The possible use of probiotics in the biotechnology of food products

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Abstract. The article represents the results of the research aimed to study the possible use of probiotics in the development of biotechnology for producing soft rennet cheeses with increased biotechnological value. The researchers found that the use of yeast consisting of L. Lactis and B. Subtilis made cheeses ripen faster and achieve the desired values of active and titratable acidity quicker. In control and experimental samples the ripening process took 8 hours while for other rennet cheeses with other probiotic consortiums including L. Lactis it took 12–14 hours to ripe. The addition of B. Subtilis to soft rennet cheese makes cells of probiotic cultures grow faster and more abundantly in comparison to the control sample. However, the microbiological analysis showed that at the end of the ripening process the number of L.Lactis bacteria cells, as well as B. Subtilis in experimental samples was higher than in the control sample by 0.5 and 1.2 l CFU/g respectively. The organoleptic evaluation showed that among seven samples of cheese the sixth sample had the best colour, smell, taste, consistency, pattern, and appearance. The sample had a sweetish cheesy taste, a tender homogeneous plastic consistency, a uniform white colour with holes of irregular, angular, slot-like, and oval forms of 1–2mm. The most rational concentration of Bacillus subtilis (strain 534) bacteria is 5 %. In this case 1ml contains 480 thousand microbial cells. This concentration gives a product a moderately marked cheesy, spicy taste that is inherent to soft cheeses. This indicates the feasibility of using Bacillus subtilis bacteria (strain 534) in the 5 % amount by milk weight.

1. Introduction

Human health majorly depends on nutrition i.e. the sufficiency of energy and nutrients for the organism. However, today many people have an unbalanced diet which leads to the lack of biologically active substances in human organisms [1, 3, 5, 7, 11]. This results in more people with a metabolic disorder, increased body weight and decreased functional activity of internal organs and systems, e.g. lactase deficiency, the compositional disorder of gut flora, etc. [15, 34, 35, 37, 39, 40]. Food products should satisfy the physiological needs of a human organism in nutrients and energy as well as perform preventive and healing functions. These are products with balanced composition and a decreased content of fat and sugar having a dietary and curative effect. They should be also convenient in use, especially in terms of quick preparation. The creation of a new generation of foods nowadays is impossible without using food and biological additives as well as product modifiers [19, 22, 27, 30, 32, 36].
Cheese is one of the most multifunctional food products nowadays. It satisfies various tastes and is suitable for all age groups. It can be consumed in any amount at any event. The major material for producing cheese is cow’s, goat’s, or sheep’s milk.

In this respect it is necessary to introduce other important components (vegetable oils, vitamins, antioxidants, dietary fibres, etc.) into the human diet besides protein.

2. Methods
The work was carried out at the Department of Food Technology and the Department of Microbiology, Virology, and Anatomic Pathology at Don State Agrarian University. The work aims to develop the technology of soft rennet cheese enriched by probiotics (pure culture of Bacillus subtilis bacteria, strain 534). This cheese is a multifunctional product used for the prevention and treatment of dysbiotic conditions of intestines. The research tasks are the following: 1) review literature; 2) develop the biotechnology of soft rennet cheese using probiotic culture consortium; 3) study physical and chemical properties of the created product.

3. Results
According to the research methodology, the development of soft rennet cheese technology based on L. Lactis pure culture consortium involved the addition of yeast culture to the mixture before clotting. In this research we used six samples of the mixture. The probiotic culture was added to each mixture in different proportions (0–5 %). The culture itself had a concentration of 480 thousand microbial cells per 1ml. The proportion of LAB was 3 %. We also added calcium chloride (40 %), rennet ferment (2.5 %), and then clotted mixtures at 32 ºС for 30 minutes. The cheese was then formed and left for self-compression at 18–20 ºС for 2 hours. The obtained clots were cut and ripened for 30 minutes. Afterwards, they were stirred until the apparition of 7–8 mm rennet grains and left for maturation at 18–20 ºС for 8 hours. The cheese was then salted in 18–22 % brine at 12–14 ºС for 1.5–3 hours. The obtained cheese samples were tested in terms of their organoleptic, physical, and chemical properties.

Table 1 shows that samples excel an intensive and uniform increase in acidity. However, sample 2 with a maximum concentration of Bacillus subtilis (strain 534) (6 %) has a differential amount of acidity (55–96 ºТ), which is higher than indicators in national standards.

|       | Sample 1 (control) | Sample 2 | Sample 3 | Sample 4 | Sample 5 | Sample 6 | Sample 7 |
|-------|--------------------|----------|----------|----------|----------|----------|----------|
| Time  | pH, °Т            | pH, °Т   | pH, °Т   | pH, °Т   | pH, °Т   | pH, °Т   | pH, °Т   |
| 0     | 5.98, 32          | 5.73, 44 | 5.63, 46 | 5.63, 46 | 5.63, 46 | 5.63, 46 | 5.47, 55 |
| 1     | 5.73, 44          | 5.73, 44 | 5.63, 46 | 5.63, 46 | 5.63, 46 | 5.63, 46 | 5.47, 58 |
| 2     | 5.53, 50          | 5.47, 54 | 5.47, 54 | 5.47, 54 | 5.47, 54 | 5.47, 54 | 5.60, 56 |
| 3     | 5.46, 52          | 5.47, 54 | 5.47, 56 | 5.47, 56 | 5.47, 56 | 5.47, 56 | 5.60, 58 |
| 4     | 5.15, 64          | 5.01, 70 | 4.87, 74 | 4.87, 74 | 4.79, 82 | 4.69, 88 | 4.76, 87 |
| 5     | 5.01, 66          | 4.87, 72 | 4.87, 76 | 4.76, 84 | 4.66, 90 | 4.62, 94 | 4.66, 96 |

The organoleptic evaluation showed that among seven samples of cheese the sixth sample had the best colour, smell, taste, consistency, pattern, and appearance. This cheese has a creamy, cheesy, pleasant taste, elastic, tender, and plastic consistency, yellow and white colour, and slot-like holes. The table shows that the most rational concentration of Bacillus subtilis, strain 534 is 5 %. This concentration gives a product a moderately marked taste that is inherent to soft cheeses.

Amateur cheese is marked and packaged according to the requirements of current technological standards. Cheese should be stored at 6 ºС. The expiry date of a product is not more than 9 days after the end of the technological process. The product is transported in specialised vehicles according to the requirements of current technological standards.
Table 2. The organoleptic evaluation of samples

| No. of sample | Taste and smell               | Consistency                                      | Colour                                           |
|---------------|-------------------------------|--------------------------------------------------|--------------------------------------------------|
| 1 (control)   | Pleasant, milky, strong milky | Crumbly, heterogeneous, lack of holes,           | White with barely visible yellow, the shade of yellow |
| 2             | Milky, with bitter shade      | Not homogeneous enough with the initial formation of holes | From white to yellow                             |
| 3             | Milky, not pleasant enough    | Not elastic enough, crumbly, with an increased number of holes | From white to yellow                             |
| 4             | Creamy, with bitter shade     | Elastic, heterogeneous, with an intensive apparition of holes | From white to yellow                             |
| 5             | Pleasant, not creamy enough   | Elastic, not plastic enough, intensive apparition and enlargement of holes | From white to yellow                             |
| 6             | Creamy, cheesy, pleasant      | Elastic, tender, plastic, with a growing number of holes and having the maximum permissible size of holes | From white to yellow                             |
| 7             | Creamy, cheesy, fragrant, tasty | Elastic, tender, plastic, with growth and disruption of holes | From white to yellow                             |

4. Conclusions
1. In this research we developed the technology of soft cheese using probiotic cultures.
2. We also determined the maximum shelf life of the product equal to 12 days.
3. Afterwards, we studied the nutritional and energy value of this product.
4. and developed standard process documentation for soft rennet cheese.

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