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CHANGES IN CHOSEN PROPERTIES OF SOFT CHEESES WITH CHILLI PEPPER DURING STORAGE

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ABSTRACT

The aim of this study was to evaluate chosen physicochemical and sensory properties of soft cheeses with addition of chilli peppers *Fatalii*. These samples were packed into plastic vacuum packages and analysed during 14 days of storage at cooling temperature (6 ±1 °C). Within the physicochemical properties, dry matter content, fat content, moisture in fat-free-substance, fat in dry matter and pH values were determined. Physicochemical analyzes, except pH value measure, were carried out only on the 1th day following the cheeses production. Textural properties hardness and stickiness were measured by the texture analyser. Within the sensory properties, consistency (hard, spreadable and friable) and taste (salty and spicy) were evaluated. Measurements of pH value, textural and sensory analysis were carried out on the 1st, 7th and 14th day of storage. All of cheese samples were classified as full-fat (FDM 48.21%) soft (MFFS 71.92%) cheeses. Their pH values decreased during 14 days of storage. The hardness of cheese samples decreased (p <0.05), while their stickiness statistic significantly increased during storage. From the view of sensory evaluation, the hard consistency of cheeses statistic significantly decreased and the spreadable consistency increased (p <0.05) during storage. The changes of friable consistency were no statistic significant. During storage of cheese samples were observed statistic significantly increase in the spicy taste and statistic significantly decrease in the salty taste.

Keywords: cheese; chilli pepper; analysis

INTRODUCTION

Cheese is a dairy product that has played a key role in human nutrition. The broad range of different cheeses available is based mainly on regional conditions and production technology, which has been repeatedly adapted and optimized. The ambition to provide nutritive rich foodstuffs with appetizing flavour increased with the development of technologies and the growing competition. The different ingredients are added to modify the taste and smell of cheese. Addition of sodium chloride is necessary for sensory properties and texture development of cheeses. The texture and appearance of cheese are as important as the taste and they are ones of the first properties that consumers use to judge the kind and quality of cheeses **(Elsamani et al., 2014; Remeňová et al., 2017; Hailu et al., 2018)**.

Chilli peppers were originated and domesticated in the American tropics, and cultivated in New Zealand, South Africa, Malaysia and other Asian counties. All spices of them are still not known, there are to be 25–27 spices of *Capsicum*, of which five are namely and domesticated *Capsicum annuum* L., *Capsicum frutescens* L., *Capsicum baccatum* L., *Capsicum chinense* and *Capsicum pubescens* Ruiz and Pavon. Within these species there are several cultivars, these differ in shapes, sizes, colours and flavours **(Ali et al., 2016)**. Chilli peppers *Fatalii* are the kind of chilli peppers, which belong to species *Capsicum chinense* and come from South Africa. After maturation, colour of fatalii is yellow, red or orange **(Peter, 2001)**.

Chilli pepper is used as a food ingredient to add pungency due to the accumulation of capsaicin and spicy flavour, as well as a food colourant or natural preservative. The colours of chilli pepper are due to a mixture of esters of capsanthin, capsorubin, zeaxanthine, cryptoxanthine and other carotenoids. These extractable colours are used in the food processing industry to wide range of products such as meat products, cheeses, butters and condiment mixtures. Chilli pepper may be used as a spice and flavouring when it is dried and ground up, but also can be employed whole and alone or in combination with other flavouring agents. Capsaicin is the main active component of chilli peppers, followed by dihydrocapsaicin, homocapsaicin and others. These are called capsaicinoids together and are responsible for the pungency of chilli peppers. Chilli peppers contain

vitamins A, B-complex, C and E, and are rich in beta carotene and minerals like molybdenum, manganese and potassium. Chilli peppers have a number of biological properties and potential health benefits, such as antioxidant, anti-inflammatory, anti-arthritic, anticancer and antifungal properties **(Kothari et al., 2010; Tunde-Akintunde, 2010; Sricharoen et at., 2017; Ghanimah et al., 2018)**.

The physical and textural properties of cheese are influenced by the milk composition and manufacturing procedures. During storage, the textural properties of various cheeses can change as a result for biochemical processes **(Nedomová et al., 2017; Alinovi et al., 2018)**. Cheese ripening is a complex process consisting of microbiological, biochemical and chemical reactions that result in physicochemical changes, such as changes of pH value and breakdown of protein. These changes lead to loses firmness and toughness of cheese **(Aminifar et al., 2010)**. Hardness and stickiness belong to the monitored properties of cheeses. Hardness (firmness) is defined as high resistance to deformation by applied stress. Stickiness (adhesiveness) is defined as the tendency of cheese to resist separation from another material with which it makes contact **(Fox et al., 2004)**. The consistency of cheeses is affected by the final composition of cheese (dry matter content, fat content, fat in dry matter and pH value), the composition of raw materials, by the production technology and the storage conditions of cheese **(Černíková et al., 2017)**. In the development of texture, two distinct phases were identified. Within the first 7-14 days, residual coagulant enzymes are responsible for hydrolysis of α_{s1}-casein to the soluble fraction. This process reduces the rubbery texture of the cheese. The second phase includes proteolysis of the protein **(Hort and Le Grys, 2001)**. To produce a cheese with a suitable flavour and texture properties, the dairy industry has to monitor all the outcomes of the whole process, from the herd to distribution network. In monitoring and assessing sensory properties of cheese, the interaction between milk quality and the type of cheese to be produced is necessary to consider **(Cipolat-Gotet et al., 2018)**. Sensory methods study the sensory attributes of products, for example cheese, giving a profile consisting of taste, smell and texture for the product. In soft cheeses, flavour compounds such as ketones, acids, alcohols, esters are especially important **(Westling et al., 2016)**.

The aim of this study was to evaluate chosen physicochemical, textural and sensory properties of soft cheese with addition of chilli peppers during 14 days of storage.

Scientific hypothesis

We tested the changes of physicochemical, textural and sensory properties of soft cheeses with chilli addition during refrigerated storage in plastic vacuum packages. We expect that flavouring additive (chilli peppers) will have a positive effect on sensory and textural properties of cheeses.

MATERIAL AND METHODOLOGY

Preparation of chilli peppers

Chilli peppers *Fatalii* were obtained from a self-employed grower. Before application into cheese, chilli peppers were dried by hot air dryer at 50 °C. Chilli peppers were grinded up also with seeds and kept in dark until the use.

Preparation of soft cheese

Soft cheeses were made and assessed in Department of Evaluation and Processing of Animal Products, Slovak University of Agriculture in Nitra. Before production, experimental samples with different additions of chilli peppers *Fatalii* (0.1 g, 0.2 g and 0.351 g per 100 g of cheese) were made for determination of optimal addition. As optimal addition of chilli peppers was determined 0.351 g. For this experiment was used raw cow milk from dairy vending machine. Milk was heated up to 72 °C during 30 sec and then milk temperature was adjusted to 35 °C for the addition of calcium chloride (Reachem Slovakia, s. r. o., Slovak Republic, 40% w/v) and starter culture (Laktoflora®, Milcom a. s., Czech Republic). After a rest period of 30 min, microbial coagulant (Milase®, CSK Food enrichment, Netherlands) was added. After coagulation, the curd was cut into cubes, reheated at 39 °C and then drained. The curd was mixed with chilli peppers, formed and then dripped out. The cheese was salted in saline solution (NaCl 6% w/v), dried, packed into plastic vacuum packages and stored at 6 ±1 °C for up to 14 days.

Physicochemical analysis

Dry matter content, fat content and pH values of cheese were determined. Analyzes were performed at least in duplicate. Dry matter content and fat content were determined on the 1st day following cheese production. Dry matter content was determined by a gravimetric reference method **(ISO 5534:2004)** by drying to constant weight at 102 ±2 °C and content of fat by Gerber´s acidobutyrometric method **(Cvak et al., 1992)**.

FDM – fat in dry matter (Eq. 1) and

MFFS – moisture in fat-free-substance (Eq. 2) were calculated according to the following equations **(Regulation MARD SR No 343/2016)**:

$$(1) \qquad \text{Fat in dry matter } (\%) = \frac{\text{fat (g) x 100}}{100 - \text{H}_2\text{O (g)}}$$

$$(2) \qquad \text{Moisture in fat} - \text{free} - \text{substance } (\%) = \frac{\text{moisture in 100 g of cheese (g)}}{100 - \text{fat in 100 g of cheese (g)}} \text{ x } 100$$

The pH values of the cheese were measured by pH meter Orion Star A211 (Thermo Fisher Scientific, USA). The pH measurement was carried out on the 1st, 7th and 14th day following the cheese production.

Textural analysis

Textural properties were measured on a texture analyser TA.XT Plus (Stable Micro Systems LTD., UK). The texture analyser was used to measure the chosen textural properties such as hardness and stickiness of cheeses. The texture analysis was carried out on the 1st, 7th and 14th day

following the cheeses production. The test was conducted on pieces of cheese (2 cm x 2 cm), using spherical probe (P/1S) and 5 kg load cell. Test speed of probe was 2 mm per sec and a distance reached in the pieces of cheese was 5 mm. Temperature of cheese was 15 °C. The course of measurement was recorded through the curves by Texture Exponent software 6.1.4.0 (Stable Micro Systems LTD., UK).

Sensory analysis

Sensory properties, consistency (hard, spreadable and friable) and taste (salty and spicy) were evaluated. Sensory analysis was performed by ten-member committee of assessors who evaluated selected parameters by five point scale. Evaluation was carried out on the 1st, 7th and 14th day following the cheeses production.

Statisic analysis

The entire experiment was replicated three times and the resulting value was calculated as the mean value, standard deviation and variation coefficient of these measurements. Obtained results were processed by variation-statistical method in ANOVA of Statistica CZ9.1 software (Stat Soft Ltd., CZ). The differences were considered significant at the p <0.05 level.

RESULTS AND DISCUSSION

Physicochemical analysis

On the first day of storage, experimental samples of cheese had dry matter content 42.98% ±2.10% and fat content 20.73% ±1.79% (Table 1). Fat in dry matter of all experimental cheeses was higher than 45% and lower than 60% and therefore all cheeses were classified as full-fat cheese. All experimental samples of cheese were classified as soft cheeses from the point of view of moisture in fat-free-substance **(Regulation MARD SR No 343/2016)**.

The pH measurement is important in the cheese production and storage. The pH values were in range from 5.15 to 4.90 during 14 days of storage (Figure 1). During first 7 days of storage, the pH value decrease was major compared to decrease after next 7 days. Twenty-four hours after cheese production, the pH values of cheeses are an indicator of right preliminary ripening of cheeses.

Textural analysis

During 14 days of refrigerated storage, a change in consistency of cheeses is to be expected **(Černíková et al., 2017)**. The texture of cheese is determined by its composition, microstructure and processing, including its microflora **(Aryana and Haque, 2005)**.

Table 1 Chemical analysis of cheese samples on the first day of storage.

	Dry matter content g.100 g^{-1}	Fat content g.100 g^{-1}	Fat in dry mater %	Moisture in fat-free-substance %
1. experimental sample	40.01	19.00	47.49	74.04
2. experimental sample	44.38	20.00	45.06	69.52
3. experimental sample	44.55	23.20	52.08	72.21
Average	42.98	20.73	48.21	71.92
Standard deviation	2.10	1.79	2.91	1.86
Coefficient of variation (%)	4.89	8.64	6.04	2.58

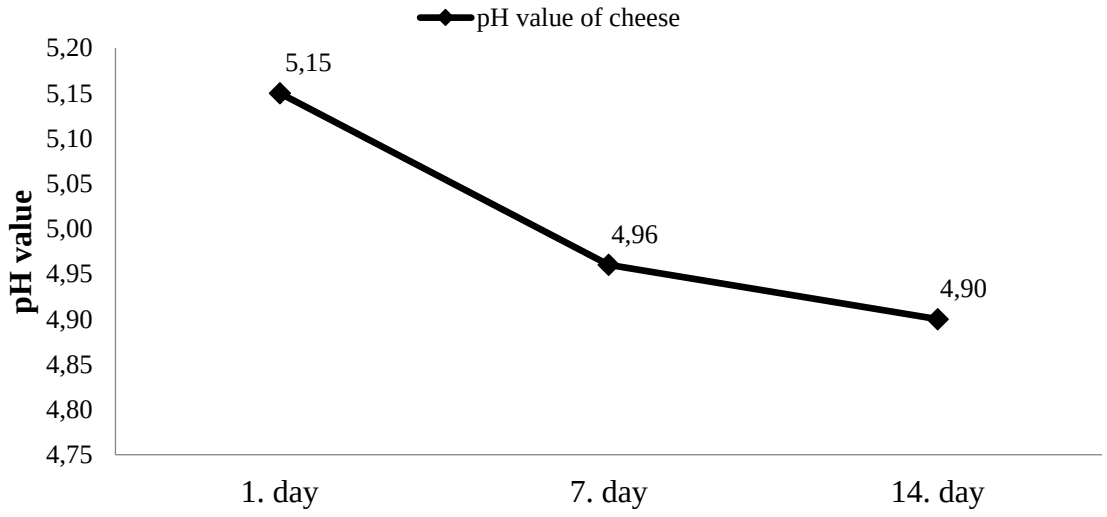

Figure 1 The pH values of cheese samples during 14 days of storage.

Table 2 Textural properties of cheese samples during 14 days of storage.

Experimental sample		1. day		7. day		14. day	
		Hardness g	Stickiness g	Hardness g	Stickiness g	Hardness g	Stickiness g
1	**Average**	420.41	-3.05	267.42	-8.01	243.62	-12.28
	Standard deviation	43.82	0.81	4.34	3.94	12.94	5.59
	Coefficient of variation (%)	10.42	-26.56	1.62	-49.19	5.31	-45.52
2	**Average**	412.39	-4.18	261.94	-9.68	194.82	-20.22
	Standard deviation	22.15	2.20	13.68	7.48	9.93	4.45
	Coefficient of variation (%)	5.37	-52.63	5.22	-77.27	5.10	-22.01
3	**Average**	415.39	-3.81	262.94	-9.45	214.82	-18.28
	Standard deviation	25.22	1.75	10.28	5.36	11.97	4.85
	Coefficient of variation (%)	6.07	-45.93	3.91	-56.72	5.57	-26.53

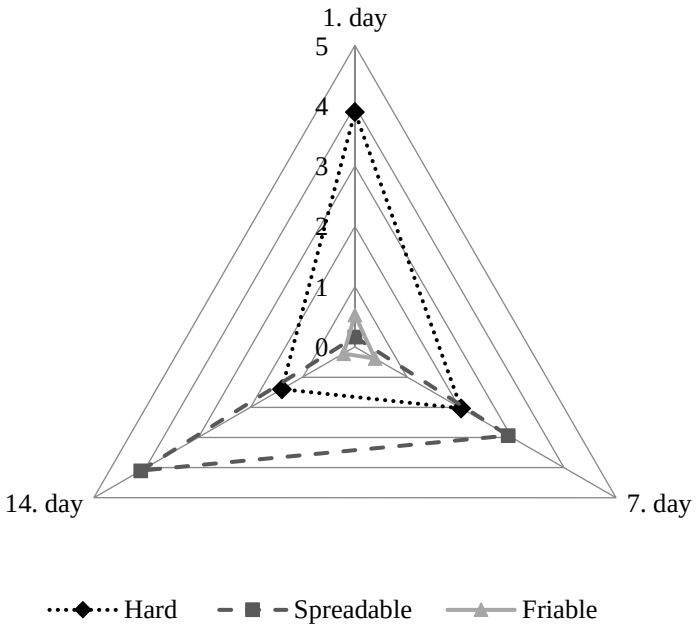

Figure 2 Sensory evaluation of consistency of cheese samples during 14 days of storage.

In all experimental samples of cheese decreased their hardness during 14 days of storage (Table 2). On the last day of storage, the hardness of cheeses showed statistically significant decrease (p <0.05) compared to the first day of storage. We suppose that the changes are due to the cheese ripening and the change of protein structure. **Eroglu et al. (2015)** reported that the texture of cheeses depends on the chemical composition of cheese, biochemical changes occurring throughout ripening and their textural properties are influenced by pH value during ripening period.

The highest stickiness of cheese was determined on the last day of storage (Table 2). During storage it was found statistically significant increase (p <0.05) in the stickiness of all experimental samples of cheese.

Sensory analysis

The assessors provided a lower score for hard and friable consistency of cheeses on the 7th and 14th day of storage compared on the 1st day (Figure 2). By contrast, the spreadable consistency statistically significant increased (p <0.05) during storage (Figure 2).

On the last day of storage, the hard consistency showed statistic significantly decrease (p <0.05) compared to the first day. This evaluation of hard consistency is in accordance with textural analysis of cheeses.

Brown et al. (2003) reported that the correlation of sensory and textural analysis associated with hardness is not surprising because the evaluations are very similar between instrumental and human techniques.

The sensory evaluation showed no statistic significantly decrease (p >0.05) of friable consistency throughout the storage. **Delgado et al. (2010)** reported that proteolysis contributes to cheese matrix textural changes due to the protein network breakdown.

Our results of pH values, textural analysis of hardness and sensory analysis of hard consistency are comparable with findings of **Chen et al. (2015)**, whoreported that

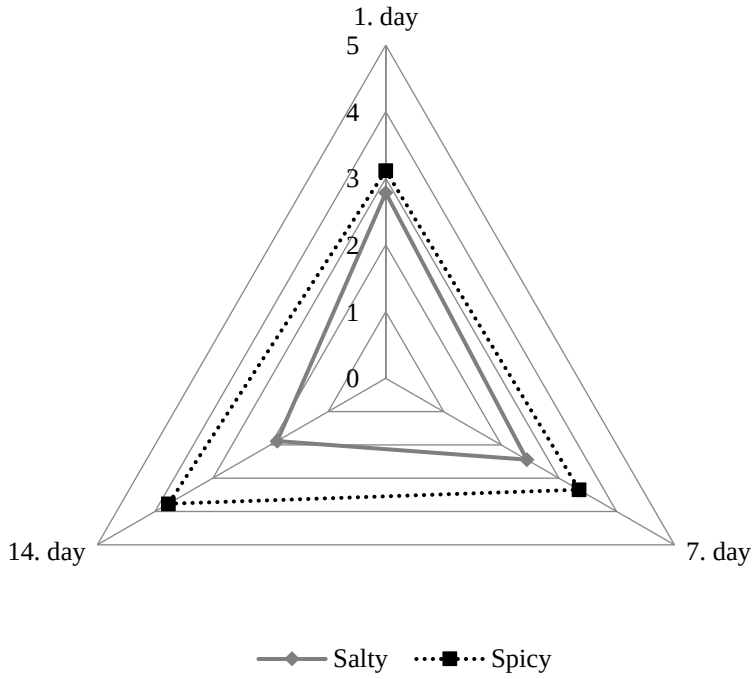

Figure 3 Taste of cheese samples during 14 days of storage.

cheeses with lower pH normally became less firm and their hardness decreased. There is a significant correlation between the pH and hardness of soft cheeses.

Changes in salty and spicy taste of cheese were observed during 14 days of storage (Figure 3). During storage period, the salty taste of cheese gradually decreased while the spicy taste gradually increased. After 14 days of storage, the score of spicy taste was statistic significantly higher (p <0.05) compared to the score on the 1st day of storage. The salty taste of cheese samples was statistic significantly lower (p <0.05) at the end of storage. We suppose that these changes are related to the diffusion of salt and capsaicinoids into the whole cheese during storage.

CONCLUSION

Addition of dried, crushed chilli peppers *Fatalii* had no negative effect on ongoing biochemical processes in full-fat soft cheeses stored during 14 days. The proofs are the changes of pH values and mainly the changes of textural properties. From the view of sensory evaluation, the textural properties of cheeses were evaluated better on the last day of storage compared to the first day. The spicy taste of cheeses became more intensive during storage however this change was unacceptable for some assessors. Our results show that the spicy taste becomes more intensive during storage and therefore the addition of chilli peppers *Fatalii* need to be reduced in cheese production. According to the Scoville heat scale, the pungency of chilli peppers Fatalii is from 125,000 to 350,000 units. The next possibility of using chilli pepper by the cheese production is to use another kind of chilli peppers with less pungency.

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