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SIGNIFICANCE AND DYNAMICS OF SALT DURING STORAGE AND RIPENING OF WHITE CHEESE IN INDUSTRIAL PRODUCTION

SUMMARY

Sjenica cheese is one of the best kinds from the group of white cheese in brine in Republic of Serbia. The production centers are mountainous highlands that surround the town of Sjenica, (Serbia), although the similar cheese is produced in the territory of neighbor municipalities. In recent years, the production has been carried out in industrial conditions -mini dairies. It is made from fresh whole sheep, cow and mixed (sheep's and cow's) milk. The investigations were aimed to determine the salt content in cheese and its changes during storage and ripening, because chemical composition of cheese depends on salt content, it effects on the maturation process, the taste, the rheological properties of cheese, and has also preserving properties. The results showed that the largest changes of salt in all three kinds of cheese occurred in the period 1-15 days of ripening. The salt content of mature cheese at the end of the ripening period of 45 days was 5.89% in cow cheese, 5.47% in mixed cheese, 5.29% in sheep cheese. As you can see the salt content in all three kinds of cheese was high which resulted in increase of dry matter content in cheese, the intensity of biochemical changes, or the content of soluble nitrogen, and thus the lower values of the coefficient of maturity.

Key words: Sjenica cheese, salt, dynamics, ripening

INTRODUCTION

Salt (NaCl) is a very important parameter of the composition of many food products, including cheese. In other words, the content of salt is especially important because of the content of sodium, which can have a negative influence on the health, particularly on vulnerable categories of consumers.

The role of the salt in cheese production is multiple and significantly influences on the chemical composition of cheese in terms of water content and dry matter, then on the sensory and nutritional properties of cheese, enzyme activity, microorganisms growth, maturation and rheological properties of cheese. It is also important to note that the salt content in cheese has a significant effect as a conservative.

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The salt influences the course and intensity of microbiological processes, on the speed and extent of protein degradation, and therefore on the rheological properties of cheese. Regardless of the manner of salting, the salt penetrates into the cheese by diffusion from the surface into the interior. Depending on the speed of penetration of salt into the cheese, actually range of salt, will also depend the intensity of development of lactic acid bacteria. Cheeses salting decreases and slows down the activity of the starter (Jordan, and Cogan, 1992).

In most cheese types, the salt is added after the formation of the curd. By salt adding, pH value of the cheese is regulated and it directs the ripening process which directly effects on the texture of the cheese (Lawrence *et al.*, 1984).

The salt content in cheese in an amount greater than 1.5% significantly slows down, and at high concentrations it inhibits the development of starter. Considering that the activity of the starter slows down or totally inhibits in a short pH range, it is very important to control the salt content in the water phase of the cheese. If salts content is less than 5% in the aqueous phase, the pH value is decreased during the salting of the cheese, due to the activities of the starter. The activity of the starter decreases and the pH value of cheese is reduced slowly and has a high value, by increasing salt content. Also, by inhibiting the starter, conditions are created for the development of non starter micro flora (Guinee, and Fox, 1993).

Thus, the speed of salting and pH value during the process of salting the cheese, are the factors that control the further maturation. Salting also manages the dynamics of non starter micro flora.

Puđa, and Obradović, (1994), state that if non starter micro flora develops on a larger scale, the products of their metabolism may threaten the development of the starter, while a non-specific ripening process start.

It is generally known that the salt content is an important factor that influences the photolytic changes during cheese ripening. Great salt content significantly effects on slowing down the flow of proteolysis, especially the degradation of casein B (Katsiari *et al.*,2000).

MATERIAL AND METHODS

The experiment was conducted in June of 2010 at "Pešter" dairy in Sjenica. All types of cheese are made from raw, whole cow milk, sheep milk and mixed milk (cow milk + sheep milk). The mixing ratio was 1: 1. Milk is delivered from individual farms. Preparation of milk included drainage and reheating at a temperature that is needed for the very process of making cheese (30-32 °C). All types of cheese were produced in 5 repetitions, so the total number of samples is 15. Cheese salting was done with coarse sea salt, and dry salting was applied. Salting was carried out successively, during the cheese stacking into package.

The dynamics of salt content during cheese ripening, we followed after production process, actually after 1st day, then after 15th, 30th and 45th day of ripening, which was the fixed period of ripening. Cheese analysis were

conducted in the chemical laboratory of the Veterinary specialist institute in Kraljevo by standard method, as follows:

- Defining the content of salt, the method by Mohr (Carić, 2000).
- Statistical analysis was performed through the median, as well as the rate of variation (standard deviation SD and coefficient of variation Cv). To test the difference of arithmetic means, we used Student's test (t-test).

RESULTS AND DISCUSSION

Depending on the type of cheese that is produced, various amounts of the salts is added, so that the different types of cheese are characterized by a different content of salt. Some types of cheese, especially those produced in warm climate regions, as well as cheese in brine are, is characterized by a large content of salt. Survey and results are presented in Table 1.

Table 1. Dynamics of salt (NaCl) during cheese ripening (%).

Cheese type	Parameters	Ripening period (days)			
		1	15	30	45
Cow milk cheese	min	3.11	5.14	5.22	5.17
	max	3.46	6.06	7.00	6.25
	\bar{x} (n=5)	3.28	5.28	5.96	5.89
	Sd	0.11	0.43	0.62	0.87
	Cv(%)	3.55	8.19	10.53	14.83
Mixed cheese	min	3.02	4.22	4.31	4.23
	max	3.81	7.01	7.08	7.11
	\bar{x} (n=5)	8.18	5.37	5.77	5.47
	Sd	0.32	0.92	1.06	1.01
	CV(%)	10.25	17.17	18.47	18.54
Sheep milk cheese	min	2.70	4.21	4.04	4.43
	max	3.43	5.45	6.41	6.38
	\bar{x} (n=5)	3.12	4.92	5.54	5.29
	Sd	0.24	0.41	0.81	0.64
	Cv(%)	7.80	8.51	14.73	12.24

Based on the results shown in Table 1, it can be seen that all types of cheese, on the first day of ripening, contained considerable amounts of salt as follow: cow milk cheese 3.28 %, mixed cheese 3.18 % and sheep milk cheese 3.12%. This was expected, because the salt penetrates into the cheese by diffusion, which contained a large amount of water at the time of preparation.

The biggest increase of salt content in cheese occurred in the period 1-15 days of ripening, which is a positive correlation with the dynamics of dry matter in the same period. Average increase of salt content in the period 1-15 day was 2.00% in cow milk cheese, 1.98% in mixed sheep and 1.80% in sheep milk

cheese, which means that increase is approximately the same in all three types of cheese. In the first 15 days of ripening, diffusion processes were the most intensive, so average amount of salt content was 28.5% in cow milk cheese, 5:37% in mixed cheese and 4.92% in sheep milk cheese. Statistical analysis showed that differences between all types of cheese were not statistically significant.

In the period of 15-30 days of ripening, percentage of salt in all three types of cheese has been increasing, although this increase was not as large as in the previous period. This increase was in cow milk cheese 0.68%, in mixed cheese 0.61% and sheep milk cheese 0.62%, which means that the increase of salt content in all three types of cheese was even. After 30 days of ripening salt content in cow milk cheese was 5.96%, in mixed 5.77% and in sheep milk cheese 5:54%. By data processing, differences were not statistically significant.

In the final ripening period of 30-40 days, salt content in all three types of cheese, was slightly reduced and moved according to the movement of dry matter content. This trend was expected because the cheese ripening occurs in acid-saline, during which occur diffusion processes of various intensity, and amount of salt in cheese, dry matter content, sensory and rheological characteristics of the cheese largely depend on it.

After a specified period of ripening of 45 days salt content was 5.89% in cow milk cheese, 5:47% in mixed and 29.5% in sheep milk cheese. The differences of salt content in all types of cheese were not statistically significant.

As can be seen all types of cheese are characterized by a high salt content which is the characteristic of this groups of cheese. The salt content in all three types of cheese does not have significant deviations from the salt content in similar types of cheese in this group specified by (Dozet *et al.*, 1987), for Travnički; (Ostojic *et al.*, 1981), for Krivovirski; (Dozet *et al.*, 1996), for Polimsko- Vasojevički and Pljevaljski; (Dozet *et al.*, 1996), for Pljevaljski cheese; (Jovanovic *et al.*, 2005), for Zlatarski; (Mačej *et al.*, 2006.), for Sjenički, Homoljski, Svrliški; (Savic, 2011), for Sjenički cheese and type of Sjenički cheese; (Jovanović *et al.*, 2004.), for Homoljski cheese. The salt content in all types of cheese can be assessed as very high, which resulted in high dry matter content and on the results of sensory evaluation of cheese. Sensory characteristics for all three types of cheese were evaluated in the following manner: consistency in all three atypical types of cheese, typical sour and salty taste, and typical, expressed, lactic acid, scent.

The content of salt in various food products, especially in cheese is particularly important because of the content of sodium, which can have a negative impact on the health of particularly vulnerable categories of consumers. Therefore, it should be found opportunities to reduce the content of salt or sodium in cheese. Specifically, it is important to determine the lowest, but sensory acceptable limit reduction. In other words, the reduction of NaCl content in cheese should be performed to the extent that does not negatively affect on the taste of the product, and does not create insipid and thus sensory unacceptable

product. This is particularly important for the group of cheese in brine, which have traditionally been burdened with a high content of salt, and are characterized by a pronounced salinity.

CONCLUSIONS

- ✓-The content of salt (NaCl), is a very important parameter of the composition of many food products, including cheese, where a high salt content and especially sodium can have a negative impact on the health of vulnerable categories of consumers
- ✓-The role of salt is multiple, additionally regulates the chemical composition of cheese in terms of dry matter content, actually of water, affects the maturation, growth and development of micro-organisms, enzyme activity, intensity and extent of proteolytic changes, nutritional also preserving role of the salt, as well as it impacts on sensory and rheological characteristics of cheese
- ✓-Change of salt content during ripening in all three types of cheese had a similar trend as dry matter, actually increase recorded during the first 30 days of ripening, and the greatest was in the period of 1-15 days of ripening. Because of storing and ripening in brine, diffusion processes of different intensity occur, whereby part of the salt moves from the cheese into brine for ripening. This resulted in decrease of percentage of salt in the cheese for ripening period of 30-45 days
- ✓-the salt content in all three types of cheese was high (5.89; 5.47, 5.29), which is the characteristic of this group of cheese. This high salt content influenced on the results of sensory evaluation. Specifically, all types of cheese were evaluated as too salty, and as atypical too hard consistency

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