Investigation of homogeneity and physicochemical characterisation of the Homemade Slavonian Sausage

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Znanstveni rad

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Summary

The aim of this study was to investigate the homogeneity of the traditional dry-fermented sausages manufactured in small scale facilities in Eastern Croatia. The homogeneity was estimated by analysis of the physicochemical parameters of 20 different brands of traditional Croatian homemade dry fermented sausage known as Homemade Slavonian Sausage. Sensory analysis and correlation analysis (multivariate method) was performed in order to check if the physicochemical differences found, were perceived by the sensory panel. All of that was made in order to perform an exhaustive physicochemical characterisation of the final product.

The physicochemical results showed that sausages were heterogeneous in composition, but only the heterogeneity in fat content was significantly perceived by the sensory panel. This may indicate that fat content is the most important parameter for sensory evaluation. Also, the highest negative correlation between fat content and slice surface appearance may indicate that visible fat on slice surface influence on panellist's perception of taste and odour of sausages.

Keywords: *Homemade Slavonian Sausage* homogeneity, *physicochemical properties, Sensory profiling*

INTRODUCTION

A Homemade Slavonian Sausage is the smoked, fermented and dried-ripened sausage produced in Slavonia (Eastern region of Croatia), using as ingredients raw pork of first and second quality, salt, garlic and red hot and sweat paprika powder. The mix is stuffed into natural casing (pig's thin intestine (lat. *intestinum tenue*)) and the resulting sausage is smoked, and than dry-ripened for three months.

The dry-ripening process can be divided into two main stages: fermentation and ripening. The fermentation is very important for pH decreasing from approximately 5.7 to its lowest value and it is achieved through the fermentation of the meat-inherent lactic acid bacteria (*Lactobacillus sakei, Lactobacillus curvatus and Lactobacillus plantarum*) (Schillinger and Lücke, 1987; Hammes et. al., 1990; Huges et.al., 1993). These micro-organisms, together with the lipolytic and proteolytic enzymes determine the characteristics of the final product.

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).

This kind of product is characterized by low acidity and the final pH is about 5.3 to 6.2 (Aymerich et. al., 2003). Greece, Italy and Spain are the countries where more effort has been made to study this traditional product (Comi et. al., 1992; Hugas et. al., 1993; Rodríguez et. al., 1994; Samelis et. al., 1994; Garriga et. al., 1996; Cappola et. al., 1998; Samelis et. al., 1998; Santos et. al., 1998; García-Varona et. al., 2000; Metaxopoulos et. al., 2001; Parente et. al., 2001).

A non-standardised production is the result of the sausages being manufactured in small facilities in a broad variety of different conditions and therefore homogeneity is hardly achievable with the products having marked variations between each other (Jordana, 2000).

Croatia has the same problem with its traditional sausages. Actually, there isn't any official Standard of Quality which defines the compositional characteristics which traditional sausages should possess and to which they as a product made by different manufacturers should be adopted.

The aim of this article was to investigate the homogeneity of the traditional dry sausages and to check if the physicochemical differences found, were perceived by the sensory panel, in order to perform an exhaustive chemical composition and physicochemical characterisation of the final product. These results will serve as a basis for the preparation of an Official Standard of Quality for *The Homemade Slavonian Sausage*. Beside that, these results should be helpful to get the legal protection of the product name (geographical indications and designations of origin according to the current legislative) as well as improving the market value of the traditional Homemade Slavonian Sausage.

MATERIAL AND METHODS

1. Sampling

In order to carry out this study, 20 samples of Homemade Slavonian Sausage, manufactured by representative homemade producers, were chosen. 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 transported to the laboratory in very short time, and stored in a refrigerator (below 4°C). Before starting the analysis, every sausage sample was triparted.

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Table 1 Basic composition, pH and a_w of Homemade Slavonian Sausage
Tablica1. Osnovni kemijski sastav, pH i a_w domaće slavonske kobasice

Parameter Parametar	Average Srednja vrijednost	Minimum	Maximum	SD	C.V. (%)
Moisture (%) Vlaga, (%)	21.70	15.97	54.65	8.19	37.74
Protein (%) Bjelančevine, (%)	22.92	7.54	34.75	8.33	36.34
Fat (%) Mast, (%)	42.30	24.23	60.34	7.89	18.65
Collagen (%) Kolagen (%)	1.42	0.77	2.16	0.41	28.87
Hydroxyproline (%) Hidroksiprolin (%)	0.18	0.09	0.27	0.05	27.78
a_w	0.85	0.73	0.91	0.04	4.72
pH	5.35	4.84	5.78	0.31	5.79

Table 2 Basic composition, pH, a_w and sensory characteristic of 5 Homemade Slavonian Sausage, evaluated with the highest overall quality scores
Tablica 2. Osnovni kemijski sastav, pH, a_w i senzorska svojstva 5 najbolje ocijenjenih domaćih slavonskih kobasica

Parameter Parametar	Average Srednja vrijednost	Minimum	Maximum	SD	C.V. (%)
Moisture (%) Vlaga (%)	28.39	17.59	54.65	14.92	52.55
Protein (%) Bjelančevine (%)	27.97	15.97	33.69	7.24	25.88
Fat (%) Mast (%)	33.29	24.23	38,86	6.01	18.05
Collagen (%) Kolagen (5)	1.42	0,95	2.16	0.45	31.69
Hydroxyproline (%) Hidroksiprolin (%)	0.18	0.12	0,27	0.45	250
a_w	0.87	0.84	0.91	0.02	2.83
pH	5.54	5.27	5.72	0.19	3.43
Appearance Izgled	9	8	10	0.71	7.89
Slice surface appearance / Izgled presjeka	27.6	25.50	29.25	1.44	5.22
Texture Tekstura	17.8	16	20	1.68	9.44
Odour Miris	13.72	12.75	15	0.90	6.56
Taste Okus	22	20.63	23.13	1.12	5.09
Overall quality Ukupna ocjena kvalitete	90.13	86.75	95.13	3.19	3.54

In order to prepare the samples for chemical analysis, after removing the outer casing of each sausage, the edible part had been ground until a homogenous mass was obtained.

2. 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.

Three independent measurements were made on each sample. Average and standard deviations were calculated.

3. Sensory analysis

The scoring test was carried out. A group of 4 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 Department of Food and Nutrition Research, Faculty of Food Technology in Osijek. Appearance, slice surface appearance, texture, odour and taste were also 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) + (slice surface appearance x 6) + (texture x 4) + (odour x 3) + (taste x 5). This expression was formulated taking into account the opinion of the experts (Benčević and Petričević, 1999), who gave the relative importance of the different sensory characteristics.

4. Data analysis

Differences among average values of the same physicochemical parameters between the best and the worst rated sausages 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, pH 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. 8.0 StatSoft Inc. Tulsa, OK. USA.

RESULTS AND DISCUSION

As the aim of this article was to perform an exhaustive chemical composition and physicochemical characterisation of the final product, Table1 shows the average, minimum and maximum, SD, and C.V. values of physicochemical parameters and composition of the Homemade Slavonian Sausage.

The average value of moisture content of the Homemade Slavonian Sausage was 21.70%, but moisture content varied significantly among brands (C.V. = 37.74%) and was lower than the values for similar products like Chorizo and Salchichon, which was reported by Gimeno et al. (2000), Salegado et al. (2005), Rubio et al. (2008).

Despite the average values, the maximum moisture content in homemade sausages (54.65%) indicates that some homemade sausages were placed on the market with moisture content higher than prescribed by legislation for industrial dry fermented sausages (max. 40%).

In relation to moisture content, the average a_w value of the Homemade Slavonian Sausage was 0.85, and the a_w value did not vary significantly

Table 3 Basic composition, pH, a_w and sensory characteristic of 5 Homemade Slavonian Sausage, evaluated with the lowest overall quality scores
Tablica 3. Osnovni kemijski sastav, pH, a_w i senzorska svojstva 5 najlošije ocijenjenih domaćih slavonskih kobasica

Parameter Parametar	Average Srednja vrijednost	Minimum	Maximum	SD	C.V. (%)
Moisture (%) Vlaga (%)	20.82	16.67	24.23	2.97	14.27
Protein (%) Bjelančevine (%)	19.01	9.54	25.62	6.32	33.25
Fat (%) Mast (%)	48.87	43.62	60.34	6.70	13.71
Collagen (%) Kolagen (5)	1.61	1.2	2.16	0.39	24.22
Hydroxyproline (%) Hidroksiprolin (%)	0.20	0.15	0.27	0.05	25.00
a_w	0.84	0.80	0.86	0.02	2,38
pH	5.11	4.84	5.4	0.26	5.09
Appearance/ Presjek	6.85	6.25	7.75	0.58	8.47
Slice surface appearance/Izgled presjeka	16.35	12	18.75	2.83	17.31
Texture Tekstura	12.5	8	16	3.04	24.32
Odour Miris	9.15	6.75	10.88	1.89	20.66
Taste Okus	12.75	8.75	15	2.52	19.76
Overall quality Ukupna ocjena kvalitete	57.60	42	62.25	8.74	15.17

Table 4 Multivariate correlations between parameters
Tablica 4. Multivarijantna regresija među parametrima

Parameter	Moisture Vlaga (%)	Fat Mast (%)	Protein Bjelančevine (%)	Collagen Kolagen (%)	pH
Appearance Izged	0.26	-0.62[a]	0.32	-0.12	0.29
Slice surface appearance Izgeld presjeka	0.23	-0.73[a]	0.37	-0.09	0.52[a]
Texture Tekstura	-0.04	-0.48[a]	0.27	-0.30	0.44
Odour Miris	0.35	-0.71[a]	0.55[a]	-0.42	0.15
Taste Okus	0.33	-0.76[a]	0.66[a]	-0.26	0.16
Overall quality Ukupna ocjena kvalitete	0.28	-0.82[a]	0.57[a]	-0.30	0.40

[a] Significant at p < 0.05

Table 5 Suggested values for basic composition, pH and a_w of Homemade Slavonian Sausage

Tablica 5. Predložene vrijednosti za osnovni kemijski sastav, pH a_w domaće slavonske kobasice

Parameter / Parametar	Optimum range / Optimalne vrijednsoti
Moisture/Vlaga (%)	21.70 – 40.00
Protein/Bjelančevine (%)	22.00 – 35.00
Fat/Masti (%)	24.00 – 45.00
Collagen/Kolagen (%)	0.8 – 2.16
a_w	< 0.9
pH	5.0 – 5.8

among brands (C.V. = 4.72%), and it was lower then a_w of Salchichon reported by Rubio et al. (2008), and Italian dry-fermented sausage reported by Comi et al. (2005). Knowing water activity values limiting the growth of the most common spoilage microorganisms, a water activity value of 0.8 seems to be a reasonable value to get a shelf-stable product (Toldra, 2007).

The average pH value of the homemade Slavonian Sausage was 5.35, and did not vary significantly among brands (C.V. = 5.79%).

The protein content of the Homemade Slavonian Sausages showed high variability (protein content was in range from 7.54 to 34.75%, with average value 22.92%) and it was similar to the protein content in Chorizo reported by Gimeno et al. (2000) and Salegado et al. (2005).

The fat content was in range from 24.23 to 60.34%, with average value 42.30% what is higher than in Chorizo de Pampllona and Italian dry-fermented sausages (Gimeno et al., 2000), (Comi et al., 2005), but lower than in Chorizo de Cebolla (Salegado et al., 2005).

The collagen content was ranged from 0.77 to 2.16 with average value 1.42%.

The average, minimum and maximum, SD, and C.V. values of physicochemical parameters and composition of the 5 Homemade Slavonian Sausages, evaluated with the highest overall quality scores (Table2), were compared with the average, minimum and maximum, SD, and C.V. values of physicochemical parameters and composition of the 5 Homemade Slavonian Sausage, evaluated with the lowest overall quality scores (Table3).

Between fat content and pH values of those two groups of samples a significant difference was found. These results may indicate that fat content and pH value are the most important parameters for sensory evaluation.

Besides that, between the fat content and the protein content a significant negative correlation was found which is similar to the Spanish and Italian dry-fermented sausages (Comi et al., 2005).

Also, significant negative correlation was found between the fat content and all sensory characteristics (Table4). The highest negative correlation between the fat content and slice surface appearance indicates that visible fat on slice surface influences on panellist's perception of taste and odour of sausages.

In general, although no significant differences were found in the protein and moisture content between the Homemade Slavonian Sausages with the highest and with the lowest overall quality scores, differences between average values for those two groups are visible (Table2 and Table3).

CONCLUSION

The physicochemical results showed that sausages were heterogeneous in composition, but only the heterogeneity in fat content was significantly perceived by the sensory panel.

Also results may indicate that fat content and pH value are the most
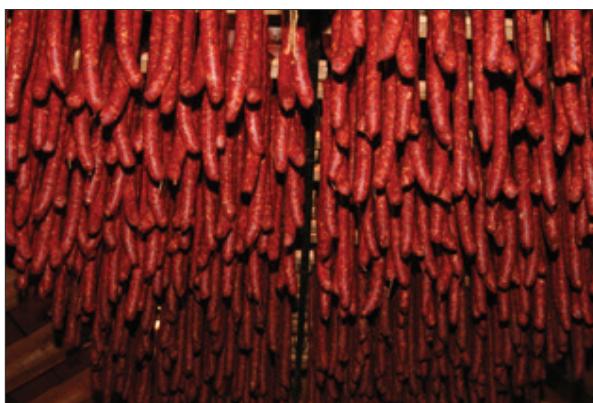
Ispitivanje homogenosti i fizikalno-kemijska karakterizacija domaće slavonske kobasice

Sažetak

Cilj ovog istraživanja bio je ispitati homogenost tradicionalnih fermentiranih kobasica proizvedenih na seoskim gospodarstvima istočne Hrvatske. Homogenost je ispitana analizom osnovnog kemijskog sastava i fizikalno-kemijskih svojstava, 20 različitih tradicionalnih kobasica, poznatih pod nazivom domaća slavonska kobasica. Kako bi se provjerilo primjećuju li članovi senzorskog panela pronađene razlike u sastavu i fizikalno-kemijskim svojstvima kobasica, provedena je i senzorska analiza ovih uzoraka te je ispitana korelacija između fizikalno kemijskih svojstava i senzorskih ocjena. Sve navedeno, provedeno je u svrhu detaljne fizikalno-kemijske karakterizacije domaće slavonske kobasice. Rezultati fizikalno-kemijskih analiza pokazuju heterogenost kobasica u sastavu i fizikalno- kemijskih svojstvima, no senzorski ocjenjivači signifikantno su uočili samo razlike utvrđene u sadržaju masti. Ta činjenica može upućivati da je sadržaj masti najvažniji parametar za senzorsku ocjenu domaće slavonske kobasice. Također, najviša negativna korelacija između sadržaja masti i izgleda presjeka kobasice, indicira da vidljiva mast na presjeku kobasice utječe na ocjenjivače prilikom ocjenjivanja okusa i mirisa.

Ključne riječi: Homogenost Domaće slavonske kobasice, fizikalno-kemijska svojstva, Senzorske analize

Prüfung der Homogenität und physikalisch-chemische Charakterisation der Einheimischen slawonischen Wurst

Zusammenfassung

Das Ziel dieser Untersuchung war, die Homogenität der traditionellen fermentierten Würste, hergestellt auf Bauernhöfen in Ostkroatien, zu prüfen. Die Homogenität ist durch die Analyse der chemischen Grundzusammensetzung und physikalisch-chemischen Eigenschaften von 20 verschiedenen traditionellen Würsten, bekannt unter dem Namen Einheimische slawonische Wurst, durchgeführt. Um zu prüfen, ob die Mitglieder des Sensorpanels die vorgefundenen Unterschiede in Zusammensetzung und physikalisch-chemischen Eigenschaften bemerken, wurde eine Sensoranalyse dieser Muster durchgeführt. Es wurde die Korrelation zwischen physikalisch-chemischen Eigenschaften und Sensorschätzungen geprüft. Alles angeführte wurde zwecks einer detaillierten Charakterisation der Einheimischen slawonischen Wurst durchgeführt.

Die Resultate der physikalisch-chemischen Analyse zeigen die Heterogenität der Würste in Bezug auf Zusammensetzung und physikalisch-chemische Eigenschaften, jedoch haben die Sensorschätzer signifikant nur Unterschiede hinsichtlich Fettgehalt bestimmt. Diese Tatsache kann darauf hinweisen, dass der Fettgehalt der wichtigste Parameter für eine Sensorschätzung der Einheimischen slawonischen Wurst ist. Außerdem, die höchste negative Korrelation zwischen Fettgehalt und Aussehen des Wurstdurchschnittes, in Bezug auf das sichtbare Fett auf dem Wurstdurchschnitt, indiziert die Beeinflussung der Schätzer bei Schätzung von Geshmack und Geruch.

Schlüsselwörter: Homogenität der Einheimischen slawonischen Wurst, physikalisch-chemische Eigenschaften, Sensoranalyse

important parameters for sensory evaluation.

The average pH value (5.35) and average a_w value (0.85) indicate that Homemade Slavonian Sausage is a shelf-stable product.

The fat content in range from 24.23 to 60.34%, with average value 42.30% what is higher than in most other dry-fermented sausages, as well as significant negative correlation found between the fat con-

tent and all sensory characteristics (Table4.) indicate that producers should decrease fat content in their products.

Significant positive correlation found between the protein content and odour, taste and overall sensory quality (Table4.) indicate that producers should increase protein content in their products.

These results can be helpful in physicochemical characterisation of

the Homemade Slavonian Sausage, so the following optimum values can be suggested:

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Oksidacija masti u ribi i ribljim proizvodima

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Stručni rad

Sažetak

Oksidacija masti u ribi i ribljim proizvodima povezana je s razvojem užeglosti i produkata oksidacijskog kvarenja. Zbog visokog sadržaja višestruko nezasićenih masnih kiselina ribe su osjetljive na oksidaciju masti tijekom manipulacije, obrade i pohrane. Produkti oksidacije mogu promijeniti kvalitetu hrane: boju, teksturu, okus i miris te imati nepovoljno djelovanje na zdravlje čovjeka. Najčešće korištena metoda za mjerenja stupnja oksidacije masti u ribi i ribljim proizvodima nastale tijekom prerade i/ili skladištenja je određivanje sekundarnih produkata lipidne oksidacije npr. malondialdehida, tiobarbiturnim testom, tj. spektrofotometrijsko određivanje ružičasto fluorescentnog tiobarbiturna kiselina-malondialdehid kompleksa. Zbog svoje jednostavnosti metoda je zadržana unatoč nedostacima.

Ključne riječi: *riba, oksidacija masti, tiobarbiturna kiselina, malondialdehid*

Uvod

Sastav ribe kao sirovine može se sagledavati s različitih stajališta, osobe koje rade u preradi ribe moraju poznavati sastav i svojstva mesa sirove ribe kako bi primijenili ispravan i pogodan tehnološki proces. Prerađivači su, za razliku od potrošača koje interesira jedino kvaliteta jestivog dijela (fileta) ribe, zaokupljeni kemijskim, nutritivnim i strukturnim sastavom ribe koji im omogućuje prilagodbu proizvodnih procesa pojedinim vrstama riba. U prehrani ljudi riba predstavlja bogati izvor bjelančevina s visokim sadržajem esencijalnih aminokiselina i masti (visoko nezasićenih masnih kiselina). Odlikuje se malom energetskom vrijednošću, te lakom probavljivošću u odnosu na meso sisavaca koje se koristi u prehrani (Cvrtila i sur. 2006.). Svojim kemijskim sastavom riblje se meso bitno ne razlikuje od mesa toplokrvnih životinja, ali se različito ponaša u tehnološkom procesu prerade ili pri čuvanju i skladištenju.

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