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RESEARCH ARTICLE

Fat and cholesterol content and fatty acid profiles in edible tissues of spiny-cheek crayfish, *Orconectes limosus* (Raf.) from Lake Gopło (Poland)

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Magdalena Stanek, Zbigniew Borejszo, Janusz Dąbrowski, Bogdan Janicki

Abstract. The aim of the present work was to determine the fatty acid profiles, total cholesterol content, and the fat percentage in the meat of the abdominal section of spiny-cheek crayfish, *Orconectes limosus* (Raf.), caught in Lake Gopło. A total of 177 males (aged 3+ and 4+) were collected in spring and summer for the analyses. The meat of crayfish caught during spring had higher fat contents (1.09 % in 3+ individuals and 1.10 % in older crayfish) than that in individuals from summer at 0.92 and 1.05%, respectively. Differences among these means were not statistically significant ($P > 0.05$). The total cholesterol content was higher in the meat of crayfish caught in summer (71.98 mg 100 g^{-1}), and these values differed significantly from those obtained from individuals in spring (65.32 mg 100 g^{-1}). In all groups of crayfish analyzed, the main SFA was C16:0, MUFAs were dominated by C18:1 n-6, and the highest percentage of PUFAs was of C20:5 n-3.

Keywords: crahfish, meat analyses, lipids, season, age

M. Stanek [✉], B. Janicki
Chair of Environmental Biochemistry
Faculty of Animal Breeding and Biology
University of Technology and Life Sciences
Mazowiecka 28, 85-084 Bydgoszcz, Poland
tel. +48 52 374-97-39, fax. +48 52 322-81-58
e-mail: winiarska@utp.edu.pl

Z. Borejszo
Chair of Commodity Science and Food Analysis
Faculty of Food Science
University of Warmia and Mazury in Olsztyn, Poland

J. Dąbrowski
Department of Ecology, Faculty of Animal Breeding and Biology
University of Technology and Life Sciences, Bydgoszcz, Poland

Introduction

Among the edible crustaceans, the most important are crab, shrimp, crawfish, and lobster, whose white meat is recognized as gourmet gifts from the sea. Other desirable products are the valuable meat of Antarctic krill and crayfish. The edible parts of crustaceans include the meat in the claws, legs, and abdominal sections of crab, the abdominal sections of shrimp, lobster, and krill, and the abdominal and claw meat of crayfish. Crustacean meat is a rich source of protein (25%) and fat (2.5%). The total cholesterol content in the edible parts of crustaceans is characteristic of the various species, and also depends on harvesting period and the type of tissue analyzed. In crab meat, the cholesterol content ranges from 40 to 140 mg 100 g^{-1}, in lobster meat it ranges from 50 to 170 mg 100 g^{-1}, while the amount of this sterol in the arms of squid can be as high as 450 mg 100 g^{-1} (Sikorski 2004). Crayfish meat is juicy, low-fat, low in calories, and rich in protein, and many consumers consider it to be a delicacy comparable to caviar (Konieczny et al. 2004).

Four species of crayfish inhabit the fresh waters of Poland: the noble crayfish, *Astacus astacus* L., the pond crayfish, *Astacus leptodactylus* Esch., the signal crayfish, *Pacifastacus leniusculus* Dana, the spiny-cheek crayfish, *Orconectes limosus* Raf. The meat of these species contains 18-20% protein and

0.8-2.8% fat. The claw meat is prepared as a canned product sold as crayfish neck. The characteristics of the crayfish body structure make their meat yield relatively low (Walkowiak 1979). It ranges, depending on individual and species size, from 12 to 18% (Krzywosz et al. 2002). The main edible part of the spiny-cheek crayfish is meat obtained from the abdomen. Many recipes for dishes with crayfish meat have been published by Mastyński and Andrzejewski (2005). Krzywosz et al. (1995) determined the total biomass of the catch population of spiny-cheek crayfish at approximately 800 tonnes in the waters of the former Suwałki Voivodeship. This species dominates throughout Poland, except in the southeastern part of the country (Krzywosz 1999).

The study of the chemical composition and meat yield of crayfish from different environments was carried out by Własow et al. (2002, 2004). Walkowiak (1979) evaluated the properties of selected fish and crayfish meat, the chemical composition of certain crustaceans and the fatty acid profiles of crayfish carapace extracts. Dąbrowski et al. (1966) researched the nutritional value of spiny-cheek crayfish meat. These studies focused mainly on protein and amino acids. In the literature, data are available on the fat content and fatty acid profiles of the meat from Japanese crayfish, *Procambarus clarkii* (Girard), Finnish crayfish, *Astacus fluviatilis* Fabricius, (Meyer--Rochow et al. 1999), and rusty crayfish, *Orconectes rusticus* (Girard) (Wolfe et al. 1965). Barim and Karatepe (2010) have evaluated the impact of pollution on the content of vitamins in the meat of pond crayfish. Additionally, numerous data are available on the chemical composition and nutritional value of meat from other crustaceans, for example, brown crab, *Cancer pagurus* L. (Barrento et al. 2010), Chinese mitten crab, *Eriocheir sinensis* (Milne-Edwards) (Chen et al. 2007), European lobsters, *Homarus gammarus* (L.), American lobsters, *Homarus americanus* (Milne-Edwards) (Barrento et al. 2009), and Antarctic krill, (*Euphausia superba* Dana (Gigliotti et al. 2011, Martin 2007).

The aim of the present paper was to compare the fat, total cholesterol content, and fatty acid profiles in the meat from the abdominal sections of 3+ and 4+ spiny-cheek crayfish caught in spring and summer. The results were also compared with the meat quality of other crayfish species and other crustaceans.

Materials and Methods

Spiny-cheek crayfish were caught with pond gear in spring (April 2010) and summer (June 2010) in Lake Gopło. Crayfish with missing or damaged claws were not analyzed. A total of 177 males were collected for the research. These individuals had total lengths ranging from 8.0 to 11.5 cm and were divided into two age groups of 3+ and 4+. The age of the crayfish was calculated based on body length according to Pieplow (Kossakowski 1966). Body length was measured from the rostrum to the end of the telston. Because the meat yield from the abdominal sections of individual crayfish was low, material from individuals of similar body lengths (about 8-10 pieces each) was combined. Thus, 12 meat samples were obtained in spring and nine in summer. The meat samples (about 12 g) were freeze dried, and then the fatty acid composition (% of the determined fatty acids), fat content (%), and total cholesterol concentration (mg 100 g^{-1}) were determined. The analyzed meat samples were freeze dried in a Lyovac GT2 freeze-drier by Finn-Aqua (Finland).

The percentage content of fat in the crayfish meat was determined with the modified method by Folch et al. (1957). Approximately 2 g of freeze-dried tissue was weighed, and total fat was extracted from crayfish meat using 30 cm^3 of the mixture of a mixture of chloroform-methanol (2:1). After shaking, filtering, and removing the solvent, the percentage content of fat in tissues was determined (% content of wet weight).

The cholesterol content was determined with the modified Liebermann-Burchardt colorimetric method (Strzeżek and Wołos 1997) using a Shimadzu spectrophotometer (Japan). The cholesterol was extracted from 0.25 g samples of freeze-dried tissue with 15 cm^3 chloroform. After filtration, the solution was supplemented with chloroform in the measurement container to a volume of 25 cm^3. One cm^3 acetic anhydride and 0.25 cm^3 sulfuric acid (VI) were added to 2 cm^3 of the filtrate obtained. After 5 minutes, the absorption value was measured in a blind test at a wavelength of 620 nm. The results are presented as mg 100 g^{-1} of wet weight.

The fatty acid profiles were determined with an HP 6890N gas chromatograph with a flame-ionization detector (Hewlett-Packard, USA). The temperature of the injector was 225°C and that of the detector was 250°C, while the column temperature was 180°C. The volume of the injected sample was 1 µl (split 1:50). The analysis was performed on a Supelcowax10 30 m × 0.32 mm × 0.25 µm column. The carrier gas was helium at a flow rate of 1 cm^3 min^{-1}. Fat was extracted with the method by Folch et al. (1957). The fatty acid methyl esters were prepared from total lipid following the Peisker method with a mixture of chloroform:methanol:sulphuric acid (100:100:1 v/v) (Żegarska et al. 1991). The group of the fatty acids analyzed included saturated acids (SFA) (C14:0, C15:0, C16:0, C17:0, C18:0, C20:0, C22:0), monounsaturated acids (MUFA) (C14:1, C16:1 n-7, C17:1 n-7, C18:1 n-9, C18:1 n-9, C20:1 n-9, C20:1 n-7), and polyunsaturated acids (PUFA) (C18:2 n-6, C18:3 n-6, C20:2 n-6, C20:3 n-6, C20:3 n-3, C20:4 n-6, C20:4 n-3, C20:5 n-3, C22:5 n-6, C22:5 n-3, C22:6 n-3). The methyl esters of the fatty acids were identified using model and Supelco 37 component FAME Mix (Supelco, USA). Lipid quality indexes (atherogenic index – AI and thrombogenicity index – TI), were calculated following Ulbricht and Southgate (1991).

Statistical analysis

Data analyses were performed by using Statistica 8.0 software (StatSoft, USA). The significance of differences in mean contents were calculated with two-way analysis of variance. All data – fat, cholesterol, and fatty acids (SFA, MUFA, PUFA, n-3, n-6, n-3/n-6, n-6/n-3, AI, TI) were analyzed statistically with Tukey's test to compare mean values. Differences in fat and cholesterol content between crayfish caught in spring and summer, and between individuals aged 3+ and 4+ were analyzed with Student's test. The normality of the data was tested using the Shapiro-Wilk's test and the homogeneity of variance with Levene's test.

Results

The total fat content of the spiny-cheek meat ranged from 0.92 to 1.10% (Table 1). No statistically significant differences were noted in these values that were were below 5%, which is generally considered to characterize low-fat foods. The fat content of meat from spiny-cheek crayfish aged 4+ was higher by about 0.03% than that in younger individuals, which contained 1.04% fat. Statistical differences (P = 0.647) between these values were not significant. There were no statistically significant differences (P = 0.263) in the fat content of crayfish meat caught in spring (1.10%) and summer (1.00%).

As analyses indicated, the total cholesterol content in meat from crayfish caught in Lake Gopło ranged from 64.84 mg 100 g^{-1} to 72.11 mg 100 g^{-1} (Table 1). The cholesterol content of meat from 4+

Table 1
Total cholesterol and fat content in the meat of 3+ and 4+ spiny-cheek crayfish caught in spring and summer in Lake Gopło

			Fat (%)	Cholesterol (mg 100 g^{-1})
Age	Catch period	n	mean SD	mean SD
3+	spring	7	1.09 ± 0.18	65.67 ± 6.48
	summer	3	0.92 ± 0.24	71.71 ± 5.84
4+	spring	5	1.10 ± 0.14	64.84 ± 5.65
	summer	6	1.05 ± 0.17	72.11 ± 5.16

TABLE 2
Fatty acid content (% of total acids; mean ± SD) in the meat of 3+ and 4+ crayfish caught in Lake Gopło

	Crayfish age			
	3+		4+	
Fatty acids	spring	summer	spring	summer
SFA				
C14:0	0.43 ± 0.06	0.46 ± 0.04	0.40 ± 0.07	0.43 ± 0.08
C15:0	0.51 ± 0.04	0.48 ± 0.00	0.50 ± 0.02	0.47 ± 0.02
C16:0	14.09 ± 0.41	14.10 ± 0.81	13.42 ± 0.32	13.44 ± 0.46
C17:0	0.85 ± 0.02	0.88 ± 0.03	0.84 ± 0.03	0.87 ± 0.05
C18:0	5.30 ± 0.15	5.63 ± 0.10	5.24 ± 0.16	5.53 ± 0.33
C20:0	0.58 ± 0.03	0.65 ± 0.12	0.59 ± 0.01	0.66 ± 0.06
C22:0	0.22 ± 0.06[a]	0.36 ± 0.16[ab]	0.26 ± 0.06[ab]	0.41 ± 0.08b
SFA	21.97 ± 0.56	22.56 ± 0.69	21.26 ± 0.45	21.80 ± 0.50
MUFA				
C14:1	0.31 ± 0.05	0.32 ± 0.01	0.36 ± 0.05	0.34 ± 0.05
C16:1	3.04 ± 0.21	2.77 ± 0.13	3.13 ± 0.13	3.20 ± 0.58
C17:1	0.66 ± 0.05	0.65 ± 0.05	0.73 ± 0.04	0.73 ± 0.07
C18:1 9c	19.59 ± 0.45[a]	19.27 ± 0.41[a]	20.93 ± 0.57[b]	19.53 ± 0.77[a]
C18:1 11c	4.02 ± 0.21	3.78 ± 0.08	3.73 ± 0.16	3.77 ± 0.18
C20:1 n9	1.18 ± 0.07	1.17 ± 0.03	1.19 ± 0.04	1.21 ± 0.08
C20:1 n7	0.26 ± 0.03	0.25 ± 0.02	0.29 ± 0.05	0.29 ± 0.05
MUFA	29.05 ± 0.52	28.20 ± 0.50	30.36 ±0.46	29.06 ± 1.25
PUFA				
C18:2	7.17 ± 0.39	6.61 ± 1.10	6.95 ± 0.75	6.66 ± 0.81
C18:3	1.89 ± 0.08	1.68 ± 0.28	1.57 ± 0.11	1.99 ± 0.80
C20:2	2.36 ± 0.09	2.38 ± 0.05	2.40 ± 0.10	2.47 ± 0.11
C20:3 n6	0.25 ± 0.02	0.25 ± 0.02	0.24 ± 0.01	0.27 ± 0.06
C20:4 n6	11.74 ± 0.17	12.20 ± 0.41	13.18 ± 0.25	12.90 ± 1.60
C20:3 n3	0.60 ± 0.02	0.60 ± 0.08	0.54 ± 0.03	0.62 ± 0.10
C20:4 n3	0.32 ± 0.03	0.31 ± 0.02	0.30 ± 0.03	0.36 ± 0.08
C20:5 n3	20.48 ± 0.51	20.15 ± 1.84	19.03 ± 0.94	19.17 ± 1.16
C22:5 n6	0.33 ± 0.02[a]	0.39 ± 0.02[b]	0.35 ± 0.03[ab]	0.41 ± 0.02[b]
C22:5 n3	0.51 ± 0.04[a]	0.59 ± 0.05[c]	0.52 ± 0.01[ab]	0.58 ± 0.04[c]
C22:6	3.34 ± 0.08	4.08 ± 0.61	3.32 ± 0.25	3.72 ± 0.84
PUFA	48.98 ± 0.60	49.24 ± 0.82	48.38 ± 0.62	49.14 ± 1.37
n-3	25.24 ± 0.23	25.73 ± 1.27	23.70 ± 1.16	24.44 ± 1.34
n-6	23.73 ± 0.51[a]	23.51 ± 0.45[ab]	24.68 ± 0.75[b]	24.70 ± 0.27[b]
n-3/n-6	1.06 ± 0.03[a]	1.10 ± 0.07[a]	0.96 ± 0.07[b]	0.98 ± 0.05[ab]
n-6/n-3	0.94 ± 0.03[a]	0.92 ± 0.06[ab]	1.04 ± 0.08[b]	1.01 ± 0.05[ab]
AI	0.20 ± 0.01	0.20 ± 0.01	0.19 ± 0.01	0.19 ± 0.01
TI	0.19 ± 0.01	0.19 ± 0.02	0.19 ± 0.01	0.19 ± 0.01

Values in a row with different letters differ significantly (Tukey's test, P < 0.05)

spiny-cheek crayfish was higher by about 1.33 mg 100 g^{-1} than that the younger individuals, which was 67.48 mg 100 g^{-1}. Differences were not statistically significant (P = 0.645). The total cholesterol content was higher in the meat of crayfish caught in summer (71.98 mg 100 g^{-1}) at significant differences (P = 0.013) in comparison with the data from individuals caught in spring (65.32 mg 100 g^{-1}).

Among the group of SFA analyzed, the highest percentage was recorded for C16:0 in all groups of samples obtained from crayfish caught in Lake Gopło (Table 2). The lowest percentage of fatty acids was of C22:0. The analysis indicated that the mean percentage contents of this saturated acid differed significantly between 3+ crayfish caught in spring and older individuals from summer.

The highest percentage in the MUFA group was noted for C18:1 9c at 29.05% for 3+ crayfish caught in spring and 28.20% for individuals from summer, and 30.36 and 29.06% for 4+ crayfish, respectively (Table 2). The mean percentage contents of C18:1 n-9 differed significantly between 4+ individuals caught in spring and the other crayfish samples. The lowest amount of this group of acids was of C14:1.

The fatty acid profiles of the spiny-cheek crayfish analyzed was dominated by PUFA, which comprised 48.38 to 49.24% of the total fatty acids (Table 2). The n3/n6 ratio in the meat of 3+ crayfish caught in spring and summer was 1.06 and 1.10, and in older individuals it was 0.96 and 0.98, respectively. AI ranged from 0.19 to 0.20, and the mean value of TI was 0.19 in all groups (Table 2).

Discussion

The fat contents of meat from different crayfish species are similar and do not exceed 1% (Konieczny et al. 2004). The mean contents of fat in crayfish meat from individuals caught in the Brda River and Lake Gopło were 0.43 and 0.44%, respectively (Stanek et al. 2010). According to Walkowiak (1979), the amount of fat in crayfish necks ranged from 0.4 to 0.9%. Reports by Własow et al. (2002) show that the percentage content of fat in the meat of crayfish caught in the Mazurian Lakeland ranged from 0.15 to 0.30%. Similar values were determined for crayfish caught in lakes Dgał, Harsz, and Pobłędzie (0.24-0.30%) (Własow et al. 2005). These values indicate that the fat content in crayfish meat is similar to that of the meat of lean fish, which contains up to 2% fat (Sikorski 2004). Larger amounts of fat are accumulated primarily in fall in crustaceans (Żyrko 1978).

Currently, one of the major concerns about food quality and nutrition in developed countries is cholesterol content, and 140 mg of cholesterol per day is considered to be a moderate value for human consumption (Barrento et al. 2009). The main total cholesterol content in the meat of brown crab males ranged from 37.0 to 40.7 mg 100 g^{-1} wet weight (Barrento et al. 2010). The cholesterol concentration in the leg and claw meat of green crab, *Carcinus maenas* L., ranged from 57.2 to 64.8 mg 100 g^{-1} (Skonberg and Perkins 2002). Sterols are stored and modified according to the needs of the animal. In summer, water temperature increases and fish adjust cell membrane component composition (with increased cholesterol content) in relation to temperature (Souchet and Laplante 2007). These data confirm the results obtained by the authors of the present work.

As the analyses indicated, the highest percentage share of the SFA was noted for C16:0 in the meat of crayfish caught in the Brda River (21.33% total acids) and in Lake Gopło (15.36% total acids) (Stanek et al. 2010).

Analyses carried out by Walkowiak (1979) demonstrated that the highest MUFA share in crayfish carapace extract was noted for C18:1 9c. The same results were obtained with the meat of brown crab (Barrento et al. 2010), while the highest amounts of MUFA in the meat of Chinese mitten crab was noted for C18:1 9c (30.96% of total acids) (Chen et al. 2007).

The fatty acid profiles of the spiny-cheek crayfish analyzed was dominated by PUFA (Table 2). The same results were observed by Naczk et al. (2004) for green crab, Barrento et al. (2010) for brown crab, and by Barrento et al. (2009) for European and American lobsters. The analysis of PUFA indicated that the highest percentage share in the meat of spiny-cheek was of C20:5 n-3 (EPA), while the lowest was of C20:3 n-6. Statistical analyses indicated that there were no significant differences in the mean percentage contents of all PUFA between 3+ and 4+ crayfish caught in both seasons. The sum of PUFA in the meat of spiny-cheek crayfish from the Brda River was 37.76 %, and 39.18% in the meat of individuals caught in Lake Gopło (Stanek et al. 2010). In analyses by Walkowiak (1979), the sum of PUFA in the crayfish carapce extract was 34.7%. PUFA from the n-3 series, especially DHA and EPA, which are now recognized as essential nutrients for marine animals in general. The n-3/n-6 PUFA ratio in the meat of crayfish from the Brda River was 0.72, while in specimens caught in in Lake Gopło it was 0.70 (Stanek et al. 2010). The n-3/n-6 ratio in the meat of lobsters was 4.2 in females and 4.1 in males (Barrento et al. 2009). In the meat of males of crabs, this ratio was 3.5 and 4.0 (Barrento et al. 2010). This coefficient fell within the range for freshwater fish (0.5-3.8) (Steffens and Wirth 2005). An increase in the ratio n3/n6 PUFA increases the availability of n-3 PUFAs, which are beneficial for human health. FAO experts have recommended that ratio of n-6/n-3 PUFAs in the diet should be between 5:1 and 10:1 (Chen et al. 2007). In the meat of spiny-cheek crayfish from Lake Gopło, the ratio of n-6/n-3 ranged from 0.92 to 1.04 (Table 2). The United Kingdom Department of Health recommends a n-6/n-3 ratio of 0.25 as optimum for the human diet (Barrento et al. 2010).

The fatty acids composition of crustaceans varies among species, the water temperatures inhabited, the food consumed, habitats, and sex (Barrento et al. 2009). EPA concentrations ranged from 0.01 to 1.5 g 100 g^{-1}, while those of DHA ranged from 0.01 to 2.00 g 100 g^{-1} in the meat of various crustacean species (Mahaffey 2004). Previous studies conducted by Stanek et al. (2010) showed that in the SFA, MUFA and PUFA groups, the highest percentage share was noted for C16:0, C18:1 n-9, and EPA, respectively. Naczk et al. (2004) studied the amino acids and fatty acid composition in the meat from the body and claws of green crabs. The total lipid content and dry weight basics were 80.6-83.5%, and 3.6-4.8%, respectively. These values concurred well with those published for meat obtained from blue crab, *Callinectes sapidus* Rathbum, which has been analyzed by many researchers, while they were somewhat lower than those reported for Atlantic Queen crab, *Chionectes opilio* (Fabricius). The main saturated fatty acids were palmitic (C16:0) and stearic (C18:0), while oleic acid (C18:1 n9) was the dominant monounsaturated fatty acid. The fatty acid profile of green crab lipids was dominated by polyunsaturated fatty acids, which comprised from 47.1 to 50.5%. The dominant PUFAs were EPA and DHA. These values were similar to those reported by other authors for snow (Queen) (*Chionoectes*) and Dungeness crab, *Romaleon antennarium* (Stimpson).

Barrento et al. (2009) conducted a study on the nutritional quality of the edible tissues of European and American lobsters, and their results concurred with those published for meat from different crab species. Our results for crayfish from Lake Gopło were very similar to those reported for other crustaceans. The dominant fatty acids were: SFA – C16:0 and C18:0; MUFA – C18:1 9c; n-3 PUFA – EPA and DHA. The major n-6 PUFA was C20:4 n-6. The fat content of krill was low, but it was rich in EPA and DHA (Martin 2007). The lipid content and its composition in krill depends on the species, age, and time between capture and freezing. The cholesterol level in krill is higher than in fish meat, but lower than in shrimp. It is very important that the two-thirds of the sterols in crustaceans are non-cholesterol sterols (Gigliotti et al. 2011).

The dietetic value of meat is also determined by SFA and MUFA and not only by n-6 PUFA. Lipid quality indicators that depend on the relative contents of particular groups of fatty acids are the atherogenic index (AI) and thrombogenicity index (TI). These indexes indicate the global dietetic quality of lipids and their potential effects on the development of coronary disease (Jankowska et al. 2010). AI ranged from 0.19 to 0.20, while the mean value of TI was 0.19 in all groups (Table 2). Such values were lower than those obtained for the other food products such as lamb, beef, pork, rabbit, and chicken. In lobster meat the AI ranges from 0.22 to 0.26, while TI was from 0.14 to 0.17 (Barrento et al. 2009). In crab meat the AI and TI index was 0.17 and 0.12, respectively (Barrento et al. 2010).

The results from this study concur with the common knowledge that seafood is a source of high-quality protein with a well-balanced essential amino acids composition, is high in essential PUFA (especially the n-3 group), and has low cholesterol levels. Seafood is a low-fat food like many fish species, and almost all crustaceans contain less than 2.5% of the total fat in the meat with only a small number of species containing more than 15% (Barrento et al. 2010).

Conclusions

1. The total fat content of crayfish meat is below 5% – a value generally considered to be characteristic of low-fat food.
2. The total cholesterol content is higher in the meat of crayfish caught in summer (71.98 mg 100 g^{-1}), and there are significant differences in comparison with the data obtained for individuals in spring (65.32 mg 100 g^{-1}).
3. The fatty acid profile of the analyzed crayfish lipids is dominated by PUFA, which comprises from 48.38 to 49.24% of the total fatty acids.

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Streszczenie

Zawartość tłuszczu i cholesterolu oraz profil kwasów tłuszczowych w jadalnej tkance raka pręgowatego *Orconectes limosus* (Raf.) z jeziora Gopło (Polska)

Celem pracy było oznaczenie zawartości tłuszczu i cholesterolu całkowitego oraz profilu kwasów tłuszczowych w mięsie odwłokowej części raka pręgowatego pozyskanego z jeziora Gopło wiosną i latem. Do badań pozyskano 177 sztuk samców (3- i 4-letnich). Analizy wykazały, że mięso raków odłowionych wiosną posiadało większą ilość tłuszczu (1,09% u osobników 3-letnich i 1,10% u raków starszych), niż u osobników pozyskanych latem, co wynosiło odpowiednio 0,92 i 1,05%. Różnice pomiędzy tymi wartościami nie różniły się statystycznie istotnie (P > 0,05). Zawartość cholesterolu całkowitego była wyższa w mięsie raków odłowionych latem (71,98 mg 100 g^{-1}) i obliczono statystycznie istotne różnice pomiędzy tą zawartością, a ilością tego sterolu w mięsie raków z wiosny (65,32 mg 100 g^{-1}). We wszystkich grupach analizowanych raków, głównym kwasem nasyconym był kwas C16:0, jednonienasyconym kwas C18:1n-6, w grupie kwasów wielonienasyconych największy udział procentowy miał kwas C20:5n-3.