REPORT OF THE FAT ANALYSIS COMMITTEE

FOR the past two or three years, the reports of the Fat Analysis Committee have only been progress reports with very few recommendations for adoption of methods. This has been due largely of course, to the fact that it has been impossible for many laboratories to undertake cooperative work and it has been the policy of the Committee not to accept the work of others but to base their recommendations on actual work of the Committee. We are, therefore, happy this year to be able to report that the activities of the Committee and the cooperative results on several lines of work warrant the recommendation to the Society of the adoption of several methods.

During the year the Committee undertook the study of:

1) Modification of the Wiley Melting Point.
2) The Thiocyanogen Method as modified and used in the Procter & Gamble Laboratories.
3) The modified Twitchell Method for the separation of liquid and solid fatty acids.
4) The detection of foreign fats containing tri-stearin in unhydrogenated pork fats.
5) Further work on development of more satisfactory color standards for the present FAC standards.

Wiley Melting Point:

In the case of the Wiley Melting Point, it was found necessary to draw the details of the method considerably closer, particularly as to the size of the pellet, the method of chilling, and the observance of the end point at which the pellet becomes a sphere. The latest modification, copy attached, was studied by the members of the Committee and cooperative results, in the opinion of the Committee, warrant the recommendation for the adoption of this method as a tentative method of the Society.

Thiocyanogen Method:

Many members of our Society are using, and have been using for a number of years, the Thiocyanogen Value determination and have found this a very useful determination in calculating the various glycerides present in fat mixtures. However, there is not, at the present time, included in the methods of the Society a method for the determination of this value. As a part of the study on liquid and solid fatty acids, the Committee used the attached method and the results were so consistently good that the Committee feels justified in recommending this method for the tentative adoption of the Society at this time.

Twitchell Method:

For a number of years the Committee has been studying various methods of separation of liquid and solid fatty acids but this year, at the suggestion of Mr. Long, it was decided to concentrate on the Twitchell Method as modified and used in the Procter & Gamble Laboratories. The cooperative results which are appended to this report indicate extremely good agreement in the several laboratories on three separate sets of results on the same sample, and also excellent agreement between the cooperating laboratories on the same sample. In view of the good agreement on all of the figures reported, the Committee recommends the adoption of the modified Twitchell method, as corrected by the use of the Iodine and Thiocyanogen values of the solid acids, as a tentative method of the Society.

It is further pointed out that the constituent fatty acids with the exception of a distinction between oleic and iso oleic acid, may be calculated from the Thiocyanogen Value and the Iodine Value of the mixed fatty acids in accordance with the formulae included in the method.

The Committee's recommendation for the modified Twitchell method corrected is based on the fact that if it is desired to determine the iso oleic acid, it is necessary to make the solid acid separation.

The Committee proposes to continue the work on liquid and solid acids, studying the Baughman-Jamieson modification for which some advantages are claimed.

Detection of Foreign Fats Containing Tri-Stearin in Unhydrogenated Pork Fats:

There are two methods at the present time given in the A.O.A.C. for the detection of tri-stearin in lard. In the first method, the fat is dissolved in ethyl ether and in the second acetone is the solvent used. There have been many complaints that it is impossible to get a satisfactory crop of crystals by the first method, and this is confirmed by the laboratories of the individual members of this Committee. The Committee, therefore, undertook the study of the second method described in the methods of the A.O.A.C. in which acetone is used as the solvent. The results indicate that a pure product may, in some instances, be condemned as adulterated if the conclusion is based on the results of the melting point of the glycerides only. The Committee found, however, that if the method is carried through to determine the Bomer number, that results appear satisfactory. The Committee, therefore, recommends the adoption of the A.O.A.C. method as modified but deleting the sentence "A melting point below 63° is regarded as evidence of adulteration, and a melting point below 63.4° is regarded as suspicious."

Messrs. L. M. Tolman and A. A. Robinson, in OIL & SOAP, Volume IX, No. 1, January, 1932, pointed out the fact that this method is not applicable to hydrogenated pork fats.

FAC Color Standards:

About three years ago, Mr. Doherty of Lever Brothers suggested a change in the chemicals used for the preparation of the FAC standards, one of the principal ones being Uranyl Chloride. The claim, which the committee agrees is a sound one, is that the inorganic salts recommended furnish more stable standards than the organic dyes dissolved in glycerin which have been used for a great many years. We found great difficulty, however, in procuring a chemically pure supply of Uranyl Chloride and, after rejection of five or six lots, the Committee is glad to report that at this time we believe we have a satisfactory lot and hope to prepare new standards during the coming year.

The change to inorganic salts in

acid solution will necessitate the use of ampules instead of the regular FAC tubes, which are closed with a rubber stopper. This is due to the action of the solution on the stopper. Users of the standards will be notified as soon as the new sets are ready for distribution.

The Committee expects to continue the study of methods which we think will be of interest to the Society during the coming year.

W. H. IRWIN, *Chairman*
R. W. BAILEY
T. C. LAW
C. P. LONG
H. J. MORRISON
M. L. SHEELY
L. M. TOLMAN
H. P. TREVITHICK
J. J. VOLLERTSEN

MODIFIED WILEY MELTING POINT METHOD FOR FATS AND FATTY ACIDS

Apparatus:

Chilling bath with heavy brass or copper plate drilled with holes 9.5 mm in diameter by 3.2 mm deep —for making discs. (See sketch.)

Thermometer graduated to one-tenth degree Centigrade.

Beakers approximately 35x10 cm.

Test tubes 30x3.5 cm.

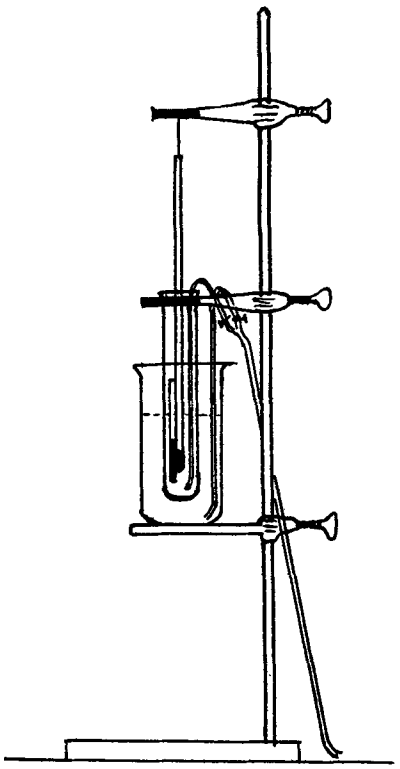
Alcohol-Water Mixture:

The specific gravity should be the same as that of the fat to be examined. Prepare by boiling, seperately, water and 95% alcohol for 10 minutes to remove the gases that may be held in solution. While still hot, pour the water into a test tube until it is almost half-full. Nearly fill the test tube with the hot alcohol, pouring it down the side of the inclined tube to avoid too much mixing. If the alcohol is added after the water has cooled, air bubbles will make the mixture unfit for use.

Determination:

Fill the chill bath with ice and water and place the copper or brass plate on the level surface of the bath. Fill the holes with the melted and filtered fat and allow to stand two or three hours before removing the disc from the plate. After the fat is thoroughly chilled, cut off the excess fat protruding above the level of the plate and either remove the discs and place in the cooler, or if no cooler is available allow to stand on the chill bath containing ice and water for a period of two or three hours until ready to make the determination.

Place a 30x3.5 cm. test tube containing the alcohol-water mixture in a tall 35x10 cm. beaker containing ice and water and leave until the mixture is cold. Then drop a disc of fat into the tube. It will sink immediately to a point where the density of the alcohol-water mixture is exactly equivalent to its own. Lower an accurate thermometer, which can be read to 0.1°, into the test tube until the bulb is



Apparatus for Determination of Melting Point.

just above the disc. In order to secure an even temperature in all parts of the alcohol-water mixture around the disc, stir gently with the thermometer. Slowly heat the water in the beaker, constantly stirring it by means of an air blast or other suitable device.

When the temperature of the alcohol-water mixture rises to about 6° below the melting point of the fat, the disc of fat begins to shrivel and gradually rolls up into an irregular mass. Lower the thermometer until the fat particle is even with the center of the bulb. Rotate the thermometer bulb gently and so regulate the heat that about 10 minutes is required for the last 2° increase in temperature. As soon as the fat mass becomes spherical, read the thermometer. Remove the tube from the bath and again cool. Place in the bath a second tube containing the alcohol-water mixture. The test tube is of sufficiently low temperature to cool the bath to the desired point. After the first or preliminary determination, regulate the temperature of the bath so as to obtain a maximum of about 1.5° above the melting point of the fat under examination.

If the edge of the disc touches the sides of the tube, make a new determination. Run triplicate determinations. The second and third results should agree closely.

THE THIOCYANOGEN NUMBER DETERMINATION

Reagents:

1. Lead thiocyanate.
2. Anhydrous glacial acetic acid.
3. Bromine.

1. Preparation of Lead Thiocyanate:

Dissolve 250 grams of the finest C.P. neutral lead acetate ($Pb(CH_3COO)_2.3H_2O$) in 500 c.c. of distilled water. Dissolve likewise 250 g. of C. P. KSCN in 500 cc. of water. Add the lead acetate solution to the potassium thiocyanate solution slowly and with stirring. Filter off the precipitated lead thiocyanate on a Buchner funnel and wash successively with distilled water, alcohol and ether. Dry the $Pb(SCN)_2$ as much as possible by drawing air through it. Remove from the funnel and dry on a watch glass in a P_2O_5 desiccator for 8-10 days before using. This $Pb(SCN)_2$ should be a greenish or yellowish-white crystalline material; if it is at all discolored it must be discarded. Precipitated $Pb(SCN)_2$ may be kept for a period not exceeding two months.

2. Preparation of Acetic Acid:

Acetic acid is conveniently and suitably dehydrated by refluxing with acetic anhydride. Into a 3 litre Florence flask, with a large test tube set in the neck and through which cold water is passed to serve as a condenser, are placed 2 liters of C. P. glacial acetic acid (99.5-100.0%) and 100 cc. of acetic anhydride (90-100.0%). This mixture is refluxed over an oil bath for three hours at approximately 135° C. After the anhydrous acid has cooled to room temperature, it should be placed in cleaned and dried glass stoppered bottles.

3. Preparation of a 0.2 N Solution of $(SCN)_2$:

For the preparation of one liter of solution: Suspend 50 g. of the dry $Pb(SCN)_2$ in 500 c.c. of anhydrous acetic acid; dissolve 5.1 c.c. of the C. P. bromine in another 500 c.c. of acid. Two glass stoppered acid bottles of 2 or 3 liters capacity,

and which have previously been thoroughly cleaned and dried, should be used for this purpose. Add the bromine solution to the $Pb(SCN)_2$ suspension slowly, in small portions, and shake vigorously, between each addition, until the solution is completely decolorized. After all the bromine has been added, allow the precipitated lead bromide and the excess lead thiocyanate to settle out, then filter the solution as rapidly as possible. A 13 cm. Buchner funnel and qualitative filter paper together with two 2 liter pressure flasks are used for the filtration. They are previously dried for one hour at 105° C. The entire solution is filtered by suction into the one flask, when the funnel, containing the paper and some cake, is transferred to the second flask and the solution refiltered. It should be perfectly clear upon the second filtration. The solution should be stored in glass stoppered brown bottles and kept in a cool place (60-70° F.). If it is convenient, the following method for the preparation of the $(SCN)_2$ solution can be used to advantage. Suspend 50 g. of the dry $Pb(SCN)_2$ in 600 c.c. of anhydrous acetic acid in a round bottomed 2 liter flask, equipped with a mechanical stirrer and a dropping tube. Slowly add with agitation 5.1 c.c. of C. P. bromine suspended in 200 c.c. of dry acid in the dropping tube. The acetic acid-bromine solution should be added at a rate such that the liquid in the reaction flask remains only faintly tinged with brown. When the entire bromine-acetic acid solution has been added, the dropping tube is rinsed out with an additional 200 c.c. of the dry acid which is added immediately to the reaction mixture. When the bromine has all reacted, as indicated by the color of the reaction mixture, the agitation is ceased, the precipitated lead bromine allowed to settle, and the $(SCN)_2$ solution filtered as described above.

4. The Determination of the Thiocyanogen Number:

Weigh 0.1-0.3 g. oil accurately into a dry 125 c.c. glass stoppered Erlenmeyer flask. Add from a pipette 25 c.c. of $(SCN)_2$ solution and allow to stand for 24 hours in the dark. The storage place should be from 65-70° F. in temperature and should not exceed 70° F. for any length of time. The size of the sample is governed largely by the expected thiocyanogen absorption. The excess $(SCN)_2$ should be at least 100% and preferably less than 150% of the amount absorbed by the oil, although a greater excess seems to do no harm. At the end of 24 hours, 1 g. of dry powdered KI is added and the flask swirled rapidly for 2 min. It is advisable to agitate the blank determination for 3 min. (Mechanical agitation such as is employed for iodine values is found very satisfactory for thiocyanogen values.) Then add 30 c.c. of distilled water and titrate the liberated iodine with 0.1 N $Na_2S_2O_3$, using starch as an indicator. At least three blanks should be run with the samples. The solution should also be titrated at the beginning of the 24 hr. period. If the drop is more than 0.2 c.c. on the blank titrations, the solution is decomposing too rapidly and erratic and low figures will be the result.

(Blank—titration) $\times$ $Na_2S_2O_3$ factor (I.V.) $\times$ 0.2 = Thiocyanogen Number (T.V.)

5. Iodine Number Determination:

An iodine number must be determined on the fat by the regular Wijs method.

6. Calculation of the Fat Composition

The following calculations are to be used when the iodine number and thiocyanogen number are determined on the fat directly and it is desired to express the percentages of the various acids as glycerides. In these formulae no unsaturation greater than linoleic is assumed to be present.

I. V. = Iodine number of the oil.
T. V. = Thiocyanogen number of the oil.
S. G. = % saturated glycerides.
O. G. = % oleic glycerides.
L. G. = % linoleic glycerides.

Then

L. G. = 1.154 (I. V. — T. V.)
O. G. = 1.162 (2 T. V. — I. V.)
S. G. = 100% — (L. G. + O. G.)

When the iodine number and thiocyanogen number have been determined directly or indirectly on the free fatty acids of the oil, the percentages of the various acids may be determined, not as glycerides but as % acid, in the following manner:

% L. A. = 1.104 (I. V. — T. V.)
% O. A. = 1.112 (2 T. V. — I. V.)
% S. A. = 100% — % (L. A. + O. A.)

Notes and Observations:

1) All glassware and chemicals used in the preparation or handling of $(SCN)_2$ solutions must be absolutely free from water. The glassware should be scrupulously cleaned with cleaning solution, water, alcohol and ether and then dried for 1-2 hours in an oven at 105° C.

2) The thiocyanogen solution should not be exposed to air, heat or light for any length of time.

3) The 0.2 N $(SCN)_2$ solution cannot be used after its decomposition exceeds 0.2 c.c. of 0.1 N $Na_2S_2O_3$ for 25 c.c. over a period of 24 hours. This rate of decomposition should not be exceeded in less than seven days.

(Reference—Oil and Fat Analysis by the Thiocyanogen Method, W. S. Martin and R. C. Stillman, OIL & SOAP, February, 1933, Vol. X, p. 29-31.)

LIQUID AND SOLID FATTY ACIDS — MODIFIED TWITCHELL SEPARATION

1. Preparation of Mixed Fatty Acids:

Saponify in a 600 c.c. beaker about 25 grams of the melted oil sample with about 15 grams potassium hydroxide dissolved in a small amount of water and 25 c.c. of 95% alcohol. Bring to dryness on steam bath or hot plate. (Care should be taken not to burn the soap.) Add to the soap about 200 c.c. distilled water; heat on steam bath until soap is dissolved; add concentrated hydrochloric acid while stirring until soap is completely broken up. A small strip of litmus will show when mixture has been acidulated. Heat the solution containing curds of fatty acids on steam bath or hot plate until they, together with the entire contents of beaker, will pour freely into a 500 c.c. separatory funnel. Transfer should be aided with 100 to 150 c.c. of ethyl ether. Fatty acid ether solution must then be washed free of acid with distilled water. Usually three washings are sufficient but tests of wash water with methyl orange indicator should be made. Separation of water from fatty acid ether solution should be made as close as possible to insure no water getting into the mixed fatty acid sample. After washing free of acid filter fatty acid ether solution through paper into a 250 c.c. Soxhlet. Evaporate all trace of ether on steam bath under a current of inert gas.

Note: Use precaution to prevent oxidation of fatty acid.

2. Separation of Solid from Liquid Fatty Acids:

From the ether-free mixed fatty acids, weigh accurately into a 250 c.c. beaker a sample that will give approximately 1.2 $\pm$ 0.3 grams of solid fatty acids. The sample weight should never exceed 5 grams. Weigh 1.5 grams powdered lead acetate into another beaker. Add to each about 50 c.c. of 95% alcohol, cover with

watch glasses, and bring both to boil on hot plate or steam bath. Transfer the hot alcoholic lead acetate to the alcoholic fatty acids, stirring continually with a glass stirring rod which may be left in sample to aid later in filtration. Cool to room temperature and place in ice bath at 15° C. for 2 hours or in ice box at approximately 15° C. overnight. Filter through 3 inch Buchner funnel which has filter paper cut to fit snugly. Suction should be used to aid filtration. Use 200 c.c. of 95% alcohol cooled to 15° C. to transfer lead soaps from beaker to Buchner and in washing. After alcohol has filtered from the lead soaps, transfer them quantitatively back to the original beaker, using about 100 c.c. warm 95% alcohol to aid the transfer. Make one-half per cent acetic acid with glacial acetic acid.

Before discarding filtrate, make a test for excess lead acetate by adding a few drops of concentrated sulfuric acid to about 50 c.c. of the filtrate. Presence of cloudiness shows the sample of fatty acids was too large and present sample is of no value; therefore, it will be necessary to weigh a smaller sample of mixed fatty acids and apply the same procedure. If there is an excess of lead acetate, continue with present sample by bringing it to a boil on hot plate, stirring occasionally to assure the lead soaps dissolving. Cool to room temperature, then in ice bath at 15° C. for two hours or ice box over night. Filter through Buchner, using suction and 200 c.c. 15° C. 95% alcohol as in first filtration. After lead soaps are drawn free of alcohol, transfer them quantitatively to original beaker, using ethyl ether to aid (about 75 c.c.). Break up lead soaps by adding 20 c.c. of 1 to 3 nitric acid. Transfer to a 500 c.c. separatory funnel, using ethyl ether to aid. An extra 5 c.c. of 1 to 3 nitric acid may be used to advantage in removing the last trace of sample from the beaker. Wash ether with distilled water until neutral to methyl orange. Transfer ether to a tared 150 c.c. Soxhlet and wash all traces of solid fatty acids into the Soxhlet with ether. Evaporate ether on steam bath under a current of inert gas. Dry in an oven at 103° C. for one hour, remove, cool and weigh. See that no water is in sample. It is well to be sure of constant weight by returning to oven a second time for 30 minutes.

$$\frac{\text{Weight of solid acids} \times 100}{\text{Weight of Sample}} = \%$$

Solid Fatty Acids.

3. Iodine and Thiocyanogen Determinations of Separated Solid Acids:

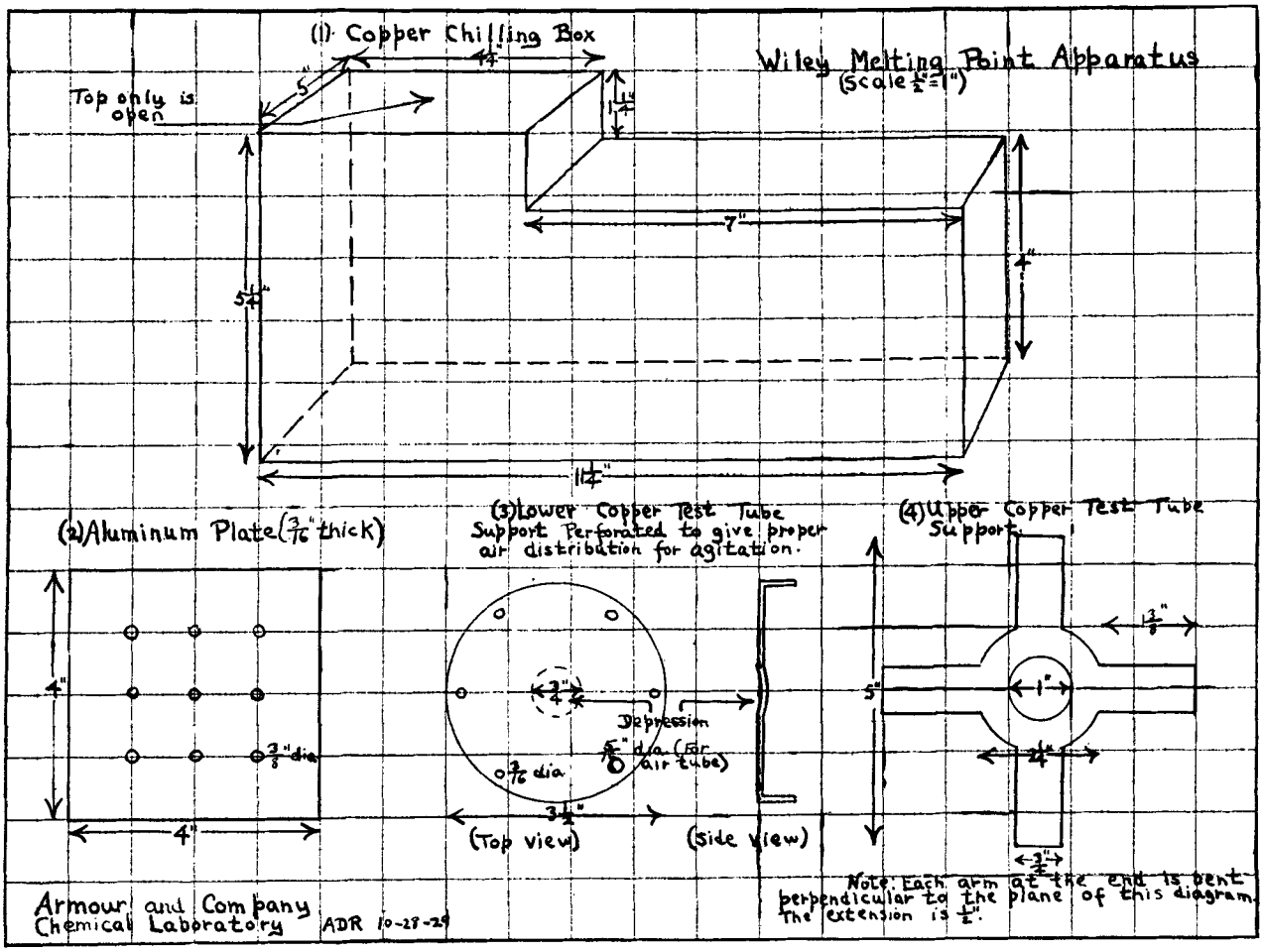
Determine these values by the regular Wijs method for Iodine Number and by the Thiocyanogen Value Method recommended by this Committee.

From these values calculate the component acids according to the following formulae:

Let I.N. = Iodine Number of Solid Acids
T.N. = SCN Number of Solid Acids
C. = Per cent Solid Acids Uncorrected
D = Per cent Liquid Acids Uncorrected
E. = Per cent Unsaturated Acids by SCN Method

Linoleic Acid in Solid Acids = 1.104 (I.N. — T.N.) × C = L.A.

Oleic Acid in Solid Acids = 1.112 (2T.N. — I.N.) × C = O.A.



Then Solid Saturated Acids = C — (L.A. + O.A.)
Then Saturated Acids in Liquid Acids = D + (L.A. + O.A.) — E
Total Saturated Acids = Per Cent Solid Acids (as found) — (Oleic in Solid Acid + Linoleic in Solid Acid) + Saturated Acids in Liquid Acids.
Total Unsaturated Acids = 100 — Total Saturated Acids
*Total Oleic Acid = (Total Unsaturated Acids × 181) — (I.V. M.F.A. × 100)

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Total Linoleic Acid = Total Unsaturated Acids — Total Oleic Acid
*This formula derived as follows:

Y = Total Unsaturated Acids
X = Total Oleic + Isooleic Acid
Y — X = Total Linoleic Acid.
Z = Iodine Value of M.F.A.
90 = Iodine Value of Oleic Acid and Isooleic Acid
181 = Iodine Value of Linoleic Acid

$$90X + 181(Y - X) = 100Z$$
$$X = 181Y - 100Z$$

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Note: Iodine and thiocyanogen values for mixed fatty acids can be computed from the corresponding values of the neutral glycerides (under 1% F. F. A.) by making use of a factor derived from the molecular weight of the glycerides. The average molecular weight of the glycerides can be determined by use of the saponification number.

Note: The calculations of constituent acids are based on the assumption that no acids more unsaturated than linoleic are present.

Reference: The Precipitation of Solid Fatty Acids with $Pb(Ac)_2$ in Alcoholic Solution, J. I. E. C. 13, 896 (1921) by E. Twitchell.

DETECTION OF FOREIGN FATS CONTAINING TRISTEARIN IN UNHYDROGENATED PORK FATS

(A.O.A.C. Method Modified)

Weigh 5 g of the filtered fat into a glass-stoppered cylinder graduated to 25 cc. and add warm acetone until the 25 cc. mark is reached. Shake the cylinder until the contents are thoroughly mixed and allow to stand where a temperature of 30° is maintained. After 18 hours, remove the cylinder and carefully decant the supernatant acetone solution from the crystallized glycerides, which are usually found in a firm mass at the bottom of the cylinder. Add warm acetone in 3 portions of 5 cc. each from a small wash bottle, taking care not to break up the deposit while washing, and decant the first 2 portions. Actively agitate the third portion in the cylinder, and by a quick movement transfer with the crystals to a small filter paper. Using the wash bottle, wash the crystals with 5 successive small portions of the warm acetone, and remove the excess acetone by suction. Transfer the paper with its contents to a suitable place, spread out, and break up by gentle pressure any large lumps of the glycerides. When dry, thoroughly comminute the mass and determine the melting point of the crystals in a closed 1 mm. tube as follows, using apparatus as shown in sketch. Heat the water in the beaker rapidly to about 55° and maintain this temperature until the thermometer carying the melting point

LIQUID AND SOLID FATTY ACIDS
Detailed Data of Cooperative Work

	C. P. LONG			J. J. VOLLERTSEN			W. H. IRWIN			M. L. SHEELY		
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Thiocyanogen Analyses:												
Iodine number of sample	70.8	70.8	70.7	70.7	70.8	70.7	70.6	70.7	70.6	70.8	70.8	70.8
Thiocyanogen number of sample	59.4	59.6	59.8	60.7	60.2	60.0	60.6	60.6	60.8	59.3	59.1	59.3
% Oleic glycerides	55.8	56.2	56.8	58.9	57.6	58.1	58.8	58.7	59.3	56.3	55.2	55.5
% Linoleic glycerides	13.2	12.9	12.6	11.5	12.2	12.3	11.5	11.6	11.3	13.0	13.5	13.3
% Saturated glycerides	31.0	30.9	30.6	29.6	30.2	29.6	29.7	29.7	29.4	30.7	31.3	31.2
Twitchell Analyses (P & G):												
Iodine number of mixed fatty acids	74.1	74.1	74.0*	73.7	73.7	73.6	73.9	73.9	73.9	73.8	73.8	73.8
Iodine number of solid fatty acids (det'd)	32.3	31.5	30.2	29.2	29.4	29.8	30.0	30.1	29.5	29.9	29.0	29.4
Iodine number of unsat. fatty acids (calc'd)	104.1	101.5	104.5	103.5	103.4	103.0	102.3	102.7	102.6	102.9	103.0	103.3
% Solid fatty acids (det'd)	45.0	41.5	43.9	42.5	42.4	42.6	41.6	42.2	41.6	42.4	41.9	42.5
% Liquid fatty acids (calc'd)	55.0	58.5	56.1	57.5	57.6	57.4	58.4	57.8	58.4	57.6	58.1	57.5
% Saturated fatty acids (calc'd)	28.8	27.0	29.2	28.7	28.6	28.5	27.7	28.0	28.0	28.3	28.4	28.6
% Iso oleic acid (calc'd)	16.2	14.5	14.7	13.8	13.8	14.1	13.9	14.2	13.6	14.1	13.5	13.9
% Linoleic acid (calc'd)	11.0	9.2	11.3	10.4	10.3	10.4	9.8	10.1	10.0	10.2	10.2	10.5
% Oleic acid (calc'd)	44.0	49.3	44.8	47.1	47.3	47.0	48.6	47.8	48.4	47.4	47.9	47.0
Twitchell and Thiocyanogen Analyses: (Calculated by Mr. Sheely's Method)												
Iodine number of solid fatty acids	32.3	31.5	30.2	29.2	29.4	29.8	30.0	30.1	29.5	29.9	29.0	29.4
Thiocyanogen number of solid fatty acids	31.9	28.2	30.1	28.6	28.2	28.4	29.7	28.7	28.6	29.4	28.3	29.0
% Solid F. A. (uncorr.)	45.0	41.5	43.9	42.5	42.4	42.6	41.6	42.2	41.6	42.4	41.9	42.5
% Liquid F. A. (uncorr.)	55.0	58.5	56.1	57.5	57.6	57.4	58.4	57.8	58.4	57.6	58.1	57.5
% Unsat. acids by $(SCN)_2$	69.0	69.1	69.4	70.4	69.8	70.4	70.3	70.3	70.6	70.1	70.1	70.3
% Linoleic acid in solid F. A.	0.2	1.5	0.0	0.3	0.6	0.7	0.2	0.6	0.4	0.2	0.2	0.2
% Oleic acid in solid F. A.	15.8	11.5	14.6	13.2	12.7	12.8	13.6	12.8	12.8	13.7	12.5	13.5
% Solid saturated acids	29.0	28.5	29.3	29.0	29.1	29.1	27.8	28.7	28.4	28.5	29.1	28.8
% Saturated acids in liquid acids	2.0	2.4	1.3	1.0	1.6	1.1	1.8	0.9	1.1	1.4	0.8	0.9
% Total saturated acids	31.0	30.9	30.6	30.0	30.7	30.2	29.7	29.7	29.4	29.9	29.9	29.7

*Calculated.

FAC COMMITTEE—LIQUID AND SOLID ACIDS
Summary of Results

Component Acids	Modified Twitchell 1.		Modified Twitchell 2.		Modified Twitchell 3.	Modified Twitchell Avg.	Corrected 1.		Corrected 2.		Corrected 3.	Corrected Avg.	Thiocyanogen 1.	Thiocyanogen 2.	Thiocyanogen 3.	Thiocyanogen Avg.
M. L. SHEELY																
Oleic acid	47.4		47.9		47.0		44.7		45.9		45.3					
Isooleic acid	14.1	61.5	13.5	61.4	13.9	60.9 61.3	13.7	58.4	12.5	58.4	13.5	58.8 58.5	57.9	58.3	58.8	58.3
Linoleic acid		10.2		10.2		10.5 10.3		11.7		11.7		11.5 11.6	12.0	11.8	11.5	11.8
Saturated acids		28.3		28.4		28.6 28.4		29.9		29.9		29.7 29.9	30.1	29.9	29.7	29.9
J. J. VOLLERTSEN																
Oleic acid	47.1		47.3		47.0		45.2		44.3		45.4					
Isooleic acid	13.9	61.0	13.8	61.1	14.1	61.1 61.1	13.2	58.4	12.7	57.0	12.8	58.2 57.9	58.2	60.4	58.8	59.1
Linoleic acid		10.4		10.3		10.4 10.4		11.6		12.3		11.6 11.8	11.8	10.7	11.5	11.3
Saturated acids		28.7		28.6		28.5 28.6		30.0		30.7		30.2 30.3	30.0	28.9	29.7	29.5
C. P. LONG																
Oleic acid	44.0		49.3		44.8		40.0		44.5		42.0					
Isooleic acid	16.2	60.2	14.5	63.8	14.7	59.5 61.3	15.8	55.8	11.5	56.0	14.6	56.6 56.1	56.0	56.6	57.2	56.6
Linoleic acid		11.0		9.2		11.3 10.5		13.2		13.1		12.8 13.0	13.9	12.8	12.5	13.1
Saturated acids		28.8		27.0		29.2 28.3		31.0		30.9		30.6 30.8	30.1	30.6	30.3	30.3
W. H. IRWIN																
Oleic acid	48.6		48.0		48.4		45.0		46.0		46.2					
Isooleic acid	13.9	62.5	14.2	62.0	13.6	62.0 62.2	13.6	58.6	12.8	58.8	12.8	59.0 58.8	59.0	59.0	59.5	59.2
Linoleic acid		9.8		10.1		10.0 10.0		11.7		11.6		11.5 11.6	11.5	11.5	11.3	11.4
Saturated acids		27.7		28.0		28.0 27.9		29.7		29.6		29.5 29.6	29.5	29.5	29.2	29.4

FAC COMMITTEE—LIQUID AND SOLID ACIDS
List of Determined Values

	C. P. LONG			J. J. VOLLERTSEN			M. L. SHEELY			W. H. IRWIN		
	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
Iodine No. of sample	70.8	70.8	70.7	70.7	70.8	70.7	70.8	70.8	70.8	70.6	70.7	70.6
Thiocyanogen No. of sample	59.4	59.6	59.8	60.7	60.2	60.0	59.3	59.1	59.3	60.6	60.6	60.8
Iodine No. of fatty acids	74.1	74.1	74.0	73.7	73.7	73.6	73.8	73.8	73.8	73.9	73.9	73.9
Thiocyanogen No. of fatty acids	62.2*	62.5*	62.7*	63.0	64.0	63.2	62.9	63.1	63.3	63.5*	63.5*	63.7*
Per cent solid fatty acids (Twitchell)	45.0	41.5	43.9	42.5	42.4	42.6	42.4	41.9	42.5	41.6	42.2	41.6
Iodine No. of solid fatty acids	32.3	31.5	30.2	29.2	29.4	29.8	29.9	29.0	29.4	30.0	30.1	29.5
Thiocyanogen No. of solid fatty acids	31.9	28.2	30.1	28.6	28.2	28.4	29.4	28.3	29.0	29.7	28.7	28.6

*Calculated from Thiocyanogen Value of Glycerides.

tube registers 50-55°; then heat again and carry the temperature of the outer bath somewhat rapidly to 67°. Remove the burner. The melting point is reached when the fused substances become perfectly clear and transparent. A dark background placed about 4 inches from the apparatus will be helpful.

After determining the melting point, transfer the crystallized glycerides to a 50 c.c. beaker, add 25 c.c. of approximately 0.5 N alcoholic KOH, and heat on a steam bath until saponification is complete. Pour the solution into a separatory funnel containing 200 c.c. of water, acidify, add 75 c.c. of ether, and shake. Draw off the acid layer and wash at least 3 times with water. Transfer the ether solution to a clean dry 50 c.c. beaker, drive off the ether on a steam bath, and finally dry the acids at 100°. After about 2 hours, determine the melting point as directed above. If the melting point of the glycerides, plus twice the difference between the melting point of the glycerides and the melting point of the fatty acids, is less than 73°, the pork fat is regarded as adulterated.

THE APPLICATION OF FATS AND OILS TO THE BAKING INDUSTRY

By GEORGE F. GARNATZ

A PAPER PRESENTED AT THE FALL MEETING, OCTOBER 17-18, 1935

IT has been suggested that I discuss for you the application of Fats and Oils to the Baking Industry. Limitations established by personal experience, in my opinion, render such an attempt on my part presumptuous. I must, therefore, before I am fairly launched on my discourse, alter my subject, perhaps not greatly but certainly significantly, to read: "Some Applications of Fats and Oils to the Baking Industry." To be more specific, I propose to confine myself to the application of fats and oils in the production of bread, cakes, biscuits, and crackers.

The history of bread and cakes dates back far enough that one is unable to definitely establish when fats and oils were used in their making, and hence one cannot relate the circumstances nor the reasons for the incorporation of these enriching materials. While very probably the inclusion of a fat or an oil in a baked product was originally accomplished inadvertently, the practice, undoubtedly, was continued because of the pleasing results obtained.

There followed a period when apparently the role of fats and oils in baked products was hardly understood and their use was continued out of custom without much questioning. However, in that period when many manufacturing processes were taken from the home the Art of Baking also went "commercial." Eventually competition for the patronage of the consumer developed and became more and more keen. Bakers became quality conscious, and to meet the ever-present threat of competition from the home-baked product, sought more efficient means of utilizing materials and for carrying out processes.

Into this picture came the engineer, and, more recently, the chemist. Progress was made rapidly despite a multiplicity of factors to be reckoned with, not to mention the complex nature of the materials involved. Knowledge has been sought and found through the application of technical investigation and research so that today we are using our materials and developing our processes more intelligently, and more efficiently than ever before, even though, in many instances, the full scientific explanation is not yet at hand.

Despite the progress made, we have but crossed the threshold of the Science of Baking and many phenomena still remain either debatable questions, or subjects for considerable speculation and conjecture. Is it any wonder, then, that I approach my subject with becoming humility and respect, conscious of the fact that whatever I may say can, and probably will, find someone who will differ in my opinion.

In the production of bread, fats or oils make a definite contribution to the finished product. *By reason of the shortening effect, the crust is rendered tender and eating quality is improved because of the resultant softer crumb and finer texture. Keeping quality is enhanced since moisture is retained, the loaf is made softer and the tendency for the interior to become crumbly is retarded. Generally speaking, the use of fats or oils in bread doughs improves the volume and the symmetry of form of the loaf produced. Flavor is also affected, usually for the better, and no matter how bland the fat or oil may be, its influence on flavor cannot be discounted, particularly when used in conjunction with the liberal proportions of sugar that are currently employed. Last, but not