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FATTY ACIDS PROFILE IN DORSAL AND VENTRAL SECTIONS OF FILLETS FROM EUROPEAN CATFISH (*SILURUS GLANIS* L.) FED VARIOUS FEEDS

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ABSTRACT. The aim of the research was to compare the basic composition and fatty acids profile from dorsal and ventral fillets of European catfish cultivated in earthen ponds on natural feed with those from fish fed artificial feed under intensive cultivation in recirculating systems. The lipid content in the dorsal and ventral fillets of catfish fed natural feed varied and were higher in the ventral fillets ($P < 0.01$). The lipid content of catfish fed artificial feed was equal ($P > 0.01$). The fatty acids profiles of dorsal and ventral fillets from catfish fed natural feed differed, while no such differences were noted in the fillets of fish fed artificial feed. It was revealed that the differences between the dorsal and ventral fillets of catfish cultivated on natural feed mainly regarded unsaturated; this led to different relationships between the amounts of MUFA and PUFA. This was due to the various amounts of oleic, palmitic, and mainly docosahexaenoic (DHA) acids. It was also determined that a 100 g ventral fillet from catfish cultivated on natural feed had an approximately two-fold higher content of various fatty acids, especially those from the valuable n-3 group, than did dorsal fillets. No such difference was noted in catfish cultivated with artificial feed in recirculating systems.

Key words: EUROPEAN CATFISH (*SILURUS GLANIS*), FILLET, CHEMICAL COMPOSITION, FATTY ACIDS

INTRODUCTION

Fish lipids can be stored in tissues, the subcutaneous fat layer, the liver, gonads and in deposits near the intestines, which is the main lipid storage area in many teleost fish. The distribution of lipids in fish meat is also uneven and depends on the species, muscle type, and location (Ackman 1967).

Based on species such as *Salmo salar* (Aursand et al. 1994), *Melanogramus aeglefinus* (Nanton et al. 2003), *Clarias gariepinus* (Hoffman et al. 1995), *Oncorhynchus mykiss* (Ingemansson 1991), and *Catostomus commersoni* (Mai and Kinsella 1979),

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dark muscle tissue contains more lipid than does light. Auborg et al. (1999) divided *Merluccius merluccius* into anterior dorsal, dorsal, tail, and dark muscle sections and reported that the lipid content in the dark muscle tissues ranged from 7-12%, while that in the other parts ranged from 0.5 to 1.1%. According to Exler (1975), the light muscle of five fish species contained fewer lipids than dark muscle lying along the lateral line or from the ventral section.

Katikou et al. (2001) reported differences in the lipid content between dorsal and ventral as well as anterior and posterior sections of *Salmo salar*. Thakur et al. (2003) determined varying amounts of lipid in the anterior dorsal, dorsal, and tail sections of light muscle in cultivated *Seriola quinquradiata*. According to Nortved and Tuene (1998), the highest lipid contents in fillets of *Hippoglossus hippoglossus* were observed in ventral sections, while lower levels were detected in the central and tail sections. Lipid content increased from the tail section (1.9%) to the head section (17.5%) and the ventral section contained more lipid (7.1%) than did the fillet (4.1%).

Studies of *Oncorhynchus mykiss* fed feed with various lipid contents for twenty-five weeks indicated that, regardless of the of the feed lipid content, the ventral section contained more lipid than did the dorsal or tail sections. However, the difference between the dorsal and ventral sections increased when feed of a higher lipid content was applied (Nickell and Bromage 1998). Similarly, Regost et al. (2001) maintained that, regardless of the chemical composition or lipid content of the feed, the ventral muscles of *Psetta maxima* contained more lipid in comparison with dorsal muscle. Dias et al. (2001) applied a diet fortified with L-carnitine and determined that the lipid content in the dorsal fillets of *Dicentrarchus labrax* was higher than in the dorsal fillets.

Data also exists regarding variation in the proportions of the neutral and polar lipid fraction shares as well as various fatty acids contents in different muscles and in fillet sections. Aursand et al. (1994) reported that the percentage of triacylglycerols in the dark muscle lipids of *Salmo salar* was higher while the phospholipids were lower in comparison to light muscles. The lipids of light muscle also had lower levels of monoenoic acids. According to Hoffman et al. (1995), the lipids in the dark muscle of *Clarias gariepinus* contained more monounsaturated fatty acids (MUFAs), while light muscle contained more polyunsaturated fatty acids (PUFAs). Ruiz-Gutierrez et al. (1997) reported that the lipids in the dorsal part of *Ruvettus pretiosus* contained more polyunsaturated fatty acids (PUFAs) and fewer saturated or monounsaturated fatty acids.

The aim of the current research was to compare the basic composition and fatty acids profile of the dorsal and ventral fillets of European catfish, *Silurus glanis* L. cultivated on natural feed in earthen ponds with those fattened intensively on artificial feed in recirculating systems.

MATERIALS AND METHODS

The material used in the study was comprised of European catfish cultivated in earthen ponds or obtained through intense fattening in recirculating systems. The pond specimens came from the Samoklęski Fish Farm in southeastern Poland. They were 2.5 years old and had been reared in polyculture with carp, *Cyprinus carpio*, and tench, *Tinca tinca*. In the first year, catfish larvae obtained from artificial reproduction were stocked into ponds with carp fry. In the fall the catfish fry were moved to grow-out ponds for the subsequent two growth seasons.

The fish that were fattened intensively with artificial feed came from the Dgał Experimental Hatchery of the Inland Fisheries Institute in Olsztyn. These were 1.5 year-old specimens obtained from artificial reproduction and intense rearing exclusively on artificial feed (Ulikowski 2003). The rearing of the larval and juvenile stages was done in basins with a volume of 1 m^3 in a recirculating system. The fish were fed *ad libitum* with Nutra Classic trout granulate by TROUVIT, France. In the last two months of fattening, Nutra Classic T-3P feed was applied; it had a granulate size of 5 mm and contained 43% protein, 18.0% lipid, 21.3% carbohydrates, and 8.0% ash. The fatty acids profile is presented in Table 1. Feed was supplied with an automatic feeder twenty-four hours per day. The stock density during the last two months was 30-60 kg m^{-3}.

Water temperature was measured daily and an OxyGuard electronic meter was used to measure the daily O_2 concentration at the basin outflow. The oxygen saturation at the outflow remained above 40%, and water temperature was 25 ± 2°C. Every two to three days water samples were taken from the system to determine overall ammonia nitrogen N-NH_4 and nitrate nitrogen N-NO_2. The ammonia level was 0.1-0.8 mg N-NH_4 dm^{-3}, and nitrites 0.02-0.35 mg N-NO_2 dm^{-3}.

In mid November ten catfish were caught from the pond and intensive cultures each. After body weight (BW ± 0.1g) was determined, the fish were filleted and the fillets were weighed. The left fillet from each fish was divided along the vertical connec-

tive tissue divide into the dorsal and ventral sections. Each section was weighed. After the samples had been ground through 3 mm mesh, the basic composition and the fatty acids profiles were determined.

TABLE 1

Fatty acids profile of artificial feed (trout feed) (% of total fatty acids)

Fatty acid	Percentage share	Fatty acid	Percentage share
14:0	6.71	20:0	0.24
14:1	0.29	20:1n-9	7.36
15:0	0.53	20:1n-7	0.38
16:0	16.39	20:2	0.23
16:1	6.96	20:3n-6	0.11
17:1	0.91	20:4n-6	0.52
16:4	0.95	20:4n-3	0.61
18:0	2.88	20:5n-3	9.99
18:1cis9	10.61	22:1n-11	8.20
18:1cis11	2.59	22:1n-9	0.93
18:2n-6	5.43	22:5n-6	0.25
18:3n-3	1.29	22:5n-3	1.15
18:4	2.96	22:6n-3	11.53

BASIC COMPOSITION ANALYSES

Water content was determined by drying the samples to a temperature of 105°C to a constant weight. Protein was determined with the Kjeldahl procedure using the 6.25 multiplyer, and lipid with the Soxhlet method with petroleum benzine. Ash content was determined by mineralizing the samples at a temperature of 550-600°C (AOAC 1975).

ANALYSIS OF THE FATTY ACIDS PROFILE

Quantitative and qualitative analysis of the fatty acids was done following the cold extraction of muscle lipids according to Folch et al. (1957). The fatty acids were methylated with a chloroform : methane : sulfuric acid mixture (100:100:1) (Peisker 1964). Chromatographic separation was performed on an Agilent Technologies 6890 N gas chromatograph with a flame-ionization detector (FID) and a 30 m capillary column with an inner diameter of 0.32 mm. The liquid stationary phase was provided by 0.25 μm thick Supelcowax 10 film. Separation was done with helium as the carrier gas at a flow rate of 1 ml min^{-1}. The detector, injector, and column temperatures were 250, 225, and 185°C, respectively. Detector signals were registered by a Philips recorder

using a 1 mV scale at a paper speed of 10 mm min^{-1}. The different acids were identified by comparing retention times with standards provided by Supelco (Bellefonte PA, USA).

STATISTICAL ANALYSES

The values given in this paper are means ± SEM obtained from the analysis of ten fish from both of the study groups (fed natural or artificial feed). The differences between the mean values of the studied parameters were calculated with one-way analysis of variance (ANOVA). The Student-Newman-Keuls test was applied, and differences were statistically significant at $P \leq 0.01$. Calculations were performed with Statistica 6.0 PL.

RESULTS AND DISCUSSION

The dorsal section of the catfish cultivated in ponds comprised 50.9% of the total fillet weight while the ventral section comprised 49.1%. The share of these two section in the catfish from intensive culture was equal (Table 2). Thus, the share of the dorsal and ventral sections was independent of the diet applied ($P > 0.01$).

TABLE 2

Share of dorsal and ventral sections in fillets from catfish cultivated in ponds (natural feed) and recirculating systems (artificial feed) (mean ± SEM)

Parameter	Unit	Catfish – natural feed*	Catfish – artificial feed*
Fish weight	(g)	1341.1 ± 45.86[a]	1189.4 ± 35.58[a]
Whole fillet	(g)	260.0 ± 9.24[a]	269.7 ± 7.94[a]
	(%)	100.0	100.0
Dorsal section	(g)	132.4 ± 5.62[a]	136.9 ± 4.95[a]
	(%)	50.9 ± 0.83[a]	50.9 ± 0.69[a]
Ventral section	(g)	127.7 ± 4.60[a]	132.8 ± 3.62[a]
	(%)	49.1 ± 0.83[a]	49.1 ± 0.69[a]

** – Values in the same row with the same letter index do not differ significantly statistically (P > 0.01)*

The lipid content of the dorsal section of fillets from catfish cultivated in ponds was lower by 1.88% than that in the ventral section, while the water content was higher by 1.44% ($P < 0.01$, Table 3). The contents of protein and ash did not differ significantly statistically ($P > 0.01$). There were no significant differences among the analyzed parameters in the dorsal and ventral fillet sections of catfish that had been fed artificial feed in recirculating systems ($P > 0.01$, Table 3).

TABLE 3

Chemical composition of the dorsal and ventral sections of fillets from catfish cultivated in ponds (natural feed) and recirculating systems (artificial feed) (%) (mean ± SEM)

	Catfish – natural feed*		Catfish – artificial feed*	
	Dorsal section	Ventral section	Dorsal section	Ventral section
Water	79.45 ± 0.37[a]	78.01 ± 0.41[b]	77.68 ± 0.45[a]	78.08 ± 0.21[a]
Protein	17.88 ± 0.34[a]	17.54 ± 0.16[a]	17.70 ± 0.27[a]	17.53 ± 0.13[a]
Lipids	1.65 ± 0.12[a]	3.53 ± 0.48[b]	3.54 ± 0.33[a]	3.24 ± 0.19[a]
Ash	1.02 ± 0.01[a]	0.92 ± 0.03[a]	1.08 ± 0.02[a]	1.15 ± 0.03[a]

** – Values for catfish cultivated on natural and artificial feed in the same row with different letter indices differ significantly statistically (P < 0.01)*

The data presented prove that did the lipid content differed between the two fillet sections only in the catfish fed natural feed. Lipids were stored more intensely in the ventral sections, and their content was more than two-fold higher in comparison with that in the dorsal sections. However, when the fish were fed intensively with artificial feed containing 18% lipids, this difference was eliminated and the lipid level was equal in the two fillet sections. Hoffman et al. (1994) reported there was no difference in lipid content between the dorsal and ventral fillet sections of *Clarias gariepinus* cultivated on artificial feed. The authors' earlier studies (Jankowska et al. 2004) indicated that, in comparison with *Silurus glanis* fed natural feed, there was a significant increase in the lipid content throughout the fillet in those cultivated on commercial feed. The results of the current study indicate that the phenomenon described above was the result of more intense lipid storage in the dorsal section of the fillet effected by the application of a much more lipid-rich feed than natural feed.

The fatty acids profile is expressed as relative contents (% of total fatty acids) and the content in 100 g of fillets (Tables 4 and 5). The same fatty acids were identified in both fillet sections of the pond catfish. Quantitative analysis indicated the following dominants: saturated acids – palmitic (16:0); monounsaturated acids – oleic acid (18:1cis9); polyunsaturated acids – docosahexaenoic (22:6n-3, DHA). No significant difference was detected between the relative quantity of palmitic acid in the dorsal and ventral fillet sections ($P > 0.01$, Table 4). Such a difference was detected, however, when comparing differences in the contents of oleic acid and DHA. The content of oleic acid was lower by 1.13% and that of DHA was higher by 2.20% in the dorsal compared to the ventral sections. Additionally, both fillet sections differed with regard to palmitic acid (16:1) content, which was higher by 1.61% in the ventral sections (Table 4).

TABLE 4

Fatty acid profile from the dorsal and ventral sections of fillets from catfish cultivated in ponds (natural feed) and recirculating systems (artificial feed) (% all fatty acids) (mean ± SEM)

Fatty acid	Catfish – natural feed*		Catfish – artificial feed*	
	Dorsal section	Ventral section	Dorsal section	Ventral section
14:0	2.36 ± 0.29 [a]	2.66 ± 0.26 [a]	5.62 ± 0.11 [a]	5.68 ± 0.12 [a]
14:1	0.63 ± 0.10 [a]	0.77 ± 0.09 [a]	0.26 ± 0.01 [a]	0.26 ± 0.01 [a]
15:0	0.94 ± 0.12 [a]	1.04 ± 0.12 [a]	0.52 ± 0.01 [a]	0.51 ± 0.01 [a]
16:0	15.69 ± 0.57 [a]	15.84 ± 0.27 [a]	16.63 ± 0.13 [a]	16.16 ± 0.14 [a]
16:1	9.81 ± 0.78 [a]	11.42 ± 0.66 [b]	6.91 ± 0.08 [a]	6.93 ± 0.07 [a]
17:1	1.22 ± 0.14 [a]	1.29 ± 0.12 [a]	0.82 ± 0.01 [a]	0.82 ± 0.03 [a]
16:4	-	-	0.50 ± 0.02 [a]	0.50 ± 0.02 [a]
18:0	5.86 ± 0.25 [a]	5.72 ± 0.13 [a]	3.69 ± 0.06 [a]	3.51 ± 0.06 [a]
18:1cis9	18.62 ± 1.92 [a]	19.75 ± 1.29 [b]	13.14 ± 0.06 [a]	13.13 ± 0.25 [a]
18:1cis11	5.27 ± 0.30 [a]	5.56 ± 0.27 [a]	3.41 ± 0.06 [a]	3.33 ± 0.02 [a]
18:2n6	5.19 ± 0.92 [a]	5.10 ± 0.71 [a]	5.38 ± 0.06 [a]	5.39 ± 0.07 [a]
18:3n4	0.55 ± 0.07 [a]	0.58 ± 0.06 [a]	0.37 ± 0.01 [a]	0.37 ± 0.01 [a]
18:3n3	4.10 ± 0.50 [a]	4.42 ± 0.37 [a]	1.13 ± 0.01 [a]	1.16 ± 0.01 [a]
18:4	0.64 ± 0.09 [a]	0.71 ± 0.07 [a]	1.74 ± 0.05 [a]	1.81 ± 0.04 [a]
20:0	0.24 ± 0.01 [a]	0.28 ± 0.04 [a]	0.21 ± 0.01 [a]	0.22 ± 0.01 [a]
20:1n9	1.84 ± 0.13 [a]	1.86 ± 0.14 [a]	7.07 ± 0.11 [a]	7.28 ± 0.15 [a]
20:1n7	0.30 ± 0.01 [a]	0.28 ± 0.03 [a]	0.36 ± 0.01 [a]	0.36 ± 0.01 [a]
20:2	0.53 ± 0.08 [a]	0.49 ± 0.07 [a]	0.44 ± 0.02 [a]	0.43 ± 0.01 [a]
20:3n6	0.70 ± 0.10 [a]	0.63 ± 0.06 [a]	0.21 ± 0.01 [a]	0.21 ± 0.01 [a]
20:4n6	3.48 ± 0.29 [a]	2.88 ± 0.14 [a]	0.71 ± 0.03 [a]	0.69 ± 0.02 [a]
20:3n3	0.64 ± 0.08 [a]	0.63 ± 0.05 [a]	0.16 ± 0.01 [a]	0.18 ± 0.01 [a]
20:4n3	1.21 ± 0.17 [a]	1.23 ± 0.12 [a]	1.04 ± 0.03 [a]	1.05 ± 0.01 [a]
20:5n3	4.66 ± 0.58 [a]	4.37 ± 0.41 [a]	7.52 ± 0.04 [a]	7.73 ± 0.06 [a]
22:1n11	0.11 ± 0.05 [a]	0.10 ± 0.03 [a]	4.95 ± 0.12 [a]	5.27 ± 0.21 [a]
22:1n9	-	-	0.75 ± 0.02 [a]	0.80 ± 0.01 [a]
21:5	0.26 ± 0.03 [a]	0.24 ± 0.02 [a]	0.47 ± 0.02 [a]	0.51 ± 0.04 [a]
22:5n6	0.91 ± 0.06 [a]	0.75 ± 0.05 [a]	0.33 ± 0.01 [a]	0.30 ± 0.01 [a]
22:5n3	2.86 ± 0.29 [a]	2.56 ± 0.21 [a]	2.18 ± 0.06 [a]	2.17 ± 0.05 [a]
22:6n3	11.11 ± 1.01 [a]	8.91 ± 0.59 [b]	13.50 ± 0.23 [a]	13.26 ± 0.24 [a]
Σ SFA	25.08 ± 0.48 [a]	25.54 ± 0.13 [a]	26.67 ± 0.20 [a]	26.07 ± 0.20 [a]
Σ USFA	74.92 ± 0.48 [a]	74.46 ± 0.18 [a]	73.33 ± 0.20 [a]	73.93 ± 0.20 [a]
Σ MUFA	38.17 ± 1.49 [a]	41.00 ± 1.35 [b]	37.68 ± 0.28 [a]	38.18 ± 0.25 [a]
Σ PUFA	36.75 ± 1.76 [a]	33.46 ± 1.39 [b]	35.66 ± 0.21 [a]	35.75 ± 0.23 [a]
Σ n-3	24.58 ± 2.39 [a]	22.12 ± 1.64 [b]	25.52 ± 0.25 [a]	25.55 ± 0.30 [a]
Σ n-6	10.28 ± 1.20 [a]	9.36 ± 0.83 [a]	6.62 ± 0.02 [a]	6.59 ± 0.06 [a]
n-3/n-6	2.58 ± 0.35 [a]	2.48 ± 0.27 [a]	3.85 ± 0.05 [a]	3.88 ± 0.06 [a]

** – Values for catfish cultivated on natural and artificial feed in the same row with different letter indices differ significantly statistically ($P < 0.01$); SFA – saturated fatty acids, USFA – unsaturated fatty acids, MUFA – monounsaturated fatty acids, PUFA – polyunsaturated fatty acids*

The fillet sections of pond catfish that were studied did not differ with regard to the combined total of saturated and unsaturated acids, although differences were detected in the combined total of monoenoic (MUFA) and polyenoic (PUFA) acids, with the dorsal sections containing fewer MUFA and more PUFA. Additionally, the fillet sections

differed with regard to the total content of n-3 acids, but there was no difference in the combined total of acids from the n-6 group or in the mutual proportions of the fatty acid groups mentioned (Table 4).

The comparison of the two fillet sections from catfish fed artificial feed indicated that there was no difference between the relative contents of the various fatty acids. There was also no difference in the combined content of saturated acids, MUFA, PUFA, total n-3 or n-6 acids or in their mutual proportions (Table 4). Similarly, Hoffman et al. (1994) did not detect a difference in the fatty acids content between the dorsal and ventral fillet sections of *Clarias gariepinus* fed artificial feed.

The results obtained indicate that the differences between the dorsal and ventral fillet sections of pond catfish that consumed natural feed regarded mainly unsaturated acids. They were most pronounced in the different contents of DHA as well as in oleic and palmitic acids. As a consequence, the there were differences in the relation of MUFA and PUFA contents. It was also determined that feeding the catfish commercial feed equalized the differences in fatty acids content that were detected in catfish that consumed natural feed. A factor that should be considered in explaining this dependence is the lipid content in feed and its composition since the two fillet sections of catfish fed natural feed differed in lipid content while no such difference was detected in the catfish cultivated on artificial feed. It is known that fish fed commercial feed are richer in intramuscular lipids, mainly triacylglycerols, than those fed natural feed (pond cultivated or wild) (Haard 1992). Changes in the content of phospholipids, which are primarily present in metabolically active membranes and cell granulation, in response to variations in lipids occur to a far lesser degree or not at all. Evidence of this was reported by Regost et al. (2003), among others, according to whom increases in the lipid content of *Psetta maxima* fillets are related to the increase of neutral lipid content, while the content of phospholipids did not change. Such a tendency was also confirmed by Cejas et al. (2004) with regard to wild and cultivated *Diplodus sargus*; the muscle of farmed fish had higher levels of triacylglycerols while those of phospholipids remained unchanged. Poli et al. (2001) also maintained that the content of lipids in *Dicentrarchus labrax* was related to the increase of triacylglycerols while the content of phospholipids remained on an unchanged level. It is also known that phospholipids have a higher PUFA content, especially of DHA, which is demonstrated in examples of both wild and cultivated species such as *Lutjanus argentimaculatus* (Ogata et al. 2004), *Diplodus*

puntazzo (Orban et al. 2000), *Psetta maxima* (Sérot et al. 1998), and *Salmo salar* (Peng et al. 2003). In the case of *Silurus glanis* fed natural feed, the results should be interpreted as the result of potentially different proportions between the share of triacylglycerols and phospholipids in the lipids of the dorsal and ventral sections and, in consequence, the relatively higher content of DHA in the dorsal lipids, which, in this species, was compensated for by the lower MUFA content.

The lack of differences in the relative fatty acids content of the two parts of the fillets from catfish fed artificial feed could have also been impacted by feed composition. The feed applied contained 35.02% polyenoic fatty acids, 24.57% of which were n-3 group acids, of which DHA occurred in the largest amount at 11.53% (Table 1). As reported in an earlier work, feeding catfish artificial feed caused an increase in the overall content of n-3 acids and DHA in the fillets compared to fish fed natural feed (Jankowska et al. 2004). Thus, it can be assumed that the equalized overall content of n-3 acids and DHA in both parts of the fillets of catfish cultivated on artificial feed could be the result of applying a diet rich in these acids.

The results of the fatty acids content expressed per 100 g of fillet indicated that there were differences in the contents of all the analyzed acids between the fillet sections from catfish cultivated in ponds. The contents and sum of saturated and unsaturated acids were higher in the ventral section. The contents of MUFA and PUFA were both higher in the ventral section by 214.85 and 37.17 mg 100 g^{-1}, respectively, in comparison with the dorsal section (Table 4). The contents of PUFA n-3, DHA, and EPA were higher by 244.27, 82.43, and 51.60 mg 100 g^{-1}, respectively, in the ventral sections than in the dorsal. These differences resulted primarily from the larger amounts of lipids in the ventral section of the fillets. On the other hand, due to the equal percentage share of fatty acids and the undifferentiated fat content in the two fillet sections of catfish fed with artificial feed, 100 g portions of them contained similar amounts of particular acids and had similar numbers of acid groups, *i.e.* SFA, MUFA, PUFA n-3 and n-6 (Table 5). The results obtained prove that, from the point of view of the consumer, the two fillet sections of catfish cultivated on artificial feed are equal sources of fatty acids, while in those of catfish fed on natural food the ventral section contains about two times the fatty acids, especially the particularly valuable n-3 acids.

TABLE 5

Contents of fatty acids (mg 100 g^{-1} fillet) in the dorsal and ventral sections of fillets from catfish cultivated in ponds (natural feed) and recirculating systems (artificial feed) (mean ± SEM)

Fatty acid	Catfish – natural feed*		Catfish – artificial feed*	
	Dorsal section	Ventral section	Dorsal section	Ventral section
14:0	26.04 ±3.39 [a]	62.56 ± 12.70 [b]	145.94 ± 26.33 [a]	136.11 ± 12.60 [a]
14:1	6.89 ±1.26 [a]	18.06 ± 4.12 [b]	6.70 ± 1.19 [a]	6.17 ± 0.59 [a]
15:0	10.29 ±1.46 [a]	24.00 ± 4.69 [b]	13.33 ± 2.28 [a]	12.24 ± 1.17 [a]
16:0	181.31 ±27.6 [a] 0	375.49 ± 66.39 [b]	427.08 ± 73.14 [a]	388.71 ± 38.34 [a]
16:1	111.90 ±16.08 [a]	276.15 ± 57.61 [b]	180.00 ± 33.26 [a]	166.52 ± 15.79 [a]
17:1	13.37 ±1.87 [a]	30.30 ± 5.91 [b]	21.31 ± 3.79 [a]	19.80 ± 1.90 [a]
16:4	-	-	3.96 ± 0.54 [a]	3.18 ± 0.21 [a]
18:0	67.64 ±10.65 [a]	134.57 ± 22.76 [b]	95.12 ± 16.95 [a]	84.36 ± 8.21 [a]
18:1cis9	223.46 ±47.79 [a]	480.26 ± 104.07 [b]	341.66 ± 63.91 [a]	317.98 ± 35.98 [a]
18:1cis11	64.36 ±7.85 [a]	128.29 ± 19.38 [b]	86.87 ± 14.09 [a]	80.15 ± 8.25 [a]
18:2n6	62.39 ±17.93 [a]	116.69 ± 20.86 [b]	139.63 ± 25.32 [a]	130.05 ± 13.82 [a]
18:3n4	5.98 ±0.90 [a]	13.69 ± 2.87 [b]	9.75 ± 1.96 [a]	8.86 ± 0.90 [a]
18:3n3	45.01 ±6.90 [a]	104.69 ± 21.38 [b]	29.31 ± 5.41 [a]	27.98 ± 2.83 [a]
18:4	7.00 ±1.29 [a]	17.11 ± 3.94 [b]	45.01 ± 8.06 [a]	43.34 ± 4.01 [a]
20:0	2.77 ±0.35 [a]	6.88 ± 1.70 [b]	5.64 ± 1.21 [a]	5.18 ± 0.52 [a]
20:1n9	21.75 ±3.97 [a]	43.92 ± 7.76 [b]	181.50 ± 30.80 [a]	175.34 ± 18.67 [a]
20:1n7	2.93 ±0.42 [a]	6.37 ± 1.14 [b]	9.44 ± 1.87 [a]	8.69 ± 0.76 [a]
20:2	6.21 ±1.60 [a]	10.73 ± 1.55 [b]	11.20 ± 1.99 [a]	10.33 ± 1.04 [a]
20:3n6	8.25 ±2.02 [a]	14.17 ± 2.01 [b]	5.34 ± 0.92 [a]	5.14 ± 0.47 [a]
20:4n6	39.00 ±5.64 [a]	65.31 ± 8.34 [b]	17.90 ± 2.94 [a]	16.43 ± 1.51 [a]
20:3n3	6.85 ±0.83 [a]	14.31 ± 2.20 [b]	4.32 ± 0.91 [a]	4.21 ± 0.38 [a]
20:4n3	13.09 ±2.18 [a]	29.00 ± 5.80 [b]	27.49 ± 5.55 [a]	25.17 ± 2.21 [a]
20:5n3	50.58 ±7.37 [a]	102.18 ± 19.77 [b]	194.30 ± 34.53 [a]	185.30 ± 16.62 [a]
22:1n11	1.87 ±0.30 [a]	3.29 ± 0.49 [a]	128.29 ± 23.01 [a]	126.33 ± 12.70 [a]
22:1n9	-	-	19.60 ± 3.80 [a]	19.16 ± 1.75 [a]
21:5	2.55 ±0.48 [a]	5.03 ± 0.83 [b]	12.18 ± 2.18 [a]	12.17 ± 1.33 [a]
22:5n6	10.17 ±1.12 [a]	16.97 ± 2.10 [b]	8.39 ± 1.47 [a]	7.28 ± 0.68 [a]
22:5n3	31.12 ±3.49 [a]	58.31 ± 9.03 [b]	57.58 ± 11.86 [a]	52.08 ± 4.91 [a]
22:6n3	121.19 ±12.14 [a]	203.62 ± 30.04 [b]	347.72 ± 61.36 [a]	317.94 ± 29.49 [a]
ΣSFA	288.04 ±39.71 [a]	603.49 ± 104.85 [b]	687.13 ± 119.70 [a]	626.61 ± 60.45 [a]
ΣUSFA	859.32 ±108.32 [a]	1765.73 ± 299.55 [b]	1889.45 ± 33976 [a]	1769.57 ± 172.94 [a]
Σ MUFA	448.24 ±68.59 [a]	990.29 ± 189.05 [b]	975.37 ± 175.40 [a]	920.13 ± 94.91 [a]
Σ PUFA	411.07 ±41.89 [a]	775.44 ± 115.82 [b]	914.08 ± 164.50 [a]	849.44 ± 79.30 [a]
Σn-3	267.83 ±30.74 [a]	512.10 ± 87.23 [b]	660.72 ± 119.49 [a]	612.67 ± 56.13 [a]
Σn-6	119.80 ±26.27 [a]	213.14 ± 30.74 [b]	171.26 ± 30.53 [a]	158.90 ± 16.37 [a]

** – Values for catfish cultivated on natural and artificial feed in the same row with different letter indices differ significantly statistically (P < 0.01). Description as in Table 4*

SUMMARY

The lipid content in the dorsal and ventral sections of fillets from catfish fed natural feed for 2.5 years differed and were higher in the ventral section. Feeding the fish artificial feed for a period of 1.5 years resulted in an equal lipid content in the two sections. The

fatty acids profiles of the dorsal and ventral fillets of catfish cultivated on natural feed differed, in contrast with those of catfish reared on artificial feed. Differences between the two fillet sections regarded unsaturated acids since the proportions of MUFA and PUFA changed primarily due to the varied contents of DHA, oleic, and palmitic acids

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STRESZCZENIE

PROFILE KWASÓW TŁUSZCZOWYCH CZĘŚCI GRZBIETOWEJ I BRZUSZNEJ FILETA SUMA EUROPEJSKIEGO (*SILURUS GLANIS* L.) ŻYWIONEGO RÓŻNYM POKARMEM

Celem badań było porównanie składu podstawowego oraz profilu kwasów tłuszczowych części grzbietowej i brzusznej fileta suma europejskiego, *Silurus glanis* (L.). Materiałem badawczym były ryby pochodzące ze stawów ziemnych odżywiające się pokarmem naturalnym oraz ryby z obiegów recyrkulacyjnych, które żywiono paszą sztuczną.

Część grzbietowa fileta suma podchowywanego w stawach różniła się od części brzusznej ponad dwukrotnie niższą zawartością tłuszczu i wyższą wody. Ilości białka i popiołu nie były natomiast istotnie zróżnicowane. Analiza mięsa suma żywionego paszą sztuczną nie wykazała istotnych różnic w zawartości wszystkich składników podstawowych pomiędzy częścią grzbietową a brzuszną fileta (tab. 3).

Obie części fileta ryb podchowanych na pokarmie naturalnym nie różniły się jakościowym składem kwasów tłuszczowych, różnice pomiędzy nimi stwierdzono natomiast w relatywnej ilości kwasów oleinowe-

go (18:1cis9), dokozaheksaenowego (22:6n-3, DHA) oraz palmitoleinowego (16:1). Ilości kwasów 18:1cis9 i 16:1 były niższe, a kwasu 22:6n-3 wyższa w części grzbietowej w porównaniu z brzuszną. Ponadto części fileta suma z chowu stawowego nie różniły się łączną ilością kwasów nasyconych i nienasyconych, różnice stwierdzono natomiast w łącznej ilości kwasów monoenowych (MUFA) i polienowych (PUFA) oraz kwasów grupy n-3. Część grzbietowa zawierała mniej MUFA, a więcej PUFA i kwasów n-3 (tab. 4).

Porównanie obu części fileta suma żywionego paszą sztuczną nie wykazało pomiędzy nimi różnic, zarówno pod względem jakościowego składu kwasów tłuszczowych, jak i ich relatywnej ilości (tab. 4). Porcja 100-gramowa części brzusznej fileta suma żywionego pokarmem naturalnym zawierała więcej wszystkich oznaczonych kwasów tłuszczowych, a w konsekwencji różniła się łączną zawartością SFA, USFA, MUFA, PUFA, n-6 oraz n-3 od części grzbietowej. U suma z chowu intensywnego takiego zróżnicowania nie stwierdzono (tab. 5).