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CHEMICAL COMPOSITION AND ENERGY VALUE OF MEAT OF RAINBOW TROUT (*ONCORHYNCHUS MYKISS* W.) FROM DOSPAT DAM LAKE FREE AQUATORY

L. HADZHINIKOLOVA* and T. HUBENOVA
Institute of Fishery and Aquaculture, BG – 4000 Plovdiv, Bulgaria

Abstract

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The aim of the present study was to determine meat chemical composition and energy value of rainbow trout (*Oncorhynchus mykiss* W.), caught in the free aquatory of the Dospat dam lake. The weight of caught fish (April, 2012) ranged between 200–1700 g, so they were divided into 4 weight groups: Group I – weighing 200–300 g; group II – weighing 500–700 g; group III група – weighing 900–1000 g; and group IV – weighing 1500–1700 g. Specific differences in the meat chemical composition in studied weight groups of rainbow trout caught from the free aquatory of the Dospat dam lake were established. A tendency for reduction of the amount of water and increase in dry matter and fat contents along with weight increase was observed. Protein levels were more stable fluctuating around a relatively high level of 20.20 –21.42%, that is why trout could be classified in the group of high-protein fish. According to the meat fat content, the studied groups of rainbow trout were classified in the group of medium-fat fish (live weight 200–1000 g) and fatty fish (live weight 1500–1700 g). The energy content of trout meat ranged between 429.64–679.73 kJ.100 g^{-1}. With regard to the relative proportion of proteins, the meat of studied groups of rainbow trout's competes with poultry and veal meats, and was superior to lamb and pork meats.

Key words: rainbow trout, *Oncorhynchus mykiss* W., fish meat, chemical composition, energy value

Introduction

Rainbow trout (*Oncorhynchus mykiss* W.) is among the most popular fish species inhabiting natural rivers and lakes. It is also of interest to aquaculture because of the rapid growth rate and excellent nutritional qualities of trout meat. A lot of extensive and detailed research has been carried out on rearing and feeding technologies, biochemical composition and flavor quality of meat of rainbow trouts reared in aqua farms (Haliloglu et al., 2002; Saglik and Guven, 2007; Stancheva et al., 2010; Farahii et al., 2011; Vranic et al., 2011; Erol et al., 2012; Ehsani et al., 2013). Comparative investigations on rainbow trout lipid fatty acid content from natural water pools and aqua farms in Turkey were performed by Saglik and Guven (2007). Merdzhanova (2014) has studied the meat lipid content and lipid fatty acid content in brown trouts (*Salmo trutta fario)*, caught in the Beglika dam lake.

In our country, the fish species inhabiting natural water ponds and dam lakes are most commonly subject to angling. The catch is not controlled by the Bulgarian Food Safety Agency and is intended for direct consumption. Out of all 214 state-owned dam lakes, 114 are intended for angling. In 2011, the registered anglers are 300 thousand.

Although no formal statistical data are available, professional evaluations of legitimate catches from licensed anglers showed that they attained 3000–4000 t on an annual basis. At the same time, there is only scarce information for the quality and nutritional quality of caught fish, including trouts. The nutritional value of fish depends on meat chemical composition and energy content, especially the content of macronutrients – proteins and fat. In the scientific literature, the chemical composition of fish meat is investigated from different points of view, as it is influenced by numerous biotic and abiotic factors such as species, gender, age,

**E-mail: hadjinikolova@abv.bg*

season, water temperature and gas content. In industrial production systems, the nutrition is the factor with the most significant effect on the chemical composition of fish meat, as the composition of the diet could partly modulate the accumulation of tissue building blocks and energy sources. In natural ponds, the nutritional value of fish meat is primarily determined by the local natural food. According to Steffens (2006) the meat lipid content of naturally inhabiting species could not be manipulated and was strongly dependent on the type and amount of available food. The differences in fatty acid composition could be attributed to the quality and quantity of food, especially of phytoplankton availability (Heidmann and Oetterer, 2003).

With this regard, the aim of the present study was to determine meat chemical composition and energy value of rainbow trout (*Oncorhynchus mykiss* W.), caught in the free aquatory of the Dospat dam lake

Materials and Methods

The meat chemical composition of rainbow trout (*Oncorhynchus mykiss* W.), caught from the free aquatory of the Dospat dam lake using fishnets was analysed. The Dospat dam lake is a mountainous dam, situated at > 800 m above the sea level, with geographical coordinates N 41°41′54″ and E 24°05′10″ and surface area of more than and 22 000 thousand squire meters; recreational fishing is allowed.

The weight of caught fish (April, 2012) ranged between 200–1700 g, so they were divided into 4 weight groups: Group I – weighing 200–300 g; group II – weighing 500–700 g; group III – weighing 900–1000 g; and group IV – weighing 1500–1700 g.

Individual meat samples for chemical analysis were obtained from the musculature (lateral muscle) after removal of the skin and homogenization of meat. The determined parameters were: water content (105°C, 24 h; Bulgarian State Standard – SR ISO 5984), protein content (Kjeldahl method by using automatic system DK 6 and UDK 132, Velp Scientifica; Bulgarian State Standard – SR ISO 5983), fat content (Soxhlet method) and mineral content (by using standard methods 550°C; Bulgarian State Standard – SR ISO 6496).

The energy value was theoretically determined on the basis of data for meat lipid and protein content using coefficients 17 kJ.g^{-1} for proteins and 37 kJ.kg^{-1} for fat (Ordinance 23 /2001 of the Ministry of Health).

As carbohydrate content of fish meat is not significant (< 0.5%), it was ignored in the calculation of meat energy value (FAO, 2005; FAO, 2010).

Data were submitted to statistical analysis for calculation of the mean value (x), standard error of the mean (Sx) and coefficient of variation (Cv, %) using the statistical package of MS Office 2010. The statistically significance of differences between samples was evaluated with the Student's t test at a level of significance $P < 0.05$.

Results and Discussion

Data about the chemical composition of meat of studied groups of trouts are presented in Table 1. With respect to the water content, ranging within 69.47–76.27%, there was a tendency towards reduction along with increase in the weight of fish, with statistically significant differences between groups I and IV ($P < 0.01$), and groups II and IV ($P < 0.05$). There were no considerable differences between groups II and III as well as between groups III and IV ($P > 0.05$). Water content is an important parameter because it is essential for the organoleptic properties of meat.

Meat protein contents were similar (20.21–21.42%), and the differences between the groups – insignificant ($P > 0.05$). The absolute values of this parameter were higher in fish weighing 900–1000 g compared to all other studied weight groups.

The trout meat fat content ranged from 2.17% to

Table 1

Chemical composition of rainbow trout meat from the free aquatory of Dospat Dam Lake, % of wet matter

Weight, g n = 3	Group		Water	Proteins	Fats	Ash	Relative share, %	
							Proteins	Fats
200–300	I	X	76.27	20.55	2.17	1.01	86.6	9.14
		Sx	0.368	0.475	0.362	0.015		
500–700	II	X	74.23	20.54	4.20	1.03	79.70	16.30
		Sx	0.821	0.894	0.053	0.20		
900–1000	III	X	71.72	21.42	5.62	1.24	75.74	19.87
		Sx	0.955	0.689	0.255	0.029		
1500–1700	IV	X	69.47	20.20	9.09	1.24	66.16	29.77
		Sx	0.094	0.408	0.441	0.008		

9.09%, with various level of significance of between-group differences ($P < 0.05$; $P < 0.01$), the difference between groups II and III was not relevant ($P > 0.05$).

The mineral content of meat varied between 1.01% and 1.24%, and the differences among the groups were insignificant ($P > 0.05$).

According to its protein content, the rainbow trouts from groups I, II and IV are classified as medium–protein fish (meat protein level from 15 to 20%), whereas fish from group III with live weight 900–1000 g: to the high protein type of fish (protein content > 20 %), (Repnikov, 2007).

Using the classification of national and foreign researchers (Repnikov, 2007; Kyosev and Dragoev, 2009) the meat of studied groups of fish is divided into two categories depending on meat fat content:

– medium-fat fish – with meat fat content up to 8% – (group I: 200 – 300 g, group II: 500–700 g and group III: 900–1000 g)

– fatty fish – with meat fat content over 8% – group IV: 1500–1700 g)

The analysis of data showed that the increase of fish weight from 200–300 to 1500–1700 g, respectively age, resulted in a m ore significant change in dry matter content – increase up to 28.7%, and fat content – up to 4.5 times. For proteins, an increase by 4% was noted for group III vs group I, as well as a reduction by 5.7% for group IV vs group III. Apparently, as live weight and age of fish increase, the metabolism is directed towards dry matter increase, i.e. reduction of water content and accumulation of fat in the meat of trouts. A comparable tendency was reported by Weatherley (1983) in different groups of trouts and by Hadzhinikolova (2004) in different freshwater fish species (carp, wels catfish, bighead carp, grass carp).

According to Saglik and Guven (2007) the total content of polyunsaturated n-6 and n-3 fatty acids in the meat of rainbow trouts from natural ponds is higher compared to fish reared in aqua farms; including 1.5 to 2 times higher content of eicosapentaenoic and docosahexaenoic acids. Therefore, the higher level of fat as well as of polyunsaturated fatty acids of studied fish makes them a source for essential fatty acids for human nutrition.

Theoretically calculated energy value of rainbow trout meat on the basis of the chemical composition (Table 2) varied from 429.64 kJ.100 g^{-1} (group I) to 679.73 kJ.100 g^{-1} (group IV). The energy from proteins in the studied fish meat was from 50.52 to 81.30%, and it was higher for fish from group I (81.30%) compared to the other three studied groups. This is attributed to the fact that in groups II, III and IV, the fat level of meat was higher in both absolute and relative terms. This was most valid for fish from group IV, whose absolute meat fat content was 9.09%, relative fat content – 29.77% and energy value from fat – 49.48%.

Table 2

Energy value of rainbow trout meat from the free aquatory of Dospat Dam Lake, kJ.100 g^{-1}

Weight, g	Group	Energy, kJ.100 g^{-1}	Energy, % from proteins
200–300	I	429.64	81.30
500–700	II	504.58	69.20
900–1000	III	572.08	63.65
1500–1700	IV	679.73	50.52

According to the present study, the relative proportion of meat proteins varied from 66.16 % to 86.60%, and that of fat – from 9.14% to 29.77% in the different groups. The fish from groups I to III weighing between 200 and 1000 g demonstrated a higher relative share of proteins (75.74–86.60%). The increase in body weight up to 1700 g, the reduction of the share of proteins was more pronounced: up to 66.16%, with respective increase in fat proportions.

The comparison of data for trout meat protein content in all studied weight groups with data for other types of meat indicates that the relative proportion of protein was higher as compared to pork meat (40.44%) and lamb meat (58.0%) (Cirkovic et al., 2002). For fish weighing 200–1000 g, the relative proportion of proteins was higher or similar to that of veal (77%), and for fish weighing 200–300 g – higher than poultry meat protein content (84.6%).

Therefore, the meat of studied fish species could be evaluated as high-protein foodstuffs, whose properties are fully in agreement with the recommendations for rational, healthy and complete nutrition.

As the balance of macronutrients and energy values is regarded, the meat of fish weighing up to 1 kg could be assessed as more dietetic due to the higher relative proportion of proteins, lower fat content and lower energy value compared to heavier fish.

Conclusions

Specific differences in the meat chemical composition in studied weight groups of rainbow trouts caught from the free aquatory of the Dospat Dam Lake were established.

A tendency for reduction of the amount of water and increase in dry matter and fat contents along with weight increase was observed.

Protein levels were more stable fluctuating around a relatively high level of 20.20–21.42%, that is why trouts could be classified in the group of high–protein fish.

According to the meat fat content, the studied groups of rainbow trouts were classified in the group of medium–fat fish (live weight 200–1000 g) and fatty fish (live weight 1500–1700 g). The energy content of trout meat ranged between 429.64–679.73 kJ.100 g^{-1}.

With regard to the relative proportion of proteins, the meat of studied groups of rainbow trouts competes with poultry and veal meats, and was superior to lamb and pork meats.

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