Effect of the drying method on textural, colour and sensory attributes of *Petrovská klobása* (traditional dry-fermented sausage)

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***Abstract* — In this study the textural, colour and sensory attributes of *Petrovská klobása* sausage, dried in different conditions, were evaluated at the end of drying period. *Petrovská klobása*, Serbian dry-fermented sausage with protected designation of origin at national level, was produced from pork meat and pork backfat, with addition of spices, salt and sugar, however, without addition of additives or starter culture. After processing in the same household mixture was manually staffed in natural casings and sausages were divided in two batches: sample I - drying process took place in industrial chamber, under controlled conditions for 45 days; sample H - drying process took place in the household, in naturally ventilated storeroom for 90 days.**

TPA test was performed for evaluation of texture attributes. The colour measurements (CIE *L, *a**, *b**) were carried out on the fresh cut sausage slices. Sensory attributes (colour, texture and juiciness) were evaluated by a panel of 10 trained panellist using scale from 0 to 5 (5 - optimal, 0 - atypical).**

Hardness of sausage H (5542.69 g) was significantly ($P < 0.001$) higher, and score for sensory evaluation of texture and juiciness (5.0) was significantly ($P < 0.001$) higher comparing to the ones of sausage I (2727.25 g; 4.5). Further, sausage H had significantly lower *L, *a** and *b** values ($P < 0.05$), and again significantly ($P < 0.001$) higher score for sensory evaluation of colour, comparing to sausage I. Analysis of the obtained results indicated that *Petrovská klobása* dried in the household had better sensory attributes.**

Keywords— **fermented sausage, texture, colour**

I. INTRODUCTION

Petrovská klobása is traditional dry fermented sausage from the north of Serbia (City of Bački Petrovac in the Autonomous Province of Vojvodina).

Petrovská klobása is usually manufactured traditionally, according to original recipe of the ancestors. It is produced from pork meat and pork backfat, with addition of spices, salt and sugar, however, without addition of additives (nitrate, nitrite, GDL, ascorbic acid etc.) or starter culture. As many other traditional dry fermented sausages it is produced by spontaneous meat fermentation at low temperatures. Specific spices added to *Petrovská* klobása are red hot paprika powder, garlic and caraway [1]. Due to all these characteristics, it displays unique organoleptic and sensory profiles that make it different from other dry-fermented sausages. That is why *Petrovská klobása* has been protected with designation of origin (PDO) at national level, under Serbian legislation [2].

Production of *Petrovská klobása* comprises mixture preparation, staffing into casings, and then smoking, drying and ripening. Regarding meat products, dry-meat products quality is strongly affected by its texture and mechanical properties, which are mainly determined by the technological parameters and the characteristics of the raw material [3]. On the other hand the main quality attributes of dry-fermented sausages are developed during drying and ripening period [4]. Therefore, these processes should be strictly controlled to prepare good quality product, having desirable texture, colour, pH value and sensory attributes [5]. Texture is an important factor in the process of selection and consumption of foods, it is one of the most important components of organoleptic quality in meat products [3, 6]. Colour is one of the most important quality attributes of fermented sausages, since it influences consumer acceptability [4]. In order to meet market demands and produce larger quantities of *Petrovská klobása* with standard quality it is necessary to develop production of this fermented sausage in controlled conditions.

The objective of this study was to determine the textural, colour and sensory attributes of *Petrovská klobása* dried in traditional manner (household) and in industrial chamber (controlled conditions) at the end

of drying process, and to compare the results of instrumental measurements with sensory evaluation.

II. MATERIAL AND METHODS

Dry fermented sausages *Petrovská klobása* were manufactured in traditional way in rural household. All sausages were produced from a mixture of lean minced pork (80%) and pig fat (20%). The other added ingredients were: red hot paprika powder, salt, raw garlic paste, caraway and sucrose. After grinding the meat and the fat to a size of about 10 mm, spices were added and raw materials were manually mixed. The mixture was immediately manually stuffed in natural casings (large intestines), in units from 35 to 45 cm long. The sausages were stored in a cold room (0–4 °C) for 24 h, and after a resting day, were divided in two groups: I – sausages were cold smoked; drying and ripening were under controlled (industrial chamber) conditions of temperature, relative humidity and air velocity; H – sausages were cold smoked in a traditional way and with specific kinds of wood during 10-15 days (with pauses); drying and ripening were under atmospheric conditions in naturally ventilated storerooms. The production of sausages started in the end of November, when temperatures were around 0°C or lower.

Moisture content, pH value, as well as texture and colour instrumental measurements, and sensory analysis (texture and juiciness and colour) were carried out on the 45th day for sausages I and on 90th day of processing for sausages H. The analyses were carried out in duplicate.

Moisture content was quantified according to the ISO recommended standard [7]. pH value was determined by portable pH meter ULTRA, type UX 390, with reinforced Ingold combined electrode for direct determination of pH in meat [8].

Texture profile analysis (TPA) was performed as described by Borne [9] with a universal testing machine Texture Analyser TA XP (Stable Micro System, Godalming, England). The samples (six cylinders) 2 cm high and 2.54 cm (1 inch) in diameter, taken from the centre of sausage, were equilibrated to room temperature and compressed twice to 50% of their original height at a constant speed of 1 mm/s. The following parameters from the force–time curves were determined: hardness, springiness, cohesiveness and chewiness.

Colour measurements were made using Minolta Chroma Meter CR-400 and colour characteristics were expressed by CIE $L^*a^*b^*$ system (lightness - L^*, redness and greenness - a^*; yellowness and blueness - b^*). The colour measurements were performed on the fresh cut of the sausage at room temperature in triplicate.

Sensory analysis was conducted by a group of 10 experienced evaluators of different ages. Sensory evaluation (colour and texture and juiciness) was carried out according point system of analytical descriptive test using scale from 0 to 5 (5-optimal; 0-visible microbial contamination, atypical product).

All data are presented as mean values. Analysis of variance (Duncan test) was used to test the hypothesis about differences among obtained results. The software package STATISTICA 8.0 [10] was used for analysis.

III. RESULTS AND DISCUSSION

The drying process was ended when the moisture content in sausages reached value lower than 35% [11]. The drying process in industrial chamber lasted 45 and in household (traditional manner) 90 days. The average moisture values found in *Petrovská klobasá* were 32.46 % and 27.29 % for sausages of I and H group, respectively.

Since both groups of sausages were produced from the same raw materials, in the same way, pH values of sausages just after staffing were the same (5.69) for both groups of samples. At the end of drying process pH values of sausages were 5.42 and 5.55 for the sausages of I and H group, respectively. These results are in agreement with results of Bover-Cid et al. [12], who reported that in meat products fermented at low temperatures fermentation is not great and thus the pH does not decrease more than 0.2 - 0.4 units. Final pH value of low-acid sausages, fermented at low temperature, may even reach the pH values of unripened meat due to the liberation of peptides, amino acids and ammonia as a result of proteolytic reactions [12].

Texture profiles of *Petrovská klobasá* (hardness, springiness, cohesiveness and chewiness), produced in

different conditions, at the end of drying process are presented in Table 1.

At the end of drying process hardness of sausage I (2727.25 g) was significantly ($P < 0.001$) lower than for sausage H (5542.69 g). Hardness of sausages is partly the result of protein coagulation at low pH, and also partly the result of decreasing moisture content [4]. Values of hardness, recorded for both groups of sausages, were lower comparing with sucuk [4] or chorizo de Pamplona [13], but similar to those of Italian low-acid [14] and slow fermented sausage analyzed by Olivares et al. [15]. Generally, the major changes in fermented sausage structure take place during fermentation when the pH declines and the myofibrillar proteins aggregate to form a gel [14]. The more rapid the pH declines the firmer the sausage is [16]. Since in analyzed sausages pH was not reduced below protein isoelectric point, lower values obtained for hardness were expected. Though the pH didn't differ significantly between the sausages of I and H group the significant difference in hardness could be attributed to the difference in drying process that is to final moisture values. After fermentation, drying is a major factor affecting binding and rheological properties of fermented sausages [6, 14]. Bozkurt and Bayram [4] found from Pearson correlation test that hardness was negatively correlated to moisture content with correlation coefficient of - 0.93.

Table 1 Characteristics of *Petrovská klobasá* at the end of drying process

Characteristic	Sample	
	I	H
Hardness (g)	2727.25^{B}	5542.69^{A}
Springiness	0.35^{b}	0.39^{a}
Cohesiveness	0.50^{b}	0.53^{a}
Chewiness	483.21^{B}	1138.69^{A}
*L**	32.75^{a}	29.61^{b}
*a**	22.22^{A}	18.68^{B}
*b**	18.25^{a}	13.68^{b}
pH value	5.42	5.55
Moisture content (%)	32.46^{a}	27.29^{b}
Sensory evaluation of texture	4.5^{B}	5.0^{A}
Sensory evaluation of colour	4.5^{B}	5.0^{A}

Different letters in the rows $^{a, b}$ *P < 0.05*; $^{A, B}$ *P < 0.001*

Chewiness values of analyzed samples differ significantly ($P < 0.001$) between groups, being higher for sausages of H group. Bozkurt and Bayram [4] also, found significant relation between moisture content and chewiness.

The results of sensory evaluation of texture and juiciness indicated that the sausages of group H (5.0) were, averagely, marked significantly ($P < 0.001$) higher comparing to sausages of group I (4.5).

Results of colour measurements, CIE *L*, a*, b** system values, of *Petrovská klobasá* processed in different conditions, at the end of drying process are shown in Table 1.

Sausage H had significantly lower *L** and *b** values ($P < 0.05$) and highly significantly lower ($P < 0.001$) *a** value comparing to sausage I. The difference in *L** values could also be correlated with the difference in moisture values. With the moisture loss the concentration of myoglobin in product increased, and on the other hand dehydrated muscle tissue absorbed a greater amount of light what resulted in a darker colour of the products, i.e. lower *L** value [1, 17, 18].

During production of dry fermented sausages *a** value increases as the result of formation of nitrosomyoglobin and moisture loss, and then again decreases by partial or total denaturation of nitrosomyoglobin because of the production of lactic acid [4]. It should be noted that the great influence on the *a** value in analyzed sausages had red hot paprika powder. Also, *b** values of analyzed sausages could probably be related to the presence of yellow carotenoids coming from paprika powder [13]. Further, sausage H had significantly ($P < 0.001$) higher score for sensory evaluation of colour, comparing to sausage I.

IV. CONCLUSIONS

The results obtained in this investigation showed that, as expected, drying process under controlled conditions of temperature, relative humidity and air velocity, lasted significantly less than in traditional manner, under atmospheric conditions.

The results of TPA test for sausages I and H, showed that processing method had significant effect on textural attributes of sausages. Sausages dried in household (H) shown higher ($P < 0.001$) values of

hardness, chewiness at the end of drying process. Further, sausage H had significantly lower *L**, *a** and *b** values than sausage I. Comparing the results obtained by instrumental measurements of texture and colour with results of sensory analyses it can be concluded that higher values for hardness and chewiness, as well as lower *L**, *a** and *b** values obtained for sausages of H group are more desirable attributes of final product.

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REFERENCES

1. Ikonic P, Petrovic Lj, Tasic T et al. (2010) Physicochemical, biochemical and sensory properties for the characterization of Petrovská klobása (traditional fermented sausage). Acta Period Technol 41:19–31
2. Petrovic Lj, Dzinic N, Tomovic V et al. (2007) Code of practice-Registered geographical indication Petrovská klobása. Intellectual Property Office, Republic of Serbia, Decision No. 9652/06 Г-03/06
3. Guerrero L, Gou P, Arnau J (1999) The influence of meat pH on mechanical and sensory textural properties of dry-cured ham. Meat Sci 52:267–273
4. Bozkurt H, Bayram M (2006) Colour and textural attributes of sucuk during ripening. Meat Sci 73:344–350
5. Bozkurt H, Erkmen O (2002) Effect of starter cultures and additives on the quality of Turkish style sausage (sucuk). Meat Sci 61:149–156
6. Gonzalez-Fernandez C, Santos E M, Rovira J et al. (2006) The effect of sugar concentration and starter culture on instrumental and sensory textural properties of chorizo-Spanish dry-cured sausage. Meat Sci 74:467–475
7. ISO 1442:1997 (1997) Determination of moisture content. ISO, Geneva
8. ISO 2917 (1999) Measurement of pH. Referent method
9. Bourne M C (1978) Texture profile analysis. Food Technol 32:62–66
10. StatSoft, Inc.: STATISTICA version 8.0, 2008. at http://www.statsoft.com/
11. Serbian Regulations (2004) Quality requirements for meat products. 33:1–15
12. Bover-Cid S, Izquierdo-Pulido M, Vidal-Carou M C (2001) Changes in biogenic amine and polyamine contents in slightly fermented sausages manufactured with and without sugar. Meat Sci 57:215–221
13. Gimeno O, Ansorena D, Astiasaran I et al. (2000) Characterization of chorizo de Pamplona: instrumental measurements of colour and texture. Food Chem 69:195–200
14. Spaziani M, Del Torre M, Stecchini M L (2009) Changes of physicochemical, microbiological, and textural properties during ripening of Italian low-acid sausages. Proteolysis, sensory and volatile profiles. Meat Sci 81:77–85
15. Olivares A, Navarro J L, Salvador A et al. (2010) Sensory acceptability of slow fermented sausages based on fat content and ripening time. Meat Sci 86:251–257.
16. Arnau J, Serra X, Comaposada J et al. (2007) Technologies to shorten the drying period of dry-cured meat products. Meat Sci 77:81–89
17. Pérez-Alvarez J A, Sayas-Barbéra M E, Fernández-López, J et al. (1999) Physicochemical characteristic of Spanich-type dry-cured sausages. Food Res Int 32:599–607
18. Rede R, Petrovic Lj (1997) Meat technology and science. Faculty of Technology, University of Novi Sad, Novi Sad (in Serbian)