IMPROVEMENT OF TEXTURAL PROPERTIES OF FERMENTED MILK BY USING STREPTOCOCCUS THERMOPHILUS STRAINS

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Abstract: Monitoring of pure cultures of *Streptococcus thermophilus* strains from Branch Collection of industrial lactic acid bacteria (LAB) was made in the Laboratory of Food Biotechnology. LAB are useful in the food industry for their contribution to the organoleptic properties of the final fermented food. Extracellularly secreted sugar polymers, or EPS, are partly responsible for this. In general, the food industry is particularly interested in natural viscosifiers and texture enhancers, so-called biothickeners. EPS production is an important feature of *Streptococcus thermophilus* characterization in forming starter cultures for fermented milk products with suitable texture and specific rheology.
Key words: *Streptococcus thermophilus,* exopolysaccharide, texture, starter cultures, dairy products

Introduction

Lactic acid bacteria (LAB) are useful in the food industry, not only because of their ability to acidify and hence preserve food products from spoilage, but also for their contribution to the organoleptic properties of the final fermented food. LAB play an important role in the texture development of yogurts and other fermented milks, low-fat cheeses, and dairy desserts [1]. Extracellularly secreted sugar polymers, or exopolysaccharides (EPS), are partly responsible for this. In general, the food industry is particularly interested in natural viscosifiers and texture enhancers, so-called biothickeners. These are mostly plant carbohydrates (e.g., starch, pectin, and guar gum), animal hydrocolloids (e.g., gelatin and casein), or bacterial biopolymers (e.g., xanthan and gellan). Also, the EPS produced by LAB may have technological and health benefits in food products.

Low-fat fermented milk are increasingly popular due to their nutritional and potentially therapeutic characteristics. Fat reduction can cause some defects in yogurt such as lack of flavour, weak body and poor texture. Several studies have discussed the improvement of physical, textural, flavor and rheological properties of low-fat yogurts by incorporating the stabilizers into the milk. This increases the viscosity and reduces syneresis.

The EPS produced by low-fat fermented milk starter cultures affect the textural and physical properties of final product and improve the sensory characteristics such as mouthfeel, shininess, clean cut, ropiness and creaminess [2]. Ropy EPS possess high water binding ability, resulting in increased water retention in yogurt. Using EPS producing cultures when developing a low-fat yogurt with physiological functions is necessary.

Streptococcus thermophilus is considered one of the most commercially important of the lactic acid bacteria. *Streptococcus thermophilus* also produces exopolysaccharides. These are essential to the texture of fermented milk products and also to the production of reduced-fat dairy products that maintain similar characteristics to their full-fat counterparts [3].

Dairy strains of *Streptococcus thermophilus* that produce exopolysaccharides (EPSs) have attracted interest recently, since the EPSs act as in situ-produced natural biothickeners that improve the texture of fermented foods. Thus, a high EPS production in situ during the fermentation of milk to yogurt could be an advantage for the food industry. However, EPSs from *S. thermophilus* strains are produced at relatively low levels, i.e., 50 to 400 mg per liter [4].

The objectives of this study was to monitor of pure cultures of *Streptococcus thermophilus* strains from Branch Collection of industrial (LAB) isolated from dairy products of spontaneous fermentation and to investigate the effect of EPS-producing culture on the textural and physical characteristic of fermented low-fat milk.

Materials and methods

Cultures

Nine strains of *S. thermophilus* were studied on ropy characteristic. They were isolated from different dairy products of spontaneous fermentation from various regions of Moldova and are stored in The Branch Collection of industrial lactic acid bacteria from the Laboratory of Food Biotechnology and The National Collection of Non-Pathogenic Microorganisms ASM.

Manufacture of dairy product of type "Reazhenka"

Ryazhenka is produced through fermentation of bacteria in the milk to "roast". Roasting process involves heating milk, standardized milk until it reaches a minimum temperature of 95 ° C for about three hours. This roasting process produces a brownish color and flavor of milk, like cream caramel.

The media used for fermentations were low fat milk medium. Was prepared starter culture combination with add of EPS-producing strain of *S. thermophilus*. The transfer inoculum was 5.0% (vol/vol) in milk medium. A Biostat A Sartorius fermenter with a working volume of 1,5 l was used to study the kinetics of exopolysaccharide production. The fermenter was operated at 40 °C. Slow agitation was maintained to keep the fermentation broth homogenous.

Isolation and quantification of EPS

EPS was isolated from the fermented milk sample using a next procedure. Trichloroacetic acid was added to the sample culture to a final concentration of 4% (w/v) and allowed to rest for 2 h at room temperature. After centrifugation (10000×g for 30 min at 4°C) to remove the precipitated proteins and bacterial cells, the supernatant was mixed with a double volume of cold ethanol and then stored at 4°C for 24 h. The precipitated EPS was collected by centrifugation (10000×g for 30 min at 4°C), dissolved in deionized water and mixed with a double volume of cold ethanol and stored at 4°C for 24 h. EPS was precipitated with ethanol. It was recovered by centrifugation at 4°C 10000×g for 30 min. Total EPS (expressed as mg/L) was estimated in each sample by phenol–sulphuric method.

Spontaneous whey separation analysis

A cup of set fermented skim milk was removed from refrigerator at 4°C, weighed and kept at approximately 45°C to allow the whey on the surface to be collected on the side of the cup. A needle connected to a syringe was used to withdraw the liquid whey from the surface of the sample, and the cup of fermented skim milk was weighed again. The process lasted for less than 10 s to avoid further leakage of whey from the curd. The syneresis was expressed as the percentage weight of the whey over the initial weight of the fermented skim milk sample.

Results and discussion

Nine strains of *S. thermophilus* were studied on ropy characteristic. Was selected one strain of *S. thermophilus* which demonstrated viscosity of gel. Characteristics of the ropy strain are listed in Table 1.

Table 1. Characteristics of the ropy strain of S. thermophilus

Characteristics	EPS-producing strain of *S. thermophilus*
Appearance of gel	Ropy, homogenenious, dense, creaminess
Taste and smell of gel	Are clean, sour-milk, moderately sweet, without any foreign taste and smell
Fermentation duration, h	4,5

In the present study we observe that ropy strain of *S. thermophilus* (Figure 1) showed faster growth capacity compared with other studied strains.

The EPS produced by low-fat fermented milk starter cultures affect the textural and physical properties of final product and improve the sensory characteristics such as mouthfeel, shininess, clean cut, ropiness and creaminess. Figure 2 shows the changes in spontaneous whey separation of fermented skim milk. The use of ropy EPS-producing strain reduced the level of syneresis in fermented skim milk. Non-EPS-producing strain of *Streptococcus thermophilus* from Branch Collection of industrial lactic acid bacteria has demonstrated this capacity on the low level. This may be due to high water binding capacity of EPS and reduce permeability of serum through skim milk gel.

In this study we are selected one EPS-producing strain of S. thermophilus and was made quantification of EPS. The amount of EPS produced by ropy strain reached 29.1 mg/ L. According to some authors, the production of exopolysaccharides by the culture is very low, maximum of ~31,4 mg/L, but it plays a major role in the development of texture of the final product [5].

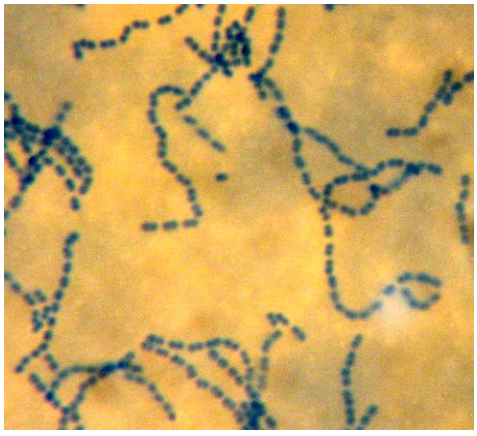

Fig. 1 Streptococcus thermophilus EPS-producing strain

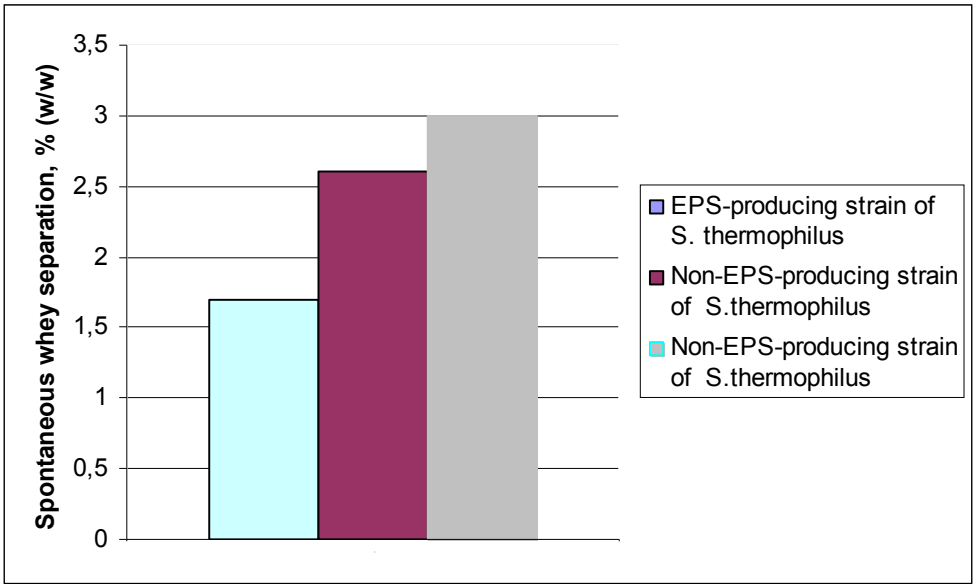

Fig. 2. Effects of ropy EPS-producing strain of S. thermophilus and non-EPS-producing strain of S. thermophilus on spontaneous whey separation of the fermented skim milk.

Was preparted samples of fermented skim-milk using added ropy EPS-producing strain of *S. thermophilus* in combination of culture starter and non-EPS-producing culture of *S. thermophilus* + commercial stabilizer.

Table 2. Characteristics of the fermented milk tipe "Ryazhenka" obtained with ropy EPS-producing culture and with non-EPS-producing culture+ commercial stabilizer

Characteristics	Fermented milk tipe "Ryazhenka" with ropy EPS-producing culture	Fermented milk tipe "Ryazhenka" with non-EPS-producing culture+ commercial stabilizer
Appearance	Ropy, homogenenious, dense, creaminess	Homogenenious, dense, creaminess
Taste and smell	Are clean, sour-milk, without any foreign taste and smell	Are clean, sour-milk, , without any foreign taste and smell
Fermentation duration, h	4,5	5,0
Acidity, °T	76	78

From table 2 we observe that "Ryazhenka" obtained with culture starter with added EPS-producing strain of *S. thermophilus* demonstrate characteristics identical "Ryazhenka" produced with commercial stabilizer. However, fermentation duration passed quicker.

Hence, the using of ropy EPS-producing starter culture reduced the level of syneresis in fermented skim milk significantly. This may be due to high water-binding capacity of EPS and reduce permeability of serum through skim milk gel. [6]

Conclusions

Results indicate that exopolysccharides produced by *S. thermophilus* have a considerable effect on the physiochemical properties and the textural characteristics of fermented skim milk by EPS-producing culture compared with the samples using with non-EPS-producing culture+commercial stabilizer. EPS-producing culture may be effective in improving the viscosity and the water holding capacity as well as reducing spontaneous whey separation. Described selected strain recommended and may be used like added strain in composition of culture starter for manufacturing dairy products.

References

[1] DE VUYST, L., and F. VANINGELGEM. 2003. Developing new polysaccharides, p. 275–320. *In* B. M. McKenna (ed.), Texture in food, vol. 2. Semi-solid foods. Woodhead Publishing Ltd., Cambridge, United Kingdom.

[2] FOLKENBERG DM, DEJMEK P, SKRIVER A, GULDAGER HS, IPSEN R (2006). Sensory and rheological screening of exopolysaccharide producing strains of bacterial yogurt cultures. Int. Dairy J. 16: 111-118.

[3] WHITFORD, E.J. et al. (2009). National Center for Biotechnology Information. Effects of Streptococcus thermophilus TH-4 on Intestinal Mucositis Induced by the Chemotherapeutic Agent, 5- Fluorouracil (5-FU).

[4] CERNING, J. 1995. Production of exopolysaccharides by lactic acid bacteria and dairy propionibacteria. Lait 75:463–472.

[5] G. I. FRENGOVA *et al.* Exopolysaccharide and Lactic Acid Bacretia 2002 Verlag der Zeitschrift für Naturforschung, Tübingen p. 805-810 (2002);

[6] AMATAYAKUL T, SHERKAT F, SHAH NP (2006). Physical characteristics of set yoghurt made with altered casein to whey protein ratios and EPSproducing starter cultures at 9 and 14% total solids. Food Hydrocolloids, 20: 314-324.