



CHARACTERISTICS OF TEXTURAL AND SENSORY PROPERTIES OF OŠTIEPOK CHEESE

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ABSTRACT

Oštiepok is a traditional half-fat semi-hard cheese made in Slovakia. The basic raw material used to produce oštiepok cheese is ewe's milk, a mixture of ewe's and cow's milk or cow's milk. Oštiepok cheese is produced either directly at a small-scale mountainside sheep farm, using the traditional on-farm method of production, or at dairies, using the industrial method. Oštiepok cheese was produced as far back as the beginning of the 18th century. An industrial production of Oštiepok cheese using cow's milk were laid by the Galbavý family in Detva (Slovakia) in 1921. The cheese is originally made by cutting off fresh sweet cheese, which is pressed into a wooden, hand-cut and decorated round shape where it is left to stand. Subsequently, it is removed and immersed in warm salty water, left to stand there until the salt penetrates completely in. Then it is necessary that it pass slightly. In its salty water, the ostrich produces its traditional durability, its surface is slightly peeled, mostly yellowish. This cheese may or may not be steamed and may be smoked or unsmoked. Slovenský oštiepok is a protected trade name under the EU's protected geographical indication. A similar cheese is made in the Polish Tatra Mountains under the name Oscypek. The cheeses differ in ingredients' ratios, cheesemaking process and the characteristics of the final products. In this study we have characterized textural and sensory properties of the Oštiepok cheese produced in Slovakia made from ewe's milk, a mixture of ewe's and cow's milk and cow's milk.

Keywords: Oštiepok cheese; Slovak oštiepok cheese; Slovenský oštiepok; cheese; traditional Slovak cheese

INTRODUCTION

Oštiepok cheese (Slovenský oštiepok – Slovak oštiepok) is characterised by its special shape, that of a large egg, pine cone or ellipsoid with decoration. The colour is golden-yellow to golden-brown on the outside after smoking, white to buttery-yellow on the inside. Consistency is solid, firm, slightly fragile, with minor cracks and cavities appearing when cut. Aroma and flavor is savoury, pleasant distinctive cheese flavour, mildly piquant to sour, moderately salty, with a typical smoky aroma resulting from the smoking process; must not be overly acidic, yeasty, tallowy, soapy, rancid, putrid, sharp, spicy or bitter or have other strange flavours. Composition depends on the raw material used and the method of production, a minimum of 48 % dry matter by weight, a minimum of 38.0 % fat in dry matter by weight.

(Council of the European Union, 2007).

Slovenský oštiepok is presented in the Figure 1. The protection of geographical indications and designations of origin for Slovenský oštiepok was established by the Commission Regulation No. 943/2008.

Slovenský oštiepok is produced using ewe's milk obtained from grazing ewes, particularly the *Wallachian*, *Improved Wallachian* and *Tsigai* breeds. These breeds are reared and

graze in mountainous areas on mountain slopes within the delimited area. Small producers obtain cow's milk by hand or mechanically and process it immediately after milking. On-farm production of Slovenský oštiepok at a *salaš* (small farm), the stages involved are as follows: curdling, shaping, salting, drying, smoking. In the case of the industrial production, the stages involved are as follows: pasteurisation, addition of cultures, curdling, curd stretching, pressing, acidification, steaming, shaping, salting, drying and smoking (Council of the European Union, 2007).

The cooled cheeses are placed in hygienic food packaging. They are packaged whole to ensure that their characteristic shape and decorations are retained (which would not be the case if they were cut and then packed) and that the quality is preserved, the product is not adulterated and consumers are not deceived. All stages of production take place within the delimited geographical area (Council of the European Union, 2007).

The cheese should be produced only from milk meeting the criteria of the Slovak technical standard STN 57 05 10 Ewe's milk and STN 57 05 29 Raw cow milk for dairy treatment and processing. Also, the Commission

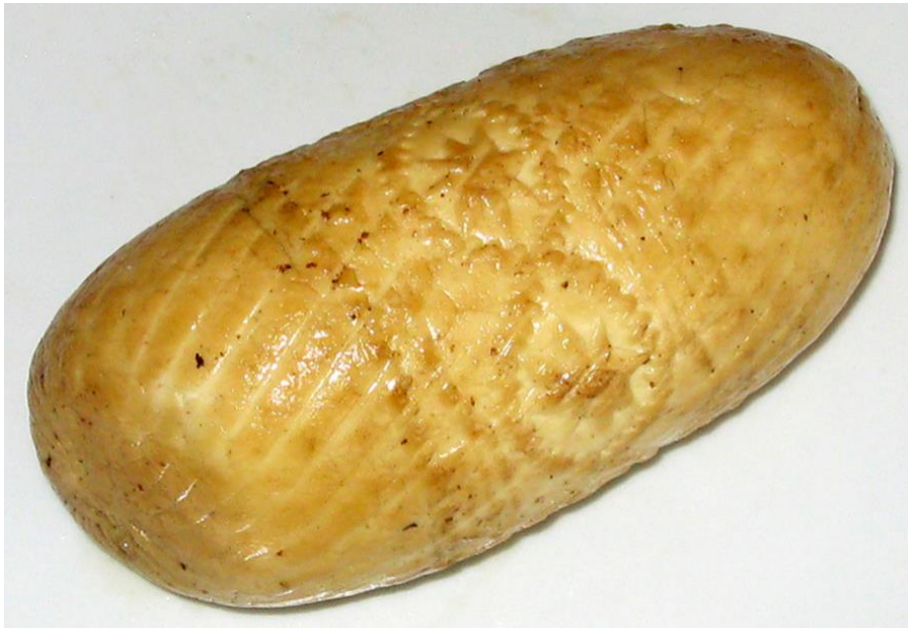


Figure 1 Slovenský oštiepok (Slovak oštiepok cheese).

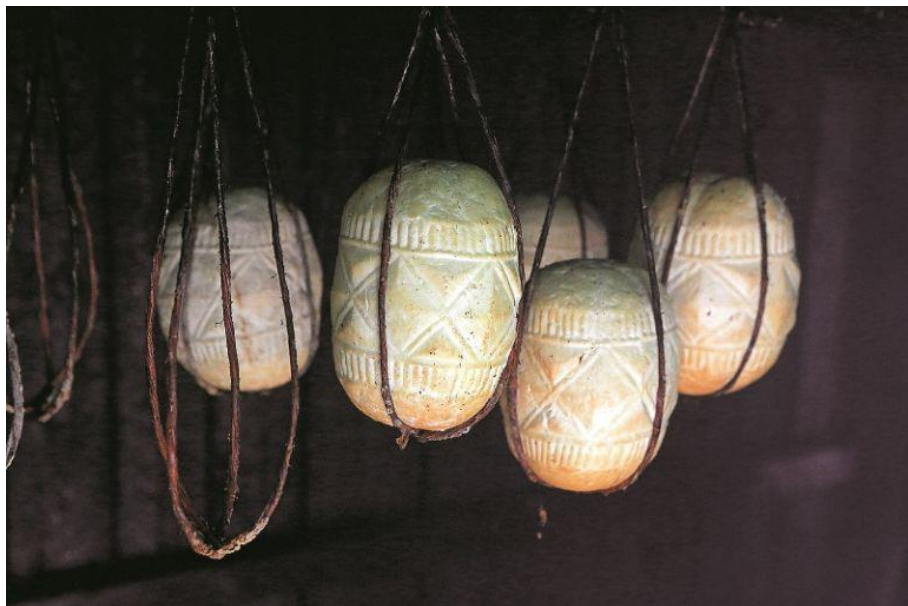


Figure 2 Smoking the Slovenský oštiepok (Slovak oštiepok cheese) by the traditional way (Getting, 2016).



Figure 3 Salaš Zbojská. Note: (Salaš is Slovak name for small farm in mountain region).

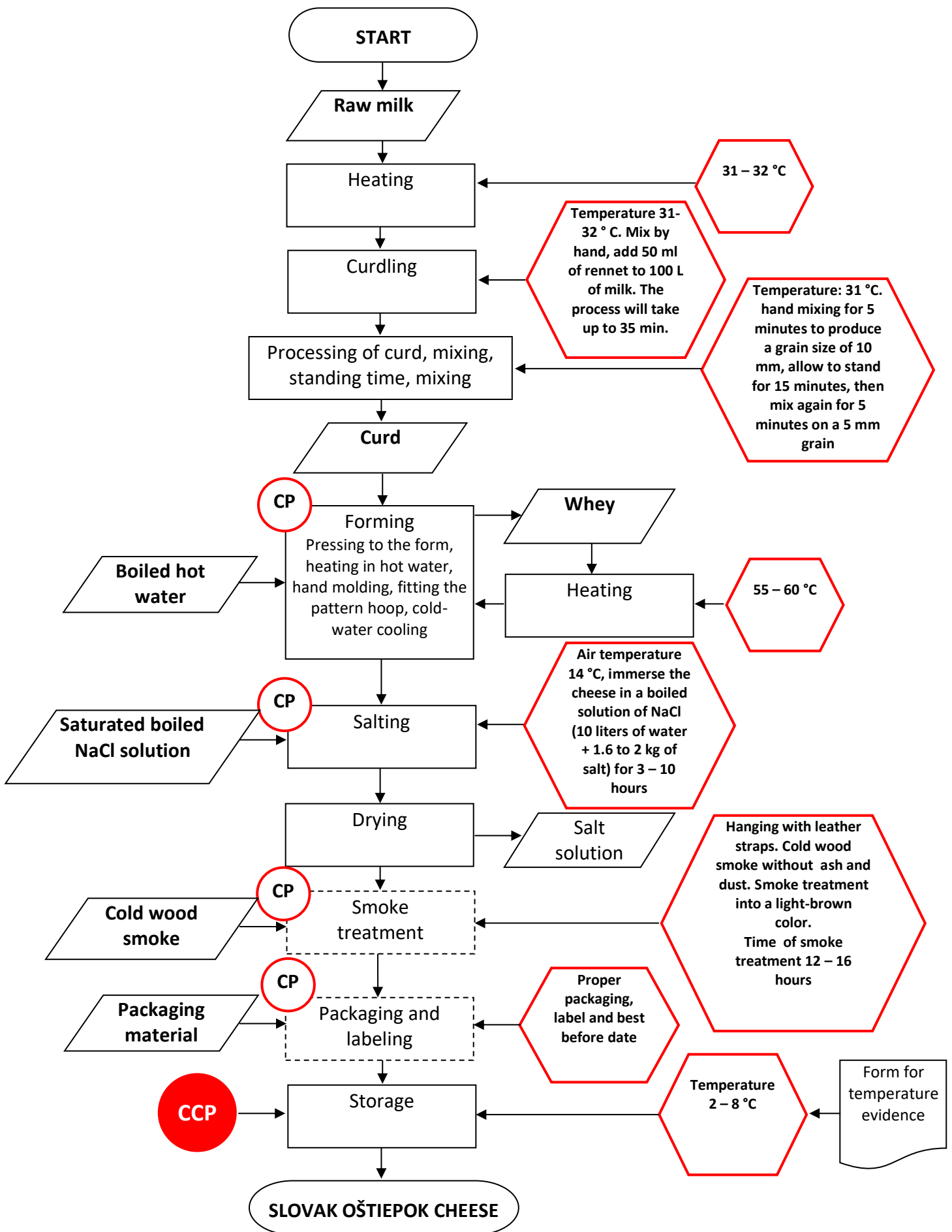


Figure 4 Technological steps of the Slovenský oštiepok (Slovak Oštiepok cheese) production.

Regulation (EC) No. 1662/2006 and No. 2073/2005 has to be fulfilled regarding to the hygienic and microbiological criteria.

In this study, we have described in detail the characteristic textural and sensoric properties of Slovenský oštiepok cheese made from ewe's milk, a mixture of ewe's and cow's milk and cow's milk. The hypothesis we have tested was that textural and sensoric characteristics of the Slovenský oštiepok cheese may vary depending on the type of milk used for the production.

Scientific hypothesis

There is a statistically significant difference between Oštiepok cheeses produced in different regions of Slovakia.

MATERIAL AND METHODOLOGY

Cheese samples

Product 1: Ewe's Oštiepok cheese 100% – smoked (Producer: Papúchová D. (Ružomberok, Slovakia), made in: PD Liptovské Revúce), characteristic: dry matter – 48 wt%, fat in dry matter – 50 %, NaCl – max. 2 %, weight – 0.356 kg.

Product 2: Orava ewe's Oštiepok cheese – smoked (Producer: Panči M. (Ružomberok), made in: Šurinák M. (KOLIBA Revišné, Veličná, Slovakia)), characteristic: dry matter min. 45 wt%, fat in dry matter: min. 48 %, NaCl: 4.5 g.100⁻¹g, proteins: 23.1 g.100⁻¹g, carbohydrates: 1.8 g.100⁻¹g, fat: 30 g.100⁻¹g, weight: 0.344 kg.

Product 3: Original ewe's Oštiepok cheese – smoked (Producer: Syrex – Zázrivá, Slovakia), characteristic: fat in dry matter: min. 45 %, salt: 4.5 g.100⁻¹g, proteins: 23.1 g.100⁻¹g, carbohydrates: 1.8 g.100⁻¹g, fat: 30 g.100⁻¹g, weight: 0.218 kg.

Product 4: Ewe's Oštiepok cheese – smoked (Producer: Plachtinská farm – Baránek, Slovakia), characteristic: dry matter: 56 wt%, fat in dry matter: 51 %, salt 1 g.100⁻¹g, proteins: 22.4 g.100⁻¹g, carbohydrates: 1.91 g.100⁻¹g, fat: 29.2 g.100⁻¹g, weight: 0,390 kg.

Product 5: Oštiepok, 100% ewe's cheese – smoked (Producer: Bryndziareň and syräreň – Zvolenská Slatina, Slovakia), characteristic: fat in dry matter: 45 – 60 %, salt: 2.37 g.100⁻¹g, proteins: 22.55 g.100⁻¹g, carbohydrates: 2.61 g.100⁻¹g, fat: 28.65 g.100⁻¹g, weight: 0.542 kg.

Product 6: Ewe's cheese Kolibka Spiš – smoked (Producer: Endel M. – VALACH (Sp. Nová Ves, Slovakia), made in: Kluknavská dairy – OOD Jaklovce, Slovakia), characteristic: fat in dry matter: min. 45 %, salt: max. 2.5 g.100⁻¹g, proteins: 24.5 g.100⁻¹g, carbohydrates: <1 g.100⁻¹g, fat: 26 g.100⁻¹g, weight: 0.328 kg. (Note: Not declared as Oštiepok cheese).

Product 7: Ewe's Oštiepok cheese – smoked (Producer: Badánik – Salaš Krajinka, Slovakia).

Product 8: Oštiepok Ewe's cheese - smoked (Producer: Konečný I. – KONNY (Trenčín, Slovakia), made in: Dairy Krivá, Slovakia), characteristic: dry matter: min. 50 wt%, fat in dry matter: min 40 %, salt: max. 2.5 g.100⁻¹g, fat: 35.26 g.100⁻¹g, weight: 0.242 kg.

Product 9: Ewe's Oštiepok cheese – smoked (Producer: Zúbek M. – OBERT (Ladce, Slovakia)).

Product 10: Ewe's Oštiepok cheese – smoked (Producer: Zvara J. (Detva, Slovakia)).

Product 11: Ewe's Oštiepok cheese – smoked (Producer: Agrosev made in: Plachtinská farm Baránek, Slovakia),

characteristic: dry matter: 56 wt%, fat in dry matter: 51 %, salt: 1 g.100⁻¹g, proteins: 22.4 g.100⁻¹g, carbohydrates: 1.91 g.100⁻¹g, fat: 29.2 g.100⁻¹g, weight: 0.284 kg.

Product 12: Oštiepok – Ewe's cheese – smoked (Producer: AgroIna (Banská Bystrica, Slovakia), made in: AgroMagura s.r.o., Slovakia), characteristic: dry matter: min. 40 wt%, fat in dry matter: min. 50 %, salt: 2.5 g.100⁻¹g, weight: 0.458 kg.

Product 13: Original Oštiepok ewe's cheese – smoked (Producer: Chlustová P. (Liptovský Mikuláš, Slovakia), made in: Syrex (Zázrivá, Slovakia)), characteristic: fat in dry matter: min. 45 %, salt: 4.5 g.100⁻¹g, proteins: 23.1 g.100⁻¹g, carbohydrates: 1.8 g.100⁻¹g, fat: 30 g.100⁻¹g, weight: 0.360 kg.

Product 14: Orava ewe's loaf cheese – smoked (Producer: Válek M. (Revišné – Veličná, Slovakia), made in: Šurinák M. – Koliba Revišné (Veličná, Slovakia)), characteristic: dry matter: min. 45 wt%, fat in dry matter: min. 48 %, salt: 4.5 g.100⁻¹g, proteins: 23.1 g.100⁻¹g, carbohydrates: 1.8 g.100⁻¹g, fat: 30 g.100⁻¹g, weight: 0.350 kg. (Note: Not declared as Oštiepok cheese).

Product 15: Ewe's cheese Kolibka Spiš – steamed (Producer: Endel M. Jr. – VALACH (Sp. Nová Ves, Slovakia), made in: Kluknavská dairy – ODD Jaklovce, Slovakia), characteristic: fat in dry matter: min. 45 %, salt: max. 2.5 g.100⁻¹g, proteins: 24.5 g.100⁻¹g, carbohydrates: <1 g.100⁻¹g, fat: 26 g.100⁻¹g, weight: 0.324 kg. (Note: Not declared as Oštiepok cheese).

Product 16: Original ewe's Oštiepok cheese – fresh (Producer: Chlustová P. (Liptovský Mikuláš, Slovakia), made in: Syrex (Zázrivá, Slovakia)), characteristic: fat in dry matter: min. 45 %, salt: 4 g.100⁻¹g, proteins: 19.7 g.100⁻¹g, carbohydrates: 0.8 g.100⁻¹g, fat: 25 g.100⁻¹g, weight: 0.286 kg.

Product 17: Oštiepok Ewe's cheese – fresh (Producer: Dairy Krivá (Krivá, Slovakia)), characteristic: dry matter: min. 50 wt%, fat in dry matter: min. 40 %, salt: max. 2.5 %, weight: 0.270 kg.

Product 18: Orava ewe's Oštiepok cheese – fresh (Producer: Panči M. (Ružomberok, Slovakia), made in: Šurinák M. – Koliba Revišné (Veličná, Slovakia)), characteristic: dry matter: min. 45 wt%, fat in dry matter: min. 48 %, salt: 1.85 g.100⁻¹g, proteins: 26.61 g.100⁻¹g, carbohydrates: 2.15 g.100⁻¹g, fat: 15.18 g.100⁻¹g, weight: 0.374 kg.

Product 19: Original ewe's Oštiepok cheese – fresh (Producer: Syrex (Zázrivá)), characteristic: fat in dry matter: min. 45 %, salt: 4 g.100⁻¹g, proteins: 19.7 g.100⁻¹g, carbohydrates: 0.8 g.100⁻¹g, fat: 25 g.100⁻¹g, weight: 0.296 kg.

Oštiepok cheeses: 1, 2, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 16, 17, 18 and 19.

Ewe's cheese not labelled as the Oštiepok cheese, but it meets the requirements for Oštiepok cheese: 14.

Ewe's cheese, but not the Oštiepok cheese: 6 and 15.

INSTRUMENTAL TEXTURAL ANALYSIS

Sample preparation

We have pillod the crust of the cheese and the cheese was cut into 30 equal parts of the size 1 x 1 cm. Fifteen parts represented the middle of cheese and 15 parts was from edge parts of cheese (**Figure 6**). Cutted chees blocks were tempered in fridge to 10 °C.

Materials and instruments

We used:

- texturometer TA.XT Plus (Stable Micro Systems),
- computer with a program Exponent (Stable Micro Systems),
- spherical probe (P/1S),
- fridge,
- cheese samples,
- knife.

The analysis of the textural properties of cheese samples was tested using texturometer TA.XT Plus (Stable Micro Systems) at 10 °C. The instrument was set up according to the manufacturer's recommendations. We focused on following indicators (Stable Micro Systems, 2016):

- firmness of the cheese (g),
- consistency of the cheese (g.s⁻¹).

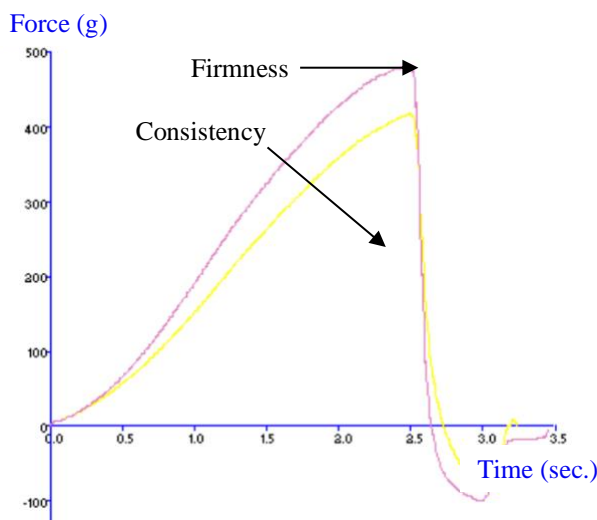


Figure 5 A curve showing the textural properties of cheese in the program Exponent (Stable Micro Systems).

The **Figure 5** shows the textural properties of the measured Oštiešpok cheese. At the highest point of the curve is the firmness of the cheese. The harder the cheese is, the higher is the curve peak (higher the value). The consistency of the cheeses shows the inner area between the curve and the x-axis in the positive area of the figure. The stronger the consistency of the cheese is, the higher is the consistency value this means the larger is the area in the figure.

SENSORY ANALYSIS

Sample preparation

We have stripped each Oštiešpok cheese and cut into 30 equal parts of the size 1 x 1cm. The sensory analysis was tested using skilled evaluators. The cheese was tempered to 10°C and the temperature in laboratory was 20 °C.

The organoleptic properties of the individual samples were evaluated using a modified profile test. Values for descriptors were: 10 – extremely strong, 9 – very strong, 8 – strong, 7 – moderately strong, 6 – above average, 5 – medium, 4 – weak, 3 – very weak, 2 – threshold, 0 – none.

- Odor: evaluators focused on two descriptors for odor: cheesy and smoke,
- Taste: evaluators focused on four descriptors for taste: salty, after smoke, total flavour and other/foreign,

Table 1 Texturometer TA.XT Plus setup

Parameter	Setup
Mode	Measure Force in Compression
Option	Return to Start
Pre-Test Speed:	1.5 mm.s ⁻¹
Test Speed:	2.0 mm.s ⁻¹
Post-Test Speed:	10.0 mm.s ⁻¹
Distance:	5 mm
Trigger Type:	Auto – 2.5 g
Tare Mode:	Auto
Data Acquisition Rate:	400 pps
1" Spherical Probe (P/1S)	Max. load: 5 kg Max. temperature: 200 °C

Note: texturometer setup for measuring firmness and consistency of Oštiešpok cheeses.

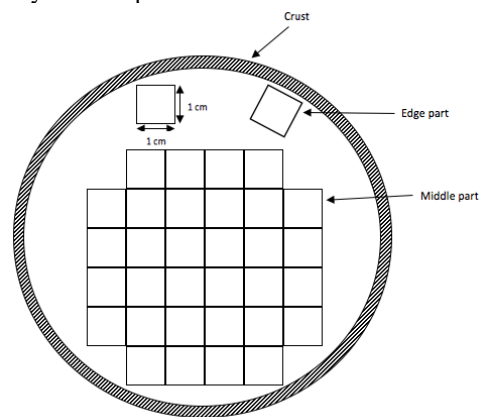


Figure 6 Oštiešpok cheese sample cutting.

- Texture: evaluators focused on two descriptors for texture: overall appearance, colour, consistency and scroop.

CHEESE COMPOSITION ANALYSIS

The cheese composition was analysed with standard laboratory methods.

Fat content: ISO 1735:2004 (IDF 5:2004) Cheese and processed cheese products -- Determination of fat content - - Gravimetric method (Reference method).

Protein content: ISO 8968-1:2014 (IDF 20-1:2014) Milk and milk products -- Determination of nitrogen content -- Part 1: Kjeldahl principle and crude protein calculation.

Lactose content: ISO 22662:2007 (IDF 198:2007) Milk and milk products -- Determination of lactose content by high-performance liquid chromatography (Reference method).

Dry matter content: ISO 5534:2004 (IDF 4:2004) Cheese and processed cheese -- Determination of the total solids content (Reference method).

Ash content: Ash content was detected after burning a sample in a muffle furnace at 550 °C for 5 h.

Salt content: ISO 5943:2006 (IDF 88:2006) Cheese and processed cheese products -- Determination of chloride content -- Potentiometric titration method.

STATISTICAL ANALYSIS

Statistical analysis of composition and texture determined by instrument

The results were statistically evaluated using XLSTAT, v. 2018.1 (Addinsoft, USA) statistical program. Firstly, we used the Shapiro-Wilk's test for verifying the normality of data. The significance level (α) was determined at level 0.05 for this test. Consequently, the Kruskal-Wallis one-way ANOVA and Dunn's test were used to test whether there is significant difference between Oštiepok cheeses in composition and texture parameters. We consider the results significantly different at $p < 0.001$. Consequently, we used the principal component analysis (PCA) to show the main factors of variance between cheeses.

Statistical analysis of data determined by sensory analysis

The results were evaluated using statistical software (XLSTAT, v. 2018.1, Addinsoft, USA). We used a method for a comprehensive assessment of similarity and organoleptic acceptability: Principal component analysis (PCA).

RESULTS AND DISCUSSION

Statistical analysis of composition and texture determined by instrumental analysis

The mean values of composition of Oštiepok cheeses are presented in **Table 2** and were as follows: dry matter 58 wt%, fat in dry matter 49%, fat 28.42 g.100g⁻¹, carbohydrates 1.81 g.100g⁻¹, protein 22.62 g.100g⁻¹, NaCl 2.85 g.100g⁻¹, other minerals 1.83 g.100g⁻¹.

The results of the normality test showed that the data had a non-normal distribution; the Shapiro-Wilk's test value was < 0.05 . Subsequently, we performed a Kruskal-Wallis one-way ANOVA and we found that individual products were statistically different ($p < 0.001$) in fat in solid content, solid content, fat, carbohydrates, proteins, NaCl, other minerals and also in textural parameters firmness and consistency. Also, the Dunn's post hoc tests identified, that there are significant differences ($p < 0.001$) between cheeses in texture parameters determined by texturometer (consistency and firmness). These results are presented in **Table 3**. The highest values of firmness and consistency parameters were determined for products No. 3 and No. 13 (**Table 3**). It is because these products have one of the highest values of % of dry matter in comparison of other cheeses analysed in our experiment. The lowest values of firmness and consistency were detected in cheese No. 7 and No. 16 (**Table 3**).

The mean value of firmness for middle parts of cheeses was 1.332 kg and 1.383 kg for edge parts. The mean value of consistency for middle parts of cheeses was 1.049 kg.s⁻¹ and 1.038 kg.s⁻¹ for edge parts. There was no significant difference ($p = 0.301$) between middle and edge parts of cheeses in firmness parameter. Also, there was no significant difference ($p = 0.819$) between middle and edge parts of cheese in consistency parameter. The overall mean of firmness of all cheeses was 1.349 ± 0.705 kg and Cv 52%. The overall mean of consistency of all cheeses was 1.045 ± 0.578 kg.s⁻¹ and Cv 55%.

Table 2 The mean values of Oštiepok cheeses composition.

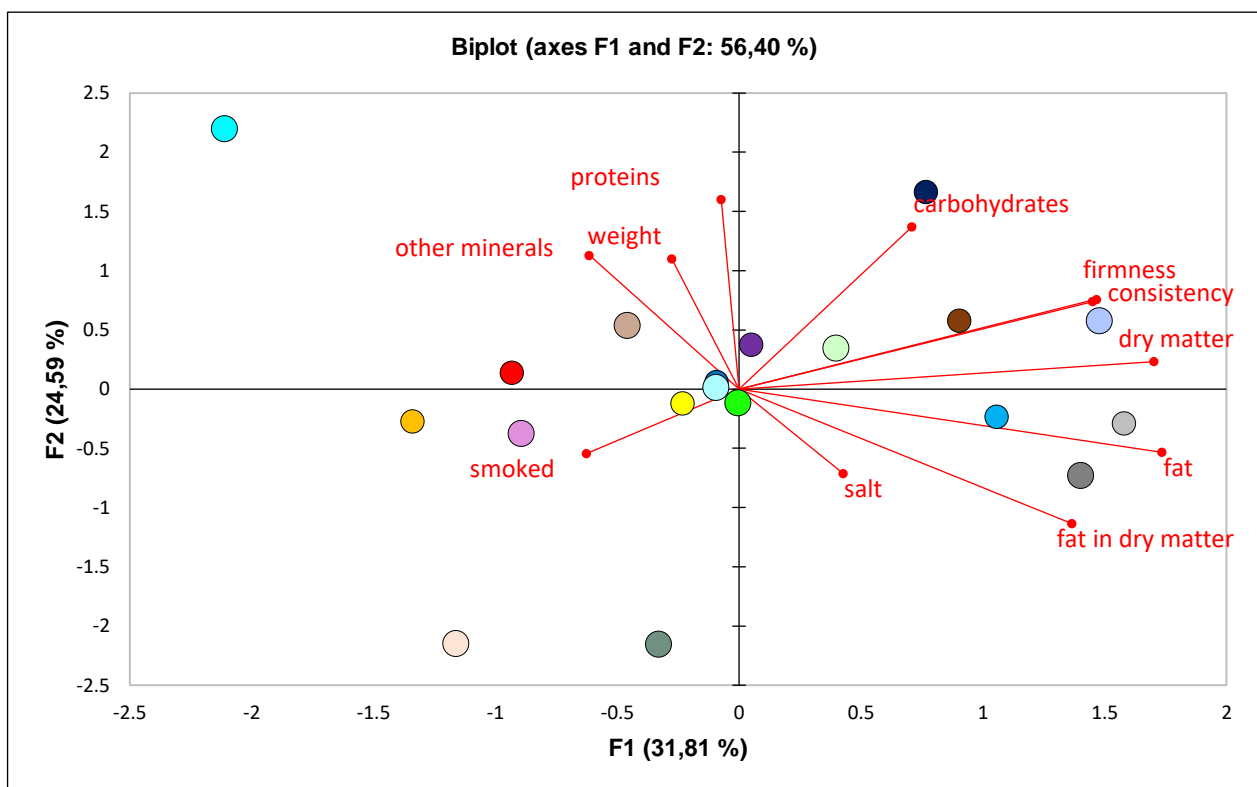
Product no.	Weight (g)	Dry Matter (wt%)	Fat in Dry Matter (%)	Fat (g.100g ⁻¹)	Carbohydrates (g.100g ⁻¹)	Protein (g.100g ⁻¹)	NaCl (g.100g ⁻¹)	Other Minerals (g.100g ⁻¹)	Smoked
1	356	48	47	22.45	1.62	19.53	2.32	1.93	yes
2	344	59	48	28.01	1.83	23.31	3.81	1.82	yes
3	218	62	49	30.21	1.85	23.53	4.44	1.74	yes
4	390	58	50	28.88	1.90	23.13	2.13	1.76	yes
5	542	59	49	28.65	2.62	23.25	2.28	1.83	yes
6*	328	55	48	26.37	1.02	22.96	2.32	1.92	yes
7	356	55	48	26.47	1.47	23.37	1.82	1.89	yes
8	242	65	54	35.35	2.10	23.43	2.48	1.78	yes
9	350	60	51	30.42	2.45	22.17	3.15	1.90	yes
10	368	53	45	24.07	2.02	21.92	3.61	1.59	yes
11	284	58	51	29.54	1.93	23.08	1.52	1.92	yes
12	458	60	51	30.13	2.00	23.22	2.46	1.71	yes
13	360	62	50	30.80	1.86	23.09	4.32	1.82	yes
14*	350	60	49	29.78	1.77	22.73	4.32	1.90	yes
15*	324	57	46	26.34	2.08	24.62	2.41	1.85	no
16	286	51	50	25.59	0.80	19.57	3.66	1.61	no
17	270	63	58	36.10	2.08	20.61	1.85	1.86	no
18	374	53	39	20.46	2.11	26.66	1.69	2.19	no
19	296	56	54	30.34	0.80	19.63	3.49	1.77	no
Mean	342	58	49	28.42	1.81	22.62	2.85	1.83	
SD	74	4	4	3.86	0.49	1.78	0.96	0.13	
Cv (%)	22	7	8	13.58	27.03	7.87	33.73	7.12	

Note: Each product n = 3. Mean, SD and Cv n = 57. *Ewe's cheese, but not the Oštiepok cheese.

Table 3 The mean values of Oštiepok cheeses textural parameters determined by instrumental method.

Product no.	Middle part of the cheese						Edge part of the cheese					
	Firmness (kg)	SD (kg)	Cv (%)	Consistency (kg.s ⁻¹)	SD (kg.s ⁻¹)	Cv (%)	Firmness (kg)	SD (kg.s ⁻¹)	Cv (%)	Consistency (kg.s ⁻¹)	SD (kg.s ⁻¹)	Cv (%)
1	0.935	0.310	33	0.699	0.265	38	1.285	0.401	31	0.850	0.325	38
2	0.954	0.145	15	0.716	0.102	14	0.779	0.351	45	0.557	0.263	47
3	2.078	0.281	14	1.620	0.259	16	1.767	0.273	15	1.319	0.253	19
4	0.972	0.090	9	0.774	0.074	10	0.876	0.132	15	0.673	0.115	17
5	2.258	0.256	11	1.759	0.248	14	2.189	0.277	13	1.724	0.231	13
6*	2.374	0.459	19	1.894	0.391	21	2.439	0.766	31	1.645	0.584	36
7	0.700	0.094	13	0.507	0.071	14	0.841	0.109	13	0.594	0.070	12
8	1.917	0.297	15	1.528	0.268	18	1.380	0.366	27	1.031	0.269	26
9	1.349	0.533	39	1.161	0.430	37	2.408	1.169	49	1.978	0.989	50
10	0.669	0.144	22	0.486	0.099	20	0.802	0.243	30	0.572	0.171	30
11	0.959	0.273	28	0.744	0.230	31	1.130	0.211	19	0.916	0.199	22
12	1.285	0.256	20	0.983	0.184	19	1.442	0.307	21	1.083	0.271	25
13	2.808	0.406	14	2.259	0.318	14	2.660	0.386	14	2.038	0.394	19
14*	0.751	0.124	17	0.602	0.079	13	0.919	0.237	26	0.676	0.202	30
15*	1.320	0.157	12	1.055	0.137	13	1.255	0.156	12	1.005	0.145	14
16	0.692	0.113	16	0.510	0.090	18	0.673	0.166	25	0.483	0.125	26
17	1.756	0.219	12	1.475	0.169	11	1.625	0.248	15	1.269	0.198	16
18	0.796	0.168	21	0.634	0.142	22	0.946	0.196	21	0.706	0.146	21
19	0.740	0.168	23	0.529	0.145	27	0.861	0.246	29	0.612	0.199	33
Mean	1.332			1.049			1.383			1.038		
SD	0.666			0.547			0.632			0.495		
Cv (%)	50			52			46			48		

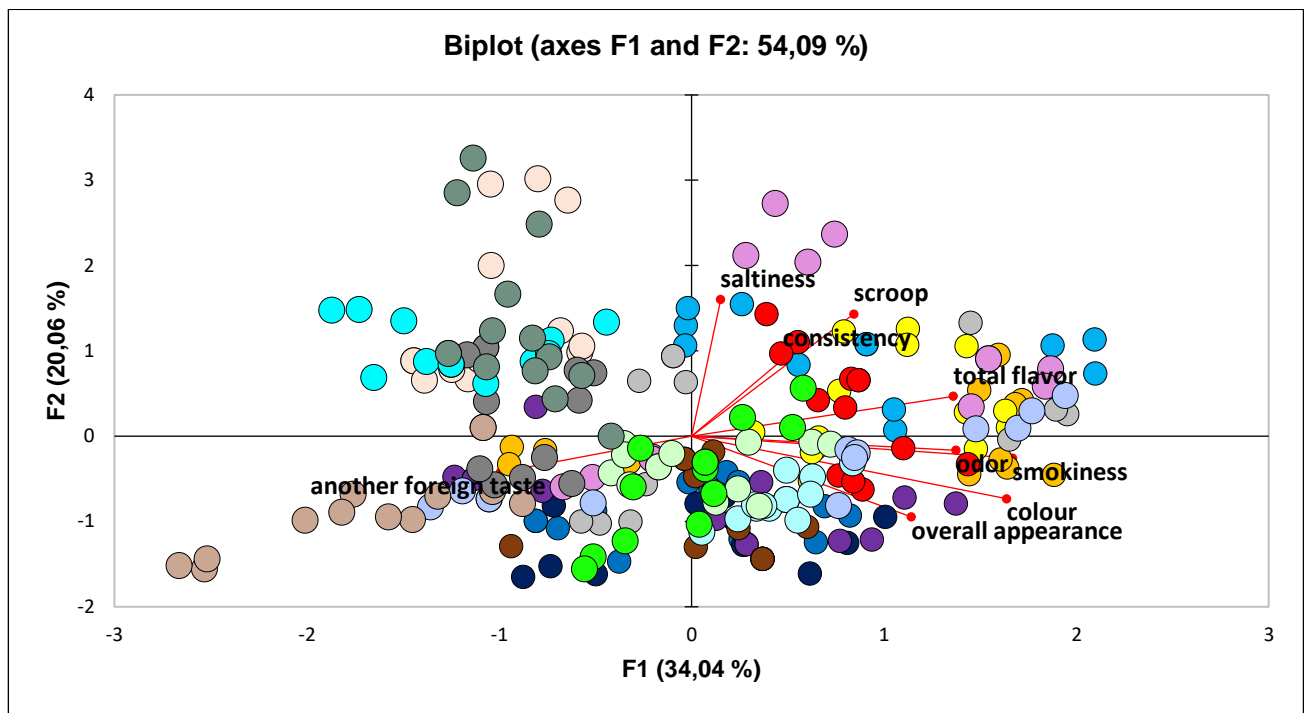
Note: SD, Cv n = 15, General Mean, SD and Cv n = 30. *Ewe's cheese, but not the Oštiepok cheese.



Note: Product No.:



Figure 7 PCA Analysis of Oštiepok cheeses (composition and textural parameters).



Note: Product No.:



Figure 8 PCA Analysis of Oštiepok cheeses (sensory parameters: saltines, scoop, consistency, total flavour, odor, smokiness, colour, overall appearance, another foreign taste).

According to **Olešová (2015)**, the average firmness of her own innovated oštiepok chesee ranged from 5.761 kg to 1.843 kg. The highest firmness had oštiepok after 5 weeks of maturing. Oštiepok cheeses after 2 weeks and 3 weeks of maturing did not differ in firmness. The average consistency of her own innovated oštiepok cheeses varied from 3.438 kg. s⁻¹ to 1.175 kg. s⁻¹. The highest consistency had the Oštiepok after 5 weeks of maturing. In our study, we have found the highest consistency in product No. 13 (2.259 kg. s⁻¹).

For consumers, texture is a very important factor of quality. It is mainly influenced by the degree of proteolysis, salt, fat and pH (**Pachlová et al., 2012**).

Cheese texture, especially firmness and sensory properties, changes during the maturing process (**Forde a Fitzgerald, 2000**). We agree with this, because evin in our work we have confirmed the change in the textural and organoleptic properties of cheeses during maturation.

Cheese texture, consistency and structure depend on the degree of primary proteolysis. Insufficient proteolysis can cause inadequate cheese consistency, which is described as a gum (**Rodriguez et al., 2011**).

The firmness of the cheese can also be influenced by the penetration of NaCl (**Pachlová et al., 2012**).

We have found statistically significant ($p < 0.001$) difference between the product No. 3 with the highest NaCl content (4.44 g.100g⁻¹) and the product No. 11 with the lowest NaCl content (1.52 g.100g⁻¹) in firmness parameter 2.078 kg vs 0.959 kg. But in our experiment, this could be influenced also by the difference in Dry matter content 62 wt% vs 58 wt% and Fat in dry matter content 49% vs 51%.

The results of sensory analysis

The results of the normality test showed that the data had a non-normal distribution; the Shapiro-Wilk's test value was < 0.05 . Subsequently, we performed a Kruskal-Wallis one-way ANOVA and we found that individual products were statistically different ($p < 0.001$) in all sensory parameters tested. Also, the Dunn's post hoc test identified, that there are significant ($p < 0.001$) differences between cheeses, specially between smoked and not smoked cheeses.

The sensory properties of Oštiepok cheeses were different because the technological process can slightly differ between the producers. Some of the most important factors, which can affect this process are: milk pasteurisation temperature, rennet, rennet dose and power, temperature of milk during curdling, different curd processing and mixing time, pressing to the form, salting, drying, smoking, temperature during storage and maturation. Differences in these technological steps lead to the differences in textural and sensory parameter, which we were identified in this work. The quality of the traditional product can varies from farm to farm and is also different among farmers.

Similar results and differences in quality of traditional products have also been achieved by **Čuboň et al. (2015)**

The temperature during cheese maturation influences the content of microorganisms (**Kunová, et al., 2015; Cwiková, 2015**).

In the case of microbial cross contamination, or inadequate pasteurisation, the risk of the presence of microorganisms will increase.



Figure 9 Product 1: Ewe's Oštiepok cheese 100% – smoked (Producer: Papúchová D. (Ružomberok, Slovakia), made in: PD Liptovské Revúce, Slovakia).



Figure 11 Product 3. Original ewe's Oštiepok cheese – smoked (Producer: Syrex – Zázrivá, Slovakia).



Figure 10 Product 2: Orava ewe's Oštiepok cheese – smoked (Producer: Pančí M. (Ružomberok, Slovakia), made in: Šurinák M. (KOLIBA Revišné, Veličná, Slovakia).



Figure 12 Product 4: Ewe's Oštiepok cheese – smoked (Producer: Plachtinská farm – Baránek, Slovakia).

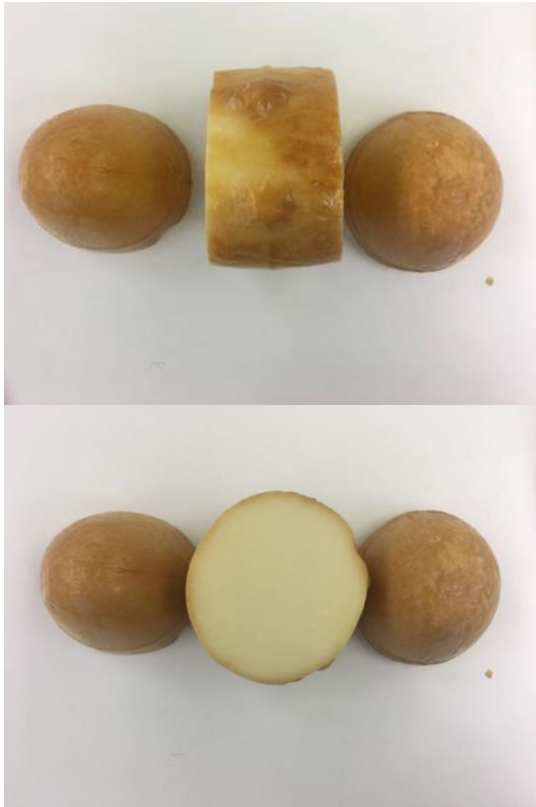


Figure 13 Product 5: Oštiepok, 100% ewe's cheese – smoked (Producer: Bryndziareň and syräreň – Zvolenská Slatina, Slovakia).



Figure 15 Product 7: Ewe's Oštiepok cheese – smoked (Producer: Badánik – Salaš Krajinka, Slovakia).



Figure 14 Product 6: Ewe's cheese Kolibka Spiš – smoked (Producer: Endel M. – VALACH (Sp. Nová Ves, Slovakia), made in: Kluknavská dairy – OOD Jaklovce, Slovakia), (Note: this is Ewe's cheese, not the Oštiepok cheese).



Figure 16 Product 8: Oštiepok Ewe's cheese – smoked (Producer: Konečný I. – KONNY (Trenčín, Slovakia), made in: Dairy Krivá, Slovakia).



Figure 17 Product 9: Ewe's Oštiepok cheese – smoked (Producer: Zúbek M. – OBERT(Ladce, Slovakia)).



Figure 19 Product 11: Ewe's Oštiepok cheese – smoked (Producer: Agrosev made in: Plachtinská farm Baránek, Slovakia).



Figure 18 Product 10: Ewe's Oštiepok cheese – smoked (Producer: Zvara J. (Detva, Slovakia)).

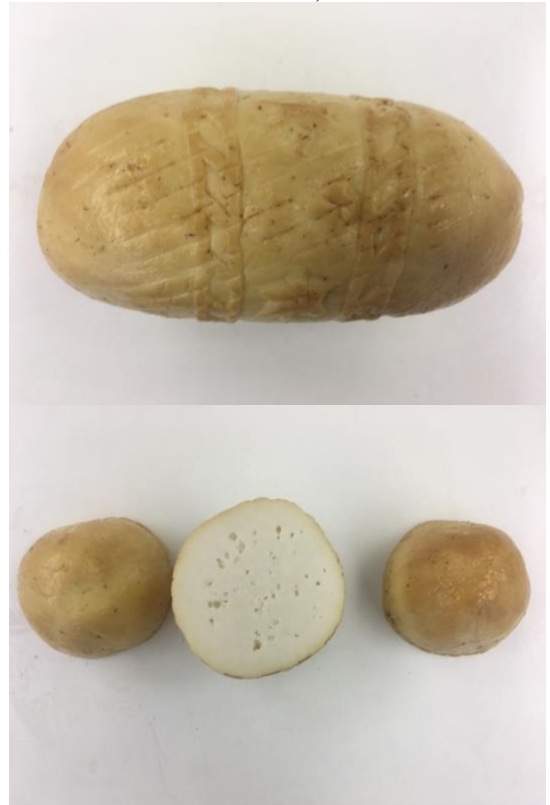


Figure 20 Product 12: Oštiepok – Ewe's cheese – smoked (Producer: AgroIna (Banská Bystrica, Slovakia)).



Figure 21 Product 13: Original Oštiepok ewe's cheese - smoked (Producer: Chlustová P. (Liptovský Mikuláš, Slovakia), made in: Syrex (Zázrivá, Slovakia)).

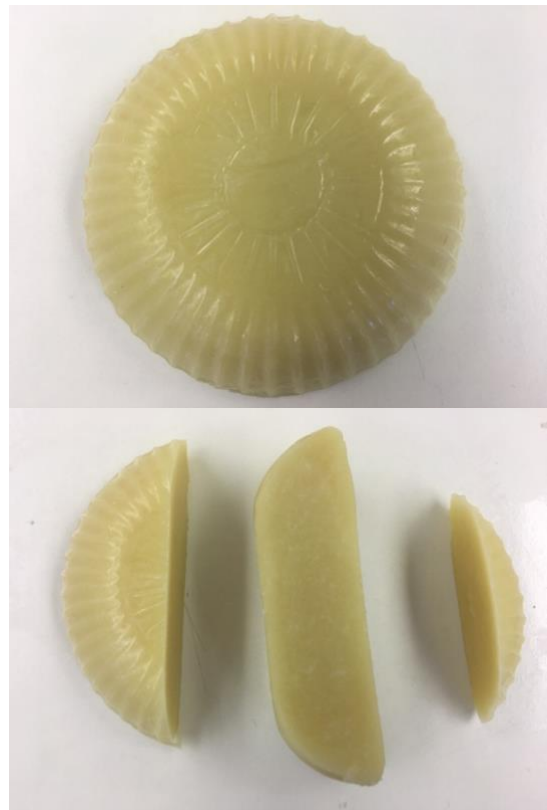


Figure 23 Product 15: Ewe's cheese Kolibka Spiš - steamed (Producer: Endel M. Jr. – VALACH (Sp. Nová Ves, Slovakia), made in: Kluknavská dairy – ODD Jaklovce, Slovakia) (Note: this is Ewe's cheese, not the Oštiepok cheese).



Figure 22 Product 14: Orava ewe's cheese – smoked (not (Producer: Válek M. (Revišné – Veličná, Slovakia), made in: Šurinák M. – Koliba Revišné (Veličná, Slovakia)) (Note: this cheese was not labelled as the Oštiepok cheese, but it meets its requirements).



Figure 24 Product 16: Original ewe's Oštiepok cheese – fresh (Producer: Chlustová P. (Liptovský Mikuláš, Slovakia), made in: Syrex (Zázrivá, Slovakia)).



Figure 25 Product 17: Oštiepok Ewe's cheese – fresh (Producer: Dairy Krivá (Krivá, Slovakia)).



Figure 27 Product 19: Original ewe's Oštiepok cheese – fresh (Producer: Syrex (Zázrivá, Slovakia)).



Figure 26 Product 18: Orava ewe's Oštiepok cheese – fresh (Producer: Panči M. (Ružomberok), made in: Šurinák M. – Koliba Revišné (Veličná, Slovakia)).

There is a lot of microorganisms, which can affect the quality and safety of the product.

The process of cheese maturation affects the growth of probiotic cultures in cheese (Poľáková, Dudriková and Gallo, 2010; Lovayová et al. 2010).

The occurrence of *S. aureus*, *E. coli* and others microorganisms in ewe's milk can lead to the serious health problems (Poľáková, Dudriková and Gallo, 2011; Medved'ová et al. 2010).

It is necessary to follow the rules of good hygiene practice, good manufacturing practice, sanitation, to use raw milk of good quality in the production of cheese and to follow the HACCP system guide (Medved'ová et al. 2010; Zajác, Čapla and Golian, 2017a; Zajác, Čapla and Golian, 2017b), which was prepared and by the Union of sheep and goats breeders in Slovakia and implemented in all small salaš farms in our country.

In our experiment we have identified one product, No. 9 (Figure 17) with evident microbial defect. In the cut of this cheese you can see an activity of sporiform microorganisms (a lot of air cavities in cheese). This defect could occur not only for technological reasons but also as a result of transport or storage at the wrong temperature.

Sensory properties can be influenced by the addition of flavorings (Pavelková, Flimelová and Vietoris, 2012), but in our experiment we didn't find any cheese with additional flavorings. All of the producers were used only the raw materials authorized by legislation (milk, rennet, NaCl and some of them also CaCl₂).

Majcher et al. (2011) states that in shaping curd into a characteristic shape is the cheese pressed into a two-part wooden mold with a cut out ornament, obtaining a Oštiepok

cheese that will be decorated on the surface with an ornament.

We agree, cheeses analysed in this work had characteristic special shape, taste and odor and overall appearance. We found that most of the Oštiepok cheese had these properties (Figures 9 – 27), but two of them, product No. 6 and No. 15 does not comply this traditional shape.

The natural preservation method, such as smoking at the salaš (small farm in the mountain region) delivers to Oštiepok cheese a typical golden brown to brown color and typical taste. (Majcher a Jelen, 2011) and these aromatic compounds play a very important role in the quality of food (Attaie, 2009, Benešová, Golian and Zajác, 2018).

It is, because cheese taste is the result of the balance between volatile and non-volatile chemical compounds (Hayaloglu et al., 2013) and the smoking of cheese add extra portion of these volatile compounds.

From the consumer point of view, it is important to ensure the quality and safety of the products. Because ewe's milk is more expensive than cow's milk, adulteration of Oštiepok cheese may occur. Oštiepok cheese produces with the addition of cow's milk are issued as products made only from ewe's milk. Various laboratory methods can be used to detect adulteration (Zeleňáková et al., 2016).

As part of our experiment, we have tested three ewe's cheeses, which were not the Oštiepok cheese (Products No. 6, No. 14 and No. 15) but sometimes the consumers may buy them instead of the Oštiepok cheese. These products had a different look, they were shaped like a bowl or the loaf. The composition of these cheese were similar to Oštiepok cheeses. The producer of the product No. 14. didn't use the possibility to mark this product as the Oštiepok cheese despite the fact that this product meets the requirements of the Oštiepok cheese. In the case of the Products No. 6 and 15 the difference was in one extra technological step – steaming the cheese in hot water and in the case of the product No. 15 also the the addition of dairy culture. The labelling of these products was correct. The producers correctly did not mark them as the oštiepok cheese.

The consumers can distinguish traditional products, but some may have a problem. It is therefore appropriate to designate such products with a specific protected geographical indication PGI mark of the European Union. At the time of our experiment, no producer of Oštiepok cheese in Slovakia used the protected geographical indication (PGI) mark “Slovenský oštiepok” in the product labelling or in its immediate vicinity of the product during its sale despite the fact that the Slovak Republic has such possibility given by the European Union and Slovak legislation. It means, the competent government authority Ministry of Agriculture and Rural Development of the Slovak Republic and interested parties like the Dairy association of the Slovak Republic or the Union of sheep and goat breeders of the Slovak Republic should do more to inform the producers of the possibility to mark this Slovak national specialty with PGI mark and help them with a bureaucratic process of this matter. It will then be necessary to carry out an information campaign for consumers to recognize such traditional products from ordinary products in the market.

CONCLUSION

Oštiepok cheese is a traditional half-fat semi-hard cheese made in Slovakia. Oštiepok cheese can be made from raw ewe's milk, a mixture of ewe's and cow's milk or cow's milk. Oštiepok cheese is characterised by its remarkable shape, that of a large egg, pine cone or ellipsoid, and is decorated according to the practices and with the typical designs of the individual area in which it is produced. The surface of this cheese is firm, smooth and shiny. Subsequent smoking gives the product its typical colour, smoked aroma and taste. This special process is originated in and is carried out throughout the entire delimited area of Slovakia mainly in small mountains farms called salaš or in dairy companies. We have found significant ($p < 0.001$) differences between Oštiepok cheeses from different regions of the Slovakia. The mean values of composition of Oštiepok cheese was: dry matter 58 wt%, fat in dry matter 49%, fat 28.42 g.100g⁻¹, carbohydrates 1.81 g.100g⁻¹, protein 22.62 g.100g⁻¹, NaCl 2.85 g.100g⁻¹, other minerals 1.83 g.100g⁻¹. The overall mean of firmness of all cheeses was 1.349 ± 0.705 kg and Cv 52%. The overall mean of consistency of all cheeses was 1.045 ± 0.578 kg.s⁻¹ and Cv 55%.

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