

TEXTURAL PROPERTIES OF SELECTED SLOVAK COW AND SHEEP PRODUCTS MEASURED BY TEXTUROMETER

Mária Angelovičová, Mária Angelovičová ml.

ABSTRACT

Sensorial assessment of selected brands of Slovak cow and sheep products, produced on farm with self-production of cow and sheep milk, was realized. The farm is situated in the North of east Slovakia. Breeding of dairy cows and sheep was realized under conditions applying animal welfare, where feedstuff was provided from self-production. By means of texture analyzer (*Texture Analyser TA.XT Plus*), textural properties (*hardness, springiness, cohesiveness and chewiness*) of sheep feta cheese, smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese, were assessed. Texture analyzer is used for texture measurement and assessment of physical properties of products, as well as for material testing by means of pressure and pull tests. Textural properties were assessed, when strength, distance and time were recorded and projected by means of fully integrated Texture Exponent 32-bit software. The measurement was realized by test, when analyzer arm with selected sensor moved down, penetrated and compressed food product and moved to default position thereafter. Statistically significant differences ($p < 0.05$) were detected at *hardness* by means of statistical results evaluation obtained from texturometer measurement of cow and sheep products samples. Sheep feta cheese was compared to smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese. Statistically significant differences ($p < 0.05$) were confirmed, when we compared smoked sheep cheese to spicy pickled sheep feta cheese, when we compared unsmoked cow cheese strings to pickled sheep feta cheese and spicy pickled sheep feta cheese and by comparison of smoked cow cheese sticks to pickled sheep feta cheese and spicy pickled sheep feta cheese. Statistically significant differences ($p < 0.05$) were confirmed at *springiness*, when we compared sheep feta cheese to unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese and by comparison of smoked sheep cheese to unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese. Statistically significant differences ($p < 0.05$) were confirmed at *cohesiveness*, when we compared sheep feta cheese to smoked sheep cheese, when we compared smoked sheep cheese to smoked cow cheese sticks and pickled sheep feta cheese, by comparison of smoked sheep cheese to spicy pickled sheep feta cheese and by comparison of unsmoked cow cheese strings to smoked cow cheese sticks. Differences at *chewiness* were statistically significant ($p < 0.05$), when we compared sheep feta cheese to smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese, when we compared smoked sheep cheese to spicy pickled sheep feta cheese, by comparison of unsmoked cow cheese strings to pickled sheep feta cheese and spicy pickled sheep feta cheese and by comparison of smoked cow cheese sticks to pickled sheep feta cheese and spicy pickled sheep feta cheese. Based on obtained analysis results were confirmed, that selected brands of cow and sheep products are characterized by different textural properties. These properties make assessed brands of Slovak cow and sheep product specific, which needs to make provision at quality assessment.

Keywords: Slovak product; cow cheese; sheep cheese; texturometer; textural property

INTRODUCTION

Cow milk is rich in nutrients, especially calcium, phosphorus, potassium, magnesium, iodine, zinc, carotenoids and A, D, E vitamins. Lysine, Tyrosine, Phenylalanine, Leucine and Glutamic acid belong among favourable amino acids in proteins (Havlová et al., 1993). Cow milk belongs to the most important kinds of milk, considering worldwide market production and economic importance (Březina a Jelínek, 1990). Cow milk contains approximately 3.14% of proteins (Xin et al., 2006).

Wheyish proteins create nearly 20% (Madureira et al., 2007) and caseins create 80% (Wal, 1998) of total content of proteins. Zajác et al., (2012) were analysed 24 460 of cow milk samples in Slovakia in 2011. Authors found that 75.42% of samples had a fat content >3.6 g/100g, 79.91% of samples had protein content >3.2 g/100g. Sheep milk has significantly higher protein content and more milk fat compared to cow milk. An average milk composition contains 5.5% of protein, 7% of fat, 5% of sugar and 0.9% of ash material. Sheep milk is richer in B vitamin compare

to cow milk (Špánik, 1992). Sheep milk quality requirements are set out in STN 57 05 10 Sheep milk, which came into force in May 1995, in Codex Alimentarius, 6th head - Milk and milk products, which came into force in 2000 (Špánik, 2003) and in Regulation of the Government of the Slovak Republic No. 312 of 9 July 2003. Píknová et al. (2002) focus on fact, that sheep and goat milk is more expensive and richer in nutrients compared to cow milk. Although a production of sheep and goat milk is seasonal, a counterfeiting of sheep and goat cheeses occurred (with non-declared addition of cow milk component). Within the aim of Sandwich ELISA method optimisation used to detect sheep milk and its products counterfeiting under laboratory conditions, Zeleňáková et al., (2010) detected different cow milk additives. The analysis results shows, that for better examination of lower concentrations, it is necessary to specify suitable dilution of various cow milk concentrations in relation of their heat treatment and further technological processing. Optimisation of ELISA tests, used to detect cow milk in sheep milk and its products, requires further laboratory studies to discover quality, reliable and economically effective method for standard utilization. Cow milk contains allergenic protein; therefore, cow milk belongs to food allergens causing allergies, which especially occur during infancy (Wal, 2001, 2004; Fiocchi, 2011). A cross allergy between cow, sheep and goat is caused by α -Casein similarity. 85% of α -Casein amino acids of selected kinds of milks are identical (Spurgin et al., 1997; Wal, 2004). Many production systems are used at cheese production, which can cause protein modification. A segregation of wheyish fraction can occur as well. Allergenic potential of cheeses and other milk products have not been assessed properly. It is known, based on clinical practice experiences that allergic reaction caused by cheese occurs at individuals allergic to cow milk. Similarly, bakery products, chocolate and sausages with milk protein additive caused many allergic reactions. These products preserved

allergenicity even though milk protein have been processed by means of different technological procedures (Fiocchi et al., 2004).

Consumers preferences on basic foodstuff (milk and cheeses included) are summarized in complex studies from 1960-1970. In this period, the food research was focused on consumer research in relation of social aspect, whereby some general principles were developed related to consumer acceptance and deprecation of food as well as developmental work direction (Szczesniak a Kleyn, 1963; Szczesniak a Kahn, 1971; Szczesniak, 1971, 1972). Food textural properties belong among the basic factors effecting food quality and safety.

The general principles of food textural properties adopted based on selected methods conclusions from 1960-1970, are applied to this day. This type of study requires repetition and reassessment. It is necessary to learn about consumer preferences on textural properties considering changes in life style and eating habits, their assessment in food industry and their selling aspect (Szczesniak, 1990).

Many progressive results about food texture were obtained by means of interdisciplinary research (Szczesniak, 1975). The beginning of this type research is connected to the work of George W. Scott Blair originated based on cooperation in the field of physical chemistry/ rheology and psychology, food industry, medicine, sociology and physiotherapy afterwards. Cooperation is extended in the field of programming and mathematical-statistical modelling (Szczesniak, 2002). Nowadays, textural properties of foodstuff and foodstuff materials are often assessed by means of specialized multi-purpose analyzers. Best-known analyzers, used for this kind of assessment, are Texturometer TA.XT Plus and Texturometer TA.XT Express, designed for pressure and pull tests. These devices have wide variety of measuring adapters (extensions), which enable to assess different materials as well as wrapping materials (Mathevon et al., 1995).

Table 1 Percentage and content of individual proteins from a total content of cow milk proteins (Wal, 1998)

Wheyish proteins (20%)	β -lactoglobulin	10%	3 - 4 g.l ⁻¹
	α -lactalbumin	5%	1 - 1.5 g.l ⁻¹
	immunoglobulin	3%	0.8 - 1.0 g.l ⁻¹
	serum albumin	1%	0.1 - 0.4 g.l ⁻¹
	lactoferrin	traces	0.09 g.l ⁻¹
Caseins (80%)	α -casein _{s1}	32%	12 - 15 g.l ⁻¹
	α -casein _{s2}	10%	3 - 4 g.l ⁻¹
	β -casein	28%	9 - 11 g.l ⁻¹
	κ -casein	10%	3 - 4 g.l ⁻¹

MATERIAL AND METHODS

The object of our study was Slovak foodstuff produced from raw cow and sheep milk: sheep feta cheese, smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese. Products were obtained from farm, which produces them and is focused on cow and sheep breeding. The farm is situated in the North of east Slovakia. The farm was established in 1999 and is focused

on dairy cows, beef cattle and sheep breeding. On farm, there are 35 pieces of Slovak Spotted Cattle, which is used for both meat and milk production and 28 pieces of Charolais cattle used only for meat production. There are 5 pieces of Holstein cattle (dairy cows), which milk production is used for final products production. The farm has been focused on Lacaune sheep breeding since 2012. Nowadays on farm, there are 650 dairying sheep, which

production is further processed to final products from raw sheep milk.

Properties monitored by means of texturometer and measurement procedure

These properties were assessed by means of texturometer: hardness, springiness, cohesiveness and chewiness.

Methodical working procedure of texturometer

Textural properties were assessed according to procedures described by Alfaig et al. (2013) and Lyon and Lyon (1990). We modified the preparation of the samples and adapted to the samples sheep and cow cheese products. The texture profile analysis was performed on cheese samples, with TA-XT Plus Texture Analyzer (Stable Micro System, Surrey, UK). From each type of cheese ten samples were tested and the tested sample dimensions were 10×10×10 mm. The samples were examined using a Stable Micro Systems Type version 5.0, 9.0). A three-inch diameter compression plate was installed to the 25 kg load cell of the analyzer. A 5-kg weight was used to calibrate the 25 kg load cell prior to analysis and the setting was adjusted at a pretest speed of 5 mm/s, a test speed of 10 mm/s and a posttest speed of 5 mm/s. All samples were compressed twice to 50% of their original height using a cylindrical-shaped piston, 38 mm in diameter and the measurements were made at ambient temperature. The obtained texture profiles were used to measure the instrumental hardness, springiness, cohesiveness, and chewiness of the cheese samples. Hardness is the force needed for the 1st compression H1. Springiness (D2/D1) is the ratio between the distance or time of contact for the 2nd compression (D2) to the distance or time of contact for the 1st compression (D1).

Statistical analysis

Results were prepared by means of calculations based on these variables: μ - mean (average value), σ - standard deviation, c_v - coefficient of variation.

Differences between individual groups were tested by means of Scheffe's test at significance level 0.05 in SAS system program, version 8.1.

RESULTS

Statistically significant differences ($p < 0.05$) of hardness were between: sheep feta cheese and smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively; pickled sheep feta cheese and smoked sheep cheese, smoked cow cheese sticks, respectively; spicy pickled sheep feta cheese and smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, respectively.

Values of cow and sheep products hardness ranged from 0.25 (unsmoked cow cheese strings) to 4.77 (sheep feta cheese). Low values of hardness, 0.28 and 0.78 were detected at smoked cow cheese sticks and smoked sheep cheese; higher values 1.41 and 2.1 were detected at pickled sheep feta cheese and spicy pickled sheep feta cheese. Based on statistical characteristic results was detected, that the lowest value variation were at sheep feta cheese expressed by coefficient of variation $c_v = 17.19\%$ and the

highest value variation expressed by coefficient of variation $c_v = 46.64\%$ were at smoked cow cheese sticks. Based on statistical assessment of hardness differences between cow and sheep products, statistical significance ($p < 0.05$) was detected between sheep feta cheese and smoked sheep cheese, between sheep feta cheese and unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, between sheep feta cheese and pickled sheep feta cheese, sheep feta cheese and spicy pickled sheep feta cheese, smoked sheep cheese and spicy pickled sheep feta cheese, between unsmoked cow cheese strings and pickled sheep feta cheese, between unsmoked cow cheese strings and spicy pickled sheep feta cheese, between smoked cow cheese sticks and pickled sheep feta cheese and between smoked cow cheese sticks and spicy pickled sheep feta cheese.

Springiness of cow and sheep products

Statistically significant differences ($p < 0.05$) of springiness were between: sheep feta cheese and unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively; smoked sheep cheese and unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively. Measured values of cow and sheep products springiness ranged from 0.62 (spicy pickled sheep feta cheese) to 0.75 (smoked sheep cheese). Measured values of cow and sheep products were relatively balanced. Higher value as mean minimal value was detected at pickled sheep feta cheese (0.63), smoked cow cheese sticks or unsmoked cow cheese strings (0.65); springiness of sheep feta cheese (0.72) was close to the value of smoked sheep cheese (0.72). Relatively balanced sheep and cow products springiness values were supported by coefficient of variation results, which values ranged from $c_v = 2.39\%$ (smoked sheep cheese) to $c_v = 8.50\%$ (spicy pickled sheep feta cheese). Based on statistical assessment of springiness differences between cow and sheep products, statistical significance ($p < 0.05$) was detected between sheep feta cheese and unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, between sheep feta cheese and pickled sheep feta cheese, between sheep feta cheese and spicy pickled sheep feta cheese, between smoked sheep cheese and unsmoked cow cheese strings, between smoked sheep cheese and smoked cow cheese sticks, between smoked sheep cheese and pickled sheep feta cheese and between smoked sheep cheese and spicy pickled sheep feta cheese.

Statistically significant differences ($p < 0.05$) of cohesiveness were between: sheep feta cheese and smoked sheep cheese; smoked sheep cheese and smoked cow cheese sticks, pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively; unsmoked cow cheese strings and smoked cow cheese sticks.

The assessment of cow and sheep products cohesiveness measurement detected, that springiness values ranged from 0.76 (smoked cow cheese sticks) to 0.87 (smoked sheep cheese). Cohesiveness values of other measured cow and sheep products were 0.8 (sheep feta cheese, pickled sheep feta cheese and spicy pickled sheep feta cheese) and 0.83 (unsmoked cow cheese strings). Statistical characteristic results present, that cohesiveness value variation of cow

and sheep products was relatively low, which is supported by coefficient of variation results from $cv = 1.07\%$ (smoked sheep cheese) to $cv = 6.08\%$ (smoked cow cheese sticks). Based on statistical assessment of cohesiveness differences between cow and sheep products, statistical significance ($p < 0.05$) was detected between sheep feta cheese and smoked sheep cheese, between smoked sheep cheese and smoked cow cheese sticks, between smoked sheep cheese and pickled sheep feta cheese, between smoked sheep cheese and spicy pickled sheep feta cheese and between unsmoked cow cheese strings and smoked cow cheese sticks.

Statistically significant differences ($p < 0.05$) of chewiness were between: sheep feta cheese and smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks, pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively; smoked sheep cheese and spicy pickled sheep feta cheese; unsmoked cow cheese strings and pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively; smoked cow cheese sticks and pickled sheep feta cheese, spicy pickled sheep feta cheese, respectively.

Based on statistical assessment results of cow and sheep products chewiness was detected, that the highest value was at sheep feta cheese (2.78) and the lowest value was at

unsmoked cow cheese strings, resp. smoked cow cheese sticks (0.13, 0.14, respectively). The values of chewiness of other measured cow and sheep products were 0.52 (smoked sheep cheese), resp. 0.72 (pickled sheep feta cheese) and 1.05 (spicy pickled sheep feta cheese). The variation of chewiness values of cow and sheep products were supported by results of statistical characteristic values. The values of coefficient of variation ranged from $cv = 18.55\%$ (smoked sheep cheese) to $cv = 54.99\%$ (smoked cow cheese sticks). Based on statistical assessment of chewiness differences between cow and sheep products, statistical significance ($p < 0.05$) was detected between sheep feta cheese and smoked sheep cheese, between sheep feta cheese and unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, sheep feta cheese and pickled sheep feta cheese, between sheep feta cheese and spicy pickled sheep feta cheese, between smoked sheep cheese and spicy pickled sheep feta cheese, between unsmoked cow cheese strings and pickled sheep feta cheese, between unsmoked cow cheese strings and spicy pickled sheep feta cheese, between smoked cow cheese sticks and pickled sheep feta cheese and between smoked cow cheese sticks and spicy pickled sheep feta cheese.

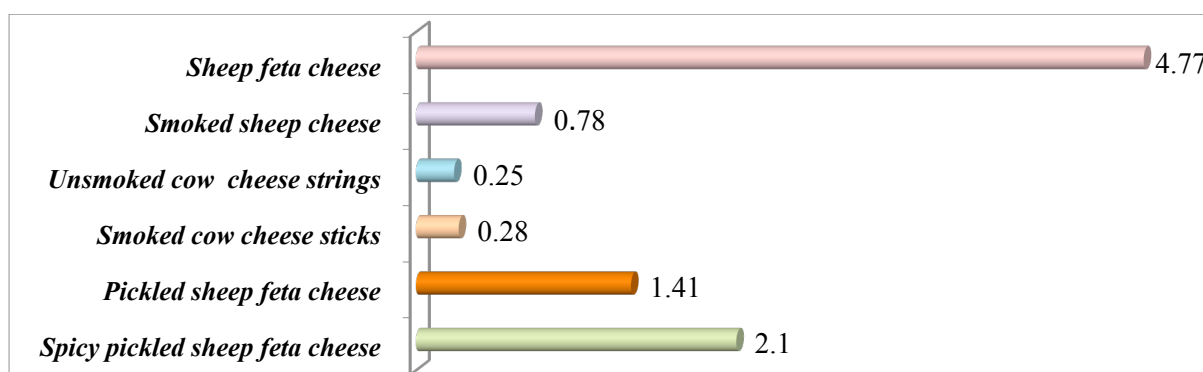


Figure 1 Mean value of cow and sheep products hardness (kg)

Table 2 The results of the statistical characteristics of hardness of cow and sheep products

Sheep and cow products	σ (kg)	c_v (%)
Sheep feta cheese	0.82	17.19
Smoked sheep cheese	0.17	21.90
Unsmoked cow cheese strings	0.06	23.10
Smoked cow cheese sticks	0.13	46.64
Pickled sheep feta cheese	0.36	25.38
Spicy pickled sheep feta cheese	0.71	33.82

σ - standard deviation, c_v - coefficient of variation

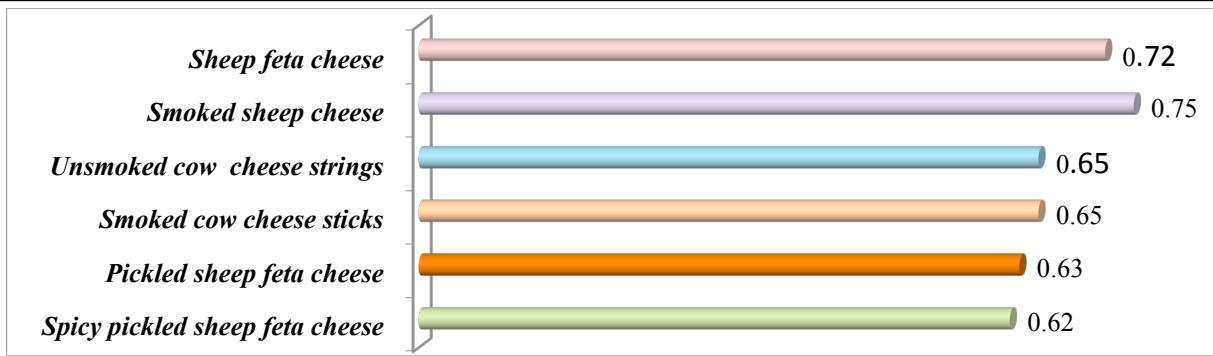


Figure 2 Mean value of cow and sheep products springiness (kg)

Table 3 The results of the statistical characteristics of springiness of cow and sheep products

Sheep and cow products	σ (kg)	c_v (%)
Sheep feta cheese	0.02	3.29
Smoked sheep cheese	0.02	2.39
Unsmoked cow cheese strings	0.02	3.26
Smoked cow cheese sticks	0.05	7.17
Pickled sheep feta cheese	0.05	7.92
Spicy pickled sheep feta cheese	0.05	8.50

σ - standard deviation , c_v - coefficient of variation

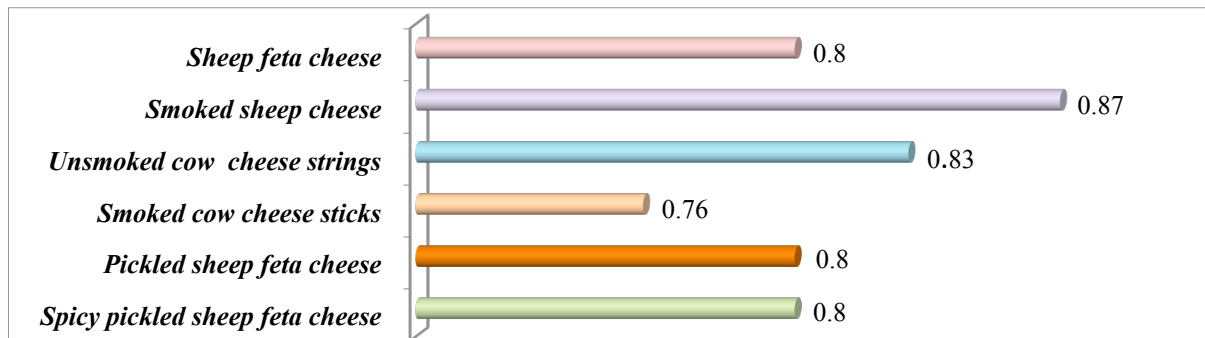


Figure 3 Mean value of cow and sheep products cohesiveness (kg)

Table 4 The results of the statistical properties of cohesiveness of cow and sheep products

Sheep and cow products	σ (kg)	c_v (%)
Sheep feta cheese	0.04	5.07
Smoked sheep cheese	0.01	1.07
Unsmoked cow cheese strings	0.04	4.99
Smoked cow cheese sticks	0.05	6.08
Pickled sheep feta cheese	0.03	3.84
Spicy pickled sheep feta cheese	0.02	2.53

σ - standard deviation, c_v - coefficient of variation

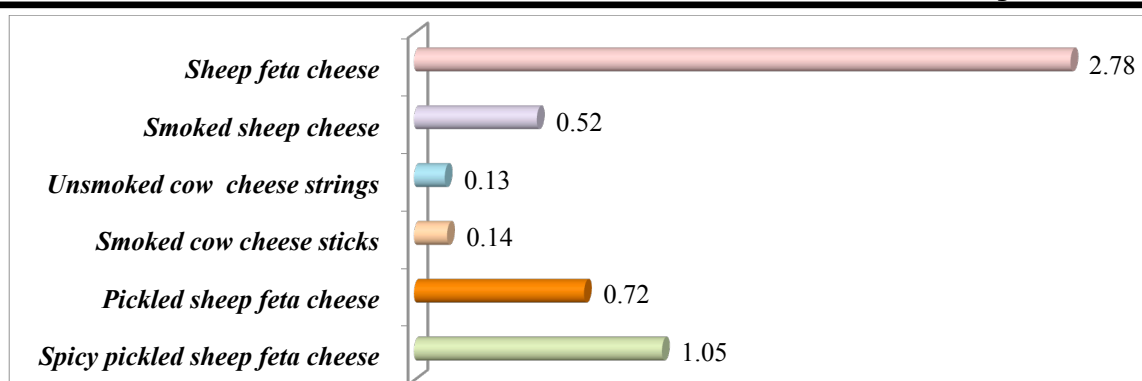


Figure 4 Mean value of cow and sheep products cohesiveness (kg)

Table 5 The results of the statistical characteristics of chewiness of cow and sheep products

Sheep and cow products	σ (kg)	c_v (%)
Sheep feta cheese	0.55	19.90
Smoked sheep cheese	0.10	18.55
Unsmoked cow cheese strings	0.03	23.10
Smoked cow cheese sticks	0.08	54.99
Pickled sheep feta cheese	0.22	29.95
Spicy pickled sheep feta cheese	0.39	37.10

σ - standard deviation, c_v - coefficient of variation

DISCUSSION

According to **Kopáček (2009)**, cheeses maturing in salt brine belong to the oldest cheeses in the world. Feta cheese belongs to these kinds of cheeses. **Ridgway (2001)** points out, that original feta cheese never turns yellow and for consumer is available in soft and hard springiness. This kind of cheese was awarded with stamp of originality in 2002, i.e. has a protected origin. Textural property results, obtained by measurement of feta cheese samples demonstrate, that sheep feta cheese achieve the highest values of hardness and chewiness assessment. Statistically significant differences ($p < 0.05$) at hardness and chewiness were confirmed, when we compare sheep feta cheese to smoked sheep cheese, unsmoked cow cheese strings, smoked cow cheese sticks and pickled sheep feta cheese. The smoked cheeses are produced from fresh sheep milk, which is sulphurized and accrued cheese curd is left to drain away. Sliced pieces of cheese curd are placed in salt brine. Official Journal of the European Union contains **Commission Regulation (EU) No. 930/2010**, entering a name in the register of traditional specialities guaranteed „Ověř saláňický úděný syr“. Textural property results, obtained by measurement of smoked sheep cheese samples demonstrate, that smoked sheep cheese achieve the highest values of springiness and cohesiveness compared to other samples of cow and sheep milk products. This textural property of smoked sheep cheese was statistically significant ($p < 0.05$) compared to unsmoked cow cheese strings, smoked cow sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese. Statistical significance ($p < 0.05$) was confirmed at cohesiveness assessment of smoked sheep cheese compare to smoked cow cheese sticks, pickled sheep feta cheese and spicy pickled sheep feta cheese. Steamed cheeses are produced from unpasteurized sheep or cow milk, when cheese with necessary level of culturing (pH 4.8 - 5.5) is

crumbled and processed by steam. Cheese steaming is realized according to methodical procedure in water under temperature of 75 - 90 °C. Cheese curd gains a plastic springiness, which enables to pull cheese strings (**Březina et al., 2001**). These strings are produced in smoked and unsmoked form. The pickled cheeses are produced from sheep, goat and cow milk, as well as their combination. Pickled cheeses are known as pickled unskimmed and skimmed white cheeses produced according to traditional procedure (**Drake et al., 1996**), but can be produced from fresh, soft, semi-hard, hard cheeses, as well as from cheeses with molds on the rind or throughout and steamed cheeses. Results of cow and sheep milk products assessment demonstrate, that pickled sheep feta cheese and spicy pickled sheep feta cheese have the second highest values of hardness (spicy pickled sheep feta cheese), respectively the third highest ones (pickled sheep feta cheese) after sheep feta cheese. Cohesiveness values of these cheeses were equal to sheep feta cheese values and have the second highest values of chewiness (spicy pickled sheep feta cheese), respectively the third highest ones (pickled sheep feta cheese) after sheep feta cheese. These results will benefit an extension of information in the field of food quality and food safety assessment. Much literature information from the field of textural properties assessment came from 1960-1970. **Szczesniak (1990)** recommended to learn about consumer preferences on textural properties considering changes in life style and eating habits, their assessment in food industry and their selling aspect.

CONCLUSION

Milk and milk products have a key position in human nutrition. Cow milk, as well as sheep milk is used for milk products production, where cheeses create an important part of a production. Texture Analyser assessment of cow

and sheep milk products demonstrates these textural property results:

- the highest value of *hardness* was detected at sheep feta cheese (4.77), the lowest value was at pickled sheep feta cheese (1.41); statistically significant differences ($p < 0.05$) of cow and sheep products were confirmed at hardness, when we compared sheep feta cheese to smoked sheep cheese, between sheep feta cheese and unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, between sheep feta cheese and pickled sheep feta cheese; sheep feta cheese and spicy pickled sheep feta cheese, smoked sheep cheese and spicy pickled sheep feta cheese, between unsmoked cow cheese strings and pickled sheep feta cheese, between unsmoked cow cheese strings and spicy pickled sheep feta cheese, between smoked cow cheese sticks to pickled sheep feta cheese and between smoked cow cheese sticks to spicy pickled sheep feta cheese,

- the highest value of *springiness* was detected at smoked sheep cheese (0.75), the lowest value was at spicy pickled sheep feta cheese (0.62); statistically significant differences ($p < 0.05$) of cow and sheep products were confirmed at springiness, when we compared sheep feta cheese to unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, between sheep feta cheese and pickled sheep feta cheese, between sheep feta cheese and spicy pickled sheep feta cheese, between smoked sheep cheese and unsmoked cow cheese strings, between smoked sheep cheese and smoked cow cheese sticks, between smoked sheep cheese and pickled sheep feta cheese and between smoked sheep cheese and spicy pickled sheep feta cheese,

- the highest value of *cohesiveness* was detected at smoked sheep cheese (0.87), the lowest value was at smoked cow cheese sticks (0.76); statistically significant differences ($p < 0.05$) of cow and sheep products were confirmed at cohesiveness, when we compared sheep feta cheese and smoked sheep cheese, between smoked sheep cheese and smoked cow cheese sticks, between smoked sheep cheese and pickled sheep feta cheese, between smoked sheep cheese and spicy pickled sheep feta cheese and between unsmoked cow cheese strings and smoked cow cheese sticks,

- the highest value of *chewiness* was detected at sheep feta cheese (2.78), the lowest value was at unsmoked cow cheese strings, resp. smoked cow cheese sticks (0.13, 0.14, respectively); statistically significant differences ($p < 0.05$) of cow and sheep products were confirmed at *chewiness*, when we compared sheep feta cheese and smoked sheep cheese, between sheep feta cheese and unsmoked cow cheese strings, between sheep feta cheese and smoked cow cheese sticks, sheep feta cheese and pickled sheep feta cheese, between sheep feta cheese and spicy pickled sheep feta cheese, between smoked sheep cheese and spicy pickled sheep feta cheese, between unsmoked cow cheese strings and pickled sheep feta cheese, between unsmoked cow cheese strings and spicy pickled sheep feta cheese, between smoked cow cheese sticks and pickled sheep feta cheese and between smoked cow cheese sticks and spicy pickled sheep feta cheese.

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Contact address:

prof. Ing. Mária Angelovičová, Ph.D., Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department of Food Hygiene and Safety, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: maria.angelovicova@uniag.sk.

Ing. Mária Angelovičová, PhD., Slovak University of Agriculture in Nitra, Faculty of Biotechnology and Food Sciences, Department of Food Hygiene and Safety, Tr. A. Hlinku 2, 949 76 Nitra, Slovakia, E-mail: maria.angelovicova@gmail.com.