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Study of Carcass Fats of Beef Animals. I. The Composition of Beef Brisket Fat[1,2]

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IN the grading of commercial inedible fats from animal sources a titer value of 40° is accepted as the characteristic which delineates a tallow (titer of 40° or higher) from a grease (titer of less than 40°). Since the fat from beef animals normally has a titer in excess of 40°, it is commonly accepted that fat from beef animals will be graded as a tallow. An exception to this was noted some months ago in a sample of so-called "tallow" rendered from trimmings of briskets used to make corned beef. In this case the fat had a titer of 38.7°.

Subsequent investigations on other samples of brisket fat revealed a titer of less than 40° in 13 of 17 samples. The color of the brisket fats varied with the grade of the animal. The higher-grade animals produced the lighter-colored fat while the fat from the lowest-grade animals was quite yellow. As a result of these observations it was decided to make a study of beef brisket fats to learn whether any correlation could be made between unsaturated fatty acid composition, iodine value, titer, and color associated with the grade of the animal.

Experimental

Portions of the fatty tissue were rendered by standard laboratory procedures. The iodine value was determined by a rapid Wijs method as described by Hiscox (3). The titer was determined by the A.O.C.S. official method (4). The unsaturated fatty acid composition was determined by the method of Mitchell, Kraybill, and Zscheile (5), using the constants of Beadle and Kraybill (1).

In many cases, the brisket fat of an animal is present in two distinct portions, which are labeled "outside" and "inside" according to location in the brisket. The first two samples obtained were marked only "brisket fat" and were undoubtedly composited from many carcasses without regard to type or grade of animal or portion of brisket used. The next three were from a cow, a steer, and a yearling, respectively, but were not identified as to grade or portion of brisket sampled.

In the next group the samples were from the "inside" portion of steer briskets, and all three were found to be composed of two layers of fat separated by what appeared to be a connective tissue. The outer layer of the "inside" brisket fat was found to be more highly colored. In sample No. 1 the yellow and white layers were composited, but in samples No. 2 and 3 the layers were divided and run separately.

Samples from the last group of briskets to be analyzed were labeled in all respects. In one instance (Choice steer—"Outside") the fat was in two layers, one more yellow in color than the other. These layers were divided and analyzed separately. This last group of brisket fats represents a range in grade of animals from prime steers to canner and cutter cows.

Results and Discussion

A total of 17 determinations have been made, and only four of the fat samples were found to have a titer of 40° or higher. These four were from samples of "inside" brisket fat, three from finished steers and one from a steer of unknown grade. Composite samples, "outside" fats and all other "inside" brisket fats, were found to have a titer of less than 40° as shown in Table I.

It is interesting to note that "outside" fats are the only brisket fats available from the low-grade animals. The fat from the canner and cutter cow was the most yellow, which probably is indicative of the influence of age on the character of the fat. Other characteristics of this fat were found to be very comparable to that from other animals.

The iodine values vary in inverse ratio to the titer values. All fats having a titer of 40° or greater have an I.V. of less than 56.

The fatty acid composition studies reveal only minor variations in polyunsaturated fatty acids, irre-

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TABLE I

Composition and Characteristics of Beef Brisket Fats

Animal	Portion of Brisket	Color	I.V.	Arach.	Linolenic	Linoleic	Oleic	Saturated	Titer
Group 1									
Unknown	Composite	......	58.3	0.40	0.39	2.4	57.4	39.5	36.8
Unknown	Composite	......	58.8	0.66	0.72	2.8	55.2	40.7	38.7
Cow	Unknown	......	71.4	0.84	0.61	3.4	67.6	27.6	31.8
Steer	Unknown	......	61.9	0.87	0.46	2.2	59.9	36.7	35.5
Yearling	Unknown	......	61.2	0.50	0.34	2.4	57.2	39.5	36.4
Group 2									
Steer No. 1	Inside	Y & W	55.6	0.29	0.55	2.7	53.6	42.9	40.2
Steer No. 2	Inside	Y	62.0	0.43	0.67	2.6	59.9	36.3	37.3
		W	51.2	0.15	0.50	2.2	50.4	46.7	41.4
Steer No. 3	Inside	Y	66.2	0.47	0.74	3.3	62.9	32.6	34.5
		W	54.4	0.53	0.48	2.2	52.5	44.3	39.4
Group 3									
Prime steer	Outside	W	61.0	0.41	0.49	2.4	59.9	36.8	36.0
	Inside	W	51.8	0.33	0.55	2.8	49.1	47.3	41.4
Choice steer	Outside	W	59.1	0.41	0.47	3.5	55.7	39.9	37.0
	Outside	Y	60.7	0.34	0.86	2.9	57.8	38.1	36.0
	Inside	W	55.0	0.68	0.81	2.5	51.2	44.9	40.0
Utility cow	Outside	Y	57.7	0.78	0.79	2.7	53.4	42.3	37.1
Canner and cutter cow	Outside	Y Y	59.1	0.70	0.74	2.3	56.2	40.0	36.6

spective of animal source or location in the brisket. The variations then occur in the relative amounts of monoethenoid and of saturated fatty acids in the fats. The monoethenoid fatty acid composition has the same relationship to the titer as the iodine value has to the titer. The saturated fatty acids are, of course, in an inverse relation and are in greater concentration in the fats with the higher titer values.

For purposes of comparison with the values obtained when commercial tallows are examined in the same way, note the values in Table II. The tallows are respectively called edible, fancy, prime, and "F" tallow. The edible and fancy tallows are known to be only from beef sources. Due to the method of selection of fats in the rendering plant the possibility of some grease in the prime and "F" tallows is not above suspicion. The iodine values range from 50.28 to 56.83, but all titer values are greater than 41°. A marked difference lies in the monoethenoid and saturated fatty acid composition of tallow representing composited fat from numerous carcasses as compared with fat from brisket. The average values in the tallows represented here are 47.9% monoethenoid fatty acid expressed as oleic, which compares with an average 56.5% in brisket fats. The saturated fatty acids in tallows average 47% whereas they average 39.8% in the brisket fats. It is apparent that a fatty acid composition exists in brisket fat that is different from the composition of fat found in the beef animal as a whole. This difference manifests itself in higher unsaturation and in a generally lower titer value than is normally expected in beef tallow. It would be interesting to know whether the beef brisket fats have the 5-10% of trans monoethenoid fatty acids found in beef fat by Swern, Knight, and Eddy (7).

Hilditch (2) makes several references to the difference in degree of unsaturation of pig depot fats with position in the depot fat. Generally the outer fats are the more highly unsaturated. No mention is made of comparable observations in bovine depot fats. From the data here determined, it appears that in beef brisket fat, at least, a comparable situation does occur. This does not seem to be limited to type of beef animal or to age of animal within the limited range of our observations. Since the monoethenoid acid concentration seems to be higher in brisket fat in all samples studied than in tallows composited from a number of animals, it is apparent that the beef animal deposits a fat of somewhat different nature in the brisket than in other parts of the carcass. The nature of this fat seems to be comparable regardless of type or age of animal so that dietary influence can be largely ruled out. This does not apparently conflict with Shorland's (6) designation of beef tallow as a "heterolipid" by which he indicates a lack of resemblance to the dietary fat. Although the animals with better finish have the harder brisket fat, there is no apparent difference in polyunsaturated fatty acids with difference in finish or age of animal.

Summary

The iodine value, titer, and unsaturated fatty acid composition of a number of beef brisket fats have been determined.

Beef brisket fats have been found to differ from beef tallows representing composites of fats from other portions of the carcass. The variations are manifested in a higher iodine value, lower titer, lower-saturated fatty acid, and a higher monoethenoid fatty acid composition. The outer brisket fat seems to differ from composite tallows more than the inner brisket fat. This observation, previously unreported, does not apparently conflict with Shorland's designation of beef tallows as "heterolipids."

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TABLE II

Composition and Characteristics of Typical Commercial Tallow

Tallow	I.V.	Fatty Acid Composition, %					
		Arach.	Linolenic	Linoleic	Oleic	Saturated	Titer
Edible	50.3	0.36	0.47	2.2	48.7	48.3	42.3
Fancy	50.8	0.31	0.47	2.6	48.6	48.0	42.2
Prime	55.3	0.55	0.46	4.1	49.7	45.2	41.3
"F"	56.8	0.65	0.47	7.3	44.6	47.0	41.8

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A Dual Purpose Extractor[1]

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THE apparatus shown in Figure 1 has proved useful for exhaustive extraction of comminuted solids with liquids, and of liquids with other non-miscible liquids.

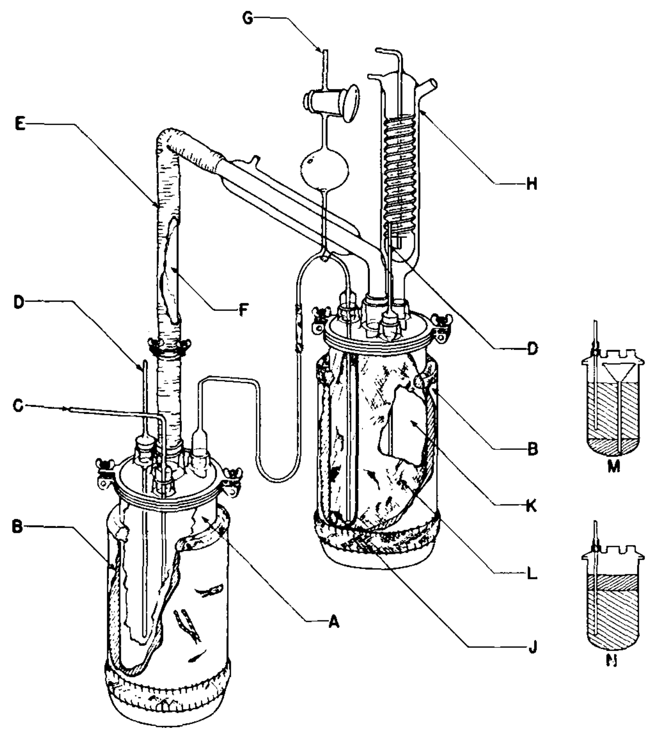
The boiling and extraction chambers (A and L) are 6-liter Pyrex resin reaction kettles equipped with ground glass covers each bearing four standard taper joints. These covers are secured to the flasks with rings and clamps. The temperature of both chambers is regulated by electric heating mantles (B) and may be read on standard taper thermometers (D). For more exact temperature control, the thermometers are replaced by special mercury thermoregulators described in an earlier report (1). Bumping and frothing in the boiling chamber are minimized by introducing inert gas at C.

The vertical portion of the vapor return system (F) is insulated with asbestos cord (E) to reduce reflux. An auxiliary condenser (H) decreases vapor loss to a minimum. Solvent is returned fractionally from the extraction chamber to the boiling chamber by an intermittent siphon (G), which carries a bubble trap, and a stopcock for filling by aspiration. The height of the discharging end of the siphon determines the volume of liquid removed from the extraction chamber each time the siphon operates. The U portion of this siphon keeps the column of liquid unbroken between operations. Flexibility in assembly of the apparatus is obtained by insertion of a spherical joint in the vapor return, and a length of Tygon or Teflon tubing in the siphon.

The main drawing shows the extraction chamber (L) equipped for eluting ground solids in a canvas bag (K). A glass separator plate (J) permits the siphon tube to extend to the bottom of the extraction chamber. For extraction of a heavier liquid with a lighter one, as shown at M, a funnel conducts the condensed lighter liquid beneath the surface of the heavier one. When a lighter liquid is extracted with a heavier one, as shown at N, the condensed heavier liquid falls through the lighter liquid. The length of the siphon tube within the extraction chamber is adjusted according to the volume of the liquid which is being extracted. The intermittent, fractional removal of solvent from the extraction chamber and the relatively long path to the top of the siphon minimize mechanical carryover of droplets of the liquid undergoing extraction.

The amount of material handled can be varied by providing chambers of different sizes. Liquids may be withdrawn or distilled from either chamber without completely dismantling the apparatus. Various refinements such as use of a sintered glass dispersion disc for extraction (as in M) may be made as required. Optimum conditions for exhaustive extraction might vary considerably for different materials.

Petroleum ether extraction of oil from kilogram quantities of ground weed seed screenings (29% oil) was complete in 16 hr. or less, as checked by extraction of 50-g. lots of the same material in a small Soxhlet apparatus. Removal of 20 to 25% of acetic or propionic acids added to kilogram lots of weed seed oil required 16 to 24 hr. extraction with water or 90 to 95% ethanol. These liquid-liquid extractions could be speeded up by alternating refluxing (with the siphon clamped off) and extraction in the extraction chamber.



DUAL PURPOSE EXTRACTOR

A	BOILING CHAMBER	J	SEPARATOR PLATE
B	HEATING MANTLE	K	BAG
C	GAS INLET	L	EXTRACTION CHAMBER
D	THERMOMETER	M	EXTRACTION OF HEAVIER LIQUID WITH LIGHTER LIQUID
E	ASBESTOS CORD	N	EXTRACTION OF LIGHTER LIQUID WITH HEAVIER LIQUID
F	VAPOR RETURN		
G	SIPHON		
H	AUXILIARY CONDENSER		

FIG. 1.

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[1] N.R.C. No. 2693.

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