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FATTY-ACID COMPOSITION OF THE LIPIDS OF COREGONIDS OF THE OB BASIN

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The fatty acid compositions of the lipids of the muscles of the back and of the abdomen of a pelyad from the lakes of the Ob basin have been studied by gas—liquid chromatography; 29 acids have been detected of which 27 have been identified. It has been established that the lipids of the muscles of the back of the pelyad contain 37.2% of polyunsaturated and 37.3% of monoenoic acids the main components of which are oleic, palmitic, palmitoleic, octadecatetraenoic, and eicosapentaenoic acids, amounting in total to 65%. The lipids of the muscles of the pelyad are unique among lipids of fresh-water fish in their content of tri- and tetraenoic acids. As compared with the usual composition, the neutral lipids are characterized by higher amounts of monoenoic and lower amounts of polyenoic acids.

In spite of the large number of publications on the fatty-acid compositions of fish lipids [1-3]. the compositions of the fatty acids of the lipids of fresh-water fish have been studied inadequately [3, 4], and the composition of the lipids of the coregonids of the Ob basin have not been studied at all. Only the food value of river and lake pelyads [5] and the amount of polyunsaturated compounds in the lipids of the pelyads [6] have been considered.

In the present communication the results are given of a study of the fatty-acid compositions of the total neutral lipids of muscle tissue of the back and abdomen of the pelyad *Coregonus peled* (Umelin) from lakes of the Ob basin by gas—liquid chromatography and IR spectrometry.

In the lipids of the muscles of the back, 29 acids were detected, of which 27 have been identified: 13 acids were present in amounts of more than 1%, the amounts of each of seven other acids did not exceed 1%, and the amounts of the remainder were each less than 0.1%.

In the lipids of the muscles of the back of the pelyad we detected the acids with even numbers of carbon atoms from C_{10} to C_{22}, the acids with odd numbers of carbon atoms from C_{13} to C_{21}, saturated acids with compositions from $C_{10:0}$ to $C_{18:0}$, monounsaturated acids from $C_{12:1}$ to $C_{20:1}$, and polyunsaturated acids from $C_{14:2}$ to $C_{22:6}$. The acids with even numbers of carbon atoms made up 96.36% of the total.

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TABLE 1. Fatty-Acid Compositions of the Lipids of the Pelyad Muscles

Acid index	Amount, %				Literature figures [4, 8]
	back		abdomen		
	total	neutral	total	neutral	
10:0	0,10	0,06	0,10	0,05	—
12:0	0,09	0,03	0,08	0,02	—
12:1	0,03	0,03	0,02	0,01	—
13:0	0,01	0,02	0,04	0,01	—
13:1	0,04	0,01	0,06	0,03	—
14:0	3,60	2,30	4,10	4,50	1,1—15,1
14:1	0,40	0,50	0,40	0,40	—
14:2	1,90	0,60	1,40	0,90	—
15:0	0,90	0,20	0,60	0,90	—
15:1	0,20	0,20	0,10	0,40	—
16:0	16,90	25,70	25,60	24,80	14,0—26,4
16:1	10,80	19,80	11,90	8,20	5,6—17,0
16:2	0,90	0,40	0,70	0,60	—
16:3	1,50	0,30	1,00	0,50	—
17:0	1,90	0,20	1,50	0,50	—
17:1	0,80	0,10	0,60	0,20	—
18:0	1,60	1,20	1,30	1,30	1,4—5,4
18:1	18,90	31,00	23,50	27,10	11,6—49,1
18:2	3,80	2,50	3,00	1,30	1,0—7,6
18:3	9,40	4,40	6,80	4,50	0,9+
18:4	11,20	4,40	6,90	6,70	0+
20:1	0,80	0,20	0,60	0,50	—
20:2	0,10	0,10	0,30	0,50	—
20:3	1,30	0,20	0,60	0,40	—
20:4	1,70	0,20	1,00	0,70	0,5—1,3
20:5	7,80	2,10	5,00	2,00	0,8—10,0
21:5	0,30	0,40	0,80	0,60	—
22:5	0,90	1,20	0,50	1,00	
22:6	1,90	1,70	1,10	1,20	0,5—9,6+
Iodine No.	139,8	—	128,1	—	

Note. + — nonpredatory fresh-water fish.

Among the macrocomponents of the fatty acids present in the lipids in amounts of more than 1% the following five predominated: oleic (18.9%), palmitic (16.9%), octadecatetraenoic (11.2%), palmitoleic (10.8%), and eicosapentaenoic (7.8%), together amounting to 65.6% of the total fatty acids.

Particular interest in the analysis of the fatty-acid composition of fish lipids is presented by the physiologically active polyunsaturated acids and also the pentaenoic and hexaenoic acids, in the amounts of which fish lipids are unique [7].

It can be seen from Table 1 that the total polyunsaturated acids, including dienoic acids, in the lipids of the pelyad muscles amount to 37.2%, the amount of tri- and tetraenoic acids exceeds 10%, pentaenoic acids 8.1%, and hexaenoic acids 1.9%.

The results of an analysis of the fatty-acid composition of the total lipids of the muscular tissue of the pelyad corresponds to literature figures for the fatty acid compositions of the lipids of the lake herring *Coregonus artedi*, the lake whitefish *Coregonus lavaretus* [8], and other fresh-water fish [4].

The lipids of the pelyads of the water bodies of the Ob basin differed substantially from the lipids of other fresh-water fish by their high contents of octadecatrienoic, eicosapentaenoic, and octadecatrienoic acids.

A comparison of the fatty acid compositions of the total and neutral lipids of the back (see Table 1) shows similar amounts of total saturated acids but considerably larger amounts of monounsaturated acids and lower amounts of polyunsaturated acids in the neutral lipids.

Among the macrocomponents in the neutral lipids the amounts of palmitic, palmitoleic, and oleic acids are considerably increased and those of myristic, linoleic, and, particularly, octadecatrienoic, octadecatetraenoic, and eicosapentaenoic acids are considerably decreased. These differences can be explained by the fact that the total lipids of the muscles

of the back contain a considerable amount of phospholipids, 228.9 mg-%, which, as is well known, are rich in the most unsaturated components [3].

From the results of a study of the fatty acid composition of the total lipids of the muscular tissue of the abdomen (tyeshi*) it can be seen that they differ from the total lipids of the muscular tissue of the abdomen (balyk*) by a higher content of saturated acids and a lower content of all the unsaturated acids and especially, by a factor of ~ 1.5, the di, tri-, tetra-, and pentaenoic acids. In the lipids of the muscular tissue of the abdomen, in contrast to the lipids of the back, the fatty acid compositions of the total and neutral lipids are similar. Among the macrocomponents of the total and neutral lipids of the muscular tissue of the abdomen differences are observed only in the amounts of palmitoleic and eicosapentaenoic acids. The lipids of the muscular tissue of the abdomen probably contain a smaller amount of phospholipids.

IR spectra usually permit the spatial configuration of the hydrocarbon skeletons of unsaturated fatty acids to be determined [9]. The spectra of none of the samples of pelyad lipids contain bands at 980, 970, and 950 cm^{-1}, which indicates the absence of the trans configuration of the double bonds in the fatty acids.

EXPERIMENTAL

Freshly-caught year-old pelyads from the lakes of the Kazan' region of the Tyumen' province obtained in the winter catch were investigated. An average sample of the fish with dimensions of 25-30 cm was taken. The lipids were extracted from the central parts of the muscles of the back and abdomen.

The samples of tissues were comminuted, and 20-g samples of the comminuted material were homogenized for 5 min with the binary solvent chloroform—methanol (2 : 1) at 4000 rpm. The subsequent operations to extract the lipids corresponded to the method of Bligh and Dayer [10]. The chloroform was distilled off in a rotary evaporator at a temperature not exceeding 30°C. Saponification and esterification with methanol were carried out by the method of Reichwald and Meizieb [4]. The resulting material was separated from unsaponifiables by column chromatography on silica gel with a particle size of 5-40 μ.

The esters were eluted with a mixture of petroleum and diethyl ethers (9 : 1), and the unsaponifiables with petroleum ether. The compositions of the eluates were monitored by thin-layer chromatography on Silufol plates in the petroleum ether—diethyl ether—acetic acid (80 : 20 : 1) system.

The neutral lipids were isolated by dissolving the total lipids in cold acetone as described by Kates [11].

The fatty acid compositions were determined on a Vyrukhrom chromatograph with a flame-ionization detector.

The fatty acid methyl esters were separated in a steel column (300 × 0.4 cm) on Celite 545 (30-60 mesh) with 15% of polyethyleneglycol succinate as the stationary phase. The temperature of the apparatus was 250°C and that of the column 198°C, and the pressure of the carrier gas, helium, was 1.26 kg/cm^2.

The majority of the macrocomponents and some minor components were identified from the retention times of markers, and the remaining components were identified by a graphical method.

IR spectra were recorded on a UR-20 spectrophotometer in the form of tablets with sodium chloride.

SUMMARY

1. The main components of the lipids of the pelyad muscles are oleic, palmitic, palmitoleic, octadecatetraenoic, and eicosapentaenoic acids, which together make up 65.6% of all the acids.

2. The lipids of the pelyad muscles are unique among the lipids of fresh-water fish in relation to their content of tri- and tetraenoic acids.

3. Differences have been detected in the fatty acid compositions of the total lipids of the muscular tissue of the back and of the abdomen.

*Parts of dried fish used as food.

4. It has been established that the total lipids of the muscular tissue of the pelyad are characterized by higher contents of unsaturated acids than the neutral lipids.

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DYNAMICS OF THE ACCUMULATION OF THE FLAVAN COMPOUNDS OF *Hibiscus cannabinus*

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The amounts and compositions of the flavan compounds in various organs of kenaf according to the vegetation periods have been studied. It has been established that the maximum amounts of flavan substances are formed in the phloem and roots in the vegetation period.

Continuing an investigation of the phenolic compounds of kenaf [1], we have studied the amount and composition of the flavan substances according to vegetation periods in order to ascertain the dependence of the accumulation of flavanoids on such factors of the environment as the temperature and humidity of the air and the soil, and also their distribution over the organs of the plant. The plants were collected in 1979 and 1980 in the fields of the Politotdel collective farm in the Tashkent province in the following phases of development: shoots, incipient vegetation, budding, incipient flowering, mass flowering, and harvesting of the green kenaf. Because of a difference of weather conditions of 1979 and 1980, the dates of the vegetation periods differed correspondingly. The phenolic compounds were isolated from the raw plant material by extraction with aqueous methanol using the method of room-temperature steeping. To determine the total phenolic compounds their property of forming colored complexes with vanillin was used [2]. The intensity of the coloration was measured in a photoelectric colorimeter. The combined material was separated by PC in system 1. The separated zones were cut out and eluted and the amounts of material in them were determined by a method described in the literature [3]. Calculation was performed by means of a calibration curve plotted for the catechin complex of kenaf. The results on the amounts of flavans are given in Table 1.

Analysis of the results on the change in the phenolic compounds during the vegetation period shows that an intensive biosynthesis of phenolic substances takes place during the flowering phase. At this time, poly- and monoflavones, and also other intermediate phenolic compounds giving a coloration with the vanillin reagent, are formed.

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