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THE COMPOSITION OF FATTY ACIDS IN MUSCLES OF SIX FRESHWATER FISH SPECIES FROM THE MAZURIAN GREAT LAKES (NORTHEASTERN POLAND)

Joanna Łuczyńska, Zbigniew Borejszo*, Marek J. Łuczyński***

*Chair of Commodity Science and Food Analysis, University of Warmia and Mazury in Olsztyn, Poland
**Department of Aquaculture, Inland Fisheries Institute, Poland

ABSTRACT. Lipid content and fatty acids composition of non-predatory fish: roach, *Rutilus rutilus* (L.), bream, *Abramis brama* (L.), vendace, *Coregonus albula* (L.), and of predatory fish: Eurasian perch, *Perca fluviatilis* L., pike, *Esox lucius* L. and burbot, *Lota lota* (L.) were examined. These fish were caught from three lakes of Mazurian Great Lakes (Kisajno, Dargin, Niegocin). The content of total lipid and some fatty acids varied widely within and among species. Generally, the lipid content was low (0.56-2.78%). Among the saturated and monounsaturated fatty acids, the predominant fatty acids were palmitic C16:0 (19.24-33.44%), stearic C18:0 (4.37-6.87%), palmitoleic C16:1 (4.51-12.93%), and oleic C18:1 n-9 (6.85-14.49%). Arachidonic C20:4 n-6 (3.17-6.55%), eicosapentaenoic C20:5 n-3 (4.14-8.91%), and docosahexaenoic C22:6 n-3 (5.91-24.67%) acids were the most abundant polyunsaturated fatty acids. In the case of all the freshwater fish, with the exception of bream, higher contents of saturated fatty acids than monounsaturated fatty acids were noted. Among the fish studied, the highest value of total n-3 polyunsaturated fatty acids (43.86%) was noted in vendace, whereas bream contained the highest content of total n-6 polyunsaturated fatty acids (11.21%). The ratio of n-3/n-6 ranged between 1.50 (burbot) and 4.40 (vendace). Differences in the content of fatty acids in fish with different feeding strategies (non-predatory and predatory) were measured. Non-predatory fish were found to have lower values of saturated fatty acids than predatory fish ($P \leq 0.05$). Non-predatory fish contained significantly more eicosapentaenoic acid (EPA) than predatory fish ($P \leq 0.01$), whereas the amounts of monounsaturated and n-3 and n-6 polyunsaturated fatty acids in non-predatory and predatory fish were not statistically significant ($P > 0.05$). The total n-3 polyunsaturated fatty acids was higher in non-predatory fish, but not statistically significant ($P > 0.05$). Similarly, the differences in DHA and n-3/n-6 ratio in muscles of predatory and non-predatory fish were not statistically significant ($P > 0.05$).

Key words: TOTAL LIPID, FATTY ACIDS, PREDATORY FISH, NON-PREDATORY FISH

INTRODUCTION

The consumption of fish provides humans with essential long-chain fatty acids which are beneficial to cardiovascular health (Ackman 1996, Uauy and Valenzuela 2000,

CORRESPONDING AUTHOR: Joanna Łuczyńska, University of Warmia and Mazury in Olsztyn, Faculty of Food Science, Chair of Commodity Science and Food Analysis, Plac Cieszyński 1, 10-726 Olsztyn, Poland, Tel.: +48 89 5234165; e-mail: jlucz@uwm.edu.pl

Kris-Etherton et al. 2003). The lipids of fish, especially marine, contain n-3 and n-6 polyunsaturated fatty acids (Gruger et al. 1964, Viswanathan and Gopakumar 1978, Vlieg and Body 1988, Rao et al. 1995, Steffens 1997, Holub and Holub 2004, Kolanowski and Laufenberg 2006). Noteworthy are acids like eicosapentaenoic (EPA, C20:5 n-3), docosahexaenoic (DHA, C22:6 n-3), and arachidonic (C20:4 n-6) that are not synthesized by humans and must be ingested with food (Glogowski and Ciereszko 2001). These essential polyunsaturated fatty acids occur, although in minor amounts, in freshwater fish. Despite this, previous studies of the fatty acids content of freshwater fish lipids showed that these fish can be good sources of polyunsaturated fatty acids (Aggelousis and Lazos 1991, Andrade et al. 1995). The average per capita consumption of fish in Poland in 2001 was 5.6 kg $person^{-1}$ $year^{-1}$. The consumption of fish in Poland is twofold lower than that in western countries and other countries from the Baltic region. The inland surface waters in Poland are inhabited by 83 fish species. Annual commercial fishing catches are about 4000 tons of fish from lakes and 1000 tons from rivers and water reservoirs (Ministry of Agriculture and Rural Development 2004). In this way, inland fisheries profit from the resources of the Mazurian Great Lakes located in northeastern Poland. Fish available for purchase on local markets are caught regularly in these lakes and include roach, *Rutilus rutilus* (L.), bream, *Abramis brama* (L.), pike, *Esox lucius* L., perch, *Perca fluviatilis* L., vendace, *Coregonus albula* (L.), eel, *Anguilla anguilla* (L.), and pike-perch, *Sander lucioperca* (L.) (Wróblewska 1998).

For the reasons stated above, the aim of the current study was to determine the fatty acids composition of the lipids of freshwater fish inhabiting the lakes of northeast Poland and to determine differences in the content of fatty acids in fish with different feeding strategies (non-predatory and predatory).

MATERIALS

Roach, bream, vendace, Eurasian perch, pike, and burbot, *Lota lota* (L.) were caught in June 1997 from three lakes (Dargin, Niegocin and Kisajno) located in the Mazurian Great Lakes region. Samples of fish were collected the same day. Body weight and total length were measured (Table 1). Muscles (without skin) were dissected from the dorsal section using a plastic knife and stored in a freezer at -18°C until analysis, which was begun two months later. In the case of large roach, perch, bream, burbot, and pike (body weight > 200 g), samples were prepared from muscles taken from one to four specimens, whereas for small roach and perch, samples were prepared from muscle tissue taken from nine to eleven and six fish, respectively. In the case of vendace, samples were prepared from muscles taken from one or two fish.

METHODS

The lipids from the fish muscles were extracted according to the Schmidt-Bondzynski-Ratzlaff procedure (Berg and Nilsson 1997). BHA (2-tert-Butyl-4-hydroxyanisole) was added to all the samples during preparation. The fatty acid methyl esters were prepared from total lipid with the Peisker method with a mixture of chloroform: methanol: sulphuric acid (100:100:1 v/v) (Żegarska et al. 1991). The fatty acids of the methyl esters of each fish muscle sample were analyzed with capillary gas chromatography with a flame-ionization detector (FID), a mass selective detector (MSD), and a column (dimension 30 m × 0.25 μm with a 0.32 mm internal diameter) coated with Supelcowax 10. The injector and flame-ionization detector temperatures were 225 and 250°C, while the column temperature was 180°C. The helium carrier gas flow was 1 cm^3 min^{-1} (FID) and 0.8 cm^3 min^{-1} (MSD). Individual fatty acids (below 0.1%) were identified by comparing the relative retention time peaks to known standards of Supelco using the flame-ionization detector. The identification of fatty acids detected in higher amounts than 0.1% were made using gas chromatography-mass spectrometry (GC-MS).

STATISTICAL ANALYSIS

Significant differences between the contents of fatty acids in the muscle lipids of fish with different feeding strategies (non-predatory and predatory) were calculated using test *t* for independent samples. In all cases, statistical significance was estimated at $P \leq 0.01$ and $P \leq 0.05$. The contents of fatty acids in the fish muscles are expressed as the percentage of total fatty acids.

TABLE 1

Body weight, total length and fatty acid composition of total lipids of freshwater fish muscles (%) (mean±SD)

Fatty acids	Roach (27)	Bream (4)	Vendace (11)	Perch (10)	Pike (6)	Burbot (1)
weight (g)	152.6±118.4	924.4±551.9	67.2±8.0	346.0±449.6	1394.5±968.8	524.7
length (cm)	21.7±4.3	42.2±7.3	20.1±0.9	25.3±9.4	55.2±11.1	39.3
total lipid (%)	0.64	1.03	2.78	0.89	0.56	0.80
Saturated						
$C_{14:0}$	3.29±1.43	1.18±1.44	4.27±0.60	3.24±0.16	2.35±0.54	4.90
$C_{15:0}$	0.63±0.10	0.50±0.08	0.49±0.08	0.61±0.15	0.51±0.14	0.91
$C_{16:0}$	25.06±6.49	20.98±3.93	19.24±1.59	26.56±6.34	26.25±3.20	33.44
$C_{17:0}$	0.57±0.36	0.58±0.10	0.59±0.06	0.56±0.10	0.48±0.10	0.60
$C_{18:0}$	5.83±1.30	6.67±1.30	4.37±0.57	6.47±2.69	6.87±0.89	6.00
Monounsaturated						
$C_{14:1}$	0.42±0.34	0.44±0.13	0.57±0.12	0.43±0.04	0.23±0.10	0.59
$C_{16:1}$	9.53±1.97	12.93±4.86	4.51±1.50	7.32±4.42	4.64±0.73	9.77
$C_{18:1(n-9)}$	11.27±4.14	12.40±3.87	8.34±1.50	10.25±3.73	6.85±2.87	14.49
$C_{18:1(n-11)}$	4.16±0.38	6.74±0.16	2.50±0.28	3.95±0.26	1.84±1.45	6.70
$C_{20:1\ (n-3)}$	0.47±0.41	0.30±0.08	0.56±0.14	0.25±0.07	0.24±0.06	0.47
$C_{20:1\ (n-6)}$	0.57±0.25	0.36±0.19	0.20±0.04	0.49±0.55	0.15±0.06	TR
$C_{22:1(n-9)}$	0.06±0.12	0.29±0.23	0.19±0.07	0.22±0.24	TR	TR
PUFA n-6						
$C_{18:2}$	1.69±1.28	3.55±0.40	3.62±0.50	1.72±1.56	2.33±0.32	1.80
$C_{20:2}$	0.48±0.08	0.51±0.11	0.53±0.03	0.24±0.05	0.28±0.19	0.35
$C_{20:3}$	0.33±0.22	0.37±0.02	0.25±0.04	0.23±0.05	0.18±0.02	TR
$C_{20:4}$	5.49±0.55	5.83±1.33	3.17±0.90	6.55±0.72	5.46±0.23	5.65
$C_{22:4}$	0.32±0.18	0.39±0.08	0.39±0.11	0.47±0.03	0.31±0.04	TR
$C_{22:5}$	1.27±0.96	0.57±0.23	2.02±0.44	1.25±0.24	1.66±0.28	0.77
PUFA n-3						
$C_{18:3}$	2.92±1.23	2.24±0.45	4.65±0.70	1.68±1.16	3.70±1.50	1.43
$C_{18:4}$	0.56±0.36	0.32±0.11	3.17±0.92	0.47±0.36	0.42±0.28	0.73
$C_{20:3}$	0.65±0.24	0.32±0.06	0.51±0.12	0.20±0.07	0.24±0.01	TR
$C_{20:4}$	0.97±0.28	0.65±0.06	1.97±0.59	0.69±0.26	0.75±0.07	0.54
$C_{20:5(EPA)}$	6.71±1.88	8.91±1.04	8.28±0.93	6.06±0.65	6.43±0.92	4.14
$C_{22:5}$	2.17±0.25	2.41±0.64	2.69±0.43	1.95±0.28	2.75±0.34	0.11
$C_{22:6(DHA)}$	14.16±4.01	9.83±2.96	22.58±3.46	17.77±1.68	24.67±2.70	5.91
Other						
$C_{16:2}$	0.44±1.13	0.79±0.48	0.33±0.05	0.33±0.13	0.42±0.19	0.70
n-3/n-6	2.94	2.20	4.40	2.75	3.82	1.50
EPA+DHA	20.88	18.73	30.86	23.84	31.10	10.05

TR – trace amounts (below 0.01%), PUFA – polyunsaturated fatty acids, EPA – eicosapentaenoic acids, DHA – docosahexaenoic acid

RESULTS

The fish muscles contained from 0.56 to 2.78% of total lipid (Table 1). The content of fatty acids varied within and among species. The total amount of saturated fatty acids varied between 28.95 and 45.85% (Fig. 1). In all the species, palmitic acid C16:0 was the dominant saturated fatty acid (SFA), accounting for 19.24% (vendace) and 33.44%

(burbot) (Table 1). Almost all freshwater species, with the exception of bream, contained lower amounts of monounsaturated fatty acids (MUFA) than saturated fatty acids (Fig. 1). The monoenes ranged between 13.95% (pike) and 33.44% (bream). In the present study, the monounsaturated fatty acids found in the highest content were C18:1(n-9) and C16:1. Palmitoleic acid C16:1 ranged from 4.51% (vendace) to 12.93% (bream), whereas oleic acid C18:1(n-9) accounted for 6.85% in pike and 14.49% in burbot (Table 1).

The relative contents of n-3 PUFA (12.86-43.86%) was higher than the n-6 polyunsaturated fatty acids containing from 8.57% to 11.21% (Fig. 1). Arachidonic acid (C20:4 n-6) was the dominant polyunsaturated (n-6) fatty acid, except in vendace (Table 1). The level of C20:4 n-6 ranged between 3.17 (vendace) and 6.55% (perch). The percentage of linoleic (C18:2 n-6) acid ranged from 1.69% (roach) to 3.62% (vendace). The most abundant polyunsaturated (n-3) fatty acids in all the fish examined were C20:5 (EPA) and C22:6 (DHA). The percentage of docosahexaenoic acid (DHA), ranging from 5.91% (burbot) to 24.67% (pike), was higher than that of eicosapentaenoic acid (EPA). The level of C20:5 n-3 varied from 4.14% in burbot to 8.91% in bream. In all the species, the n-3/n-6 ratio was higher than 1 and ranged from 1.50 to 4.40 (Table 1). Vendace had a higher n-3/n-6 ratio than the other fish species, while a lower n-3/n-6 ratio was observed in burbot.

A lower value of saturated fatty acids (SFA) was noted in non-predatory than in predatory fish ($P \leq 0.05$) (Table 2). The amounts of monounsaturated (MUFA) and n-6 polyunsaturated fatty acids were close to those of predatory fish ($P > 0.05$). Total n-3 polyunsaturated fatty acids and PUFA were higher in non-predatory fish than in predatory fish, but not statistically significantly ($P > 0.05$).

TABLE 2

Differences in the content of fatty acids and the n-3/n-6 ratio in muscle lipids of non-predatory and predatory fish (%) (mean±SD)

	Non-predatory fish	Predatory fish
Σ SFA	31.25±5.77[a]	38.22±6.87[b]
Σ MUFA	22.84±8.05[a]	20.37±8.37[a]
Σ n-6 PUFA	10.05±1.66[a]	10.09±1.01[a]
Σ n-3 PUFA	35.42±9.65[a]	30.89±9.66[a]
Σ PUFA	45.47±14.62[a]	40.98±12.65[a]
EPA	7.86±1.49[a]	5.94±1.04[b]
DHA	17.65±6.28[a]	19.03±6.98[a]
EPA+DHA	25.51±7.77[a]	24.98±8.03[a]
n-3/n-6 ratio	3.53±1.23[a]	3.06±0.92[a]

Values in the same row with the same letter index do not differ significantly statistically (P > 0.05)

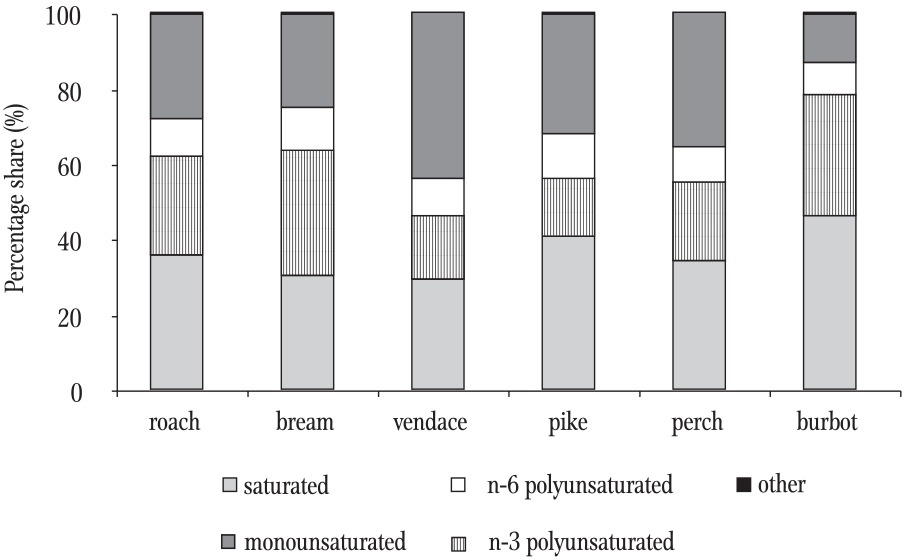

Fig. 1. Total fatty acids in muscles of selected freshwater fish.

Similarly, the differences in the DHA and n-3/n-6 ratio in the muscles of predatory and non-predatory fish were not statistically significant ($P > 0.05$). Non-predatory fish contained significantly more eicosapentaenoic acid (EPA) than did predatory fish ($P < 0.01$).

DISCUSSION

The total lipid content of the fish muscles studied varied considerably both within and among species (Table 1). The same regularity was observed by Belinsky et al. (1996). Significant interspecific differences in the content of lipid was noted by Grela and Dudek (2007). The bream caught in the waters of Greece had 1% lipid (Aggelousis and Lazos (1991), and similar values were found in the present study (Table 1). The percentage of total lipid in pike from James Bay Cree of Quebec (Canada) was 0.4% (Belinsky et al. 1996), whereas the content of total lipid for pike examined was 0.56% (Tab. 1). These findings are not consistent with levels noted by Czerwińska (2005). According to Kołakowska et al. (2000), the content of lipid in muscles (together with skin) of freshwater fish (crucian carp, *Carassius carassius* (L.), carp, *Cyprinus carpio* L., rainbow trout, *Oncorhynchus mykiss* Walbaum, pike-perch, roach, burbot, and whitefish, *Coregonus lavaretus* (L.)) and marine fish (garpike, *Belone belone* (L.), European flounder, *Platichthys flesus* (L.) and sprat, *Sprattus sprattus* (L.)) ranged between 1.61 (burbot) and 19.05% (carp). The muscles of the burbot studied (without skin) contained twofold lesser amounts of total lipid (Table 1). Similarly, the content of total lipid in the muscles of the roach examined was lower than that observed by the authors cited above. Previous studies showed that the total lipid contents in commonly consumed fish species in India were from 0.78 to 1.28% (freshwater) and from 0.32 to 1.82% (marine) (Rao et al. 1995). Whereas, the muscle tissue of the fish examined by Passi et al. (2002) contained 1.23-5.83% total lipids.

In the case of freshwater fish from Greece, the most abundant fatty acids were palmitic (C16:0), palmitoleic (C16:1), oleic (C18:1), eicosapentaenoic (C20:5 n-3), and docosahexaenoic (C22:6 n-3) (Aggelousis and Lazos 1991). This concurs with the present study (Table 1). According to Andrade et al. (1995), the most dominant saturated acids in freshwater fish from south Brazil were palmitic (C16:0) and stearic (C18:0), whereas palmitoleic (C16:1) and oleic (C18:1) acids were the major component among monounsaturated fatty acids. Among saturated and monounsaturated acids in the fish studied, palmitic acid was the highest, followed by oleic acid (C18:1 n-9) and stearic acid (C18:0) (Table 1). Grela and Dudek (2007) also found that the palmitic (22.2%) and stearic (10.98%) acids were the dominant component among saturated acids in muscle lipids of pike from ponds. The content of oleic acid (14.22%) observed by the same authors was higher than the content of this acid in the pike examined (Table 1). Kołakowska et al. (2000) noted that the roach contained higher amounts of saturated (34.98%) and monoene (46.83%) fatty acids than total polyunsaturated fatty acids (18.19%). Total saturated, monounsaturated, and polyunsaturated fatty acids in burbot measured by these authors were 32.30, 32.60, and 32.36%, respectively. These results were not consistent with the findings of the present study (Fig. 1). Only the values of saturated fatty acids in roach and monounsaturated fatty acids in burbot were close to those of the roach and burbot examined. Aggelousis and Lazos (1991) obtained similar amounts of total saturated (30.4%) and total n-6 polyunsaturated fatty acids (10.7%) in bream to those observed in the present study (Fig. 1). According to these authors, the value of total monounsaturated fatty acids (67.1%) in bream was higher than other groups of fatty acids. Similar findings were reported by

Kujawa et al. (2005). The same authors found that the value of PUFA in the muscle lipids of pike was superior to the monounsaturated fatty acids. Total PUFA in the pike examined was lower than total PUFA observed by the above authors for the same species (Fig. 1). The results for pike published by Grela and Dudek (2007) also concur with the results mentioned in the present study, because these authors found that total PUFA in muscle of pike was higher than total saturated and monounsaturated fatty acids. Perch from three reservoirs located in Italy had more total PUFA (37.93-46.97%) than saturated (29.08-33.68%) and monounsaturated fatty acids (15.18-27.31%) (Orban et al. 2000). These observations are consistent with the data of the current findings (Fig. 1). Passi et al. (2002) showed that total polyunsaturated fatty acids in marine fish (Mediterranean Sea) were the highest (21.7-61.5%), while amounts of saturated (16.9-41.3%) and monounsaturated (9.1-42.8%) fatty acids were lower. Similar observations were made by other authors for zander and cod, *Gadus morhua* (L.) (Grela and Dudek 2007). Jankowska et al. (2003) and Rennert et al. (2004) showed that the total contents of some fatty acid groups in the lipids of zander depended on food composition. The same regularity was observed by Henderson et al. (1996) for herbivorous piranha, *Mylossoma aureum* (Spix and Agassiz) and carnivorous piranha, *Serrasalmus nattereri* (Kner).

The present study found that the fish contained more DHA and EPA in comparison to other PUFA n-3. This concurred with the findings of other investigators (Grela and Dudek 2007). The percentage of EPA (11.8%) and DHA (15.3%) in bream caught in the waters of the Evros River (Greece) was higher than other n-3 polyunsaturated fatty acids (Aggelousis and Lazos 1991). The present studies confirmed the findings of these authors (Table 1). The values of DHA and EPA in the muscle lipids of burbot (with skin) measured by Kołakowska et al. (2000) were 17.21 and 6.38%, whereas the percentages of the same fatty acids for roach were 8.76% (DHA) and 4.03% (EPA). In the case of the burbot from the present study, the results were lower than those obtained by the authors above (Table 1); therefore, the percentage of DHA and EPA in the muscles (without skin) of roach in the current study were higher. The ratio of n-3/n-6 for roach and burbot observed by these authors was 11.9 and 13.9, respectively. These values are not consistent with those of the present study for the same species. The ratio of n-3/n-6 in perch from three reservoirs in Italy ranged from 1.99 to 4.47 (Orban et al. 2000). The same ratio in the muscle lipids was determined in the current study with regard to perch (Table 1). In the case of bream, the n-3/n-6 ratio (2.1) reported by Kujawa et al. (2005) is close to result noted in the present study, whereas the ratio n-3/n-6 for pike (6.4) is superior to that of the current study (Table 1).

The ratio of n-3/n-6 ranged from 1.50 to 3.82 (predatory fish) and from 2.20 to 4.40 (non-predatory fish) (Table 1). This did not confirm previous data reported by Bieniarz (2005), because the ratio of n-3/n-6 in predatory fish (2.39-3.45) was higher than that in non-predatory fish (0.74-1.68). The predatory fish (asp, *Aspius aspius* (L.), and pike) had higher n-3/n-6 ratios than did non-predatory fish (bream) (Kujawa et al. 2005). The percentage of polyunsaturated fatty acids measured by the same author were from 23.3 to 44.1% (predatory fish) and from 16.2 to 30.3% (non-predatory fish). Although total PUFA in the muscle lipids of the predatory fish examined was lower, it was not statistically significantly lower ($P > 0.05$) than PUFA in non-predatory fish (Table 2). Carp, as a representative of non-predatory fish, had lower total PUFA and total saturated fatty acids than did predatory fish (pike and pikeperch) (Grela and Dudek 2007). These results concerning saturated fatty acids concur with the results of the present study. Bieniarz (2005) found that it is possible to influence the polyunsaturated fatty acids composition of lipids through rearing conditions, particularly feed type. According to Jankowska et al. (2006), the qualitative fatty acids composition as well as saturated and unsaturated fatty acids of the meat of tench, *Tinca tinca* (L.), was not dependent on the diet, whereas tench reared on formulated feed had higher amounts of monounsaturated fatty acids and respectively less polyunsaturated fatty acids than did tench fed natural food. In the case of catfish, *Silurus glanis* L., the feeding type did not influence the total share of saturated, monounsaturated, or polyunsaturated fatty acids (Jankowska et al. 2004). On the contrary, these authors observed differences in total PUFA n-6 and n-3 between catfish fed natural feed (reared in ponds) and artificial feed (fattened in a recirculating system).

As in the case of the fish studied by Aggelousis and Lazos (1991) or Grela and Dudek (2007), the fish from the present study are good sources of docosahexaenoic (DHA) and eicosapentaenoic (EPA) fatty acids.

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STRESZCZENIE

ZAWARTOŚĆ KWASÓW TŁUSZCZOWYCH W MIĘŚNIACH SZEŚCIU GATUNKÓW RYB SŁODKOWODNYCH Z WIELKICH JEZIOR MAZURSKICH (PÓŁNOCNO-WSCHODNIA POLSKA)

Określono zawartość tłuszczu oraz skład kwasów tłuszczowych lipidów tkanki mięśniowej płoci, *Rutilus rutilus* (L.), leszcza, *Abramis brama* (L.), sielawy, *Coregonus albula* (L.), okonia, *Perca fluviatilis* L., szczupaka, *Esox lucius* L. i miętusa, *Lota lota* (L.). Ryby odławiano z trzech Wielkich Jezior Mazurskich (Kisajno, Dargin i Niegocin). Stwierdzono różnice wewnątrz- i międzygatunkowe zawartości tłuszczu oraz składu kwasów tłuszczowych. Zawartość tłuszczu mieściła się w zakresie od 0,56 do 2,78%. Wśród nasyconych i monoenowych kwasów tłuszczowych dominowały kwasy: palmitynowy C16:0 (19,24-33,44%), stearynowy C18:0 (4,37-6,87%), palmitooleinowy C16:1 (4,51-12,93%) i oleinowy C18:1 n-9 (6,85-14,49%) (tab. 1). Wśród kwasów polienowych dominowały kwasy: arachidonowy C20:4 n-6 (3,17-6,55%), eikozapentaenowy C20:5 n-3 (4,14-8,91%) i dokozaheksaenowy C22:6 n-3 (5,91-24,67%) (tab. 1). W przypadku wszystkich ryb, z wyjątkiem leszcza, odnotowano, że procentowy udział nasyconych kwasów tłuszczowych był wyższy niż monoenowych kwasów tłuszczowych (rys. 1). Najwyższą zawartość

kwasów z grupy n-3 zaobserwowano w tłuszczu sielawy (43,86%), natomiast leszcze zawierały najwięcej kwasów z grupy n-6 (11,21%) (rys. 1). Stosunek polienowych kwasów tłuszczowych z grupy n-3 do kwasów tłuszczowych z grupy n-6 wynosił od 1,50 (miętus) do 4,40 (sielawa). Niższą zawartość nasyconych kwasów tłuszczowych odnotowano w przypadku ryb spokojnego żeru ($P < 0,05$) w porównaniu z rybami drapieżnymi (tab. 2). Ryby spokojnego żeru zawierały więcej kwasu eikozapentaenowego niż ryby drapieżne ($P < 0,01$). Nie stwierdzono istotnych różnic w zawartości monoenowych oraz n-3 i n-6 polienowych kwasów tłuszczowych pomiędzy rybami spokojnego żeru i rybami drapieżnymi ($P > 0,05$). Podobnie, zawartość kwasu dokozaheksaenowego oraz stosunek kwasów n-3/n-6 w mięśniach ryb drapieżnych i spokojnego żeru nie różniły się istotnie ($P > 0,05$).