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Application of sensory analysis in the assessment of the quality of meat products with different sodium chloride content

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Abstract

The aim of this paper was to evaluate sensory quality of commercial boiled chicken sausages and boiled pork sausages with different salt content. Descriptive sensory analysis was used. The basic physicochemical parameters of samples were also determined. The results showed that the chicken sausage sample with 3.42% salt and the pork sausage sample with 3.03% salt had better sensory quality compared to the samples with 2.43 and 3.30% salt, respectively. Chicken sausages with lower salt content had a less pronounced odour, aroma, taste, and softer consistency with significant differences ($P < 0.05$) comparing to the sample with higher salt content. The difference in salt content between pork sausages was smaller than between chicken sausages, but also significant ($P < 0.05$). The sample with lower salt content had better sensory quality, but the differences between all sensory properties, except the colour of two samples, were not significant ($P > 0.05$).

Key words: boiled sausages, NaCl, sensory quality

Introduction

The main source of sodium in human nutrition is sodium chloride (NaCl) commonly known as salt and it mostly comes from processed foods. Main dietary sources of salt are processed meat products (27%), especially cured meat

products and sausages; processed cereal products and salty snacks (26%); dairy products (14%), and ready-to-eat meals (13%) (Partearroyo et al., 2019). Excessive salt intake is one of the leading problems in human nutrition. High sodium consumption contributes to high blood pressure and increases the risk of cardiovascular and kidney diseases. Most people from industrialized and developing countries consume much more than the currently recommended amount of sodium chloride, which should be less than 5 grams per day (WHO, 2012). Modern trends in nutrition require reduction in the amount of sodium chloride in food. However, salt is an essential ingredient in meat processing, it inhibits the growth of microorganisms by reducing water activity, affects the creation of salty and masking the bitter taste, and affects the binding of proteins and other components in food to achieve desired textures (Kim et al., 2021). The meat industry is facing the challenge of how to reduce the NaCl content without over-modifying the taste and other sensory characteristics of meat products. A number of methods are used for analytical testing and precise definition of food products quality, among which sensory methods take a significant place. Pleasant smell, aroma and taste, colour, and texture characteristic of food products can significantly affect the quality and acceptability of the product by consumers. A product's quality can be identified and controlled by the descriptive sensory analysis which provides a complete description of all essential sensory properties (Grujić et al., 2014). This method can be used to identify and measure the influence of ingredients or modifications of recipes and process parameters on the changes in the quality level of one or more sensory properties of the product. In descriptive testing, evaluators use descriptive terms to identify sensory characteristics of a product's quality and to quantitatively compare differences between two or more products (Grujić, 2015). The aim of this paper was to evaluate sensory quality of commercial chicken boiled sausages and pork boiled sausages with different salt content. The basic physicochemical parameters of the analyzed samples were also determined.

Material and Methods

For the purposes of this experiment, boiled sausages of coarsely cut chicken meat (samples coded CS1 and CS2) and boiled sausages of coarsely cut pork meat (samples coded PS1 and PS2) were used. All samples were purchased from the market in the area of the Banja Luka city and stored in a refrigerator at + 4˚C until analysis.

The moisture content of samples was determined by drying in an oven at 105±2°C until constant weight (ISO, 1997). The NaCl content was determined by the Volhard method (ISO, 1996) and fat content of samples was determined by the Soxhlet method (ISO, 1973). The content of proteins was calculated after

determination of total nitrogen content (Kjeldahl method) by multiplying the obtained value with a nitrogen conversion factor of 6.25 (ISO, 1992). The content of total ash was determined after burning samples in a muffle furnace at 550±25°C until constant weight (ISO, 1998).

The pH value was measured using a portable pH meter (HANNA HI 99161) for semi-solid samples by direct insertion of the electrode into sausage samples. Water activity (a_w) was measured by direct readings in water activity meter (LabMaster - a_w Novasina Switzerland) at a constant temperature of 25˚C. The obtained results are expressed as the mean of 3 measurements ± standard deviation. Colour measurement was performed on the cross section of the samples immediately after cutting, using a spectrophotometer CM 2600d (Konica Minolta Sensing INC Osaka Japan) with 8 mm port size, illuminant D 65 and a 10° standard observer. The obtained colour parameters, expressed as CIE-Lab tristimulus values, represent indicators of lightness (L*), redness (a*), and yellowness (b*). The obtained results are expressed as the mean of 12 measurements ± standard deviation. The texture of the samples (hardness) was determined using the Texture Analyzer TA.XT plus Stable Micro Systems Godalming. The texture analyzer measures the shear force (kg) required to cut the sample. The obtained results are expressed as the mean of 8 measurements ± standard deviation.

Sensory analysis of samples was performed by 13 selected and trained assessors who worked independently in separate booths in the Laboratory for sensory analysis of foods. To evaluate the quality of samples, descriptive sensory analysis (scoring method) was used. The assessors analyzed and evaluated the selected sensory parameters: external appearance (packaging), cross section appearance, cross section colour, odour, aroma, taste, and consistency, using points from 5 (appropriate, expected quality) to 1 (inappropriate, unacceptable quality) with the possibility of using semi-points (Grujić, 2015).

An independent *t* Test was performed to estimate the significance of differences between mean values at $P < 0.05$, using the Statistica 12.0 software (StatSoft, Inc., Tulsa, OK, USA).

Results and Discussion

Table 1 shows the basic chemical composition of samples. Different salt content was found in boiled chicken sausages, as well as in boiled pork sausages. In samples CS1 and PS1, which had a lower content of NaCl, a lower content of total ash was determined in relation to samples CS2 and PS2. All samples had high water content and low-fat content. Protein content in all samples was in line with the requirements defined by the Regulation of fragmented/minced meat, semi-finished products, and meat products (Official Gazette of BH No. 82/13 2013).

Tab. 1. Results of basic chemical composition of boiled sausage samples

Samples / Parameters		Moisture content (%)	Total ash content (%)	Total fat content (%)	Protein content (%)	NaCl content (%)
Chicken sausage samples	Sample CS1	79.93 ± 0.33	2.22 ± 0.01	1.00 ± 0.01	13.32 ± 0.26	2.43 ± 0.11
	Sample CS2	78.41 ± 0.04	3.87 ± 0.02	0.98 ± 0.04	12.78 ± 0.21	3.42 ± 0.05
	t value	8.129	-123.500	0.603	4.709	-18.609
	P value	0.001	0.000	0.579	0.009	0.000
Pork sausage samples	Sample PS1	79.93 ± 0.03	3.26 ± 0.04	0.99 ± 0.07	13.03 ± 0.11	3.03 ± 0.03
	Sample PS2	79.34 ± 0.29	3.51 ± 0.09	1.16 ± 0.02	13.48 ± 0.13	3.30 ± 0.02
	t value	11.555	-4.265	-4.045	-14.417	-8.575
	P value	0.000	0.013	0.016	0.000	0.001

Data are presented as mean ± standard deviation. P < 0.05 - the means in the same column are significantly different according to the *t* test.

Sample CS1 with lower salt content had statistically higher ($P < 0.05$) L* and b* values for lightness and yellowness and lower a* value for redness compared to sample CS2. The same dependence was found in samples of pork sausages (Table 2). NaCl can reduce the stability of myoglobin and haemoglobin, and excessive addition of NaCl could accelerate the oxidation of myoglobin, thus reducing the redness of cooked meat (Bae et al., 2018). Higher NaCl content can cause higher levels of soluble proteins extraction in the intercellular space, and thus higher pH values. Differences in pH values between samples of boiled chicken sausages with different salt content were significant ($P < 0.05$). Sample PS2 with higher salt content had statistically higher ($P < 0.05$) pH value compared to sample PS1 (Table 2). Due to the different composition in muscle and connective tissue, the texture of meat also varied. According to Doyle and Glass (2010), the texture of meat products is significantly affected by the addition of salt in a percentage of 1.5% to 2.5%, with an increase in softness of the texture. Differences in texture between chicken sausages and between pork sausages with different salt content were not significant ($P > 0.05$).

Tab. 2. Results of physical characteristics of boiled sausage samples

Samples / Parameters		L*	a*	b*	pH	aw	Texture hardness (kg)
Chicken sausage samples	Sample CS1	81.32±5.31	2.37±0.41	10.17±1.46	6.41±0.01	0.38±0.05	0.38±0.05
	Sample CS2	75.93±2.94	3.72±1.07	9.63±1.02	6.30±0.02	0.94±0.00	0.35±0.07
	t value	3.076	-3.833	-8.04	7.603	-12.394	0.882
	P value	0.006	0.001	0.430	0.002	0.000	0.393
Pork sausage samples	Sample PS1	71.64±2.65	6.47±1.08	9.43±0.67	6.00±0.01	0.95±0.01	0.58±0.47
	Sample PS2	68.46±1.61	6.84±0.97	9.21±0.64	6.16±0.02	0.94±0.00	0.47±0.14
	t value	3.551	-0.881	0.835	1.732	3.536	0.832
	P value	0.002	0.388	0.413	0.158	0.024	0.419

Data are presented as mean ± standard deviation. $P < 0.05$ - the means in the same column are significantly different according to the *t* test.

Tab. 3. Results of descriptive sensory analysis of boiled sausage samples

Samples	Parameters	External appearance (packaging)	Cross section appearance	Cross section colour	Odour, aroma and taste	Consistency
Chicken sausage samples	Sample CS1	5.00±0.00	4.31±0.60	4.50±0.50	4.19±0.38	4.42±0.61
	Sample CS2	5.00±0.00	4.54±0.56	4.81±0.33	4.85±0.38	4.96±0.14
	t value	-	-1.091	-1.860	-4.389	-3.118
	P value	-	0.318	0.075	0.000	0.005
Pork sausage samples	Sample PS1	5.00±0.00	3.96±0.32	4.62±0.32	4.62±0.68	4.69±0.43
	Sample PS2	5.00±0.00	3.35±0.55	3.96±0.52	4.17±0.65	4.35±0.59
	t value	-	0.578	2.208	1.617	0.744
	P value	-	0.570	0.040	0.122	0.466

Data are presented as mean ± standard deviation. P < 0.05 - the means in the same column are significantly different according to the *t* test.

No noticeable defects were noticed on the packaging. The sausages were adequately stuffed, closed, and were slightly elastic under pressure. All samples received 5.00 points for appearance. Evaluating the cross-sectional appearance of boiled chicken sausages (CS1 and CS2), it was found that the ingredients in the cross-section were approximately and evenly distributed, with noticeable muscle and connective tissue. Air bubbles (2-3 mm) were visible in some parts. The difference in the assessment of the cross-sectional quality of these two samples was not statistically significant ($P > 0.05$). Ingredients were not evenly distributed in the cross-section of pork sausages, and a small amount of separated jelly was observed in some parts, as well as air bubbles (2-3 mm) in sample PS2. Sample PS1 was rated as a sample with better cross-sectional appearance, but without statistical significance ($P > 0.05$) in relation to sample PS2. A light colour of chicken meat with a slight cream and pink hue with more or less noticeable colour transitions within the cross section of chicken sausages was observed. Sample CS1 had a lighter cross-section colour than sample CS2. The results of colour measurements showed that sample CS1, with lower salt content, had a higher proportion of yellow and a lower proportion of red colour (Table 2). The results of sensory evaluation of sausage colour were in line with research conducted by Petit et al. (2019), which stated that products with lower salt content were evaluated as products whose colour was lighter than expected, compared to products with higher salt content. Within the cross section of the pork sausage samples a reddish light pink colour with lighter whitish shades of muscle and connective tissue was observed. Sample PS1 was lighter than sample PS2 which was consistent with the results of colour measurements (Table 2). Schmidt et al. (2016) found that products with lower red values (a*) were more acceptable to consumers. Sample CS1 had a less pronounced aroma and odour than the characteristic one for this type of product, but it was still pleasant. The content of aromatic compounds that originate from

the decomposition of amino acids is lower in products with a lower NaCl content (Lilić et al., 2013). This sample was less salty than expected with a slightly pronounced bitter taste. Sample CS2 was slightly saltier than expected, this being in line with the results of the chemical analysis for NaCl content (Table 1). However, this sample was rated as better than sample CS1 (Table 3) because it had a pronounced pleasant characteristic aroma and taste of chicken meat without the presence of foreign odours. In pork sausage PS1, with 3.03% of NaCl, pleasant and characteristic aroma, odour, and taste of pork meat were expressed without foreign odours. The salty taste was moderately pronounced. Sample PS1 received better points for odour, aroma, and taste compared to sample PS2, but without a statistically significant difference ($P > 0.05$). Sample PS2 also had a pleasant aroma and odour of pork meat ,but it was saltier compared to the previous sample. Texture is a sensory property perceived by the senses of sight, hearing, and touch, and represents the overall sense of food structure, composition, softness or hardness, adhesiveness, elasticity, cohesiveness, viscosity, and chewing sensation. The consistency of sample CS2 was stable, firmly elastic with good mass compactness even during sample cutting and it was neither too soft nor too hard during chewing. In sample CS1 softer consistency was observed which resulted in a statistically lower point compared to sample CS2. The consistency of sample PS2 was evaluated as stable, but slightly plastic, which resulted in a lower point compared to sample PS1. However, there was no significant statistical difference between the consistencies of two samples ($P > 0.05$).

Conclusion

Difference in salt content between the two samples of boiled chicken sausages was statistically significant ($P < 0.05$) and affected the sensory quality of the samples. It can be concluded that the sample with a lower NaCl content (2.43%) had significantly inferior sensory quality, especially in terms of taste, aroma, colour, and consistency compared to the sample with 3.42% NaCl. The sample with lower salt content had less pronounced smell and aroma, as well as less salty taste than expected. On the other hand, the analysis of samples of boiled pork sausages showed that the sample with 3.03% NaCl had better quality compared to the sample with 3.30% NaCl although differences in points of sensory parameters of cross-section, taste, aroma, and consistency were not statistically significant ($P > 0.05$).

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Примјена сензорне анализе у оцјени квалитета производа од меса са различитим садржајем натријум хлорида

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Сажетак

Циљ овог рада био је оцијенити сензорни квалитет комерцијалних барених кобасица од пилећег и барених кобасица од свињског меса са различитим садржајем соли. Кориштена је дескриптивна сензорна анализа. Одређени су и основни физичко-хемијски параметри анализираних узорака. Резултати су показали да су узорци барене пилеће кобасице са 3,42% соли и барене свињске кобасице са 3,03% соли имали бољи сензорни квалитет у односу на узорке са 2,43 и 3,30% соли, респективно. Узорак пилеће кобасице са нижим садржајем соли имао је мање изражен мирис, арому и укус и мекшу конзистенцију са статистички значајним разликама ($P < 0,05$) у односу на узорак са већим садржајем соли. Између узорака свињских кобасица разлика у садржају соли је била мања него између узорака пилећих кобасица али такође значајна ($P < 0.05$). Узорак са мањим садржајем соли имао је бољи сензорни квалитет, али разлике између свих сензорних својстава осим боје два узорка нису биле значајне ($P > 0.05$).

Кључне ријечи: барене кобасице, NaCl, сензорни квалитет

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