JAP&T
TPA-Timisoara

Available on-line at www.japt.tpa.usab-tm.ro

Journal of Agroalimentary Processes and Technologies 2009, *15*(2), 222-228

Journal of Agroalimentary Processes and Technologies

The influence of starch addition on the quality of sour milk obtained with a probiotic culture

Georgiana Gabriela Codina, Ana Leahu

"Stefan cel Mare" University, Faculty of Food Engineering13th University Street, 720229, Suceava - Romania

Abstract

The research carried on in the lab phase aimed to establish the opportunities and the conditions of using starch as a thickening agent to prodce sour milk. Therefore, experiments have been carried out regarding the influence of starch addition in doses of 3%, 5%, 7% and 10% on the rheological, physical-chemical, microbiological and sensorial properties of sour milk obtained with a starter culture of probiotic bacteria of Bifidobacterium infantis and Lactobacillus acidophilus. The rheological experiments have been carried out with the help of a capillary viscometer and the rheological and microbiological behavior of the analysed samples has been evaluated both through classic methods and with the help of automatic devices such as EcoMilk, Solaris. This research was carried out throughout the technological process and on the final products, the best results being registered for a dosis of 3% starch added during processing.

Keywords: sour milk, starch, starter culture

1. Introduction

Fermented dairy products like sour milk are extremely popular worldwide due to their pleasant sensorial characteristics as well as to the potential they have in maintaining and improving the health of the consumer.

The identification of microorganisms responsible for fermentation and their use for preparing pure cultures has led to the development of numerous probiotic products that are healthy for the human body as they improve the intestinal microbial equilibrium. [1] The main bacterial stems used as probiotics, *Lactobacillus acidophilus* and various species of bifidobacteria are dominant organisms in the small intestine and in the human colon. [2] These microorganisms are important throughout the process of inhibiting the development of the pathogen bacteria by producing organic acids and bacteriocine and by deconjugating the billiary salts. [3, 4]

The texture is of great importance for the quality and customer acceptance of fermented dairy products. Thus, in order to produce them, a series of stabilizer additives are used (such as starch) in order to improve their structure and consistency. [5] The amount that should be added must me determined experimentally by each producer, taking into account the concrete factory conditions.

Therefore, we thought an analysis of the way in which the starch influences the physical chemical, rheological, microbiological and sensorial properties as well as the technological process and the quality of sour milk obtained with a probiotic culture, was extremely useful.

2. Materials and methods

For experiments there were chosen cow milk like raw material. The starter culture used for inoculation is DI-PROX YBA 986 delivered by Enzymes&Derrivates Romania. DI-PROX YBA 986 is a mesophilic culture which contains 6x 10^9 cells of *Bifidobacterium* and 6x 10^9

* Corresponding author: *e-mail address*: codinageorgiana@yahoo.com

Lactobacillus acidophilus. The producer recommends the use at 37˚C of a dosis of 5 UA/100 litters of milk. The block diagram used for producing sour milk is presented in figure 1.

Milk
↓
Starch Addition
↓
Homogenization:60-70 ºC
↓
Cooling the milk :30-32ºC
↓
Inoculation : EDR culture
DI-PROX YBA 986 0,125 U.A./500 ml milk
↓
Mixing:20-30 min
↓
Packing
↓
Incubation:8 h/30-32 ºC pana la pH=4.5
↓
Cooling :2-8 ºC
↓
Cold store:2-8 ºC

Figure 1. Block diagram of sour milk processing

Starting from the milk chosen for analysis, different doses of starch were used as follows:

- L_1 – control sample, no starch addition;
- L_2 – sample with 3% starch addition;
- L_3 - sample with 5% starch addition;
- L_4 - sample with 7% starch addition;
- L_5 - sample with 10% starch addition;

For the five samples obtained, the following aspects were analyzed: characterization of the sour milk products obtained from a sensorial, physical-chemical, rheological and microbiological point of view, the evolution of the fermentative process of the dairy products obtained during the cold store at 4˚C for 5 days.

The quality assessment of the samples was performed by Romanian standards, using physical and chemical methods. Mositure content was determined by STAS 6344-88, pH by STAS 8201-82, acidity by SR ISO 11169.

The microbiological determinations were carried out with Solaris device and the rheological behaviour were carried out with a capillary viscometer with a diameter of 2 mm, a thermometer and a cylinder with a volume of 500 ml. The physical-chemical characteristics of milk and sour milk (fat content, protein substances, lactose, density) were carried out using EcoMilk device.

3. Results and discussions

In experiments was used a cow milk with 17˚T acidity, 6.66 pH, 3.65% fat content, 28.8 g/cm^3 density, 54.1 freezing point, 3.28% protein content and 8.14% dry substance.

During those experiments on started from the evolution of the fermentative process (figure 2).

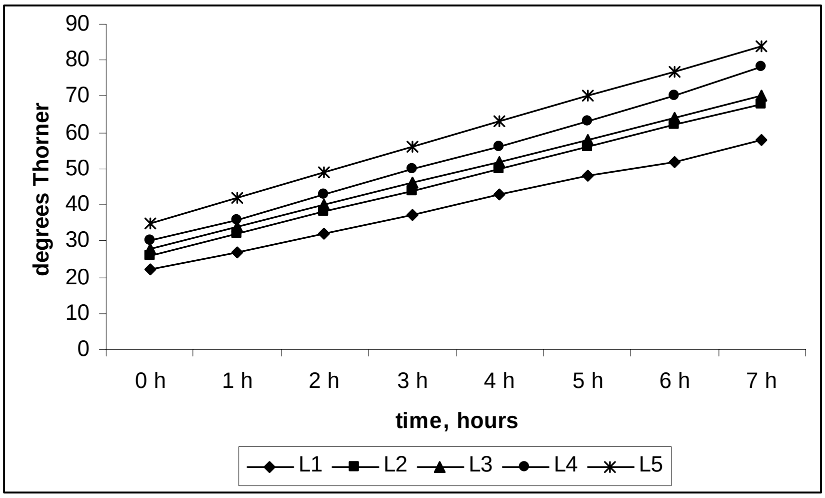

Figure 2. The evolution of the fermentative capacity of the sour milk samples during fermentation (7 hours)

It is to be noticed that the acidity developed in the sour milk samples analyzed, has grown proportionally with the starch addition incorporated in the fabrication recipe.

At the same time, it has been noticed that the developed acidity has varied significantly between samples, reaching a maximum value in L5 (10% added starch), seven hours after the beginning the fermentative process (84˚T).

This fact is to be explained because the starch contains a certain amount of protein substances, which constitutes a source of nitrogen for bacteria, stimulating the lactic fermentation. At the same time, the starch has an acidity of ~2.5, which leads to a decrease of milk pH with 6.6-6.8.

The data in figure 2 reveal a clear increase of milk acidity proportionally with the fermentation time, which is to be explained by the fact that the lactic bacteria have produced a lactic fermentation through lactose hydrolyse in glucose and galactose. Glucose is afterwards decomposed in various ways in the lactic acid, which leads to a significant increase of milk acidity. This increase of acidity is correlated with the evolution of the number of microorganisms (lactic bacteria), which is to be seen in figure 3.

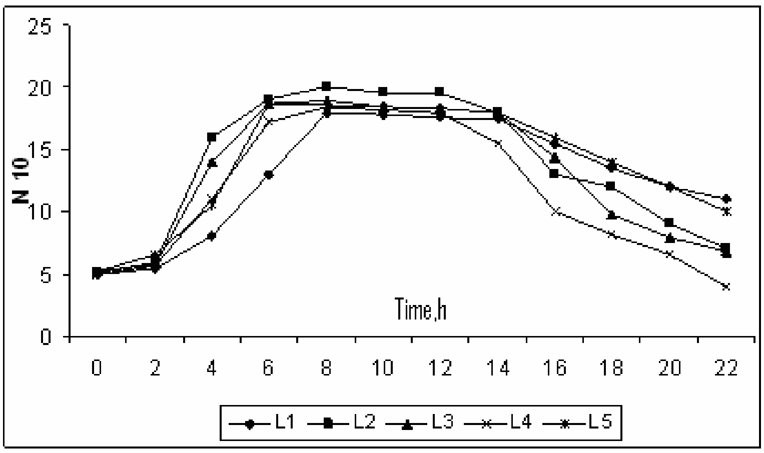

Figure 3. The curve indicating the increase of microorganisms for the sour milk samples with different quantities of starch added, compared to the control sample

Figure 3 shows that all the starch samples have a larger number of microorganisms than the control sample up to 15 hours of fermentation followed by a decrease due to the inhibition of the development of the acidifying microflora in the product. At the same time, the sample with 10% starch has the largest number of microorganisms.

From the rheological point of view, starch addition leads to an increase of sour milk viscosity proportionally with the starch dose added (figure 4).

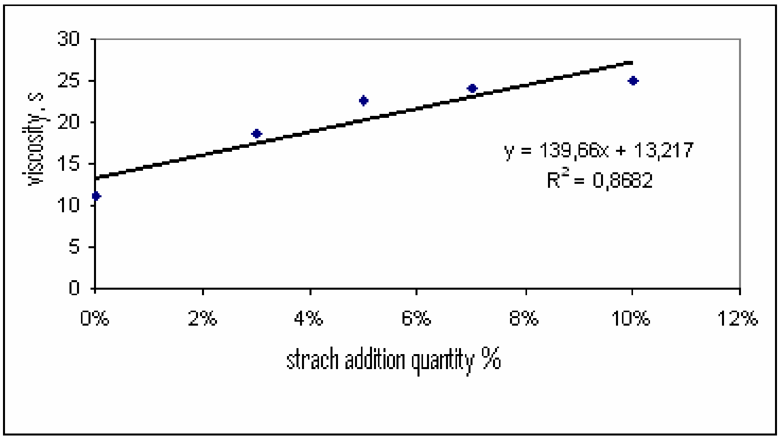

Figure 4. The variation of sour milk viscosity for different quantities of starch added.

This fact is explainable, starch being a hydrocolloid that behaves like a pseudoplatic liquid which gives solutions with a viscosity that depends on the quantity of product incorporated. It creates a stability of watery dispersions for which the continual phase is water and the dispersed phase is solid or liquid and has the tendency to separate. Through starch addition, the viscosity of sour milk is increased and the tendency of destabilizing through components separation is reduced. The effect of improving the consistency of the samples became obvious when 3% starch was added for the quantity of milk used. Through the samples with starch addition, sour milk viscosity described a linear function, statistically significant up to a 5% incorporated quantity of added starch.

Therefore we can say that from a rheological point of view, the best dose of starch that should be added to sour milk in order to obtain significant rheological properties is 3-5 %.

From a microbiological point of view, the data obtained do not vary significantly and it corresponds to the values given by the specialty literature (NTG: L1-3000, L2-3000, L3-3100, L4-3100, L5-3200).

The physical-chemical characteristics of the samples obtained determined by the EcoMilk are presented in table 1. One can notice that the values obtained for the 5 samples of sour milk are very close and they correspond to the values given by the specialty literature.

Table 1. The phisical-chemical characteristics of the sour milk samples.

Characteristics	L1	L2	L3	L4	L5
Acidity	63	65	68	72	76
pH	4.70	4.72	4.73	4.71	4.75
Fat content%	2	1.86	1.99	2.04	2
Lactose	6.70	6.71	6.77	6.75	6.78
Protein	3.20	3.18	3.21	3.24	3.20
Dry substance	8.32	8.18	8.20	8.34	8.31
Density	28.9	29.1	29	29.3	29

From a sensorial point of view, the characteristics presented in table 2 have been obtained. The best sensorial characteristics were reflected in sample L3 with 3% starch added during processing.

Table 2. The sensorial characteristics of the sour milk samples obtained.

Indices	Characteristics				
	L1	**L2**	**L3**	**L4**	**L5**
Aspect and consistency	Homogenous, fluid-viscous, with few fat content agglomeration.	Homogenous, viscous, without fat content agglomeration or proteic substances.	Homogenous, more viscous than L1, without fat content agglomeration	Homogenous, more viscous than L3, without fat content agglomeration or proteic substances.	Homogenous, more viscous than L4, a little sedimented starch can be noticed, without fat content agglomeration
Taste and flavor	Pleasant, flavored, slightly sour, without foreign taste or smell	Pleasant, flavored, slightly sour, without foreign taste or smell	Pleasant, flavored, slightly sour, with a slight taste of cereal	Pleasant, flavored, sweet-sour flavor, with cereal smell, and a perceived taste of flour	Pleasant, weak flavor smell and acute taste of flour
Colour	White-yellow, homogenous	White, with a weak greysh nuance homogenous	White, with a grey nuance homogenous	White, with a stronger nuance of grey, homogenous	Grey, homogenous

While cold stock the sour milk samples, we analysed the evolution of acidity and of the total number of germens for 5 days. The continual fermentation leads to an increase of acidity as figure 5 shows.

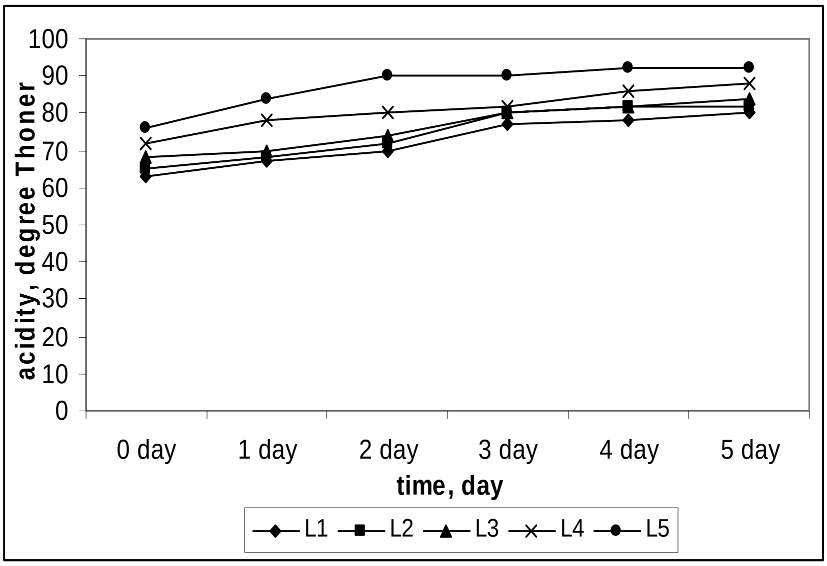

Figure 5. The evolution of the fermentative capacity of sour milk samples for 5 days, during cold store

The increase of acidity is correlated with the evolution of the number of microorganisms (lactic bacteria), as figure 6 reveals. Due to the low pH, sour milk can become a selective environment for the development of some contamination microorganisms. Therefore we thought it was useful to determine NTG for the first five days of stock-piling the dairy products obtained. The values obtained for acidity and NTG for the five samples of sour milk obtained correspond to the values given by the specialty literature.

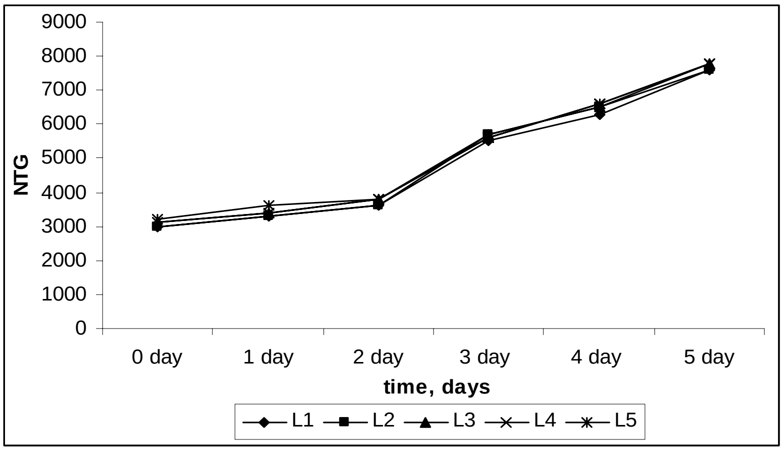

Figure 6. NTG evolution for the sour milk samples for 5 days of cold store.

The values obtained for acidity and NTG for the five samples of sour milk correspond to the values given by the specialty literature.

4. Conclusions

From the rheological point of view, starch addition leads to an increase of sour milk viscosity proportionally with the starch dose added. Through the starch added samples, the viscosity of the product obtained revealed a linear function, statistically significant up to a 5% incorporated quantity of added starch. No significant rheological modifications were registered above this value.

From the microbiological point of view, the increase of acidity is correlated with the evolution of the number of microorganisms, the sample with 10% starch having the largest number of microorganisms up to 15 hours from the beginning of the fermentation process. After this period of time, a microbiological decrease follows due to the inhibition of the development of the acidifying microflora in the product. During 7 hours of fermentation, the evolution of the fermentative capacity varied significantly between samples, reaching a maximum value with L5 (10% added starch) seven hours after the beginning of the fermentative process (84˚T).

During cold-stock for 5 days, at refrigerating temperature, an increase of acidity was registered along with a microbiological load of the sour milk samples analyzed until reaching values that are in conformity with the current stas, which shows that all the products are consumable. From the sensorial point of view, the best sample was the one with 3% starch added in the recipe.

The physical-chemical, rheological, microbiological and sensorial results obtained show that the best starch dose that should be added in the recipe to obtain a high-quality sour milk is 3%.

Acknowledgements

The authors thank to Enzymes&Derivates Romania for the technical support.

Refrences

1. A.M.P. Gomes, F.X. Malacta, Bifidobacterium spp. And Lactobacillus acidophilus: biological, biochemical,

technological and therapeutical properties relevant for use as probiotics, 1999, Trends in Food Science and Technology, 10: 139-157

2. R.C. Chandan, Enhancing Market value of milk by adding cultures, 1999, J. Dairy Science, 82: 2245-2256
3. D.G. Hoover, Bifidobacteria: Activity and Potential Benefits, 1993, Food Technology, 47 (6): 120-124
4. H. Martine, Effect of lactic acid bacteria on diarrheal diseases, 2000, Journal of American College of Nutrition, 19 (2): 137-146
5. R.C. Chandan, K.M.Shahani, (Y.H. Hui editor), Dairy Science and Tehnology Handbook (chapter Yougurt), 1993, U.S.A., pp. 39-40