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TECHNOLOGIES FOR PRODUCING COTTAGE CHEESE WITH PROBIOTIC PROPERTIES

The article pays special attention to the enrichment of cottage cheese with probiotic cultures. Therapeutically significant level of content of probiotic microorganisms in cottage cheese determines its functional purpose. Currently, curd products with probiotic microorganisms are not sufficiently represented in the trade network, which actualizes the conduct of scientific research on the development of a line of such products. The choice of enriching cottage cheese with propionic acid bacteria is due to antagonistic properties, which are expressed in the suppression of the development of pathogenic and conditionally pathogenic microflora. Another important feature of them is the ability to produce vitamin B12, which is involved in the regulation of hematopoiesis, prevents the destruction of red blood cells and fatty degeneration of internal organs, and also provides a coating of nerve fibers with a myelin sheath. The article presents the results of studies of the microbiological and physico-chemical properties of the finished product, as well as those requiring energy purposes.

Keywords: in cottage cheese, probiotic microorganisms, functional nutrition, microflora.

Introductions

Nutrition is one of the most important environmental factors affecting the human body. It is known that a person receives everything necessary for his life, except oxygen, from food. Food is the starting material for the construction and renewal of human body cells and determines the state of human health. In the charter of the World Health Organization (WHO), health is interpreted as «a human condition that is characterized not only by the absence of diseases or physical defects, but complete physical, mental and social well-being». The theory of adequate nutrition was formulated in the 80s of the twentieth century, when new scientific results were obtained in the field of digestive physiology, food biochemistry, microbiology, and new digestive mechanisms were discovered. A significant contribution to the development of this theory was made by Academician A. M. Ugolev, head of the Laboratory of Nutrition Physiology at the I. P. Pavlov Institute of Physiology in St. Petersburg. The theory of adequate nutrition absorbed everything valuable that was in the theory of balanced nutrition, and was its further development [1]. A full and healthy diet is one of the most important and necessary conditions for preserving the life and health of the nation. In recent years, a new direction has been developed in the science of nutrition – functional nutrition.

There is no single formula for ensuring good health. But there are key components that allow you to maintain good health and longevity. These are regular sports, rest and a balanced diet

The first thing to realize when learning the principles of a balanced diet is that, in addition to the well-known basic macro- and microelements, different foods also contain a variety of useful phytonutrients (chemicals or compounds of plant origin that do not belong to vitamins and minerals). That's why it's so important to diversify your diet, especially foods containing vitamins and minerals.

All the most important life processes in our body take place with the participation of vitamins and minerals. Moreover, the body itself is not able to produce them independently, so the body must receive vitamins and minerals daily with food or from food additives.

Judging by global trends, it is clear that a healthy lifestyle has become popular. Many people began to understand that proper nutrition and physical activity are important for health. Playing sports has become popular among those who are engaged in their body and correspond to the modern image of a successful person, this image includes visual appeal.

Food for the body is the primary factor. The healthier and more correct it is, the better the performance will be and this will help all internal systems to live longer. It is not surprising that athletes pay a lot of attention to their diet – after all, endurance, muscle volume, and, therefore, the result depend on it.

For those who do sports just for the sake of health and pleasure, it is enough to properly balance the main nutrients – proteins, carbohydrates, fats, get enough minerals and vitamins, as well as liquids.

Unfortunately, the not very high quality of modern products and the low content of important elements in them leads to the fact that we do not receive the right amount. Vitamins and minerals play an important role at many stages of our life, and for those who do sports, they are especially important.

The creation of therapeutic and preventive dairy products is most widely carried out by the branch institutes of the Russian Agricultural Academy, specialists of educational branch universities, dairy industry enterprises [2].

Dairy products occupy a significant niche in the field of food products. One of the most common dairy products is cottage cheese. It is attractive to producers because it does not require maturation, i.e. it provides a quick turnover of funds, is less demanding on the quality of milk, can be stored frozen for a long time. The difficulty in the production process of obtaining cottage cheese is its dehydration and cooling. The hardware design of these operations is quite cumbersome and energy-intensive. And if large enterprises have the opportunity to use automated lines using membrane methods, then for most cottage cheese producers it is necessary to solve these problems using existing equipment, supplementing them with the necessary devices. Nevertheless, interest in the production of cottage cheese is growing. To a certain extent, this is facilitated by the growth of consumer interest in this product. The fact is that cottage cheese is available

in a very wide range. There are various types of packages with a wide range in the mass fraction of fat, in the unit weight of the package, with various fillers, flavor enhancers.

In 2015, the volume of purchases of cottage cheese and cottage cheese products per Russian consumer amounted to almost 9 kg, which is 0,7 kg more than in 2011. According to experts, the physiological rate of consumption of cottage cheese should be about 18 kg per year per person. This circumstance gives grounds to say that the consumption of cottage cheese in the country will grow in the long term.

In 2016–2020, retail sales of cottage cheese and cottage cheese products in Russia will continue to grow by 2–3 % annually [3].

From the point of view of technology, cottage cheese is interesting because it can be easily combined with flavoring additives and can be portioned into various consumer containers. From a consumer point of view, this product is high in calories, contains a large amount of proteins, including easily digestible, can be used both directly in food and in the preparation of various dishes. Unlike cheeses, the protein composition of which is mostly represented by casein, cottage cheese, due to high-temperature processing, contains whey proteins to a greater extent. Whey proteins are globular proteins and are hydrophilic colloids. Due to the strong hydrate shell and high dispersion, they are in a state of stable colloidal solution. During temperature treatment, they begin to denature, followed by aggregation and deposition on casein [4, 5].

Materials and methods of research

The implementation of the plan of experimental, analytical research and mathematical data processing were carried out in the laboratories of the Federal State Budgetary Scientific Institution Federal Altai Scientific Center for Agrobiotechnology department of the Siberian Research Institute of Cheese Making (Barnaul).

In the work, in the process of implementing the tasks of the experiment, methods published in the specialized literature were used that satisfy the research goals. To determine the physico-chemical, microbiological and organoleptic parameters of raw materials and finished products, generally accepted and standard methods of analysis, methods of mathematical modeling and processing of experimental data, etc. were used.

The parameters of the properties of the strains and the finished product were determined by standard methods: antagonistic activity by diffusion method according to TU 9229-026-04610209-94, the number of lactic acid microorganisms according to GOST 33951-16, the number of bifidobacteria according to GOST R 56139-14, active acidity by potentiometric method according to GOST 32892-14.

Results and discussions.

The amino acid composition of whey proteins is closest to the composition of human muscle tissue, and in terms of the content of essential amino acids (lysine, tryptophan, methionine, threonine) and branched chain amino acids (valine, leucine and isoleucine), they surpass all other proteins of animal and vegetable origin [6]. In addition, approximately 14 % of whey proteins are in the form of hydrolysis products, which are the initiators of digestion and participate in the synthesis of most vital enzymes and hormones [7]. Analysis of the spectrum of cottage cheese products produced leads to the conclusion that there is a very small number of cottage cheese products belonging

to the category of probiotic products. The vast majority have the form of sweet cheeses with fruit and other confectionery additives. High-temperature processing of the milk mixture during the preparation of cottage cheese largely ensures the guarantee of sanitary indicators, extends the shelf life of the product. On the other hand, such technology practically destroys microflora, which may contain useful microflora and, first of all, microflora with probiotic properties. Microbiological indicators of cottage cheese in relation to extraneous microflora should correspond to the values given in Table 1.

Table 1 – Microbiological indicators of cottage cheese

The name of the indicator	The norm at the end of the expiration date
Coliforms, in 0,01 g	not allowed
S. aureus, in 0,1 g	not allowed
Pathogenic microorganisms, including salmonella, in 25 g	not allowed
Yeast, CFU/g, no more	100
Mold, CFU/g, no more	50

The curd mass can be obtained with a different mass fraction of fat and at humidity (66 + 1) % can contain up to 13 % proteins in its composition. This is almost half of all dry substances in the finished product. Enriching the curd mass with useful microflora will allow you to obtain a product that has a number of valuable properties, both in terms of its nutritional value and in terms of the availability of functional properties in relation to probiotic indicators. Based on modern requirements, a product belonging to the group of therapeutic and prophylactic products should contain a therapeutically significant amount of useful probiotic microflora (dose) in its composition. It is expressed by the number of colony-forming microorganisms in 1 gram of the product. This value varies depending on the type of microorganisms from 10⁵ to 10⁷ CFU/g.

Such a number of microflora can be obtained by adding the necessary amount to the product. Using a concentrate of microorganisms (starter culture) containing 10⁸ CFU/g, it is possible to obtain a product with probiotic properties. Such a product can be used for daily use, with virtually no age restrictions. The technology of production of such a product at the first stage can represent the usual sequence of operations for the preparation of curd mass with the specified parameters. After cooling, it can be combined with the necessary amount of bacterial preparation. To ensure the number of microflora in the product at the level of 10⁶ CFU/g, it is necessary to add about 1 % of the pharmaceutical preparation. Such technology can be implemented on the serial equipment available at the dairy factory.

It may be of interest that several products can be made from one production of curd mass by adding various probiotics and flavor enhancers of natural origin. Such flavor enriching agents can be fruit juices and their concentrates. In some cases, it is possible to combine both probiotics and flavor enhancers. At the same time, the compatibility of the components should be taken into account, since the habitat has a great influence on the preservation of microflora (acidity, the presence of inhibitors, mineral composition, etc.).

The technology of cottage cheese products has been sufficiently developed and is widely used, but, as mentioned earlier, the range of probiotic products is very poor. And therefore, the problem of enriching cottage cheese products requires a solution. Its solution should begin with the creation of a product containing living microflora. At the first stage, this will make it possible to study the features of such production, identify the vulnerabilities of the technology and formulate specific requirements for the production technology of a product containing useful microflora. You can start working with the use of microflora containing propionic acid bacteria (PAB). These bacteria are producers of vitamin B12, which is necessary for the vital activity of the body [8, 9]. The presence of such microflora enriches the taste range of the product and at the same time does not increase the acidity during storage.

Propionic acid bacteria (PAB) have a variety of practical applications. Therefore, the biology of the PAB is under the constant «sight» of specialists of different profiles. The international thematic symposium «Propionibacteria» is regularly held. In various studies, considerable attention has been paid to the role of cobalt and cobalamin (true vitamin B12) in the biosynthesis of corrinoids, compounds of the vitamin B12 group. Propionic acid bacteria are used to enrich fermented milk products with vitamin B12, both in pure form and in the form of a concentrate prepared on whey [10].

The approximate composition of such a product is presented in Table 2.

Table 2 – The content of the main components and the energy value of the curd product

Indicators	Content in the curd product
Mass fraction of dry substances, %	33,0
Mass fraction of fat, %	2,0
Mass fraction of carbohydrates, %	10,0
Mass fraction of protein, %, not less	13,0
Mass fraction of carotenoids, mg/100 g, not less	0,27
Mass fraction of minerals, %	2,8
Vitamin E, mg /100 g, not less	1,81
Vitamin C, mg /100 g, not less	5,32
Vitamin B1, mg /100 g, not less	0,09
Vitamin B2, mg /100 g, not less	0,22
Vitamin B6, mg /100 g, not less	0,12
Energy value, kcal per 100 g of product	107,5

The number of propionic acid bacteria in the product is not less than 10⁶ CFU/g. The shelf life of the product is 72 hours (3 days).

Conclusions

One of the directions of enriching food products, including cottage cheese, is the use of sourdough, which includes propionic acid microorganisms.

Propionic acid bacteria (PAB) have a variety of practical applications. Therefore, the biology of the PAB is under the constant «sight» of specialists of different profiles. The international thematic symposium «Propionibacteria» is regularly held. In various

studies, considerable attention has been paid to the role of cobalt and cobalamin (true vitamin B12) in the biosynthesis of corrinoids, compounds of the vitamin B12 group.

The presence of such a curd product on the shelves of stores will reveal the interest of customers and choose the direction of further development of the production of therapeutic and preventive products.

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ПРОБЛОТТЫҚ ҚАСИЕТТЕРІ БАР СҮЗБЕ ӨНДІРУ ТЕХНОЛОГИЯЛАРЫ

Мақалада сүзбені пробиотикалық дақылдармен байытуға ерекше назар аударылады. Сүздедегі пробиотикалық микроорганизмдер құрамының емдік маңызды деңгейі оның функционалдық мақсатын анықтайды. Қазіргі уақытта пробиотикалық микроорганизмдері бар сүзбе өнімдері сауда желісінде жеткіліксіз ұсынылған, бұл осындай өнімдер желісін әзірлеу бойынша ғылыми зерттеулер жүргізуді өзектендіреді. Сүзбені пропион қышқылы бактерияларымен байытуды таңдау патогендік және оппортунистік микрофлораның дамуын тежейтін антагонистік қасиеттерге байланысты. Олардың тағы бір маңызды ерекшелігі – В12 витаминін шығару қабілеті, ол гемопоэзді реттеуге қатысады, эритроциттердің бұзылуына және ішкі ағзалардың май бұзылуына жол бермейді, сонымен қатар жүйке талшықтарын миелин қабығымен жабуды қамтамасыз етеді. Мақалада дайын өнімнің микробиологиялық және физика-химиялық қасиеттерін, сондай-ақ энергия мақсаттарын қажет ететіндерді зерттеу нәтижелері Берілген.

Түйінді сөздер: сүзде, пробиотикалық микроорганизмдер, функционалдық тамақтану, микрофлора.

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ТЕХНОЛОГИИ ПРОИЗВОДСТВА ТВОРОГА С ПРОБИОТИЧЕСКИМИ СВОЙСТВАМИ

В статье особое внимание уделяется обогащению творога пробиотическими культурами. Терапевтически значимый уровень содержания пробиотических микроорганизмов в твороге определяет его функциональное назначение. В настоящее время творожные продукты с пробиотическими микроорганизмами недостаточно представлены в торговой сети, что актуализирует проведение научных исследований по разработке линейки такой продукции. Выбор обогащения творога пропионовокислыми бактериями обусловлен антагонистическими свойствами, которые выражаются в подавлении развития патогенной и условно-патогенной микрофлоры. Еще одной важной их особенностью является способность вырабатывать витамин В12, который участвует в регуляции кроветворения, предотвращает разрушение эритроцитов и жировую дегенерацию внутренних органов, а также обеспечивает покрытие нервных волокон миелиновой оболочкой. В статье представлены результаты исследований микробиологических и физико-химических свойств готового продукта, а также тех, которые требуют энергетических целей.

Ключевые слова: в твороге, пробиотические микроорганизмы, функциональное питание, микрофлора.

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