Influence of keeping system on the quality of Slavonian Kulen

Senčić[1], Đ., D. Samac[1], M. Škrivanko[2]

scientific paper

Summary

*Slavonian Kulen is a type of a sausage with long shelf life, produced from the combination of the highest quality pork (back, leg) and spices (ground paprika and minced garlic) stuffed in the appendix (cecum). This product is protected in Croatia under Protected Geographical Indication (PGI). Meat for sausages was obtained from Black Slavonian Pigs fattened to 130 kg body weight , kept either in outdoor or semi-outdoor system. Meat from each group of pigs was used and 16 pieces of kulen were produced and analyzed per group. The choice of the keeping system (outdoor and semi-outdoor) had a significant impact on some quality indicators of Slavonian Kulen. Compared to kulen made from pigs kept in the semi-outdoor system, kulen produced from pigs kept in the outdoor system has a significantly ($p<0.01$) lower pH value (5.81 : 5.97), a more intense degree of redness (CIE a * 18.74 : 17, 36) , and yellowness (CIE b * 12.85 : 10.11) for color , and significantly ($p <0.05$) lower moisture content (29.84% : 32.10%), a highly significantly ($p<0,01$) higher content of crude protein (45.41% : 43.59%). Slavonian Kulen produced from pigs kept in the ootdoor system has a very significantly ($p<0.01$) better odour and significantly ($p<0.05$) better taste .*

Keywords: *the Slavonian Kulen, Black Slavonian Pig, outdoor system , semi-outdoor system*

Introduction

Slavonian kulen is a dry, fermented sausage of low acidity and low water activity (a_w) which is produced from the top-quality ground pork meat (back, leg), seasoned with table salt, ground sweet paprika powder, red hot paprika and ground garlic (Allium sativum L.), and then stuffed in the pig cecum. The first reference of this durable product by the name of kulen appeared in 1768 in the poem by Vid Došen (1719 – 1778) who was a priest, poet and publicist from Dubovik near Slavonski Brod and it was mentioned by the name of kulin in 1823 in Zapovist Babogredske Kompanije (Anon, 1823).

According to the proposal of the Croatian Chamber of Economy, Slavonian kulen (kulin) was protected for the first time in 1997 in the State Intellectual Property Office of the Republic of Croatia with Protected Geographical Indication scheme. The procedure of the protection of this product by the Protected Geographical Indication (PGI) at the national level was finished this year. This time it was in the Ministry of Agriculture, according to the Act on Geographical Indications and Designations of Origin of Products and Services by designations of geographical origin and designations of traditional reputation of agricultural products and foodstuffs (Official Gazette No. 50/12), then according to the Regulation on designations of origin and geographical indications for agricultural products and foodstuffs (Official Gazette No. 102/12) which are also in accordance with the regulations of the European Parliament and EU Council No. 1151/2012. The request for the protection of Slavonian kulen/kulin with the designation of geographical origin was submitted to the Ministry of Agriculture by the association "Slavonian homemade kulen/kulin" from Bošnjaci.

There is a growing attention in the world towards the research of quality of traditional dry sausages like Greek ones (Ambrosiadis et al., 2004), Spanish (Perez-Alvarez et al., 1999), Italian (Dellagio et al., 1996) and others. We have very little professional data on quality of kulen as a dry sausage. Karolyi et al. (2005) researched physical-chemical characteristics of Slavonian kulen, Karoly and Kovačić (2008) indicated to its organoleptic traits and Kovačević et al. (2010) researched physical-chemical characteristics, color and texture of Slavonian kulen. The knowledge of the influence of genotype, keeping system, feeding manner and other paragenetic factors to quality of Slavonian kulen is insufficient.

Considering the fact that keeping systems can influence significantly the quality of pork meat (Gentry et al., 2004; Bee et al., 2004; Lebret et al., 2006; Senčić et al., 2011), there is an assumption that they can also influence the quality of pork products. The goal of this paper is to indicate to physical-chemical and sensory characteristics of Slavonian kulen produced from Black Slavonian Pigs kept either in outdoor or semi-outdoor system.

Material and methods

The research was conducted on two groups both containing 16 kulen pieces made from Black Slavonian Pigs, from outdoor or semi-outdoor systems. The pigs from the outdoor system were fattened at pastures, stubble fields and

[1] **Đuro Senčić, PhD**, Full professor; **Danijela Samac, PhD**, senior assistant; Faculty of Agriculture in Osijek, Kralja Petra Svačića 1d, Osijek

[2] **Mario Škrivanko, PhD**, scientific associate – Veterinary Department Vinkovci, I. i J. Kozarca 24, Vinkovci

Table 1 **Physico-chemical properties of the Slavonian Kulen from pigs in an outdoor and semi-outdoor systems**

Traits	Keeping systems		Significance of differences
	Outdoor (n=16)	Semi-outdoor(n=16)	
	$\bar{\chi} \pm s$	$\bar{\chi} \pm s$	
pH	5,81 ± 0,10	5,97 ± 0,15	**
Colour CIE L* CIE a* CIE b*	36,20 ± 1,80 18,74 ± 1,00 12,85 ± 1,15	36,72 ± 1,86 17,36 ± 1,06 10,11 ± 1,23	NS ** **
Water activity (a_w)	0,83 ± 0,50	0,79 ± 0,03	*
NaCl (%)	4,97 ± 0,40	5,22 ± 0,43	NS
Water (%)	29,84 ± 3,10	32,10 ± 3,20	*
Crude proteins (%)	45,41 ± 1,65	43,59 ± 1,73	**
Crude fat (%)	18,48 ± 0,90	18,24 ± 0,97	NS
Ash (%)	6,01 ± 0,59	6,07 ± 0,62	NS

*p<0,05 **p<0,01 NS = p>0,05

Table 2 **Sensory properties of Slavonian Kulen from pigs in outdoor and semi-outdoor systems**

Traits	Keeping systems		Significance of differences
	Outdoor (n=16)	Semi-outdoor (n=16)	
	$\bar{\chi} \pm s$	$\bar{\chi} \pm s$	
Appearance (1 – 5)	4,50 ± 0,35	4,53 ± 0,38	NS
Structure (1 – 3)	2,70 ± 0,20	2,76 ± 0,26	NS
Cross-selection appearance (1 – 10)	8,50 ± 0,30	8,42 ± 0,31	NS
Odour (1 – 5)	4,95 ± 0,20	4,75 ± 0,23	**
Taste (1 – 10)	9,70 ± 0,20	9,52 ± 0,21	*
General impression (1-5)	4,70 ± 1,00	4,42 ± 1,20	NS

*p<0,05 **p<0,01 NS = p>0,05

cornfields and they received a minimal supplemental feeding with corn during wintertime and early spring. They were kept in improvised wooden pigsties in the open space. The pigs from the semi-outdoor system were fed on fresh alfalfa and feed with 14.00% crude protein and 13.37 MJ ME/kg in the first period of fattening (30-60 kg of body weight) and with 11.84% crude protein and 13.34 MJ ME/kg in the second period of fattening (60-130 kg of body weight). Pigs of both analyzed groups were fattened up to around 130 kg of body weight.

The technology of kulen production was according to the Regulation on the production of domestic Slavonian kulen/kulin of the "Association of producers of Slavonian kulen (kulin)" from Bošnjaci (2004). For the production of kulen there was used muscle tissue of ham and loin (80%) and shoulder (16.20%), without deposits of connective and adipose tissue. Muscle tissue was minced by a meat grinder with the diameter of grinder plates of 8 and 6 mm. After that there was mixed in the mixture for kulen with 2% table salt, 1% ground sweet paprika, 0.4% ground hot paprika and 0.4% ground garlic. The mixture for kulen was stuffed into the pork caecum with the help of sausage stuffing device. Drying (smoking) of kulen lasted during the period of 15 days, on the smoke of the ash tree (*Fraxinus sp.*). After that period, there followed drying and maturing of kulen during the period of 9 months in a special room with conditioned microclimate. The pieces of kulen originated from two producers, one out of which produces kulen from the meat of pigs from outdoor keeping system and the other from the semi-outdoor keeping system.

pH value of kulen was determined by the contact pH-meter "Mettler Toledo", by a sting in the middle of the cross-section.

The color of kulen was measured in the standard CIE L* a* b* color system by the instrument Minolta Chroma Meter CR-410 (Minolta Camera Co. Ltd. Japan).

Water activity (a_w) in kulen was determined by the device "Higrolab 3" (Rotronic) by using a_w Quick working model on chopped and homogenized samples of 100 g of the middle part of kulen.

The NaCl content in kulen was determined by titration method and the content of crude protein by the Kjeldahl method. The content of raw fat in kulen was determined according to the Soxhlet method. Water content in kulen was defined as the loss of sample mass by drying at 105°C until the constant mass is reached. Ash content was determined by combustion of organic matter at 550°C until the constant mass is reached and it is shown as percentage remain of sample mass.

Five evaluators performed the evaluation of sensory traits. Each kulen was cut in half and then each evaluator was served a slice of kulen, 0.5 cm thick. The evaluators were served apples, bread, cheese and water for neutralization of aromas between individual samples. The evaluation of kulen properties was performed as follows: appearance (1-5 points), structure (1-3 points), cross-

section appearance (1-10 points), odor (1-5 points), taste (1-10 points) and general impression (1-5 points). 16 pieces of kulen from each test group were evaluated for sensory and physical-chemical properties. Statistical data analysis was performed by Stat. Soft. Inc. (2010). The significance of differences between and within the groups was determined by analysis of variance (ANOVA).

Results and discussion

Physical and chemical properties of Slavonian kulen made from the meat of Black Slavonian Pigs in comparison to the production system of keeping (outdoor and semi-outdoor) are shown in Table 1. Kulen made from the meat of pigs from the outdoor system had a significantly ($p<0.01$) lower pH value in comparison to kulen made from the meat of pigs from the semi-outdoor system. pH values of kulen from both analyzed groups were higher than pH values of kulen (5.42 – 5.49) listed by Karolyi et al. (2005), the values (5.35) determined by Kovačević et al. (2010) and the values (5.07 – 5.75) listed by Karolyi et al. (2011). The differences in pH values of Slavonian kulen between the authors can mostly be attributed to the influence of a longer maturing of kulen but also to technology of production, genotype and other factors. Lower pH value of kulen made from the meat of the pigs from the outdoor system could also be the consequence of lower pH value of the meat of pigs from the outdoor system, which was indicated to by Butko et al. (2007), then Senčić et al. (2008). In terms of color of kulen, there weren't determined significant differences ($p>0.05$) between the analyzed groups regarding the degree of lightness (L*), but significant differences ($p<0.01$) were determined between the groups in terms of redness (a*) and yellowness (b*) of kulen. Kulen from the meat of pigs from the outdoor system had a more intensive red color. A more intensive red color of kulen from the meat of pigs from the outdoor system is the consequence of more intensive red color of muscle tissue of Black Slavonian Pigs from the outdoor system (Senčić et al., 2011), which is connected to higher motor activity of pigs in an outdoor system which leads to larger content of myoglobin. Kulen of the meat of pigs from the outdoor system had a significantly ($p<0.01$) higher degree of yellowness (b*).

Salt content (NaCl) in kulen was equal in both analyzed groups so there weren't determined significant differences ($p>0.05$) which would be attributed to influence of the production system of keeping pigs. Water activity (a_w) was slightly but significantly ($p<0.05$) higher in kulen from pigs from the outdoor system, which can also be the consequence of a somewhat larger share of intramuscular fat with older pigs, but with the same body weight as in the semi-outdoor system and, due to that, slower drying of kulen.

Kulen from the meat of pigs kept at the open had a significantly ($p<0.05$) lower content of water, i.e. a larger content of dry matter than kulen from the meat of pigs from semi-outdoor keeping system. It is known that pigs in the outdoor system grow slower and are older than pigs kept in a semi-outdoor or closed system, at the same body weight. The meat of the older pigs has less water and a larger content of dry matter, especially intramuscular fat (Čandek - Potokar et al., 1998).

Crude protein content in kulen from the meat of pigs from the outdoor system was significantly ($p<0.01$) larger than in kulen from the meat of pigs from the semi-outdoor system. Kovačević et al. (2010) and Karolyi et al. (2011) determined a lower content of crude protein (22.92%, i.e. 30.3 – 39.6%) in comparison to the content of crude protein in this research and that is the consequence of different composition of meat, degree of maturing of kulen and other factors.

In terms of content of fat and ash, there weren't determined significant differences ($p>0.05$) between kulen pieces made from the meat of pigs from the outdoor and semi-outdoor systems. Fat content in kulen in this research is lower than the fat content (24.23%) which was determined in kulen by Kovačević et al. (2010) or the contents (16.4% - 31.00%) listed by Karolyi et al. (2011). This can be explained as the consequence of a higher content of fat in the meat or as a result of adding fatty tissue (back bacon) into the mixture for making kulen in researches by the listed authors.

Sensory properties of kulen are shown in Table 2. In terms of appearance, cross-section appearance and general impression there weren't determined significant differences ($p>0.05$) between kulen pieces from the meat of pigs from outdoor and semi-outdoor keeping systems. Both analyzed groups of kulen got high grades for the listed properties. Kulen from the meat of pigs from the outdoor system had a significantly ($p<0.01$) better odor and significantly ($p>0.05$) better taste than kulen made from the meat of pigs from the semi-outdoor system.

Conclusion

Keeping systems of Black Slavonian Pigs (outdoor and semi-outdoor) had a significant influence to some quality indicators of Slavonian kulen. Kulen from the meat of pigs from the outdoor system, in comparison to kulen made from the meat of pigs from the semi-outdoor system, had a significantly ($p<0.01$) lower pH value, more intensive degree of redness (CIE a*) and yellowness (CIE b*) for color, then a significantly ($p<0.05$) lower water content and a significantly ($p<0.01$) higher content of crude protein. Slavonian kulen from the meat of pigs from the outdoor system had a significantly ($p<0.01$) better odor and a significantly ($p<0.05$) better taste.

References

Ambrosiadis, J., N. Soultos, A. Abrahim, J.G.

Einfluss von Haltungssystemen der Schweine auf die Qualität von Slavonski Kulen

Zusammenfassung

Slavonski kulen ist eine Dauerwurst aus Schweinefleisch von bester Qualität (Rücken, Schenkel) und Gewürzen (feingemahlene rote Paprika und gemahlener Knoblauch) gefüllt in Schweinedarm (caecum). Das Erzeugnis ist in Kroatien durch Angabe und Bezeichnung der geographischen Herkunft geschützt. Das Fleisch für Kulen stammt von schwarzen slawonischen Schweinen, gemastet bis 130 kg Körpermasse, im offenen und halboffenen Haltunssystem. Aus Fleisch von jeder Schweinegruppe wurden 16 Stück Kulen hergestellt und analysiert. Die Haltungssysteme (offenes und halboffenes System) hatten einen bedeutenden Einfluss auf einige Qualitätsindikatoren von Slavonski Kulen. Kulen von Schweinen aus dem offenen System in Bezug auf Kulen aus dem halboffenen System hatte einen bedeutend ($p<0,01$) niedrigeren pH Wert (5,81 : 5,97), intensiveren Grad der Röte (CIE a 18,74:17,36) und der Gelbe (CIE b* 12,85 : 10,11) für die Farbe, einen bedeutend ($p<0,05$) niedrigeren Wassergehalt (29,84 % : 32,10 %) und einen bedeutend ($p<0,01$) größeren Gehalt von rohen Eiweißstoffen (45,41 % : 43,59 %).*

Slavonski Kulen aus Fleisch der Schweine aus offenem System hatte einen bedeutend ($p<0,01$) besseren Geruch und einen bedeutend ($p<0,05$) besseren Geschmack.

Schlüsselwörter: *Slavonski Kulen, schwarze slawonische Schweine, offenes System, halboffenes System*

Influenza del sistema di allevamento dei suini sulla qualità del "kulen" di Slavonia

Sommario

Il kulen di Slavonia è una salsiccia stagionata prodotta riempiendo con le carni più pregiate del suino (schiena e coscia) e alcune spezie (paprika rossa in polvere e aglio tritato) un budello naturale di suino (intestino cieco). In Croazia il kulen di Slavonia è un prodotto tutelato col Marchio di provenienza geografica. La carne impiegata per il kulen è quella dei maiali neri della Slavonia, ingrassati sino a 130 kg di massa corporea e allevati in sistemi aperti o semiaperti. Con la carne di ogni gruppo di suini sono stati prodotti e analizzati 16 kulen. I sistemi d'allevamento dei maiali (aperto o semiaperto) hanno inciso significativamente su alcuni indicatori della qualità del kulen di Slavonia. Il kulen prodotto con le carni dei suini allevati in un sistema aperto, rispetto al quello prodotto con le carni dei maiali allevati in un sistema semiaperto, presentava un ($p<0,01$) pH molto più basso (5,81 : 5,97), dal punto di vista del colore un grado di rossore (CIE a 18,74 : 17,36) e di giallore (CIE b* 12,85 : 10,11) più intenso, una minore percentuale di acqua (29,84% : 32,10%) e una maggiore presenza di proteine gregge (45,41% : 43,59%). Il kulen di Slavonia prodotto con le carni dei maiali allevati in un sistema aperto aveva un profumo ($p<0,01$) e un sapore ($p<0,05$) sensibilmente migliori rispetto a quelli del kulen prodotto con le carni di suini allevati in un sistema semiaperto.*

Parole chiave: *kulen di Slavonia, maiali neri della Slavonia, sistema aperto, sistema semiaperto*

Bloukas (2004): Physicochemical, microbiological and sensory attributes for the characterization of Greek traditional sausages. Meat Science 66, 279-287.

Bee, G., Gnex, G., Herzog, W. (2004): Free range rearing of pigs during the winter: Adaptations in muscle fiber characteristics and effects on adipose tissue composition and meat quality traits. J. Anim. Sci. 82, 1206-1218.

Butko D., Đ. Senčić, Z. Antunović (2007): Porc carcass composition and the meat quality of the Black Slavonian Pig – the endangered breeds in the indoor and outdoor keeping system. Agriculture 13, 1, 167-173.

Čandek-Potokar, M., B. Zlender, M. Bonneau (1998): Effects of breed and slaughter weight on longissimus muscle biochemical traits and sensory quality in pigs. Meat Science, 48, 287-300.

Dellagio, S., E. Casiraghi, C. Pompei (1996): Chemical, physical and sensory attributes for the characterization of an Italian dry-cured sausage. Meat Science 42, 25-35.

Došen, V. (1768.): Aždaja sedmoglava. Nova Ves. (preuzeto od: Djela Vida Došena, Aždaja sedmoglava, Stari pisci hrvatski, knj. XXXIV, ur. Tomo Matić i Antun Djamić, JAZU, Zagreb, 1969., str. 146).

Gentry, J.G., McGlone, J. J., Miller, M.F., Blanton, Jr.J.R. (2004.): Environmental effects on pig performance, meat quality and muscle characteristics. J. Anim. Sci., 82: 209-217.

Lebret, B., Meunier-Salaün, M. C., Foury, A., Mormède, P., Dransfield, E., Dourmad, J. Y. (2006.): Influence of rearing conditions on performance, behavioral, and physiological responser of pigs to preslaughter handling, carcass traits, and meat quality. Journal of Animal Science 84, 2436-2447.

Karolyi, D., D. Kovačić (2008): Organoleptička ocjena slavonskog domaćeg kulena od crne slavonske i bijelih svinja. Meso 5, 356-360.

Karolyi, D., K. Salajpal, M. Đikić, A. Kostelić, I. Jurić (2005): Fizikalno-kemijske osobine slavonskog kulena. Meso 7, 35-37.

Karolyi, D., (2011): Fizikalno-kemijska, higijenska i organoleptička karakterizacija slavonskog kulena. Meso 6, 423-429.

Kovačević, D., K. Suman, D. Šubarić, K. Mastanjević, S. Vidaček (2010): Investigation of homogeneity and physicochemical characterization of the Homemade Slavonian Sausage. Meso 6, 338-344.

Péréz-Alvarez, J., M. A. Sayas-Barberà, J. Fernàndez-López, V. Aranda-Catalià (1999): Physicochemical characteristics of Spanish-type dry-cured sausage. Food Research International 32, 599-607.

Senčić, Đ., D. Butko, Z. Antunović (2008): Evaluacija crne slavonske svinje u odnosu na sustav držanja i križanje. Stočarstvo 62, 1, 69-73.

Senčić, Đ., D. Samac, Z. Antunović (2011): Utjecaj proizvodnog sustava na fizikalno-kemijska i senzorska svojstva mesa crnih slavonskih svinja. Meso 1, 32 – 35.

Anonimno (2004): Pravilnik o proizvodnji slavonskoga domaćeg kulena / kulina. Udruga „Slavonski domaći kulen-kulin". Vinkovci.

Anonimno (2012): Zakon o oznakama izvornosti, oznakama zemljopisnog podrijetla i oznakama tradicionalnog ugleda poljoprivrednih i prehrambenih proizvoda (NN br. 50/12)

Anonimno (2012): Pravilnik o oznakama izvornosti i oznakama zemljopisnog podrijetla poljoprivrednih i prehrambenih proizvoda (NN br. 102/12)

Anonimno (2012): Uredba Europskog parlamenta i Vijeća (EU-a) br. 1151/2012.

Anonimno (1823.): Zapovist Babogredske Kompanije. Muzej Stjepana Grubera, Županja.

Anonimno (2010): **STATISTICA Stat Soft. Inc.,** 2010. Version 10, www.statsoft.com

Received: 2nd November 2013
Accepted: 28th November 2013