The Component Acids of Some Indian Fresh-water Fish Fats

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The component acids of fats from different parts of bhakur (*Catla buehanani*) were investigated by Pathak & Agarwal (1952). Pathak, Pande & Mathur (1954) studied the component acids of body and visceral fats from rohu (*Labeo rohita*) and nain (*Cirrhina mrigala*). The fats obtained from the body and viscera of belgagra (*Rita buehanani*) and from the body of hilsa (*Clupondon ilisha*) comprise the present study. These fishes were from the River Ganges at Banaras.

EXPERIMENTAL

Body and visceral tissues of *R. buehanani* and body tissues only of *C. ilisha* were separated from the fishes immediately after catching, cut into small pieces and exhaustively extracted with hot acetone. The extracted material was taken up in light petroleum (b.p. 40–60°), leaving the aqueous portion. The lipids were recovered from the petroleum solution and dried at 100° under reduced pressure. The fats were kept in 10 vol. of acetone at 0° to remove the phosphatides.

The fats were hydrolysed, and the mixed fatty acids recovered were resolved into groups of simpler mixtures of acids by lithium salt-acetone treatment (Tsuji moto, 1920; Tsujimoto & Kimura, 1923) and lead salt-ethanol fractionation (Hilditch, 1949). Each group of acids was separately converted into methyl esters, with the usual precautions (Bjarnason & Meara, 1944), and fractionated at approx. 0.1 mm. pressure through an electrically heated and packed column (Longenecker, 1937). The compositions of the ester fractions were calculated from the saponification equivalents and iodine values by the method of Hilditch (1949). The mean unsaturation, expressed as the number of hydrogen atoms short of saturation (e.g. 2.0, monoethenoid), was determined as usual by the interpolation and extrapolation of the respective ester fractions in each group. The compositions of the original fats were obtained from those of the separated groups of fatty acids.

RESULTS

The preliminary separation of the mixed fatty acids from the fats into groups of acids differing in unsaturation, e.g. mostly saturated, mainly monoethenoid and polyethenoid, was done as described above. Three fractions were obtained from the mixed acids (91.37 g.) from the body fat of *R. buehanani*, i.e. *A* (25.44 g., iodine value 6.7), *B* (43.18 g., iodine value 92.96) and *C* (22.55 g., iodine value 195.6). Similarly, the visceral fat of *R. buehanani* was divided into two parts, i.e. *A* (6.9 g., iodine

value 20.5) and *B* (15.4 g., iodine value 122.5). In the same way the acids of the body fat of *C. ilisha* were divided into three fractions, i.e. *A* (45.67 g., iodine value 7.9), *B* (45.11 g., iodine value 104.0) and *C* (19.25 g., iodine value 236.2). Subsequent fractionation and analysis, as described in the Experimental section, led to the results recorded in Table 1.

DISCUSSION

Belgagra and hilsa body fats are typical fresh-water fish fats; C_{18} acids predominate in both, 43.8 moles % in the former and 37.1 moles % in the latter, palmitic acid being the major saturated acid component. There are traces of unsaturated C_{24} acids in hilsa body fat, and this has also been observed in the body fat of bhakur and rohu fish body fats (see Table 2). The body fats of belgagra and hilsa have been compared with British fresh-water-fish body fats and are recorded in Table 2, together with values for a marine fish (herring). Similarities in the proportions of saturated and unsaturated fatty acids and the mean unsaturation of unsaturated acids are observable.

It is to be noted (Table 2) that the hexadecenoic acid content of the Indian fishes belgagra and hilsa body fats is 14.3 and 13.9 moles % respectively, which is less by about 8 moles % than in the fresh-water body fats of fishes from British waters, where the hexadecenoic content is conspicuously constant at 20 moles %. The palmitic acid contents of the Indian fish fats referred to above are 22.2 and 26.8 moles % respectively, which are both higher than the palmitic acid contents of the body fats of fresh-water fishes from English waters, e.g. *Corregonus pollan* and *Esox lucius* contain 14.3 and 13.2 moles % of palmitic acid respectively. Nevertheless, the total C_{16} acid contents remain nearly constant, i.e. 36.5, 40.8, 34.1 and 34.0 moles % in the above four fishes.

Again, the C_{18} unsaturated content in the same order is 34.9, 28.1, 40.0 and 38.4 moles % respectively, and the stearic acid content, in the same order, is 8.9, 9.0, 1.9 and 0.5 moles %. The total C_{18} acids remain almost constant in the two Indian and other two British fish body fats, i.e. 43.3, 37.1, 41.9 and 40.5 moles % respectively. This may be due to the fact that biohydrogenation occurs to a greater degree in the fats of Indian fresh-water fishes living

Table 1. *Component acids of Rita buchanani (belgagra) and Clupondon ilisha (hilsa) fish (body and visceral) fats*

Percentages do not include the unsaponifiable fraction, which was less than 1% in each. Degrees of unsaturation are given in parentheses.

	<i>Rita buchanani</i>				<i>Clupondon ilisha</i>	
	Body fat		Visceral fat		Body fat	
	(wt. %)	(moles %)	(wt. %)	(moles %)	(wt. %)	(moles %)
Saturated acids						
Myristic (C ₁₄)	4.2	5.0	2.9	3.1	5.7	6.8
Palmitic (C ₁₆)	20.8	22.2	21.1	22.8	25.3	26.8
Stearic (C ₁₈)	9.3	8.9	12.0	11.7	9.4	9.0
Arachidic (C ₂₀)	Nil	Nil	Nil	Nil	2.0	1.7
Unsaturated acids						
C ₁₄	1.4	1.7 (-2.0)	0.5	0.6 (-2.0)	2.0	2.4 (-2.0)
C ₁₆	13.2	14.3 (-2.0)	9.1	10.0 (-2.4)	13.0	13.9 (-2.4)
C ₁₈	36.0	34.9 (-2.7)	34.3	33.8 (-2.4)	29.2	28.1 (-2.7)
C ₂₀	8.9	7.9 (-5.6)	20.1	18.0 (-4.3)	5.8	5.3 (-5.7)
C ₂₂	6.2	5.1 (-6.5)	Nil	Nil	4.3	3.5 (-10.2)
C ₂₄	Nil	Nil	Nil	Nil	3.3	2.5 (-10.2)

Table 2. *Component acids of body fats of some fresh-water fishes*

Results are expressed as moles %, excluding unsaponifiable material. Figures in parentheses show the degree of unsaturation. The only marine fish is the herring. The first five are Indian fishes, the remainder are British.

	<i>Rita buchanani</i> * (belgagra)	<i>Clupondon ilisha</i> * (hilsa)	<i>Catla buehanani</i> † (catla-catla)	<i>Labeo rohita</i> ‡ (rohu)	<i>Cirrhina mrigala</i> ‡ (nain)	<i>Clupea harengus</i> § (herring)	<i>Esox lucius</i> (pike)	<i>Salmo trutta</i> ¶ (trout)
Saturated acids								
Myristic (C ₁₄)	5.0	6.8	2.9	3.4	1.9	8.3	4.7	3.1
Palmitic (C ₁₆)	22.2	26.8	29.0	21.2	21.4	12.1	13.2	19.0
Stearic (C ₁₈)	8.9	9.0	6.5	11.5	3.1	0.3	0.6	4.5
Arachidic (C ₂₀)	Nil	1.7	Nil	0.5	Nil	Nil	Nil	Nil
Unsaturated acids								
C ₁₄	1.7 (-2.0)	2.4 (-2.0)	0.2 (-2.0)	3.7 (-2.0)	3.7 (-2.0)	0.5 (-2.0)	0.8 (-2.0)	0.4 (-2.0)
C ₁₆	14.3 (-2.0)	13.9 (-2.4)	25.3 (-2.7)	8.1 (-2.2)	32.6 (-2.2)	6.4 (-3.4)	20.8 (-2.0)	11.5 (-2.6)
C ₁₈	34.9 (-2.7)	28.1 (-2.7)	17.9 (-2.5)	32.2 (-3.3)	29.5 (-3.6)	31.1 (-4.5)	38.4 (-2.8)	38.3 (-3.9)
C ₂₀	7.9 (-5.6)	5.3 (-5.7)	7.5 (-5.7)	12.4 (-5.2)	5.0 (-4.9)	29.3 (-5.5)	15.3 (-7.5)	15.0 (-7.8)
C ₂₂	5.1 (-6.5)	10.1 (-10.2)	10.1 (-9.0)	6.7 (-6.9)	2.8 (-6.0)	23.1 (-4.6)	6.3 (-7.5)	8.2 (-10.1)
C ₂₄	Nil	2.5 (-10.2)	0.6 (-11.0)	0.3 (-9.0)	Nil	Nil	Nil	Nil

* Present authors.

† Pathak & Agarwal (1952).

‡ Pathak *et al.* (1954).

§ Lovern (1938).

|| Lovern (1932).

¶ Lovern (1937).

Table 3. *Component acids of visceral fats of some fresh-water and marine fishes*

The results are expressed as moles %, excluding unsaponifiable material. Figures in parentheses show the degree of unsaturation.

	<i>Rita buchanani</i> *	<i>Catla buchanani</i> †	<i>Labeo rohita</i> ‡	<i>Cirrhhina mrigala</i> ‡	<i>Clupea harengus</i> §
Saturated acids					
Myristic (C ₁₄)	3.1	2.8	1.6	5.7	5.8
Palmitic (C ₁₆)	22.8	25.3	26.0	20.1	15.7
Stearic (C ₁₈)	11.7	7.9	14.6	5.7	2.8
Arachidic (C ₂₀)	Nil	1.4	3.1	0.5	0.3
Unsaturated acids					
C ₁₄	0.6 (-2.0)	1.4 (-2.0)	0.7 (-2.0)	4.2 (-2.0)	1.4 (-2.0)
C ₁₆	10.0 (-2.0)	10.0 (-2.7)	8.6 (-2.7)	26.5 (-2.2)	10.5 (-2.5)
C ₁₈	33.8 (-2.4)	37.2 (-2.5)	30.3 (-3.7)	32.3 (-2.9)	31.8 (-2.6)
C ₂₀	18.0 (-4.0)	11.9 (-5.7)	9.6 (-6.3)	5.0 (-4.0)	22.4 (-7.1)
C ₂₂	Nil	2.1 (-9.0)	5.5 (-9.0)	Nil	9.3 (-10.5)

* Present authors.

† Pathak *et al.* (1954).

‡ Pathak & Agarwal (1952).

§ Hilditch & Pathak (1948).

in tropical waters, leading to the partial saturation of the unsaturated component acids. Aquatic animals from tropical fresh waters probably produce a fat having a higher melting point. Lovern (1936) suggested a similar effect of temperature on tunny fat (*Thunnus thynnus*).

The nature of the belgagra visceral fat can be assessed from the nature and the proportions of the component acids (Tables 1 and 3). It shows similarities to the typical fats of the fresh-water fishes in having C₁₈ acids as the major predominant group, palmitic acid being the major saturated acid component. The composition of visceral fat is somewhat different from that of the body fat in both saturated and unsaturated fractions. Unsaturated C₂₂ and C₂₄ acids are absent.

It is interesting to note the gradual increase in the relative proportions of the saturated acids of higher molecular weight from body to visceral fat in the belgagra fish fats (Tables 2 and 3). Stearic acid has increased from 8.9 to 11.9 moles % from body to viscera. In unsaturated acids, the increase in C₂₀ acids from 7.9 to 19.9 moles % is very marked. It is also accompanied by a general decrease in the mean unsaturation of unsaturated acids in the visceral fats. Some of the other comparisons of fish body and visceral fats show similar trends (Tables 2 and 3).

SUMMARY

1. The compositions of the body and visceral fats from belgagra (*Rita buchanani*) and the body fat of hilsa (*Clupondon ilisha*) have been studied. Lithium salt-acetone and lead salt-ethanol frac-

tions were used to separate the fatty acids into groups differing in unsaturation. Their compositions were studied by methyl ester fractionation.

2. A comparison has been made of the body and visceral fat from belgagra fish.

3. Comparison has also been made between the body fats of Indian and British fresh-water fishes. It has been suggested that whereas the fishy character of the acids remains the same, there is a possibility of biohydrogenation of unsaturated acids in the body fats of fishes from tropical waters.

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