



Active and titratable acidity changes (ph) during ripening of white sjenica cheese in industrial production

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Abstract

Sjenica cheese is from the group of white cheese in brine in Republic of Serbia. It is produced in wide area of Sjenica-Pester plateau, by indigenous technology, and lately much more in industrial conditions -mini dairies. It is made from fresh whole sheep milk and cow milk, which process of making cheese, starts immediately, without any heat treatment. By the plan of experiment, we followed the acidity changes of the ripening period of 45 days after production. We followed changes after 15 days and then again after 30 days of ripening. Acidity is one of the most important properties of cheese which influences the structure, rheological, sensory characteristics and overall quality of the cheese. Therefore, it is necessary to monitor the acidity, both during development and during ripening. The results showed that the most significant changes, actually the largest increase of titratable acidity occurred in the period of 15-30 days. Ripe cheese had the following values 189.20^oT for cow milk cheese and 173.10^oT for sheep milk cheese. The durability and sustainability of cheese is affected by pH value. Changes in pH values in both types of cheese, have occurred in the period of 1-15 day of ripening. In that period, we recorded the largest decrease of pH value. Cow milk cheese had 4.04 pH value and sheep milk cheese had 4.87 pH value. The least change occurred in the period of 30-45 days, which is due of forming of soluble nitrogen compounds and buffer capacity of cheese.

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Introduction

Sjenica cheese it is predominantly produced by indigenous technology on individual farms of Sjenica-Pester plateau area . Lately, it is produced in industrial conditions. The raw material for cheese production is fresh, full-fat sheep and cow milk.

Sjenica cheese it belongs to the group white cheese in brine. The main feature of this cheese group is the storage and ripening in brine, which provides anaerobic conditions. The brine is used as a preservative and contributes to specific taste, smell and brittle and fragile structure of these types of cheese (Codex Stand. 2002.).

Titrate acidity is an important feature of cheese, because it shows the intensity of fermentative processes during cheese ripening. It is one of the indicators of technological process of development and degree of cheese ripening. During cheese ripening, the fastest changes occur on the milk sugar, that under the influence of lactic acid bacteria, rapidly decomposes and forms a lactic and other organic acids and aromatic substances, which play an important role in the formation of sensory and rheological properties of mature cheese.

According to (Fox and Cogan-in.1990.), approximately 98% of milk lactose, exceeds in the whey, as lactose or lactate, and the remaining part transforms rapidly , which depends of the content of salt in the water phase of the cheese.

The acidity of the cheese is a result of several different factors such as the fermentation of lactose into lactic acid, cheese proteins and their degradation products, as well as various salts which also in less extent affect the acidity of the cheese. The acidity of cheese is significant because it depends on the intensity of biochemical changes during ripening, which are of great importance for the quality, taste, smell, texture and overall appearance of the cheese.

Unlike titrate acidity, active acidity (pH) gives a true picture of inside cheese reaction during ripening.

On the speed of biochemical processes, that occur under the influence of microorganisms and their enzymes, we can influence by the regulation of pH values. It may affect the intensity and amount of degradation products of lactose, protein and fat. Cheese active acidity (pH) is one of the most important process parameters, which strongly influences on the extent of syneresis, actually to the degree of separation of the whey from the curd. All this, is closely related to its influence on the state and structure of paracasein micelles, and thus the matrix protein as a whole. It is generally known that the pH of the cheese has a great influence on the characteristics of the protein matrix and the rheological properties of cheese. Changes of pH values strongly influence on the hydration paracasein micelles, their integrity and structure, which is associated with the position and influence of colloidal calcium phosphate (CCP).

Materials and methods

The experiment was performed in June 2010. All types of cheese were produced in industrial conditions of "Pester" dairy in Sjenica. Basic principles of production, during the production process of cheese, were as follows:

Milk: Full fat cow and sheep milk.

Preparing and the process of making cheese: included the draining, filtering and reheating at coagulation temperature . The temperature during the process of making cheese was 32°C, and the time was 50 min.

Treatment of curd: the curd was cut into cubes - size 5x5cm, and then placed in a strainer. Dewatering was carried out on the table with the application of pressing, and it lasted two hours. After filtering and separation of whey, the clod was formed.

Cheese cutting and salting: clod was cut into slices of 15X15X5cm and 10X10X3cm. The cheese was salted successively with dry, sea salt, during stacking in the packaging.

Ripening: It was occurred in salty whey, and optimal

ripening period was 40 days.

Research goal: to determine the value of titratable and an active acidity(pH) after the production of cheese, and then to monitor the dynamics during maturation period after 15, 30 and 45 days of ripening.

Analysis

The analyzes were carried out at the Veterinary-Specialistics Institute of Kraljevo by following methods.

determination of titratable acidity IDF by Torner (Caric *et al.* 2000).

Determination of titratable acidity by Turner

Procedure

At the beginning we put 5 g of cheese to a watch glass and quantitatively transfer it to a mortar where it is dissolved with the gradual addition of 100 mL H₂O t = 50 o C. The resulting emulsion we titrated with 0.1 M NaOH using fenolftaelin indicator (3-5 drops) until the appearance of pale pink color . It must be carried out at least two determinations, On the same sample for testing.

The acidity of the cheese in degrees by Turner is calculated using the formula:

$$^{\circ}T = V_{\text{NaOH}} * F * 20$$

NaOH - ml consumed NaOH for titration;

F- factor molarity;

No. 20 - by definition $^{\circ}T$ acidity it refers to the sample of 100 g of cheese, and in the analysis it is measured in 5 g.

determination of active acidity using pH-meter electrode (Caric *et al.* 2000).

pH

The pH is determined potentiometrically in a solution of cheese prepared by mixing equal volumes of cheese and water.

procedure

Mix in a porcelain pot 10 g of pre-comminuted cheese with 10 ml of distilled water and measure pH value on previously regulated pH meter . Measured value on the pH meter is a pH of cheese.

Statistical Analysis

The experiment was conducted with two types of milk by 5 repetitions.

The analysis included

To define the significance of differences of arithmetic means and, also measures of variation standard deviation (SD) and coefficient of variation (CV).

To test differences of arithmetic means, we used Student's (t-test) Stankovic *et al.* 1989).

Results and discussion

Beginning of the creation and development of acidity is a critical moment in the process of development and start of ripening. Therefore, the initial acidity immediately after production is crucial for the further course of biochemical-tectonic changes, and for the direction and flow of cheese.

The values of titratable acidity and changes during ripening are given in Table 1.

According to the results shown in Table 1, it can be seen that acidity during the first day of ripening was 97.17 $^{\circ}T$ in cow milk cheese, and 97.91 $^{\circ}T$ in sheep milk cheese. During the first 15 days of ripening, the acidity increased for 12.33 $^{\circ}T$ in cow milk cheese and after that it was 109 $^{\circ}T$. The acidity increased for 32.29 $^{\circ}T$ in sheep milk cheese, and after 15 days it was 130.20 $^{\circ}T$. The largest increase of titratable acidity, was recorded from 15 to 30 days of ripening, so the increase was 58.0 $^{\circ}T$ in cow milk cheese, and 169.20 $^{\circ}T$ in sheep milk cheese. Recorded results are the same as results which are stated by (Živković, 1964.), that titratable acidity increases during ripening of white cheese, and its maximal increase is after 30 days of ripening, depending on the conditions. By the statistical processing of data, it was found that the difference between cow milk cheese and sheep milk

cheese were not significant. During the last 15 days of ripening for both types of cheese was recorded further increase of titratable acidity. Though, this increase was of lower intensity according to the period of 15-30

days of ripening. The lower increase of titratable acidity in this period is a consequence of increased content of soluble nitrogen materials which slow down acidity change.

Table 1. The dynamic of titratable acidity during cheese ripening (° T).

Cheese type	Parameters	Period of ripening (days)			
		1	15	30	45
Cow milk cheese	min	95.94	85.37	105.40	119.80
	max	111.10	130.60	210.30	229.80
	–	97.17	109.50	167.50	189.20
	\bar{x} (n=5)				
	Sd	10.07	16.91	38.67	38.11
	Cv (%)	10.36	15.43	23.08	20.14
Sheep milk cheese	min	69.12	75.07	92.73	101.30
	max	127.70	159.80	215.50	223.10
	–	97.91	130.20	169.20	173.10
	\bar{x} (n=5)				
	Sd	19.52	31.75	45.18	42.65
	Cv (%)	19.93	24.38	26.70	24.64

At the end of the test delivery (period of maturity of 45 days), the average titratable acidity of cow milk cheese was 189.20°T and sheep milk cheese was 173.09°T. Analysis of the data showed no statistically significant differences between the types of cheese. The obtained values of titratable acidity are in accordance to the results of following: (Dozet *et al.*,

1996.) for Pljevlja and Vasojević cheese (Maćej *et al.*, 2004.) for Sjenica cheese (Maćej *et al.*, 2006.) for Homoljski, Zlatarski and Svrlijski cheese (Jovanovic *et al.*, 2005.), for similar cheese types from this group, Homoljski, Zlatarski, (Maćej, 1989.) for white slices cheese (Savić, 2011.) Sjenica cheese and type of Sjenica cheese.

Table 2. The dynamic of active acidity (pH-value).

Cheese type	Parameters	Period of maturity (days)			
		1	15	30	45
Cow milk cheese	min	6.56	4.78	3.80	3.67
	max	6.71	5.41	4.94	4.71
	–	6.61	5.03	4.23	4.04
	\bar{x} (n=5)				
	Sd	0.05	0.21	0.38	0.36
	Cv (%)	0.76	4.24	9.09	9.09
Sheep milk cheese	min	6.63	4.92	4.43	4.32
	max	6.74	5.38	5.36	5.33
	–	6.67	5.18	4.83	4.81
	\bar{x} (n=5)				
	Sd	0.03	0.15	0.31	0.32
	Cv (%)	0.59	2.98	6.44	6.66

The acidity of cheeses can be further increased due to the effect of other factors such as: higher temperature at the beginning of the process of making cheese, higher temperature in the room during squeezing, pressing and ripening.

significantly affects the properties of the cheese is pH value. One of the most important process parameters is cheese pH value, which strongly influences the scope of sinarezis, or degree of separation of the whey from the system.

One of the most studied parameters, which Savić

Results about changes of pH values during the

ripening period are given in Table 2.

We can see that, based on the results shown in Table 2, the first day of ripening average pH value of cow milk cheese was 6.61 and 6.67 of sheep milk cheese. The processing of the results showed no statistically significant differences.

During the period of ripening pH value decreased, so after 15 days of ripening it decreased averagely 1:58 in cow milk cheese and 1:49 in sheep milk cheese. If we analyze the flow of pH values, it can be seen that in the period from 1 to 15 day of ripening, the pH value decreased the most, which means that in this period of ripening the largest part of the lactose fermented. After this the average pH value of cow milk cheese was 5:03 and sheep milk cheese was 5.18.

After 30 days of ripening, further decrease in pH values is noted in both kinds of cheese. It decreased 0.80 in cow milk cheese and 0.35 in sheep milk cheese. The average pH value was 4.23 in cow milk cheese and 4.83 in sheep milk cheese. Analysis of the data showed that the differences between both types of cheese were statistically significant.

At the end of the ripening period of 45 days, a pH value of both types of cheese, remained at the same level, as it was compared to 30 days of ripening. It decreased 0.19 in cow milk cheese and 0.02 in sheep milk cheese. At the end of the ripening period of 45 days average pH value was 4.04 in cow milk cheese and 4.81 in sheep milk cheese. Processing of the data showed that the differences between both types of cheese were statistically highly significant.

Demineralization is expressed at pH values below 5. Therefore, in low pH values calcium content is significantly reduced, causing a distortion of the structure of casein. Micelle hydration, show a tendency towards aggregation to form the structure of high rigidity, but very low elasticity (Puda, 2009).

One of the most important parameters is also pH value, which strongly influences the extent of

syneresis, actually the degree of separation of the whey from the system. The reduction of pH values from 5.0 to 4.5 affects the intensification of syneresis (Miočinović, 2010). Awad (2007) believes that generally, there is a high correlation between pH value and texture of cheese, actually that with decreasing pH values, significantly increases the strength of cheese. Similar trend of changes in pH value during cheese ripening in brine produced with indigenous lactic acid bacteria was established by (Radulović, 2007). On the first day of ripening, pH value of both kinds of cheese, ranged from around 5.2 to around 4.42 after 60 days of ripening.

Conclusion

Cheese acidity influence flow, the intensity, depth of proteolytic changes, the amount of degradation products of which depends the taste, smell, consistency and other sensory characteristics of cheese

pH-value affects the state of paracasein micelles, their integrity, structure and condition of colloidal calcium phosphate, because the rheological properties of cheese depend of these factors. The cheese have expressed brittle texture and poor rheological properties.

pH-value affects the extent of syneresis, the degree of separation of the whey from the curd and the extent of demineralization of curds. The low pH values (cheese from the experiment) have intensified these processes.

Cheese is characterized by high titratable value, or low pH values, which affected the structure of these types of cheese, characterized by brittleness and fragility, and this is the main feature of this group of cheese.

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