Distribution of Branched-Chain Fatty Acids in Tissue and Organs of Adult, Nursling and Foetus of a Kind of Marine Little Toothed Whale, *Stenella caeruleo-alba*

Hideaki MORII

The fatty acid composition of lipids in the subcutaneous tissue, muscle and organs such as the liver of the adult, nursling and foetus whales, *Stenella caeruleo-alba* was studied. In the adult and nursling, short- and long-chain branched acids (including both iso and anteiso acids) were contained also in the muscle (body part) and organs in addition to the adipose tissue (muscle of jaw and melon parts and subcutaneous tissue). However, the acids in the muscle and organs were much less than those in the adipose tissue, and their compositions in the former differed from that in the latter. Especially, the long-chain branched acid composition in the muscle and organs was rather similar to that of fish oil. On the other hand, a fair amount of the branched-chain acids existed in the tongue and gall-bladder of the adult and nursling and in the stomach of the nursling, and thier compositions also were similar to that in the adipose tissue. In the foetus, the lipid content in the melon and jaw (corresponding to the adipose tissue in the adult and nursling) was less than 1.0% and the branched-chain acids also were scanty, although they were more than in the muscle and organs. The relative content of short- and long-chain branched acids in various kinds of adipose tissue was almost similar in both the adult and nursling.

It had been considered that both the short- and long-chain branched acids of subcutaneous tissue lipids of the whales were produced by microorganisms in the stomach like in the ruminants, since the structure of alimentary tract of the whales is similar to that of the ruminants, microorganisms were isolated from the stomach of the whales (Morii, 1972, 1973, and 1979b), and free volatile fatty acids were detected in the stomach fluid (Morii and Kanazu, 1972b). However, microorganisms were not constantly existent in the stomach of the living whales. Moreover, the viable counts were only 10^3 to 10^4/ml in the stomach fluid. The free volatile acid content in the stomach fluid was extremely low as compared with that of the ruminants (Morii, 1979b) and the long-chain branched acid composition of lipids in the bacterial fraction of the stomach contents also differed from that of subcutaneous tissue lipids of the whales (Morii, 1979c). In view of these findings, the previously proposed mechanism of the branched-chain acids of subcutaneous tissue lipids described above was denied and it was considered that branched-chain acids (including both the short- and long-chain branched acids) must be biosynthesized in the tissue or organs of the living whales.

To study the origin and the function of branched-chain acids, a method using trac-

er is most desirable, but actually it is impracticable in large marine animals. Therefore, an investigation with respect to the distribution of branched−chain acids in the tissue and organs of the whales firstly aimed and the origin and the function were estimated through the results obtained. In the previous paper (Morii and Kanazu, 1972a), the authors reported that a large amount of branched−chain acids was contained in subcutaneous tissue lipids of the foetus, nursling and adult whales. In this experiment, the fatty acid composition (including short− and long−chain acids) of lipids of the muscle, liver and other organs in addition to subcutaneous tissue of the three generations was studied and the site of biosynthesis, origin and function of branched−chain acids were discussed through the results obtained. It was presumed that the distribution of branched−chain acids in the subcutaneous tissue of the whales which is formed in several layers might vary by layer, and therefore, the analyses was carried out for each layer. The fatty acid composition of lipids in each layer of the melon has already been reported (Wedmid et al., 1973).

Materials and Methods

Animals. The whales used for the experiment were an adult (235 cm, female), a foetus (39 cm, 728 g) obtained from this adult, and a nursling (111 cm, female) of a kind of *Stenella caeruleo−alba* which were caught alive at Kawana Bay in Ito City of Izu Peninsula, Japan in the latter part of October, 1971.

Sections. The subcutaneous tissue, muscle and organs (including a part of tissue) were used for the experiment. The subcutaneous tissue was obtained from three

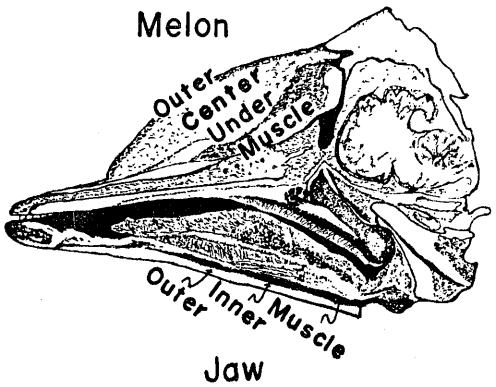

Fig. 1. Section of head of the whale

parts, namely, melon, jaw and blubber. In the adult, the subcutaneous tissue was separated into outer, center and under layers for the melon (Fig. 1), and into outer and inner layers for the jaw and blubber. The inner layer of the blubber is a film−like layer and it differs from that of the melon and jaw. In the nursling, the melon was separated into outer and inner layers (the inner layer corresponds to lump part of center and under layer in the adult) but the jaw and blubber were analysed in the lump without separation (The inner layer of the blubber was very little. The majority of subcutaneous tissue in the jaw was occupied by outer layer and therefore it should be regarded as the outer in the adult). In the foetus, all of the melon, jaw and blubber had not been differentiated as adipose tissue. The muscle was obtained from the melon, jaw and body (dorsal) parts for the adult and from the body part for the nursling and foetus. As other tissue and organs, the peritoneum, tongue, alimentary cannal, liver, pancreas, gall−bladder, kindney, heart, lung and navel string were used but the lung for the nursling and the gall−bladder and kidney for the foetus were excluded. The alimentary cannels were divided into the I st, II nd and III rd stomachs and intestine (including the IV th stomach) in the

adult and the nursling but all the stomachs and intestine were regarded as a lump section in the foetus.

Extraction of lipids. Lipids were extracted with chloroform–methanol following the method of Bligh and Dyer (1959).

Analyses of lipids. The standard methods were used for determination of saponification value, iodine value, Reichert–Meissel value and unsaponifiable content. The method of Liebermann–Burchardt was used for determination of a mixture of bound and free cholesterols.

In the foetus, the analyses of lipids were not carried out owing to the small quantity of the sample.

Preparation of short–chain acids. The salt solution of the short–chain acids obtained through determination of Reichert–Meissel value was dried *in vacuo*. The dried matter was acidified with a small quantity of 1N–H_2SO_4 and the short–chain acids liberated were extracted several times with diethyl ether. The other solution was dehydrated with anhydrous Na_2SO_4 and then filtrated. The short–chain acids obtained by evaporating diethyl ether from the filtrate at room temperature were analysed by gas–liquid chromatography.

In the foetus, the analysis of short–chain acids was not performed owing to the insufficient lipids available.

Preparation of methyl esters of long–chain acids. The fatty acids obtained by removing unsaponifiable matters from lipids by the standard method were esterized with 10% BF_3–methanol solution under N_2 flow.

Hydrogenation of methyl esters of long–chain acids. The methyl esters were fully hydrogenated using 5% Pd–carbon catalyst in anhydrous methanol under atmospheric pressure.

Gas–liquid chromatography of short–chain acids. Short–chain acids were analysed by gas–liquid chromatograph (Yanagimoto Gas–Liquid Chromatograph, model GCG–1) equipped with a thermal conductivity detector. Helium was used as carrier gas at an inlet gauge pressure of 0.8 Kg per square cm. The injector and detector temperatures were 240 and 210°C, respectively. Chromatography was conducted on a column consisting of the stainless–steel spiral tubing (3 m, 2.2 mm–inside diameter) packed with 20% tween 20 on diasolid S, 80 to 100 mesh. The column temperature was 165°C.

Identification of each peak on chromatogram was performed by comparison with the standards purchased (In addition, 2–methyl butyric acid was not separable from isovaleric acid due to overlapping peaks on the chromatogram).

Gas–liquid chromatography of long–chain acids. Long–chain acid methyl esters were analysed by gas–liquid chromatograph (Yanagimoto Gas–Liquid Chromatograph, model GCG–500) equipped with a hydrogen flame detector. Helium was used as carrier gas at a flow rate of 20 ml per min. The flow rate of hydrogen was 40 ml per min. The detector temperature was 200°C. Chromatography was conducted on both polar columns consisting of the copper spiral tubing (4m, 4 mm–i.d.) packed with 5% ethylene glycol adipate polyester (EGA) on Chamelite FS, 40 to 60 mesh, and on nonpolar columns consisting of the copper spiral tubing (2 m, 4 mm–i.d.) packed with 5% Apiezon grease L (APL) on Celite 545, 80 to 100 mesh. The EGA column was operated at 185 °C and the APL column at 200°C.

Identification of each peak on chromatogram was performed by comparison with the data presented in the previous paper (Morii and Kanazu, 1979a; Morii, 1974, 1979a,

and 1979c), the standards purchased, and retention time, ECL (equivalent chain length) and FCL (fractional equivalent chain length) shown by Ackman et al. (1963).

Results

The lipid content of tissue and organs in the adult, nursling and foetus is shown in Tables 1-3 and the chemical characters of lipids obtained from the adult and nursling are shown in Tables 1 and 2.

In the adult, the lipid content, in comparison among the layers in each part of subcutaneous tissue, was higher in the inner layer (center plus under layers in the melon) than in the outer layer for the melon and jaw but in the outer layer than in the inner layer for the blubber. Within the inner melon, it was higher in the center layer than in the under layer. In comparison among the parts of subcutaneous tissue in each layer, the content was much higher in the melon than in the jaw and blubber for the inner layer, though any considerable difference was not recognized among the three parts for the outer layer. As for the muscle, the content was low in the body part but extreamely high in the melon and jaw parts. As for other tissue and organs, the content was low in all the tissue and organs, and especially low in the stomachs except the II nd stomach and intestine.

The short-chain acid content (namely, Reichert-Meissel value) of subcutaneous tissue lipids in the adult in comparison among the layers in each part was higher in the inner layer than in the outer layer for the melon and jaw but in the outer layer than in the inner layer for the blubber. Within the inner melon, it was

Table 1. Character of lipids of tissue and organs in the adult whale, *Stenella caeruleo-alba*.

Character \ Sample	Outer melon	Center melon	Under melon	Muscle (melon)	Outer jaw	Inner jaw	Muscle (jaw)	Outer blubber	Inner blubber	Muscle (dorsal)	Peritoneum
Oil content (%)	56.1	87.7	72.0	17.9	44.3	51.3	14.5	49.3	8.3	1.2	0.8
Saponification value	282.3	334.0	314.1	296.7	263.1	267.4	286.4	237.2	216.6	169.6	156.3
Iodine value (wijs)	68.1	11.7	23.7	29.6	109.9	88.6	81.2	135.4	133.4	130.4	121.6
Unsaponifiable matters(%)	1.2	19.9	8.2	13.8	0.9	12.9	2.4	0.3	1.3	2.0	2.3
Sterols/Unsaponifiable matters(%)	20.1	0.5	1.4	2.3	20.8	0.3	15.9	50.8	17.4	60.4	69.8
Reichert-Meissel value	84.1	180.8	150.3	132.2	47.9	54.8	69.7	22.0	7.0	2.3	5.7
SCFA*/SCFA plus LCFA** (weight %)	16.2	39.1	32.3	28.7	8.7	9.8	12.5	3.9	/	0.5	1.5
(mole %)	33.4	60.7	53.7	50.0	20.4	23.0	27.3	10.4	3.6	1.5	4.1

	Tongue	Stomach			Intestine	Liver	Pancreas	Gallbladder	Kidney	Heart	Lung
		Ist	IInd	IIIrd							
Oil contents (%)	2.8	1.2	2.5	1.3	1.2	3.7	2.3	2.2	3.2	2.4	2.1
Saponification value	227.3	216.1	190.0	199.2	157.4	188.7	149.0	242.1	172.1	175.5	173.2
Iodine value (wijs)	82.1	99.0	102.5	96.5	118.5	137.5	127.1	80.9	125.0	114.7	113.2
Unsaponifiable matters(%)	7.3	12.6	6.3	3.1	5.2	2.5	4.1	11.4	1.7	2.3	9.3
Sterols/Unsaponifiable matters(%)	31.4	83.0	54.9	96.0	90.8	84.4	91.2	16.3	72.1	73.1	27.1
Reichert-Meissel value	47.8	15.0	8.7	12.4	4.8	5.8	2.2	25.0	5.1	7.2	5.4
SCFA*/SCFA plus LCFA** (weight %)	9.1	4.6	1.8	2.6	1.3	1.6	0.6	4.7	1.3	1.7	1.4
(mole %)	23.6	7.8	5.1	7.0	3.4	3.5	1.7	11.6	3.3	4.6	3.5

*Short-chain fatty acids. **Long-chain fatty acids.

Table 2. Character of lipids of tissue and organs in the nursling whale, *Stenella caeruleo−alba*.

Character \ Sample	Outer melon	Inner melon	Jaw	Blubber	Muscle	Peri-toneum	Tongue	Stomach			Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart
								Ist	IInd	IIIrd						
Oil content (%)	38.5	71.0	34.9	22.6	2.4	1.0	1.1	1.0	1.8	1.1	1.8	4.4	8.0	1.7	10.6	1.2
Saponification value	248.6	319.4	243.9	215.6	176.3	191.5	214.7	218.8	202.8	214.7	204.4	200.9	197.9	227.6	198.1	190.7
Iodine value (wijs)	52.2	19.5	71.2	102.1	100.6	/	/	/	/	/	/	106.2	103.1	/	107.1	/
Unsaponifiable matters(%)	5.7	21.0	2.4	1.2	14.2	7.4	4.6	21.2	7.6	12.3	6.7	3.4	3.4	3.5	4.8	3.9
Sterols/Unsaponifiable matters(%)	2.9	0.4	3.0	21.0	44.0	62.8	36.7	17.1	34.2	40.0	72.0	82.5	25.1	44.1	42.5	47.9
Reichert-Meissel value	88.8	113.4	74.6	36.9	4.1	7.4	20.5	38.0	20.1	38.2	8.2	3.5	5.1	69.0	3.2	3.6
SCFA*/SCFA plus LCFA** (weight %)	20.3	21.2	16.4	7.8	0.9	1.6	4.2	8.3	4.5	2.8	1.7	0.7	1.3	1.3	0.7	0.6
(mole %)	40.1	39.8	34.3	19.2	2.6	4.3	10.7	19.5	11.1	7.2	4.5	2.0	2.9	3.4	1.8	1.9

*Short−chain fatty acids. **Long−chain fatty acids.

Table 3. Oil content (%) of the foetus whale, *Stenella caeruleo−alba*.

Melon	Jaw	Blubber	Muscle	Tongue	Stomach Intestine	Liver	Pan-creas	Heart	Lung
0.78	0.83	0.76	0.57	1.32	1.11	1.67	1.24	1.23	0.92

higher in the center layer than in the under layer. These trends corresponded with those of lipid content. In comparison among the parts of subcutaneous tissue in each layer, the short−chain acid content was higher in the melon than in the jaw and blubber and in the jaw than in the blubber for both the outer and inner layers. That is, these trends did not always correspond with those of lipid content. As for the muscle, the content was extremly low in the body part but remarkably high in the melon and jaw parts, like in the case of subcutaneous tissue. As for other tissue and organs, the content was higher in the tongue, stomachs and gall−bladder than in other tissue and organs, and especially in the tongue and gall−bladder, it was higher than that in the blubber.

The unsaturated acid content (namely, iodine value) of each lipid in the adult was recognized in an inverse trend to the short-chain acid content. In the inner layer of the melon and jaw, the unsaponifiable matters were remarkably high but the cholesterol content was extremely low. It was considered that the majority of unsaponifiable matters was fatty alcohols.

In the nursling, the content and the characters of tissue and organ lipids showed almost similar trends to the adult. Especially the trend in the adult that the short-chain acid content showed considerably high value in the tongue, stomachs and gall−bladder where the lipid content was little, was more obvious in the nursling.

In the foetus, the lipid content of the melon, jaw and blubber was less than 1%, indicating that the adipose tissue was not formed yet.

The short−chain acid composition of tissue and organ lipids in the adult and nursling is shown in Tables 4 and 5.

In the adult, short−chain acids in the subcutaneous tissue of the melon, jaw and blubber, in the muscle of the melon and jaw parts, and in the tongue were composed of those with carbon number under 5. Moreover, the short−chain acids were mostly branched−chain acids. Isobutyric acid in addition to isovaleric acid also was recognized, though it was little. Isobutyric acid was more and isovaleric acid was less in the jaw and blubber than in the melon. In the stomach, intestine, gall−bladder

Table 4. Short−chain fatty acid composition (Weight %) of lipids of tissue and organs in the adult whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Center melon	Under melon	Muscle (melon)	Outer jaw	Inner jaw	Muscle (jaw)	Outer blubber	Inner blubber	Muscle (dorsal)	Peri-toneum
2:0	0.13	0.25	tr	0.19	0.08	0.11	0.38	0.41	/	2.20	2.66
3:0	tr	tr	tr	tr	tr	0.09	0.28	0.41	/	0.78	0.09
iso- 4:0	3.13	2.40	2.62	2.96	4.65	5.61	4.14	4.07	/	2.62	3.54
n- 4:0	tr	tr	tr	0.42	0.31	0.68	0.74	1.23	/	2.76	2.07
iso- 5:0	96.74	97.35	97.38	96.43	94.96	93.51	94.46	93.88	/	86.16	86.65
n- 5:0	tr	tr	tr	tr	tr	tr	tr	tr	/	0.93	1.59
iso- 6:0										1.14	0.56
n- 6:0				not detected C_6 to C_{10}						tr	nd
iso- 7:0										4.42	0.73
n- 7:0										nd	1.29
										not detected C_8 to C_{10}	
iso (total)	99.87	99.75	100.00	99.39	99.61	99.12	98.60	97.95	/	93.34	91.48

Fatty acid \ Sample	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart	Lung
2:0	0.29	2.09	2.41	2.38	1.43	1.38	5.26	4.12	4.99	4.69	4.45
3:0	0.07	0.27	1.35	1.64	0.24	2.22	3.25	0.35	1.74	1.35	1.14
iso- 4:0	2.39	3.65	3.44	2.73	2.14	3.53	4.01	1.08	8.02	5.29	2.22
n- 4:0	1.05	0.77	2.18	3.43	0.59	4.27	2.58	0.47	5.92	8.69	2.93
iso- 5:0	95.47	90.43	74.97	61.27	87.75	16.16	50.65	58.10	30.18	33.95	49.75
n- 5:0	0.74	1.23	3.21	2.30	0.23	7.25	3.25	1.58	3.74	2.27	1.96
iso- 6:0	nd	0.26	1.05	1.65	0.91	1.16	2.69	3.86	2.36	2.65	2.59
n- 6:0	nd	0.71	4.47	2.82	tr	10.36	15.31	8.17	8.03	9.91	5.21
iso- 7:0	nd	0.21	1.91	4.79	4.61	6.00	1.65	7.86	1.64	2.24	2.22
n- 7:0	nd	0.38	5.03	7.56	2.10	5.83	11.36	7.82	2.82	2.51	4.49
iso- 8:0	nd	nd	nd	1.24	nd	1.97	/	1.20	1.53	1.84	1.18
n- 8:0	nd	nd	nd	8.19	nd	5.59	/	5.39	8.47	9.72	3.60
iso- 9:0	nd	nd	nd	nd	nd	2.91	/	nd	1.67	tr	tr
n- 9:0	nd	nd	nd	nd	nd	14.76	/	nd	9.24	2.96	3.60
iso-10:0	nd	nd	nd	nd	nd	1.81	/	nd	tr	tr	tr
n-10:0	nd	nd	nd	nd	nd	13.93	/	nd	9.56	11.93	14.65
iso (total)	98.04	94.55	80.83	71.68	94.93	33.98	59.00	72.10	45.40	45.97	57.96

tr: trace.

Table 5. Short−chain fatty acid composition (Weight %) of lipids of tissue and organs in the nursling whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Inner melon	Jaw	Blubber	Muscle	Peri-toneum	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart
2:0	0.27	0.33	0.28	1.35	5.56	10.46	1.95	2.35	3.22	1.51	4.99	4.30	4.01	2.51	7.00	3.98
3:0	0.12	0.14	0.04	0.41	0.78	1.73	0.74	0.41	0.49	0.44	0.12	1.68	1.21	0.81	1.51	1.19
iso- 4:0	10.19	9.57	11.60	13.54	9.97	12.72	7.88	12.60	9.12	8.67	1.09	2.40	9.88	9.57	12.13	10.15
n- 4:0	2.10	0.54	2.47	6.43	1.84	5.02	2.54	0.56	0.99	1.73	1.21	5.59	10.19	0.78	10.96	6.98
iso- 5:0	86.77	89.13	85.47	77.33	79.81	67.90	85.74	83.57	84.17	87.65	82.76	55.04	71.27	85.11	64.27	76.16
n- 5:0	tr	0.29	0.12	0.31	0.28	0.64	0.34	0.50	tr	tr	tr	8.85	0.32	0.54	1.74	0.50
iso- 6:0	0.17	nd	nd	0.21	0.68	0.62	1.43	nd	nd	nd	nd	1.97	0.20	0.36	0.38	tr
n- 6:0	0.38	nd	nd	0.42	1.08	0.90	0.67	nd	2.00	nd	nd	20.17	2.92	0.32	2.00	1.04
iso (total)	97.13	98.70	97.07	91.08	90.46	81.24	95.05	96.34	93.29	96.32	83.85	59.41	81.35	95.04	76.78	86.31

tr : trace. nd : not detected under the condition employed.

and muscle (body part), the fatty acids with carbon number 7 or 8 which were mainly isovaleric acid also were found.

Other branched−chain acids as isobutyric, isocaproic, isoenanthic or isocaprylic acids were detected though in a small quantity. In the other tissue and organs than those mentioned above, fatty acids with carbon number 2 to 10 were observed, and the percentage of the branched−chain acids in which isovaleric acid showed the maximum chromatographic value was much less being nearly half as compared with that in the above mentioned tissue or organs.

As mentioned above, the majority of short-chain acids in the adult was composed of branched-chain acids, which showed the same tendency in distribution as the short-chain acids. Thus the distribution of short-chain branched acids may be explained accordingly.

In the nursling, the majority of short-chain acids in the subcutaneous tissue (melon, jaw and blubber), tongue, stomachs and gall-bladder was composed of isovaleic and isobutyric acids like in the adult. However, isobutyric acid showed higher values than in the adult. In the muscle and intestine, short-chain acids showed a similar composition. In the other tissue and organs n-butyric acid was more and isovaleric acid was less as compared with the above mentioned tissue and organs.

The long-chain acid composition of tissue and organ lipids of the adult, nursling and foetus is shown in Tables 6-9.

In the adult, long-chain branched acid content, in comparison among the layers in each part of subcutaneous tissue, was higher in the inner layer than in the outer layer for all of the melon, jaw and blubber and in the outer layer than in the under layer for the inner melon. In comparison among the parts of subcutaneous tissue in each layer, the content in the outer and inner layer was much higher in the melon than in the jaw and blubber. Between the jaw and the blubber, the value was higher in the former. The content was very little in the outer blubber. As for the muscle, the content was very low in the body part but was very high in the melon and jaw parts, that is, the melon muscle showed a higher value than the outer melon and the jaw muscle showed a higher value than the inner and outer layers of the jaw. In the tongue, stomachs except for the II nd stomach, and gall-bladder, long-chain branched acids were recognized at almost the same level as in the outer blubber, though they were far less in other organs including the liver. That is, these trends were similar to that in short-chain branched acids.

With respect to the long-chain branched acid composition in the adult, the content of both odd-numbered iso and anteiso acids with maximum carbon number of 15 and under 13 was relatively high in the subcutaneous tissue and muscle of the melon and jaw parts and in the inner blubber where the branched-chain acids existed abundantly. Among the even-numbered iso acids, iso-16:0 and iso-14:0 were remarkably frequent and fewer iso-under 12:0 was also observable. In comparison of content by part between odd- and even-numbered iso acids, odd-numbered iso acids were more in the subcutaneous tissue of the melon, and in the muscle of the melon part and the inner blubber but conversely even-numbered iso acids were more in the subcutaneous tissue and muscle of the jaw part. In all of these parts, iso-15:0 was the most abundant branched-chain acids. As for odd-numbered iso acids in the muscle of the body parts and organs including the liver where branched-chain acids were little, iso-17:0 was more than iso-15:0 and iso-13:0 or under was scarcely recognized. As for even-numbered iso acids in these parts, iso-18:0 was more than iso-16:0 and iso-14:0. Anteiso acids were scarcely recognized.

With respect to long-chain straight acids in the adult, saturated acids were very little, and under n-15:0 was more (especially, n-14:0 was very much) but conversely above n-16:0 was less (especially, n-18:0 was very little) in the subcutaneous

Table 6. Long–chain fatty acid composition (Weight %) of lipids of adipose tissue and muscle in the adult whale, *Stenella caeruleo–alba*.

Fatty acid \ Sample	Outer melon	Center melon	Under melon	Muscle (melon)	Outer jaw	Inner jaw	Muscle (jaw)	Outer blubber	Inner blubber	Muscle (dorsal)	Peri-toneum
iso-10:0	0.04	0.15	0.07	0.10	0.05	0.06	0.11	tr	0.06	0.04	0.06
n-10:0	0.18	0.11	0.09	0.16	0.14	0.20	0.25	0.07	0.20	0.08	0.09
iso-11:0	0.24	0.65	0.58	0.54	0.14	0.22	0.28	0.05	0.25	0.04	0.06
anteiso-11:0	0.04	0.03	0.05	0.04	0.04	0.05	0.06	0.02	0.05	nd	0.01
n-11:0	0.06	0.02	0.02	0.02	0.03	0.06	0.05	0.04	0.02	tr	0.01
A(12):0	nd	0.02	0.02	0.02	0.01	0.01	0.02	tr	0.02	nd	nd
iso-12:0	0.41	0.75	0.82	0.79	0.30	0.48	0.55	0.07	0.35	tr	0.01
n-12:0	0.79	0.50	0.75	0.70	0.63	0.85	0.77	0.39	0.77	0.33	0.11
A(13):0	0.18	0.52	0.55	0.85	0.13	0.26	0.75	0.14	0.52	nd	0.11
iso-13:0	0.64	2.62	2.18	1.58	0.23	0.38	0.49	0.05	0.40	0.03	0.02
anteiso-13:0	0.21	0.31	0.26	0.35	0.14	0.23	0.18	0.03	0.15	tr	nd
n-13:0	0.19	0.14	0.22	0.17	0.15	0.16	0.13	0.09	0.13	tr	0.27
A(14):0	nd	nd	0.01	nd	nd	tr	tr	tr	tr	0.09	nd
C(14):0	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.04	nd
iso-14:0	2.12	11.78	7.54	5.70	0.97	1.47	1.70	0.18	1.24	0.13	0.17
n-14:0	5.75	8.15	9.43	9.49	4.04	5.67	6.99	4.06	6.42	1.32	1.04
A(15):0	0.08	0.16	0.12	0.12	nd	nd	0.06	0.05	nd	nd	0.05
iso-15:0	4.05	28.74	18.62	13.00	1.42	2.11	2.48	0.40	2.57	0.22	0.15
anteiso-15:0	0.79	3.13	1.95	1.34	0.38	0.50	0.80	0.14	0.68	0.17	nd
n-15:0	0.63	0.84	0.86	1.12	0.59	0.73	0.90	0.47	0.86	0.39	0.20
A(16):0	0.10	0.44	0.51	0.14	nd	nd	nd	nd	nd	nd	nd
C(16):0	nd	nd	nd	nd	nd	nd	nd	nd	0.61	4.42	4.40
iso-16:0	2.21	12.62	8.72	5.22	0.85	1.23	1.35	0.22	0.89	0.20	0.14
n-16:0	6.61	9.03	12.78	13.57	5.58	9.43	14.53	8.62	16.58	15.66	12.49
B(17):0	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.09	0.43
iso-17:0	0.41	0.86	0.99	0.56	0.26	0.29	0.30	0.30	0.27	0.19	0.20
anteiso-17:0	0.16	0.44	0.40	0.41	0.16	0.16	0.19	0.14	0.08	nd	nd
n-17:0	0.07	0.75	0.69	0.74	0.36	0.38	0.61	0.44	0.62	0.94	0.87
A(18):0	nd	nd	0.16	nd	nd	nd	nd	nd	nd	nd	nd
C(18):0	nd	nd	nd	0.38	nd	nd	0.34	0.31	0.44	2.24	2.93
iso-18:0	0.26	0.18	0.49	0.18	0.42	0.21	0.20	tr	0.20	0.18	0.30
n-18:0	0.77	0.23	0.56	1.26	0.99	1.09	1.99	1.72	4.22	9.46	11.58
iso-19:0	tr	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.18
n-19:0	nd	nd	nd	tr	nd	tr	nd	tr	tr	0.14	0.07
C(20):0	nd	nd	nd	nd	nd	nd	nd	nd	0.09	nd	nd
n-20:0	0.17	0.16	0.21	0.23	0.32	0.30	0.25	0.39	0.29	0.20	0.21
n-22:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.15
Total saturated	27.16	83.33	69.65	58.78	18.33	26.53	36.13	18.39	39.25	36.60	36.31
iso (total)	10.38	58.35	40.01	27.67	4.64	6.45	7.46	1.27	6.23	1.03	1.28
anteiso (total)	1.20	3.91	2.66	2.14	0.72	0.94	1.23	0.33	0.96	0.15	0.01
10:1	0.07	0.13	0.03	0.10	0.01	0.01	nd	nd	nd	nd	nd
11:1	0.09	0.08	0.05	nd	nd	nd	nd	nd	nd	nd	nd
A(12):1	nd	0.07	0.05	0.08	0.01	0.02	0.05	nd	tr	nd	nd
12:1	0.34	tr	0.11	0.16	0.20	0.22	0.08	0.09	0.13	nd	nd
13:1	nd	nd	0.04	0.10	0.04	nd	nd	nd	nd	nd	nd
14:1	1.24	0.77	0.26	0.26	0.61	0.69	0.41	0.38	0.75	0.14	0.09
14:1	2.58	tr	0.37	1.54	2.69	1.63	0.64	1.38	0.61	tr	0.12
15:1	0.25	tr	0.24	0.20	0.29	0.07	0.21	0.17	0.26	tr	0.27
16:1	21.88	6.41	10.41	13.49	20.54	18.91	14.30	13.63	10.67	3.50	3.09
B(17):1	0.65	0.27	0.44	0.57	0.67	0.56	0.70	0.66	0.56	0.14	0.37
17:1	0.79	0.37	0.43	0.70	1.18	0.87	0.73	0.69	0.92	0.31	0.27
18:1	29.66	6.30	14.07	17.04	34.31	32.90	31.70	36.96	30.54	28.03	30.54
19:1	0.16	0.04	0.07	0.12	0.28	0.23	0.20	0.34	0.26	0.31	0.29
20:1	3.99	0.35	0.84	1.74	5.27	4.36	3.95	8.50	3.34	2.95	3.03
21:1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.03
22:1	1.43	0.17	0.35	0.75	2.25	1.82	1.67	3.89	1.42	1.86	1.54
Total monoene	63.13	14.96	27.76	36.85	68.35	62.29	54.84	66.69	49.46	37.24	39.64
12:2 ω ?	0.08	0.04	0.05	nd	0.16	0.04	0.02	0.07	0.02	nd	nd
16:2 ω 4	0.44	0.11	0.15	0.39	nd	0.24	0.36	0.33	0.39	0.08	0.09
16:3 ω ?	0.05	0.10	0.05	tr	0.08	0.22	tr	tr	0.21	1.39	1.51
16:4 ω 3	0.26	0.08	0.14	0.16	0.45	0.38	0.29	tr	tr	nd	nd
18:2 ω 6	0.84	0.20	0.48	0.59	1.07	1.01	0.95	1.11	0.92	1.15	1.34
18:2 ω 4	0.02	0.10	0.02	tr	0.05	nd	tr	tr	0.04	tr	0.04
18:3 ω 6	nd	nd	nd	tr	nd	nd	tr	tr	tr	0.05	0.05
18:3 ω 3	0.17	0.10	0.16	0.25	1.13	0.51	0.43	0.60	0.43	0.39	0.38
18:4 ω 3	0.11	0.03	0.03	0.11	0.13	0.17	0.16	0.33	0.12	0.10	0.09
20:2 ω 6	0.07	0.03	0.03	0.08	0.07	0.08	0.09	0.09	0.07	0.04	0.06
20:3 ω 9	0.07	nd	0.03	0.05	0.10	0.11	0.09	0.19	0.09	0.15	0.12
20:3 ω 6	0.13	nd	0.03	0.06	0.07	0.10	0.07	0.11	0.13	0.19	0.17
20:4 ω 6	0.85	0.09	0.16	0.59	1.05	0.77	0.86	1.02	2.21	5.54	5.57
20:4 ω 3	0.36	0.07	0.08	0.19	0.49	0.56	0.36	0.74	0.22	0.47	0.25
20:5 ω 3	1.97	0.16	0.36	0.10	2.46	2.25	1.86	2.70	2.37	6.34	5.36
21:5 ω 2	0.16	0.05	0.15	0.13	0.20	0.25	0.25	0.41	0.42	0.35	0.48
22:3 ω 6	0.06	nd	nd	tr	tr	nd	nd	nd	tr	nd	0.01
22:4 ω 6	0.17	nd	nd	tr	0.19	0.23	0.15	0.43	0.15	0.17	0.18
22:5 ω 6	0.14	nd	0.06	tr	0.21	0.24	0.17	0.42	0.22	0.28	0.22
22:5 ω 3	0.87	0.20	0.17	0.47	1.19	0.92	0.57	1.46	0.73	1.12	0.95
22:6 ω 3	2.89	0.35	0.44	1.20	4.22	3.10	2.35	4.91	2.55	8.35	7.18
Total polyene	9.71	1.71	2.59	4.37	13.32	11.18	9.03	14.92	11.29	26.16	24.05

tr : trace. nd : not detected under the condition employed.
A–C : unknown. The same alphabets signify identical FCL.

Table 7. Long-chain fatty acid composition (Weight %) of organs in the adult whale, *Stenella caeruleo-alba*.

Fatty acid \ Sample	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intestine	Liver	Pancreas	Gallbladder	Kidney	Heart	Lung
iso-10:0	nd	0.04	0.03	0.04	0.04	0.04	0.04	0.17	0.03	0.04	0.04
n-10:0	0.04	0.09	0.08	0.07	0.08	0.10	0.06	0.32	0.08	0.07	0.06
iso-11:0	0.03	0.09	0.10	0.09	0.05	0.07	0.05	0.17	0.05	0.02	nd
anteiso-11:0	nd	tr	tr	tr	tr	0.03	tr	0.05	nd	nd	nd
n-11:0	tr	0.03	0.02	0.02	0.03	0.03	tr	0.05	nd	0.01	nd
C(12):0	nd	0.03	0.02	tr	nd	nd	tr	0.05	nd	nd	nd
iso-12:0	0.03	0.04	0.02	tr	0.02	0.03	tr	0.05	nd	0.01	nd
n-12:0	0.18	0.04	0.04	0.08	0.09	0.05	0.04	0.14	0.12	0.12	0.05
A(13):0	0.20	0.27	0.05	0.12	0.12	0.05	0.12	0.07	0.23	0.30	0.07
iso-13:0	0.04	0.07	0.01	0.02	0.02	nd	tr	0.04	nd	nd	nd
anteiso-13:0	tr	0.03	tr	0.01	tr	nd	nd	tr	nd	nd	nd
n-13:0	0.04	0.03	tr	0.03	0.01	tr	tr	0.15	0.10	0.12	0.25
C(14):0	nd	nd	0.24	nd	nd	nd	nd	0.04	nd	nd	0.04
iso-14:0	0.20	0.29	tr	0.22	0.13	0.08	0.06	0.35	0.10	0.09	0.08
n-14:0	4.78	2.04	0.63	1.23	1.30	1.44	1.08	1.23	2.17	2.44	1.76
A(15):0	nd	nd	nd	0.04	0.04	0.05	0.03	0.06	0.04	0.07	0.05
B(15):0	nd	nd	nd	nd	nd	nd	tr	nd	nd	0.08	nd
iso-15:0	0.54	0.37	0.06	0.18	0.15	0.12	0.09	0.14	0.11	0.15	0.15
anteiso-15:0	0.03	0.07	0.04	0.09	0.08	nd	nd	0.05	nd	0.07	0.06
n-15:0	0.45	0.32	0.19	0.30	0.33	0.28	0.31	0.33	0.34	0.33	0.57
C(16):0	nd	1.37	0.77	1.55	1.09	0.14	1.06	1.34	1.80	2.55	1.55
iso-16:0	0.25	0.40	0.15	0.31	0.26	0.13	0.21	0.17	0.19	0.18	0.15
n-16:0	12.82	15.73	16.08	15.77	16.19	12.77	20.83	18.68	15.35	14.68	24.65
iso-17:0	0.25	0.13	0.20	0.26	0.27	0.25	0.24	0.30	0.19	0.24	0.18
anteiso-17:0	0.13	tr	0.11	tr	0.13	0.13	nd	nd	nd	0.10	0.11
n-17:0	0.76	0.89	0.70	0.78	0.81	0.99	0.76	0.81	0.88	0.88	0.72
C(18):0	nd	2.22	1.09	2.54	1.66	0.14	1.26	1.63	0.97	1.18	1.11
iso-18:0	0.24	0.20	0.17	0.29	0.16	0.23	0.30	0.47	0.29	0.23	0.23
n-18:0	3.18	12.40	11.27	12.83	12.86	17.68	10.35	12.65	9.16	9.11	11.17
iso-19:0	0.04	tr	0.08	tr	nd	0.07	0.08	0.15	0.08	0.03	0.08
n-19:0	0.12	0.10	0.15	0.09	0.14	0.22	0.12	0.13	0.09	0.18	0.11
C(20):0	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	0.02	nd	nd	nd	nd	nd	nd	nd	nd	0.08	nd
n-20:0	0.04	0.43	0.75	0.52	0.81	0.34	0.43	0.68	0.53	0.38	0.48
n-22:0	tr	0.20	0.48	0.18	0.36	nd	0.16	0.25	0.36	tr	0.36
A(23):0	nd	nd	0.17	tr	0.12	nd	nd	nd	nd	nd	nd
A(24):0	nd	nd	0.40	nd	0.17	nd	nd	nd	nd	nd	nd
Total saturated	24.80	37.92	34.10	37.66	37.52	35.46	37.68	40.72	33.26	33.74	44.08
iso (total)	1.64	1.63	0.82	1.41	1.10	1.02	1.07	2.01	1.04	1.07	0.91
anteiso (total)	0.16	0.10	0.15	0.10	0.21	0.16	nd	0.10	nd	0.17	0.17
A(12):1	0.03	0.07	nd	nd	nd	nd	nd	nd	nd	nd	nd
A(13):1	nd	nd	nd	nd	nd	nd	nd	nd	0.06	0.02	nd
14:1	0.08	0.13	tr	0.02	0.06	tr	nd	0.01	0.03	0.03	nd
14:1	0.32	0.18	nd	nd	nd	0.20	0.05	0.03	0.09	0.08	nd
15:1	0.02	0.04	tr	tr	tr	nd	nd	0.17	0.12	0.10	0.20
16:1	6.51	4.97	4.27	3.51	3.57	5.32	2.88	2.52	3.70	3.60	3.45
B(17):1	0.61	0.57	0.27	0.43	0.62	0.57	0.78	0.80	0.44	0.42	0.54
17:1	0.57	0.53	0.50	0.26	0.54	0.58	0.31	0.08	0.56	0.49	0.26
18:1	32.59	31.31	31.78	27.34	29.28	25.72	28.50	21.29	28.18	28.72	18.32
19:1	0.34	0.34	0.27	0.32	0.31	0.31	0.35	0.30	0.33	0.28	0.14
20:1	10.75	5.03	3.31	4.12	4.04	2.72	3.81	3.49	6.07	5.75	3.39
21:1	0.04	0.06	0.07	0.07	tr	0.08	0.03	0.04	0.09	0.03	0.05
22:1	6.87	2.97	1.62	2.69	2.20	1.06	1.88	2.24	4.48	3.67	2.42
Total monoene	58.73	46.20	42.09	38.76	40.62	36.56	38.59	30.97	44.15	43.19	28.77
16:2 ω 4	0.33	0.20	0.06	0.12	0.26	0.25	0.19	0.21	0.24	0.12	0.14
16:3 ω ?	nd	0.52	0.47	1.22	0.56	nd	0.60	0.60	0.54	0.55	0.38
16:4 ω 3	nd	tr	nd	nd	tr	nd	nd	tr	nd	nd	nd
18:2 ω 6	1.12	1.44	4.07	1.45	1.15	1.11	1.88	1.09	1.37	1.60	0.64
18:2 ω 4	tr	0.06	nd	tr	0.03	tr	nd	0.06	nd	nd	0.05
18:3 ω 6	tr	tr	nd	tr	tr	nd	0.02	nd	nd	nd	0.08
18:3 ω 3	0.46	0.20	0.18	0.14	0.18	0.40	0.16	0.13	0.22	0.43	0.12
18:4 ω 3	0.51	0.14	0.09	0.11	0.06	0.17	0.05	0.09	0.11	0.28	0.10
20:2 ω 6	0.10	0.09	1.32	0.11	0.10	0.19	0.08	0.11	0.07	0.19	0.11
20:3 ω 9	0.22	0.24	0.21	0.18	0.17	0.27	0.16	0.16	0.17	0.21	0.10
20:3 ω 6	0.07	0.24	0.32	0.24	0.27	0.27	0.40	0.32	0.22	0.13	0.28
20:4 ω 6	0.74	6.71	7.84	7.70	6.52	7.66	7.41	10.53	8.10	5.92	6.72
20:4 ω 3	0.74	0.19	0.28	0.37	0.29	0.51	0.46	0.36	0.32	0.58	0.35
20:5 ω 3	1.32	1.20	5.04	3.89	3.17	5.27	4.94	5.27	4.45	4.78	5.36
21:5 ω 2	0.55	0.96	0.87	0.73	1.18	0.19	0.46	1.42	0.94	0.61	2.02
22:3 ω 6	nd	0.25	nd	nd	nd	0.17	0.09	nd	nd	0.12	0.07
22:4 ω 6	0.39	0.91	0.49	0.67	0.84	0.59	0.35	1.01	0.52	0.30	1.84
22:5 ω 6	0.42	0.31	0.11	0.32	0.36	0.44	0.23	0.33	0.32	0.35	0.49
22:5 ω 3	2.20	1.59	0.68	1.85	2.06	2.55	1.62	2.72	1.24	1.17	4.38
22:6 ω 3	7.30	0.63	1.78	4.48	4.66	7.94	4.63	3.90	3.76	5.73	3.92
Total polyene	16.47	15.88	23.81	23.58	21.86	27.98	23.73	28.31	22.59	23.07	27.15

tr : trace. nd : not detected under the condition employed.
A-C : unknown. The same alphabets signify identical FCL.

Table 8. Long−chain fatty acid composition (Weight %) of lipids of tissue and organs in the nursling whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Inner melon	Jaw	Blubber	Muscle	Peri-toneum	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart
iso-10:0	0.09	0.38	0.15	0.07	tr	0.03	0.04	0.14	0.13	0.02	tr	tr	0.02	0.15	tr	0.01
n-10:0	0.22	0.26	0.24	0.12	0.02	0.09	0.11	0.25	0.19	0.08	0.07	0.03	0.07	0.03	0.05	0.12
iso-11:0	0.34	0.92	0.13	0.04	0.01	0.01	0.02	0.23	0.17	0.07	0.05	tr	0.01	0.09	0.02	0.02
anteiso-11:0	0.04	0.13	0.03	0.01	nd	0.01	tr	0.08	0.02	0.03	0.02	tr	nd	0.04	nd	0.02
n-11:0	0.04	0.13	0.05	0.03	tr	0.01	0.04	0.06	0.04	0.03	0.01	0.06	0.02	0.03	0.03	0.03
iso-12:0	1.28	3.40	0.85	0.09	0.01	0.04	0.08	0.66	0.35	0.23	0.09	tr	0.02	0.35	0.02	0.07
n-12:0	0.09	0.66	0.84	0.43	0.11	0.32	0.51	0.44	0.28	0.17	0.54	0.13	0.27	0.36	0.15	0.48
A(13):0	0.23	0.84	0.55	0.29	0.10	0.51	0.34	0.35	0.18	0.16	nd	0.14	0.41	nd	0.55	0.46
iso-13:0	0.71	1.52	0.47	0.19	nd	0.03	0.08	0.35	0.25	0.11	0.08	0.05	0.08	0.26	0.07	0.07
anteiso-13:0	0.81	0.45	0.15	0.05	nd	0.02	0.04	0.13	0.08	0.03	0.03	tr	0.03	0.13	tr	0.03
n-13:0	0.09	0.12	0.07	0.05	nd	0.07	0.05	0.10	0.07	0.05	0.03	0.03	0.08	0.21	0.05	0.07
C(14):0	tr	tr	nd	nd	nd	nd	0.02	nd	nd	nd	nd	nd	0.02	nd	nd	nd
iso-14:0	3.28	10.86	1.81	0.25	0.05	0.12	0.23	2.35	1.68	0.79	0.37	0.06	0.06	1.69	0.05	0.23
n-14:0	8.14	8.99	7.47	5.70	1.89	4.14	4.22	5.21	3.09	2.24	2.08	2.22	4.85	3.60	4.03	5.03
B(15):0	0.18	0.21	0.11	nd	nd	nd	nd	0.04	nd	nd	nd	0.21	0.13	nd	0.15	nd
iso-15:0	4.52	10.97	2.02	1.25	0.19	0.21	0.36	2.60	1.94	0.91	0.54	0.19	0.23	1.96	0.34	0.38
anteiso-15:0	0.51	1.90	1.07	0.13	tr	0.09	0.13	0.48	0.38	0.18	0.13	0.07	0.09	0.38	tr	0.10
n-15:0	0.76	1.27	0.62	0.49	0.65	0.52	0.51	0.67	0.52	0.38	0.46	0.37	0.63	0.92	0.53	0.63
C(16):0	nd	nd	tr	nd	1.40	0.98	0.64	0.58	0.41	0.54	0.37	0.09	nd	0.75	0.41	0.48
iso-16:0	5.74	12.42	2.59	1.03	0.28	0.12	0.30	3.05	2.32	1.12	0.52	0.20	0.10	2.53	0.13	0.23
n-16:0	11.94	12.13	13.55	12.51	29.98	15.98	18.97	15.63	15.19	13.85	16.60	14.43	16.58	20.90	17.47	18.34
B(17):0	0.78	nd	tr	nd	nd	nd	0.71	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-17:0	0.80	1.26	0.62	0.53	0.25	0.29	0.25	0.42	0.40	0.32	0.27	0.18	0.31	0.40	0.54	0.25
anteiso-17:0	0.34	0.63	0.27	0.16	tr	tr	0.05	0.16	0.12	0.07	tr	0.11	0.08	0.11	tr	tr
n-17:0	0.69	0.51	0.68	0.57	0.78	0.56	0.53	0.73	0.80	0.76	0.74	0.53	0.77	0.99	0.43	0.66
C(18):0	nd	nd	nd	nd	1.23	0.52	0.60	1.31	1.30	1.26	1.03	0.17	0.13	2.09	0.43	0.44
iso-18:0	0.13	tr	nd	0.16	tr	0.21	nd	0.18	0.21	0.17	0.17	0.16	tr	tr	0.18	0.25
n-18:0	1.05	0.45	1.37	1.97	12.15	7.27	8.60	7.05	9.59	9.36	11.15	14.02	5.11	12.02	6.20	5.42
B(19):0	nd	0.18	nd	nd	nd	nd	0.36	nd	nd	nd	nd	nd	0.11	nd	nd	nd
iso-19:0	nd	nd	nd	nd	nd	0.16	nd	0.10	0.32	0.07	0.07	nd	nd	0.21	nd	nd
n-19:0	nd	nd	tr	tr	0.14	nd	0.14	0.38	0.07	0.07	0.06	0.18	0.11	0.04	nd	0.03
C(20):0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.04	0.09
iso-20:0	nd	nd	nd	nd	nd	0.02	nd	0.05	0.09	0.08	tr	nd	nd	0.08	nd	0.06
n-20:0	nd	nd	nd	nd	nd	0.44	0.07	0.38	0.51	0.61	0.55	nd	nd	0.64	tr	0.31
n-21:0 ?	nd	nd	nd	nd	nd	0.06	nd	0.08	0.08	0.10	0.07	nd	nd	0.09	nd	0.06
n-22:0	nd	nd	nd	nd	nd	tr	nd	0.10	0.17	0.36	0.07	nd	nd	0.08	nd	tr
Total saturated	42.81	70.59	35.71	26.12	49.34	32.83	38.00	44.34	40.95	34.22	36.17	33.54	30.32	51.13	31.87	34.37
iso (total)	16.72	41.73	8.64	3.61	0.79	1.24	1.36	10.13	7.86	3.89	2.16	0.84	0.83	7.72	1.35	1.57
anteiso (total)	1.07	3.11	1.52	0.35	tr	0.12	0.22	0.85	0.60	0.31	0.18	0.18	0.20	0.66	tr	0.15
10:1	0.04	0.09	0.12	0.04	nd	nd	0.02	0.04	0.01	0.01	nd	nd	nd	nd	nd	nd
11:1	nd	tr	nd	0.02	nd	nd	tr	0.30	0.20	0.02	0.02	nd	nd	0.26	nd	nd
12:1	0.36	0.25	0.20	0.15	0.05	nd	0.32	0.25	0.06	0.04	nd	0.05	0.25	0.81	0.04	0.03
13:1	nd	0.04	nd	nd	0.02	nd	tr	0.69	0.19	0.11	0.02	tr	tr	0.07	nd	nd
14:1	0.06	0.17	0.04	tr	nd	0.07	0.38	0.78	0.21	0.29	0.12	nd	nd	0.41	nd	0.22
14:1	2.70	1.32	2.45	1.97	0.17	0.38	0.45	0.61	0.31	0.24	0.27	0.53	0.45	0.28	0.41	0.39
15:1	0.16	0.25	0.20	0.17	tr	0.06	0.11	0.38	nd	0.09	0.18	0.07	nd	0.57	0.08	0.09
16:1	22.95	13.30	23.01	22.60	6.40	8.57	9.86	8.79	8.85	8.38	9.55	15.55	9.88	8.42	9.44	10.29
C(16):1	0.59	0.66	0.76	0.81	0.45	0.68	tr	0.63	0.75	0.57	0.59	0.38	0.65	0.80	0.84	1.11
17:1	0.58	0.49	0.83	0.89	0.26	0.85	0.36	0.56	0.61	0.64	0.69	0.66	0.72	0.11	0.57	0.98
18:1	22.93	11.00	28.32	34.35	22.44	38.41	35.37	27.73	28.09	35.19	29.84	25.68	41.79	26.89	38.66	35.16
19:1	0.15	0.06	0.28	0.29	tr	0.28	0.18	0.20	0.16	0.21	0.19	0.10	0.29	0.25	0.36	0.21
20:1	1.40	0.24	1.61	2.65	1.98	1.79	1.56	1.78	1.64	1.98	1.66	0.63	3.93	2.06	3.48	3.03
22:1	0.33	0.03	0.33	0.82	0.71	1.18	0.98	0.78	0.80	1.00	0.71	0.13	0.92	1.05	0.97	0.81
Total monoene	52.25	27.90	58.15	64.76	32.48	52.27	49.59	43.52	41.91	48.77	43.84	43.78	58.88	41.98	54.85	52.32
16:2 ω4	0.24	0.38	0.33	0.29	0.01	0.26	0.29	0.25	0.26	0.17	0.22	0.55	0.39	0.11	0.08	0.35
16:3 ω?	0.29	0.26	0.40	0.16	0.78	0.50	0.29	0.34	0.34	0.42	0.18	0.15	0.21	0.34	0.15	0.29
16:4 ω3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.13	nd	nd
18:2 ω6	0.76	0.39	0.96	1.13	0.90	nd	1.52	1.14	1.26	2.59	1.02	1.50	1.41	0.59	1.73	1.27
18:2 ω4	nd	nd	nd	nd	nd	nd	nd	0.04	0.05	0.05	0.01	nd	nd	nd	nd	nd
18:3 ω6	nd	nd	nd	nd	nd	nd	nd	0.03	0.05	0.04	0.03	nd	nd	0.07	nd	0.03
18:3 ω3	0.19	0.11	0.16	0.31	0.22	0.48	0.41	0.27	0.29	0.30	0.26	0.51	0.37	0.07	0.20	0.59
18:4 ω3	0.11	0.04	0.17	0.22	nd	0.13	0.18	0.09	0.19	0.08	0.07	0.10	0.15	nd	0.30	0.20
20:2 ω6	0.07	nd	0.07	0.11	0.08	0.18	0.10	0.13	0.13	0.11	0.10	0.06	0.13	0.10	0.24	0.13
20:3 ω6	0.04	nd	0.04	0.05	0.26	0.16	0.07	0.15	0.27	0.25	0.21	0.22	0.05	0.17	0.13	0.09
20:4 ω6	0.42	0.06	0.50	0.84	7.56	2.94	4.77	4.45	6.99	6.82	8.01	9.06	1.12	1.81	3.36	2.69
20:4 ω3	0.18	nd	0.25	0.37	0.10	0.30	0.10	0.23	0.28	0.23	0.21	0.22	0.31	0.71	0.32	0.39
20:5 ω3	0.87	0.08	1.15	1.81	3.67	1.48	1.83	1.15	1.96	2.46	2.62	4.20	0.77	0.31	1.84	2.01
21:5 ω2	nd	nd	nd	nd	nd	0.29	nd	0.37	0.48	0.38	0.38	nd	0.03	1.30	nd	0.09
22:3 ω6	nd	nd	nd	nd	nd	nd	0.08	nd	nd	nd	nd	nd	nd	nd	nd	nd
22:4 ω6	nd	nd	nd	0.11	0.73	0.33	0.08	0.84	0.82	0.61	0.85	0.24	0.13	0.72	0.19	0.33
22:5 ω6	nd	nd	0.06	0.11	0.17	0.37	0.06	0.22	0.24	0.15	0.31	0.20	0.24	tr	0.21	0.27
22:5 ω3	0.46	0.08	0.49	0.87	1.60	1.55	0.60	0.81	1.26	0.76	1.57	1.52	1.26	0.34	1.12	1.10
22:6 ω3	1.31	0.11	1.56	2.74	2.10	5.93	2.03	1.63	2.27	1.59	3.94	4.15	4.23	0.12	3.41	3.48
Total polyene	4.94	1.51	6.14	9.12	18.18	14.90	12.41	12.14	17.14	17.01	19.99	22.68	10.80	6.89	13.28	13.31

tr : trace. nd : not detected under the condition employed.
A−C : unkown. The same alphabets signify identical FCL.

Table 9. Long-chain fatty acid composition (Weight %) of lipids of tissue and organs in the foetus whale, *Stenella caeruleo-alba*.

Fatty acid \ Sample	Melon	Jaw	Blubber	Muscle	Tongue	Stomach Intestine	Liver	Pancreas	Kidney	Heart	Lung	Navel string
iso-10:0	0.09	0.09	0.02	tr	0.07	0.10	0.02	0.01	0.01	0.03	0.01	0.02
n-10:0	0.05	0.05	0.04	0.02	0.02	0.04	tr	0.02	0.01	0.02	tr	0.01
A(11):0	0.09	0.02	0.04	nd	nd	nd	nd	0.02	nd	nd	nd	nd
iso-11:0	0.14	0.07	tr	tr	0.08	0.08	nd	0.01	0.01	0.01	0.01	0.01
anteiso-11:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
n-11:0	nd	tr	tr	tr	tr	0.04	tr	0.01	0.01	tr	tr	0.01
A(12):0	0.06	0.03	nd	nd	nd	nd	nd	0.01	nd	nd	nd	nd
iso-12:0	0.09	0.09	0.03	tr	0.03	0.07	nd	0.01	0.02	0.04	0.03	0.02
n-12:0	1.14	0.64	0.64	0.26	0.18	0.13	0.12	0.23	0.14	0.14	0.08	0.24
iso-13:0	0.05	0.05	nd	nd	0.03	tr	nd	0.02	tr	nd	nd	0.03
anteiso-13:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
n-13:0	0.08	0.03	0.07	0.03	tr	nd	0.03	0.01	nd	nd	nd	0.04
A(14):0	0.04	0.03	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
C(14):0	nd	0.03	nd	0.05	0.12	0.08	0.03	0.03	0.27	0.16	0.83	0.25
iso-14:0	0.16	0.05	0.06	0.02	0.04	tr	tr	0.05	0.06	0.08	tr	0.09
n-14:0	9.80	5.52	5.87	4.33	3.41	1.92	3.07	3.86	1.91	2.50	3.56	2.59
iso-15:0	0.41	0.22	0.14	0.11	0.07	0.04	0.07	0.06	tr	0.07	0.05	0.19
anteiso-15:0	nd	nd	nd	nd	nd	nd	nd	nd	tr	nd	nd	tr
n-15:0	1.00	0.59	0.7	0.69	0.66	0.69	0.73	0.61	0.49	0.51	0.72	0.52
C(16):0	0.27	0.39	0.20	0.31	0.20	0.38	0.14	0.16	1.34	2.06	1.98	0.98
iso-16:0	0.69	0.26	0.17	nd	0.11	0.09	tr	nd	nd	nd	nd	tr
n-16:0	17.62	22.36	21.69	21.48	23.36	20.34	25.10	21.65	18.87	20.13	22.92	16.45
iso-17:0	0.20	tr	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.03
anteiso-17:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
n-17:0	0.53	0.65	0.71	0.92	0.78	0.73	0.69	0.86	0.62	0.55	0.67	0.85
C(18):0	0.62	0.43	0.32	0.43	0.18	0.21	0.16	0.17	nd	nd	0.60	0.49
iso-18:0	nd	0.05	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
n-18:0	4.14	7.60	8.06	10.12	12.77	14.78	9.44	8.92	14.21	11.48	13.18	13.71
iso-19:0	nd	nd	nd	tr	nd	nd	nd	nd	nd	nd	nd	nd
n-19:0 ?	0.14	0.52	0.19	0.19	0.08	0.17	0.34	0.19	0.18	0.03	0.15	0.15
C(20):0	nd	nd	nd	nd	nd	0.05	nd	nd	nd	0.04	nd	0.08
n-20:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
A(21):0	0.35	0.38	0.44	0.32	0.33	0.32	0.22	0.53	0.38	0.53	0.40	0.64
Total saturated	37.76	40.15	39.39	39.26	42.52	40.26	40.16	37.44	38.53	38.36	45.19	37.76
iso (total)	1.83	0.88	0.40	0.13	0.43	0.38	0.09	0.16	0.10	0.23	0.10	0.39
anteiso (total)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	tr
10:1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
11:1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
12:1	0.16	nd	0.06	0.02	nd	nd	nd	nd	nd	nd	nd	nd
13:1	0.07	nd	0.03	0.07	nd	nd	nd	nd	nd	nd	nd	nd
14:1	0.22	0.05	0.14	0.20	0.10	0.05	tr	0.29	0.09	0.13	0.07	0.03
C(14):1	3.59	0.80	0.94	0.30	0.20	0.06	0.35	0.26	0.09	0.09	0.04	0.10
15:1	nd	nd	nd	nd	nd	0.14	nd	nd	0.30	0.45	0.52	0.31
16:1	0.72	0.22	0.37	0.14	0.14	0.08	0.04	0.37	nd	nd	nd	nd
C(16):0	30.73	15.23	16.43	11.59	8.74	6.83	10.64	10.72	7.09	7.61	7.80	8.37
17:1	nd	nd	nd	nd	nd	nd	nd	nd	0.81	2.04	1.45	0.34
18:1	nd	0.19	0.32	0.26	0.35	0.60	0.23	0.44	0.32	0.81	0.23	0.39
C(18):0	15.04	19.47	21.95	24.34	23.30	24.86	19.04	24.59	22.67	26.89	22.43	26.62
19:1	nd	nd	nd	nd	nd	0.04	nd	nd	nd	nd	0.09	0.08
20:1	0.30	1.55	0.45	0.46	0.37	0.35	0.74	0.47	0.54	0.33	0.44	0.36
22:1	0.67	0.88	1.06	1.09	1.08	1.55	0.78	1.21	1.26	1.21	1.59	1.69
Total monoene	0.47	0.71	0.67	0.55	0.92	1.15	0.93	1.08	1.36	0.67	0.77	1.20
18:2 ω6	51.97	39.10	42.42	39.02	35.20	35.71	32.75	39.43	34.53	40.23	35.43	39.49
18:3 ω3	1.02	5.23	1.43	1.55	1.35	1.04	1.22	1.55	0.94	1.02	0.39	0.50
20:2 ω6	0.18	0.24	0.23	0.27	0.27	0.47	0.21	0.22	0.44	0.31	0.38	0.39
20:3 ω9	0.64	0.76	0.80	0.79	0.79	0.79	0.76	0.92	0.76	0.94	0.91	1.11
20:3 ω6	1.16	1.50	1.88	1.77	1.66	2.89	3.17	2.08	4.01	1.95	2.76	3.79
20:4 ω6	0.94	1.44	1.76	1.74	1.77	1.79	2.02	1.88	2.16	1.86	2.06	1.86
20:5 ω3	1.08	1.70	1.59	2.01	2.57	3.40	3.60	2.42	5.38	3.76	2.72	2.85
21:5 ω2	0.93	1.94	1.77	2.34	2.96	2.37	3.77	2.87	5.09	4.09	2.37	2.08
22:3 ω6	0.11	0.22	0.22	0.22	0.28	0.45	0.29	0.22	0.27	0.27	0.21	0.34
22:4 ω6	0.59	1.07	1.63	1.21	1.56	2.11	0.89	1.33	1.59	1.24	1.74	1.94
22:5 ω6	0.28	0.47	0.72	0.71	0.58	0.72	0.57	0.63	0.70	0.70	0.58	0.40
22:5 ω3	0.20	0.35	0.74	0.31	0.96	1.58	1.02	0.36	0.71	0.60	0.45	1.46
22:6 ω3	1.47	2.73	2.54	4.30	3.95	2.76	2.97	4.39	1.56	2.46	2.47	2.70
Total polyene	1.67	3.10	2.88	4.50	3.58	3.66	6.60	4.26	3.33	2.21	2.34	3.33
	10.27	20.75	18.19	21.27	22.28	24.03	27.09	23.13	26.94	21.41	19.38	22.75

tr : trace. nd : not detected under the condition employed.
A-C : unkown. The same alphabets signify identical FCL.

tissue of the melon, jaw and blubber and the muscle of the melon and jaw parts (all these parts are collectively named adipose tissue in this paragraph) as compared with the muscle of the body parts and organs including the liver (in the same manner, named muscle-organs). Monoene acids were much less in the inner melon among the adipose tissue but equal or more in the other adipose tissue, and much higher especially in the outer layer of every adipose tissue as compared with the muscle-organs. As for individual monoene acid, under 16:1 were contained more but above 17:1 were

equally or only less in the adipose tissue as compared with the muscle−organs. Generally, polyene acids were contained equally or only less in the adipose tissue as compared with the muscle−organs. Especially, 20 : 4 ω6, 20 : 5 ω3, 22 : 5 ω3 and 22 : 6 ω3 were very little in the adipose tissue.

In the nursling, the quantitative composition of branched−chain acids in each sample was almost similar to that in the adult. However, the branched−chain acid content in the outer layer of the subcutaneous tissue (as mentioned above, the jaw and blubber of the nursling are herein considered as the outer layer) showed a higher value as compared with that in the adult. In the stomach and gall−bladder, the content showed a remarkably high value almost proportionated to that in the subcutaneous tissue. The content in the stomach decreased in the order of the I st, II nd, III rd and IV th stomachs (or intestine). On the other hand, the composition each of odd−numbered iso acids, even−numbered iso acids and anteiso acids showed a similar trend to that in the adult. However, there was a difference from the adult in that iso−16 : 0 showed the maximum value among every branched−chain acid in the tissue and organs where branched−chain acids existed in large quantity. Moreover, even−numbered iso acids in the subcutaneous tissue except for the blubber, stomach and gall−bladder were more than odd−numbered iso acids (see also Table 14 and 15), showing a trend opposite to the adult.

The quantitave composition of saturated straight−chain, monoene and polyene acids in each sample of the nursling also showed a similar trend to that in the adult but the quantitative difference among the parts was smaller than that in the adult. In comparison of the nursling with the adult, the content of such lower acids among saturated acids as 14:0 and 16:0 was higher and that of such higher acids as 18 : 0 and 20 : 0 was lower ; among monoene acids, the content of 16 : 1 was higher, 18 : 1 was almost equal and 20 : 1 and 22 : 1 was lower; and among polyene acids, 20 : 4 ω6, 20 : 5 ω3 and 22 : 6 ω3 were much lower.

In the foetus, the differentiation to adipose tissue was not recognized in any of the melon, jaw and blubber. Branched−chain acids also were much less than in the adult and nursling, but neverthless branched−chain acids were contained more in the melon and jaw than in the muscle and organs including the liver. Even−numbered iso acids were more than odd−numbered iso acids, and anteiso acids were not detected. The iso acid composition was similar to that of the nursling, that is, iso−15 : 0 was the maximum value among odd − numbered iso acids, and iso−16 : 0 among even−numbered iso acid.

The quantitative composition of saturated straight−chain, monoene and polyene acids in each sample of the foetus was similar to that in the adult or nursling but the quantitative difference among the parts was smaller than that in the adult. It was particularly different from the adult and nursling in that, among polyene acids, 16 : 2 ω4, 16 : 3 ω?, 16:4 ω3, 18 : 2 ω4, 18:3 ω6, 18:4 ω3 and 20:4 ω3 were not recognized but 20 : 2 ω6, 20 : 3 ω9, 20 : 3 ω6 and 22 : 3 ω6 were rather abundant.

The weight and molar percentages of branched−chain acids per total acids in the tissue and organs of the adult and nursling are shown in Tables 10−15.

In this paragraph, it was examined particularly on the relations between isobutyric acid and even−numbered iso acids above carbon number 6 (even−numbered iso $>C_6$

Table 10. Composition (weight %) of branched-chain fatty acids in all of the short- and long-chain fatty acids from adipose tissue and muscle in the adult whale, *Stenella caeruleo-alba*.

Fatty acid \ Sample	Outer melon	Center melon	Under melon	Muscle (melon)	Outer jaw	Inner jaw	Muscle (jaw)	Outer blubber	Inner blubber	Muscle (dorsal)	Peritoneum
iso- 4:0	0.51	0.94	0.84	0.84	0.40	0.54	0.52	0.16	/	0.01	0.05
iso- 5:0	15.64	38.06	31.19	27.35	8.27	8.97	11.83	3.70	/	0.38	1.31
iso- 6:0	nd	nd	nd	nd	nd	nd	nd	nd	/	0.01	0.01
iso- 7:0	nd	nd	nd	nd	nd	nd	nd	nd	/	0.20	0.01
iso- 8:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso- 9:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso-10:0	0.03	0.09	0.05	0.08	0.04	0.06	0.09	tr	/	0.04	0.06
iso-11:0	0.20	0.39	0.39	0.39	0.13	0.20	0.25	0.04	/	0.03	0.06
anteiso-11:0	0.04	0.02	0.03	0.03	0.04	0.05	0.05	0.02	/	nd	0.01
iso-12:0	0.34	0.46	0.55	0.56	0.28	0.43	0.48	0.07	/	tr	0.01
iso-13:0	0.54	1.60	1.48	1.13	0.21	0.35	0.43	0.04	/	0.03	0.01
anteiso-13:0	0.17	0.19	0.18	0.21	0.13	0.20	0.16	0.03	/	tr	nd
iso-14:0	1.78	7.17	5.10	4.06	0.89	1.33	1.48	0.21	/	0.12	0.17
iso-15:0	3.39	17.50	12.61	9.25	1.30	1.90	2.17	0.37	/	0.19	0.14
anteiso-15:0	0.66	1.91	1.32	0.96	0.34	0.45	0.70	0.13	/	0.15	nd
iso-16:0	1.85	7.68	5.91	3.73	0.78	1.11	1.18	0.21	/	0.18	0.14
iso-17:0	0.35	0.53	0.67	0.41	0.24	0.26	0.26	0.28	/	0.17	0.20
anteiso-17:0	0.14	0.27	0.27	0.30	0.15	0.15	0.17	0.13	/	0.11	nd
iso-18:0	0.22	0.11	0.33	0.13	0.38	0.19	0.18	tr	/	0.16	0.30
iso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	0.17
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso-20:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso (total, $>C_6$)	8.70	35.53	27.09	19.74	4.25	5.83	6.52	1.22	/	1.13	1.28
even number	4.22	15.51	11.94	8.56	2.37	3.12	3.41	0.49	/	0.51	0.69
odd number	4.48	20.02	15.15	11.18	1.87	2.71	3.11	0.73	/	0.62	0.59
anteiso (total, $>C_6$)	1.01	2.39	1.80	1.50	0.66	0.85	1.08	0.31	/	0.26	0.01
Sum total	25.86	76.92	60.92	49.43	13.58	16.19	19.95	5.39	/	1.78	2.65

tr : trace. nd : not detected under the condition employed.
The values of iso-10 : 0 adopted from the long-chain fatty acids.

Table 11. Composition (weight %) of branched-chain fatty acids in all of the short- and long-chain fatty acids from organs in the adult whale, *Stenella caeruleo-alba*.

Fatty acid \ Sample	Tongue	Stomach			Intestine	Liver	Pancreas	Gall-bladder	Kidney	Heart	Lung
		Ist	IInd	IIIrd							
iso- 4:0	0.22	0.10	0.06	0.07	0.03	0.05	0.02	0.05	0.10	0.09	0.03
iso- 5:0	8.67	2.60	1.13	1.61	1.10	0.25	0.31	2.73	0.39	0.57	0.69
iso- 6:0	nd	0.01	0.02	0.04	0.01	0.02	0.02	0.18	0.03	0.04	0.04
iso- 7:0	nd	tr	0.04	0.13	0.06	0.09	0.01	0.37	0.02	0.04	0.03
iso- 8:0	nd	nd	nd	0.03	nd	0.03	nd	0.06	0.02	0.03	0.02
iso- 9:0	nd	nd	nd	nd	nd	0.04	nd	nd	0.02	nd	nd
iso-10:0	nd	0.04	0.03	0.04	0.04	0.04	0.04	0.17	0.03	0.03	0.04
iso-11:0	0.03	0.09	0.09	0.09	0.05	0.07	0.05	0.16	0.05	0.02	nd
anteiso-11:0	nd	tr	tr	tr	tr	0.03	tr	0.05	nd	nd	nd
iso-12:0	0.02	0.04	0.02	tr	0.02	0.03	tr	0.05	nd	0.01	nd
iso-13:0	0.03	0.06	0.01	0.02	0.02	nd	tr	0.03	nd	nd	nd
anteiso-13:0	tr	0.03	tr	0.01	tr	0.08	nd	tr	nd	nd	nd
iso-14:0	0.16	0.28	tr	0.21	0.12	0.11	0.06	0.33	0.10	0.08	0.08
iso-15:0	0.44	0.37	0.06	0.17	0.15	nd	0.09	0.13	0.11	0.14	0.14
anteiso-15:0	0.02	0.06	0.04	0.09	0.08	nd	nd	0.05	nd	0.07	0.06
iso-16:0	0.20	0.39	0.13	0.30	0.26	0.13	0.21	0.17	0.18	0.16	0.14
iso-17:0	0.21	0.13	0.25	0.25	0.26	0.24	0.24	0.28	0.18	0.22	0.18
anteiso-17:0	0.11	tr	0.10	tr	0.14	0.13	nd	nd	nd	0.09	0.12
iso-18:0	0.19	0.19	0.15	0.28	0.15	0.22	0.30	0.46	0.28	0.21	0.23
iso-19:0	0.03	tr	0.08	tr	nd	0.07	0.08	0.14	0.08	0.03	0.09
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	0.18	nd	nd	nd	nd	nd	nd	nd	nd	0.08	nd
iso (total, $>C_6$)	1.49	1.60	0.88	1.56	1.14	1.09	1.10	2.53	1.10	1.09	0.99
even number	0.75	0.95	0.35	0.90	0.60	0.58	0.63	1.42	0.64	0.64	0.55
odd number	0.74	0.65	0.53	0.66	0.54	0.51	0.47	1.11	0.46	0.45	0.44
anteiso (total, $>C_6$)	0.13	0.09	0.14	0.10	0.22	0.24	tr	0.10	nd	0.16	0.18
Sum total	10.51	4.39	2.39	3.34	2.49	1.63	1.43	5.41	1.59	1.91	1.89

tr : trace. nd : not detected under the condition employed.
The values of iso-10 : 0 adopted from the long-chain fatty acids.

Table 12. Composition (mole %) of branched−chain fatty acids in all of the short− and long−chain fatty acids from adipose tissue and muscle in the adult whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Center melon	Under melon	Muscle (melon)	Outer jaw	Inner jaw	Muscle (jaw)	Outer blubber	Inner blubber	Muscle (dorsal)	Peritoneum
iso- 4:0	1.21	1.68	1.62	1.71	1.09	1.48	1.29	0.49	/	0.04	0.17
iso- 5:0	32.12	58.76	52.08	47.90	19.21	21.27	25.50	9.64	/	1.26	3.50
iso- 6:0	nd	nd	nd	nd	nd	nd	nd	nd	/	0.02	0.02
iso- 7:0	nd	nd	nd	nd	nd	nd	nd	nd	/	0.05	0.02
iso- 8:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso- 9:0	nd	nd	nd	nd	nd	nd	nd	nd	/	nd	nd
iso-10:0	0.04	0.08	0.05	0.08	0.06	0.08	0.12	tr	0.09	0.07	0.10
iso-11:0	0.23	0.33	0.36	0.37	0.16	0.26	0.29	0.06	0.35	0.06	0.09
anteiso-11:0	0.04	0.02	0.03	0.03	0.05	0.06	0.06	0.03	0.07	nd	0.01
iso-12:0	0.36	0.36	0.47	0.50	0.33	0.52	0.53	0.09	0.45	tr	0.01
iso-13:0	0.53	1.18	1.18	0.94	0.23	0.39	0.44	0.05	0.48	0.04	0.01
anteiso-13:0	0.17	0.14	0.14	0.21	0.14	0.23	0.16	0.04	0.18	tr	nd
iso-14:0	1.63	4.95	3.81	3.18	0.92	1.41	1.43	0.20	1.40	0.17	0.20
iso-15:0	2.93	11.39	8.87	6.83	1.27	1.90	1.97	0.41	2.72	0.27	0.16
anteiso-15:0	0.57	1.24	0.93	0.71	0.33	0.45	0.64	0.14	0.72	0.21	nd
iso-16:0	1.51	4.72	3.93	2.60	0.72	1.05	1.01	0.22	0.89	0.23	0.15
iso-17:0	0.27	0.31	0.42	0.27	0.21	0.23	0.21	0.28	0.26	0.21	0.20
anteiso-17:0	0.11	0.16	0.17	0.20	0.13	0.13	0.14	0.13	0.08	0.14	nd
iso-18:0	0.16	0.06	0.20	0.08	0.32	0.16	0.14	tr	0.18	0.19	0.29
iso-19:0	tr	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.16
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso (total, $>C_6$)	7.66	23.38	19.29	14.85	4.22	6.00	6.14	1.31	6.82	1.31	1.41
even number	3.70	10.17	8.46	6.44	2.35	3.22	3.23	0.51	3.01	0.68	0.77
odd number	3.96	13.21	10.83	8.41	1.87	2.78	2.91	0.80	3.81	0.63	0.64
anteiso (total, $>C_6$)	0.89	1.56	1.27	1.15	0.65	0.87	1.00	0.34	1.05	0.35	0.01
Sum total	41.88	85.38	74.26	65.61	25.17	29.62	33.93	11.78	7.87	2.96	5.09

tr : trace. nd : not detected under the condition employed.
The values of iso−10:0 adopted from the long−chain fatty acids.

Table 13. Composition (mole %) of branched−chain fatty acids in all of the short− and long−chain fatty acids from organs in the adult whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intestine	Liver	Pancreas	Gallbladder	Kidney	Heart	Lung
iso- 4:0	0.65	0.32	0.20	0.23	0.08	0.17	0.08	0.15	0.33	0.30	0.10
iso- 5:0	22.36	6.91	3.79	4.41	2.98	0.69	0.85	6.98	1.07	1.66	1.87
iso- 6:0	nd	0.02	0.05	0.10	0.03	0.06	0.04	0.41	0.07	0.11	0.09
iso- 7:0	nd	0.01	0.08	0.27	0.12	0.20	0.02	0.74	0.05	0.09	0.07
iso- 8:0	nd	nd	nd	0.06	nd	0.06	nd	0.10	0.04	0.06	0.04
iso- 9:0	nd	nd	nd	nd	nd	0.08	nd	nd	0.04	tr	nd
iso-10:0	nd	0.06	0.05	0.07	0.06	0.07	0.06	0.25	0.05	0.06	0.06
iso-11:0	0.04	0.13	0.14	0.13	0.08	0.11	0.08	0.23	0.08	0.03	nd
anteiso-11:0	nd	tr	tr	tr	tr	0.05	tr	0.07	nd	nd	nd
iso-12:0	0.03	0.06	0.03	tr	0.03	0.04	tr	0.06	nd	0.01	nd
iso-13:0	0.04	0.08	0.01	0.03	0.03	nd	tr	0.04	nd	nd	nd
anteiso-13:0	tr	0.04	tr	0.01	tr	0.01	nd	tr	nd	nd	nd
iso-14:0	0.19	0.33	tr	0.26	0.15	0.14	0.07	0.38	0.12	0.11	0.10
iso-15:0	0.48	0.41	0.07	0.20	0.17	nd	0.10	0.14	0.13	0.17	0.16
anteiso-15:0	0.02	0.07	0.05	0.10	0.09	nd	nd	0.05	nd	0.08	0.07
iso-16:0	0.21	0.41	0.15	0.33	0.28	0.14	0.23	0.17	0.20	0.19	0.15
iso-17:0	0.20	0.13	0.27	0.26	0.27	0.25	0.25	0.27	0.19	0.24	0.18
anteiso-17:0	0.11	tr	0.11	tr	0.14	0.14	nd	nd	nd	0.10	0.12
iso-18:0	0.18	0.18	0.16	0.28	0.15	0.22	0.30	0.42	0.28	0.22	0.22
iso-19:0	0.03	tr	0.08	tr	nd	0.07	0.08	0.12	0.08	0.03	0.08
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	0.15	nd	nd	nd	nd	nd	nd	nd	nd	0.08	nd
iso (total, $>C_6$)	1.55	1.82	1.09	1.99	1.37	1.44	1.23	3.33	1.33	1.40	1.15
even number	0.76	1.06	0.44	1.10	0.70	0.73	0.70	1.79	0.76	0.84	0.66
odd number	0.79	0.76	0.65	0.89	0.67	0.71	0.53	1.54	0.57	0.56	0.49
anteiso (total, $>C_6$)	0.13	0.11	0.16	0.11	0.23	0.20	tr	0.12	nd	0.18	0.19
Sum total	24.69	9.16	5.24	6.74	4.66	2.50	2.16	10.58	2.73	3.54	3.31

tr : trace. nd : not detected under the condition employed.
The values of iso-10 : 0 adopted from the long-chain fatty acids.

Table 14. Composition (weight %) of branched−chain fatty acids in all of the short− and long−chain fatty acids from tissue and organs in the nursling whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Inner melon	Jaw	Blubber	Muscle	Peri-toneum	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart
iso- 4:0	1.18	1.77	1.67	0.81	0.08	0.18	0.29	0.92	0.36	0.21	0.02	0.02	0.12	0.11	0.07	0.06
iso- 5:0	17.84	19.13	14.25	6.26	0.71	1.13	3.66	7.09	3.82	2.47	1.45	0.40	0.97	1.12	0.43	0.50
iso- 6:0	0.04	nd	nd	0.02	0.01	0.01	0.07	nd	nd	nd	nd	0.02	tr	tr	tr	tr
iso-10:0	0.15	0.30	0.12	0.06	tr	0.03	0.04	0.13	0.13	0.02	tr	tr	0.02	0.14	tr	0.01
iso-11:0	0.27	0.73	0.11	0.04	0.01	0.01	0.02	0.21	0.16	0.06	0.05	tr	0.01	0.09	0.02	0.02
anteiso-11:0	0.04	0.10	0.03	tr	nd	0.01	tr	0.08	0.02	0.03	0.02	tr	nd	0.04	nd	0.02
iso-12:0	1.02	2.68	0.71	0.08	0.01	0.04	0.08	0.61	0.34	0.23	0.09	tr	0.03	0.34	0.02	0.07
iso-13:0	0.57	1.20	0.40	0.18	nd	0.03	0.08	0.32	0.25	0.11	0.08	0.05	0.10	0.25	0.07	0.07
anteiso-13:0	0.14	0.35	0.12	0.04	nd	0.02	0.04	0.12	0.08	0.03	0.03	tr	0.04	0.13	tr	0.03
iso-14:0	2.61	8.56	1.51	0.23	0.05	0.11	0.21	2.15	1.64	0.78	0.38	0.06	0.07	1.66	0.05	0.22
iso-15:0	3.60	8.64	1.70	1.16	0.19	0.21	0.34	2.38	1.89	0.90	0.55	0.19	0.02	1.94	0.34	0.38
anteiso-15:0	0.41	1.50	0.90	0.12	tr	0.09	0.12	0.44	0.37	0.18	0.13	0.07	0.11	0.38	tr	0.10
iso-16:0	4.35	9.79	2.16	0.95	0.27	0.12	0.29	2.79	2.27	1.11	0.52	0.20	0.13	2.49	0.13	0.23
iso-17:0	0.64	1.00	0.51	0.49	0.24	0.29	0.23	0.38	0.39	0.32	0.28	0.18	0.38	0.40	0.53	0.25
anteiso-17:0	0.27	0.50	0.23	0.15	tr	tr	0.05	0.15	0.12	0.07	tr	0.11	0.10	0.11	tr	tr
iso-18:0	0.11	tr	nd	0.15	tr	0.20	nd	0.17	0.20	0.17	0.17	0.16	tr	tr	0.18	0.25
iso-19:0	nd	nd	nd	nd	nd	0.16	nd	0.09	0.31	0.07	0.07	nd	nd	0.20	nd	nd
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	nd	nd	nd	nd	nd	0.02	nd	0.04	0.09	0.08	tr	nd	nd	0.08	nd	0.06
iso (total, $>C_6$)	13.36	32.90	7.22	3.36	0.78	1.23	1.36	9.27	7.67	3.85	2.19	0.86	0.76	7.59	1.34	1.56
even number	8.28	21.33	4.50	1.49	0.34	0.53	0.69	5.89	4.67	2.39	1.16	0.44	0.25	4.71	0.38	0.84
odd number	5.08	11.57	2.72	1.87	0.44	0.70	0.67	3.38	3.00	1.46	1.03	0.42	0.51	2.88	0.96	0.72
anteiso (total, $>C_6$)	0.86	2.45	1.28	0.31	tr	0.12	0.21	0.79	0.59	0.31	0.18	0.18	0.25	0.66	tr	0.15
Sum total	33.87	56.25	24.42	10.74	1.57	2.66	5.52	18.07	12.44	6.84	3.84	1.46	2.10	9.48	1.84	2.27

tr : trace. nd : not detected under the condition employed.
The values of iso−10 : 0 adopted from the long−chain fatty acids.

Table 15. Composition (mole %) of branched−chain fatty acids in all of the short− and long−chain fatty acids from tissue and organs in the nursling whale, *Stenella caeruleo−alba*.

Fatty acid \ Sample	Outer melon	Inner melon	Jaw	Blubber	Muscle	Peri-toneum	Tongue	Stomach Ist	Stomach IInd	Stomach IIIrd	Intes-tine	Liver	Pan-creas	Gall-bladder	Kidney	Heart
iso- 4:0	4.09	3.81	3.98	2.23	0.26	0.55	0.84	2.46	1.01	0.62	0.05	0.05	0.29	0.33	0.22	0.19
iso- 5:0	34.79	35.47	29.32	14.85	2.08	2.92	9.17	16.30	9.34	6.31	3.72	1.10	2.07	2.89	1.16	1.45
iso- 6:0	0.07	nd	nd	0.04	0.02	0.03	0.15	nd	nd	nd	nd	0.04	tr	0.01	tr	tr
iso-10:0	0.17	0.33	0.15	0.09	tr	0.05	0.06	0.18	0.19	0.03	tr	tr	0.03	0.22	tr	0.02
iso-11:0	0.29	0.74	0.12	0.05	0.02	0.01	0.03	0.27	0.22	0.09	0.07	tr	0.01	0.13	0.03	0.03
anteiso-11:0	0.04	0.10	0.03	tr	nd	0.01	tr	0.10	0.03	0.04	0.03	tr	nd	0.06	nd	0.03
iso-12:0	1.01	2.53	0.74	0.10	0.02	0.05	0.10	0.71	0.43	0.30	0.12	tr	0.03	0.45	0.03	0.10
iso-13:0	0.53	1.06	0.39	0.20	nd	0.04	0.09	0.35	0.29	0.13	0.10	0.06	0.10	0.31	0.09	0.10
anteiso-13:0	0.13	0.31	0.12	0.05	nd	0.02	0.05	0.13	0.09	0.04	0.04	tr	0.04	0.16	tr	0.04
iso-14:0	2.28	7.10	1.39	0.24	0.07	0.13	0.24	2.21	1.79	0.89	0.43	0.07	0.07	1.91	0.06	0.29
iso-15:0	2.96	6.75	1.47	1.16	0.23	0.23	0.36	2.31	1.95	0.97	0.59	0.22	0.02	2.10	0.38	0.46
anteiso-15:0	0.34	1.17	0.78	0.12	tr	0.10	0.13	0.43	0.38	0.19	0.14	0.08	0.10	0.41	tr	0.12
iso-16:0	3.38	7.23	1.77	0.90	0.32	0.12	0.29	2.56	2.21	1.13	0.53	0.22	0.11	2.55	0.14	0.27
iso-17:0	0.47	0.70	0.40	0.44	0.27	0.28	0.22	0.33	0.36	0.31	0.27	0.19	0.31	0.39	0.54	0.27
anteiso-17:0	0.20	0.35	0.18	0.13	tr	tr	0.05	0.13	0.11	0.07	tr	0.11	0.08	0.11	tr	tr
iso-18:0	0.08	tr	nd	0.13	tr	0.19	nd	0.14	0.18	0.16	0.16	0.16	tr	tr	0.17	0.26
iso-19:0	nd	nd	nd	nd	nd	0.14	nd	0.07	0.26	0.06	0.06	nd	nd	0.18	nd	nd
anteiso-19:0	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
iso-20:0	nd	nd	nd	nd	nd	0.02	nd	0.03	0.07	0.07	tr	nd	nd	0.07	nd	0.06
iso (total, $>C_6$)	11.24	26.44	6.43	3.35	0.95	1.29	1.54	9.16	7.95	4.14	2.33	0.96	0.68	8.32	1.44	1.86
even number	6.99	17.19	4.05	1.50	0.43	0.59	0.84	5.83	4.87	2.58	1.24	0.49	0.24	5.21	0.40	1.00
odd number	4.25	9.25	2.38	1.85	0.52	0.70	0.70	3.33	3.08	1.56	1.09	0.47	0.44	3.11	1.04	0.86
anteiso (total, $>C_6$)	0.71	1.93	1.11	0.30	tr	0.13	0.23	0.79	0.61	0.34	0.21	0.19	0.22	0.74	tr	0.19
Sum total	50.83	67.64	40.84	20.73	3.29	4.89	11.78	28.71	18.91	11.41	6.31	2.30	3.26	12.28	2.82	3.69

tr : trace. nd : not detected under the condition employed.
The values of iso−10 : 0 adopted from the long−chain fatty acids.

acids), between isovaleric acid and odd−numbered iso acids above carbon number 7 (odd−numbered iso $>C_7$ acids), and between 2−methyl butyric acid [2−methyl butyric acid was estimated to be as much as 5% of isovaleric acid following the data of Ackman et al. (1973)] and anteiso acids above carbon number 7 (anteiso $>C_7$ acids). Therefore, the data in Tables 10−15 are indicated separately for fatty acids under carbon number 5 and above carbon number 6. Moreover, the malar percentages also

are provided.

The percentages of the content of branched −chain acids with higher carbon number against that of the acids with lower one in the adipose tissue of the adult and nursling showed a remarkable difference among the three groups of acids mentioned above. In the adipose tissue of the adult, the even−numbered iso $>C_6$ acid content was 3.06−16.5 times (weight %) or 1.04−6.05 times (mole %) as much as the isobutyric acid content, the odd−numbered iso $>C_6$ acid content was 0.21−0.55 times (weight %) or 0.09−0.24 times (mole %) as much as the isovaleric acid content, and the anteiso $>C_7$ acid content (all anteiso acids were odd number) was 1.29−1.89 times (weight %) or 0.48−0.82 times (mole %) as much as the 2−methyl butyric acid content. In this respect, the percentages in the nursling showed an almost similar trend to that in the adult. In the case of iso acids wherein the content of branched − chain acids with higher carbon number was high, the percentages differed among various parts of the adipose tissue. Moreover, the values changed in proportion to the content of branched−chain acids with higher carbon number. In the case of anteiso acids wherein the content of branched − chain acids with higher carbon number was low, the percentages did not show any remarkable difference among various parts of the adipose tissue. The proportional relation of the percentages to the content of branched −chain acids with higher carbon number was not recognized. However, these findings may be due to the caluculation of 2−methyl butyric acid content as 5% of isovaleric acid.

In the tissue and organs other than the adipose tissue, the percentages showed remarkable variations without any specific a trend.

Discussion

In the adult and nursling, the long−chain branched acid content showed a high value in the adipose tissue, especially in the melon and jaw parts. The content of both isobutyric acid and even−numbered long−chain iso acid in the adipose tissue was higher in the nursling than in the adult, and, in the adult, the content of these acids in the jaw parts was higher than in the melon parts. These facts suggest that long−chain branched acids are biothynthesized from short−chain branched acids in the adipose tissue. On the other hand, in the adipose tissue the percentages of the content of branched−chain acids with higher carbon number against the content of the corresponding branched−chain acids of lower carbon number increased or decreased in proportion to the content of the corresponding branched −chain acids with higher carbon number. This fact supports the aforementioned speculation and suggests that biosynthetic activities differ by the kind of tissue.

In land mammalia, it has been known that long−chain branched acids are biosynthesized from short−chain branched acids in the adipose tissue (Horning et al., 1961), and in the case of straight−chain acids, the biosythetic activities by which short−chain acids is transformed to long−chain acids differ by the kind of adipose tissue (Ingle, Bauman, and Carribus, 1972a and 1972b ; Pothoven and Beitz, 1973 ; Pothoven, Beutz, and Zimmerli, 1974). Therefore, it is quite possible that the same biosynthetic process occurs in the whales.

The content of isobutyric, isovaleric and 2−methyl butyric acids in lipids of the adult and nursling differed by the kind of tissue

and organs, and showed a considerably higher value in the adipose tissue than in the muscle (body part) and organs including the liver. In the adipose tissue of land mammalia, each short−chain branched acid is biosynthesized from the corresponding branched−chain amino acid (Itakura, 1972), and the metabolic activities of branched−chain amino acids are very high in the adipose tissue. Morover, the conversion from branched−chain amino acids to fatty acids is much more enhanced in the adipose tissue than in the muscle and organs (Feller and Feist, 1959; Rosenthal, Angel, and Farkas, 1974). These evidences are useful to explain the peculiarities of distribution of short−chain branched acids in the whales. It is considered that short−chain branched acids of adipose lipids in the whales are biosynthesized from the corresponding branched−chain amino acids independently in each adipose tissue. However, short−chain branched acids existed also in the muscle, liver and other organs. Such short−chain branched acids are not recognized in the fish and squids which are food of the whales. Therefore, it is deservedly considered that short−chain branched acids in the muscle, liver and other organs are biosynthesized in these parts. The short−chain branched acid composition in these parts was similar to that in adipose tissue. Therefore, it is impossible to deny entirely the possibility that the short−chain branched acids of adipose tissue lipids originate in metabolic matters of the body. To clarify this, at least the fatty acid composition in blood must be studied.

In the foetus, the lipid content in the subcutaneous tissue of the melon and jaw was rather lower than that in other tissue and organs. However, the long−chain branched acid content in the jaw and melon was higher than in other tissue and organs. Moreover, the long−chain branched acid composition in the melon and jaw differed from that in other tissue and organs, being similar to that in the adipose tissue of the nursling. These facts can be understood better by assuming that branched−chain acids in each adipose tissue are biosynthesized independently in that adipose tissue like in the adult and nursling. In the foetus of the present study, branched−chain acids were contained only little in adipose tissue lipids, but in the foetus just before the birth a large amount of both short− and long−chain branched acids were contained in adipose tissue lipids as describeb in the previous paper (Morii and Kanazu, 1972a).

Branched−chain acid content in the tongue, stomachs and gall−bladder wherein the lipid content was very low was relatively high. Among these three parts, the tongue is in immediate contact with the jaw muscle, and, it is possible that branched−chain acids may be detected aboundantly in the tongue, depending on sampling procedure. However, the stomachs and gall−bladder are independent of the adipose tissue. Especially, in the stomachs, the branched−chain acid content was recognized more in the nursling than in the adult. In ruminants, short−chain branched acids are absorbed through the wall of the stomachs. Therefore, if short−chain branched acids exist in milk of the whales, it may also be considered that the branched−chain acids in the stomachs of the nursling originate from the short−chain branched acids in milk. If this is true, it is possible to consider that short−chain branched acids in stomach lipids of the adult also originate from the short−chain branched acids which are probably produced by microorganisms in stomach cavity.

In the muscle, and liver and other organs, the branched−chain acid content was only little and the composition also differed remarkably from that in the adipose tissue. Especially. the long−chain branched acid composition was rather similar to fish oil. Accordingly, it may also be considered that the branched−chain acids in these parts originate from fatty acid in blood.

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References

Ackman, R. G., Burgher, R. D., and Jangars, P. M. (1963). *Can. J. Biochem. Physiol.*, 41, 1627−1641.

Ackman, R. G., Sipos, J. C., Eaton, C. A., Hilaman, B. L., and Litchfield, C. (1973). *Lipids*, 8, 661−667.

Bligh, E. G. and Dyer, W. J. (1959). *Can J. Biochem. Physiol.*, 37, 911−917.

Feller, D. D. and Feist, E. (1959). *J. Lipid Res.*, 1, 90−96.

Horning, M. G., Martin, D. B., Karmon, A., and Vagelos, P. R. (1961), *J. Biol. Chem*, 236, 669−672.

Ingle, D. L., Bauman, D. E., and Garrigus, U. S. (1972a). *J. Nutr.*, 102, 609−616.

Ingle, D. L., Bauman, D. E., and Garrigus, U. S. (1972b). *J. Nutr.*, 102, 617−624.

Itakura, H. (1972). (ed. by Hara, I., Hosoya, N., Takahashi, Y., and Naito, C.) in "Clinical Lipids Biochemistry", Igaku Shoin Ltd., Tokyo, Japan, 372. (in Japanese)

Morii, H. (1972). *Bull. Japan. Soc. Sci. Fish.*, 38, 1177−1183. (in Japanese)

Morii, H. (1973). *Bull. Japan. Soc. Sci. Fish.*, 39, 333.

Morii, H. (1974). *Bull. Japan. Soc. Sci. Fish.*, 40, 275−282. (in Japanese)

Morii, H. (1979a). *This Bull.*, (47), 49−54. (in Japanese)

Morii, H. (1979b). *This Bull.*, (47), 55−60. (in Japanese)

Morii, H. (1979c). *This Bull.*, (47), 61−65. (in Japanese)

Morii, H. and Kanazu, R. (1972a). *Bull. Japan. Soc. Sci. Fish.*, 38, 559−605. (in Japanese)

Morii, H. and Kanazu, R. (1972b). *Bull. Japan. Soc. Sci. Fish.*, 38, 1035−1039. (in Japanese)

Pothoven, M. A. and Beitz, D. C. (1973). *J. Nutr.*, 103, 468−475.

Pothoven, M. A., Beitz, D. C., and Zimmerli, A. (1974). *J. Nutr.*, 104, 430−433.

Rosenthal, J., Angel, A., and Farkas, J. (1974). *Am. J. Physiol.*, 226, 411−418.

Wedmid, Y., Litchfield, C., Ackman, R. G., Sipos, J. C., Eaton, C. A., and Mitchell, E. D. (1973). *Biochem. Biophys. Acta.*, 326, 439−447.

海洋性小型歯鯨（スジイルカ）の成体，乳児，胎児の組織および器官における分枝鎖脂肪酸の分布

森　井　秀　昭

成体，乳児，胎児イルカの各皮下組織，筋肉，肝臓などの諸器管の脂質の低級および高級酸組成をしらべた．成体と乳児では，脂肪組織（顎部およびメロン体部の筋肉と皮下組織）のほか，筋肉（体部）や肝臓などの諸器管にも低級および高級分枝酸（イソおよびアンテイソ酸の双方を含む）が存在した．しかしながら，筋肉や肝臓などの諸器管では分枝酸は少なく，組成も脂肪組織と異なり，高級分枝酸に至っては魚油に類似していた．ところが，成体と乳児の舌，胆のうおよび乳児の胃にはかなり多量の分枝酸が存在し，その組成も脂肪組織のものと似ていた．胎児のメロン体と顎皮（成体および乳児では脂肪組織）の脂質量は1％以下で，分枝酸も少なかった．しかしながら，分枝酸は筋肉や肝臓などの諸器管以上に含まれていた．成体，乳児とも，各種脂肪組織の低級分枝酸量と高級分枝酸量の大小関係はほぼ似ていた．