

Physico-chemical and colour properties of homemade slavonian sausage

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Summary

A study of physico-chemical properties and instrumental measurement of colour was carried out on seven different brands of traditional Croatian homemade dry fermented sausage known as Slavonian homemade Sausage. Basic physico-chemical properties showed a large variability, except for the values of a_w and pH. This can be related to different recipes used by different producers, but on the other hand these producers follow traditional production conditions. Parameters related to colour showed little variability, especially L^* and a^* values. The higher variability of b^* could be related to the amount of paprika used in the recipe. Some differences in L^* , b^* and a^* values were significantly correlated to moisture, fat and salt content.

Keywords: Slavonian homemade Sausage, traditional manufacturing technology, physico-chemical properties, colour

Introduction

The traditional Croatian dry sausages are, in almost all cases, fermented sausages that undergo more or less prolonged process of smoking and drying-ripening before consumption. The most represented Croatian dry fermented sausage except for Slavonian Kulen is Slavonian homemade Sausage. Slavonian homemade Sausage is a traditional meat product from Eastern Croatia, Slavonia region, with specific sensorial properties (smell and taste), which mainly originate from being dried and smoked, and from ripening and enzymatic and lactic acid bacteria activity. It is produced according to a traditional procedure, from minced pork, with the addition

of salt, red paprika, hot paprika and garlic. The mixtures are stuffed into natural casings (a pig's thin intestine, lat. *intestinum tenue*). After stuffing, the sausages undergo a smoking and drying-ripening process. The most demanding operation in production is the ripening stage. The coherence of the processing parameters (temperature, relative humidity and air velocity) in ripening chambers are the most important, because they have the largest impact on the sensorial properties (smell, taste, colour and texture) of the finished product. The production of traditional Slavonian homemade Sausage mainly takes place on small farms in small amounts and it is seasonal in character. Because of that, there is a great

need for the standardization of production. Similar products from Spain (Chorizo de Pamplona and Salchichón) and Italy (Felino and Milano salami) have been intensively studied for their physical-chemical composition and sensorial properties (Dellaglio et al., 1996; Perez-Alvarez et al., 1999; Gimeno et al., 2000; Bruna et al., 2003). There is no existing information in scientific literature on this dry sausage, which could contribute efficiently to its characterization. The purpose of this work was to examine, for the first time, physico-chemical composition and colour properties of Slavonian homemade Sausage, leading to the protection of geographical indications, and receiving the protected geographical

indication (PGI), according to the EU Council Regulation (EC) No 510/2006 and EU Commission Regulation (EC) No 1898/2006.

MATERIAL AND METHODS

Material

Seven samples of traditional Slavonian homemade Sausages were collected from different producers in Eastern Croatia (the Slavonia region). All samples had been prepared according to the traditional processing procedures without any additives such as nitrites or ascorbic added. The traditional production starts in November and lasts until February or March. It is made of the meat of pigs of at least 12 months old and over 150 kg of live weight. Only the meat from the high quality parts of the pig, such as the thigh, the back and shoulder is used in the production of traditional Slavonian homemade Sausage. After choosing the high quality meat without a high amount of connective tissue, the meat is cut into stripes 30 cm long, 10 cm wide and 3 cm thick and put on a pierced inox/stainless steel plate and placed in a freezer until the temperature of the meat reaches -2 to -5 °C. The meat is then grinded through a grinding plate with holes of 6 mm in diameter. Optimum pH values of the minced meat at this stage should be below 5.9. The grinded meat is then mixed with salt in the amount of 1.8%, red paprika in the amount of 0.6% and garlic in the amount of 0.2%. The minced meat is then stuffed only into a pig's thin intestine, (lat. *intestinum tenue*). Thereafter, the Slavonian Sausage is smoked with dry hard wood (hornbeam, beech and its sawdust) every other day for two weeks. The temperature and relative humidity at this stage should be 18 to 20 °C and 70 to 90%. After the smoking, the Slavonian homemade Sausage is left for the ripening stage. This stage is the longest and

Table 1 General composition of Slavonian homemade Sausage
Tablica 1. Opći sastav domaće slavonske kobasice

Brand	Moisture (%)	Fat (%)	Protein (%)	Collagen (%)
Uzorak	Vlaga (%)	Mast (%)	Proteini (%)	Kolagen (%)
1	19.01 ^a ± 0.05	44.42 ^b ± 0.04	29.07 ^b ± 0.04	4.63 ^a ± 0.05
2	25.01 ^b ± 0.03	38.14 ^a ± 0.03	28.18 ^c ± 0.03	5.37 ^b ± 0.04
3	19.44 ^d ± 0.04	37.47 ^c ± 0.04	19.46 ^e ± 0.05	5.25 ^c ± 0.03
4	19.48 ^d ± 0.03	44.30 ^b ± 0.04	26.29 ^d ± 0.02	5.17 ^c ± 0.04
5	25.28 ^a ± 0.03	40.36 ^d ± 0.05	26.28 ^d ± 0.03	4.89 ^d ± 0.03
6	22.72 ^c ± 0.03	45.13 ^a ± 0.03	25.57 ^a ± 0.04	6.57 ^a ± 0.04
7	17.07 ^e ± 0.03	35.50 ^e ± 0.04	36.47 ^a ± 0.04	4.23 ^e ± 0.03

Values are means ±SD of triplicate. Values in the same column with different superscripts (a-g) are significantly different (P<0.05)

Vrijednosti su srednje vrijednosti ± SD triplikata. Vrijednosti u istom stupcu s različitim superskriptima (a-g) su značajno različite (P<0.05)

it should last for more than 2 months in a dark room with the temperature from 14 to 17°C and relative humidity 70 to 80%. After this stage the Slavonian homemade Sausage is ready for consumption.

Physico-Chemical analysis

The samples of Slavonian homemade Sausage were cut into small pieces and homogenized in a household kitchen blender. The pH level was measured in a homogenate of the sample with distilled water (1:10, p/v) with pH/Ion 510 – Bench pH/Ion/mV Meter (Eutech Instruments Pte Ltd/ Oakton Instruments, USA). Water activity (a_w) was determined using a Rotronic Hygrolab 3 (Rotronic AG, Bassersdorf, Switzerland) at room temperature (20 ± 2 °C). The FoodScan Meat Analyser Lab was used to determine moisture, total protein, total fat and collagen according to the AOAC method number 2007. 04. Salt (sodium chloride (NaCl)) was determined according to the ISO method 1841.

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).

Data analysis

Three determinations for general composition and five for colour parameters were measured from each sample. Experimental data were analyzed by the analysis of variance (ANOVA) and Fisher's least significant difference (LSD), with significance defined at P<0.05. a_w , pH, NaCl, moisture, fat, protein and collagen content and colour parameters were subjected to correlation analysis (multivariate method) to determine possible statistical relationships between them. Statistical analysis was carried out with Statistica ver. 8.0 StatSoft Inc. Tulsa, OK, USA.

RESULTS AND DISCUSION

Basic chemical compositions of seven brands of Slavonian homemade Sausage are given in Table 1. Moisture content of Slavonian homemade Sausage varied significantly among brands and was lower then values for a similar product like Chorizo and Salchichon (Gimeno

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et al., 1999; Rubio et al., 2008). Protein content of Slavonian homemade Sausages showed high variability (protein contents were in range from 19.46 to 36.47%) and it was higher than protein content in Chorizo reported by Gimeno et al. (1999) and Muguerza et al. (2001) and Salchichon Rubio et al. (2007) and Rubio et al. (2008). Fat and collagen content showed high variability among brands (Table 1). Comparing these values with values reported by Gimeno et al. (1999) and Muguerza et al. (2001) for Chorizo and Salchichon, Slavonian homemade Sausage had lower fat content (Table 1). Slavonian homemade Sausage must be produced only from the meat of high quality, such as ham, back and shoulder. In this case, collagen is undesirable in Slavonian homemade Sausage. Contents of collagen in seven brands analyzed in this study varied significantly among brands (C.V. = 14.29%).

a_w , pH and salt content of seven brands of Slavonian homemade Sausage are given in Table 2. a_w did not vary significantly among brands (C.V. = 3.69%), and it was lower than a_w of Salchichon reported by Rubio et al. (2008).

In many cases pH value has been recognized as fermentation indicator, as well as like indicator of ripening stage (Hagen et al., 2000; Salgado et al., 2005; Revilla et al., 2005). In this study, variations in pH values between seven different brands were not significant (pH values varied between 4.97 and 5.55). The low variations in a_w and pH suggests similar stages of maturation between collected brands.

If we compare pH values of Slavonian homemade Sausage with pH values of Chorizo and Salchichon, which have been observed by Gimeno et al., (1999), Gimeno et al., (2000) and Rubio et al. (2007), it is

Table 2 a_w , pH and NaCl of Slavonian homemade Sausage
Tablica 2. a_w , pH and NaCl domaće slavonske kobasice

Brand Uzorak	a_w	pH	NaCl (%)
1	0.82 ^b ± 0.01	4.97 ^a ± 0.02	3.01 ^a ± 0.2
2	0.86 ^a ± 0.01	5.34 ^b ± 0.01	1.69 ^d ± 0.1
3	0.83 ^b ± 0.01	4.78 ^c ± 0.01	2.07 ^c ± 0.04
4	0.83 ^b ± 0.01	4.87 ^a ± 0.03	2.45 ^b ± 0.2
5	0.83 ^b ± 0.01	5.25 ^c ± 0.02	2.97 ^a ± 0.01
6	0.83 ^b ± 0.01	4.96 ^d ± 0.01	2.94 ^a ± 0.03
7	0.76 ^c ± 0.01	5.55 ^a ± 0.03	2.59 ^b ± 0.04

Values are means ±SD of triplicate. Values in the same column with different superscripts (a-g) are significantly different (P<0.05)

Vrijednosti su srednje vrijednosti ± SD triplikata. Vrijednosti u istom stupcu su različitim superskriptima (a-g) su značajno različite (P<0.05)

Table 3 Instrumental colour measurement
Tablica 3. Instrumentalno mjerenje boje

Brand Uzorak	L^*	a^*	b^*
1	36.12 ^b ± 0.95	27.13 ^b ± 1.02	24.54 ^a ± 1.23
2	26.87 ^c ± 0.72	16.59 ^a ± 1.26	12.10 ^c ± 1.38
3	32.69 ^{cd} ± 0.67	21.06 ^b ± 0.92	22.68 ^b ± 1.55
4	36.09 ^b ± 1.02	26.22 ^a ± 0.50	25.06 ^a ± 2.40
5	30.02 ^d ± 0.29	18.65 ^d ± 0.83	16.22 ^b ± 1.09
6	38.13 ^a ± 0.52	23.59 ^b ± 0.69	24.87 ^a ± 0.99
7	34.57 ^c ± 1.47	22.39 ^{bc} ± 1.95	25.01 ^a ± 3.21

Values are means ±SD of triplicate. Values in the same column with different superscripts (a-g) are significantly different (P<0.05)

Vrijednosti su srednje vrijednosti ± SD triplikata. Vrijednosti u istom stupcu su različitim superskriptima (a-g) su značajno različite (P<0.05)

noticeable that Slavonian homemade Sausage has higher pH values than Chorizo and Salchichon. This could be explained by longer ripening stage of Slavonian homemade Sausage.

Salt contents were in the range from 1.69 and 3.01% and did not vary significantly among brands (Table 2).

CIE $L^*a^*b^*$ system values are shown in Table 3. The lightness (L^*) values of all brands ranged from 26.87 to 38.13, the redness (a^*) of all brands ranged from 16.59 to 27.13, and the yellowness (b^*) from 12.10 to 25.06. Compared to other studies on similar samples (Chorizo) (Anserona et al., 1997; Fernández-Fernández et al., 1998; Gimeno et al., 2000; Muguerza et al., 2001; Muguerza et

Table 4 Multivariate correlations between parameters
Tablica 4. Multivarijatne korelacije među parametrima

	pH	NaCl	Moisture (%) Vlaga (%)	Fat (%) Mast (%)	Protein (%) Proteini (%)	Collagen (%) Kolagen (%)
L^*	-0.44	0.63 ^a	-0.60 ^a	0.60 ^a	0.07	0.21
a^*	-0.49	0.55 ^a	-0.68 ^a	0.64 ^a	0.10	-0.07
b^*	-0.40	0.50	-0.82 ^a	0.35	0.10	-0.02

^aSignificant at p < 0.05

Fizikalno-kemijska svojstva i boja domaće slavonske kobasice

Sažetak

U ovom istraživanju određivana su fizikalno-kemijska svojstva i instrumentalno određena boja sedam različitih uzoraka domaće slavonske kobasice. Osnovni kemijski sastav pokazao je velike razlike u masenom udjelu vode, proteina, masti i kolagena, dok su a_w i pH vrijednosti domaće slavonske kobasice bile ujednačene. Na temelju tih rezultata se može zaključiti da proizvođači koriste različite recepture u proizvodnji, ali da se druge strane proizvođači pridržavaju tradicionalnih tehnoloških uvjeta proizvodnje. Instrumentalni parametri boje L^* i a^* domaće slavonske kobasice bili su slični dok je parametar b^* značajno varirao između uzoraka, što se može biti posljedica različitog udjela paprike u uzorcima domaće slavonske kobasice. Vrijednosti parametara L^* , a^* i b^* pokazale su značajne korelacije s masenim udjelom vode, masti i soli.

Ključne riječi: domaća slavonska kobasica, tradicionalna tehnologija proizvodnje, fizikalno-kemijska svojstva, boja

al., 2002), the value of lightness (L^*) was lower, (b^*) was higher, but the values of a^* were similar. The differences in L^* values can be explained by the longer ripening period of Slavonian homemade Sausage, than the Chorizo. Although some significant differences were found among different brands, the total variability can be considered low especially for L^* (C.V. among brands = 11.76%).

Compared with different types of dry cured sausage, Italian Felino salami (Dellaglio et al., 1996) and Salchichon (Rubio et al., 2008) showed similar L^* values but lower b^* value, the values of a^* were similar to Italian but higher than Spanish sausage. The higher b^* (yellowness) values found in Slavonian homemade Sausage are probably related to the presence of yellow carotenoids (β -carotene and cryptoxanthine) coming from paprika, a typical spice used in Slavonian homemade Sausage production

The higher variability of b^* values found among samples (C.V. = 24.26%) could be related to the different amounts of this spice used in the recipes of different brands. Sensorial properties can be affected by the technological process and obviously by the composition. In general, low fat levels and high water content lead to higher a^* values and lower L^* values.

Other studies have found that the lower the protein content, the small-

er the a^* value (Blukas and Paneras, 1993; Carballo et al., 1996). These researchers explained this fact by the dilution of myoglobin as a consequence of the reduced protein content.

Significant correlations were found between L^* parameter moisture, fat and salt levels (Table 4). a^* values showed negative correlation with moisture and positive correlations with salt and fat content, b^* showed negative correlation with moisture content (Table 4). Significant correlations were not found between colors parameters and pH, protein and collagen content (Table 4).

CONCLUSION

There were large differences in the basic composition of Slavonian homemade Sausage, especially in fat, protein and collagen content. This shows that producers still use very different recipes in production of Slavonian homemade Sausage. pH and a_w values were very similar, which can indicate similar ripening stages of brands. Colour parameters were very similar with the exception of b^* value, which can be related to the different amounts of this spice used in the formulations. Content of moisture, NaCl and fat, had significant influence on colour parameters.

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Physikalisch-chemische Eigenschaften und Farbe der einheimischen slawonischen Wurst

Zusammenfassung

In dieser Untersuchung wurden physikalisch-chemische Eigenschaften und instrumentale bestimmte Farbe von sieben verschiedenen Mustern der einheimischen slawonischen Wurst festgestellt. Chemische Grundzusammensetzung zeigte große Unterschiede im Massenanteil von Wasser, Proteinen, Fett und Kollagen, während a_w und pH Werte ausgeglichen waren. Auf Grund dieser Reultate kann festgestellt werden, dass die Hersteller verschiedene Rezepturen bei der Herstellung benutzen, aber auch, dass sich die Hersteller an die traditionellen technologischen Herstellungsbedingungen halten. Instrumentale Farbenparameter L^* und a^* der einheimischen slawonischen Wurst waren ähnlich, während der Parameter b^* zwischen den Mustern bedeutend variierte, was eine Folge von verschiedenem Paprikaanteil in den Mustern der einheimischen slawonischen Wurst sein kann. Die Parameterwerte L^* , a^* und b^* zeigten bedeutende Korrelationen mit dem Massenanteil von Wasser, Fett und Salz.

Schlüsselwörter: einheimische slawonische Wurst, traditionelle Herstellungstechnik, physikalisch-chemische Eigenschaften, Farbe

Le caratteristiche fisico-chimiche e il colore della salsiccia domestica di Slavonia

Sommario

In questa ricerca sono state determinate le caratteristiche fisico-chimiche, ed è stato determinato il colore di sette campioni della salsiccia domestica della regione di Slavonia. Il contenuto chimico di base ha dimostrato le differenze grandi nella percentuale in massa di acqua, proteine, grassi e collagene, mentre i valori a_w e pH della salsiccia domestica di Slavonia sono rimasti equilibrati. A base di questi risultati si può concludere che i produttori usano le varie ricette nella produzione, ma dall'altra parte i produttori rispettano le condizioni tecnologiche tradizionali delle condizioni di produzione. I parametri strumentali di colore L^* ed a^* della salsiccia erano simili, mentre il parametro b^* oscillava notevolmente tra i campioni, ma questo può essere la conseguenza della percentuale differente di peperone nei campioni trattati. I valori dei parametri L^* , a^* e b^* hanno dimostrato le correlazioni importanti con la percentuale in massa di acqua, grassi e sale.

Parole chiave: salsiccia domestica di Slavonia, tecnologia tradizionale di produzione, caratteristiche fisico-chimiche, colore

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Dalmatinska kaštradina [koštradina]

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Stručni rad

Sažetak

Dalmatinska kaštradina (koštradina) se tradicionalno proizvodi od mesa uškopljenih, utovljenih ovnova i jalovih ovaca ili koza dobi 1 do 5 godina. Nakon klanja, hlađenja i rasijecanja trupova na polovice, svaka se polovica rasjeća na tri dijela: but, lopaticu i preostali dio tzv. „koru“. Meso se potom soli morskom solju (sa ili bez začina) i slaže u posude. U ovim posudama meso stoji 6 do 13 dana, ovisno o kojoj se partiji mesa radi. Potom se meso ispere hladnom vodom, ocijedi i prenese u prostoriju za sušenje. Postupak sušenja traje 15 do 60 u kombinaciji s hladnim dimljenjem. U prosjeku prva faza sušenja traje 7 do 10 dana (dimljenje i prosušivanje), a slijedećih 30 do 50 dana odnosi se na sušenje i zrenje mesa, odnosno cijeli postupak traje 30 do 60 dana. To ovisi o partiji mesa i tipu proizvoda (polutrajni ili trajni). Kaštradina od uškopljenog ovna se najviše cijeni.

Gljučne riječi: dalmatinska kaštradina, tehnologija prerade, kvaliteta

Uvod

Dalmatinska kaštradina (koštradina, slika 1.) je suhomesnati proizvod od mesa ovaca i koza koji se dobiva postupcima soljenja, salamurenja, dimljenja, sušenja i zrenja. Radi se u osnovi o polutrajnom proizvodu, ali se produženim zrenjem određenih dijelova mesa proizvodi i kao trajni suhomesnati proizvod (npr. ovčji pršut).

Kaštradina ili koštradina je autohtoni hrvatski proizvod što dokazu-

ju povijesni podaci koji datiraju još iz srednjeg vijeka. Tradicionalno se proizvodi u širem području Dalmacije, Like, južnim dijelovima Bosne i Hercegovine. Slični se proizvodi pod različitim nazivima mogu naći u gotovi svim zemljama Mediterana. Naziv kaštradina dolazi od latinske riječi *castrare* = kastrirati, škopiti, a koristi se više u priobalnom dijelu Dalmacije, dok je naziv koštradina prisutan u Dalmatinskoj Zagori.

Dukala dužda Sebastiana Zianija iz 1173.g. iz rane faze mletačke države, kaštradinu i ovčetinu koja se usoljena ili sušena dovozila na tržnicu u lagunama te kuhana ili pečena posluživala na duždevoj trpezi, naziva *carnis de romania et slavinia* - mesom iz romanskih i slavenskih krajeva (područje današnje Dalmacije). Sušenu ovčetinu Venecijanci 1600 g. nazivaju *castradina Schiavona* (hrvatska kaštradina) ili *castradina della Salute*. Naime, Venecija nakon epidemije

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