Biotechnology in Animal Husbandry 25 (5-6), p 725-735, 2009 ISSN 1450-9156
Publisher: Institute for Animal Husbandry, Belgrade-Zemun UDC 637.352

INFLUENCE OF THE pH OF MILK, CHEESE MASS AND BRINE ON A COMPLETE NUMBER OF BACTERIA DURING THE PRODUCTION OF WHITE SOFT CHEESE

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Original scientific paper

Abstract: The white soft cheese is a traditional product of Serbia and Pcinja area. The specific microbial flora is in connection with particularity of white soft cheese. The microbial flora, which was present in raw milk, is not static during the cheese making, but it steadily changes. There are some causes for these changes such as change of temperature, pH, and the presence of microbe products. The course of pH during cheese making is in connection with the course of the total number of bacteria. In raw milk, with the biggest pH, the total number of bacteria is the biggest. During cheese making, pH is in decrease and the total number of bacteria in cheese is in decrease too. In brine too is registered the tendency of decrease of the total number of bacteria, with the decrease of pH.

Key words: total number of bacteria, pH, soft white cheese

Introduction

Determination of the presence of total bacteria count in milk and dairy products is important because it is used as a standard for sanitary and technological correctness of milk and the final product, as its quality too. The total bacteria count represents one of the parameters which is the part of the legislation for quality measuring and the sanitary standards of milk and dairy products.

Active acidity of milk, cheese mass and brine during the production of white soft cheese is monitored and kept under control, in order to prevent its enormous increase which would result in final product of bad characteristics. High values for pH and high percentage of microorganisms in milk make good environment for intensive effect of proteolytic enzymes of lactic acid bacteria, micrococa, coliform bacteria, ferment and mildew, which would bring to deterioration of cheese.

Materials and Methods

Researches which are the subject of this project are made in the "Dairy Han" DOO Vladicin Han, in a microbiological and physical-chemical laboratory which are both in the dairy. 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 Serbia.

Research in the dairy plant are made on the three separate production processes in production of white soft cheese, realized in three summer months (July, August and September), with the milk from summer lactation. During the production of white soft cheese, samples for microbiological testing are taken to dairy plant in from:

- Raw collective milk, milk before making of cheese, whey, coagulate before production and from it after self pressure and pressure on the first day;
- Cheese after moulding and salting, on the second day;
- Cheese and brine, on the first, tenth, twentieth, thirtieth and fortieth day of brine.

In the physical-chemical laboratory, the pH (active acidity)was monitored 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 brine.

Results and Discussion

The total number of bacteria in white soft cheese during the whole production and in brine too is represented tabular (Table 1, Graphs 1 and 2).

Moving of the active acidity of milk, cheese mass and brine during the production of white soft cheese is represented tabular (Table 2, Graphs 3 and 4).

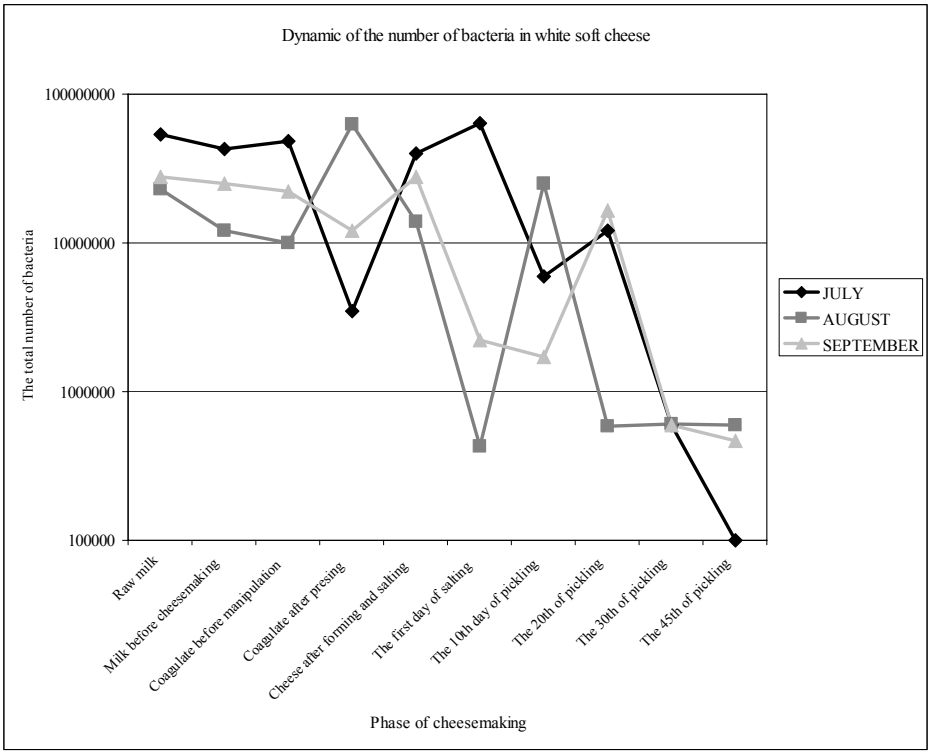
In the dairy plant "Han", in the summer months for the modification is used milk with the high total number of bacteria, which is the result of bad hygienic conditions of milk, storage and transportation of milk. Values of the active acidity of raw milk are higher than those in other phases of the cheese production and they vary from 6,5 to 6,7.

Table 1. The total bacteria count in white soft cheese and in brine (in ml or g test)

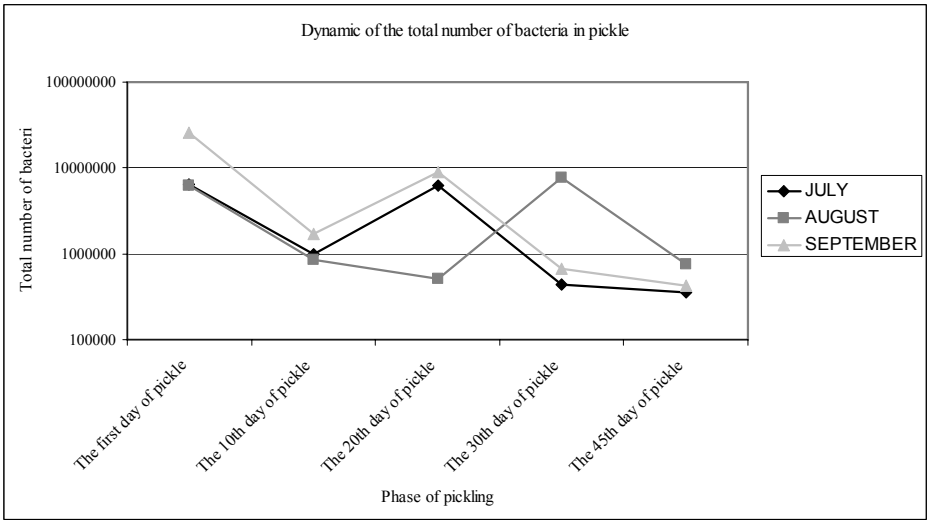
TEST	JULY	AUGUST	SEPTEMBER
Raw milk	5.4×10^7	2.3×10^7	2.8×10^7
Milk before cheese making	4.3×10^7	1.2×10^7	2.5×10^7
Whey	3.9×10^7	1.0×10^5	2.0×10^6
Coagulate before manipulation	4.8×10^7	1.0×10^7	2.2×10^7
Coagulate after pressing	3.5×10^6	6.3×10^7	1.2×10^7
Cheese after forming and salting	4.0×10^7	1.4×10^7	2.8×10^7
The first day of salting	6.4×10^7	4.3×10^5	2.2×10^6
Brine the 1 day	6.4×10^6	6.3×10^6	2.6×10^7
The 10 day of brining	6.0×10^6	2.5×10^7	1.7×10^6
Brine the 10 day	1.0×10^6	8.6×10^5	1.7×10^6
The 20 day of brining	1.2×10^7	5.8×10^5	1.65×10^7
Brine the 20 day	6.3×10^6	5.1×10^5	8.8×10^6
The 30 day of brining	6.0×10^5	6.1×10^5	5.9×10^5
Brine the 30 day	4.4×10^5	7.7×10^6	6.6×10^5
The 45 day of brining	1.0×10^5	6.0×10^5	4.7×10^5
Brine the 45 day	3.5×10^5	7.5×10^5	4.2×10^5

Table 2. pH in milk, cheese and brine during cheese making

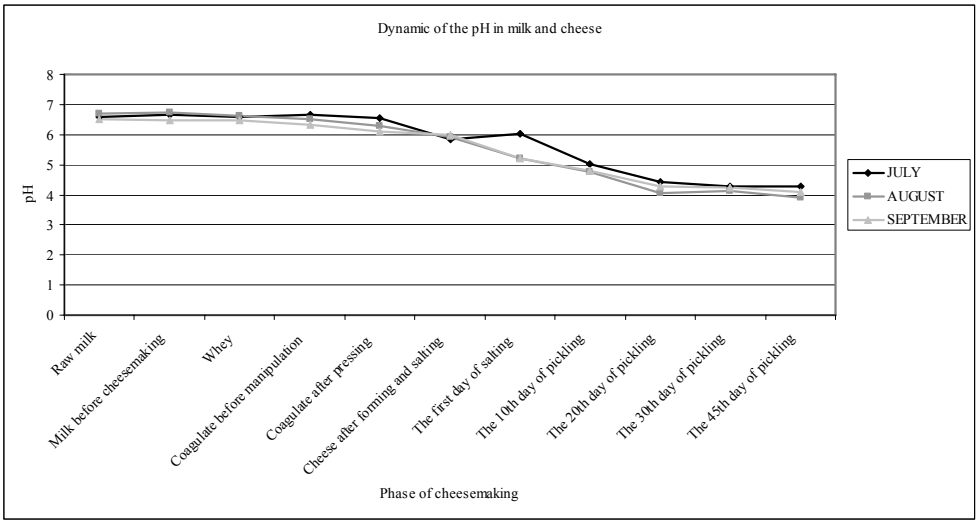
TEST	JULY	AUGUST	SEPTEMBER
	Activ acid	Activ acid	Activ acid
Raw milk	6.60	6.70	6.50
Milk before cheesemaking	6.67	6.73	6.47
Whey	6.60	6.64	6.46
Coagulate before manipulation	6.67	6.53	6.31
Coagulate after pressing	6.56	6.29	6.11
Cheese after forming and salting	5.83	5.93	5.98
The first day of salting	6.03	5.22	5.21
Brine the 1 day	6.03	5.23	4.68
The 10 day of brine	5.03	4.78	4.81
Brine the 10 day	5.03	4.02	4.82
The 20 day of brine	4.43	4.05	4.28
Brine the 20 day	4.17	4.00	4.31
The 30 day of brine	4.29	4.13	4.25
Brine the 30 day	4.10	4.07	4.06
The 45 day of brine	4.27	3.90	4.11
Brine the 45 day	4.09	4.02	4.03



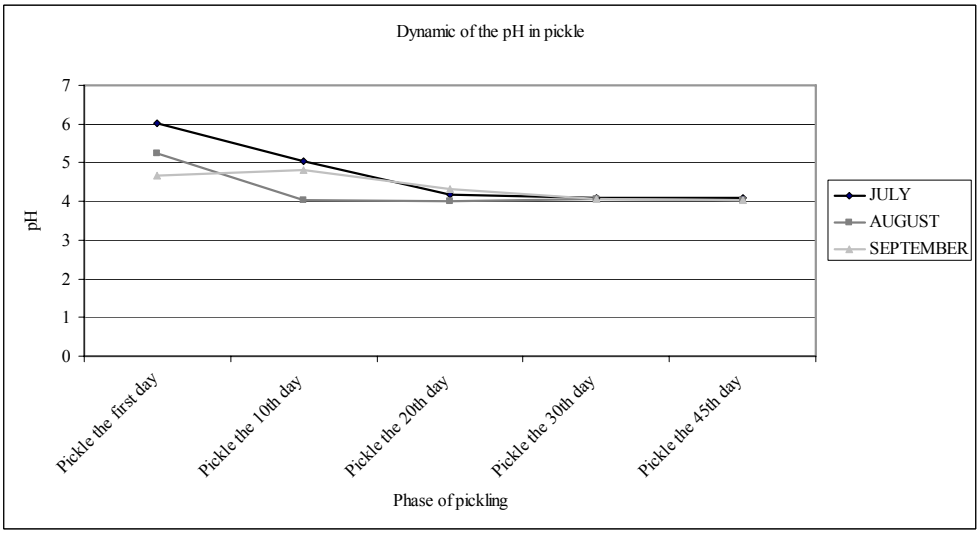
Graph 1. Dynamic of the total bacteria count in white soft cheese (in ml or g test)



Graph 2. Dynamic of the total bacteria count in brine



Graph 3. Dynamic of the pH in milk and cheese



Graph 4. Dynamic of the pH in brine

After percolation, homogenization, pasteurization and cooling of milk, at the moment of making cheese, at the active acidity from 6,47 to 6,73 (Table 2), the total number of bacteria moved from 1,2 x 10^7 to 4,3 x 10^7/ml (Table 1). 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 bacteria count in coagulate remained almost on the same level as it used to be in milk before making cheese. Compared to raw milk, the total bacteria count 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%).

Stević (1962) concluded that it kept from 70 – 75% in coagulate from the total number of bacteria in milk, while 25-30% disappeared together with whey.

During 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).

After the phase of moulding and dry salting of white soft cheese in the dairy plant "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. From the graph 3 you can see that pH values are almost the same and they cut themselves in the same spot. In this phase of producing cheese, active acidity is decreasing comparing with the phase of self pressure and pressure for all of the three repetitions.

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 increased 1,6 times compared to previous phase.

Salt can represent one more inhibition factor which brings to decreasing of the total number of bacteria, considering that it reduces the content of active water. Certainly, the inhibition effect of salt depends on its concentration, the content of moisture in cheese, as pH value too *(Bersford et al., 2001)*. On the other side, with bringing salt into cheese is possible to bring in microorganisms, which brings to higher pollution of cheese.

Concentration of whey in which cheese was put in the "Han" dairy, was 8-10%. It was high enough to have inhibition effect on growth of the total number of bacteria in cheese (the total number decreased 32,56 and 12,73 times). Low pH value influences inhibition of total number of bacteria and their number in cheese paste is 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). That is how we explain the rise of the total number of bacteria 1,6 times at first repetition. This is in agreement with the *Nikolaou et al.(2002), Psoni et al. (2003)* and *Hatzikamari et al. (1999)*, 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 of cheese paste.

Fontan et al. (2001), concluded that, during the ripening of the cheese San Simon, there was no rapid decreasing of the bacteria count as the 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.

Values of the total bacteria count in brine on the first day of brining are similar for the first and second repetition and they are 6,4 x 10^6/ml and 6,3 x 10^6/ml, while it is higher for the third repetition and is 2,6 x 10^7/ml (Table 1). Comparing the results with the already existing data, rising of the total number of bacteria during the phase of ripening was noted in couple of cheeses made from raw cow's milk. In 2-3 weeks old cheese Tetilla made from raw cow's milk, the complete number of bacteria came to the value of 10^{10}/g *(Menendez et al., 2001)*.

After tenth day of brining of cheese, the total bacteria count 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 brine.

In cheese and brine too at the third repetition the total number of bacteria is with the same value and is 1,7 x 10^6/g (or ml). At the first and second repetition in brine comparing with cheese is 6 and 29 times is smaller the total number of bacteria.

In brine the total number of bacteria decreased in all three repetitions compared to first day of brining and is 6,4 times for the first repetition, 7,32 times for the second repetition and 15,29 times for the third repetition.

Comparing with the previous phase of brining on the twentieth day, the total number of bacteria scored its maximum value in the first and second repetition and was 1,2 x 10^7/g and 1,65 x 10^7/g which means that it increased 2 times and 9,7 times. In the second repetition, the total number of bacteria was 5,8 x 10^5/g which means that it decreased 43 times compared to

previous phase. Polluted salt is cause of all the high values of the total number of bacteria in this phase of brine.

In brine on the twenty-fifth day of brining in the same way as in cheese for the first and third repetition, the total number of bacteria increased and it was 6,3 x 10^6/ml and 8,83 x 10^6/ml. The total number of bacteria in brine on the twentieth day compared to cheese decreased 1,9 times at the first repetition and 1,87 times at the third repetition, while at the second repetition the value for the total number of bacteria in brine is similar to the value in cheese (in brine is 5,1 x 10^5/ml, and in cheese 5,8 x 10^5/g).

On the thirtieth day of brining of cheese, for all three repetitions, tendency of decrease of total bacteria count was registered and with decrease of pH values varied from 5,9 x 10^5/g to 6,1 x 10^5/g (Table 1). Values for pH varied from 4,13 to 4,29 (Table 2). In brine on the thirtieth day of brine the total number of bacteria varied 4,4 x 10^5/ml to 7,7 x 10^6/ml.

On the forty-fifth day of brining, in all three repetitions values for the total number of bacteria decreased and varied from 1 x 10^5 to 6 x 10^5/g (Table 1). pH varied from 3,90 to 4,27 (Table2). The highest decrease of the total number of bacteria in cheese is equal to the highest decrease of pH.

Values for the total number of bacteria in brine on the forty-fifth day compared to the thirtieth day, also showed the tendency of decrease and varied from 3,5 x 10^5/ml to 7,53 x 10^5/ml (Table 1). Compared to cheese, the total bacteria count in brine was 3,5 times higher for the first repetition, 1,25 times for the second and almost on the same level for the third repetition. Higher number of bacteria in brine from the same in cheese represents more intensive pollution of brine with the polluted salt or additional pollution with dirty hands.

Rapid decrease of the total number of bacteria during ripening of white soft cheese in brine, *(Lomsadez*, *1976)*, was in the cheese Imperetinski.

On the other side *Centeno et al. (1996),* considering the presence of the total bacteria count 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 (1997)*, made on Kumanovo's yellow cheese and bitten cheese produced in the dairy in Kumanovo. The highest decrease of the number of

bacteria was noted on the tenth day of brine, when the pH of brine was the lowest and it was 3,8-4,13.

By *Eck (1987),* with the activity of the proteolytics enzymes are released the most different compounds like peptides, amino acids, aldehydes, amins, organic acids, phenol, indol, volatile components and certainly ammonia which can prove or spoil the taste of cheese, and to cause the rise of pH value.

Conclusion

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

1. In raw milk is noted the high active acidity and the high total number of bacteria as a result of non-sanitary conditions of milk, keeping and bad transport of milk to the dairy plant.
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.
3. From the first to the twentieth day of brine cheese, values for the pH are in great number decreasing in cheese and brine too, and the total number of bacteria except some extreme cases also shows the run of decreasing.
4. From the twentieth to the forty-fifth day of brine cheese, the values of the pH stay almost on the same level as in cheese and brine, while the value of the total number of bacteria has its lowest value.
5. Low values of pH affect inhibition of the total number of bacteria.

Uticaj pH mleka, sirne mase i salamure na ukupni broj bakerija pri proizvodnji belog mekog sira

J. Stojiljković

Rezime

U ovom radu je prikazana veza između praćenja pH vrednosti tokom proizvodnje belog mekog sira sa praćenjem dinamike ukupnog broja bakterija. U sirovom mleku, u kome je zabeležena najveća pH vrednost,

ukupni broj bakterija je najveći. Tokom daljeg toka proizvodnje sira, pH vrednost počinje da se smanjuje, a time se smanjuje i ukupan broj bakterija u sirnoj masi. Takodje, u salamuri je zabeležena tendencija smanjenja ukupnog broja bakterija, sa smanjenjem pH vrednosti.

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Received 31 May 2009; accepted for publication 15 August 2009