CCLXXVII. THE BODY FATS OF SOME SEA-BIRDS

By JOHN ARNOLD LOVERN

*From the Torry Research Station, Aberdeen, Department of
Scientific and Industrial Research*

(Received 11 October 1938)

IN earlier papers [e.g. Lovern, 1937] the writer has discussed specific features in fats which are largely independent of the diet of the animal, and Hilditch & Lovern [1936] have considered the relationship between species and fat composition. The broad schemes suggested in this second paper are not, however, free from exceptions, e.g. the whales of the Balaenidae family have fats closely resembling those of fish to which they are not, of course, zoologically related. Without, for the present, considering the matter in detail, it is evident that the diet of marine organisms is ultimately responsible for the fat of these whales having such a composition.

Sea-birds, living exclusively on fish, should be of interest in this respect. The fats of comparatively few birds have been examined, and those of only one (the hen) quantitatively analysed [Hilditch *et al.* 1934]. The hen is particularly interesting in that its fat contains about 7 % of hexadecenoic acid, until recently considered characteristic of aquatic life. However, hen fat is not closely similar to that of fish, since it contains only traces of C₂₀ and C₂₂ acids. Koyama [1928] has examined the fats of a number of birds qualitatively, and shown that some (the carnivorous ones) give small yields of ether-insoluble polybromides. In the present paper the results of the quantitative analyses of the body fats of four species of sea-bird are given.

EXPERIMENTAL

The birds were obtained in Shetland waters where it is almost certain that their diet would consist wholly of fish or other aquatic life. The percentages of fat recorded are on the plucked, eviscerated and decapitated birds. Small quantities of accompanying phosphatides (order 10 % of total) were removed by means of acetone. In Table I are given the particulars of the fats and in Table II the compositions.

Table I. *Particulars of fats*

Species	No. of specimens	Fat content %	I.v.	Unsaponi- fiable %
Herring gull (<i>Larus argentatus</i>)	7	9.7	107.9	3.0
Skua gull (<i>Megalestris catarrhactes</i>)	7	7.0	95.8	6.6
Gannet (<i>Sula bassana</i>)	2	6.7	123.9	8.1
Fulmar petrel (<i>Fulmarus glacialis</i>)	6	15.2	130.2	7.8

Table II. *Composition of fats (wt. %)*

Species	Saturated				
	C ₁₀	C ₁₄	C ₁₆	C ₁₈	C ₂₀
<i>L. argentatus</i>	Nil	3.3	18.5	6.2	0.2
<i>M. catarrhactes</i>	Nil	1.9	16.4	5.7	0.2
<i>S. bassana</i>	Trace	3.2	17.1	3.6	Nil
<i>F. glacialis</i>	0.3	2.0	13.9	3.2	Nil

Species	Unsaturated					
	C ₁₄	C ₁₆	C ₁₈	C ₂₀	C ₂₂	C ₂₄
<i>L. argentatus</i>	0.5	4.0 (-2.3 H)	30.5 (-2.8 H)	20.3 (-4.1 H)	16.5 (-4.9 H)	Trace?
<i>M. catarrhactes</i>	0.4	4.6 (-2.1 H)	32.6 (-2.6 H)	19.7 (-3.3 H)	18.5 (-3.8 H)	Trace
<i>S. bassana</i>	1.0	5.2 (-2.0 H)	28.3 (-2.8 H)	24.2 (-4.0 H)	17.4 (-6.0 H)	—
<i>F. glacialis</i>	0.9	3.9 (-2.0 H)	26.9 (-2.8 H)	26.8 (-4.0 H)	22.1 (-6.6 H)	Trace?

The small quantity of acid lower than C₁₄ in two of the fats was only examined in the case of the fulmar petrel. It appeared to consist of *n*-decoic acid, no lauric acid being present.

DISCUSSION

It can be seen at once from Table II that all four fats are of the "aquatic" type. By comparison with the frequency curves for marine fish fats [Lovern, 1937] it can be seen that these bird fats are also closely similar to the average marine fish fat. Total C₁₆, C₂₀ and C₂₂ acid percentages roughly coincide with the maxima on the curves. Total C₁₈ is rather high, but on the whole it is obvious that the fats of these birds cannot be very different (as regards the proportions of the various acid groups) from the fat which they ingest.

At the same time the fats have been considerably altered in unsaturation. The stearic acid content is higher than in fish fats, whilst in two cases arachidic acid (which can hardly have been ingested) appears. Concurrently the degrees of average unsaturation of the C₂₀ and C₂₂ acids are reduced below the average for fish fats. Apparently all the birds have hydrogenated the ingested fat, the process having gone further in the two gulls than in the other two birds. The reason for such hydrogenation may be found in the higher temperature of birds than fish. In the case of fish themselves the author has shown [Lovern, 1938] that a difference of 9° has a slight effect of the type expected.

These birds thus form another exception to the broad rule that fat types can be correlated with phylogenetic relationships. The position may perhaps be summarized thus. Many animals, such as the fish discussed by the writer [Lovern, 1937], produce characteristic depot fats considerably different from the fat which they ingest. The differences are specific and can be correlated with the phylogenetic relationships of the animal in question. Certain other animals (including many fish, such as the cod) deposit fat closely resembling that which they habitually ingest. This may mean one of at least two things: (a) that they have no specific requirements and any type of depot fat will serve equally well, or (b) that in the course of evolution their specific requirements have been produced or modified to suit the normal diet. To decide between these two ideas it would be necessary to make many feeding experiments with different fats and with fat-free diets. Possibly theory (a) would apply to some animals and theory (b) to others.

SUMMARY

The fats of four species of sea-bird have been quantitatively analysed. They markedly resemble the fats of marine fish in the proportions of the various acid groups, although some hydrogenation has occurred.

These birds form another exception to the broad rule that fat types can be correlated with phylogenetic relationships. Two possible explanations are advanced.

REFERENCES

- Hilditch, Jones & Rhead (1934). *Biochem. J.* **28**, 786.
— & Lovern (1936). *Nature, Lond.*, **137**, 478.
Koyama (1928). *J. Soc. chem Ind., Japan*, **31**, 72 B, 140 B, 211 B, 238 B, 259 B, 298 B.
Lovern (1937). *Biochem. J.* **31**, 755.
— (1938). *Biochem. J.* **32**, 1214.