613. *The Component Acids and Glycerides of a Badger Fat.*

By S. Gupta, T. P. Hilditch, and M. L. Meara.

The component acids of a mixture of the back and mesenteric fats of a badger have been found to be largely palmitic (21%), oleic (31%), and unsaturated (mainly polyethenoid) acids of the C_{20} series (15%), with subordinate proportions of myristic (6%), stearic (8%), hexadecenoic (6%), octadecadienoic (8%), and octadecatrienoic (4%) acids. Ordinary linoleic and linolenic acids are present in the polyene C_{18} acids. This animal fat is not of the "stearic-rich" type, and is peculiar, for a land animal, in its high content of polyethenoid C_{20} acids. It seems probable, from the component acids present, that the animal had derived its fats largely by assimilation from dietary fat, and the latter may have included frogs or similar small amphibia in whose fats these C_{20} acids occur in some quantity. With seven different component acids present in appreciable proportions, the constituent mixed glycerides of the badger fat are numerous and complex in character, but are shown to be assembled according to the principles which are followed in the great majority of natural fats.

The badger (*Meles meles* L.), which with the pine marten, the polecat, and some other animals of similar habit is placed in the family Mustelidae, is one of the less abundant but well-known wild animals indigenous to this country. In diet it is omnivorous, feeding for the most part on roots, acorns, and other fruits, on insects, and on small animals such as mice, frogs, lizards, and snakes. Animal fats of this species or, indeed, family have not previously been studied in detail, and we have therefore been glad to have the opportunity to investigate a specimen of the body fat from a badger killed in Somerset which was extracted and placed at our disposal by Mr. E. G. Neal of Taunton.

The fat (which is often reputed by country people to have specific value as an ointment in relieving rheumatism) was derived mainly from the back of the badger but also contained some fat from the mesentery: it was thus a mixture of external adipose tissue and intestinal depot fats, with the former predominating. As received, it was dull cream in colour and semi-solid at room temperature; the presence of 8·2% of free fatty acid indicated that retrogressive changes had taken place to a small but definite extent during or before rendering the fatty tissues to liberate the fat.

Only cursory characteristics for badger fats have previously been recorded. Amthor and Zink (*Z. anal. Chem.*, 1897, **36**, 6) stated that a specimen of fat from the abdominal cavity melted at 30—35°, had iodine value 71·3, saponification equivalent 290, and contained 2·5% of free fatty acid. Lobachev (*Soviet Med.*, 1943, **7**, No. 10, 21) gave the following figures for the back fat of a hibernating badger: m. p. 34—35°, iodine value 70—73, saponification equivalent 276—280; he reported that the fat obtained from badgers during hibernation (but not during spring and summer) appeared to have medicinal value in the treatment of wounds.

The specimen of badger fat examined by us differed from those recorded earlier in its softer consistency and higher degree of unsaturation, its iodine value being 91·6. Its component fatty acids were determined in detail by preliminary resolution of the mixed fatty acids by crystallisation from acetone and from ether at low temperatures, followed by fractional distillation of the methyl esters of each group of separated fatty acids: this procedure, some details of which are given later (p. 3147), was the same as that applied to the acids of hippopotamus fat described in the preceding paper. The detailed analysis showed that three acids made up about 66% of the total acids of the badger fat: palmitic (21%), oleic (31%), and unsaturated (largely polyethenoid acids) of the C_{20} series (14—15%). The other unsaturated acids present were linoleic (8%), linolenic (4%) and hexadecenoic (6%, including traces of hexadecadienoic acid), whilst similar amounts of other saturated acids (stearic 8%, myristic 6%) were also present.

The component acids of badger fat thus differ somewhat remarkably in some respects from those of the majority of fats of the (relatively few) larger mammalian species which have so far been examined. The most outstanding peculiarity is the presence of 15% of unsaturated C_{20} acids, a group of acids which have usually been found in so high proportion only in the fats of marine animals and of some amphibious animals. In the latter classes the unsaturated C_{20} (and C_{22}) acids in the body fats are accompanied by smaller, but comparable, proportions of hexadecenoic acid; and it is seen that in the badger fat also the proportion of the latter acid (6%) is about twice that found in many other land animals.

The large amount (31%) of oleic acid is accompanied by subordinate proportions of C_{18} diene- and triene-acids, which are largely the ordinary forms of linoleic and linolenic acids produced in the vegetable kingdom. The presence of these acids suggests that some proportion of the badger reserve fats is derived by direct assimilation of the fats present in vegetable matter consumed by the animal.

The saturated acids of the badger fat are distinguished by comparatively low proportions of stearic acid and rather more myristic acid than is usually found in fats of land animals, and

the palmitic acid content is definitely lower than the 30 ± 3% (mol.) which is characteristic for very many land animal fats. The badger-fat component acids are thus definitely not of the " stearic-rich " type which are present in many animal reserve fats and in which there is evidence (Hilditch, Lea, and Pedelty, *Biochem. J.*, 1939, **33**, 493; Hilditch and Pedelty, *ibid.*, 1941, **35**, 932), that such fats have mainly been synthesised in the animal from ingested carbohydrate. The unusually low palmitic acid content, and the presence of vegetable (seed-fat) linoleic and linolenic acids and of prominent proportions of unsaturated C_{20} and C_{18} acids reminiscent of aquatic fats are all consistent with the badger body fat being derived to a considerable extent more or less directly from fats present in its diet. It is at all events suggestive that the unsaturated acids mentioned are those found on the one hand in vegetable fruit fats and on the other in the fats of frogs and other small amphibia, both of these sources being reported amongst the common foods of the badger. At the same time it must be remembered that, as emphasised in the preceding paper, knowledge of the composition of the fats from a far wider range of animal species than is available at present is essential before any firm generalisations on their specific characteristics can be reached. With our present limited knowledge it is only permissible to put on record the composition of fats of animal species of the less common types and to point with some diffidence to definite resemblances or differences between fats from different animals or to features which, as in the present instance, seem to be common to an animal fat and to the fats of some of the main constituents of its food.

Having regard to the reputed value of badger fat for rheumatic conditions, it may be well to add that there is nothing about the composition of its fatty acids which suggests that such properties, if real, are due to any of the fatty constituents. The main difference between badger fat and other land animal fats is the presence of about 15% of polyethenoid acids of the C_{20} series, acids which are present in still greater proportions in most fish oils; we are not aware, however, that fish oils have been credited with this therapeutic property. If the popular belief is well-founded, it would appear that some specific consituent of the non-fatty matter which accompanies the fat itself is more likely to be the factor concerned.

The composition of the mixed glycerides present in badger fat has also been studied during the present investigation. As would be expected in a fat in which more or less substantial proportions of some seven different fatty acids are incorporated, it has been found to be a very complex mixture of mixed triglycerides, so complicated that it is not possible to distinguish the presence or proportion of any individual mixed triglyceride. Some general features can however be deduced from the component acids present in each of seven glyceride groups into which the fat was resolved after systematic crystallisation from solution in acetone at low temperatures (cf. Experimental, p. 3149). When this procedure has been carried so far that little further alteration in mean unsaturation is effected by further crystallisation, any one glyceride group will consist substantially of mixtures of only two of four possible categories of mixed glycerides, for example, tri- and di-saturated glycerides, di- and mono-saturated glycerides, or monosaturated and triunsaturated glycerides. Similarly, although the degree of separation is somewhat less certain, the same considerations will hold approximately for glycerides of individual acids so that, for instance, a given group may consist of mixtures of dioleo- and mono-oleo-glycerides but will not include any significant quantity of triolein or of glycerides from which oleic acid is absent. The composition of such binary mixtures of glyceride categories in any one glyceride group can therefore be estimated approximately from the determined composition of its fatty acids, and by summation the proportions of various categories of glycerides in the whole fat can be estimated, not with precision, but with sufficient accuracy to indicate the general constitution of the whole fat.

Application of this procedure to the badger fat has indicated that about half of the fat consists of glycerides with one saturated and two unsaturated acyl groups; of the rest, about equal proportions of glycerides contain one unsaturated and two saturated groups, or contain three unsaturated groups, and only a very small proportion (3%) consists of trisaturated glycerides. The two major component acids, oleic and palmitic, are distributed in the fat as follows: oleic groups occur twice in some 5—6% of the triglyceride molecules, and palmitic groups occur twice in about 4%, whilst oleic groups occur once in over 80% of the triglycerides, and palmitic groups occur once in about 52%. No indication of the presence of more than one acyl group of any of the other constituent acids per triglyceride molecule was observed in any of the seven glyceride fractions which make up the whole fat (except for possible traces of glycerides containing two of the unsaturated C_{20} acid groups). Badger fat thus follows the general principle observed in the constitution of natural fatty glycerides: there is the usual marked tendency towards the most even or widest distribution of the fatty acids amongst the triglyceride molecules.

No individual component acid forms more than one-third of the total fatty acids, and only in the cases of oleic acid (31%) and palmitic acid (21%) is there evidence of the presence of small proportions of dioleo- and dipalmito-glycerides respectively.

From the final figures for the various categories of glycerides (Table V, p. 3151) it is evident that a large proportion (perhaps nearly half) of the glycerides contain both an oleic and a palmitic group. The 23% of triunsaturated glycerides probably also contain at least one oleo-group associated with acyl groups of other unsaturated acids. In the monounsaturated glycerides there is probably one palmitic group, the remaining saturated group being either stearic or myristic; and, similarly, the small quantity (3%) of trisaturated glycerides is probably largely mixed in character (dipalmitostearin, myristopalmitostearin, etc.). Whilst palmito-oleo-unsaturated C_{20}-acid glycerides are the most abundant individual mixed glycerides in the fat, the unsaturated C_{20} acids are also present in association with other combinations of fatty acids.

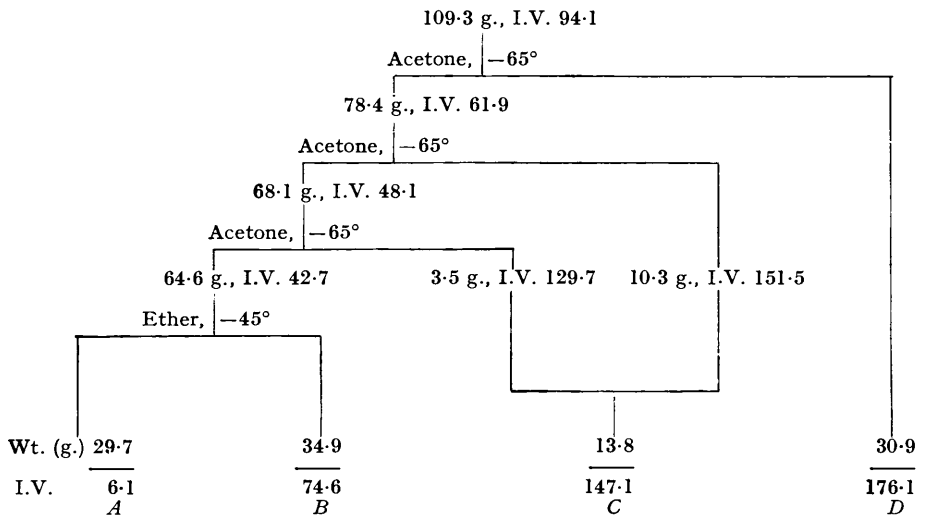
Experimental.

The opportunity is taken to describe, in greater detail than usual, the experimental techniques, applicable to most fats, which are currently employed in the Liverpool laboratories.

The badger body fat was dull cream in colour and semi-solid (pasty) at room temperature. It had a saponification equivalent of 284·8, an iodine value of 91·6, and contained 8·2% of free fatty acid (as oleic) and 0·6% of unsaponifiable matter.

Scheme 1.

Crystallisation of mixed fatty acids of badger fat.



Determination of the Component Acids.—The mixed fatty acids (109·3 g.) obtained by hydrolysis of the fat were successively crystallised from 10% solutions in acetone at −65°, and in ether at −45°, according to Scheme 1. The following four fractions were thus finally obtained :

Group.		G.	%.	Iodine value.
A	Insoluble in ether at −45°	29·7	27·2	6·1
B	Soluble in ether at −45°	34·9	31·9	74·6
C	,, acetone at −65° (2nd and 3rd crystallisations)	13·8	12·6	147·1
D	,, ,, ,, (1st crystallisation)	30·9	28·3	176·1

Each group of acids was separately converted into methyl esters, which were distilled in a vacuum through an electrically-heated and packed column. Table I is a summary of the ester-fractionation data, showing the fractions obtained from each group, with their equivalents and iodine values.

The proportions of polyethenoid acids, when present, were determined by spectrophotometric analysis (fractions *B*4, *C*1, *C*3, *D*2, and *D*5). The unsaturated acids in fractions *C*1 and *D*2 belong wholly to the C_{16} series, those in other fractions being wholly unsaturated C_{18} acids. The acids from each fraction were isomerised with alkali under standardised conditions (Hilditch, Morton, and Riley, *Analyst*, 1945, **70**, 68), and the extinction coefficients then determined of the bands developed at 268 mμ. (for " linolenic " unsaturation after isomerisation at 170° for 15 minutes) and at 234 mμ. (for " linoleic " unsaturation after isomerisation at 180° for 60 minutes). The results are given in Table II.

The C_{18} diene- and triene-acids were shown to contain the ordinary (seed-fat, *cis*-) forms of linoleic and linolenic acids by the isolation (from the acids of ester fractions *C*3 and *D*5) of characteristic tetrabromo-adducts (m. p. and mixed m. p. 113—114°) and hexabromo-aducts (m. p. and mixed m. p. 177—179°).

TABLE I.

Fractionation of methyl esters of fatty acids of groups A, B, C, *and* D.

No.	Wt. (g.).	Sap. equiv.	Iodine value.	No.	Wt. (g.).	Sap. equiv.	Iodine value.
	Methyl esters from group A,				*Methyl esters from group* B.		
1	1·63	246·6	0·2	1	1·53	244·3	5·6
2	2·31	261·7	0·6	2	2·61	268·3	29·6
3	3·02	270·4	0·9	3	2·96	287·4	62·5
4	3·63	271·0	0·8	4	3·60	294·2	76·4
5	3·58	273·6	2·2	5	4·03	296·5	82·3
6	3·03	283·0	9·0	6	3·12	297·2	84·8
7	3·69	295·0	17·4	7	3·07	296·8	85·4
8	1·63	317·1 *	20·2 *	8	3·44	301·4	86·3
				9	1·64	333·9 *	94·7 *
	22·52				26·00		
	Methyl esters from group C.				*Methyl esters from group* D.		
1	1·50	253·2	54·6	1	1·33	228·4	51·3
2	2·06	272·7	94·7	2	1·91	262·8	82·4
3	2·35	291·2	130·7	3	2·30	274·2	99·3
4	2·72	296·7	143·0	4	2·90	290·9	142·9
5	3·04	304·6	172·5	5	3·16	295·5	156·8
6	1·69	336·6 *	223·0 *	6	3·41	298·4	162·2
				7	2·39	299·5	171·8
	13·36			8	2·83	306·5	197·2
				9	2·89	321·5	223·6
				10	3·00	346·6 *	222·5 *
					26·12		

* Residual esters, freed from unsaponifiable matter :

*A*8 Sap. equiv. 295·3, iodine value 20·2 — *C*6 Sap. equiv. 315·7, iodine value 221·7

*B*9 ,, 320·6 ,, 97·2 — *D*10 ,, 322·9 ,, 241·3

TABLE II.

Spectrophotometric analyses of acids in selected ester fractions.

	Mixed acids of fractions			Unsaturated acids (% wt.)			
Ester fraction.	Iodine value.	Extinction coefficients $E^{1\%}_{1\,cm.}$ at 234 mμ.	268 mμ.	Series.	Monoene.	Diene.	Triene.
*C*1	57·8	16	negligible	C_{16}	97·2	2·8	—
*D*2	87·0	35	,,	C_{16}	95·8	4·2	—
*B*4	80·3	18	,,	C_{18}	97·7	2·3	—
*C*3	137·3	338	67	C_{18}	56·7	30·3	13·0
*D*5	164·6	511	118	C_{18}	31·6	44·9	23·5

The approximate iodine values of the acids of the C_{20} series present in the final fractions from the distillation of the esters of groups *B*, *C*, and *D* were deduced by extrapolation, and hence the approximate equivalents of their methyl esters, as described by Hilditch (" Chemical Constitution of Natural Fats," 2nd Edn., 1947, p. 509). The proportions of the C_{18} and C_{20} esters in these fractions were then estimated from their respective equivalents and the observed equivalent of the fraction in question. The components of each ester fraction having then been determined by methods described in detail elsewhere (Hilditch, *op. cit.*, pp. 505—509), the percentages of the component acids in each group, and therefrom those for the total fatty acids in the badger fat, follow as shown in Table III.

TABLE III.

Component fatty acids of the badger body fat.

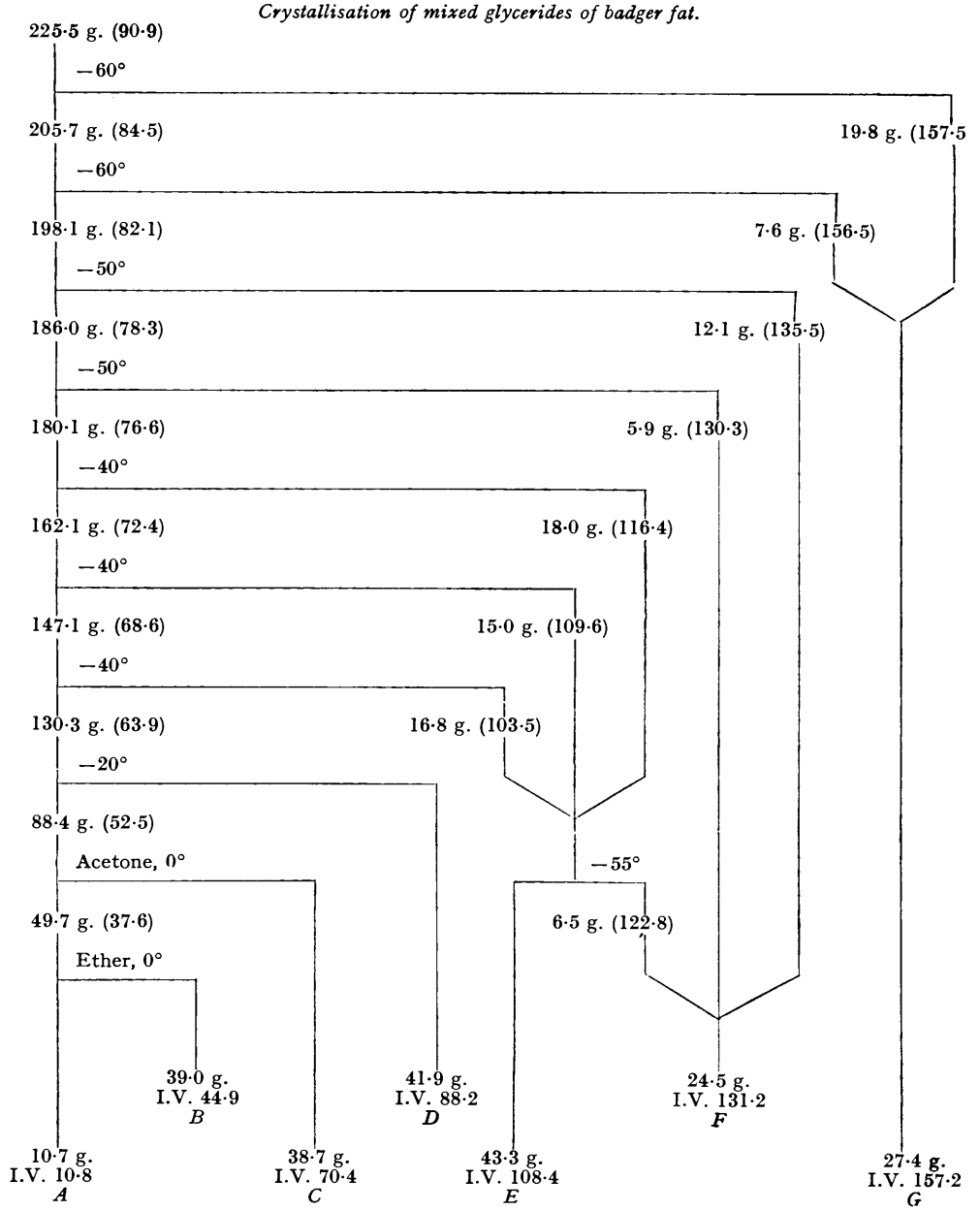
	Acid groups *A*—*D*.				Total fatty acids (excluding unsaponifiable)	
	A. % (wt.).	*B*. % (wt.).	*C*. % (wt.).	*D*. % (wt.).	% (wt.).	% (mol.).
Myristic	8·9	5·6	3·0	3·9	5·7	6·8
Palmitic	59·4	10·9	4·3	2·9	21·2	22·5
Stearic	24·1	3·3	—	2·0	8·2	7·9
Tetradecenoic	—	—	2·9	2·4	1·1	1·3
Hexadecenoic *	—	3·7	14·0	11·3	6·2	6·6
Oleic	7·1	65·4	30·3	14·4	30·9	29·9
Octadecadienoic	—	1·5	16·2	20·4	8·4	8·1
Octadecatrienoic	—	—	7·0	10·7	3·9	3·9
Unsaturated C_{20}	—	9·3	21·5	31·2	14·6	13·0
(mean unsaturation) †	—	(−2·5H)	(−6·7H)	(−5·6H)	(−5·1H)	(−5·1H)
Unsaponifiable	0·5	0·3	0·8	0·8	—	—

* Including traces of polyethenoid C_{16} acids. † See footnote, p. 3142.

Investigation of the Component Glycerides.—The free fatty acid present in the badger fat as received was removed by neutralisation with alkali before undertaking the study of its constituent glycerides. The neutral fat (225 g.) was submitted to a series of systematic crystallisations from 10% solution in acetone at temperatures successively rising from −60° to 0°. Three fractions of fat left in solution at −40° were combined and subjected to a further crystallisation from acetone at −55°. The glycerides which were finally left insoluble in acetone at 0° were given a crystallisation from ether at 0°. Each solution was left at the selected temperature for 4½—5 hours, except in crystallisations at 0° in which the solutions were left overnight in a refrigerator. In this way the original fat of iodine value 90·9 was separated into a series of seven glyceride groups, the iodine values of which ranged from 10·8 to 157·2. The complete series of crystallisations is illustrated in Scheme 2.

SCHEME 2.

Crystallisation of mixed glycerides of badger fat.



[*All crystallisations from* 10% *solutions in acetone, except in one instance* (*ether*) *indicated.*]
(*Figures in parentheses are iodine values.*)

The mixed acids in each of the seven groups *A*—*G* of the glycerides were determined by fractionation of their methyl esters, the acids of groups *B*—*E* being first separated into relatively saturated and unsaturated portions by crystallisation from ether at −25° (*B*), acetone at −35° (*C* and *D*), or acetone at −40° (*E*). The composition of mono- and poly-ene-acids of the C_{16} and C_{18} series was estimated spectrophotometrically in selected ester fractions in which (as shown by their saponification equivalents) unsaturated C_{16} acids were not accompanied by unsaturated C_{18} acids, or in which the latter were unmixed with unsaturated acids of the C_{18} or C_{20} series. The approximate equivalent of the unsaturated C_{20} esters was deduced from the extrapolated iodine values, as mentioned earlier in describing the analysis of the component acids of the original fat (p. 3148). Each of these analyses thus involved a series of determinations and consequent calculations of the same nature as those illustrated in Tables I, II, and III for the component acids of the whole fat. These details are not given here, but Table IV shows the proportions and characteristics of each of the groups *A*—*G* of the glycerides obtained by crystallisation, and also the percentage composition (by weight and by mol.) determined from the detailed analyses of the fatty acids in each group of glycerides.

TABLE IV.

Badger fat glyceride groups obtained by low-temperature crystallisation.

	A.	*B*.	*C*.	*D*.	*E*.	*F*.	*G*.	Total.
Weight (g.)	10·7	39·0	38·7	41·9	43·3	24·5	27·4	225·5
Iodine value	10·8	44·9	70·4	88·2	108·4	131·2	157·2	90·9
Sap. equiv.	275·1	280·0	284·7	286·4	288·5	290·2	296·9	287·2
Unsaponifiable, % (wt.)	—	0·2	0·5	0·3	0·5	0·6	0·9	0·6
Glycerides, % (wt.)	4·7	17·3	17·1	18·6	19·2	10·9	12·2	100·0
,, % (mol.)	4·9	17·7	17·3	18·6	19·1	10·7	11·7	100·0
Component acids (% wt.).								
Myristic	11·6	9·2	7·7	5·7	4·3	5·2	3·1	6·3
Palmitic	48·8	34·8	24·7	17·3	9·6	7·3	4·2	18·9
Stearic	27·2	16·2	9·2	7·9	2·2	1·9	0·5	7·8
Hexadecenoic *	—	3·4	7·2	7·6	10·1	12·8	10·3	7·8
Oleic	12·4	26·0	30·6	36·8	43·4	33·2	25·5	32·2
Octadecadienoic	—	4·3	5·6	9·8	12·7	14·5	12·0	9·0
Octadecatrienoic	—	1·5	2·5	4·2	4·8	7·5	7·9	4·2
Unsaturated C_{20}	—	4·6	12·5	10·7	12·9	17·6	36·5	13·8
(mean unsaturation) †	—	(−4·3H)	(−4·3H)	(−4·8H)	(−5·1H)	(−6·2H)	(−6·2H)	(−5·4H)
Component acids (% mol.).								
Myristic	13·3	10·8	9·2	6·8	5·2	6·2	3·9	7·5
Palmitic	50·0	36·2	26·1	18·4	10·3	7·8	4·5	20·2
Stearic	25·1	15·2	8·6	7·5	2·1	1·9	0·5	7·5
Hexadecenoic *	—	3·6	7·8	8·4	11·1	14·1	12·0	8·6
Oleic	11·6	24·6	29·4	35·7	42·2	32·4	25·5	31·1
Octadecadienoic	—	4·1	5·4	9·5	12·4	14·3	12·0	8·7
Octadecatrienoic	—	1·5	2·5	4·2	4·8	7·4	8·0	4·1
Unsaturated C_{20}	—	4·0	11·0	9·5	11·9	15·9	33·6	12·3

* Including, in some cases, traces of polyethenoid C_{16} acids, or tetradecenoic acid.
† See footnote, p. 3142.

The values in the final column for the fatty acid percentages obtained by summation from the seven glyceride groups do not accord so well as usual with those determined on the component acids of the whole fat (Table III), but this is probably due in part to slight differences in composition between the acids in the neutralised fat and the free fatty acids in the original fat.

If, in the first place, the relative amounts of saturated and unsaturated acids in the glycerides of the different groups are considered, fraction *A* is seen to contain some trisaturated glycerides; but the very small amount present makes it reasonably certain that these do not occur in any of the remaining fractions. In the more soluble groups, triunsaturated glycerides are evidently present, whilst the relatively sparing solubility of monounsaturated disaturated glycerides makes it unlikely that any of these, or at most very small traces, will be present in groups *E*, *F*, and *G*, which may therefore safely be taken as binary mixtures of di- and tri-unsaturated glycerides. Similarly, triunsaturated glycerides will have been removed from groups *B* and *C*, which are thus mixtures of mono- and di-unsaturated glycerides. In group *D* it is however probable that a small proportion of monounsaturated glycerides still persists, but it is only possible to calculate this as a binary mixture of di- and tri-unsaturated glycerides. Thus, when due care has been taken to pursue the crystallisation of the original fat to a point at which little or no change takes place on further recrystallisation of intermediate fractions, it can be assumed with considerable confidence that any one group contains only binary mixtures of tri- and di-saturated, di- and mono-saturated, or monosaturated and triunsaturated glycerides. The proportions of such binary mixtures [Table V, (i)] follow from the component-acid data in Table IV.

The probable approximate proportions in each glyceride group of mono- and di-palmito-glycerides [Table V, (ii)], and of mono- and di-oleoglycerides [Table V, (iii)], can be deduced on similar lines, although of course the degree of segregation of the unsaturated glycerides, at all events, cannot be postulated so certainly as in the case of the various categories of saturated-unsaturated glycerides. Summation of all the data so calculated (Table V, final column) nevertheless affords an approximate measure of each of the different glyceride categories present in the original fat.

TABLE V.

Component acid and glyceride categories in the glyceride groups A—G.

	A.	*B.*	*C.*	*D.*	*E.*	*F.*	*G.*	Total.
Glycerides, % (mol.)	4·9	17·7	17·3	18·6	19·1	10·7	11·7	100·0
Component acid categories (increments, % mol.).								
Myristic	0·6	1·9	1·6	1·2	1·0	0·7	0·5	7·5
Palmitic	2·5	6·4	4·5	3·4	2·0	0·8	0·5	20·1
Stearic	1·2	2·7	1·5	1·4	0·4	0·2	0·1	7·5
Hexadecenoic *	—	0·6	1·3	1·6	2·1	1·5	1·4	8·5
Oleic	0·6	4·4	5·1	6·6	8·0	3·5	3·0	31·2
Octadecadienoic	—	0·7	0·9	1·8	2·4	1·5	1·4	8·7
Octadecatrienoic	—	0·3	0·5	0·8	0·9	0·8	0·9	4·2
Unsaturated C_{20}	—	0·7	1·9	1·8	2·3	1·7	3·9	12·3
Component glyceride categories (increments, % mol.).								
(i) Trisaturated	3·2	—	—	—	—	—	—	3·2
Disaturated-monosaturated	1·7	15·4	5·5	—	—	—	—	22·6
Monosaturated-diunsaturated	—	2·3	11·8	18·3	10·1	5·1	3·2	50·8
Triunsaturated	—	—	—	0·3	9·0	5·6	8·5	23·4
(ii) Dipalmito-	2·5	1·5	—	—	—	—	—	4·0
Monopalmito-	2·4	16·2	13·6	10·3	5·9	2·5	1·6	52·5
No palmitic group	—	—	3·7	8·3	13·2	8·2	10·1	43·5
(iii) Dioleo-	—	—	—	1·3	4·3	—	—	5·6
Mono-oleo-	1·7	13·1	15·2	17·3	14·8	10·4	8·9	81·4
No oleic group	3·2	4·6	2·1	—	—	0·3	2·8	13·0
(iv) Diunsaturated C_{20}	—	—	—	—	—	—	0·1	0·1
Monounsaturated C_{20}	—	2·2	5·7	5·3	6·8	5·1	11·6	36·7
No unsaturated C_{20} group	4·9	15·5	11·6	13·3	12·3	5·6	—	63·2

* Including, in some cases, traces of polyethenoid C_{16} acids, or tetradecenoic acid.

The proportions of myristic, stearic, hexadecenoic, octadecadienoic, and octadecatrienoic acids in all the groups of glycerides are small enough to indicate that each contributes only one acyl group to any triglyceride in which it is present. This also applies to the unsaturated acids of the C_{20} series, except that very small proportions of glycerides containing two acyl radicals from this group were indicated in glyceride group *G*.

We record our thanks to Mr. E. G. Neal for providing the specimen of badger fat, and to Dr. L. Harrison Matthews for putting us in contact with Mr. Neal. We thank the Government of India for a scholarship held by one of us (S. S. G.) during the course of this work.

THE UNIVERSITY, LIVERPOOL. [*Received, July 19th,* 1950.]