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PROXIMATE COMPOSITION AND SENSORY CHARACTERISTICS OF SREMSKA SAUSAGE PRODUCED IN A TRADITIONAL SMOKING HOUSE

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ABSTRACT: The goal of this paper was to determine the proximate composition and sensory characteristics during storage of Sremska sausage produced in a traditional way in the smoking house, from the meat of commercial 7-month-old Swedish Landrace pigs. Sausages were produced in December; the muscle-fat ratio was 75:25, with the addition of 2.2% nitrite curing salt and spices. After filling in pig small intestine, the sausages were hung to dry with the temperature ranging between 10–15°C and relative humidity between 75–90%. They were then occasionally smoked during the first 14 days. Sampling and chemical analyses were carried out on 0, 3rd, 7th, 14th and 21st day of production. Sensory evaluation was performed at the end of the production process (first day) and during storage, on 60th and 120th day. The sausage was characterized by a long ripening period, which is considered typical for the traditional production method. The minimum pH (4.97) was reached on 14th day, then it increased slightly to 5.18 (21st day). The values of acidity and peroxide number of the fat increased at the end of the production process. During the ripening, water content significantly decreased (from 58.13% at beginning to 30.21% at the end), that resulted in large weight loss of 41%, while the proportion of fat, protein and ash significantly increased. At the end, final product had distinctive spicy flavor, dark red color and firm consistency. During storage, overall sensory quality has slightly reduced, but sensory scores were still high for this type of product.

Key words: *Sremska sausage, traditional smoking house, proximate composition, sensory characteristics*

INTRODUCTION

Majority of fermented sausages are produced in Italy, Germany and Spain (Di Cagno et al., 2008), but almost every European country has at least several country specific products belonging to this group (Casaburi et al., 2007). Sremska sausage is typical representative of fermented sausages of small diameter in Serbia, and it is traditionally produced in households or small manufacturing facilities in the region of Vojvodina (North Serbia). In households, traditionally, during winter time, Sremska sausage is produced from pig meat, with the addition of salt and spices. Stuffing obtained in this way is often filled using manual stuffer into pig intestines which are then formed into pairs 20-25 cm long. Sausages are hung on wooden sticks, drained, and transferred to smoking room where they are smoked using so called cold procedure for 6 to 7 days, often even longer. After smoking process, comes drying which usually lasts about 2 weeks (Tojagić, 1996). In said conditions, maturation is finished by the end of the third week, when Sremska sausage acquired all typical sensory and physical-chemical properties. Said composition and production conditions (animals fed in households with various food, smoking of sausages in conventional smoke rooms, air drying) are some of the factors of the specificity of the sausages produced in this manner, and give them advantage in regard to sensory traits, compared to sausages produced in industrial conditions where climate chambers are used (Karan et al., 2009).

Currently, there is a much higher market share for the sausages produced with starter cultures and in controlled climatic conditions than the naturally fermented sausages. However, there is a strong demand for the naturally fermented sausages by consumers. In

this regard, objective of this paper was to determine changes in chemical composition during production and of sensory properties during storage of Sremska sausage produced in traditional smoking house.

MATERIAL AND METHODS

The sausages were produced during December in small processing plant of the Institute for Animal Husbandry (Belgrade, Serbia). In production of sausage meat originating from pigs of Swedish Landrace of average age of 7 months, was used. Main raw materials used for production of Sremska sausage were meat of leg and shoulder and back fat in ratio 75:25. Meat and fat tissue were previously frozen at the temperature -18°C , and then chopped using the cutter machine (Seydelman K60) until granulation of around 8 mm was achieved. Following additives were used: 2.2% nitrite salt, 0.3% sugar (glucose), 0.8% hot ground peppers, 0.5% sweet ground peppers, 0.15% onion (powder) and 0.15% black pepper (ground). Stuffing was filled into pig small intestine, diameter 32 mm. After filling, sausages were hung in the traditional smoke room, without any possibility of temperature and humidity control, where temperature ranged from 10 to 15°C and humidity from 75 to 90%. Sausages were occasionally smoked during first 14 days. Whole process of production lasted 21 days, after which time sausages were vacuum packaged and stored at 4°C . Samples used in our study were taken on 0 (mix before stuffing), 3rd, 7th, 14th and 21st day of production and on 60th and 120th day of storing.

During the production process the following was monitored: weight loss, by measuring 12 individual sausages on a scale (Chyo MK-2000B), accuracy of 0.1 g; pH value, measured using pH-meter with glass electrode Hanna, HI 83141 (Hanna Instruments, USA); the values of acidity and peroxide of the fat were determined, following the Serbian Official Standards SRPS ISO 660 2000 and SRPS ISO 3960 2001, respectively, after extraction of the fat, following the method of Folch et al. (1957); main chemical composition: quantity of water by drying of samples at temperature of 105°C to a constant mass, quantity of fat by method of extraction according to Soxhlet (with petrol-ether as solvent), quantity of proteins using method according to Kjeldahl and quantity of mineral matters (ashes) by burning of samples at temperature of $550\text{--}600^{\circ}\text{C}$ to a constant mass (AOAC, 1990).

Sensory analysis of sausages was done by seven semi-trained evaluators at the end of production process (first day) and after 60 and 120 days of storage. For sensory evaluation numeric-descriptive scales with 5 point system were used (from 1-exceptionally unacceptable to 5-exceptionally acceptable). Following meat attributes were determined/scored: appearance, colour, texture, odor and taste.

For statistical analyses of changes in proximate composition during production process the ANOVA procedure of Statistica 7 software (StatSoft, USA) was performed. If the main effect was found significant, Tukey's test was used to evaluate the significance of difference at $p < 0.05$.

RESULTS AND DISCUSSION

The drop of pH value in traditional dry sausages is slight and fermentation is long because of low temperatures (Stajić et al., 2011). pH values are result of the influence of multiple factors, the most important are the amount and type of added sugars, type of muscle tissue and composition of stuffing, as well as present microflora (Hiero et al., 1997). Changes in pH values of Sremska sausages during ripening are given in Figure 1. During the first two weeks of ripening, the pH value decreased from 5.88 to about 4.97, possibly due to production of organic acids by microorganisms, basically production of lactic acid (Lücke, 1994). After that, it increased slightly to about 5.18 in the last 7 days of ripening, probably as a consequence of proteolytic changes. These results were in agreement with literature data for similar fermented products (Salgado et al., 2005; Kozačinski et al., 2008; Stajić et al., 2011).

Processing conditions can influence the rate of acid production and also the change of pH value in products (Salgado et al., 2005). In the research of the changes occurring during ripening of Sremska sausage in climate chamber, Živković et al. (2012) stated that the minimum pH value was reached on day seven of the production process, afterwards a slight increase was registered, to reach the value of 5.17 at the end of production process (14th day).

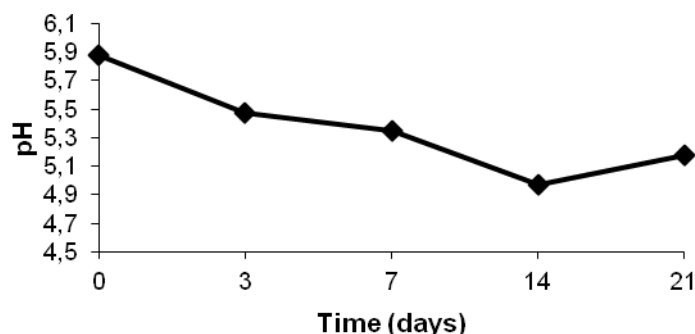


Figure 1. Changes in pH value during production

Dry fermented sausages are characterized by significant water loss during production process, whose intensity depends on the duration of drying, air temperature and humidity (Lücke, 1994). Figure 2. shows the weight loss during production of Sremska sausage. The most intensive loss occurred between day 3 and 7 of production. After one week, the weight loss was 25.25%, and at the end of the production process 44.05% (21st day).

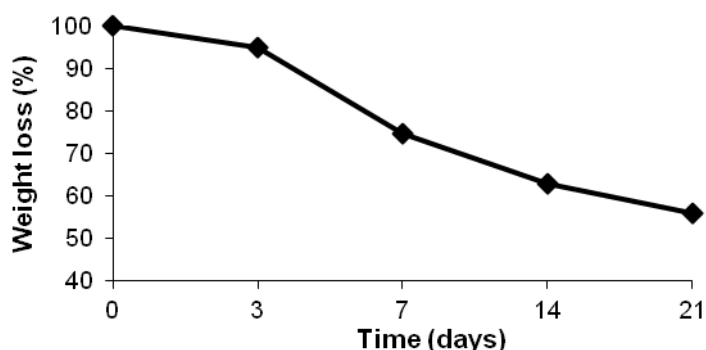


Figure 2. Weight losses of Sremska sausage during production (%)

The acidity of the fat increased during the ripening of Sremska sausage (Fig. 3). The acid number increased slightly in the first seven days of ripening and, afterwards, more rapidly until the end of ripening. Increase of the acid number during ripening of fermented sausages was recorded by other authors, however, our final value at 21st day (8.11 mg KOH/g fat) are much higher than those described by (Roncalés et al., 1991; Salgado et al., 2005).

The intensity with which lipolysis is developed during ripening varies considerably between different varieties of fermented sausages as a function of the different manufacturing procedures and the raw material used (Lois et al., 1987; Domínguez Fernández and Zumalacárregui Rodríguez, 1991). The peroxide number increase constantly during the production process (Fig. 3) and similar results have been reported by Ferrer and Arboix (1986). On the other hand, Nagy et al. (1989) found that the peroxide number of Hungarian Salami decreased in the first 10 days of ripening. The final peroxide number of the fat from Sremska sausage in this trail was 9.08 meq O₂/kg fat, which is in accordance with values stated by Salgado et al. (2005) for *Chorizo de cebolla*, a Spanish traditional sausage.

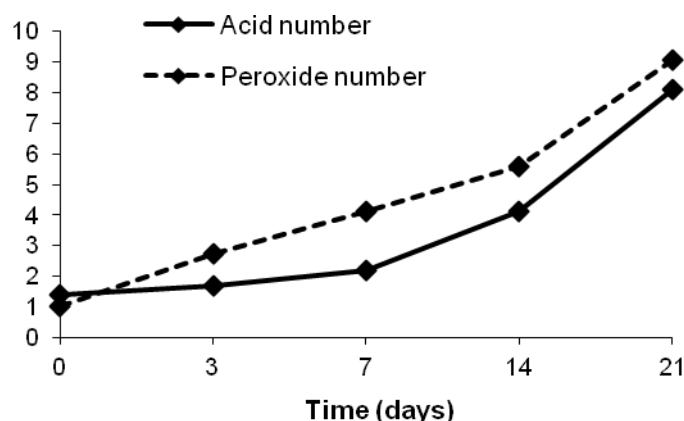


Figure 3. Changes in the fat acid number (mg KOH/g fat) and peroxide number (meq O₂/kg fat) during ripening

Changes of main chemical parameters of Sremska sausage during ripening are characterized by known tendency of increase of dry matter content (Živković et al., 2011). The proximate composition of Sremska sausage during the ripening is shown in Table 1. As a consequence of drying, at the end of ripening, sausages were characterized by a high fat content (36.42%) and low moisture content (30.21%). Ash and protein content also significantly increased during the production process, which is typical for dry fermented products (Kožačinski et al., 2008).

Table 1. Changes in proximate composition (%) of the Sremska sausage during ripening (mean ± standard deviation)

Day	Moisture	Lipid	Protein	Ash
0	58.13 ± 1.81 ^a	21.23 ± 0.56 ^a	17.73 ± 1.12 ^a	2.85 ± 0.10 ^a
3 rd	56.93 ± 2.43 ^b	21.69 ± 1.38 ^a	18.37 ± 0.76 ^a	3.04 ± 0.06 ^a
7 th	49.22 ± 1.06 ^c	24.50 ± 0.82 ^b	21.79 ± 0.93 ^b	4.41 ± 0.12 ^b
14 th	38.45 ± 2.21 ^d	31.98 ± 0.30 ^c	24.39 ± 1.07 ^c	5.31 ± 0.25 ^c
21 st	30.21 ± 0.95 ^e	36.42 ± 2.09 ^d	27.79 ± 1.14 ^d	5.67 ± 0.18 ^c

^{a,b,c,d,e} Mean values in the same column with the different superscripts differ significantly (p<0.05)

Sensory characteristics of fermented sausages are related to breakdown products of lipids which, in turn, transform to flavour compounds during ripening and they are influenced by the quality and type of raw material, smoking, fermentation rate and time, and the rate and extent of drying (Berdagué et al., 1993; Johansson et al., 1994). Sensory evaluation of sausages at the end of production process (first day) and after 60 and 120 days of storage are presented in Figure 4. At the end of production process, final product had distinctive spicy flavor, dark red color and firm consistency.

The overall sensory quality of the sausages reduced during storage, especially in sensory scores for texture and smell, but these scores do not indicate that the product is unacceptable and they were still high (greater than 4.1). On the first and the 60th day from the production, the color was evaluated with 4.5 and after 120 days, color was evaluated with 4.3. Less average evaluation for the color was due to changes in the color after cutting (appearance of the grayish color).

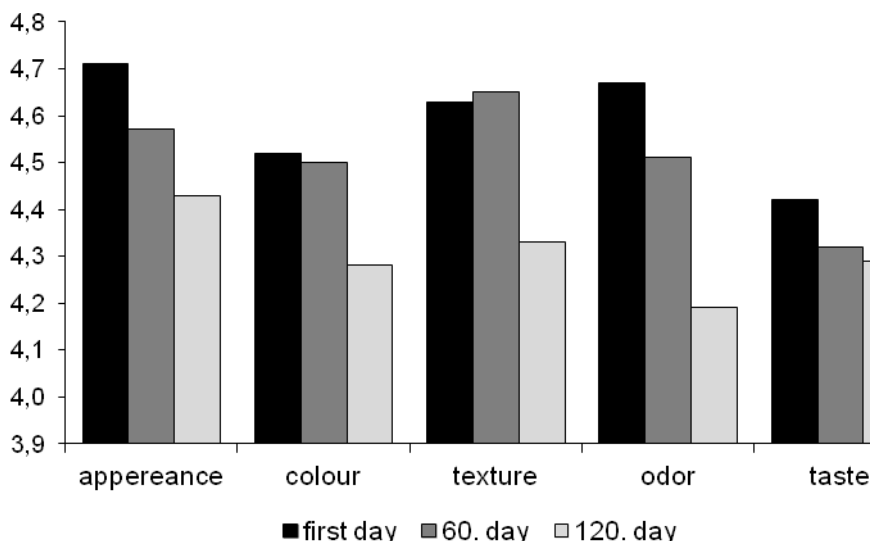


Figure 4. Sensory evaluation of Sremska sausage

CONCLUSIONS

The sausages were characterized by a long ripening period of 21 day, which is considered typical for the production in traditional smoking house. The minimum pH (4.97) was reached on 14th day, then it increased slightly to 5.18 (21st day). The values of acidity and peroxide number of the fat increased during the production process. As a consequence of drying and large weight loss, at the end of ripening, sausages were characterized by a low moisture content and high fat, protein and ash content. At the end, final product had distinctive spicy flavor, dark red color and firm consistency. During storage, overall sensory quality has slightly reduced, but sensory scores were still high for this type of product.

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