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SENSORY PROFILE OF PARENICA CHEESE VARIETIES MADE FROM PASTEURIZED COW'S MILK

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ABSTRACT

Parenica is a steamed, lightly smoked or unsmoked cheese wounded into a roll made from pasteurized cow's milk, with characteristic pronounced fibrous structure of curd. The aim of this work was to set up the sensory profile of smoked and unsmoked parenica cheese varieties made from pasteurized cow's milk and changes in sensory descriptors during 14 days of storage period at the temperature of 4 ±2 °C. Descriptive analysis was carried out by 18 trained assessors, who used a vocabulary of 26 terms to quantitatively describe appearance, aroma, consistency and taste of the experimental samples and also these overall sensory parameters with acceptability. Assessors evaluated the intensity of each descriptor by assigning the score on a 10 points linear scale. Analysis of variance found significant differences between cheese varieties ($p < 0.05$) and the effect of storage period ($p < 0.05$) on sensory quality of experimental parenica cheese varieties. The analysis showed that each sample group in observed representative sensory attributes was significantly different ($p < 0.05$). Multiple factorial analysis showed in parenica cheese samples three selected components that explain more than 69% of the total variation in the dataset at the level of statistical significance $p < 0.05$.

Keywords: cheese; sensory profile; parenica; storage; statistics

INTRODUCTION

The pasta filata cheese is a diverse group of cheeses, which originated mainly in the northern Mediterranean, in countries such as Italy, Greece, the Balkans, Turkey and Eastern Europe (**Zimanová et al., 2016**).

Parenica is a steamed, lightly smoked or unsmoked cheese wounded into a roll made from pasteurized cow's milk. It is known for the characteristic pronounced fibrous structure of curd. The roll is ussualy bounded with cheese string.

In the last years, there has been a growing attention towards food quality and food safety, as well as an increasing demand for "natural" products, especially those enjoying a 'recognition of quality' status and recognition of 'geographical indications and traditional specialties' (PDO, PGI and TSG) conferred by the European Community to promote and protect the names of quality agricultural products and foodstuffs (**Todaro et al., 2017**).

Steamed cheese production has a long tradition in Slovakia, although originally made from sheep's milk (**Čuboň et al., 2015**). However, similar dairy product "Slovenská parenica" cheese obtained the "Protected Geographic Indication" designation (PGI) in 2008, but according the "Methods of Production" described in application for registration of "Slovenské parenica", it could be made from fresh raw, unprocessed sheep's milk or a mixture with fresh raw, unprocessed cow's milk, containing at least 50% sheep's milk (**Council Regulation (EC) No. 510/2006**).

In comparison to Cheddar and Dutch-type cheeses, pasta-filata cheeses represent a special case, in terms of proteolytic pattern (**Salek et al., 2017**). The pasta filata cheeses varied in sensory quality, which depends on the quality of milk and processing technology (including the process of pasteurisaztion). These cheeses could be made according the following methods: 1. traditional process of making steamed cheese, 2. a method of making steamed cheese using direct acidification of the milk and continuous processing (**Zimanová et al., 2016**).

Recent studies aimed to the traditional pasta filata, stretched or steamed cheese making technology have been published (**Di Grigoli et al., 2015; Scatassa et al., 2015; Sulejmani and Hayaloglu, 2016; Cuffia et al., 2017; Paz et al., 2017; Salek et al., 2017; Todaro et al., 2017**). However, many of them deal with the physicochemical and microbial quality of the pasta filata cheeses.

Cheese is an irreplaceable dairy product in human nutrition and it could be consumed fresh or ripened (**Ozcan et al., 2011**). Parenica cheese could be lightly smoked during the processing of curd. Smoking is technique of food preservation, but it is also used to enhance sensory properties, taste, color and texture (**Esposito et al., 2015**). The special taste and textural parameters of traditional

cheese specialties could make them popular **(Farahani, Ezzatpanah and Abbasi, 2014)**.

Generally, smoking of high protein foods enrich the food with aromatic components that provide organoleptic properties as color and flavour to meals and have bacteriostatic and antioxidant effect **(Amran and Abbas, 2011)**. Because of that it is very important to study the qualitative sensory parameters that define the product in order to determine its acceptability to consumers **(Semjon et al., 2018)**. The sensory quality of a product like parenica cheese can be also evaluated using quantitative descriptive analysis.

The aim of this study was to describe sensory profile of smoked and unsmoked parenica cheese manufactured according to the traditional method of production during storage period.

Scientific hypothesis

Hypothesis 1: There exist differences in evaluation of sensory overall attributes (appearance, aroma, consistency, taste and acceptability) in parenica cheese varieties before and after storage of 14 days at 4 ±2 °C.

Hypothesis 2: Sensory profile of parenica cheese varieties changes during storage for 14 days at 4 ±2 °C.

Hypothesis 3: Statistically significant correlations exists between individual sensory descriptors and overall sensory parameters in parenica cheese varieties.

Hypothesis 4: A dissimilarity in sensory parameters exist between each sample groups (smoked/unsmoked parenica cheese samples and samples before/after storage).

MATERIAL AND METHODOLOGY

Processing of experimental cheese

Raw milk was standardised to fat content that final parenica cheese has a minimum fat in dry matter content 30%. Subsequently, raw milk was pasteurised before curdling at a temperature of 72 °C for 20 seconds. The milk was heated to the temperature 30 ±2 °C and inoculated with a fermenting agent composed of mesophilic lactic acid bacteria (*Lactococcus lactis* ssp. *lactis, Lactococcus lactis* ssp. *cremoris*). After adding the rennet was milk curdled at a temperature 29 – 32 °C. Curdled cheese mass was mixed using a cheese harp to produce 1 cm pieces. The cheese mass was left to settle down before being moulded into a lump. The lump was then lifted out of the whey with a cheese cloth and left to drain. After 8 hours of draining and solidifing was the lump placed on a rustproof shelf to ferment. Fermentation continued approximately 24 hours at a temperature 20 ±2 °C to achieve a pH level for the cheese about 5.2. Then the lump cheese was cut into smaller pieces and placed in a water bath (temperature of 60 – 70 °C). When the cheese curd become more plastic, it was removed from the bath and excess water was squeezed out. Subsequently it was streched and folded over several times and a cheese strips were formed by hand, so that they had a length of 1 – 2 m, a width of about 3 cm and a thickness 2 – 3 mm. The cheese strips were placed in a prepared cold saturated salt solution to cool down and after that they were squeezed out. Cheese strips were rolled up and bounded with a cheese strings made separately in water bath from the lump cheese. Then they were dried and a half of them were smoked in a smoking chamber. From a dairy plant to laboratory were the samples packed and transported at the temperature of 4 ±2 °C in plastic bags.

Sampling

To study the sensory profile and quality of parenica cheese were evaluated following sample groups (Figure 1):
• PU (unsmoked parenica cheese made from pasteurized cow's milk),
• PS (lightly smoked parenica cheese made from pasteurized cow's milk).

A total of 72 experimental parenica cheese samples were evaluated in this study. On the initial day of manufacture were from each group (PU, PS) randomly selected samples and divided into the following groups:

Figure 1 Experimentally made smoked and unsmoked parenica cheese varieties.

• the first group consisted of initial samples (n = 18) which were analyzed before storage period (BS),
• the second group contained samples (n = 18) that were placed in plastic bags to prevent desiccation but exposed to normal atmosphere conditions and stored for 14 days at the temperature of 4 ±2 °C (samples after storage – AS).

Plastic bags used in AS sample groups were made from polyethylene with thickness of 70 µm (G-PACK, LLC. Slovak Republic).

All experimental parenica cheese samples were produced in compliance with the traditional methods of production in a dairy plant according to the traditional processing procedures for parenica cheese according **Zimanová et al. (2016)** and modified method of production of "Slovenská parenica" PGI cheese **(Council Regulation (EC) No. 510/2006)**.

Sensory analysis

Samples were received from the dairy plant in plastic bucket containers and stored at 4 ±2 °C until use. The cheeses were portioned into 25 × 25 × 25 mm cubes with approximate weight of 25 g using a wire slicer, served in white plastic dishes and coded with three-digit random numbers. Samples were served at temperature of consumption 20 ±2 °C. Mineral water was provided for mouth rinsing.

Descriptive Analysis

The descriptive sensory evaluation was carried out in a standardized sensory laboratory **(ISO 8589, 2007)** built in the Institute of Postgraduate Education of Veterinary Medicine in Košice according to **Lawless and Heymann (2010)**. The sensory evaluation was performed by a panel from the staff of the University of Veterinary Medicine and Pharmacy in Košice. The group contained 18 panelists aged between 28 and 65. All the assessors were trained in the sensory analysis. Sensory profile was conducted according the General guidance for establishing a sensory profile **(ISO 13299, 2016)**.

Steps in establishing a sensory profile included following steps: establishing a sensory facility (design of test rooms), selection of products by trained experts, selection and traing assessors for the study purpose (selected assessors and recognition of odours), selection of descriptors suitable for the application (vocabulary, flavour profiles, identification of descriptors and texture profile), determination of the perception order of the attributes in the profile (evaluation using scales and magnrie estmation), training the assessors to use the selected descriptors and scale (selected assessors and expert assessors), conduction the test (general guidance and flavour profiles) and reporting the results.

Subsequently, the panel evaluated experimental parenica samples before and after the 14th day by the same panel. Assessors evaluated the intensity of each descriptor by assigning the score on a 10 points linear scale (0 – absence of sensation and 10 – extremely intense). Each assessor evaluated also the overall sensory parameters (appearance, smell, consistency and taste) of the served samples.

Statisic analysis

Data analysis was carried out with R-statistics software **(R Core Team, 2017)**. The differences between experimental parenica cheese varieties and the effect of storage were set as the main factors. A two-way analysis of variance (ANOVA) and multiple factor analysis with "FactomineR" **(Sebastien, Josse and Husson, 2008)** and "factoextra" package **(Kassambara and Mundt, 2007)** were conducted and a confidence interval was set at 95%.

RESULTS AND DISCUSSION

Description terminology for the sensory attributes of both varieties of parenica cheese (PU and PS) was introduced during the training sessions of panellist. Descriptors for appearance (white, polished, fibrous, smoked), aroma (lactit, buthyric, yoghurt, nutty), consistency (firm, elastic, cohesive, gummy, juicy, sticky, formable, fibrous, supple greasy) and taste (sour, bitter, sweet, salty, lactic, creamy, spicy, smoked), were selected.

The results of overall sensory characteristics in PU experimental cheese samples during storage period are shown in Figure 2. We observed decreased trend in overall sensory characteristics after storage in PU samples at a statistical significance level p <0.05 (Figure 2). Descriptive sensory analysis performed on unsmoked experimental parenica cheese samples demonstrated statistically significant influence of storage on the intensities of sensory descriptors of white appearance; descriptors of aroma: buthyric, yoghurt, nutty; descriptors of consistency: firm, cohesive, juicy, sticky, formable, fibrous, greasy; descriptors of taste: sweet, lactic, spicy and smoked (p <0.001). In comparison to Cheddar and Dutch-type cheeses, pasta-filata cheeses represent a special case (in terms of proteolytic pattern). Particularly, the casein molecules ("fibres" or "strings") are arranged distinctly after the stretching process **(Costabel, Pauletti and Hynes, 2007)**.The cheese stretching temperature can dramatically influence the behavior of aroma compounds, colour and texture attributes **(Sulejmani and Hayaloglu, 2016).** The immersion of the cheese-curd in the hot liquid is a specific process enhancing its plasticization and stretching properties **(Salek et al., 2017)**.

At the initial stage of storage were found statistically significant differences between experimental cheese varieties in each sensory descriptor except fibrous appearance, nutty aroma, firm, elastic, cohesive, gummy, sticky, fibrous consistency, and sour and spicy taste.

Figure 3 shown that overall sensory paramters in PS samples significantly changed after storage period only in consistency, taste and acceptability (p <0.05).

Descriptive sensory analysis performed on smoked experimental parenica cheese samples demonstrated statistically significant influence of storage on the intensities of sensory descriptors of white and smoked appearance; descriptors of aroma: buthyric and nutty; descriptors of consistency: elastic, cohesive, gummy, juicy, sticky, formable and greasy; descriptors of taste: sweet, lactic and smoked (p <0.001). Consistency is an important viscoelastic property of the product **(Amiri et al., 2018)**. **Cais-Sokolińska, Pikul and Lasik (2012),** found that changes in texture parameters of cheeses as a result of smoking depended on their storage time. We agree with the autors that smoked cheese not subjected to storage was harder than unsmoked cheese. It could be caused by increased dry matter of smoked cheese, or by loss of water content, respectively.
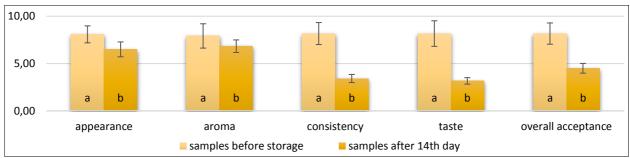
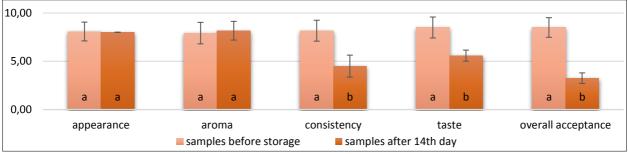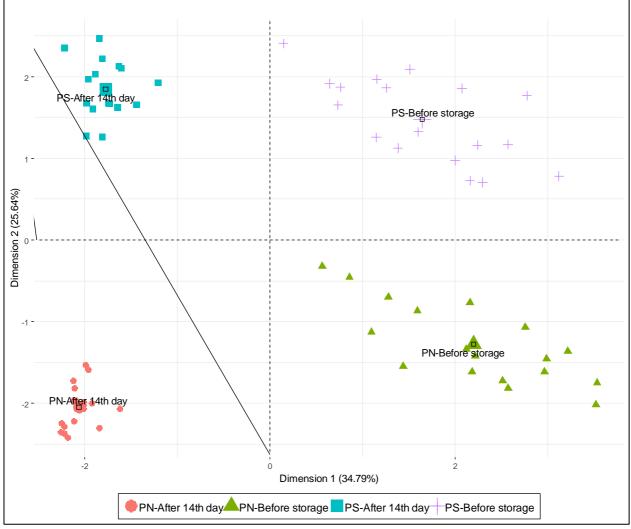**Figure 2** Overall sensory parameters of experimental unsmoked parenica cheese (PU) during storage period.
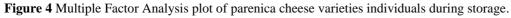

Figure 3 Overall sensory parameters of experimental smoked parenica cheese (PS) during storage period.

Figure 4 Multiple Factor Analysis plot of parenica cheese varieties individuals during storage.
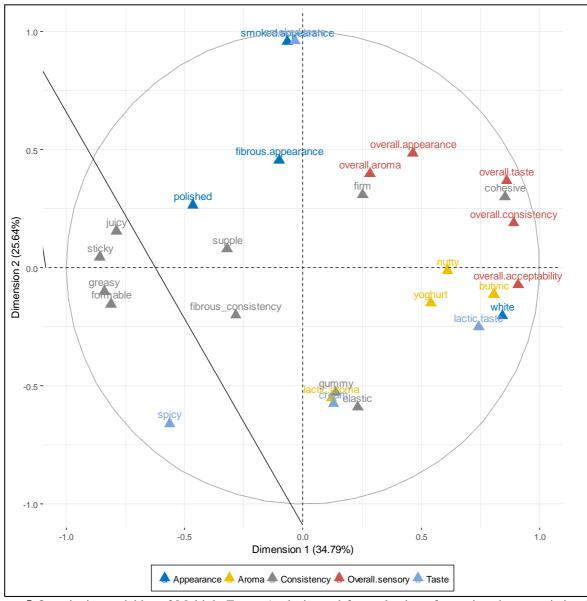
Figure 5 Quantitative variables of Multiple Factor Analysis used for evaluation of parenica cheese varieties during storage.

We observed statistical significant efect of storage on salty taste only in PU samples. Assessors evaluated salty taste in PU samples after storage with higher intensity. On the other hand, intensity of salty taste in PS samples was at the same level before and after storage period of 14 days. We agree with the authors **Todaro et al. (2017)** and **Gaucheron et al. (1999)** who found a slightly increase of salt during 14 days of storage of stretched cheese, and moreover, these authors established a migration of sodium, potassium and chloride ions from the outer layer versus the core of cheese which ended after 5 days.

In our study, multiple factorial analysis (MFA) method was applied to the sensory data, whereas were analysed results of overall sensory characteristics and sensory profile of two varieties of parenica cheese samples during storage period of 14 days. The analysis extracted the most significant variables with a minimum loss of information. Kaiser's criterion (eigenvalue >1) was applied to determine the number of final factors from the initial ones **(Chapman, Lawless and Boor, 2001)**.

The results of MFA showed in parenica cheese samples three selected components that explain more than 69% of the total variation in the dataset. The first dimension (Dim1) explains 34.79% of variation, second dimension (Dim2) 25.64% and third dimension (Dim3) 8.39%.

The highest contribution of the analysed data in Dim1 was related to the effect of storage period (21.93%, r = 0.95) and overall sensory parameters (18.19%, r = 0.89). The highest contribution in Dim 1 included following overall sensory parameters: acceptability (r = 0.91), consistency (r = 0.89), taste (r = 0.86), appearance (r = 0.46) and aroma (r = 0.28), which correlated at statistically significant level ($p < 0.05$).

The first two dimensions explained a total of 60.43% of variance (Figure 4). The highest effect of variety on parenica cheese characteristics was in Dim2 (30.33%, r = 0.84), followed by the descriptors of taste (30.48%, r = 0.52) and descriptors of appearance (21.59%, r = 0.89). In Dim 2 were significantly correlated following descriptors of taste smoked (r = 0.96), lactic (r = -0.25), creamy (r = -0.59) ans spicy (r = -0.66) and following descriptors of appearance: smoked (r = 0.96), fibrous (r = 0.45) and

polished (r = 0.26), at statistically significant level (*p* <0.05) (Figure 5).

Descriptors of consistency contribute mainly to Dim3 with 25.07% (r = 0.67), followed by the descriptor of aroma 24.64% (r = 0.57). In Dim3 were correlated following descriptors of consistency: supple (r = 0.65), firm (r = 0.54), greasy (r = 0.34), formable (r = 0.32), fibrous (r = 0.28) and juicy (r = 0.24).

MFA analysis showed that each sample group was different in observed sensory characteristics, according to measured attributes data (*p* <0.05). Figure 4 shown that experimental cheese samples groups were not plotted closely to each other. We agree with the authors **Smit et al. (2005)** that flavor of cheese improved with storage days because during ripening the metabolic processes are responsible for the basic flavor and texture changes. However, further study of individual sensory dexriptors, particularly their intensities, could provide methods such as measurement of intensity in time (**Pavelková, Flimelová and Vietoris, 2012**).

CONCLUSION

In this experiment we set up the sensory profile of smoked and unsmoked parenica cheese varieties made from pasteurized cow's milk. Panelist evaluate each sensory descriptor of two parenica cheese varieties before and after 14 days of storage period. Sensory profile of parenica cheese varieties changed during storage (*p* <0.05). We observed decreased trend in overall sensory characteristics after storage in unsmoked parenica cheese samples, but in smoked variety only in consistency taste and overall acceptability (*p* <0.05).

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