

FATTY ACID PROFILE OF CARP FISH SPECIES FROM TWO AQUACULTURE SYSTEMS

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SASTAV MASNIH KISELINA ŠARANSKIH VRSTA RIBA IZ DVA SISTEMA GAJENJA

Abstrakt

Cilj ovog rada je bio ispitivanje masnokiselinskog profila mišićnog tkiva šaranskih vrsta riba gajenih u polikulturi u dva ribnjaka sa poluintenzivnim uzgojem. Poređen je profil masnih kiselina mišićnog tkiva šarana, tolstolobika i amura u vidu ukupnih zasićenih (ZMK), mononezasićenih (MNMK) i polinezasićenih masnih kiselina (PNMK), kao i odnosi P/S i n-3/n-6. Odnos P/S u lipidima mišićnog tkiva šarana kretao se od 0,26 (amur) do 0,80 (šaran). Veći sadržaj n-3 PNMK uočen je u mišićnom tkivu amura. Odnos n-3/n-6 iznosio je kod amura 2.15, dok je kod tolstolobika i šarana bio 0.07. Dobijeni rezultati ukazuju da je glavna razlika između šaranskih vrsta bila u sadržaju ukupnih PNMK, posebno u sadržaju n-6 masnih kiselina. Sastav masnih kiselina amura iz dva ribnjaka nije se statistički značajno razlikovao. Šarani sa dva ribnjaka su se značajno razlikovali u ukupnom sadržaju MNMK i PNMK. Da bi se procenio kvalitet slatkovodne ribe sa domaćeg tržišta, dobijeni rezultati su, takođe, poređeni sa gajenim vijetnamskim somom (*Pangasius hypophthalmus*) koji je uzet sa našeg tržišta. S obzirom na masno-kiselinski sastav, *Pangasius* se ne može smatrati nutritivno vrednom namirnicom. Dalja ispitivanja su neophodna da se oceni kvalitet slatkovodne ribe sa našeg tržišta.

Ključne reči: *profil masnih kiselina, šaran, tolstolobik, amur, pangasius*

INTRODUCTION

Fish from the *Cyprinidae* family are the most widely cultured species. Common carp (*Cyprinus carpio*) in fish ponds is produced in polyculture with accompanying species

such as bighead and silver carp and grass carp. Polyculture involves the culture, in the same pond, of several fish species that feed on different natural resources and thus improve water quality and increase fish production.

Grass carp (*Ctenopharyngodon idella*) is reared in fish ponds for regulation of overgrown aquatic plants like reed and rush. Silver carp (*Hypophthalmichthys molitrix*) is strong phytoplankton and zooplankton feeder. Polyculture in Europe expanded from the 1960s with the introduction of Chinese carp and often involves only two or three species (common carp, silver and grass carp) (Horvath *et al.*, 1984; Olah, 1986).

The aim of this study is comparison of the fatty acid profile of carp fish from two semi - intensive culture ponds with different rearing system. Within the last few years farmed Asian white catfish, *Pangasius hypophthalmus*, has been introduced as a successful new fish species on the European market. *Pangasius* is fast growing fish species which reaches market size within eight months. In this study the fatty acid profile of Vietnamese catfish fillets from domestic market was investigated.

MATERIALS AND METHODS

Investigation was carried out on fifteen samples of marketable (two year old) common carp, silver carp and grass carp, collected in October and November 2010, from two semi-intensive fish pond with different feeding regime: in the first pond fish was fed with commercial extruded diet and in the second pond fish was supplementary feed with wheat only. Analysis was carried out on homogenized fish muscle samples after evisceration and deprivation of skin, tail, head, fins and bones. Five samples of *Pangasius* fillets were obtained from the market and analyzed too.

Total lipids for fatty acid determination were extracted from fish muscle tissue with hexane/isopropanol mixture by accelerated solvent extraction (ASE 200, Dionex, Germany). After evaporation of solvent until dryness under the stream of nitrogen total lipids were converted to fatty acid methyl esters (FAME) by trimethylsulfonium hydroxide. FAMES were determined by using Shimadzu 2010 gas chromatograph equipped with flame ionization detector (FID) and cyanopropyl HP-88 capillary column (100m x 0.25 mm x 0.20 μ m).

Statistical analysis

Data obtained for fatty acid composition were subjected to analysis of variance (ANOVA) with the least significant difference test at the level of significance of 5%.

RESULTS AND DISCUSSION

Fatty acid composition of muscle tissue of carp species is presented in Table 1.

Table1. Fatty acid composition (g100g⁻¹ of total fatty acids) of muscle tissue of common carp, silver carp and grass carp (mean ± SD) from two aquaculture ponds.

Pond / Fatty acid	Common carp		Silver carp		Grass carp	
	I	II	I	II	I	II
SFA	27.21±1.56 ^a	27.02±1.93 ^a	29.40±1.93 ^a	32.61±1.23 ^b	34.48±0.94 ^b	35.49±0.64 ^b
MUFA	50.40±1.39 ^b	63.50±1.58 ^d	54.87±3.40 ^a	57.60±2.20 ^c	54.90±0.71 ^a	54.64±0.62 ^a
PUFA	21.67±1.12 ^c	8.91±0.44 ^b	16.52±1.63 ^a	9.15±1.23 ^b	9.83±1.04 ^b	9.23±1.02 ^b
n-3	1.43±0.13 ^a	0.63±0.01 ^b	1.14±0.34 ^a	2.66±0.24 ^c	6.70±0.74 ^d	6.14±0.54 ^d
n-6	20.12±0.98 ^c	8.28±0.44 ^d	15.39±1.38 ^a	6.50±1.18 ^d	3.12±0.35 ^b	3.09±0.25 ^b
n-3/n-6	0.07±0.01 ^a	0.08±0.01 ^a	0.07±0.01 ^a	0.41±0.01 ^c	2.15±0.16 ^b	1.99±0.11 ^b
P/S	0.80±0.01 ^a	0.33±0.04 ^c	0.56±0.07 ^d	0.28±0.02 ^b	0.28±0.03 ^b	0.26±0.03 ^b
UFA/SFA	2.65	2.68	2.43	2.05	1.88	1.80

I pond - extruded diet, II - grain (wheat, barley, maize)

Values in the same row followed by the same letters do not differ significantly (p>0.05)

Table 2: Fatty acid profile (g100g⁻¹ of total fatty acid) of *Pangasius hypophthalmus* fillets from Serbian market (mean ± SD)

Fatty acid	<i>Pangasius fillets</i>
SFA	41.36±2.60
MUFA	42.36±1.78
PUFA	15.77±4.98
n-3	1.31±0.16
n-6	14.46±2.82
n-3/n-6	0.09±0.03
P/S	0.38±0.15
UFA/SFA	1.40

The quality of fat has been described by using different ratios, such as PUFA/SFA and n-3/n-6 (Ahlgren et al. 1994). Human diets with a P/S lower than 0.45 have been viewed as unfavorable, as they possibly promote the occurrence of hypercholesterolemia. In the present study, the lipid fraction of muscle tissue showed P/S values ranging from 0.26 (grass carp) to 0.80 (common carp). However, this index, which is based only on the degree of fatty acid saturation, also ignores the metabolic effects of MUFA. The ratio of unsaturated (UFA) vs. saturated fatty acids is of greater importance in edible fat. The value higher than 0.35 is usually believed to be beneficial. Higher ratio in this study was obtained for common carp (2.68) and silver carp (2.43).

The ratio between PUFA of the n-3 and n-6 groups is one of the indices used to evaluate the nutritional value of the lipid fraction present in foods. Henderson and Tocher (1987) reported n-3/n-6 value of 0.5-3.8 for freshwater and 4.7-14.4 for marine fish. The n-3/n-6 ratio in this study ranged from 0.07 (common carp) to 2.15 (grass carp).

A total PUFA content in the muscle tissue lipids of the investigated fish varied from 9.23% (grass carp) to 21.67% (common carp). The higher amount of total n-3 PUFA was observed in muscle tissue of grass carp (6.70%) as well as lower amount of n-6

PUFA (3.12%). The n-3 to n-6 ratio was 2.15 in grass carp. Fatty acid profile of grass carp from two fish ponds was not significantly different. Higher n-3 to n-6 ratio in grass carp depends on the type of diet consumed, i.e. feed on natural food that are richer in the n-3 families of acids (Steffens and Wirth, 2007).

Common carp from two fish ponds were significantly different in the total MUFA and total PUFA content. Supplementary feeding of carp with wheat results in a lower amount of n-3 essentially fatty acids in fish muscle (0.63% in common carp from II pond). This is due to the lower proportion of natural feed in the diet of the carp which received supplementary grain (Steffens, 1997). Similar results for common carp were previously reported (Trbovic *et al.*, 2009., Trbovic *et al.* 2010).

Obtained results indicate to different feeding habit of carp fish. The main difference is in the total PUFA content and, particularly, n-6 fatty acids.

As an omnivorous species, *Pangasius hypophthalmus* is fed agricultural by-products, mainly rice bran, soy and fish by-products during rearing. However, more recent information shows that farm-made feeds consist of 30-40% trash marine fish and 60-70% rice bran (Phu and Thanh Hien, 2003). The nutritional quality of catfish was not considered to be excellent due to their fatty acid profile. Total lipids were characterized by high percentage of saturated fatty acids (41.4%), monounsaturated fatty acid amounting to 42.4%. Total PUFA content was characterized by a high proportion of n-6 and low n-3/n-6 ratio (0.09). Similar results for the fatty acid profile of *Pangasius* filets from the domestic market were reported by Orban *et al.*, 2008. and Karl *et al.* 2010. Further investigations are needed to evaluate the quality of freshwater fish from Serbian market as well as more fish samples.

CONCLUSION

Fatty acid profile of common carp, silver carp and grass carp in terms of sum of total SFA, MUFA and PUFA as well as P/S and n-3 to n-6 ratios of carp fish meat were compared. The lipid fraction of muscle tissue showed P/S values ranging from 0.26 (grass carp) to 0.80 (common carp). The n-3/n-6 ratio in this study ranged from 0.07 (common carp) to 2.15 (grass carp). Common carp from two fish ponds were significantly different in the total MUFA and total PUFA content. Supplementary feeding of carp with wheat results in a lower amount of n-3 essentially fatty acids in fish muscle.

The nutritional quality of analyzed *Pangasius* filets from Serbian market was not considered to be acceptable due to their fatty acid profile. Total lipids were characterized by high percentage of saturated fatty acids (41.4%), monounsaturated fatty acid amounting to 42.4%. Total PUFA content was characterized by a high proportion of n-6 and low n-3/n-6 ratio (0.09).

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