

# STUDY ON THE NUTRITIONAL QUALITY OF ATLANTIC SALMON (*SALMO SALAR*) AND SALMONIZED TROUT MEAT

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## Abstract

The aim of this study was a comparative analysis of nutritional quality of Atlantic salmon (*Salmo salar*) and salmonized trout, hybrid of salmon with brown trout (*Salmo trutta*), based on chemical composition and energetic value. There were analyzed 10 samples of salmon and 10 samples of salmonized trout purchased from stores from Iasi in July. Salmon originating from Norway and salmonized trout from Italy. The content of proteins, lipids, water and collagen was determined using the automatic analyzer Food Check (infrared spectrophotometer); minerals were determined by calcination and nitrogen free extract (NFE) and energetic value were determined by calculation, using conventional formulas. The average values determined for salmon were: 6.64% lipids, 20.84% proteins, 72.06% water, 3.9% collagen and 1.17% crude ash, while for salmonized trout mean values were: 10.75% lipids, 19.75% proteins, 68.7% water, 3.57% collagen and 1.25% ash. The largest differences were observed for lipids, salmonized trout having with 4.11 g/100g meat more than salmon. The energetic value was higher for salmonized trout (180.23 kcal/100g meat) due to higher proportion of lipids, compared with salmon (146.73 kcal/100 g meat). The results were statistically analyzed, including analysis of variance (ANOVA), observing significant and very significant differences for the most of the parameters (differences that can be attributed to different technology of growth), excluding ash and NFE, where the differences were insignificant.

**Keywords:** salmon, salmonized trout, proteins, lipids, collagen

## INTRODUCTION

Fish quality can be assessed by several characteristics including nutritional value, processing properties, appearance and palatability [16, 12].

The beneficial effects to humans of consuming fish, particularly oily fish such as salmon, herring and mackerel with a high content of the (n-3) highly unsaturated fatty acids, eicosapentaenoic acid [EPA; 20:5(n-3)] and docosahexaenoic acid [DHA; 22:6(n-3)], have been well documented [2, 9, 4]. However, global capture fisheries are a finite resource. As a result of overfishing and subsequently tighter regulation, future demand for wild-caught fisheries products will exceed supply [2, 12].

Currently, farmed salmon is a good source of n-3 LC-PUFA, as a 150 g portion

of farmed salmon fillet provides about 1.5 g EPA + DHA [8, 5]. This is six times the daily dose of 250 mg recommended by the European Food Safety Authority (EFSA, 2009), while others recommend 500 mg per day (ISSFAL, 2004).

Atlantic salmon (*Salmo salar*) and brown trout (*Salmo trutta*) are sympatric species that exhibit introgressive hybridization in the wild in all their distribution areas. Interspecific hybridization seems increased by different factors, such as escapes or releases of domestic individuals and alternative mating behaviour like male cloaking. Both species are intensively reared and exploited worldwide, and it is possible to find reciprocal situations, where one species acts as a recent colonizer of an ecosystem already inhabited by the other species [3, 7].

The majority of the world's fish resources are fully exploited or overexploited [6, 17]. Aquaculture now accounts for almost half of the total food fish supply and the percentage is increasing every year [6, 17, 14].

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The manuscript was received: 05.10.2016

Accepted for publication: 05.11.2016

Atlantic salmon (*Salmo salar* L.) represents an increasingly popular species in the global fish market, largely due to its high market value over freshwater species, the main producers being Norway, Chile, Scotland and North America with a combined production volume of around 2 million metric tonnes [14, 17, 15].

The aim of this study was a comparative analysis of nutritional quality of salmon and salmonized trout, commercialized in Iasi, based on chemical composition and energetic value. The importance of this work is the lack of information concerning the nutritional value of meat of salmon and of salmonized trout. From the perspective of their chemical composition we have encounter studies only for the salmon meat (studies that provide data on the percentage of lipids, proteins, ash, water and dry matter). Information regarding the characterization of salmonized trout meat are missing entirely.

## MATERIALS AND METHODS

Were analyzed 20 samples (10 samples of salmon and 10 samples of salmonized trout) purchased from stores from Iasi in July (this

summer). The weight of fishes was  $2 \pm 0.2$  kg. The content of proteins, lipids, collagen and water were determined using the automatic analyzer Food Check (infrared spectrophotometer); minerals were determined by calcinations, and nitrogen free extract and energetic value were determined by calculation, using conventional formulas. The conversion factors were: for proteins 4.27, for lipids 9.02 and for nitrogen free extract 3.87 (after FAO, 2003). The results were statistically analyzed, including analysis of variance (ANOVA).

## RESULTS AND DISCUSSIONS

In the present study, the mean values determined for salmon have been: 6.64% for lipids, 20.84% for proteins, 72.06% for water, 3.9% for collagen and 1.17% for crude ash, while for salmonized trout, the mean values were: 10.75% lipids, 19.75% proteins, 68.7% water, 3.57% collagen and 1.25% ash (Table 1).

The energetic value was higher for salmonized trout (180.23 kcal/100g meat) due to higher percentage of lipids, compared with salmon (146.73 kcal/100g meat).

Table 1 The chemical composition and energetic value of meat of salmon and salmonized trout

Chemical components	Fish	$\bar{X} \pm s_{\bar{x}}$	S	S <sup>2</sup>	CV%	Min.	Max.	P value
Lipids%	Salmon	6.64±0.25	0.70	0.49	10.50	5.30	7.90	***
	S. trout	10.75±0.05	0.13	0.02	1.22	10.60	10.90	p=1.54668
Proteins%	Salmon	20.84±0.16	0.46	0.21	2.21	20.10	21.80	***
	S. trout	19.75±0.12	0.35	0.12	1.75	18.90	19.90	p=0.01103
Collagen%	Salmon	3.90±0.09	0.27	0.07	6.80	3.28	4.20	**
	S. trout	3.57±0.04	0.12	0.01	3.24	3.30	3.70	p=0.00541
Water%	Salmon	72.06±0.19	0.52	0.28	0.73	71.15	73.10	***
	S. trout	68.68±0.04	0.10	0.01	0.15	68.60	68.80	p=4.87545
Ash%	Salmon	1.17±0.06	0.17	0.03	14.21	1.01	1.36	ns
	S. trout	1.25±0.04	0.11	0.01	9.18	1.13	1.37	p=0.27138
Dry matter%	Salmon	27.94±0.19	0.52	0.28	1.88	26.90	28.85	***
	S. trout	31.33±0.04	0.10	0.01	0.33	31.20	31.40	p= 4.87545
OS%	Salmon	26.78±0.22	0.63	0.40	2.36	25.54	27.84	***
	S. trout	30.08±0.02	0.05	0.00	0.17	30.03	30.15	p=6.43246
NFEs%	Salmon	0.70±0.37	1.04	1.08	18.72	2.96	0.69	ns
	S. trout	0.42±0.10	0.32	0.11	5.51	0.67	0.33	p=0.48699
GE kcal/100g	Salmon	146.73±0.14	0.37	0.13	0.25	146.38	147.23	***
	S. trout	180.23±0.57	0.75	0.27	0.42	179.52	181.32	p=3.96745

OS%= organic substances  
 NFEs%=nitrogen free extract  
 GE kcal/100g= gross energy  
 S. trout =salmonized trout

After applying the analysis of variance test ANOVA, significant and very significant differences are observed for the most parameters, between salmon and salmonized trout, excluding ash and NFE where insignificant differences have been highlighted.

The coefficient of variation (CV%) calculated, has not exceeded the threshold of 10% for the most parameters (expressing very high homogeneity of the samples) excepting lipids, ash and NFE where was showed a relative homogeneity of the samples, for the salmon.

Salmon and salmonized trout are two representative types of fatty fish (rich in polyunsaturated fatty acids) on the internal market of Romania. Salmon is always present in stores and has high price (approximate 10 euro/kg). Salmonized trout recently entered in supermarkets from Iasi (2015) with considerable price, relatively close to that of salmon (about 7,5 euro/kg).

We could not find studies on the nutritional value of salmon, and for nutritional value and meat quality of the salmonized trout, the hybrid of salmon with brown trout (*Salmo trutta*), we did not find any study.

The values obtained in this study for lipids and dry matter (DM), were similar to those obtained in the warm season by Oppedal et al., 2006, in which study was pursued their variation (30 to 25.6% DM and 9.1 to 4.1% lipids), depending on the season and according to the light regime applied.

Bell et al 2001, determined higher values for water content (74.7%) and lowest for lipids (5.37%) than in the present study (72.06% water respectively 6.64% fat).

In Figure 1 are presented the main nutritional components underlying calculation of the nutritional value of meat of salmon and salmonized trout.

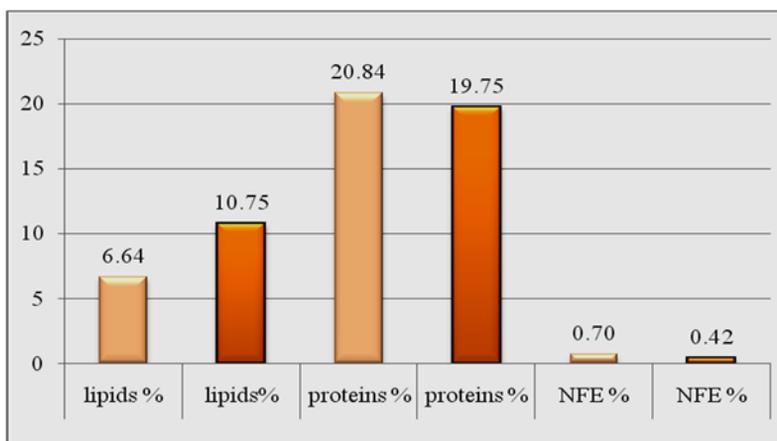


Fig. 1 The main nutritional components of the salmon and salmonized trout

Viera et al, in 2007, studying the heritability of the numbers and sizes of muscle fibers correlated with meat quality of Atlantic salmon (*Salmo salar* L.) has observed variables average value of the amount of lipid according to the year in which the samples were collected (from 9.6 to 14.7%). In their opinion, the high amount of fat, negatively affects the meat quality of

salmon, decreasing the density and the number of muscle fibers.

Ytrestøyl et al., 2015, into a more recent work, has determined for salmon much higher amounts of lipids (18.4%) than in the present study (6.64%); instead, the proteins have recorded a lower proportions (19.1%) compared with those found in this study (20.84%).

Atanasoff et al., 2013 has determined the average amounts close to those of the current study (slightly lower for lipids 4.46%, proteins 18.81% and ash 0.96% (differences put on the weight/age lower at the moment of slaughter of fish) and higher by about 1% for the water 73%).

Pratoomyot et al. 2010 has determined a greater lipids content for salmon (11.7%) compared with the present study (6.64%),

concluding that this value is significantly influenced by fish feed (after a comparison made between vegetable and animal sources of feed).

In the present study (Figure 2, Table 1), the energetic value of salmon (146.73 kcal/100g of meat) was lower than that obtained for salmonized trout (180.23 kcal/100g meat) mostly due to variables proportion of lipids contained therein.

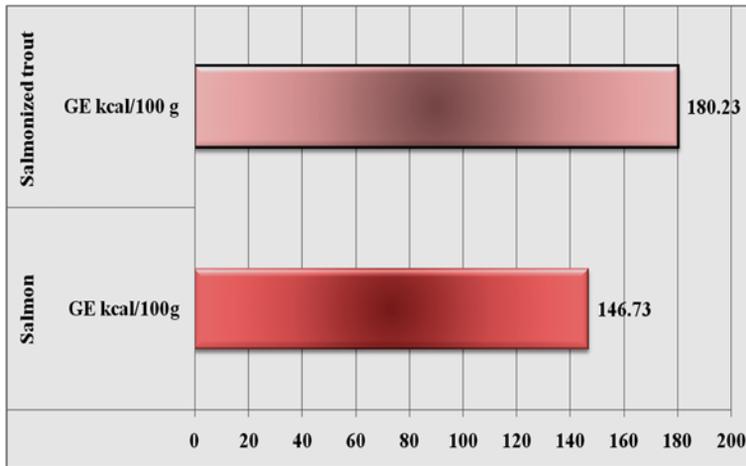


Fig. 2 The energetic value of salmon and salmonized trout meat (kcal/100g)

For the correct interpretation of the data obtained should be taken into account that the chemical composition of fish meat varies between individuals of the same species, being closely related with the consumption of feed, the swimming for migration and sexual changes (of spawning), with the age, size, sex and the living environment.

The nutritional quality of the salmon and salmonized trout, being viewed through the basic chemical composition and energetic value of their, justify the relatively high price of these two representative types of fatty fish in the internal market of Romania (being known that the lipids contained therein (6.64% and 10.75% respectively), are healthy due to the high content of polyunsaturated fatty acids).

Moreover, the meat of salmon and salmonized trout offers a high amount of proteins (20.84% for salmon and 19.75% for salmonized trout) with high biological value

compared to other meats. The proportion of collagen is lower for salmonized trout (3.57%) compared with salmon (3.9%) probably due to the lower proportion of its crude protein.

The energetic value was higher for salmonized trout (180.23 kcal/100 g meat) due to higher proportion of lipids compared with salmon (146.73 kcal/100 g meat), differences that can be attributed to different species, different technologies of growth and of the season in which took place meat harvesting (in winter, in some studies, the amount of lipids determined for salmon being doubled or sometimes even triple).

It can be appreciated that the energetic value of the salmon and of salmonized trout meat collected in summer, it is close to that of meat of mackerel (185.3 kcal/100g meat), chicken (118.79 kcal/100g meat) or rabbit (144.2 kcal/100g meat).

## CONCLUSIONS

The comparative analysis of two sources of meat (salmonized trout versus salmon) showed the greatest differences in the case of lipids content, salmonized trout having with 4.11 g/100g meat more lipids than salmon. The proteins contained of salmon, were with 1.09 g/100g meat higher than those contained by the salmonized trout, and the collagen content, higher with 0.36 g/100g meat. The amount of minerals was slightly higher for salmonized trout (1.25% crude ash) compared with salmon (1.17% crude ash), being noticed a difference of 0.08 g/100g meat, and the proportion of water (68.7%), lower than of salmon (72.06%), with 3.36 g/100 g meat. The energetic value was higher for salmonized trout with 33.5 kcal/100g meat, compared to salmon.

After statistical processing of the obtained data were observed significant and very significant differences for the most parameters, excepting ash and NFE, were have been highlighted, insignificant differences.

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