Scientific Papers. Series D. Animal Science. Vol. LXI, Number 1, 2018
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

STUDY ON THE NUTRITIONAL QUALITY OF SOME ASSORTMENTS OF SMOKED SALMON FILLETS

Mircea POP, Gabriela FRUNZA

„Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine of Iasi,
3 Mihail Sadoveanu Alley, 700490, Iasi, Romania

Corresponding author email: frunza.gabriela27@gmail

Abstract

The study aimed a comparative analysis of the nutritional-economic characteristics of smoked products from wild salmon (Oncorhynchus keta) and respectively Norwegian salmon (Salmo salar) from aquaculture. Twelve samples (three samples for each type of study product) were analyzed. The proteins, lipids, collagen and water content was determined using the automated analyzer Food Check (infrared spectrophotometer); mineral substances were determined by calcination and the carbohydrates content and energy value were determined by calculation, using conventional relations. The most important differences between the products analyzed have targeted the lipid content: to the smoked Norwegian salmon fillets was determined an almost double amount of lipids (45.5 g/kg product) compared to smoked wild salmon fillets (23.5 g/kg of product). It is interesting the price difference between the two products under study, the product based on smoked Norwegian salmon fillets being over 40% more expensive than wild salmon.

Key words*: lipids, proteins, salt, smoked salmon.*

INTRODUCTION

Fresh fish bring an important nutritional contribution in the diet, offering protein, fatty acids, vitamins and minerals; however, is a perishable commodity very susceptible to oxidation and alteration. Accordingly, conservation technologies are needed, such as smoking, to maintain the quality of the fish (Albertosa et al., 2017).

The conservation effect of smoching is due to a combination of factors, including salt addition, partial dehydration of tissues which takes place in the different stages of the process and the conservation action of the smoke components.

The smoking process slows down biological processes and oxidative degradation and confers of the final product sensory characteristics which consumers appreciate very much (Rizo, 2015).

Quality of raw material, also, represents an important factor for achievement a high quality smoked product (Lerfall, 2017; Usydus et al., 2011).

Smoked salmon is rich in polyunsaturated fatty acids, being used as ready-to-eat food, without cooking (Baek and Song, 2018). The study aimed a comparative analysis of the nutritional-economic characteristics of some smoked products from salmon fillets marketed in Romania.

MATERIALS AND METHODS

The biological material was represented by smoked products of wild salmon fillets (*Oncorhynchus keta*) of USA origin, fishing in the Pacific Ocean (FAO 67 zone) and respectively Norwegian salmon (*Salmo salar*) from aquaculture (Norway origin). The products studied were purchased from the supermarkets from Iasi.

Twelve samples of smoked salmon fillets were analyzed (six samples for each product type taken into study), the samples being chopped and homogenized with the help of an electric shredder.

The content of water, protein, fat, and collagen was determined using the automated analyzer Food Check (infrared spectrophotometer); mineral substances were determined by calcination, and the content of carbohydrates and energy value were determined by calculation, using conventional relations; energy conversion factors were: 4.27 for proteins, 9.02 for lipids and 3.87 for carbohydrates (according

to FAO relations, 2003). The results obtained were statistically processed using the classic method.

RESULTS AND DISCUSSIONS

The most important differences between the products analyzed (Table 1 and Table 2) have targeted the content of lipids: thus, to the smoked Norwegian salmon fillets was determined an almost double amount of lipids (4.45 g/100 g product) and an energy value (134.6 kcal/100 g of product) about 16% higher compared to smoked wild salmon fillets (2.35 g lipids and 115.59 kcal, respectively, for 100 g product); was noted and very high variability of the lipid content to samples of norway salmon fillets (33.7 % CV).

Table 1. Chemical composition and energy value of smoked wild salmon fillets

Chemical components	$\bar{x} \pm s_{\bar{x}}$	s	CV%	Min.	Max.
Lipids%	2.35 ±0.05	0.16	6.73	2.10	2.60
Proteins%	21.77 ±0.05	0.15	0.69	21.50	21.90
Collagen%	4.37 ±0.04	0.12	2.83	4.06	4.45
Water%	74.39 ±0.04	0.12	0.16	72.40	75.60
Ash%	4.86 ±0.13	0.41	8.48	4.24	5.26
Salt%	4.77 ±0.23	0.74	15.45	0.89	1.49
Dry matter%	24.49 ±0.03	0.08	0.34	24.30	24.70
Organic matter%	19.63 ±0.12	0.38	1.91	19.14	20.20
Carbohydrates %	0.21 ±0.17	0.54	14.02	0.08	0.96
GE kcal/100g	115.6 ±0.80	2.53	2.19	112.55	118.24
GE Kj/100g	483.2 ±4.30	13.59	2.81	464.32	505.95

GE = Gross Energy

Determined water content for the two types of products was relatively close (73-74 g/100 g product) as well as ash content (4.9-5.3 g/100 g product); little differences were highlighted in terms of content in protein, in favor of wild salmon fillets (21.77 vs. 21.55 g per 100 g of product). Noteworthy (Table 1 and Table 2) the different content of salt for the two types of products (4.9 vs. 3.3 g per 100 g product).
The collagen content (Table 1 and Table 2) was slightly lower for smoked Norwegian salmon compared to wild salmon (4.31 versus 4.37 g/100 g product).

Table 2. Chemical composition and energy value of smoked Norwegian salmon fillets

Chemical components	$\bar{x} \pm s_{\bar{x}}$	s	CV%	Min.	Max.
Lipids%	4.45 ±0.38	1.20	33.70	2.60	6.90
Proteins%	21.55 ±0.09	0.27	1.26	20.80	21.80
Collagen%	4.31 ±0.05	0.17	3.89	3.98	4.61
Water%	72.56 ±0.32	1.02	1.38	69.40	75.10
Ash%	5.27 ±0.08	0.25	4.79	4.90	5.61
Salt%	3.28 ±0.49	0.82	7.12	2.40	4.10
Dry matter%	25.15 ±0.05	0.17	0.67	24.90	27.60
Organic matter%	19.88 ±0.08	0.24	1.21	19.60	22.60
Carbohydrates %	0.24 ±0.09	0.28	5.19	0.11	2.41
GE kcal/100g	134.6 ±0.21	0.66	0.64	117.92	153.34
GE Kj/100g	562.46 ±19.77	62.50	11.11	492.91	640.96

GE = Gross Energy

The amount of proteins, lipids, ash, salt and water determined in this study are relatively similar to those observed in specialty literature for these product categories, with the remark that there is a very high variability of available data related to the chemical composition of wild and aquaculture salmon. Also, it can be noted the inconsistency and/or lack of complete presentation of the chemical composition of smoked salmon - some authors only mention the amount of fat and fatty acids (Espe et al., 2002), others the amount of water, salt (Lin et al., 2003), lipids, dry matter (Brillet, 2005), or the

one of proteins, fatty acids, minerals, vitamins (Usydus et al., 2009) etc.

Espe et al. 2002 have determined for smoked salmon fillets 4.4% lipids and 10.1% lipids for the Norwegian one of aquaculture.

Lin et al. (2003) have determined for smoked Pacific salmon fillets (*Oncorhynchus tshawytscha* and *Oncorhynchus keta*) a total salt content which ranged from 1.66 to 5.95% and respectively from 2.15 to 5.69%, and the moisture varied from 50.7 to 71.6% and respectively, from 55.5% to 69.7%.

Hanne, in 2007, has found for Atlantic salmon fillets (*Salmo salar*) a quantity of salt which varies between 2 and 5%, and Gallart-Jornet et al., in 2007, an average of 3.5%.

Hanne (2007) specifies the fact that cold smoked salmon appears to be a slightly preserved product, with a small amount of salt, more moisture and less smoke favour than in the past.

Brillet A. (2005) has noticed (in a larger study carried out in France on several batches of smoked Norwegian salmon (*Salmo salar*) weighing 4-5 kg) a wide variation in the chemical composition (lipids: 8.4-15.4%, salt 3.8-5.6%; dry substance: 35.7-41.7%), but states all results meet the current French standards.

Mol et al. (2008) have determined for smoked salmon the following values: water 60.7 ± 2.9%, proteins 19.9±1.4%, lipids 13.6±1.5%, ash 4.4±1.2%, carbohydrates 1.4±0.8% and an energy value of 247.1±7.1 Kcal/100g but does not specify which type of smoked salmon has been analyzed.

Usydus et al. (2009) have determined for Baltic wild smoked salmon (*Salmo salar*) 22.35% proteins and 11.51% lipids, versus 19.71% proteins and 15.46% lipids, for Norwegian aquaculture salmon.

Espe et al. (2002) mentions that the freshly used raw material affects smoke losses of the nutritional components of salmon fillets. The weaker the fish, the higher the fat loss of the fillets, and if the fish raw material is fatter, the fillets does not suffer a large changes in weight and fat through smoking.

The price of the two assortments analyzed was different, the Norwegian salmon product being over 40% more expensive (12.49 RON/100g product) than the wild salmon (8.79 RON/100g of product) at the same economic agent.

The two product assortments studied have been characterized and compared and through the prism the amount of nutrients (protein, fat) and respectively the energy and water offered to the consumer for a value unit (1 RON) (Table 3). It can be seen from the analysis of these data how the amount of protein and energy offered to consumers for the same value unit (1 RON) is higher for wild salmon (this having a lower price) compared to Norwegian salmon (Table 3).

Table 3. Nutritional - economic characteristics of analysed products (smoked salmon filets)

Nutritional - economic characteristics		Captured wild salmon (*Oncorhynchus keta*)		Norvegian culture salmon *(Salmo salar)*		
		values	%	values	%	± %
Price	RON/ kg	87.9	100	124.9	142.1	+ 42.1
Protein	g / kg	217.7		215.5	99.0	- 1.00
	g / RON	2.47		1.73	70.0	- 30.0
Fat	g / kg	23.5		44.5	189.4	+ 89.4
	g / RON	0.27		0.36	133.3	+ 33.3
Energy GE	kcal / kg	1156		1346	116.4	+ 16.4
	kcal / RON	13.15		10.77	81.9	- 19.1
Water	g / kg	743.9		725.6	97.5	- 2.5
	g / RON	8.46		5.81	68.7	-31.3

In the somewhat paradoxically mode, the price of the wild salmon product is much lower; a possible explanation could be based on the controversial situation in the world through is incriminated constipation of radioactive contamination with Caesium 137 of aquatic products coming from the following FAO areas: area 61: Pacific Northwest, area 67: Pacific Northeast, area 71: Pacific Western Central, area 77: Pacific Eastern Central, area 81: Pacific Southwest and area 87: Pacific Southeast.

The European Commission recommends its Member States to randomly monitor the levels of radioactive substances in the seafood captured in the FAO main fishing area 61, as well as those from FAO major fisheries areas 67, 71 and 77 - but of lesser importance of risk of contamination resulting from the Fukushima nuclear accident (WHO/FAO, 2011).

CONCLUSIONS

The amount of protein offered to consumers is similar for the two smoked salmon assortments marketed in Romania, but reported at the purchase price the salmon of aquaculture offers with 30% less protein than the wild one;

The most important differences between the products analyzed have targeted the lipid content: to the smoked Norwegian salmon fillets was determined a quantity almost double of lipids (+89.4%). Reported to purchase price of Norwegian salmon, the amount of lipids offered to consumers is over 33% higher.

The amount of salt contained of fillets of Norwegian salmon it is smaller than that of wild salmon with 1.6 g / 100g of product.

We recommend authorities in the field to introduce the obligation to mention on the labels of food products the area they come from fish raw material, given the potential hazards to which consumers may be expose if purchases products coming from the areas with a risk of radioactive contamination or of another nature. Thus, the consumers should make a conscious, informed choice between the price of the product and the culinary gustatory, properties, nutritional quality, but also the consumer's safety of the product it buys, carefully reading product labels.

REFERENCES

Albertosa Irene, Roberto J. Avena-Bustillosb, Ana Belén Martín-Dianaa , Wen-Xian Dub , Daniel Ricoa, Tara H. McHughb, 2017. Antimicrobial Olive Leaf Gelatin films for enhancing the quality of coldsmoked Salmon. Food Packaging and Shelf Life, 13, 49-55.

Baek S.-K., Song K.B., 2018. Development of Gracilaria vermiculophylla extract films containing zinc oxide nanoparticles and their application in smoked salmon packaging. LWT - Food Science and Technology, 89, 269-275.

Brillet Anne, 2005. Sélection et caractérisation de souches de Carnobacterium pour la biopréservation du salmon fumé These de Doctorat, Discipline: Biotechnologies Agroalimentaires, Sciences de l'Aliment, Spécialité: Microbiologie.

Espe M., Nortvedt R., Lie O., Hafsteinsson H., 2002 Atlantic salmon (*Salmo salar*, L) as raw material for the smoking industry. II: Effect of different smoking methods on losses of nutrients and on the oxidation of lipids. Food Chemistry, 77, 41-46.

Lerfall C J., Skuland A. V., Skare E.F., Rune Hasli P., Rotabakk B.T. WT, 2017. Quality characteristics and consumer acceptance of diploid and triploid cold smoked Atlantic salmon reared at 5, 10 and 15^0C. Food Science and Technology, 85, 45-51.

Gallart-Jornet L., Barat J.M., Rustad T., Erikson U., Escriche I., Fito P., 2007. Influence of brine concentration on Atlantic salmon fillet salting. Journal of Food Engineering, 80, 267-275.

Hanne Løje, 2007. The quality of cold smoked salmon - Influence of raw material and technological parameters. Ph. D. thesis, Technical University of Denmark Danish, Institute for Fisheries Research, Department of Seafood Research BioCentrum.

Lin M., Cavinato AG., Huang Y., Rasco BA., 2003. Predicting sodium chloride content in commercial king (*Oncorhynchus tshawytscha*) and chum (*O. keta*) hot smoked salmon fillet portions by short-wavelength near-infrared (SW-NIR) spectroscopy. Food Research International, 36(8), 761-766.

Mol Sühendan, Alakavuk Ü. Didem, Tosun Ş. Yasemin, 2008. Effects of Different Processing Technologies on the Chemical Composition of Seafoods. Food Sci. Technol. Res., 14 (5), 467-470.

Rizo Arantxa, Máñes Verónica, Fuentes Ana, Fernández-Segovia Isabel, Barat José M., 2015. A novel process for obtaining smoke-flavoured salmon using water vapour permeable bags. Journal of Food Engineering 149, 44-50.

Usydus Z., Szlinder-Richert Joanna, Polak-Juszczak Lucyna, Komar Katarzyna, Adamczyk Maria, Malesa-Ciecwierz Małgorzata, Ruczynska Wiesława, 2009. Fish products available in Polish market – Assessment of the nutritive value and human exposure to dioxins and other contaminants. Chemosphere, 74, 1420-1428.

Usydus Z., Szlinder-Richert Joanna, Adamczyk Maria, Szatkowska Urszula, 2011. Marine and farmed fish in the Polish market: Comparison of the nutritional value. Food Chemistry, 126, 78-84.

WHO/FAO, 2011. Impact on Seafood Safety on Nuclear Accident in Japan.
www.iaea.org/sites/default/files/seafoodsafety05110.pdf