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MICROSCOPICAL AND PHYSICO-CHEMICAL ASPECTS OF THE COMPOSITION AND INTEGRITY OF RAW DRIED SALAMI WITH NOBLE MOULD

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Abstract

Raw dried salamis with noble mould are among Romania's most popular meat food products. The assumption that there might be an unknown side to the structural integrity of the ingredients in such products has developed over time. A physico-chemical analysis was carried out on six salami samples of various brands of the raw dried salamis known as "Salam de Sibiu" and "Salam de Hateg", both available on the retail market. The following parameters were measured: humidity percentage, nitrites content, NaCl content, easily hydrolysable nitrogen, percentage of fat and amount of protein. All samples underwent the histopathologic examination routine procedure with paraffin and HE (haematoxylin and eosin) stain. The values of the integrity parameters comply with the applicable legislation, but vary significantly from a producer to another. The histopathologic examination indicated the presence of animal tissue and plant structures. We consider this examination to be useful in identifying structural non-compliance.

Key words*:* raw dried salamis, physico-chemical analysis, histopathologic examination.

INTRODUCTION

Salami is dried fermented sausage consisting of pork mixed in different proportions with beef, mutton or horse meat with different additives, represented by salt, spices and curing salt (Feiner, 2006).

Salami was produced for the first time in Italy more than 270 years ago (Leistner, 1986).

The European countries recognized for the production of salami are: Italy, Germany, Spain, France and Hungary. They produce several hundred million kilograms of salami per year (Bertolini et al., 2006).

The suitable technology is selected according to climatic conditions, as seen in the Mediterranean region and Southern Europe, where meat products are dried to lower the amount of water taking advantage of long dry and sunny days, while in Northern Europe fermented sausages require smoke for subsequent preservation (Toldra, 2014).

In Northern and Central Europe, smoked salami is preferred, and maturation is controlled by the addition of acid-starter cultures, while in Southern Europe, salami is slowly dried in the air and it is often mould-maturated. Preparations that are typical for a region or area have specific characteristics derived from the use of ingredients and local production techniques that are deeply rooted in tradition and linked to the territory where they come from (Aquilati et al., 2016).

In Romania, among the most popular varieties of raw dried salami we mention: Banat salami, Bacau salami, Sibiu salami and Hateg sausages (Mencinicopschi et al., 2006).

The Sibiu salami is a type of salami that is made of raw meat. Due to the artificial climate conditions this product can be manufactured in any part of the country throughout the year. The materials used for the Sibiu salami are pork and pork fat.

The pig has to be healthy, to have a reduced degree of contamination and to be properly refrigerated. It must neither be too young, nor too fat. It needs to have a certain ratio of water/protein and fat/protein content, to be rich in heminic compounds (myoglobin), to have a low amount of connective tissue and to have an optimal water retention capacity (the PSE-pale, soft, exsudative and DFD- dark, firm, dry meat

is excluded). Also, boars, pregnant sows or animals fed with oleaginous plants or fish flour are rejected. In the production of the Sibiu salami are used only half-carcasses from pigs that weigh over 130 kg, belong to the Mangalita breed and are degreased and refrigerated for minimum 72 hours before processing. The fat used must have increased consistency and high freshness. The mixture of spices can be made according to different recipes or according to the requirements of the beneficiary It can include the following: sodium chloride, glucono-lactone, carbohydrates, ascorbic acid/ ascorbates, organic food acids (citric, lactic, tartaric), enibahar, garlic, sugar, and starter cultures (Comanaru, 2000).

The quality of the Sibiu salami depends directly on the quality of raw material as it is raw dried salami that is processed only by cold smoking and maturing by drying, without the use of thermal treatments.

The histological method and physico-chemical analysis are the mostly applied techniques for detecting unauthorized tissues in meat products. Sezer et al. (2013) showed in their study that in a type of sausage they found animal hair of root of hair, spleen, esophagus and epithelium of sensory organs, tissues that should not exist in this food product (Sezer et al., 2013). In another study also using a histological approach Malakauskienė et al. (2016) discovered nerve tissue, fat and blood vessels in canned sausages (Malakauskienė et al., 2016).

Therefore, the physico-chemical and histological evaluation of the composition of this type of meat preparation is essential for the quality assessment.

The aim of the present paper is to evaluate the quality of the Sibiu Salami by analysing the regular physico-chemical parameters and by performing the histological analysis of the composition in order to emphasise the particularities derived from each method in terms of product integrity and composition assessment.

MATERIALS AND METHODS

Physico-chemical analysis were carried out on six salami samples of various brands of raw dried salami known as “Salam de Sibiu” and “Salam de Hateg”, both available in the retail chain. The analysed samples of “Salam de Sibiu” are similar in terms of formulation. However, “Salam de Hateg” distinguishes by the inclusion of beef mixed with pork and a hydrolysed vegetable protein (Table 1).

Table 1. Label composition of analyzed samples

Sibiu salami	Sample A	Sample B	Sample C
label composition	pork, fat, salt, sugars, spices, ascorbic acid, sodium nitrite	pork, fat, salt, sugars, spices, ascorbic acid, brandy 0.4%, sodium nitrite	unknown recipe
Sibiu salami	Sample D	Sample E	Sample F
label composition	pork, fat, salt, sugars, spices, ascorbic acid, sodium nitrite, starter culture	pork, fat, salt, dextrose, spices, sodium ascorbate, sodium nitrite	pork, fat, salt, dextrose, spices, ascorbic acid, sodium ascorbate, sodium nitrite, starter culture
Hateg salami	Sample G		
label composition	beef, pork, soybean protein, salt, sugar, spices and spice extracts, corn hydrolysed protein, sodium ascorbate, carmine, sodium nitrite, starter culture		

The following analyses were performed: moisture content, nitrites content, collagen/ protein ratio, NaCl content, easily hydrolysable nitrogen, lipids and proteins content.

From each sample 200-300 g were taken according to protocol, from the middle and the ends of the bars (Purcărea, 2015).

The samples were previously prepared according to the methods that were going to be used and with the results that were going to be obtained.

The determination of moisture content was obtained by oven drying.

The determination of the nitrite content was performed by Griess method according to the SR EN 12014-3:2005.

For the determination of total nitrogen and total content of protein the Kjeldahl method was used, according to SR ISO 937: 2007.

The content of easily hydrolysable nitrogen was indirectly determined by titration with NaOH according to SR 9065-7: 2007.

The content of lipids was determined by using the Soxhlet method.

The regulations for the minimum and maximum values of the parameters pursued in this study for the product groups mentioned above are found in The Order MARD 560 / 16.08.2006 and the means of conducting the analyses are described in ISO Reference Standards. In order to obtain high accuracy results, the analyses were performed at a laboratory accredited by RENAR.

Table 2. Physico-chemical parameters of analyzed samples

No.	Sample	Moisture (%)			nitrites (mg/kg)			NaCl (%)			Easily hydrolyzable nitrogen (mg NH_3/100g)			Fats (%)			Proteins g/100g		
		Reg*	Result	Literature	Reg.**	Result	Literature	Reg*	Result	Literature	Reg.*	Result	Literature	Reg.*	Result	Literature	Reg*	Result	Literature
1.	A	30	29.17	39,8 [1]	150	0.79	1-6 [7]	6	4.10	4.32 [1]	200	73.61	63.59-176.3 [8]	46	38.86	18.5-31.1 [9]	20	23.79	31,3 [1]
2.	B	30	25.66	36,25 [2]	150	0.54	0.6-3.4 [9]	6	4.04	4.70 [2]	200	129.46	17.3-32.03 [9]	46	40.31		20	25.78	25,76 [2]
3.	C	30	27.59	48,6 [3]	150	0.38		6	3.95	3.8 [3]	200	64.99		46	39.83		20	24.21	15,5 [3]
4.	D	30	27.47	30,5 [5]	150	0.43		6	5.26	5.50	200	129.48		46	40.35		20	25.80	20,3 [5]
5.	E	30	29.51	75,45 [6]	150	0.56		6	3.80	4.90	200	89.78		46	38.81		20	29.19	21,29 [6]
6.	F	30	26.4		150	0.53		6	5.35	1.72-1.96 [9]	200	95.97		46	39		20	25.83	
7.	G	35	31.89	38,00 [4]	150	0.45		6	3.9	4.32 [4]	200	43.36		50	38.83		16	23.44	29,7 [4]
	Average		28.24			0.53			4.34			89.52			39.43			25,43	
	Std. dev.		2.11			0.1337			0.6647			32.1954			0.7112			1.9448	

(*Ord. 560/2006; ** Ord. 438/295/2002; [1]Zanardi et al., 2010; [2]Casiraghi et al., 1996; [3]Van Schalkwyk et al., 2011; [4] Demeyer, 2007; [5]Ockerman and Basu, 2007; [6] Conte et al., 2012; [7] Păduraru et al., 2010; [8] Jude et al., 2011; [9]Dobrinas et al., 2013)

The freshness of the samples, evaluated by the determination of easy hydrolyzable nitrogen was appropriate, the maximum limit of 200 mg NH3 / 100 g of product was not exceeded.
The values obtained ranged between 43.36-129.48 mgNH3 / 100 g, with a mean of 89.52 ± 32.1554.
As the standard deviation indicates, easy hydrolysable nitrogen values vary significantly from one sample to another. Nevertheless, a similar variation in the values was reported by other authors for similar products; Jude et al. (2011) communicating for the analysed samples an interval between 63.59 and 176.3 mgNH3 / 100g.
A significantly lower value for easily hydrolysable nitrogen was reported by Dobrinas et al., (2013) (the value of f is 21.93159, p is 0.000668, the results are statistically significant at $p < 0.05$) for pork and sheep samples, their study range being 17.3-32.03 mgNH3/100g, with an average of 26.76 ± 5.71 mgNH3/100 g.
The protein percentage was superior to the minimum value for the considered meat products category, the values for the studied samples ranging between 23.44-29.19%, with a mean of 25.43 ± 1.9448.
In literature, there are recorded much lower protein levels, such as 15.5% (Van Schalkwyk et al., 2011), but also higher, up to 29.7% (Demeyer, 2007), or even 31.3 (Zanardi et al., 2010).
Histological findings were revealed in various tissues: stranded muscle tissue (Figure 1), different types of conjunctive tissue, dominant fat tissue (Figure 2), vascular structures and nerve threads (Figure 3).

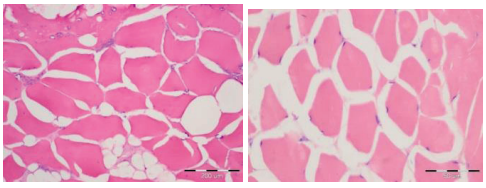

Figure 1. Left - cross-sectional muscle fibers and reduced area of adipose tissue (ob.10x, HE stain); Right - cross-sectional muscle tissue, homogenized muscle fibers and inconsistent spacing from the endomisium (ob.40x, HE stain).

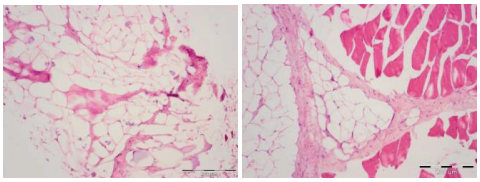

Figure 2. Left - Adipose tissue (ob. 10x, HE stain); Right - Adipose tissue, conjunctival stroma and obliquely sliced muscle tissue (ob. 10x, HE stain)

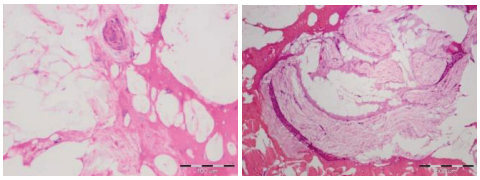

Figure 3. Left - Amorphous structure, adipose tissue and cross-sectional vessel (ob. 20, HE stain); Right - Muscle fibers and nerve threads (ob. 4x, HE stain)

In some sections there were found vegetal structures with different morphology and tincture than that of animal tissues (Figure 4).

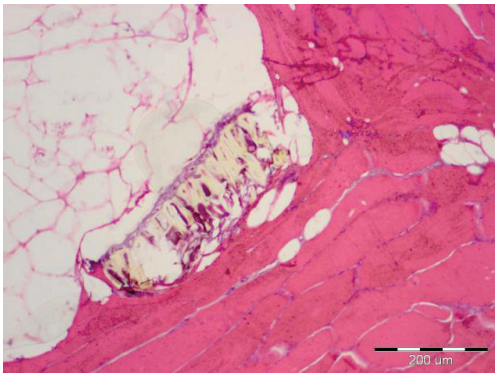

Figure 4. Muscle tissue and adipose tissue; fragment of plant fiber (ob. 10x, HE stain)

The composition and techniques of preparing a food product are key elements for its quality. Although the analyses show differences in physico-chemical properties from one sample to another, it is important that when notifying any changes to the original recipe, these should be redressed in order to preserve the quality of the product. The values of the integrity parameters comply with the applicable legislation, but vary significantly from one producer to another. These significant variations in parameter values integrity lead to important quality differences between products

that all fall into what is considered to be the premium category.

According to the histopathological examination, it is found that the products under examination show specific tissues of pork and pork fat. Vegetable structures are met either in the form of fibers or in the form of basophilic anchovy deposits. What has kept our attention is the homogeneous appearance of the muscular fibers and their inconsistent spacing from the endomisium. Appearance could be associated with the dehydration process following the treatment of meat with salt. The homogenization of the fibers without revealing contractile protein-specific striations may be an aspect associated with muscle tissue maturation and we consider that the integrity of the analyzed products is not negatively influenced.

CONCLUSIONS

The values of physico-chemical parameters are in accordance with the applicable legislation. However, statistically, they vary significantly from the same preparation analysed by other specialists.The histopathological examination indicated the presence of animal tissue and plant structures. The morphological analysis complements the data on the integrity and quality of raw-dried salami.

In accordance with the data recorded by literature, the present study does not find structures foreign to the salami recipe.

We consider this examination to be useful in identifying structural non-compliances.

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