INFLUENCE OF LINOLENIC ACID FROM PELETED FOOD ON MUSCLE LIPID COMPOSITION OF TENCH (*Tinca tinca L.*)

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Background

Composition and quantity of lipids from tissues and organs are influenced by genetic characteristics of individual species, but also by paragenetic factors. Amounts and composition of alimentary fats and fatty acids significantly determine the composition of lipids in fish tissues (HENDERSON et al., 1987). Fatty acids from food, after digestion and absorption, could be deposited in the body of the fish in original and transformed form. Mostly, they are deposited as reserve fat in fat depots, adipose tissue, liver and in other visceral organs (FARKAS et al., 1977; HENDERSON et al., 1987; CSENGERI, 1993). Distribution of tissue lipids of fish was studied from a long time ago. It was noticed that there is a significant difference and certain ranges of values for lipid distribution in whole fish or individual fish tissue. Muscles, which make main component of raw fish mass and are the most important for human food, contain the most of the total fish fat. Naturally, all other lipids, which are stored in other tissues and organs, are of great importance for the life of the fish and physiological functionality (WATANABE et al., 1982). Different tissues and organs (muscles, skin, bones, brain, eyes, blood, adipose tissue, ovaries, testes etc.) were studied recently regarding the content and composition of lipids of various fish species (HENDERSON et al., 1987).
This paper deals with influence of linolenic acid (essential for fish and precursor for polyunsaturated fatty acids) from food on lipid composition in muscles of tench (Tinca tinca L.) which is not studied in this species till now.

Material and methods

Six experimental groups in 3 repetitions were involved in this research. Hundred tench fries in the age of 2 years (L_2), from the same population, with average individual weight of 32.0±0.5% g, were placed in each of 18 cages (individual dimension 1x1x1.2 m). Control group was fed peleted food with 45% proteins. Other 5 experimental groups were fed with addition of 0.5% (P1), 0.75% (P2), 1.00% (P3), 1.25% (P4) and 1.50% (P5) linolenic fatty acid (18:3ω3). Experimental part of the research lasted for 126 feeding days. Lipids were extracted from homogenized tench fillets (without skin and bones) by the method of FOLCH et al. (1957). GLC separation of fatty acids was performed by JEOL G 1100 gas chromatograph. Identification was carried out using specific standards of fatty acids and by logarithming the relative retention times against the number of C atoms in molecules. Quantification was curried out using trigonometric net technique. Results of the research were processed using standard statistic methods (OLSON, 1988).

Results and discussion

Statistically significant differences in content of the most important fatty acids from tench fillets were found between studied groups. Data from table 1 show that palmitic acid (16:0) was present in largest amounts of all saturated fatty acids as in the case of other fish species (CASTELL et al., 1972, WATANABE et al., 1974, FARKAS et al., 1977). Content of miristic acid (14:0) was very low and similar in all groups. Significant difference was found only between groups P1 and P3 ($p<0.05$). Difference in content of stearic acid (18:0) between groups P1 and P2 was not significant ($p>0.5$), while between all other groups this difference was statistically very significant ($p<0.01$).

Table 1. Composition of the important fatty acids in the fillets on tench after 18 weeks of feeding different levels of linolenic in the food

	14:0	16:0	18:0	18:1 ω9	18:2 ω6	18:3 ω3	20:2 ω6	20:3 ω9	20:3 ω6	20:4 ω6	20:5 ω3	22:5 ω3	22:6 ω3	Total SFA	Total MUFA	Total PUFA
contr	2.4 ±0.2	16.8 ±0.9	2.05 ±0.4	28.3 ±1.2	4.3 ±0.5	2.8 ±0.3	0.4 ±0.1	3.3 ±0.2	0.85 ±0.1	1.4 ±0.7	2.9 ±0.2	1.8 ±0.4	3.4 ±0.2	24.25 ±0.5	28.3 ±1.2	21.5 ±0.6
P1	2.2 ±0.4	17.1 ±0.6	2.3 ±0.4	22.8 ±0.9	4.4 ±0.3	4.3 ±0.2	+	1.3 ±0.2	0.9 ±0.3	1.7 ±0.4	4.2 ±0.4	2.2 ±0.2	4.8 ±0.3	21.6 ±0.6	22.8 ±0.9	23.8 ±0.5
P2	2.3 ±0.4	19.7 ±0.6	2.9 ±0.3	23.1 ±1.1	4.7 ±0.4	8.3 ±0.2	+	1.2 ±0.3	1.2 ±0.8	1.6 ±0.5	5.5 ±0.8	2.4 ±0.7	6.2 ±0.3	24.9 ±0.4	23.1 ±1.1	31.1 ±0.5
P3	2.6 ±0.6	22.6 ±0.2	2.8 ±0.7	23.1 ±0.5	4.7 ±0.3	8.8 ±0.1	0.5 ±0.3	1.2 ±0.3	1.1 ±0.4	1.6 ±0.4	5.7 ±0.7	2.6 ±0.1	8.5 ±0.2	28.0 ±0.5	23.1 ±0.5	34.7 ±0.4
P4	2.3 ±0.5	27.7 ±0.4	2.7 ±0.4	22.7 ±1.2	4.2 ±0.4	9.5 ±0.6	0.5 ±0.3	1.25 ±0.2	1.2 ±0.6	1.5 ±0.7	5.8 ±0.6	2.5 ±0.2	10.6 ±0.3	22.7 ±0.4	22.7 ±0.4	37.05 ±0.5
P5	2.4 ±0.2	21.5 ±0.3	2.2 ±0.2	22.8 ±0.6	4.5 ±0.5	10.8 ±0.7	0.6 ±0.2	1.4 ±0.7	1.3 ±0.5	1.7 ±0.3	5.95 ±0.4	2.9 ±0.7	11.8 ±0.2	26.1 ±0.2	22.8 ±0.6	40.95 ±0.4

+ present in trace; SFA saturated fatty acids; MUFA monounsaturated fatty acids; PUFA polyunsaturated fatty acids

Of all monounsaturated fatty acids, oleic acid (18:1) was found in largest amounts.
Linoleic acid (18:2) was present in lower amounts in muscles of tench than in muscles of carp of similar age (FARKAS et al., 1977). Difference in amounts of this fatty acid between experimental groups was statistically non significant ($p>0.05$).
Changes in lipid composition of tench fillets regarding important fatty acids were obviously influenced by feeding and different levels of linolenic acid as shown in numerous earlier researches (CASTELL et al., 1972a,b, WATANABE, 1982, FARKAS et al., 1977, BOGUT, 1995).
Lowest amount of linolenic acid was found in control group fed with food containing 0.39% of linolenic acid. All other groups had significantly higher ($p<0.01$) level comparing to control: P1 for 53.37%, P2 for 196.4%, P3 for 214.3%, P4 for 239% and P5 for 285.7%.
This increase of linolenic acid in fillets of tench by increased amount of it in food also influenced the biosynthetic changes and contents of polyunsaturated fatty acids (PUFA), omega-3 series: eicosapentaenic (EPA, 22:6ω3) and docosahexaenic (DHA, 22:6ω3) as the main products of desaturation and elongation of linolenic acid (CASTELL et al., 1972, WATANABE et al., 1974)
Fish which have sufficient amounts of essential fatty acids stimulatively deposit long chain polyunsaturated fatty acids in tissues. This fact was also confirmed in this study where control group contained 21.5±0.6% of all PUFA and all other groups of fish had significantly higher amount of PUFA ($p<0.05$ and $p<0.01$). Highest levels of all PUFA had DHA which is, according to FARKAS et al. (1977), the most important fatty acid in membrane permeability and in processes of fish adjustments to external factors.
This experimental rearing of tench in intensive condition shows that essential linolenic acid should be supplemented in food in minimal amounts of 0.9%, which is similar to the needs of carp (WATANABE et al., 1975).

Conclusion

The results of this research leads to the following conclusion:
Regarding the content of important fatty acids in fillets of tench, of total saturated fatty acids palmitic (16:0) was present in largest amount (16.8±0.9% in control to 27.7±0.4% in P4).
Oleic acid (18:1) was present in the largest amount of all monounsaturated fatty acids (28.3%±1.2% in control to 22.7%±1.2% in P4).
Content of total PUFA was between 21.5%±0.6% in control and 40.95% in P5. Of all PUFA, highest concentration was found for DHA: 3.4±0.2% while all other groups of tench had significantly increased amount of this fatty acid in fillets ($p<0.01$) Largest amount of DHA was found in P5 (11.8%±0.2%).
Results of this research showed that minimal needs of tench for essential, linolenic acid in food is 0.9%. Values between 0.9 and 1.38% are recommended in intensive feeding of tench.

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