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Comparison of Organic and Cultured Rainbow Trout (*Oncorhynchus mykiss*) Fry with Respect to Chemical Composition

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In present study, differences of organic fish from the cultured one was investigated with respect to moisture, crude protein, crude fat, dry matter and muscle fatty acid distribution. The experiment was carried out in 6 earthen ponds with 3 m × 2 m × 1 m dimensions at the farm in central research and extension center of agricultural faculty for 120 d in Turkey. The analysis showed that while the fish of control groups had the level average water content 81.4 ± 0.8 %, crude protein 17.6 ± 0.3 %, crude fat 1.2 % and dry ingredient 18.6 ± 0.5 %, the organically cultured fish had the averages as 80.7 ± 0.8 %, 16.8 ± 0.1 %, 0.71 % and 19.2 ± 0.3 %, respectively. Between the groups, intensively cultured fish found to have statistically higher rates of crude protein and crude fat than organically cultured fish. The differences in saturated fatty acids were not significant between fish muscle cultured intensively and organically. However, the muscle lipids of intensively cultured fish contained significantly higher percentages of linoleic acid (18:2ω6) and docosahexaenoic acid (22:6ω3) than those of the organically cultured ($p < 0.01$). The significantly high percentages of palmitoleic acid (16:1ω7) ($p < 0.01$), linolenic acid (18:3ω3) ($p < 0.01$) and eicasanoic acid (20:1ω9) ($p < 0.05$) in organically cultured fish were observed. The n-3 to n-6 fatty acid ratio was two times higher in the organically cultured fish than in the intensively cultured fish. In conclusion, fish cultured organically contain less protein, fat and more essential fatty acid than intensively cultured fish and evidently organically cultured fish are a better source of n-3 fatty acids than their intensively cultured counterparts.

Key Words: Organic fish, Chemical composition, Fatty acid, Polyunsaturated fatty acids.

INTRODUCTION

Extensive, semi-intensive and intensive systems of production are adopted according to local conditions. Extensive fish farming systems may offer only marginal improvements on natural levels of fish productivity in

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the wild. Intensive systems are designed to allow close control over the environment, feed requirement are met entirely by specially formulated diets and high yields of fish are harvested in a predictable fashion[1].

The aquaculture sector is one of the fastest growing segments in international food markets and organic fish production forms an important part of this sector. An EU directive[2] has decreed that nothing captured or harvested from the wild can be labelled as organic. Organic fish farming without pesticides and chemicals, no artificial colour or genetically modified organisms is the approved method for producing organic fish. The main features involved in organic fish farming are as follows: (1) The pesticides and chemicals involved in conventional fish farming are prohibited (2) Aquatic ecosystems are maintained (3) The fish are not fed with food with ingredients containing artificial colour or genetically modified organisms (4) The farm should promote a good use of local good and services. Currently, only farmed fish can be given the organic label with only salmon and trout[3,4].

It is believed that the future of organic aquaculture will become a significant sector, offering a real alternative to intensive fish farming. However, there is a little knowledge that effects of organic fish produce on the chemical composition of fish. Therefore, this study was carried out to determine some nutritional components in fillets of extensively (organically) and intensively cultured rainbow trout from fry to fingerling in earthen ponds.

EXPERIMENTAL

The experiment was carried out in 6 earthen ponds with 3 m × 2 m × 1 m dimensions at the farm in central research and extension center of agricultural faculty for 120 d. The ponds were free from aquatic vegetation with natural photoperiod. No fertilizer was placed into the ponds. The ponds were randomly divided into two treatments *i.e.*, three ponds for organic fish production and the others for regular culture (control). Ponds were rested for 4 months and then filled with running water with a constant water flow of 1.5 L/min, 14 ± 1 ºC average temperature, 9.1 ppm dissolved oxygen, 7.2 pH and 108 mg as $CaCO_3$ total hardness. They were stocked with rainbow trout fry with mean weight 2 ± 0.2 g obtained from the Fisheries Department of Agricultural Faculty at Ataturk University.

While 700 rainbow trout fry were randomly sorted into 3 earthen ponds (control groups), 70 fish were stocked in the other each pond (organic fish producing groups). The commercial No. 2 granule diet with 52 % protein, 14 % fat, 88 % dry matter and 13 % ash was used to feed the fish of control groups at initial. Fry and fingerlings were fed four times per day and the daily amount of feed was 4 % of their body weight. Rainbow trout fry and fingerlings in organic fish producing groups never fed commercial diet.

Analyses were carried out in triplicate and all reagents were of analytical grade. Moisture, protein and fat content were determined according to AOAC[5]. Samples were also characterized according to pH and fatty acid analysis. The pH values were recorded by using a Schott model pH meter (Schott, Lab Star pH). Fatty acid analysis was performed according to the method described by Microbial ID Inc.[6].

RESULTS AND DISCUSSION

Given the importance of fish and fish products consumed by humans it is important to have knowledge about the chemical compositions of fish. Fish are important as a protein source, but are also source of lipid. They are generally low in cholesterol and have a complex spectrum of lipids high in polyunsaturated fatty acids. Of particular importance is the high proportion of (n-3) fatty acids, contrasting with the (n-6) fatty acids vegetable origin.

In this study, fish of control groups had the average water content, crude protein, crude fat and dry ingredient 81.4 ± 0.8, 17.6 ± 0.3, 1.2 and 18.6 ± 0.5 %, while the organically cultured fish had the averages as 80.7 ± 0.8, 16.8 ± 0.1, 0.71 and 19.2 ± 0.3 %, respectively. Between the groups, intensively cultured fish found to have statistically higher rates of crude protein and crude fat than organically cultured fish.

Fatty acids of the dorsal muscle lipids of intensively and organically cultured rainbow trout fingerlings and of the commercial diet lipids used in intensive culture, were also analyzed. Table-1 shows the fatty acid composition of the lipids of dorsal muscle of intensively and organically cultured fish and commercial diet. The differences in saturated fatty acids were not significant between fish muscle cultured intensively and organically. However, the muscle lipids of intensively cultured fish contained significantly higher percentages of linoleic acid (18:2ω6) and docosa-hexaenoic acid (22:6ω3) than those of the organically cultured ($p < 0.01$). The significantly high percentages of palmitoleic acid (16:1ω7) ($p < 0.01$), linolenic acid (18:3ω3) ($p < 0.01$) and eicasanoic acid (20:1ω9) ($p < 0.05$) in organically cultured fish were observed. The n-3 to n-6 fatty acid ratio was two times higher in the organically cultured fish than in the intensively cultured fish.

It is well known that relative changes in the chemical composition of a growing animal will be a reflection of differences in the rates of accretion of lean body mass and lipid reserves. Moreover the changes that occur during times of feed shortage will reflect the differences in the rates at which the chemical components of different body compartments are mobilized to meet energy demand.

TABLE-1
FATTY ACID COMPOSITION OF THE LIPIDS OF DIET, ORGANIC AND CULTURED RAINBOW TROUT FRY†‡

Fatty acid	Diet		Rainbow trout			
			Cultured		Organic	
	Mean	SD	Mean	SD	Mean	SD
14:0	8.2	0.2	2.5	0.2	3.7	0.8
16:0	22.7	0.3	23.6	0.8	21.5	1.1
16:1ω7	7.8	0.4	4.2	0.2	9.8**	0.4
18:0	3.7	0.3	4.8	0.8	3.6	0.6
18:1ω9	19.7	0.6	16.6	0.7	18.8	1.4
18:2ω6	12.1	0.5	11.8	0.8	4.5**	0.6
18:3ω3	2.0	0.4	0.9	0.2	7.3**	0.5
20:1ω9	0.9	0.1	0.9	0.1	1.4*	0.3
20:4ω6	0.5	0.1	1.5	0.2	1.9	0.2
20:5ω3	4.5	0.1	3.9	0.6	4.5	0.7
22:6ω3	4.9	0.2	18.4	0.5	12.7**	0.8
Sum of n-3	34.2	1.4	69.7	8.1	73.5	3.6
Sum of n-6	38.0	6.4	40.1	13.6	19.2	6.2
n-3/n-6	0.9	0.0	1.7	0.1	4.1**	0.3

†Per cent by weight; ‡Each value represents the mean and standard deviation for triplicate analyses.
Means with different stars represent significant differences between cultured and organic trout; *$p < 0.05$, **$p < 0.01$.

The present findings showed that how fish body compositions may be influenced by types of feed consumed. The amount of 18:3ω3 in organically culture fish was higher than that in the intensively cultured fish. Despite the higher amount of 20:5ω3 in the fish diet, that the percentage of the fatty acid of dorsal muscle lipids in organically cultured fish was similar to those in intensively cultured fish was also observed. This may be concluded from fresh water invertebrates that are natural food organism available to trout contain higher levels of 18:3ω3 and 20:5ω3 than commercial diets used in fingerling production[7]. On the other hand, due to the amount of 18:2ω6 of dorsal muscle lipid in the intensively cultured fish depends on the diet lipids. The lipids of intensively cultured fish contained higher percentages of linoleic acid (18:2ω6) than those of the organically cultured fish. In addition, several studies have reported that composition of farmed fish may be much more stable than that of their wild counterparts, because farmed fish are provided with food throughout the year and are not subject to the vagaries of changes in prey abundance[8,9].

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