CHANGES OF THE FATTY ACID COMPOSITION AND TOTAL LIPID CONTENT IN CULTURED CARP (*CYPRINUS CARPIO* L.) CORRELATED TO SUPPLEMENTARY DIET

DEJANA TRBOVIĆ[1*], ZORAN MARKOVIĆ[2], RADIVOJ PETRONIJEVIĆ[1], STEVAN ČANAK[3], DANKA SPIRIĆ[1], VESNA ĐORĐEVIĆ[1], AURELIJA SPIRIĆ[1]

[1]Institute of Meat Hygiene and Technology, Kaćanskog 13, 11000 Belgrade, Serbia

[2]University of Belgrade, Faculty of Agriculture, Nemanjina 6, 11080 Belgrade - Zemun, Serbia

[3]State University of Novi Pazar, Vuka Karadžića bb, 36300 Novi Pazar, Serbia

**Corresponding author: e-mail: dejana@inmesbgd.com*

PROMENE SASTAVA MASNIH KISELINA I SADRŽAJA LIPIDA U MESU ŠARANA (*CYPRINUS CARPIO* L.) U ZAVISNOSTI OD DODATNE HRANE

Apstrakt

U ovom radu razmatrane su promene grupa masnih kiselina (zasićenih, mononezasićenih, polinezasićenih n-3 i n-6, kao i njihovog odnosa n-3/n-6) u zavisnosti od sadržaja lipida u mesu šarana sa dve vrste prihranjivanja (ekstrudirane hrane i kukuruza). Vrsta korišćene hrane značajno je uticala na sadržaj lipida deponovanih u tkivu ribe. Korelacija lipida sa sastavom masnih kiselina pokazala je, da se sa povećanjem sadržaja lipida u mesu šarana, masnokiselinski sastav značajno menjao: povećavale su se mononezasićene masne kiseline, sa dominantnom oleinskom kiselinom (18:1n-9), a istovremeno smanjivale n-3 i n-6 polinezasićene masne kiseline. Istraživanja koja su prikazana u ovom radu su ukazala na opravdanost prihranjivanja šarana ekstrudiranom hranom u cilju poboljšanja kvaliteta mesa ribe.

Ključne reči: šaran, dodata hrana, masnokiselinski sastav
Key words: common carp, supplementary feed, fatty acid composition

INTRODUCTION

Production of freshwater fish dominates in the world with 71% of cyprinid family (FAO, 2010). Carp (*Cyprinus carpio)* is one of the most cultivated species and accounted

for 18% of total production of cyprinids in the world (Takeuchi et al. 2002). Recently, more than 50% of the carp additionally fed by complete, primarily extruded feed which enabled more intensive carp production and the development of aquaculture in Serbia (Marković, 2010; Marković, Poleksić, 2013) what follows trend in the world carp production (De Silva, 2012).

The main objective of this study was to implement the relevant test for the influence of diet in the semi-intensive carp farming system, primarily on lipid content and fatty acid composition.

MATERIALS AND METHODS

Fish samples

The total of 64 two-year old carp samples were taken during the autumn/winter 2009 from two ponds with the semi-intensive farming, Ečka a.d. and Živača a.d., according to the breeding season and fish farm productivity. Except naturally occurring food, fish was additionally fed extruded feed (25/7), from the first fish farm and maize from the second fish farm. Before analysis, the skin, heads, tails, fins, and intestines were removed and fish was filleted. The obtained fillets were homogenized in a laboratory blender.

Fatty acid analysis by GC

Total lipids for the fatty acid determination were extracted with hexane/isopropanol mixture by accelerated solvent extraction (ASE 200, Dionex, Sunnyvale, CA) and further converted to fatty acid methyl esters (FAMEs) by transesterification with trimethylsulfonium hydroxide (EN ISO 5509:2000). FAMEs were analyzed by gas-liquid chromatography (GLC, Shimadzu 2010) using the strongly polar column in the temperature range from 125 °C to 230 °C. The duration of the analysis was 50.5 min. (Spirić et al., 2010). Results were expressed as mass of fatty acid (g) in 100 g of fatty acids.

Statistical analysis

Correlation analysis was performed using JMP 8.0.1 software (SAS Institute Inc. NC, USA) to determine significance of the lipid content increase on the fatty acid composition during carp breeding in two fish ponds, (groups of saturated, monounsaturated and polyunsaturated n-3 and n-6 fatty acids and n-3/n-6 ratio).

RESULTS AND DISCUSSION

The share of lipids was significantly higher in carp fillets supplemental fed maize (8.6-11.6%) than supplemental fed extruded feed (3.2-4.7%) which is in accordance with the results of other researches (Fajmonova et. al, 2003; Vacha et al., 2007; Trenovszki et. al. 2011).

Correlation of the groups of fatty acids and total lipids content in carp fillets with corresponding levels of significance are given in table 1.

Table 1. Correlation of the groups of the fatty acids (% of total fatty acids) and total lipids (g/100 g of fillet) in carp suplemental fed extruded feed and maize

Fatty acids	Lipids (extruded feed)		Lipids (maize)	
	r	P	r	P
SFA	-0.820	<0.0001*	-0.241	0.192
MUFA	0.702	<0.0001*	0.447	0.012*
PUFA	-0.465	0.0127*	-0.453	0.010*
n-3	-0.596	0.0008*	-0.369	0.041*
n-6	-0.358	0.0612	-0.482	0.006*
n-3/n-6	-0.634	0.0003*	-0.383	0.033*

r – coefficient of correlation, P – level of significance

The studies of Trenovszki et al. (2011) have shown that the different types of supplementary carp feeding lead to significant variation in the contents of fat, monounsaturated and n-6 and n-3 polyunsaturated fatty acid in the carp meat.

Monounsaturated fatty acids were dominated with an increase in lipid content in carp fillet (Table 1). Variability in the content of monounsaturated fatty acids were closely related to changes in the share of lipids in fish, which was influenced by the type and amount of food, the growing season, the diversity of individuals etc (Geri et al., 1995; Kiessling et al., 2001; Fajmonova et al., 2003). The opposite was the effect on the content of saturated fatty acids, which are considerably reduced with the increase in the proportion of lipids in the fish (Table 1), which is a possible consequence of the enzyme desaturation of saturated to monounsaturated fatty acids (Henderson, 1996). The total lipids content in carp supplemental fed maize was from 8% to 11%, which makes, probably, neutral lipids and also due to less differentiation of carp specimens than were the lower correlation coefficients of the fatty acids.

Polyunsaturated n-6 fatty acids were not strongly correlated with the lipid content (r = -0.358; -0.482). However, the proportion of n-3 polyunsaturated fatty acids with an increase in the lipid content in fish significantly decreased (r = -0.596; -0.369) as similarly reported for carp by Geri et al., 1995, Fajmonova et al., 2003, Mráz and Pickova, 2009. Correlation of total lipids content with oleic acid and the most important content of n-3 and n-6 in carp supplemenatal fed extruded feed and maize were presented in Figures 1 and 2.

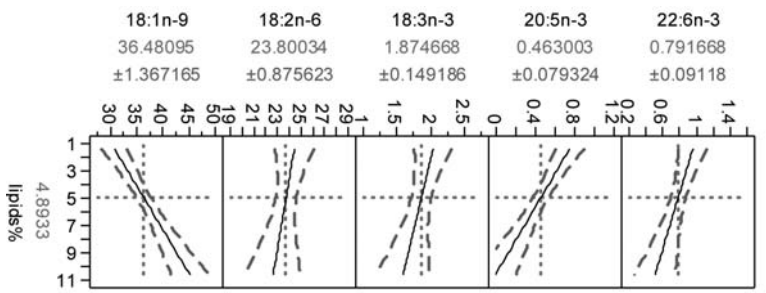

Figure 1. Correlation of total lipids content with oleic acid and the most important content of n-3 and n-6 in carp supplemenatal fed extruded feed

Since the content of the total lipids strongly influences on the composition of lipid classes, the change in the lipid composition were more impact on the reduction of n-3, which were less represented than n-6 (Mráz and Pickova, 2009, Mráz et al., 2012). With the increase of the total lipids increased the share of neutral lipids in which are less present n-3 fatty acids (Kiessling et al., 2001; Wood et al., 2008, Henderson, 1996).

The changes in the content of n-3 fatty acids with the change in the lipid content have resulted in reduction of the n-3/n-6 ratio.

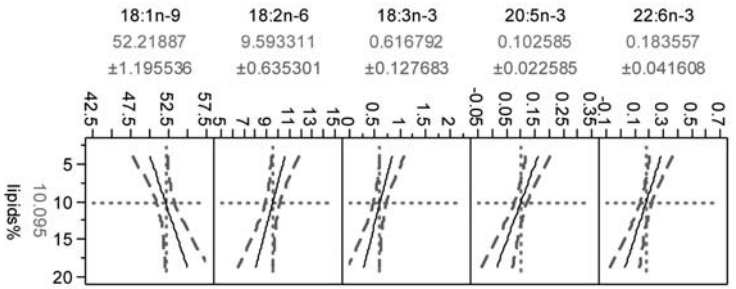

Figure 2. Correlation of total lipids content with oleic acid and the most important content of n-3 and n-6 in carp supplemenatal fed maize

CONCLUSION

Carp, regardless of the type of additional feed, shows similar metabolic changes of fatty acids as well as other fish species. The type of feed which was used on the farm significantly influenced the content of lipids which were deposited in the tissues of fish. The correlation of lipids to fatty acid composition showed that by the increase in the content of lipids, the fatty acid composition of carp meat significantly changed: the monounsaturated fatty acids increased, with the predominant oleic acid (18:1n-9), and, at the same time, the n-3 and n-6 polyunsaturated fatty acids decreased. The results presented in this work have indicated the justification for supplementary feeding of carp with extruded feed in order to improve the quality of meat. The need to improve the composition or quality of the supplementary feed and feed efficiency is essential to the continuous improvement of aquaculture.

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