The impact of different starter cultures on pH and SH dynamics during the storage of three variants probiotic yogurt

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Abstract

Fermented dairy products, also known as cultured milk products, are dairy foods that have been fermented by using lactic acid bacteria (Lactobacillus, Lactococcus, and Leuconostoc). Fermented dairy products are described as a potential cure for different digestive disorders. The popularity of these products is growing, not only because of its organoleptic properties, but also because of its nutritional value and health benefits. Probiotic yogurt is a dairy product obtained by milk fermentation process, by adding a probiotic starter culture. The aim of this survey was to follow the pH and SH values during the storage period of probiotic yogurt manufactured from three different starter cultures with the following commercial names: ABT-6, ABT-750 and ABT-10 consisting of *Streptococcus thermophilus*, *Lactobacillus acidophilus* and *Bifidobacterium bifidus*.

Key words: Keywords: probiotic yogurt, active acidity, titrable acidity, storage period;

Introduction

Dairy products, particularly those that contain probiotics, prebiotics and symbiotic are the most popular functional foods. It can be defined as foods 'that can have beneficial effect on one or more body functions, nutritional effect and can also reduce the risk of disease appearance (Stanton et al., 2005).

Probiosis can be defined as the positive effect of consumption of fermented dairy products with lactic acid bacteria (LAB) on the equilibrium of intestinal microflora (Tomasik & Tomasik, 2003). Probiotics are live microbial food ingredients that have a beneficial effect on human health. Prebiotics can be defined as no digestible substances that exert some biological effect on humans by selective stimulation of growth or bioactivity of beneficial microorganisms either present or therapeutically introduced into the intestine (Roberfroid, 1998).

The main milk function in young mammal's diet is providing nutrients that are essential for their normal growth, development and immune protection. Milk is a major source of protein, essential fatty acids, vitamins and minerals that are important for normal human metabolism functioning. Some substances are added in small amounts in order to improve the functional, sensory, nutritional, immunological, therapeutic and even technological milk properties and dairy products. This group of substances includes probiotics which always go together with prebiotics (Ramchandran, 2009).

The primary probiotic bacteria associated with dairy products have been Lactobacillus acidophilus, Lactobacillus casei and bifidobacteria. The most common probiotic dairy products worldwide are various types of yogurt (Gilliland, 2002).

In this research paper three different types of probiotic yogurt were produced. The differences were in the probiotic starter cultures that were used in the production process. The impact of starter culture on pH and SH were followed.

Materials and Methods

Materials

The following raw materials were used during the research work: standardized cow milk, 0.1% skimmed powder milk up to 0.7%, three types of frozen probiotic cultures - 0.02% which are produced by CHR Hansen (ABT10, ABT750 and ABT6), Copenhagen, Denmark and prebiotic oligofructose - 1.5%.

The probiotic cultures that were used in this research paper(ABT10, ABT750 and ABT6) were composed with the following types of bacteria in different proportion:

-*Streptococcus thermophilus* – St- M5;
-*Lactobacillus acidophilus* – LA – 5;
-*Bifidobacterium bifidus* – BB – 12;

The fermentation process was obtained according to the dairy industry standards and operating instructions of the probiotic cultures manufacturer CHR Hansen - Denmark.

Methods

Measurement of pH

The pH or active acidity was determined by using digital pH MP120 Meter, Mettler Toledo, Switzerland. After each usage the pH-meter was calibrated with buffer solutions pH = 7.00 and pH = 4.01. The concentration of hydrogen ions present in the three variants probiotic yogurts was measured after 24h, on the 4^{th}, 8^{th}, 12^{th}, 17^{th} and 21^{st} d during the storage period.

Measurement of Titratable Acidy

Titratable acidity is a very important factor, which affects the shelf life and the acceptability of fermented dairy products (Mahmoudi et al., 2012). The measurement of tirtable acidity (°SH) was according the method used that is described by Caric et al. (2000). In erelenmaer with transfer pipette 20ml yogurt and 1ml of 2% w/v solution of phenolphthalein. Content is titrated with 0.1M NaOH solution till appearance of faint pink color that will not get lost for over 2min. Acidification of yogurt is calculated by the formula:

$$K = V.2 \quad (1),$$

where: V-volume of NaOH spent during titration.

The titrable acidity in the three variants probiotic yogurts was measured after 24h, on the 4^{th}, 8^{th}, 12^{th}, 17^{th} and 21^{st} d during the storage time period.

Results and discussion

pH dynamics of probiotic yogurt during storage period

The pH values regarding the examined three varieties of probiotic yogurt are presented in Table 1. According to the results presented in Table 1, it can be concluded that pH values in the three variants of probiotic yogurt (produced with different probiotic starter culture) at the first day of production were the following: from 4.51 to 4.41 (probiotic yogurt produced with starter culture ABT10), from 4.50 to 4.43 to (probiotic yogurt produced with starter culture ABT750) and from 4.49 to 4.39 (probiotic yogurt produced with starter culture ABT6).

The pH values at the 4th d were the following: from 4.42 to 4.35 to (probiotic yogurt produced with starter culture ABT10), from 4.39 to 4.37 to (probiotic yogurt produced with starter culture ABT750) and from 4.36 to 4.30 (probiotic yogurt produced with starter culture ABT6).

The pH values at the 12th d were the following: from 4.24 to 4.31 (probiotic yogurt produced with starter culture ABT10), from 4.19 to 4.26 (probiotic yogurt produced with starter culture ABT750) and from 4.20 to 4.16 (probiotic yogurt produced with starter culture ABT6).

Continuous decreasing of active acidity during storage time to all examined variants of probiotic yogurt but without significant peaks was noticed. After 21d of storage period the pH values were as follow: from 4.15 to 4.06 (probiotic yogurt produced with starter culture ABT10), from 4.12 to 4.03 (probiotic yogurt produced with starter culture ABT750) and from 4.10 to 3.99 (probiotic yogurt produced with starter culture ABT6).

°SH dynamics of probiotic yogurt during storage period

The °SH values regarding the examined three varieties of probiotic yogurt are presented in Table 2. According to the results presented in Table 2, it can be concluded that SH values in the three variants of probiotic yogurt (produced with different probiotic starter culture) at the first day of production were the following: from 27.50 to 29.30 °SH (probiotic yogurt produced with starter culture ABT10), from 27.70 to 29.50°SH (probiotic yogurt produced with starter culture ABT750) and from 28.20 to 30.00 °SH (probiotic yogurt produced with starter culture ABT6). The °SH values at the 4th d were the following: from 28.90 to 31.30 °SH (probiotic yogurt produced with starter culture ABT10), from 28.10 to 31.00°SH (probiotic yogurt produced with starter culture ABT750) and from 28.90 to 30.50 °SH (probiotic yogurt produced with starter culture ABT6).

The °SH values at the 12th d were the following: from 29.90 to 33.50 °SH (probiotic yogurt produced with starter culture ABT10), from 29.50 to 33.30°SH (probiotic yogurt produced with starter culture ABT750) and from 31.10 to 33.70 °SH (probiotic yogurt produced with starter culture ABT6).

Continuous increase of titrable acidity was noticed to all examined variants of probiotic yogurt without significant peaks.

After 21d of storage period the °SH values were as follow: from 28.90 to 31.30 °SH (probiotic yogurt produced with starter culture ABT10), from 28.10 to 31.00°SH (probiotic yogurt produced with starter culture ABT750) and from 33.40 to 37.00 °SH (probiotic yogurt produced with starter culture ABT6).

It appears that the composition of starter culture, and storage period could influence the overall level of acidity and pH of stored probiotic yogurt samples. These results were in agreement with those reported by Ozer et al. (2005), Ranathunga & Rathnayaka (2013).

Conclusions

Fermented dairy products are are very important to the human diet. Nowadays, due to the increasing demand on safe and functional foods, consumption of new and enriched foods has shown growth to higher rates. In our country, the consumption of probiotic yogurt increases with each passing day and there will be growing demand on these products. In this research paper three different types of probiotic yogurt were produced, which differ by the starter culture that were used in the production process (ABT10, ABT750 and ABT6). The starter cultures that were used did have impact on the dynamics on pH and °SH during the storage period. Continuous increase of titrable acidity and continuous decreasing of active acidity was noticed during the storage time to all examined variants of probiotic yogurt but without significant peaks.

References

Carić, M., S. Milanović, D. Vucelja (2000). Standardne Metode Analize Mleka i Mlečnih Proizvoda. Tehnološki fakultet u Banjoj Luci, University of Novi Sad, Serbia. https://www.tehnologijahrane.com/knjiga/standardne-metode-analize-mleka-i-mlecnih-proizvoda-2

Gilliland S. E. (2002). Technological & Commercial Applications of Lactic Acid Bacteria. PhD Thesys. Department of Animal Science Food & Agricultural

Products, Center Oklahoma State University, Stillwater, OK 74078, USA.

Mahmoudi, R., P. Zare, P. Hassanzadeh, S. Nosratpour (2012). Effect of *Teucrium polium* essential oil on the physicochemical and sensory properties of probiotic yoghurt. *Journal of Food Processing and Preservation*, **38**(3): 880-888. DOI: 10.1111/jfpp.12042

Ozer, D., S. Akin, B. Ozer (2005). Effect of inulin and lactulose on survival of *Lactobacillus acidophilus* LA-5 and *Bifidobacterium bifidum* BB-02 in acidophilus-bifidus yoghurt. *Food Science and Technology International*, **11**(1): 19-24. DOI: 10.1177/1082013205051275

Ramchandran, L. (2009). Physico-chemical and Therapeutic Properties of Low-Fat Yogurt as Influenced by Fat Replacers, Exopolysaccharides and Probiotics. PhD Thesys, Victoria University, Faculty of Health, Engineering and Science, School of Biomedical and Health Sciences, Werribee Campus, VIC, Australia. http://vuir.vu.edu.au/ 15511/1/ ramchandran.pdf

Ranathunga, M. T. N., R. Rathnayaka (2013). Comparison of physicochemical and sensory properties of probiotic and natural yoghurt. *Journal of Biological and Food Science Research*, **2**: 1-6.Singh, G., I. P. S. Kapoor, P. Singh (2011). Effect of volatile oil and oleoresin of anise on the shelf life of yoghurt. *Journal of Food Processing and Preservation*, **35**(6): 778-783. DOI: 10.1111/j.1745-4549.2011.00528.x

Roberfroid, M. B. (1998). Prebiotics and synbiotics: concepts and nutritional properties. *The British Journal of Nutrition*, **98**(4): S197-202.

Stanton, C., R. P. Ross, G. F. Fitzgerald, D. V. Sinderen (2005). Fermented functional foods based on probiotics and their biogenic metabolites. *Current Opinion in Biotechnology*, **16**(2): 198-203. DOI: 10.1016/j.copbio.2005.02.008

Tomasik, P. J., P. Tomasik (2003). Probiotics and prebiotics. *Cereal Chemistry*, **80**(2): 113-117. DOI: 10.1094/CCHEM.2003.80.2.113

Table 1. Dynamics of active acidity (pH) during storage time of probiotic yogurt

Dynamics of active acidity (pH) during storage time (5 repetitions)							
Number of repetition	**Type of probiotic culture**	**Storage period (day)**					
		1	**4**	**8**	**12**	**17**	**21**
I	ABT 10	4,51	4,42	4,33	4,26	4,20	4,14
	ABT 750	4,50	4,38	4,30	4,26	4,19	4,12
	ABT 6	4,49	4,35	4,29	4,18	4,14	4,10
II	ABT 10	4,50	4,40	4,35	4,31	4,22	4,15
	ABT 750	4,49	4,47	4,29	4,25	4,20	4,11
	ABT 6	4,48	4,36	4,28	4,20	4,15	4,06
III	ABT 10	4,52	4,42	4,35	4,30	4,22	4,13
	ABT 750	4,49	4,39	4,31	4,25	4,20	4,12
	ABT 6	4,46	4,36	4,31	4,19	4,13	4,05
IV	ABT 10	4,44	4,39	4,33	4,27	4,18	4,08
	ABT 750	4,45	4,37	4,26	4,19	4,15	4,05
	ABT 6	4,40	4,31	4,25	4,17	4,11	4,00
V	ABT 10	4,41	4,35	4,30	4,24	4,15	4,06
	ABT 750	4,43	4,37	4,25	4,19	4,14	4,03
	ABT 6	4,39	4,30	4,23	4,16	4,08	3,99

Table 2. Dynamics of titrable acidity (°SH) during storage time of probiotic yogurt

Dynamics of titrable acidity (°SH) during storage time (5 repetitions)							
Number of repetition	**Type of probiotic culture**	**Storage period (day)**					
		1	**4**	**8**	**12**	**17**	**21**
I	ABT 10	27,50	28,90	29,10	29,90	30,30	31,80
	ABT 750	27,70	28,10	28,90	29,50	30,80	32,00
	ABT 6	28,20	28,90	29,90	31,10	31,90	33,40
II	ABT 10	28,60	29,00	29,80	29,90	30,80	32,30
	ABT 750	28,90	28,90	29,20	31,80	32,30	32,90
	ABT 6	28,90	29,60	30,30	31,80	32,40	34,60
III	ABT 10	28,40	30,00	31,20	32,10	33,10	34,90
	ABT 750	29,10	30,50	31,30	32,60	33,80	34,30
	ABT 6	29,40	30,00	31,80	32,60	34,10	35,80
IV	ABT 10	28,90	31,01	32,10	33,20	34,80	35,80
	ABT 750	29,40	30,80	31,90	32,90	34,00	36,20
	ABT 6	29,70	30,30	31,60	33,30	34,50	36,60
V	ABT 10	29,30	31,30	32,30	33,50	34,90	36,00
	ABT 750	29,50	31,00	31,90	33,30	34,20	36,80
	ABT 6	30,00	30,40	31,80	33,70	34,70	37,00