FATTY ACID COMPONENT OF VARIOUS BLUBBER OIL OF GANGES RIVER DOLPHIN*

HIDEO TSUYUKI** AND SHINGO ITOH**

ABSTRACT

The oil contained in various blubbers of Ganges river dolphin, *Platanista gangetica*, has been investigated in the present work.

The fatty acid component of sample oil has been analyzed by GLC. Thirty-seven fatty acids with chain lengths from 5 to 24 carbon atoms and zero to six double bonds were tentatively identified in Ganges river dolphin oil. Three fatty acids of C_{16} saturated, C_{16} monoenoic and C_{18} monoenoic acids constituted an average of more than 66.45% of total acids. The fatty acid component of each sample oil was found to be relatively rich in unsaturated fatty acids (62.35–77.62%), and saturated fatty acids were contained in small amounts (22.38–37.65%).

INTRODUCTION

In the previous paper (Tsuyuki and Itoh, 1971), we reported that Ganges river dolphin oil comprized more than 24 kinds of fatty acids with 12–22 carbon atoms, including mostly hexadecanoic, hexadecamonoenoic and octadecamonoenoic acids. Further, Pilleri has studied the chemical properties on the lipid of the blubber of *Platanista indi* and *gangetica* (1971).

In the present investigation, the fatty acid component of various blubber oils of two Ganges river dolphins was studied by gas liquid chromatography using a hydrogen ionization detector.

This study is reported as a part of the examination of *Platanistidae* which had been continuing to date by organized Japanese Scientists.

It was a pleasure for us to join in this study.

MATERIALS AND METHODS

The materials used in this study were two Ganges river dolphins (body length 126.0 cm, body weight 17.0 kg, immature female as sample A and 199.0 cm, 84.0 kg, mature male as sample B).

Oils were extracted by boiling various blubbers of Ganges river dolphins with water. The chemical properties of these oils were examined by ordinary methods (Tables 1 and 2).

* An outline of this article was presented to the Annual Meeting of Japanese Society of Scientific Fisheries, Tokyo, April 4, 1972.

** Department of Food Engineering, College of Agriculture & Veterinary Medicine, Nihon University.

Sci. Rep. Whales Res. Inst.,
No. 24, 1972, 117-125.

TABLE 1. PROPERTIES OF OILS CONTAINED IN VARIOUS BLUBBERS OF GANGES RIVER DOLPHIN (A).

Parts of blubbers	Oil content (%)	Acid value	Iodine value	Sapon. value	Unsapon. matter (%)
Thoracic blubber	38.4	1.40	115.5	193.1	1.36
Umbilicus blubber	49.1	1.26	125.6	197.5	1.02
Abdominal hind blubber	40.4	0.62	114.2	189.3	1.26
Frontal back blubber	40.1	1.01	102.9	194.6	1.16
Middle back blubber	50.7	1.46	113.3	190.4	1.72
Posterior back blubber	33.2	1.07	96.1	189.3	1.10

TABLE 2. PROPERTIES OF OILS CONTAINED IN VARIOUS BLUBBERS OF GANGES RIVER DOLPHIN (B).

Part of blubbers	Oil content (%)	Acid value	Iodine value	Sapon. value	Unsapon. matter (%)
Thoracic blubber	48.3	1.10	113.9	198.1	1.70
Umbilicus blubber	48.9	0.90	117.4	207.0	1.65
Frontal back blubber	52.5	1.04	121.9	208.2	1.46
Middle back blubber	50.1	1.41	99.3	195.3	1.03
Tail blubber	34.2	1.05	101.2	128.0	31.80
Melon	51.8	1.00	70.9	218.3	0.92

The fatty acid methyl esters of various blubber oils were prepared with BF_3-methanol reagent according to Metcalfe *et al* (1966). Approximately 200 mg sample of each blubber oil was added to 10 ml of 0.5 N potassium hydroxide-methanol and heated on a steam bath for several minutes. Next, 10 ml of BF_3-methanol (125 g BF_3 per liter of methanol) was added to the above sample and boiled for a few minutes under an atmosphere of nitrogen gas. Then, enough of half saturated sodium chloride solution was added to the sample to float up the methyl esters. About 30 ml of ethyl ether was added to the sample to extract the methyl esters, and the same extraction was repeated for 5 times. The ethyl ether solution was dehydrated with anhydrous sodium sulfate, and evaporated under an atmosphere of nitrogen gas on a water bath. The methyl esters obtained were refined by thin layer chromatography on silica gel (petroleum ether: ethyl ether: glacial acetic acid, 90: 10: 1).

The fatty acid component of each blubber oil was determined quantitatively by GLC of methyl esters in a Shimadzu Gas Chromatograph Model GC–1C apparatus equipped with a flame ionization detector. The columns were 1.80 m × 3 mm diameter stainless-steel tubing packed with 25% DEGS on 60/80 mesh Chromosorb W, and also 2.68 m × 3 mm diameter glass coil packed with 5% PEG on 60/80 mesh Chromosorb W. The carrier gas was nitrogen at a flow rate of 70 ml per minute for stainless-steel column and 35 ml per minute for glass coil column. The stainless-steel column was operated isothermally at 205°C, and the glass coil column was programmed from 70°C–150°C at 4°C per minute and 150°C–190°C at 8°C per minute. The injector block was at 275°C for stainless-steel column and glass coil column was injected by on-column.

The fatty acid components were identified by comparing their retention times to those of purified standards and estimated by comparing the semilog plots of retention times *vs* carbon numbers of the blubber oil methyl esters with those of known mixtures of methyl esters run on the same columns under the same conditions, according to Nelson and Freeman (1960). Also, the identification of fatty acids of odd-carbon chain lengths was checked by hydrogenation over platinum black as a catalyst.

The fatty acid component of sample oil was expressed as percentage of area to total area of all methyl esters, according to Ettre and Kabot (1963).

RESULTS AND DISCUSSION

The fatty acid component of various blubber oils of two Ganges river dolphins are listed in Tables 3 and 4. A detailed analysis of the fatty acid component of various blubber oils revealed the presence of fatty acids 5–24 carbon atoms with zero to six double bonds.

With a few exception, the fatty acid distribution in each blubber oil is nearly seemed to be the same pattern. The three main fatty acids which represented an average of more than 64.18 %(A)–68.72 %(B) of total fatty acids in each blubber oil of Ganges river dolphins are as follows; hexadecanoic acid, hexadecamonoenoic acid and octadecamonoenoic acid.

In the case of Ganges river dolphin A, oils in abdominal hind and middle back blubbers were found the presence of 37 kinds of fatty acids, but it was not find to be presence of eicosatrienoic acid in thoracic, frontal back and posterior back blubber oils, and docosatetraenoic acid in umbilicus blubber oil. The total of hexadecanoic, hexadecamonoenoic and octadecamonoenoic acids had an average of more than 64.18% of total fatty acids in all blubber oils of Ganges river dolphin A. Also, various blubber oils of Ganges river dolphin A had the large portion of total unsaturated acids (63.93–77.62%) which contained almost twice the amount of total saturated acids (22.38–36.07%). Finally, the fatty acid distribution of each blubber oil from Ganges river dolphin A was found relatively the same trend.

In the case of Ganges river dolphin B, the fatty acid component of blubber oils contained mainly hexadecanoic, hexadecamonoenoic and octadecamonoenoic acids which represented an average of more than 68.72% of total fatty acids. An amount of total saturated acids (25.46–37.65%) was almostly half of total unsaturated acids (62.35–74.54%). The oils of thoracic and umbilicus blubbers were found the presence of 36 kinds of fatty acids, and were not identified docosatetraenoic acid. Frontal back blubber oil was found the presence of 37 kinds of fatty acids. Middle back blubber oil contained 33 kinds of fatty acids and did not contain eicosapentaenoic, docosatetraenoic, docosapentaenoic and tetracosamonoenoic acids. Moreover, middle back blubber oil had very small amount of tetradecanoic acid (0.40%) compared with other blubber oils (average 6.61%) and conversely the higher amount of octadecamonoenoic acid (35.28%) more than that of other blubber oils (average 25.41%). Tail blubber oil contained 32 kinds of fatty acids with absence of eicosadienoic, eicosatrienoic, eicosapentaenoic, docosatetraenoic and tetracosamonoenoic

TABLE 3. FATTY ACID COMPONENT OF OILS CONTAINED IN VARIOUS BLUBBERS OF GANGES RIVER DOLPHIN (A).

Blubbers / Fatty acid	Thoracic blubber (%)	Umbilicus blubber (%)	Abdominal hind blubber (%)	Frontal back blubber (%)	Middle back blubber (%)	Posterior back blubber (%)
iso–5–0	0.22	tr	0.23	0.13	0.34	0.16
n–5–0	0.06	tr	0.11	0.05	0.21	tr
6–0	tr	tr	0.07	0.03	0.07	tr
8–0	0.75	0.25	0.79	0.81	0.87	0.46
10–0	0.13	tr	0.12	tr	0.22	tr
12–br*	tr	tr	tr	tr	tr	tr
12–0	1.02	0.37	1.06	0.20	0.57	0.48
12–1	0.04	tr	0.07	tr	0.13	0.10
13–0	tr	tr	0.03	tr	0.06	tr
14–br*	0.21	0.17	0.19	tr	tr	tr
14–0	5.48	5.39	7.56	6.62	4.13	4.50
14–1	2.94	1.72	1.30	1.33	1.85	3.12
14–2	1.07	0.24	0.79	1.61	1.64	1.08
15–0	0.44	0.26	0.58	0.82	0.69	0.75
16–br*	0.31	0.43	0.60	0.32	0.38	0.44
16–0	12.76	12.66	20.34	11.59	13.61	12.72
16–1	23.22	22.29	16.78	23.89	23.72	21.87
16–2	1.46	2.30	0.84	2.32	0.92	2.65
16–3	1.47	1.43	1.55	2.64	1.48	2.26
17–0	0.91	0.89	0.62	1.15	1.14	1.82
18–0	1.55	0.95	2.43	2.14	1.01	3.61
18–1	27.71	30.68	24.83	29.09	29.12	28.17
18–2	3.84	3.47	2.33	3.95	4.36	3.96
18–3	1.52	0.82	1.65	1.54	1.43	0.82
19–0	0.25	0.19	0.32	0.28	0.35	0.20
20–0	0.76	0.36	0.82	0.76	0.71	0.31
20–1	0.71	0.49	1.13	0.88	1.07	0.23
20–2	0.95	0.60	0.95	0.49	0.96	0.44
20–3	—	0.52	1.04	—	0.67	—
20–4	1.38	3.25	2.53	1.36	1.05	1.90
20–5	0.54	1.10	0.45	0.32	0.74	0.66
21–0	0.42	0.46	0.20	0.35	0.68	0.39
22–1	0.69	1.16	0.48	1.32	0.41	1.30
22–4	0.60	—	0.43	0.29	0.48	0.27
22–5	2.75	2.83	3.11	1.48	1.91	2.17
22–6	2.91	3.94	3.21	1.85	2.38	2.54
24–1	0.93	0.78	0.46	0.39	0.64	0.62
Saturated	25.27	22.38	36.07	25.25	25.04	25.84
Unsaturated	74.73	77.62	63.93	74.75	74.96	74.16

* Branched fatty acids.

TABLE 4. FATTY ACID COMPONENT OF OILS CONTAINED IN VARIOUS BLUBBERS OF GANGES RIVER DOLPHIN (B).

Blubbers / Fatty acids	thoracic blubber (%)	Umbilicus blubber (%)	Abdominal hind blubber (%)	Frontal back blubber (%)	Middle back blubber (%)	Posterior back blubber (%)
iso–5–0	0.15	0.35	0.17	tr	0.26	0.55
n–5–0	tr	0.27	0.10	tr	0.19	0.27
6–0	tr	tr	tr	tr	0.08	0.10
8–0	0.53	0.99	0.94	0.47	1.32	1.93
10–0	tr	tr	0.21	tr	0.41	0.36
12–br*	tr	tr	tr	tr	tr	tr
12–0	0.29	0.38	0.32	0.23	0.81	0.97
12–1	tr	tr	0.16	tr	0.23	0.18
13–0	tr	tr	tr	tr	0.10	0.09
14–br*	tr	0.19	0.22	tr	0.27	0.12
14–0	5.84	6.33	6.65	0.40	7.15	7.08
14–1	0.92	2.92	2.09	0.81	3.24	3.76
14–2	0.19	0.35	1.10	0.34	1.16	1.17
15–0	tr	0.31	0.53	0.15	0.43	0.41
16–br*	0.66	0.37	0.40	0.83	1.13	0.75
16–0	16.20	14.13	15.48	18.20	22.47	17.09
16–1	22.05	17.24	25.99	26.84	23.94	38.97
16–2	0.99	0.40	0.90	1.22	1.06	0.40
16–3	2.43	1.92	2.52	1.76	2.09	1.86
17–0	1.01	0.94	1.28	1.49	0.83	0.38
18–0	1.17	3.82	3.04	2.89	1.29	1.02
18–1	27.32	29.30	24.31	35.28	24.83	21.31
18–2	2.89	1.68	2.02	2.37	1.56	0.45
18–3	1.69	1.12	0.64	0.95	0.53	0.39
19–0	0.35	0.23	0.14	0.37	0.20	0.14
20–0	0.84	0.51	0.32	0.24	0.71	—
20–1	1.34	0.77	0.78	0.55	0.30	0.25
20–2	1.30	1.17	0.69	0.67	—	—
20–3	0.62	0.48	0.24	0.30	—	—
20–4	1.54	2.23	1.47	0.56	1.02	—
20–5	1.13	1.04	0.98	—	—	—
21–0	0.37	0.55	0.27	0.19	tr	—
22–1	0.85	1.29	0.73	1.28	0.52	—
22–4	—	—	0.38	—	—	—
22–5	3.13	3.61	1.56	—	0.83	—
22–6	3.44	3.90	2.45	1.61	1.04	—
24–1	0.76	1.21	0.92	—	—	—
Saturated	27.41	29.37	30.07	25.46	37.65	31.26
Unsaturated	72.59	70.63	69.93	74.55	62.35	68.74

* Branched fatty acids.

acids. Although the fatty acid component deviated from other blubber oils, there were a few exception. For example, the ratio of total unsaturated acids (62.35%) to total saturated acids (37.65%) was found to be the lower amount than that of other blubber oils, also there was a few presence of fatty acids with 20 or more carbon atoms. Finally, with the exception of melon oil, the fatty acid distribution pattern of thoracic, umbilicus, frontal back, middle back and tail blubber oils from Ganges river dolphin B was relatively followed the same trend as those from Ganges river dolphin A.

In the fatty acid component, melon oil was radically different with other blubber oils, and the levels of individual and groups of fatty acids were unique to this sample. The fatty acid component of melon oil was only 26 kinds of fatty acids. In melon oil, the most notable deviation was the high level of hexadecamonoenoic acid (38.97%), and other main fatty acids were 21.31% of octadecamonoenoic acid and 17.09% of hexadecanoic acid. On the other hand, the short chain acids (less than 17 carbon atoms) were present at high levels (76.44%) while the concentrations (23.56%) of fatty acids with more than 18 carbon atoms were considerably lower than that of other blubber oils. It was probably seemed because melon was not a blubber and was an adipose tissue on an upper jaw.

As concerned with the chemical properties, most of deviation in tail blubber oil of Ganges river dolphin B can be attributed to the high level of unsaponifiable matter (shown in Table 2) and characterized by the low level of saponification value. It was seemed that tail blubber oil had notably some unsaponifiable matters.

In comparison with oils of Ganges river dolphins in fresh water and oils of other dolphins in sea water (Table 5), they have no definite analogy on the fatty acid component. The major acids of Many toothed pilot whale and Common dolphin oils are hexadecanoic and octadecamonoenoic acids and have a low amount of hexadecamonoenoic acid which is contained as one of the main fatty acids of Ganges river dolphin oil. Moreover, Finless porpoise oil has the high amount of hexadecamonoenoic and octadecamonoenoic acids, but it has a few presence of hexadecanoic acid which is one of the main fatty acids of Ganges river dolphin oil. Viewing in comparison of saturated and unsaturated fatty acids, it is found that all dolphin oils have approximately the same distribution of ratio of total saturated and unsaturated fatty acids. The long chain acids with 20 or more carbon atoms which represented 12.50%(A) or 9.30%(B) of the total acids in Ganges river dolphin oil, are only the minor presence or are not present at all in Finless porpoise oil and Many toothed pilot whale oil. 3 kinds of short chain acids with 6 less carbon atoms are contained in Ganges river dolphin oil, however, it is not reported in Many toothed pilot whale, Finless porpoise and Common dolphin oils. It is seemed to be caused by that the analytical method was different in each experiment. The docosahexaenoic acid (10.4%) of highly unsaturated acid which is contained in Common dolphin oil, are only 2.81%(A) or 1.24%(B) of total acids in Ganges river dolphin oil.

Finally, it was seemed that Ganges river dolphin, Finless porpoise, Many toothed pilot whale and Common dolphin oils had not a completely analogical distribution pattern of fatty acid component in this study.

TABLE 5. A COMPARISON OF FATTY ACID COMPONENT OF DOLPHINS OIL.

Dolphins	Ganges river dolphins		Many toothed pilot whale[3]	Finless porpoise[4]	Common dolphin[5]
Fatty acids	A[1]	B[2]			
iso–5–0	0.18%	0.19%	—%	—%	—%
n–5–0	0.07	0.11	—	—	—
6–0	0.03	0.02	—	—	—
8–0	0.66	0.85	0.1	0.1	—
10–0	0.08	0.12	0.3	0.2	—
12–br	tr	tr	—	0.3	—
12–0	0.62	0.41	1.3	0.9	—
12–1	0.06	0.08	2.0	0.7	—
13–0	0.02	0.02	0.3	0.2	—
14–br	0.10	0.14	—	0.4	—
14–0	5.61	5.27	7.3	8.4	2.0
14–1	2.04	2.00	13.8	4.1	—
14–2	1.07	0.63	4.9	0.7	—
15–0	0.59	0.28	0.5	1.1	—
16–br	0.41	0.68	—	—	—
16–0	13.95	17.30	11.4	7.2	21.2
16–1	21.96	23.21	5.3	2.6	6.0
16–2	1.13	0.91	6.9	1.9	—
16–3	1.81	2.14	0.9	1.2	—
17–0	1.09	1.11	—	—	—
18–0	1.95	2.44	0.8	0.9	2.7
18–1	28.27	28.21	28.1	20.4	27.5
18–2	3.65	2.10	3.7	2.1	1.3
18–3	1.30	0.99	0.8	2.0	0.6
19–0	0.27	0.26	1.4	1.6	—
20–0	0.62	0.52	1.7	1.8	0.7
20–1	0.75	0.75	0.6	1.4	5.8
10–2	0.73	0.77	1.5	—	—
20–3	0.37	0.33	—	1.7	—
20–4	1.91	1.36	2.3	4.6	2.5
20–5	0.64	0.63	—	—	7.9
21–0	0.42	0.28	—	—	—
22–1	0.89	0.93	—	—	4.1
22–4	0.35	0.08	—	—	—
22–5	2.37	1.83	—	3.9	2.3
22–6	2.81	1.24	—	5.3	10.4
24–1	0.64	0.58	—	—	—
Saturated	26.64	29.99	25.1	23.1	26.6
Unsaturated	73.36	70.01	70.8	76.9	68.4

[1] Average of all blubbers.
[2] Average of blubbers without melon.
[3] Tsuyuki and Itoh (1969a).
[4] Tsuyuki and Itoh (1969b).
[5] Japan Oil Chemists' Society (1971).

SUMMARY

1. The properties of oils contained in various blubbers of two Ganges river dolphins (A and B), *Platanista gangetica*, were studied.

2. The fatty acid component of Ganges river dolphin oil was analyzed by GLC on DEGS and PEG columns.

3. The fatty acid component is as follow:

total saturated fatty acids 26.64% (average of A), 29.99% (average of B);

	A (ave.)	B (ave.)
iso-C_5	0.18%,	0.19%,
n-C_5	0.07%,	0.11%,
C_6	0.03%,	0.02%,
C_8	0.66%,	0.85%,
C_{10}	0.08%,	0.12%,
C_{12} br	tr.	tr.
C_{12}	0.62%,	0.41%,
C_{13}	0.02%,	0.02%,
C_{14} br	0.10%,	0.14%,
C_{14}	5.61%,	5.27%,
C_{15}	0.59%,	0.28%,
C_{16} br	0.41%,	0.68%,
C_{16}	13.95%,	17.30%,
C_{17}	1.09%,	1.11%,
C_{18}	1.95%,	2.44%,
C_{19}	0.27%,	0.26%,
C_{20}	0.62%,	0.52%,

total unsaturated fatty acids 73.36%(A), 70.01%(B);

	A (av.)	B (av.)
C_{12} monoenoic	0.06%,	0.08%,
C_{14} monoenoic	2.04%,	2.00%,
C_{14} dienoic	1.07%,	0.63%,
C_{16} monoenoic	21.95%,	23.21%,
C_{16} dienoic	1.13%,	0.91%,
C_{16} trienoic	1.81%,	2.14%,
C_{18} monoenoic	28.27%,	28.21%,
C_{18} dienoic	3.65%,	2.10%,
C_{18} trienoic	1.30%,	0.99%,
C_{20} monoenoic	0.75%,	0.75%,
C_{20} dienoic	0.73%,	0.77%,
C_{20} trienoic	0.37%,	0.33%,
C_{20} tetraenoic	1.91%,	1.36%,

C_{20} pentaenoic	0.64%,	0.63%,
C_{22} monoenoic	0.89%,	0.93%,
C_{22} tetraenoic	0.35%,	0.08%,
C_{22} pentaenoic	2.37%,	1.83%,
C_{22} hexaenoic	2.81%,	1.24%,
C_{24} monoenoic	0.61%,	0.58%.

4. The fatty acid component of various blubber oils was appeared relatively at the same distribution pattern.

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