between correlation tests of the ether extraction (AOAC) army modified method. The average difference between correlation tests was found to be 2.51 per cent. The next greatest difference was found to exist between correlation

tests conducted by the rapid fat determination method without centrifuging (using sulphuric acid), the average difference being 2.45 per cent. The least difference between correlation tests existed in the case of the modified Babcock method (using sulphuric acid). In this case the average difference was 1.5 per cent.

2. The average of the differences between the correlation tests conducted on pork samples again showed the greatest difference between correlation tests, to occur in the ether extraction (AOAC) army modified method, and the rapid fat determination method without centrifuging (using sulphuric acid). The differences found in these two tests were 1.10 per cent and 1.08 per cent respectively. The least difference between correlation tests in the pork samples was in the use of the modified Babcock method. In this case the average difference was 0.4 per cent.

For the determination of the average differences between the standard ether extraction (AOAC) army modified method and the rapid method of fat determination the following data was taken from Table 13.

1. Beef samples.

a. There was 2.22 per cent difference between the ether extraction (AOAC) army modified method and the rapid fat determination method without centrifuging (using sulphuric acid).

b. There was only .82 per cent difference between the ether extraction (AOAC) army modified method and the modified Babcock method (using sulphuric acid).

2. Pork samples.

a. There was 1.5 per cent difference between the ether extraction (AOAC) army modified method and the rapid fat determination method without centrifuging (using sulphuric acid).

b. There was 0.5 per cent difference between the ether extraction (AOAC) army modified method and the modified Babcock method (using sulphuric acid).

The results and findings of tests conducted on group IV series of pork sausage samples are recorded in Tables 15, 16, 17 and 18. Again an average of the differences were taken from the results shown in the tables.

Table 16 shows the following information on the average of the differences between duplicate samples:

The average of the differences between duplicate samples was .15 per cent for the ether extraction (AOAC) army modified method and .79 per cent for the modified Babcock method (using sulphuric acid).

The average differences between the correlation tests conducted only in the case of the modified Babcock method as shown in Table 17 was .52 per cent.

Table 10. Results of tests conducted on group III series of samples.

Sample series	Test number 1A ether extraction (AOAC) modified army laboratory method		Test number 1B correlation test with test 1A		Test number 2A rapid method for fat determination of ground meat w/o centrifuging	
5B	43.1%	Fat[1]	45.3%	Fat	41.17%	Fat
$5B_1$	43.1	Fat	45.3	Fat	41.61	Fat
6A	44.6	Fat[1]	49.4	Fat	44.75	Fat
$6A_1$	45.7	Fat	48.0	Fat	43.85	Fat
6B	45.9	Fat[1]	49.2	Fat	42.06	Fat
$6B_1$	47.3	Fat	51.1	Fat	42.51	Fat
7A	48.0	Fat[1]	47.7	Fat	48.33	Fat
$7A_1$	47.2	Fat	46.4	Fat	46.52	Fat
8A	40.6	Fat[1]	40.6	Fat	38.03	Fat
$8A_1$	41.3	Fat	40.8	Fat	41.17	Fat
9B	48.7	Fat[1]	46.3	Fat	44.75	Fat
$9B_1$	49.5	Fat	46.7	Fat	42.06	Fat
10B	38.2	Fat[1]	43.2	Fat	38.93	Fat
$10B_1$	39.1	Fat	43.3	Fat	38.03	Fat
11A	39.4	Fat[1]	40.9	Fat	38.03	Fat
$11A_1$	38.6	Fat	41.2	Fat	38.48	Fat
12B	37.9	Fat[2]	41.6	Fat	39.38	Fat
$12B_1$	39.4	Fat	42.3	Fat	40.27	Fat
Pork No. 3	32.5	Fat[2]	34.2	Fat	30.1	Fat
Pork No. 3_1	31.5	Fat	32.1	Fat	30.3	Fat
Pork No. 4	41.8	Fat[2]	43.0	Fat	42.0	Fat
Pork No. 4_1	41.8	Fat	42.5	Fat	41.5	Fat
Pork No. 5	49.8	Fat[2]	48.7	Fat	46.5	Fat
Pork No. 5_1	48.7	Fat	47.5	Fat	47.6	Fat

Table 10. (concl.).

Sample series	Test number 2B: correlation test with test number 2A	Test number 3A: modified Babcock method	Test number 3B: correlation test with 3A
5B	42.06% Fat	43.0% Fat[1]	44.0% Fat
$5B_1$	42.06 Fat	43.0 Fat	43.5 Fat
6A	48.77 Fat	45.5 Fat[1]	51.0 Fat
$6A_1$	47.78 Fat	44.0 Fat	51.0 Fat
6B	50.57 Fat	47.1 Fat[1]	47.5 Fat
$6B_1$	51.01 Fat	45.2 Fat	47.5 Fat
7A	Unknown	47.5 Fat[1]	47.2 Fat
$7A_1$	45.64% Fat	48.4 Fat	Unknown
8A	41.61 Fat	39.8 Fat[1]	41.0% Fat
$8A_1$	41.61 Fat	40.5 Fat	40.0 Fat
9B	51.01 Fat	47.5 Fat[1]	45.0 Fat
$9B_1$	41.17 Fat	47.0 Fat	49.5 Fat
10B	37.59 Fat	41.0 Fat[2]	41.5 Fat
$10B_1$	37.59 Fat	41.0 Fat	40.6 Fat
11A	39.38 Fat	38.5 Fat[2]	39.5 Fat
$11A_1$	37.59 Fat	Unknown	39.5 Fat
12B	38.93 Fat	39.0% Fat[2]	40.5 Fat
$12B_1$	38.93 Fat	39.5 Fat	39.5 Fat
Pork No. 3	32.0 Fat	32.8 Fat[2]	32.5 Fat
Pork No. 3_1	31.5 Fat	32.0 Fat	32.1 Fat
Pork No. 4	41.8 Fat	42.0 Fat[2]	42.3 Fat
Pork No. 4_1	40.0 Fat	41.8 Fat	42.0 Fat
Pork No. 5	45.9 Fat	48.6 Fat[2]	47.5 Fat
Pork No. 5_1	46.6 Fat	48.9 Fat	48.2 Fat

[1]Samples were ground and mixed three times.
[2]Samples were ground and mixed five times.

Table 11. Difference between duplicate samples in each of tests conducted on group III series of samples.

Sample series	Test number 1A ether extraction (AOAC) army modification method	Test number 1B correlation test with number 1A	Test number 2A rapid method for fat determination of ground meat w/o centrifuging
5B & $5B_1$	No difference	No difference	.44 per cent
6A & $6A_1$	1.1 per cent	1.4 per cent	.90 per cent
6B & $6B_1$	1.4 per cent	1.9 per cent	.45 per cent
7A & $7A_1$	.8 per cent	1.3 per cent	1.81 per cent
8A & $8A_1$	.7 per cent	.2 per cent	3.14 per cent
9B & $9B_1$	.8 per cent	.4 per cent	2.69 per cent
10B & $10B_1$	.9 per cent	.1 per cent	.90 per cent
11A & $11A_1$	.8 per cent	.3 per cent	.45 per cent
12B & $12B_1$	1.5 per cent	.7 per cent	.89 per cent
Pork No. 3 & Pork No. 3_1	.5 per cent	1.1 per cent	.20 per cent
Pork No. 4 & Pork No. 4_1	No difference	.5 per cent	.50 per cent
Pork No. 5 & Pork No. 5_1	1.1 per cent	.5 per cent	1.10 per cent

Table 11. (concl.).

Sample series	Test number 2B correlation test with test number 2A	Test number 3A modified Babcock method	Test number 3B correlation test with test number 3A
5B & $5B_1$	No difference	No difference	.5 per cent
6A & $6A_1$	.99 per cent	1.5 per cent	No difference
6B & $6B_1$	.44 per cent	1.9 per cent	No difference
7A & $7A_1$	Unknown	.9 per cent	Unknown
8A & $8A_1$	No difference	.7 per cent	1.0 per cent
9B & $9B_1$	9.84 per cent	.5 per cent	4.5 per cent
10B & $10B_1$	No difference	No difference	.9 per cent
11A & $11A_1$	1.79 per cent	Unknown	No difference
12B & $12B_1$	No difference	.5 per cent	1.0 per cent
Pork No. 3 & Pork No. 3_1	.50 per cent	.8 per cent	.4 per cent
Pork No. 4 & Pork No. 4_1	1.80 per cent	.2 per cent	.3 per cent
Pork No. 5 & Pork No. 5_1	.70 per cent	.3 per cent	.7 per cent

Table 12. Difference between correlation tests conducted on group III series of samples.

Sample series	Test number 1A and correlation test 1B ether extraction (AOAC) modified army laboratory method	Test number 2A and correlation test 2B method for fat determination of ground meat w/o centrifuging	Test number 3A and correlation test 3B modified Babcock method
5B	2.20 per cent	.89 per cent	1.0 per cent
$5B_1$	2.20 per cent	.45 per cent	.5 per cent
6A	4.8 per cent	4.02 per cent	5.5 per cent
$6A_1$	2.3 per cent	3.93 per cent	7.0 per cent
6B	3.3 per cent	8.51 per cent	.4 per cent
$6B_1$	3.8 per cent	8.50 per cent	2.3 per cent
7A	.3 per cent	Unknown	.3 per cent
$7A_1$	.8 per cent	.88 per cent	Unknown
8A	No difference	3.58 per cent	1.2 per cent
$8A_1$	.5 per cent	.44 per cent	.5 per cent
9B	2.4 per cent	6.26 per cent	2.5 per cent
$9B_1$	2.8 per cent	.89 per cent	2.5 per cent
10B	5.0 per cent	1.34 per cent	.5 per cent
$10B_1$	4.2 per cent	.44 per cent	1.6 per cent
11A	1.5 per cent	1.35 per cent	1.0 per cent
$11A_1$	2.6 per cent	.89 per cent	Unknown
12B	3.7 per cent	.45 per cent	1.5 per cent
$12B_1$	2.9 per cent	1.34 per cent	No difference
Pork No. 3	1.7 per cent	1.9 per cent	.3 per cent
Pork No. 3_1	.6 per cent	1.3 per cent	.1 per cent
Pork No. 4	1.8 per cent	.2 per cent	.3 per cent
Pork No. 4_1	.7 per cent	1.5 per cent	.2 per cent
Pork No. 5	1.1 per cent	.6 per cent	1.1 per cent
Pork No. 5_1	1.2 per cent	1.0 per cent	.7 per cent

Table 13. Difference in results between ether extraction (AOAC) (army modified laboratory method) and rapid methods of fat determination in group III series of samples.

Sample series	Test number 2A and 2B (average) rapid method for fat determination of ground meat w/o centrifuging	Test number 3A and 3B (average) modified Babcock method
5B	2.59% + AOAC[1]	.70% + AOAC[3]
$5B_1$	2.37 + AOAC	.95 + AOAC
6A	.24 + AOAC	1.25 - AOAC[2,3]
$6A_1$	.99 + AOAC	.50 + AOAC
6B	1.19 + AOAC	.25 + AOAC[3]
$6B_1$	2.44 + AOAC	2.85 + AOAC
7A	.48 - AOAC	.50 + AOAC[4]
$7A_1$	.72 + AOAC	1.60 - AOAC
8A	5.78 + AOAC	.20 + AOAC[4]
$8A_1$	.34 - AOAC	.80 + AOAC
9B	.38 - AOAC	1.25 + AOAC[4]
$9B_1$	6.49 + AOAC	.15 - AOAC
10B	7.56 - AOAC	.55 - AOAC[4]
$10B_1$	3.39 + AOAC	.40 + AOAC
11A	1.45 + AOAC	1.15 + AOAC[4]
$11A_1$	1.87 + AOAC	.40 + AOAC
12B	.56 + AOAC	No difference[4]
$12B_1$	1.20 + AOAC	1.30% + AOAC
Pork No. 3	1.0 + AOAC	.6 + AOAC[4]
Pork No. 3_1	.9 + AOAC	.7 - AOAC
Pork No. 4	.5 + AOAC	.35 + AOAC[4]
Pork No. 4_1	1.4 + AOAC	.2 + AOAC
Pork No. 5	3.2 + AOAC	1.3 + AOAC[4]
Pork No. 5_1	2.1 + AOAC	.3 - AOAC

[1] + AOAC indicates greater amount of fat found in ether extraction (AOAC) army modified laboratory method.
[2] - AOAC indicates less amount of fat found in ether extraction (AOAC) army modified laboratory method.
[3] Samples were ground and mixed three times.
[4] Samples were ground and mixed four times.

Table 14. Difference in reading of fat column in modified Babcock method from upper level of top meniscus to lower level of bottom meniscus, as compared to standard method (in milk) of reading from lower level of top meniscus to lower level of bottom meniscus in group III series of samples.[1]

Sample series	Test 3A modified Babcock method	Test 3B modified Babcock method (correlation test)
5B	.5 per cent	1.0 per cent
$5B_1$	.5 per cent	1.0 per cent
6A	.5 per cent	1.0 per cent
$6A_1$	.5 per cent	.5 per cent
6B	.9 per cent	.5 per cent
$6B_1$	.8 per cent	.5 per cent
7A	.5 per cent	.8 per cent
$7A_1$	.6 per cent	Unknown
8A	.4 per cent	.5 per cent
$8A_1$	1.0 per cent	.5 per cent
9B	.5 per cent	.5 per cent
$9B_1$	.5 per cent	No difference
10B	.5 per cent	1.0 per cent
$10B_1$	.8 per cent	1.4 per cent
11A	.5 per cent	1.0 per cent
$11A_1$	Unknown	1.0 per cent
12B	.9 per cent	1.0 per cent
$12B_1$	1.0 per cent	1.0 per cent
Pork No. 3	.6 per cent	.6 per cent
Pork No. 3_1	.5 per cent	.9 per cent
Pork No. 4	.5 per cent	.5 per cent
Pork No. 4_1	.7 per cent	.5 per cent
Pork No. 5	.7 per cent	.5 per cent
Pork No. 5_1	.5 per cent	.5 per cent

[1]In each case the figure shown was the amount in favor of the reading from the top level of upper meniscus to lower level of bottom meniscus.

The average difference in results between the ether extraction (AOAC) army modified method and modified Babcock method in this group of samples the data for which was recorded in Table 18 was 2.5 per cent. The individual differences was found to be from 0.2 per cent to 11.5 per cent.

As indicated the samples used in the group IV series were all pork sausage samples. The seasoning in the pork sausage collected at the bottom of the fat column in the Paley test tube, used in modified Babcock method, and made the reading to determine the amount of fat in the sample difficult, and interferred materially with the accuracy of the test.

The method of rapid fat determination without centrifuging using sulphuric acid or Minnesota reagent (Plate III) were found unsatisfactory largely because considerable fat adhered to the side of the flask, including the neck and ground glass joints. It was also most difficult to add the sample to the Erlenmeyer flask without causing a slight amount of the sample to stick to the ground glass neck, thereby preventing proper seal between the tube and flask.

The Paley test tubes used in modified Babcock method using sulphuric acid or Minnesota reagent, were easy to fill with the measured sample. A convenient arrangement of clamping the rubber stopper into place, rather than the use of wire would be desirable.

Table 15. Results of tests conducted on group IV series of samples.

Sample series pork sausage	Test number 1A ether extraction (AOAC) modified army laboratory method	Test number 2A modified Babcock method	Test number 2B correlation test with 2A
A-1-1	31.7% Fat	31.1% Fat	31.3% Fat
A-1-1_1	31.6 Fat	30.0 Fat	30.6 Fat
B-1-1	30.8 Fat	34.5 Fat	34.5 Fat
B-1-1_1	30.9 Fat	33.5 Fat	33.5 Fat
1-2	32.1 Fat	32.4 Fat	31.8 Fat
1-2_1	32.1 Fat	31.4 Fat	31.6 Fat
2-1	26.5% Fat	31.4% Fat	33.5% Fat
2-1_1	26.8 Fat	33.5 Fat	33.5 Fat
2-2	35.0 Fat	34.9 Fat	34.9 Fat
2-2_1	35.0 Fat	35.0 Fat	37.0 Fat
3-1	45.8 Fat	43.1 Fat	43.2 Fat
3-1_1	45.9 Fat	43.9 Fat	42.5 Fat
3-2	39.6% Fat	39.8% Fat	39.0% Fat
3-2_1	39.3 Fat	38.1 Fat	38.5 Fat
Q	37.9 Fat	36.5 Fat	36.0 Fat
Q_1	38.0 Fat	36.5 Fat	35.0 Fat
R	47.8 Fat	36.1 Fat	36.5 Fat
R_1	47.9 Fat	36.0 Fat	36.9 Fat
S	30.3 Fat	29.5 Fat	27.9 Fat
S_1	30.3 Fat	29.9 Fat	30.0 Fat
T	35.5 Fat	34.0 Fat	34.5 Fat
T_1	35.1 Fat	--	34.5 Fat
U	28.7 Fat	29.5 Fat	29.6 Fat
U_1	29.1 Fat	29.5 Fat	29.5 Fat

Table 16. Difference between duplicate samples in each of tests conducted on group IV series of samples.

Sample series pork sausage	Test number 1A : ether extraction (AOAC) modified laboratory method	Test number 2A modified Babcock method	Test number 2B correlation test with 2A
A-1-1 & A-1-1_1	.1 per cent	1.1 per cent	.7 per cent
B-1-1 & B-1-1_1	.1 per cent	1.0 per cent	1.0 per cent
1-2 & 1-2_1	No difference	1.0 per cent	.2 per cent
2-1 & 2-1_1	.3 per cent	2.1 per cent	No difference
2-2 & 2-2_1	No difference	.1 per cent	2.1 per cent
3-1 & 3-1_1	.1 per cent	.8 per cent	.7 per cent
3-2 & 3-2_1	.3 per cent	1.7 per cent	1.7 per cent
Q & Q_1	.1 per cent	No difference	1.0 per cent
R & R_1	.1 per cent	.1 per cent	.4 per cent
S & S_1	No difference	.4 per cent	2.1 per cent
T & T_1	.4 per cent	--	No difference
U & U_1	.4 per cent	No difference	.1 per cent

Table 17. Difference between correlation tests conducted on group IV series of samples.

Sample series pork sausage	Test number 2A and correlation test 2B modified Babcock method
A-1-1	.2 per cent
A-1-1_1	.6 per cent
B-1-1	No difference
B-1-1_1	No difference
1-2	.6 per cent
1-2_1	.2 per cent
2-1	1.1 per cent
2-1_1	No difference
2-2	No difference
2-2_1	2.0 per cent
3-1	.1 per cent
3-1_1	1.4 per cent
3-2	.8 per cent
3-2_1	.4 per cent
Q	.5 per cent
Q_1	1.5 per cent
R	.4 per cent
R_1	.9 per cent
S	1.6 per cent
S_1	.1 per cent
T	.5 per cent
T_1	Unknown
U	.1 per cent
U_1	No difference

Table 18. Difference in results between ether extraction (AOAC) army modified laboratory method and the modified Babcock method in group IV series of samples.

Sample series pork sausage	Test number 2A and 2B (average) modified Babcock method
A-1-1	.5% + AOAC[1]
A-1-1_1	1.3 + AOAC
B-1-1	3.7 - AOAC[2]
B-1-1_1	2.6 - AOAC
1-2	.5 - AOAC
1-2_1	.4 + AOAC
2-1	4.9% - AOAC
2-1_1	6.7 - AOAC
2-2	.1 + AOAC
2-2_1	1.0 - AOAC
3-1	2.7 + AOAC
3-1_1	2.7 + AOAC
3-2	.2% + AOAC
3-2_1	1.0 + AOAC
Q	1.7% + AOAC
Q_1	2.3 + AOAC
R	11.5% + AOAC
R_1	11.5 + AOAC
S	1.6% + AOAC
S_1	.4 + AOAC
T	1.3% + AOAC
T_1	.6 + AOAC
U	.8% - AOAC
U_1	.4 - AOAC

[1] + AOAC indicates greater amount of fat found in ether extraction (AOAC) army modified laboratory method.
[2] - AOAC indicates less amount of fat found in ether extraction (AOAC) army modified laboratory method.

Difficulty was encountered in using the Minnesota reagent in the rapid methods of fat determination, for it was impossible in most cases to bring about complete digestion, even after heating the sample for 20 to 30 minutes. The fat column was quite clear and distinct when the Minnesota reagent was used in the modified Babcock method with centrifuging (Plate IV). The fat column was, however, not as distinct and some fat failed to rise when the Minnesota reagent was used in the rapid method of fat determination without centrifuging (Plate III).

SUMMARY AND CONCLUSIONS

On the basis of the findings of results, in the tests conducted, it was considered that the following conclusions and summary could be made:

1. The modified Babcock method of rapid fat determination, centrifuging the sample and using sulphuric acid to digest the ground beef and pork compares closely with the results obtained from the ether extraction (AOAC) army modified method of fat determination. Also the results obtained in duplicate samples and correlation tests were as close as those obtained by the ether extraction (AOAC) army modified method. It is considered that this rapid method of fat determination is suitable for use by packing plants, and regulatory officials for checking the fat content of ground beef and ground pork.

EXPLANATION OF PLATE III

Results of tests using the rapid method of fat determination without centrifuging. Sample number 1 shows the use of the Minnesota reagent and number 2 the use of sulphuric acid.

PLATE III

EXPLANATION OF PLATE IV

Results of tests using the modified Babcock method of fat determination. Sample number 1 shows the use of the Minnesota reagent and number 2 the use of sulphuric acid.

PLATE IV

2. The rapid method of fat determination without centrifuging using sulphuric acid was not a satisfactory method of fat determination in ground meat. The results are variable with those results obtained by all other methods of fat determination used. In most cases the results obtained in duplicate samples and correlation tests were not consistent.

3. The use of the Minnesota reagent in the modified Babcock method and the rapid method of fat determination is not satisfactory because of the difficulty in bringing about complete disintegration of the tissues and release of all fats.

4. A complete mixing and grinding of the samples are essential in order to get as representative a sample as possible for testing, regardless of the method employed.

5. The most accurate method of reading the fat column in the graduated neck portion of the Paley test tube is by reading from the bottom of the upper meniscus to the bottom of the lower meniscus.

6. Pork sausage which has had seasoning added interferes with the accuracy of the fat determination by the modified Babcock method. The lower meniscus of the fat column in the neck of the Paley test tube is not distinct.

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A STUDY OF METHODS OF TESTING AND SAMPLING TECHNIQUE IN THE DETERMINATION OF FAT CONTENT OF GROUND MEAT

by

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ABSTRACT OF THESIS

The study of methods of testing and sampling technique in the determination of fat content of ground meat was set up primarily to determine if a more rapid method of testing could be satisfactorily used on properly sampled ground meat.

The following methods of testing were utilized in the work from which comparisons were drawn:

1. Ether extraction (Method of Official Analysis of the Association of Agricultural Chemists).

2. Ether extraction (Method of Official Analysis of the Association of Agricultural Chemists) modified army laboratory method.

3. Method for rapid fat determination of ground meat without centrifuging, using sulphuric acid.

4. Method for rapid fat determination of ground meat without centrifuging, using Minnesota reagent.

5. Modified Babcock method of fat determination with centrifuging, using sulphuric acid.

6. Modified Babcock method of fat determination with centrifuging using Minnesota reagent.

The samples were set up in four groups or series. The results of tests were set down in table form showing the difference between duplicate and correlation tests. These tables were used in each group to show the difference between the ether extraction methods and the rapid tests used in determination of

fat content of ground meat.

Also comparisons were made in reading the amount of fat present in the samples using the Paley test tube in the modified Babcock method. Readings were made by placing the calipers at the top of the upper meniscus to the bottom of the lower meniscus on the graduated neck of the Paley test tube. These readings were compared to those made by placing the calipers at the bottom of the upper meniscus to the bottom of the lower meniscus.

On the basis of the findings of results, in the tests conducted, it was considered that the following conclusions could be made:

1. The modified Babcock method of rapid fat determination, centrifuging and using sulphuric acid compares closely with the results obtained from the ether extraction (AOAC) army modified method of fat determination. It is considered that this rapid method of fat determination is suitable for use by packing plants, and regulatory officials for checking the fat content of ground beef and ground pork.

2. The rapid method of fat determination without centrifuging, using sulphuric acid was not a satisfactory method of fat determination in ground meat.

3. The use of the Minnesota reagent in the modified Babcock method and the rapid method of fat determination is not satisfactory because of the difficulty in bringing about

complete disintegration of the tissues and release of all fats.

4. The most accurate method of reading the fat column in the graduated neck portion of the Paley test tube is by reading from the bottom of the upper meniscus to the bottom of the lower meniscus.

5. A complete mixing and grinding of the samples are essential in order to get as representative a sample as possible for testing, regardless of the method employed.

6. Pork sausage which has had seasoning added interferes with the accuracy of the fat determination by the modified Babcock method.