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SENSORIAL CHARACTERIZATION OF MUTTON PRODUCTS IN MEMBRANE MADE IN THE MEAT PROCESSING

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Abstract

The paper aimed to produce four different types of sheep meat products with heterogeneous structures in the meat processing workshop of the University of Life Sciences Iasi, which presented as variation factors the type of membrane and the type of product (salami/sausage, imprinted by the membrane used). Two varieties of salami (in collagen and polyamide membrane) and two varieties of sausages (in natural pork and sheep membrane) served as the four samples. The four samples obtained were subjected to sensory analysis, carried out in two stages: the first stage consisted of assessing the products based on the main sensory attributes (appearance, aroma, taste, texture, overall acceptability), and the second stage aimed at describing the products using specific sensory terms included in the CATA (Check-All-That-Apply) test from the perspective of consumer perception. The results obtained revealed sensory attributes characteristic of membrane products with heterogeneous structure, with the CATA test describing the products through positive attributes (colour, aroma, texture), with the differentiation of a firmer, harder texture in the case of natural membrane products, superior juiciness in the case of the S3MC sample, and a slightly brittle texture in the S4MP sample. In terms of the results of the hedonic scale, the sausage samples received a higher score for section appearance (7.91 ± 0.831 for C1MP and 8.00 ± 0.775 for C2MO), compared to the salami samples (7.73 ± 1.104 for S3MC and 7.18 ± 1.168 for S4MP). The overall acceptability was highest for C1MP, which received 8.36 ± 0.674 points, being followed in descending order by C2MO (8.55 ± 0.688), S3MC (8.18 ± 0.751) and S4MP (7.45 ± 0.522).

***Key words**: CATA, mutton, natural / sintetic membranes, sensory evaluation.*

INTRODUCTION

Sensory evaluation is used in the food industry to meet various purposes, the most important of which is to control the quality of the sensory properties of a product by checking compliance with established parameters and design criteria (specifications). Thus, sensory testing is an essential tool to ensure that food products meet the required quality standards, helping to identify defects, unfavourable flavours and other quality issues that may affect the overall acceptability of a product (Lawless & Heymann, 2010; Saint-Denis, 2018). Hence, the sensory analysis examines the properties (texture, aroma, taste, appearance, smell, etc.) of a food product through the senses (sight, smell, taste, touch and hearing) of the panellists. This type of analysis has been used for centuries to accept or reject food products (Nederkoorn et al., 2015; Issanchou, 2018). Technological advances in recent years have led to the development of new sensory analysis techniques, such as electronic noses and tongues, which use sensors to detect and analyze the chemical composition of food (Di Rosa et al., 2020).

In addition, since, for many products, sensory properties deteriorate before microbial quality, sensory testing can be used to determine shelf life and product variability along the supply chain in tandem with microbial testing (Kemp et al., 2011).

The meat we eat is an integral component of the human diet. It contains essential nutrients that help maintain normal physiological functions, improve immunity and prevent certain diseases, including malnutrition (Biswas & Mandal, 2020).

In sheep meat, as in meat in general, the nutritional value, as well as the quality, is determined by the chemical composition, especially the essential amino acids, vitamins

and mineral salts contained in it. The complex but at the same time balanced chemical composition of sheepmeat, mainly due to its protein, vitamin and mineral salt content, determines the nutritional and biological value of this product.

The influence of chemical composition on the sensory quality of meat mainly involves the lipid components as variations in these affect sensory attributes such as taste, flavour, juiciness and texture. Sheep meat, in particular lamb meat, is recognised as a good source of Omega-3 polyunsaturated fatty acids, with more than 60 mg/100 g of meat. Moreover, it also contains significant amounts of conjugated linoleic acid, with multiple benefits for the body, found in proportions between 0.2 - 2% of total fat (Ponnampalam et al., 2016).

In meat processing to obtain unstructured products, membranes are used as fillers. These are natural, semi-synthetic or synthetic coatings used to introduce the meat composition, give it a certain size and shape, reduce weight loss and protect the product against the harmful action of microorganisms in the external environment (Georgescu et al., 2000; Wenther, 2003).

Considering the wide variety of meat products on the market, the paper aims to conduct a sensory evaluation of some assortments of salami and sausages made of mutton in four different membranes, products manufactured in the Meat Processing Workshop of USV Iasi.

MATERIALS AND METHODS

To characterize the sensory properties of the products an experimental protocol has been designed, including the assortment manufacturing technology and the sensory evaluation questionnaire. Therefore, the sausage assortments were placed in natural pork (Ø 28-30 mm) and sheep (Ø 20-22 mm) membranes and formulated according to Table 1.

The salami assortments were placed in collagen and polyamide membranes, their manufacture following the ingredients in Table 1 and the heat treatment parameters presented in Table 2.

Table 1. Formulations to prepare the experimental batches

Batch code	Membrane type	Ingredients (%)							
		1st QSM	2nd QSM	Salt	Black pepper	Garlic	Sweet paprika	Spicy paprika	Chili
C1MP	pork intestine	35	65	2	0.3	0.5	2	0.2	0.2
C2MO	sheep intestine								
S3MC	collagen								
S4MP	polyamide								

1st QSM - first quality mutton; 2nd QSM - second quality mutton; C1MP - sausages in pork natural membrane; C2MO - sausages in sheep natural membrane; S3MC - salami in collagen membrane; S4MP - salami in polyamide membrane.

The manufacturing process involved specific steps for membrane meat products:

- salting of the raw meat material in the mixers, followed by a maturation period of at least 24 hours at a temperature of 2-4°C in the frigorific maturation room;
- granulated mincing of the meat, with a grinding machine (GRINDER WP - 105), through an 8 mm sieve for salami and 6 mm for sausages;
- the bradt is formed by weighing 30% of the total mass of ground meat and finely mincing without exceeding a temperature of 13°C;
- preparing the raw and auxiliary materials according to the technological sheets of the four batches;
- mixing the raw materials with the condiments for approximately 10-20 minutes until the composition is completely homogenised;
- filling the membranes corresponding to each batch, forming the sausage sticks and twisting the sausages to form individual pieces of 15 cm each.

The heat treatment involved four stages (drying, smoking, boiling and hot air drying / high-temperature cooking) carried out at different parameters, considering the types of membranes used, as shown in Table 2. After the heat treatment stage, the product was cooled to room temperature for a maximum of 60 minutes,

packed, labelled and stored until sensory evaluation.
The samples were prepared before sensory evaluation by cutting them into identical size pieces, coding and distribution to the evaluators.
Sensory analysis was carried out in the Sensory Analysis Laboratory of Iasi University of Life Sciences and involved sensory evaluation by a group of 11 trained evaluators from the Food Science and Technology Department. The evaluators assessed 6 parameters: surface appearance, section appearance, aroma intensity, taste, texture, and overall acceptability, scoring the samples on a 9-point scale.
The second stage of the sensory evaluation involved applying the CATA (Check-All-That-Apply) test to a group of 52 consumers for the four samples of sheep meat products in membranes. The descriptive terms (20) that composed the CATA test were: uniform colour, red colour, colour intensity, mosaic appearance, characteristic aroma, intense meat flavour, strong lamb flavour, rancid flavour, salty taste, tasteless, perfect seasoned, bitter taste, acid taste, juicy texture, firm texture, elastic texture, brittle texture, hard, dry, fatty.
The chemical composition (moisture, fat, protein, and collagen) was determined using a FoodCheck analyzer (Bruins Instruments, OmegAnalyzer), a spectrophotometer that uses infrared light rays.
The results obtained after applying the first stage of sensory evaluation were subjected to analysis of variance (ANOVA) followed by Tukey's test at a 5% significance level ($p < 0.05$) to compare the mean values. CATA test results were expressed by analysing the citation frequency for each sensory term of each sample using XLStat software (Addinsoft version, 2022).

Table 2. Heat treatment scheme of the batches

Batch code	Heat treatment				
	Drying	**Smoking**	**Boiling**	**Hot air drying**	**High temp. cooking**
C1MP	t = 30 min.; U = 10%; T = 50°C (4°C inside the product)	t = 30 min.; U = 10%; T = 60°C (50°C inside the product)	T = 72°C (69°C inside the product); U = 99%	-	t = 25 min.; U = 10%; T = 80-85°C (69°C inside the product)
C2MO					
S3MC	t = 30 min.; U = 22%; T = 60°C (50°C inside the product)	t = 35 min.; U = 22%; T = 65°C (55°C inside the product)	t = 60 min.; U = 99%; T = 72°C (69°C inside the product)	t = 20 min.; U = 22%; T = 80°C (69°C inside the product)	-
S4MP					

t - time; U - humidity; T - temperature

RESULTS AND DISCUSSIONS

The results from the sensory evaluation of the salami and sausage samples by the scale method were assessed by the mean on each parameter (mean ± SD). The specific values including statistical evaluation are presented in Table 3.
The highest scores for all 6 attributes were given to the sausage in sheep natural membrane (C2MO). Therefore, in the classification of the experimental samples in descending order of the scores given by the sensory evaluation, it can be observed that the natural membrane preparations (sausage samples) were scored higher, followed with close scores by the salami in collagen membrane (S3MC) and the salami in polyamide membrane (S4MP, Figure 1) samples.
Regarding surface and section appearance, the mean scores ranged from a minimum of 7.18 ± 1.168 (S4MP) to a maximum of 8.36 ± 0.674 (C2MO). The samples received relatively high scores (Table 3); insignificant differences were observed for the appearance attributes between samples of sausage in pork membrane (C1MP) and salami in collagen membrane (S3MC), possibly due to the similarity of the products in terms of diameter and external appearance.
Taste and aroma intensity attributes were superior in the sausage samples, the two assortments being close in mean scores. These results can be explained by the fact that natural membranes behave differently to heat treatment, it has high permeability so that flavour substances during smoking are deposited and absorbed more efficiently by the product.

The sensory attributes of texture and overall acceptability received the highest scores of the sensory characteristics evaluated (Figure 1). The most appreciated sample in terms of texture was identified in the C2MO product (8.73 ± 0.467), which may be due to the smaller diameter of the membrane type and the fact that the heat treatment was more intense on this product, the degree of drying being higher. Significant differences ($p < 0.05$) were particularly evident for C2MO and S4MP samples (6.82 ± 0.751). At the acceptability level, the sausage samples also received the highest scores, not being significantly different ($p > 0.05$).

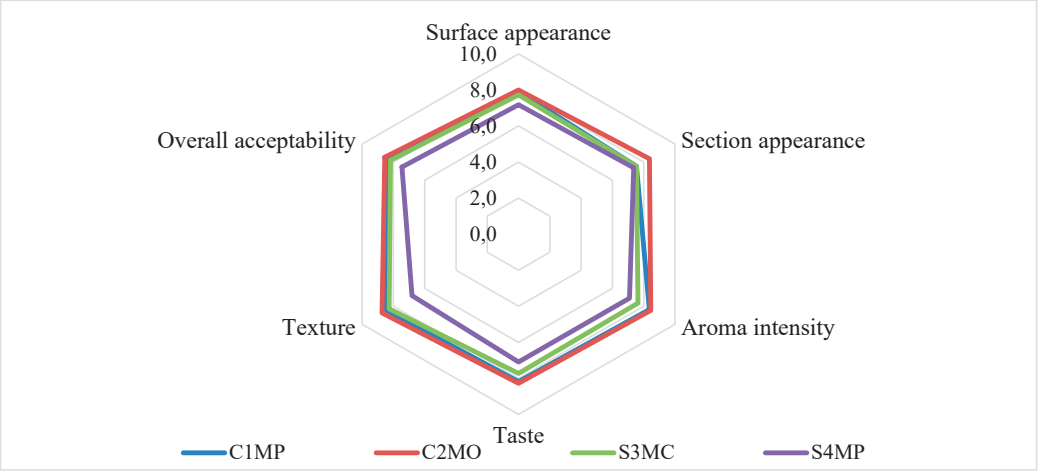

Figure 1. The results of sensory evaluation of sausages and salami samples

The statistical analysis of the mean results using the ANOVA test revealed by p-values (Table 3) the non-significant influence of product type and membrane on the sensory attributes related to appearance (external and section). Regarding the texture and aroma intensity attributes, both factors of variation (product type and membrane) imprinted distinctly significant differences ($p < 0.001$) on the samples, while the differences identified for the taste attribute were more evident between product types (highly significant differences, $p < 0.001$) and less due to membrane type (significant differences, $p < 0.05$).

Table 3. Sensory analyses of sausages and salami samples

Sensory attributes	Sausages samples		Salami samples		p-value	
	C1MP	C2MO	S3MC	S4MP	Membrane type	Product type
Surface appearance	$7.91^{ab} \pm 0.831$	$8.00^{a} \pm 0.775$	$7.73^{b} \pm 1.104$	$7.18^{c} \pm 1.168$	0.223^{ns}	0.098^{ns}
Section appearance	$7.55^{b} \pm 1.214$	$8.36^{a} \pm 0.674$	$7.55^{b} \pm 0.820$	$7.36^{c} \pm 0.809$	0.058^{ns}	0.082^{ns}
Aroma intensity	$8.36^{a} \pm 0.809$	$8.45^{a} \pm 0.522$	$7.64^{b} \pm 0.674$	$7.11^{c} \pm 0.831$	0.00013^{***}	$<0.0001^{***}$
Taste	$8.18^{a} \pm 0.751$	$8.27^{a} \pm 0.647$	$7.73^{b} \pm 0.647$	$7.09^{c} \pm 0.701$	0.001^{*}	0.0004^{***}
Texture	$8.45^{b} \pm 0.688$	$8.73^{a} \pm 0.467$	$8.27^{b} \pm 0.786$	$6.82^{c} \pm 0.751$	$<0.0001^{***}$	0.0002^{***}
Overall acceptability	$8.36^{a} \pm 0.674$	$8.55^{a} \pm 0.688$	$8.18^{b} \pm 0.751$	$7.45^{c} \pm 0.522$	0.002^{**}	0.004^{**}

Means presented with the same letter on the same row show that there was no significant difference ($p < 0.05$) in the Tukey test; ns = $p > 0.05$; * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$

The overall acceptability of the samples was distinctly significantly ($p < 0.01$) influenced by both product type ($p = 0.004$) and membrane type ($p = 0.002$).

The CATA test was used to describe the sensory characteristics of the products by assigning specific terms to each sample by a group of 52 consumers.

The results of the CATA test were statistically analysed to highlight the sensory terms checked by the evaluators for each of the four samples. Therefore, a symmetric plot (Figure 2) was used to design the distribution of the four products evaluated on the F1 and F2 axes, which explains the variation between the samples, as well as a distribution of the descriptive terms according to the evaluators' responses.

Hence, the symmetric plot places the positive attributes mainly in the right-hand quadrants. By grouping the terms in this manner, it is noticeable that the majority of the evaluators described the samples as having a uniform, red and intense colour, showing the characteristic mosaic of products with a heterogeneous structure, with a characteristic, intense meaty and appropriate seasoned flavour.

The terms describing possible negative attributes of the samples were represented in Figure 2 in the left quadrant, thus, it was noted that the evaluators did not identify rancid flavour, bitter or sour taste, intense sheep flavour, or bland taste in the products.

By placing the samples closer to the respective attributes in the graph, it is observed that the sausage samples (C1MP and C2MO) were described as having a firm texture, slightly higher elasticity and a more intense salty taste identified by consumers compared to the salami samples. Moreover, the natural membrane samples were also described by some consumers as dry and hard, explained by the smaller diameter of the products (compared to salami assortments), the permeability of the membrane allowing for higher water loss and a higher degree of dryness, and the possibility to apply a more intense heat treatment.

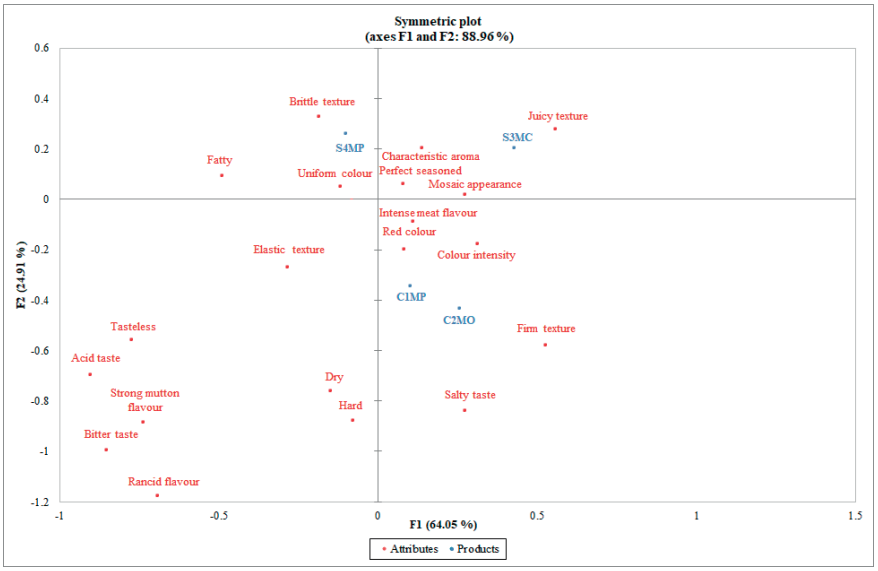

Figure 2. Multiple factor analysis (MFA) of membrane mutton products evaluated by means of the CATA test

The salami samples (S3MC and S4MP) were located at the top of the diagram. Sample S3MC, in collagen membrane, was described as displaying a juicy texture in addition to the positive attributes identified in all samples. The presence of juiciness in the salami sample in the collagen membrane can be explained by the higher diameter compared to the sausage samples, correlated with the lower permeability of the membrane compared to the natural ones.

At the opposite pole, the sample in polyamide membrane was described as having a brittle texture, a characteristic explained by the melting of the fat in the product structure and its elimination to the outside, accumulating between the product and the membrane, since due to the impermeability no exchange of substances was possible.

The results for the chemical composition are shown in Table 4.

The water content in the four batches varied in the interval 61.12±0.21% (for C2MO) – 62.88±0.35% (for S4MP), with the products in natural membrane showing a higher humidity, although no significant differences were found between bathes ($p > 0.05$).

The lipid content in the sausage and salami batches did not differ significantly ($p > 0.05$), thus showing an insignificant influence determined by the type of membrane.

The protein content varied within strict limits (19.11±0.09% for S3MC and 19.88±0.25% for C2MO) as all samples were obtained with the same quantities of raw materials.

Table 4. Analysis of the proximate composition of the batches

Parameters	C1MP	C2MO	S3MC	S4MP	p-value
Moisture (%)	61.29 ± 0.14	61.12 ± 0.21	62.22 ± 0.08	62.88 ± 0.35	0.072 ^{ns}
Lipid (%)	16.64 ± 0.19	16.88 ± 0.22	16.41 ± 0.28	16.02 ± 0.41	0.161 ^{ns}
Protein (%)	19.27 ± 0.23	19.88 ± 0.25	19.11 ± 0.09	19.35 ± 0.18	0.093 ^{ns}
Collagen (%)	16.80 ± 0.40	17.10 ± 0.29	16.40 ± 0.54	16.80 ± 0.62	0.055^{ns}

Means followed by standard deviation. ANOVA Tukey test: ns = $p > 0.05$; *** = $p < 0.001$

CONCLUSIONS

The sensory characterisation of four different types of mutton products showed that, although differentiated by membrane type (different in diameter, colour, and properties), the samples did not differ significantly ($p > 0.5$) in the 9-point scale sensory evaluation of appearance characteristics (external and per section). Sensory attributes of aroma, taste and texture were significantly influenced by the two factors of variation determined by membrane type and product type. The highest sensory acceptability was observed for sheep and pork natural membrane products, with mean scores around 8.5, and the lowest acceptability was observed for polyamide membrane products, which obtained a mean score of 7.45.

Through the CATA test, the samples were described with positive sensory attributes, with small differences between the products in terms of texture attributes due to the characteristics of the membranes used. It was observed that consumer perception was positive for all products, without being influenced by the form of presentation given by the type of membrane. The differences in perception were rather attributed to the way the product performed during the production process (specifically heat treatment), considering that the heat treatments were differentiated according to the origin of the membrane (natural/artificial).

REFERENCES

Biswas, A. K., & Mandal, P. K. (2020). *Current perspectives of meat quality evaluation: Techniques, technologies, and challenges*. In: Meat Quality Analysis, Chapter 1, p. 3-17. London, UK: Academic Press.

Di Rosa, A. R., Leone, F., & Chiofalo, V. (2020). Electronic noses and tongues. *Chemical Analysis of Food (Second Edition)*, 353-389.

Georgescu, G., Banu, C., & Croitoru, C. (2000). *Treatise with the production, processing and utilization of meat.* Bucharest, RO: Ceres Publishing House.

Issanchou, S. (2018). *General Considerations*. In: Kemp, S. E., Hort, J., & Hollowood, T. (Eds.). *Descriptive analysis in sensory evaluation*. West Sussex, UK: John Wiley & Sons Publishing House.

Kemp, S.E., Hollowood, T., & Hort, J. (2011). *Sensory evaluation: a practical handbook*. West Sussex, UK: John Wiley & Sons Publishing House.

Lawless, H. T., & Heymann, H. (2010). *Sensory evaluation of food: principles and practices* (Vol. 2). New York, USA: Springer Publishing House.

Nederkoorn, C., Jansen, A., & Havermans, R. C. (2015). Feel your food. The influence of tactile sensitivity on picky eating in children. *Appetite, 84*, 7-10.

Ponnampalam, E., Holman, B., & Scollan, N. (2016). *Sheep: Meat. Encyclopedia of Food and Health*. Oxford, UK: Academic Press Publishing House, p. 750-757.

Saint-Denis, C.Y. (2018). *Consumer and Sensory Evaluation Techniques. How to Sense Successful Products*. New Jersey, USA: John Wiley & Sons Publishing House.

Wenther, J.B. (2003). *The effect of various protein ingredients utilized as a lean meat replacement in a model emulsion system and frankfurters*. Retrospective Theses and Dissertations, 1472.