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THE DYNAMIC OF THE TOTAL NUMBER OF BACTERIA IN WHITE SOFT CHEESE

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Abstract

The aim of the study was to investigate the effect of pH and the temperature on the total number of bacteria during 45 day cheese making time. The determination of the presence of total bacteria counted in milk and cheese is important because it is used as a standard for sanitary and technological correctness of milk and the final product, as its quality, too.

Raw material for white soft cheese production was bulk cow milk (summer lactation) from the terrain of the whole Pcinja region in Serbia. The samples for microbial and physical-chemical testing were monitored from: raw milk, milk before making cheese, whey, coagulate before production, after self pressure and pressure, cheese after moulding and dry salting and cheese after the 1st, 10th, 20th, 30th and 45th day of brine.

The specific microbial flora in connection with particularity of white soft cheese which was present in raw milk is not static during the cheese making, but it steadily changes and influences changes in cheese pH. Reversible effect on this specific microbial flora has cheese making technology as used temperature.

Key words: *Milk, white soft cheese, total number of bacteria*.

1. Introduction

White cheese is the traditional product on the whole Balkan Peninsula, and the Serbian Republic too. The specific geographic and the climate conditions of Pcinja region, the particularity of technological operations are all connected with the white soft cheese characteristics. Microflora which is present in milk in certain number is not static during the cheese production; it is changing constantly. The causes of these changes are: the change of temperature, pH, the presence of microb's products etc.

The total number of bacteria represents one of the parameters which are the part of the legislation for quality measuring and the sanitarity of milk and dairy products. Active acidity and temperature of milk and cheese mass during the production of white soft cheese is followed and kept under control, in order to prevent its enormous rising which would bring to final product but with bad characteristics.

High values for pH and high percentage of microorganisms in milk make good environment for intensive effect of proteolitycs enzymes of lactic acid bacteria, micrococcus, coliform bacteria, ferment and mildew, which would bring to deterioration of cheese. Low values of pH and temperature affect inhibitory on the total number of bacteria.

2. Materials and Methods

Researches which are the subject of this project are made in the "Diary Han" DOO Vladicin Han, in a microbiological and physical-chemical laboratory, both in the diary. As raw for producing white soft cheese is used collective cow milk from the terrain of the whole Pcinja region (Vladicin Han, Vranje, Surdulica, Bujanovac, Trgoviste) in the Republic of Serbia.

Researching in the dairy are made on the three separate production processes in production of white soft cheese, realized in three summer months (July and September), with the milk from summer lactation.

During the production of white soft cheese, samples for microbiological testing are taken in a diary from:

1. Raw collective milk, milk before making cheese, whey, coagulate before production and from it after self pressure and pressure on the first day;
2. Cheese after moulding and salting, on the second day;
3. Cheese on the first, tenth, twentieth, thirtieth and forty-fifth day of pickling.

Samples are taken sterile on the following way:

1. Milk and whey samples are taken with sterile pipette of 10mL.

2. Coagulate samples before production, after self pressure and from cheese are taken with the pearlitic knife with sharp spire which is sterilized by flaming.

After taking, samples are put in sterile glass Petri dishes. The number of the total number of bacteria is determined due to classic cultural method, based on the number of colonies grown on the hard stratum. The researches of the total number of bacteria are done on the standard Torlak's substratum (meat peptone agar).

In a physical-chemical laboratory is followed pH (active acidity) and temperature (K) of: raw milk, milk before making cheese, whey, coagulate before production, after self pressure and pressure, cheese after moulding and dry salting and white soft cheese after the first, tenth, twentieth, thirtieth and forty-fifth day of pickling. Measuring of pH is done with digital pH-meter HANNA HI199161 FOOD CARE and temperature with digital thermometer HANNA HI 145.

3. Results and Discussion

From the analysis made from raw cow's milk in the summer period of lactation (July, August and September), which is also used for the production of white soft cheese in the diary "Han", can be concluded the presence of 2,3 x 10^7 – 5,4 x 10^7/mL (Table 1). It represents that in the diary "Han", in the summer months for the modification is used milk with the high total number of bacteria, which is the result of bad hygienic conditions of milk, keeping and the transport of milk. Values of the active acidity of raw milk are higher than those in other phases of the cheese production and they vary from 6,5 to 6,7 (Table 2).The total number of bacteria in white soft cheese during the whole production is represented tabular (Table 1).

Table 1. The total number of bacteria in milk and white soft cheese (in mL or g test)

Samples from	Total number of bacteria/mL or g sample		
	July	August	September
Raw milk	5,4 x 10^7	2,3 x 10^7	2,8 x 10^7
Milk before cheese making	4,3 x 10^7	1,2 x 10^7	2,5 x 10^7
Whey	3,9 x 10^7	1,0 x 10^5	2,0 x 10^6
Coagulate before manipulation	4,8 x 10^7	1,0 x 10^7	2,2 x 10^7
Coagulate after pressing	3,5 x 10^6	6,3 x 10^7	1,2 x 10^7
Cheese after forming and salting	4,0 x 10^7	1,4 x 10^7	2,8 x 10^7
The first day of salting	6,4 x 10^7	4,3 x 10^5	2,2 x 10^6
The 10 day of pickling	6,0 x 10^6	2,5 x 10^7	1,7 x 10^6
The 20 day of pickling	1,2 x 10^7	5,8 x 10^5	1,65 x 10^7
The 30 day of pickling	6,0 x 10^5	6,1 x 10^5	5,9 x 10^5
The 45 day of pickling	1,0 x 10^5	6,0 x 10^5	4,7 x 10^5

Moving of the active acidity and temperature of milk and cheese mass during the production of white soft cheese is represented in Table 2.

Table 2. Active acidity pH and temperature (°C) in milk and cheese during cheese making

Test	July		August		September	
	pH	°t	pH	°t	pH	°t
Raw milk	6.60	17.4	6.70	18.5	6.50	17.8
Milk before cheese making	6.67	33.6	6.73	32.5	6.47	33.8
Whey	6.60	32.4	6.64	32.2	6.46	32.6
Coagulate before manipulation	6.67	32.5	6.53	32.2	6.31	32.5
Coagulate after pressing	6.56	29.6	6.29	28.8	6.11	29.6
Cheese after forming and salting	5.83	18.0	5.93	6.80	5.98	18.8
The first day of salting	6.03	19.0	5.22	16.7	5.21	18.7
The 10 day of pickling	5.03	19.1	4.78	18.5	4.81	18.2
The 20 day of pickling	4.43	18.4	4.05	16.3	4.28	18.1
The 30 day of pickling	4.29	17.6	4.13	17.2	4.25	17.6
The 45 day of pickling	4.27	10.1	3.90	18.1	4.11	16.9

After percolation, homogenization, pasteurization and cooling of milk, at the moment of making cheese, at the active acidity from 6,47 to 6,73 and the temperature from 32,5 to 33,8 °C (Table 2), the total number of bacteria moved from 1,2 x 10^7 to 4,3 x 10^7/mL (Table 1). In average, the total number of bacteria in this phase of cheese production comparing with the total number of bacteria in raw milk decreased 1,43 times. After making coagulate the total number of bacteria in it is moving from 1,0 x 10^7/mL to 4,8 x 10^7/mL (Table 1). In all three repetitions the total number of bacteria in coagulate stays almost on the same level as it used to be in milk before making cheese. Comparing with the raw milk, the total number of bacteria is decreasing. In this phase of production, pH of whey and coagulate is moving in approximately the same values.

Comparative analysis of the percentage of the total number of bacteria in whey and coagulate in the dairy "Han", show that in whey in the first, second and third repetition stay 44,83%, 0,99% and 8,33%, which brings to 55,17%,99% and 91,67% in coagulate (from 55,17 to 99).

During the self pressure and pressure of cheese paste, the total number of bacteria in the first and third repetition is decreasing 13,7 and 1,83 times, and in the second repetition is rising 6,3 times comparing with the phase of producing coagulate, on pH from 6,11 to 6,56 (Table 2). Values for temperature are going from 28,8 to 29,6 °C .

After the phase of moulding and dry salting of white soft cheese in the diary "Han" , high values of the total number of bacteria are noted and they moved from 1,4 x 10^7 to 4,0 x 10^7/mL. During the production of white soft cheese, after the cutting of pressed coagulate, masters moved the pieces by hand on frames where the cheese is salted with dry salt. It is possible that in this phase of producing cheese, as a result of dirty hands of workers and salting cheese with dirty salt in moulded cheese, to bring in additionally microorganisms.

On the first day of cheese ripening in whey, the total number of bacteria in cheese moved from 4,3 x 10^5/g to 6,4 x 10^7/g. After keeping cheese in whey for one day, and for the second and third repetition the total number of bacteria decreased 32,56 times and 12,73 times, while for the first repetition the value of the total number of bacteria raised 1,6 times comparing with the previous phase.

Salt can represent one inhibitorier factor which brings to decreasing of the total number of bacteria, considering that it brings to reduction of content of active water. Certainly, the inhibitory effect of salt depends on its concentration, the content of moisture in cheese, as pH value too (Beresford *et al.* [1]). Concentration of whey in which cheese was put in the "Han" dairy, was 8-10%. It was high enough to have inhibitory effect on growth of the total number of bacteria in cheese. Low pH value influences inhibitory on the total number of bacteria and their number in cheese paste are decreasing no matter on the temperature of ripening. If we look at the value of active acidity, it is similar with the value for the second and third repetition 5,22 and 5,21, and higher for the first repetition 6,03 (Table 2). This is in agreement with the Psoni's *et al.* [6] and Hatzikamari's *et al.* [4], who, all of them, in cheese *Batzos*, made from raw sheep's milk, as in cheese *Anevato*, made from raw goat's milk, concluded that the total number of bacteria shows the run of rising at the beginning of ripening cheese paste.

It means that white soft cheese contains microorganisms tolerant on high concentration of salt, which, in the terms of higher pH, higher temperature of salting and additional pollution of salt from whey, is going to result with the higher content of the total number of bacteria. Garsia Fontan *et al.* [3] concluded that, during the ripening of the cheese *San Simon,* didn't happen rapid decreasing of the total number of bacteria as a result of weak effect of physical – chemical parameters on microbe's growth or pH value during ripening, which decreased a little and got the final value of 5,5.

After the tenth day of pickling cheese the total number of bacteria scored its maximum value in the second repetition for 2,5 x 10^7/g. For the first and third repetition the total number of bacteria decreased for 10,66 times and 1,29 times comparing with the first day of pickling.

On the thirtieth day of pickling cheese, for all of the three repetitions is noticeable run of decreasing of the total number of bacteria and with decreasing of pH value the number is going from 5,9 x 10^5/g to 6,1 x 10^5/g (Table 1). Values for pH are going from 4,13 to 4,29 and temperature from 17,2 to 17,6 °C (Table 2).

On the forty-fifth day of pickling, at all three repetitions values for the total number of bacteria are decreasing and are from 1 x 10^5 to 6 x 10^5/g (Table 1). pH is going from 3,90 to 4,27 and temperature from 10,1 to 18,1 °C (Table 2). The highest decrease of the total number of bacteria in cheese is equal with the highest decrease of pH and temperature. On the other side Centeno *et al.* [2] considered the presence of the total number of bacteria with the value of 10^9/g in cheese *Cebreiro* the basic cause for its spoiling and those results are different than the results got from the analysis of white soft cheese. The results of white soft cheese are similar with the results of Kakurinov [5], made on Kumanovo's yellow cheese and bitten cheese produced in the dairy in Kumanovo.

4. Conclusions

From all of the things written above, we can conclude the following things:

1. The high active acidity is noted in raw milk and the high total number of bacteria as a result of insanitary conditions of milk, keeping and bad transport of milk to the diary.
2. During the production of cheese, active acidity has the high value until the phase of moulding and dry salting, and the total number of bacteria is influenced by some other factors: temperature, salting cheese with dirty salt, manipulating with cheese with dirty hands by the employees. From the first to the twentieth day of pickling cheese, values for the pH are in great number decreasing in cheese, and the total number of bacteria except some extreme cases also shows the run of decreasing. From the twentieth to the forty-fifth day of pickling cheese, the values of the pH stay almost on the same level as in cheese, while the value of the total number of bacteria has its lowest value.
3. Low values of pH and temperature affect inhibitory on the total number of bacteria.

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