

STUDY OF CONSORTIUMS BASED ON THE SPORE-FORMING PROBIOTIC MICROORGANISM BACILLUS COAGULANS FOR THE PRODUCTION OF FERMENTED DAIRY PRODUCTS (BIOYOGURT)

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Abstract: The article describes the developed line of starter with spore-forming probiotic microorganism *Bacillus coagulans* for functional products, study of organoleptic and physicochemical properties (acid accumulation and speed of fermentation) of sour milk product samples (bioyogurt).

Key words: consortium, microorganisms, *Bacillus coagulans*, probiotic effect, sourdough starter.

Relevance. Currently, there is an acute problem of sourdough starter shortage due to disrupted supplies amid sanctions imposed on the Russian Federation and the lack of domestic analogues. In this regard, there is a need to develop domestic products and their subsequent introduction into the production process at enterprises specialising in the production of fermented dairy products. Therefore, many companies are doing their best to support the trend of import substitution in this area. The relevance of this development lies in the possibility of prolonging the shelf life of fermented milk products due to the metabolites released by spore-forming bacteria, as well as in contributing to the health of the population of the Russian Federation through the consumption of products that have a probiotic effect, achieved by using probiotic microorganisms [1]. This initiative not only addresses the current shortage issue but also promotes the growth of domestic industries and enhances the availability of healthy products for the population. Furthermore, it demonstrates the resilience and adaptability of businesses in responding to challenges and seeking innovative solutions to meet the needs of consumers. The development of domestic products in this area is essential for ensuring food security, promoting self-sufficiency, and contributing to the overall well-being and health of the population.

The aim of the study was to identify microbial consortia for the development of a starter with the spore-forming probiotic microorganism *Bacillus coagulans* for bio-yoghurt production.

Materials and methods of research. Tests are carried out by creating different combinations of fermented milk microorganisms and observing their interaction. Organoleptic properties and the rate of acid accumulation and, consequently, casein coagulation of various combinations of microorganisms as additive cultures to the main microorganism *Bacillus coagulans* were investigated [2]. The method of organoleptic evaluation is used to assess the quality of products based on human sensory perception. Organoleptic evaluation includes the analysis of visual components of the product, odour, flavour and textural characteristics. The study of the rate of acid accumulation and the rate of sample fermentation included the following steps: sample preparation, determination of initial acidity using pH-meter and titration method, fermentation at 30 ± 2 °C, periodic sampling to determine changes in acidity over time, and processing of the results obtained.

Results of the research. Interaction tests of fermented milk microorganisms within different consortia are conducted to study the interaction between different species of bacteria that are used in the production of fermented milk products. A consortium is a group of microorganisms formed to fulfil different objectives, for example: providing protection against pathogens, synthesis of useful metabolites. Each member of the consortium fulfils a specific function, while joint interactions allow the common goal to be achieved more efficiently than would be possible for each microorganism individually. Tests are conducted by creating different combinations of fermented milk microorganisms and observing their interactions. The organoleptic properties and the rate of acid accumulation and consequently casein coagulation of different combinations of microorganisms as additive cultures to the main microorganism *Bacillus coagulans* were investigated [3]. Based on the results of organoleptic evaluation of yoghurt samples, the highest score was given to the following samples: *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Lactobacillus delbrueckii* subsp. *bulgaricus* 14 (L. b. 14) + *Streptococcus thermophilus* 9 (S. t. 9), *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Streptococcus thermophilus* 9 (S. t. 9), *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Streptococcus thermophilus* 9 (S. t. 9) + *Lactobacillus plantarum* KI (L. p. KI), *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Streptococcus thermophilus* 9 (S. t. 9) + *Lactobacillus animalis* 501 (L. animalis 501), *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Lactobacillus delbrueckii* subsp. *bulgaricus* D (L. b. D) + *Lactobacillus animalis* 501 (L. animalis 501), *Bacillus coagulans* MTCC 5856 (B. coagulans) + *Streptococcus thermophilus* 1-5 (S. t. 1-5). A trend was observed that the addition of auxiliary culture of S. t. 9 improved the organoleptic profile of the samples irrespective of the microbiological composition. As a probiotic, the strains L. p. KI and L. animalis 501 showed the best organoleptic profile. However, samples with them had a more liquid consistency and sour taste. The results of the organoleptic evaluation are presented in Figure 1.

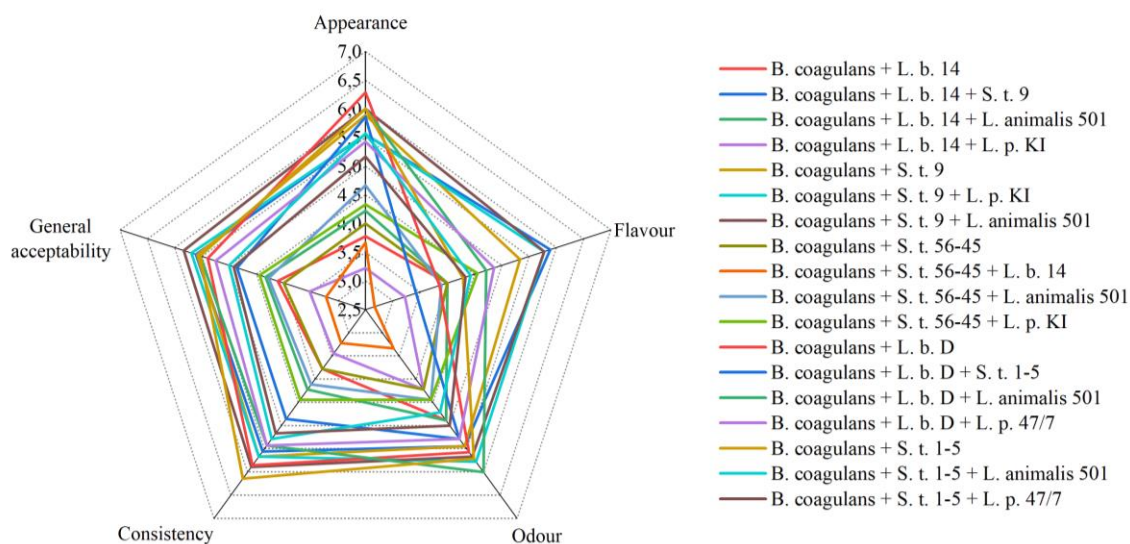


Figure 1 – Graphical representation of organoleptic evaluation of products

Further, the selected microbial consortia were examined for the rate of acid accumulation and coagulation of milk proteins at a temperature of 43 ± 2 °C. Acid accumulation curves are shown in Figure 2.

The fastest rate of fermentation occurred in samples with *S. t. 9*, with the acidity starting to increase vigorously after 2 hours of fermentation, except for the sample with *L. b. 14*, where the acidity increased sharply after one hour. The data obtained show the best result for the rate of lactic acid accumulation and consequently for the rate of fermentation of yoghurt during the production process with *S. t. 9*.

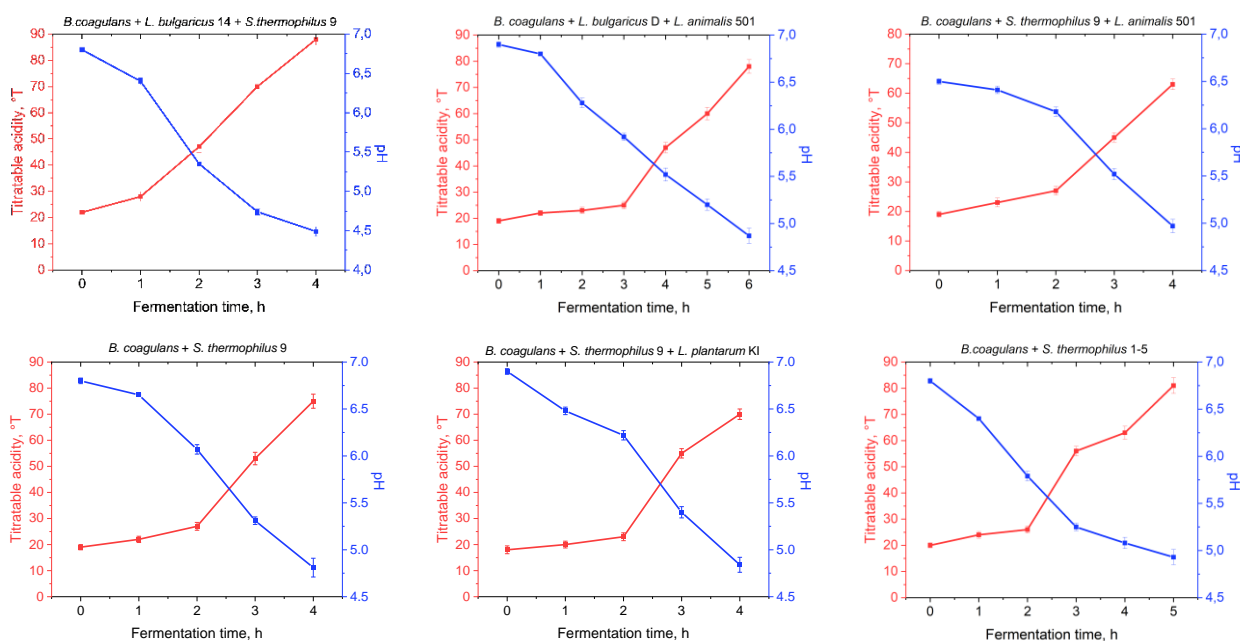


Figure 2 – Acid accumulation and the speed of welling of samples with the highest total organoleptic score

Thus, the best microbial consortium to develop a starter for yoghurt production with *B. coagulans* can be considered a combination of 3 microbial species: *B. coagulans* + *S. t. 9* + *L. b. 14* or *L. b. D*.

Conclusions. During the conducted research, the optimal combinations of strains were identified to produce starter cultures with the spore-forming probiotic microorganism *Bacillus coagulans* to produce bio-yogurt.

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ИЗУЧЕНИЕ КОНСОРЦИУМОВ НА ОСНОВЕ СПОРООБРАЗУЮЩЕГО ПРОБИОТИЧЕСКОГО МИКРООРГАНИЗМА *BACILLUS COAGULANS* ДЛЯ ПРОИЗВОДСТВА КИСЛОМОЛОЧНОГО ПРОДУКТА (БИЙОГУРТА)

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Аннотация: статья содержит описание разрабатываемой линейки заквасок со спорообразующим пробиотическим микроорганизмом *Bacillus coagulans* для функциональных продуктов, изучение органолептических и физико-химических свойств (кислотонакопление и скорость сквашивания) образцов кисломолочного продукта (биойгурта).

Ключевые слова: консорциум, микроорганизмы, *Bacillus coagulans*, пробиотический эффект, закваски.

УДК 641.05

ИСПОЛЬЗОВАНИЕ ФИТОСТЕРОЛОВ И ТОКОФЕРОЛОВ ПРИ СОЗДАНИИ ПРОДУКТОВ ПИТАНИЯ ФУНКЦИОНАЛЬНОГО НАЗНАЧЕНИЯ

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Аннотация: Токоферолы и фитостеролы – биологически активные вещества, обладающие антиоксидантным, противовоспалительным действием, они также участвуют в работе нервной и сердечно-сосудистой систем. Ввиду их термической и окислительной нестабильности подходящим способом хранения и направленной доставки в пищеварительную систему является инкапсулирование в эмульсии типа «масло – вода» при создании инновационных продуктов функционального питания.

Ключевые слова: фитостеролы, токоферолы, функциональные продукты питания, эмульсионные жировые продукты, антиоксидантная и противовоспалительная активность.

Актуальность. Функциональное питание — это стиль питания, в котором учитываются индивидуальные потребности человека, его физиологические особенности и образ жизни. В отличие от традиционного, продукты