

STUDY ON THE NUTRITIONAL QUALITY OF MARINATED AND SMOKED MACKEREL (*SCOMBER SCOMBER*)

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Abstract

The aim of this study was a comparative analysis of nutritional quality of two different types of mackerel (marinated mackerel and smoked mackerel) on the basis of chemical composition and energy value. There were analyzed 20 samples of mackerel (*Scomber scomber*) purchased from stores from Iasi. The content of protein, lipids, collagen, salt and water was determined using the automatic analyzer Food Check (infrared spectrophotometer); the mineral substances were determined by calcination, and non-nitrogenous extractive substances and energy value were determined by calculation, using conventional formulas. The results were statistically analyzed, including analysis of variance (ANOVA). The average values determined for smoked mackerel were: 27.15% for lipids 16.13% for the protein, 55.53% for water, 2.29% for collagen, 3.83% for crude ash and 3.82% for salt, while for marinated mackerel mean values were: 7.75% lipids proteins 20.50%, 71.05% water, 3.85% collagen, 4.31% crude ash and 4.25% salt, highlighting significant differences for all analyzed parameters, differences which may be attributed to different technologies of production (processing and preservation) of the two assortments analyzed.

Key words: mackerel, proteins, lipids, collagen, salt

INTRODUCTION

Smoking is an ancient fish preservation method and has economic importance for the seafood market [2]. It provides specific aroma and colour to the fish. Smoking extends the shelf life of fish due to dehydration and antibacterial and antioxidant effects of the smoke components such as formaldehyde, carboxylic acids, phenols [5]. Smoking is primarily used to print desirable colour and flavour of smoked to the food and most common is hot smoking, which is still widely used in fish processing [9]. Smoked fish is a highly nutritious food containing highly unsaturated fatty acids, fat-soluble vitamins, essential minerals as well as proteins containing the essentials amino acids for human beings. Marinating, other food-preservation technique, and provides high sensory acceptability [14]. Marinated fish is treated, in order to improve the flavour and

textural properties, with acids (acetic or citric), salt, sugar, spices and oil [6]. Marinating process slows down the bacterial and enzyme activity and provides taste, tenderness, textural and structural changes with a prolonged shelf life [12].

The mackerel flesh is considered as one of high nutritional level, due to their protein content and polyunsaturated fatty acids, being also rich in vitamins and minerals [10, 4, 13].

The purpose of this research was to determine the nutritional quality of two different types of mackerel (marinated mackerel and smoked mackerel) on the basis of chemical composition and energy value.

MATERIALS AND METHODS

There were analyzed 20 samples of mackerel (*Scomber scomber*) purchased from stores from Iasi. The content of protein, lipids, collagen, salt and water was determined using the automatic analyser Food Check (infrared spectrophotometer); the mineral substances were determined by calcination, and non-nitrogenous extractive

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substances and energy value were determined by calculation, using conventional formulas. The conversion factors for proteins were 4.27, for lipids were 9.02 and for non-nitrogenous extractive substances were 3.87 (by FAO, 2003). The results were statistically analyzed, including analysis of variance (ANOVA).

RESULTS AND DISCUSSIONS

In the present study, the average values determined for smoked mackerel were: 27.15% for lipids 16.13% for the protein, 55.53% for water, 2.29% for collagen, 3.83% for crude ash and 3.82% for salt, while for marinated mackerel mean values were: 7.75% lipids proteins 20.50%, 71.05% water, 3.85% collagen, 4.31% crude ash and 4.25% salt, highlighting significant differences for all analyzed parameters, differences which may be attributed to different technologies of production (processing and preservation) of the two assortments analyzed.

The energy value of smoked mackerel (tab. 1) is much higher (344.70±6.17

kcal/100g) compared to the one determined for marinated mackerel (185.30±5.72 kcal/100g), due to the increased proportion of lipids (by evaporation of water during the smoking process).

As regards the statistical interpretation of results, after applying the test for analysis of variance ANOVA, very significant differences are observed between smoked mackerel and marinated mackerel, for all analyzed parameters.

The coefficient of variation calculated not exceeded the 10% threshold for the majority of parameters (expressing a very high homogeneity of the samples analyzed for smoked mackerel and marinated mackerel), excluding non-nitrogenous extractive substances where was showed a relative homogeneity of the samples (tab 1.).

Industrial specifications for "smoked finished products" generally recommend a water content in the fish meat of less than 65% (Cardinal et al. 2001, Ozogul Yesim & Esra Balikci, 2013). This is in agreement with our value of 55.45%.

Table 1 Chemical composition of smoked and marinated mackerel

Chemical components	Mackerel	$\bar{X} \pm S \bar{x}$	CV%	S ²	S	Min.	Max.
Lipids%	Smoked	27.15±0.13 ^{ad}	1.14	0.09	0.31	26.70	27.50
	Marinated	7.75 ±0.08	2.41	0.03	0.19	7.50	8.00
Proteins%	Smoked	16.13±0.11 ^{ad}	1.60	0.07	0.26	15.80	16.50
	Marinated	20.50 ±0.06	0.69	0.02	0.14	20.30	20.70
Collagen%	Smoked	2.29±0.03 ^{ad}	3.21	0.01	0.07	2.18	2.41
	Marinated	3.85 ±0.03	1.86	0.01	0.07	3.75	3.94
Water%	Smoked	55.53 ±0.17 ^{ad}	0.74	0.17	0.41	54.90	56.10
	Marinated	71.05 ±0.08	0.26	0.03	0.19	70.80	71.30
Ash%	Smoked	3.83±0.03 ^{ad}	2.06	0.01	0.08	3.77	3.98
	Marinated	4.31±0.02	0.94	0.01	0.04	4.28	4.39
Salt%	Smoked	3.82±0.06 ^{ad}	3.86	0.02	0.15	3.60	4.00
	Marinated	4.25 ±0.04	2.47	0.01	0.10	4.10	4.40
Dry matter%	Smoked	44.47±0.41 ^{ad}	0.93	0.17	0.41	43.90	45.10
	Marinated	28.95±0.08	0.65	0.03	0.19	28.70	29.20
OS%	Smoked	40.45±0.75 ^{ad}	1.87	0.57	0.75	39.11	41.33
	Marinated	24.64±0.06	0.64	0.03	0.16	24.41	24.81
NnES%	Smoked	0.20±0.29 ^{ad}	14.59	0.09	0.29	0.02	0.79
	Marinated	0.08±0.03	18.91	0.01	0.06	0.01	0.18
BE kcal/100g	Smoked	344.70±6.17 ^{ad}	4.38	228.39	15.11	315.07	355.96
	Marinated	185.30±5.72	7.57	196.65	14.02	157.03	193.23

OS%= organic substances

NnES%= Non-nitrogenous Extractive Substances

BE kcal/100g= brute energy

After Ozogul Y. and Balıkcı E., 2013, the protein, lipid, moisture, and ash contents of smoked and marinated mackerel were found to be $26.92 \pm 0.83\%$, $26.74 \pm 0.64\%$, $40.55 \pm 0.77\%$ and $4.49 \pm 0.20\%$, respectively.

Ozogul et al. (2010) reported that protein contents of smoked anchovy marinate was $25.19 \pm 0.71\%$ and lipid was $2.40 \pm 0.20\%$. The mean water content of 56.7% in smoked mackerel, was found by Kolodziejska et al. (2002).

Goulas and Kontominas (2005) reported, similarly, the mean water values for chub mackerel of 59.0% and 58.1% , respectively, for two different smoked methods.

Duyar and Eke E., 2009, has found the following average values for marinated bonito fish: 11.45% protein, 22.40% fat, 4.76% ash and water 59.07% and for marinated anchovy has determined: protein 10.19% , 11.59% fat, 5.12% ash and 70.75% water which are similar to those found in our study.

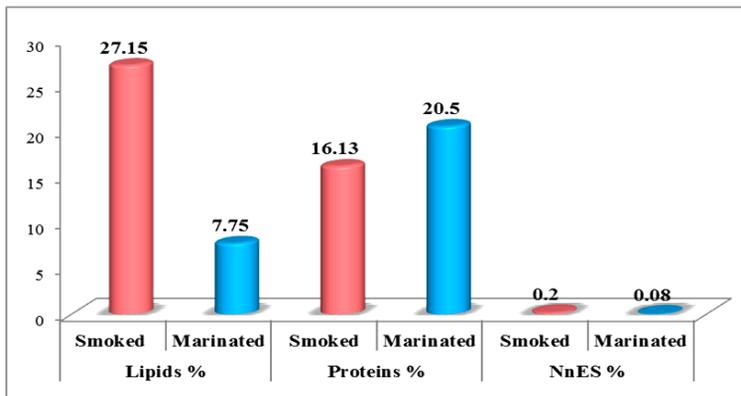


Fig. 1 Main nutritional components of marinated mackerel and smoked mackerel

Having some difficulties in fresh fish consumption coerces aquaculture industry to make researches for extending shelf life of this; therefore processing technology it gain importance, being suitable for aquatic products, by Oguzhan P. and Simay Angis, 2013. This authors found in smoked rainbow trout the following average values: protein $28.0 \pm 1.25\%$ for hot smoked trout and $22.6 \pm 1.56\%$ for cold smoked trout, fat 7.5 ± 0.38 for hot smoked 4.7 ± 0.36 for cold smoked, moisture 59.2 ± 2.55 for hot smoked and 64.9 ± 0.93 for cold smoked and ash 2.0 ± 0.30 for hot smoked and 1.8 ± 1.19 for cold smoked.

Ozden O., 2005, found: moisture contents in marinated fish for anchovy 66.75% and for trout 74.02% , ash 1.92% for anchovy and 1.76% for trout, protein 19.10% for anchovy and 19.43% for trout and finally, the content of fat 11.51% for anchovy and 4.11% for trout. The relative amounts of fat content, protein, ash and other components increased

as a result of the water loss caused by the penetration of salt into the meat.

The chemical composition of fish muscle varies greatly from one species to another and among the individuals from the same species. This variation depends and is closely connected to feed intake, migratory swimming and sexual changes (spawning), with the age, size, sex, environment and season.

The consumer preference for smoked fish products (mainly the most consumed are herring, mackerel, salmon, halibut and sprats) resulted not only from their desirable smoky flavor, but also from their high contents of poly unsaturated fatty acids (PUFA) of the n-3 family in fish lipids. These fatty acids decrease the contents of triacylglycerols, cholesterol, and low density lipoproteins in the human serum, and inhibit the aggregation of blood platelets and the damage to blood vessels (Stolyhwo et al., 2006).

Before the different manufacturing techniques can be rightly applied, the

processors have a direct interest in the chemical composition of fish, needing to know the nature of the biological material

Duyar Eke E., 2009 found that marination of bonito and anchovy in a solutions containing 10% NaCl and 4% acetic acid can

extend the shelf life of the product during refrigerated storage 4°C; therefore, marination process can be used as a safe method for preservation of fatty fish (herring, mackerel, anchovies, bonito etc.)

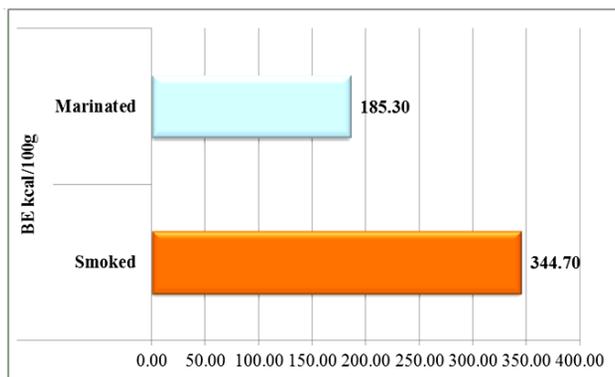


Fig. 2 Energetic value of marinated mackerel and smoked mackerel

CONCLUSIONS

Marinated and smoked mackerel is an alternative food to fresh fish in human alimentation. These two varieties are highly appreciated by consumers due to the convenience that can be consumed and for their high contents of poly unsaturated fatty acids of the n-3 family.

The energy value of smoked mackerel is much higher (344.70 kcal/100g) compared to marinated mackerel (185.30 kcal/100), due to the increased proportion of lipids (due to the smoking process).

Marinated mackerel can be recommended for diets, the nutritional value of this being close with rabbit meat or chicken meat.

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