Salt reduction in Homemade Slavonian Sausage: effect on compositional, physico-chemical, colour and texture parameters, sensory characteristics and hygienic quality

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Summary

The aim of this study was to investigate acceptability of the Homemade Slavonian Sausage with reduced mass fraction of salt. The effect of reducing mass fractions of NaCl in some sensory, microbiological and physicochemical characteristics of Homemade Slavonian Sausage was evaluated. Sensory analysis and correlation analysis (multivariate method) was performed in order to check if the physicochemical, colour and texture differences found between control (2% NaCl) and sausages with decreasing mass fraction of NaCl were perceived by the sensory panel. According to results, it seems that reduction of NaCl affects the increase in the number of Enterobacteriaceae and Staphylococcus aureus, but all samples were microbiologically safe according to current legislation. Sensory analysis showed that the panelists do not sense a significant difference in individual characteristics, but when you take into account the factors of significance of individual properties, the samples differ significantly in overall quality rating. The best grades will bee given to sausages with the highest mass fraction of salt, the highest springiness, the lowest mass fraction of fat and the lowest mass fraction of connective tissue.

The biggest differences between the sample with 40% salt reduction and other samples in all the individual sensory characteristics and overall quality indicate that reduction of salt below more than 30% is still not recommended.

Keywords: *Homemade Slavonian Sausage, salt content reduction, physicochemical properties, sensory characteristics, microbiological analysis*

Introduction

Excessive intake of sodium (Na) has been linked to hypertension and consequently to increased risk of stroke and premature death from cardiovascular diseases. The main source of sodium (Na) in the diet is sodium chloride (NaCl) (Ruusunen & Puolanne, 2005). NaCl contains 39.3% Na. Sodium intake exceeds the nutritional recommendations (WHO 2004) which say that total amount of dietary salt should maintained 5-6 g NaCl/day/person (2 g/day/person of Na) and 1–3 g NaCl/day/person for salt susceptible individuals and hyperensives. Salt (sodium chloride, NaCl) is one of the major ingredients in dry fermented sausages which are one of the biggest sources of dietary NaCl from meat products. NaCl in these products contributes to water-holding capacity, fat binding, colour, flavour and texture. Also, salt plays an important role in ensuring the microbial stability of dry fermented sausages (Gelabert et al. 2003; Zanardi et al. 2010). Usually 2.0-2.60% NaCl is added to the sausage mixture (Ockerman & Basu, 2007; Stahnke & Tjener, 2007), and this value increase in final product to 3.3 – 4.3%, due to drying process. In Ireland, UK and US, public health and regulatory authorities (Food Standards Agency (FSA, UK); Food Safety Authority of Ireland, US Dept of Health and Human Services, 2005) recommend reducing dietary intake of sodium from sodium chloride. In August 2005 the FSA produced a salt model in order for the UK food industry to reduce the amount of salt in food products. The new proposed target (g/100 g) what supposed to be achieved by 2010 is a maximum of 1.4 g salt/550 mg sodium for sausages (Desmond, 2006; FSA, 2006). There is no accurate data on sodium intake from meat products in Croatia, nor any research on reducing salt in the Croatian autochthonous meat products has been published. Therefore, the aim of this research was to investigate acceptability of the Homemade Slavonian Sausage, traditional dry-fermented sausages, with reduced salt content as well as effects of reducing levels of NaCl in some sensory, microbiological and physicochemical characteristics of Homemade Slavonian Sausage.

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Table 1 **Mass fraction of NaCl (%) employed in Homemade Slavonian Sausages produced with different mass fractions of salt**

Sample	Mass fraction of NaCl (%)	Percentage of sodium reduction (%)
Control	2	0
Sample 1	1,8	10
Sample 2	1,6	20
Sample 3	1,4	30
Sample 4	1,2	40

Table 2 **Classical microbiological methods of isolation and identification of microorganisms**

Microorganisms	Method	Nutrient media	Incubation condition
Salmonella spp	HRN ISO 6579	RP-broth, XLD (Biolife)	37 °C 24-48 hours
Enterobacteriaceae	HRN ISO 5552	VRBG (Biolife)	37 °C 24 hours
Staphylococcus aureus	HRN ISO 6888-1	BP (Merck)	37 °C 48 hours
Sulphite-reducing Clostridium	HRN ISO 15213	SPS (Merck)	37 °C 72 hours
Listeria monocytogenes	HRN ISO 11290-1	Palcam (Merck)	37 °C 24 hours
Escherichia coli	HRN ISO 6391	ENDO (Biolife)	44 °C 24 hours
Aerobic mesophilic total viable count	HRN ISO 4833	TGYA (Biolife)	30 °C 48 hours
Moulds	HRN ISO 7954	YGCA (Biolife)	25 °C 5 days

Material and methods

Sausage preparation

Five types of Homemade Slavonian Sausages were manufactured in a small scale facility in Eastern Croatia. One with traditional formulation (control) and four with decreasing amount of NaCl (Table 1). All five sausage types (5 samples of each type of sausage) were made with a standard formulation for Homemade Slavonian Sausage: raw pork of first and second quality (96.8 %), garlic (0.2%), red hot paprika powder (0.4%) and sweat paprika powder (0.6%), but they differ in NaCl content (Table 1). The mix was stuffed into natural casing (pig's thin intestine (lat. *intestinum tenue*)) and the resulting sausages were smoked with dry hard wood every second day for two weeks. The temperature and relative humidity at this stage was about 18 to 20 °C and 70 to 90%. After smoking, the Slavonian homemade Sausages were left for the ripening in a dark room with the temperature from about 14 to 17 °C and relative humidity 70 to 80% for 45 days. The sausages were made in a non-industrial environment, characterised by small-scale batch production with a limited degree of mechanisation, using traditional techniques and strongly defined by the climate and region of origin. Once collected, the samples were placed in a portable cooler and transported to the laboratory within one hour, and then stored in a refrigerator (below 4°C). Before starting the analysis, every sausage sample was triparted. In order to prepare the samples for chemical and microbiological analysis, after removing the outer casing of each sausage, the edible part had been ground until a homogenous mass was obtained. Samples for instrumental colour measurement were chipped in 1 cm thick slices of sausages after removing the outer casing. Samples for texture analysis (TPA) were chipped in 1 cm long, 1 cm thick and 1 cm wide cubic samples after removing the outer casing.

Physicochemical parameters

The FoodScan Meat Analyser was used to determined moisture, total protein, total fat and collagen according to the Association of Official Analytical Chemists method 2007. 04. pH values were determined in a homogenate of the sample with distilled water (1:10, p/v) using pH/Ion 510 – Bench pH/Ion/mV Meter (Eutech Instruments Pte Ltd/ Oakton Instruments, USA), according to the ISO recommended standard 2917:1999 (HRN ISO 2917, 2000) and pH/Ion 510 Instruction Manual. Salt (sodium chloride (NaCl)) was determined according to the ISO method 1841. Water activity (a_w) was determined using a Rotronic Hygrolab 3 (Rotronic AG, Bassersdorf, Switzerland) at room temperature (20 ± 2 °C). Three independent measurements were made on each sample. Average and standard deviations were calculated.

3. Determination of colour

Colour measurements (L*, a*, and

b* values) were taken using a Hunter-Lab Mini ScanXE (A60-1010-615 Model Colorimeter, Hunter-Lab, Reston, VA, USA). The instrument was standardized each time with a white and black ceramic plate (L_0 = 93.01, a_0 = -1.11, and b_0 = 1.30). The Hunter L*, a*, and b* values correspond to lightness, greenness (-a*) or redness (+a*), and blueness (-b*) or yellowness (+b*), respectively. The colour measurements were performed on Slavonian homemade Sausage at room temperature (20 ± 2 °C).

4. Texture profile analysis

A Universal TA-XT2i texture analyzer was used to conduct texture profile analysis (Bourne, 1978). Cubic samples 1x1x1 cm were compressed twice to 60% of their original height with a compression platen of 75 mm in diameter. Textural analyses were performed at ambient temperature. Force-time deformation curves were recorded at a crosshead speed of 5 mm/s and recording speed also 5 mm/s. Hardness, springiness, cohesiveness, gumminess and chewiness were evaluated. These parameters were obtained using the Texture Expert for Windows (version 1.0) Stable Micro Systems.

5. Sensory analysis

The scoring test was carried out. A group of 5 people evaluated the sensory characteristics of the sausages studied. It is important to underline that those people were trained sensory analysts and they are employees of The Faculty of Food Technology in Osijek. Appearance, texture, taste, colour and odour were assessed using the scoring test in which samples were given scores of 1 (very poor) to 5 (excellent). The global quality was calculated from the expression: overall quality = (appearance x 2) + (texture x 6) + (taste x 8) + (colour x 2) + (odour x 2). This expression was formulated taking into account the relative importance of the different sensory characteristics.

Table 3 **Basic composition, pH and a_w (average values) of Homemade Slavonian Sausages produced with different mass fractions of salt**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
Moisture (%)	32,225^{a}	27,180^{c}	29,820^{b}	29,965^{b}	27,060^{c}
Protein (%)	31,790^{d}	35,220^{a}	32,630^{c}	33,295^{b}	35,440^{a}
Fat (%)	26,175^{d}	28,470^{b}	28,210^{c}	28,040^{c}	30,765^{a}
Collagen (%)	4,320^{bc}	3,640^{c}	4,930^{ab}	4,940^{ab}	5,620^{a}
NaCl (%)	3,855^{a}	3,765^{a}	3,070^{b}	2,890^{c}	2,690^{d}
a_w	0,886^{a}	0,839^{c}	0,880^{b}	0,885^{a}	0,876^{b}
pH	5,285^{a}	5,165^{b}	5,010^{e}	5,040^{d}	5,065^{c}

^{a,b,c,d,e} Within a row, least squares means with different superscripts differ significantly (p<0.05)
Values represent the average value of the 5 samples analyzed for each type of sausage

Table 4 **Instrumental colour measurement of Homemade Slavonian Sausages produced with different mass fractions of salt**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
L*	32,611^{a}	30,259^{c}	31,090^{b}	31,666^{ab}	29,552^{d}
a*	20,770^{b}	18,626^{c}	22,089^{a}	21,687^{ab}	19,463^{c}
b*	14,008^{ab}	13,499^{bc}	14,753^{ab}	15,069^{a}	12,213^{c}

^{a,b,c,d} Within a row, least squares means with different superscripts differ significantly (p<0,05)

Table 5 **Texture profile analysis (TPA) of Homemade Slavonian Sausages produced with different mass fractions of salt**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
Hardness	2889,646^{c}	6759,134^{a}	3336,013^{c}	3533,952^{c}	4669,881^{b}
Springiness	0,523^{a}	0,439^{b}	0,436^{b}	0,455^{b}	0,421^{b}
Cohesiveness	0,356^{a}	0,298^{b}	0,332^{ab}	0,345^{a}	0,356^{a}
Gumminess	1027,984^{c}	2009,373^{a}	1108,360^{c}	1204,534^{c}	1639,958^{b}
Chewiness	540,681^{c}	883,971^{a}	486,787^{c}	549,003^{c}	694,375^{b}

^{a,b,c} Within a row, least squares means with different superscripts differ significantly (p<0,05)

6. Microbiological analysis

The microbiological analyses were carried out on the 5 samples of each type of sausage (control sausage and four sausages with decreasing mass fractions of NaCl). Classical microbiological methods were used for isolation and identification of the microbial population (Table 2).

7. Data analysis

Differences among average values of the same physicochemical, colour, texture and sensory parameters between sausages with different NaCl content were analyzed through the analysis of variance (ANOVA) and Fisher's least significant difference test (LSD), with significance defined at P<0.05. Moisture content, fat content, protein content, collagen content, NaCl content, pH, a_w, colour parameters, textural parameters and sensory characteristics were subjected to correlation analysis (multivariate method) to determine possible statistical relationships between them. Statistical analysis was carried out with Statistica ver. 7.0 StatSoft Inc. Tulsa, OK. USA.

Results and discussion

As the aim of this article was to investigate the effect of reducing mass fraction of NaCl in some sensory, microbiological and physicochemical characteristics of Homemade Slavonian Sausage, Table 3 shows basic composition, pH and a_w of Homemade Slavonian Sausages (final products) produced with different mass fraction of salt. Although initial values of pH, a_w and moisture content was similar for all sausage types and all sausages followed the same drying process, the highest moisture content was observed in the control sausage sample (sausage with the highest mass fraction of NaCl). These results agree with the results of Guàrdia et al. (2008). Beside that, it is important to notify that pH value was the highest in control sausage.

Table 4 shows results of instrumental colour measurement of Homemade Slavonian Sausages (final products) produced with different mass fraction of salt.. Control sausage shows the highest L* (lightness) values. There is also positive significant correlation between moisture content and L* value and negative significant correlation between L* value, mass fraction of protein and fat (Table 10).

Textural properties are shown in Table 5. Control sausage shows the lowest value for hardness and the highest value for springiness, but beside that, no clear effect was found in the texture as a consequence of the reduction of NaCl.

Gelabert et al. (2003), notified that the lower moisture content at the surface of the sausage at the end of the process could be related with the higher hardness, which is similar to our results (Table 11).

Table 11 also shows significant negative correlation between mass fraction of fat and springiness, and significant positive correlation between mass fraction of protein and gumminess. Also, there is a significant negative correlation between a_w value and hardness, gumminess and chewiness what implies significant positive correlation between hardness, gumminess and chewiness. As one of the aims of this study was to investigate acceptability of the traditional dry-fermented sausages with reduced mass fraction of salt, Table 6 shows sensory scores for appearance, texture, taste, colour and odour for Homemade Slavonian Sausages produced with different mass fraction of salt. Scores indicate that there is no significant difference between samples, but since the overall quality was calculated from the expression: overall quality = (appearance x 2) + (texture x 6) + (taste x 8) + (colour x 2) + (odour x 2), taking into account the relative importance of the different sensory characteristics, the significant difference between scores for overall quality

Table 6 **Sensory characteristic of Homemade Slavonian Sausages produced with different mass fractions of salt**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
Appearance	3,4^{a}	3,2^{a}	3,4^{a}	3,4^{a}	3,2^{a}
Texture	4,0^{a}	3,8^{a}	3,8^{a}	3,8^{a}	3,6^{a}
Taste	3,6^{a}	3,6^{a}	3,6^{a}	3,4^{a}	3,2^{a}
Colour	4,2^{a}	3,8^{ab}	4,2^{a}	3,6^{ab}	3,4^{b}
Odour	3,8^{a}	3,8^{a}	3,4^{a}	3,2^{a}	3,4^{a}
Overall quality	76,5^{a}	74,9^{b}	73,6^{c}	71,5^{d}	67,2^{e}

^{a,b,c,d,e} Within a row, least squares means with different superscripts differ significantly (p<0,05)

Table 7 **Microbiological analysis of Homemade Slavonian Sausages produced with different mass fractions of salt (parameters prescribed by the current legislation)**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
Listeria monocytogenes	-	-	-	-	-
Sulphite-reducing Clostridium	-	-	-	-	-
Staphylococcus aureus ($\log_{10}$ CFU/g)/	-	1,00*	1,00*	2,00*	2,00*
Salmonella spp	-	-	-	-	-
Escherichia coli	-	-	-	-	-
Enterobacteriaceae ($\log_{10}$ CFU/g)/	-	-	1,00*	1,90*	1,95*

* Value appears in one of the 5 samples analyzed for each type of sausage

Table 8 **Microbiological analysis of Homemade Slavonian Sausage produced with different mass fraction of salt (parameters that are not prescribed by the current legislation)**

Parameter	Samples				
	Control	Sample 1	Sample 2	Sample 3	Sample 4
Staphylococcus sp. ($\log_{10}$ CFU/g)/	4,64*	3,27*	3,47*	3,51*	3,58*
Moulds	-	-	-	-	-
Aerobic mesophilic total count ($\log_{10}$ CFU/g)	8,68*	8,52*	8,64*	8,70*	8,28*

* Values represent the average value of the 5 samples analyzed for each type of sausage

indicate that reduction of salt content were perceived by the sensory panel. The highest score got control sausage (2% NaCl) and the lowest score got the sausage with the lowest mass fraction of NaCl (1.2% NaCl).

In relation to sensory analysis, there is significant positive correlation between mass fraction of NaCl and scores for odour and for overall quality. Also, there is significant positive correlation between instrumental measured springiness and sensory score for texture. Beside that significant positive correlation was found between moisture content and sensory scores for appearance (Table 9). Significant negative correlation was found between mass fraction of fat and sensory score for texture, and between mass fraction of fat and score for overall quality (Table 9). Mass fraction of protein showed significant negative effect on appearance, and mass fraction of collagen showed significant negative effect on scores for taste and odour (Table 9).

Microbial results are shown in Table 7 and 8. Parameters prescribed by the current legislation *(NN 74/08, NN 156/08, NN 89/10)* and *Vodič za mikrobiološke kriterije za hranu)* are shown in Table 7 and parameters which are not prescribed by current legislation are shown in Table 8. It seems that no problems in the hygienic quality were detected as a consequence of the NaCl reduction according to currently valid legislation. But, in samples with reduced mass fractions of salt (Samples 1, 2, 3 and 4), in one of 5 probes analysed for each type of sausage were occurred a certain number of *Staphylococcus aureus* (In samples 1, 2, 3 and 4) and *Enterobacteriaceae* (In samples 2, 3 and 4), probably as a result of salt reduction.

The aerobic mesophylic total count was similar to those find by Gelabert et al. (2003) (Table 8).

Table 9 **Multivariate correlations between parameters**

Parameter	Moisture (%)	Protein (%)	Fat (%)	Collagen (%)	NaCl (%)	pH	a_w
Appearance	0,89[a]	-0,94[a]	-0,72	0,07	0,05	-0,02	0,85
Texture	0,84	-0,80	-0,99[a]	-0,62	0,78	0,69	0,34
Taste	0,30	-0,37	-0,69	-0,88	0,83	0,43	-0,27
Colour	0,69	-0,79	-0,78	-0,44	0,62	0,38	0,29
Odour	0,28	-0,15	-0,65	-0,88[a]	0,91[a]	0,86	-0,31
Overall quality	0,59	-0,60	-0,89[a]	-0,83	0,89[a]	0,63	-0,01

[a]Significant at $p < 0,05$

Table 10 **Multivariate correlations between parameters**

Parametar/Parameter	L*	a*	b*
Moisture (%)	0,97[a]	0,69	0,63
Protein (%)	-0,93[a]	-0-78	-0,71
Fat (%)	-0,94[a]	-0,41	-0,65
Collagen (%)	-0,27	0,36	-0,20
NaCl (%)	0,46	-0,30	0,09
a_w	0,68	0,86	0,50
pH	0,47	-0,38	-0,19

[a]Significant at $p < 0,05$

Table 11 **Multivariate correlations between parameters**

Parameter	Moisture (%)	Protein (%)	Fat (%)	Collagen (%)	NaCl (%)	pH	a_w
Hardness (g)	-0,79	0,82	0,41	-0,47	0,15	-0,03	-0,93[a]
Springiness (mm)	0,80	-0,68	-0,90[a]	-0,52	0,75	0,85	0,35
Cohesiveness	0,37	-0,31	0,04	0,61	-0,22	0,20	0,59
Gumminess (g)	-0,86	0,89[a]	0,52	-0,35	0,07	-0,04	-0,93[a]
Otpor žvakanju (g x mm)	-0,72	0,79	0,33	-0,52	0,26	0,15	-0,92[a]

[a]Significant at $p < 0,05$

It should be notice that there is a lack of information on simple lowering the level of salt added to dry fermented sausages. Most authors studied effect of partial replacement of sodium chloride by KCl, potassium lactete (K-lactate), glycine, calcium ascorbate, calcium chloride (Gou et al. 1996.; Gimeno et al. 1998, 1999 2001; Ibànez et al. 1995; Gelabert et al. 2003; Guàrdia et al., 2006, 2008).

Conclusion

In relation to the sausages with a lower mass fraction of salt, the control sausage (2% NaCl) showed significant differences in pH, moisture content and mass fraction of protein and fat.

Also, the control sausage had the highest moisture content, L* value (lightness), a_w and pH value and the lowest mass fraction of protein and fat. In textural properties, there is a significant difference between control and other sausages only in springiness, while the control sausages had the highest springiness.

From microbiological point of view, it seems that reduction of NaCl affects the increase in the number of *Enterobacteriaceae* and *Staphylococcus aureus*, but all samples were microbiologically safe according to current legislation.

Sensory analysis showed that the panelists do not sense a significant difference in individual characteristics, but when you take into account the factors of significance of individual properties, the samples differ significantly in overall quality rating. Significant positive correlation between taste, texture and overall quality indicate that the taste and texture of the samples are best indicators of overall quality and acceptability. Also, it can be concluded that the best grades got sausages with the highest mass fraction of salt (the best scores for texture and taste), the highest springiness, (the best scores for texture), the lowest mass fraction of fat (the best scores for texture) and the lowest mass fraction of connective tissue (the best scores for taste and odor).

The largest differences between the sample 4 in comparison with other samples in all the individual sensory characteristics and overall quality indicate that reduction of salt below more than 30% is still not recommended.

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Verminderung von Salzanteil in der slawonischen Wurst: Einfluss auf die Zusammensetzung, physikalisch-chemische Eigenschaften, Farbe, Textur, sensorische Eigenschaften und gesundheitliche Richtigkeit

Zusammenfassung

Das Ziel dieser Arbeit war die Zulässigkeit der einheimischen slawonischen Würste mit der Verminderung von Salzanteil zu prüfen. Es wurde der Einfluss der Verminderung von NaCl auf sensorische, mikrobiologische und physikal-chemische Eigenschaften der einheimischen slawonischen Würste geprüft. Es wurden Sensoranalysen und Korrelationsmatrizen (multivariatne Methode) durchgeführt, um zu prüfen, ob Sensoranalytiker die festgestellten Unterschiede zwischen der Kontrollwurstmuster (2 % NaCl) und der Würste mit dem verminderten NaCl-Anteil hinsichtliche der physikal-chemischen Eigenschaften, Farbe und Textur, perzipieren. Nach den bekommenen Resultaten kann man in Betracht ziehen, dass die Verminderung von NaCl-Anteil einen Einfluss auf Vergrößerung der Enterobakterien und Staphylococcus aureaus haben, jedoch sind alle Muster nach gültigen gesetzlichen Vorschriften mikrobiologisch richtig. Sensorische Analyse hat gezeigt, dass Panelisten keine bedeutenden Unterschiede in sensorischen Eigenschaften perzipieren. Jedoch, wenn man die Faktoren der Bedeutung von einzelnen Eigenschaften in Betracht zieht, unterscheiden sich die Muster statistisch bedeutend gegenüber der geamten Qualitätsbewertung. Würste mit bester Bewertung enthalten den meisten Salzanteil, zeigen die bessere Elastizität, enthalten am wenigsten Fett und Kollagen. Der größte Unterschied zwischen den Mustern mit dem verminderten Salzanteil um 40 % und anderen Mustern, in allen einzelnen sensorischen Eigenschaften und der gesamten Qualitätsbewertung zeigt, dass eine Verminderung des Salzanteiles um mehr als 30 % in Bezug auf das Kontrollmuster, nicht empfehlt werden kann.

Schlüsselwörter: *einheimische slawonische Wurst, physikalisch-chemische Eigenschaften, sensorische Eigenschaften, mikrobiologische Analyse*

Riduzione di sale nelle salsicce di casa dell'area di Slavonia: effetto sulla composizione, sulle caratteristiche fisico-chimiche, sul colore, sulla struttura, sulle caratteristiche sensoriche e sulla qualita' di salute

Sommario

Lo scopo di questa ricerca era esaminare l'accettabilità delle salsicce di casa dell'area di Slavonia con la percentuale di sale ridotta. È stato esaminato l'effetto della riduzione del NaCl sulle caratteristiche sensoriche, microbiologiche e quelle fisico-chimiche delle salsicce di casa dell'area di Slavonia. L'analisi sensorica e quella correlativa (metodo multivariante) sono state fatte per verificare se gli analitici sensorici possono percepire le differenze constatate fra il campione di controllo della salsiccia (con il 2% del NaCl) e le salsicce con la percentuale di sale ridotta nelle caratteristiche fisico-chimiche, nel colore e nella struttura.

Secondo i risultati la riduzione del NaCl ha l'effetto sull'aumento delle enterobatterie e quelle di tipo Staphylococcus aureus. Tutti i campioni sono però accettabili quanto alla microbiologia secondo i regolamenti legislativi attuali. L'analisi sensorica ha mostrato che i panelisti non sentono le differenze significanti nelle singoli caratteristiche sensoriche ma considerando i fattori del significato delle singoli caratteristiche i campioni sono differenti in gran parte quanto alla valutazione finale di qualità. I massimi voti avranno quindi le salsicce con la massima percentuale di sale, con la massima elasticità, con la minima percentuale di grasso e del tessuto connettivo. La maggior differenza fra il campione con la percentuale di sale ridotta al 40% e gli altri campioni in tutte le singoli caratteristiche sensoriche e la valutazione finale di qualità rivelano che la riduzione di sale di più deli 30 % in riferimento al campione di controllo non viene raccomandata.

Parole chiave: *salsicce di casa dell'area di Slavonia, riduzione di sale, caratteristiche fisico-chimiche, caratteristiche sensoriche, analisi microbiologica*