

ANNOTATION

dissertation for the degree of Doctor of Philosophy (PhD) by specialty
"6D070100 –Biotechnology"

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Development of biotechnology of fermented milk drink with prebiotic properties based on camel milk

General description of work. The dissertation is devoted to the development of biotechnology for the production of a fermented milk drink with prebiotic properties based on camel milk, the study of its effect on nutritional and biological value.

Relevance of the research topic. One of the main tasks of food biotechnology is the production of food products that contribute to the preservation and improvement of human health. The need to enrich the human diet with products that enhance the body's adaptive capabilities to the effects of negative environmental factors is being updated in the light of global changes on the planet - increasing the number of people, quality and culture of consumption changes, environmental problems, etc. In this view, the use of symbiotic products is much more effective, since combinations of prebiotics and probiotics make it possible to achieve a more pronounced physiological effect from their use, including improvement of the microflora of the gastrointestinal tract, replenishment with vitamins and minerals, etc.

Camel milk, due to the harsh living conditions of animals and special food factors, has a unique chemical composition and biological properties. Therefore, for people working in environmentally unfavorable working conditions, camel milk and its processed products are ideal healing and prophylactic food.

Due to the variety and balance of the contained substances (proteins, fats, vitamins, enzymes, carbohydrates, trace elements and a number of other important substances), camel milk has a high biological value and digestibility. Despite the fact that camel milk is a traditional component in the diet of the population of Kazakhstan, the assortment of fermented milk products is insignificant.

Camel milk has historically been used for therapeutic and preventive purposes: against tuberculosis, diseases of the gastrointestinal tract, diabetes mellitus, allergies, to activate hematopoiesis, and others. Camel milk protein is dominated by immunoglobulin and lactoferrin, which have therapeutic antioxidant, immunostimulating properties. In addition, they have high antibacterial, antiviral and anti-inflammatory properties that protect the human body from pathogenic bacteria and viruses.

In recent years, the problem of developing functional food products with prebiotics has been developed in the form of scientific developments, which makes it possible to create modern products of high biological value and targeted action, since normal microflora is not only a qualitative and quantitative ratio of various

microorganisms of individual organs and systems, but also supporting the biochemical, metabolic and immune balance of the macroorganism, which is necessary to maintain human health. The problem of creating functional food products fortified with prebiotics is of scientific interest and is rapidly developing due to a variety of scientifically based studies.

It should be noted that the use of prebiotics in the production of food products allows not only to impart functional properties to the product, but also to increase the technological characteristics of the finished product, improve the quality and increase the shelf life.

Recently, in the food industry, special interest has been shown in sweeteners with a low glycemic index that do not increase blood sugar, do not contribute to the initiation and development of the caries process, etc. The use of certain sweeteners makes it possible to obtain a product not only with a pleasant taste, but also enrich it with prebiotics.

The dissertation is devoted to the creation of a technology for a fermented milk product based on camel milk, which has functional properties due to the presence of useful natural ingredients in its composition, which is relevant, increasing the efficiency of using domestic raw materials, expanding the range of products.

The purpose and objectives of the study. The purpose of this work is to develop biotechnology for the production of lactic acid drinks with prebiotic properties based on camel milk, to study the effect of a carbohydrate composition on food and biological value.

In accordance with the goal, the following research tasks are defined:

- to study the physico-chemical, biochemical and microbiological indicators of camel milk;
- to substantiate the starter culture and carbohydrate composition with prebiotic properties, to determine their optimal dose;
- develop a biotechnological scheme for producing a fermented milk drink with prebiotic properties based on camel milk;
- determine the nutritional, energy and biological value of a fermented milk drink with prebiotic properties based on camel milk;
- to investigate the storage process of a fermented milk drink with prebiotic properties based on camel milk and determine its shelf life;
- develop a standard organization for a new sour-milk drink, conduct pilot-industrial testing;
- to study the immunobiological and antioxidant properties of a fermented milk drink based on camel milk.

Object of study. The objects of research are: camel milk of a private farm "Dimash", located in the village of Karay, Ili district, Almaty region; production symbiotic starter cultures MicroMilk YO 60 (Italy), BK-Uglich-B (Russia), STB and KTS starter cultures developed by the All-Russian Research Institute of the Dairy Industry (VNIMI), Genesis (Bulgaria-Russia), VIVO (Russia), YoFlex® Advance (Denmark), Lactoferm ECO (Italy), Danisco (France) consisting of

Streptococcus salivarius subspecies termophilus and Lactobacillus delbruki subspecies bulgaricus, fructose, isomaltulose, lactulose, oligofructose, inulin.

Research methods. The work was carried out using standard, generally accepted methods for the study of physical and chemical characteristics, organoleptic and microbiological parameters of the objects of study.

The following methods were used to study the quality of raw materials and finished products: bioreactor, capillary electrophoresis, atomic absorption spectrometer, Yauza-01-AAA analyzer, Hygrolab-3 apparatus for determining “water activity”, ELISA Vector Best enzyme-linked immunosorbent analyzer.

Statistical processing of experimental data was carried out using the programs "Statistica", Microsoft Excel, etc.

The scientific novelty of the study.

For the first time, syrup from a carbohydrate composition of fructose, isomaltulose, lactulose was added to camel milk, its prebiotic properties were revealed and the patterns of action on organoleptic, physicochemical and microbiological indicators of lactic acid were determined.

For the first time, the effect of a complex of sweetening carbohydrates with prebiotic properties on the nutritional, biological and energy value of a lactic acid drink made from camel milk was studied and the shelf life of the drink was determined.

It has been shown that the use of a fermented milk product with prebiotic properties based on camel milk in preclinical studies increases the immunobiological and antioxidant properties of the body.

The theoretical significance of the work.

On the basis of camel milk, a technological scheme for the production of a fermented milk product with the addition of sweetening carbohydrates with prebiotic properties has been developed.

Research results and initial data obtained on the basis of dissertation research can be used in the preparation of bachelors, masters and doctoral students in the specialty "Biotechnology".

The practical value of the work.

Based on the results of experimental and analytical studies, biotechnology of a fermented milk drink with prebiotic properties based on camel milk was developed, the standard of organizations for its production ST LLP 161140015749-4-2019 “A method for producing drinking yogurt with prebiotic properties based on camel milk” was approved.

Industrial testing was carried out in the conditions of LF Company LLP.

The novelty of the technology is confirmed by the patents of the Republic of Kazakhstan “Method for producing drinking yogurt from camel milk”, “Method for producing low-lactose fermented milk drink from camel milk”, “Method for producing yogurt with prebiotic properties based on willow milk”.

The main provisions to be defended:

- high nutritional and biological value of camel milk, corresponding to the physical and chemical characteristics;

- the influence of the prebiotic properties of the carbohydrate composition on the organoleptic, physicochemical and microbiological parameters of fermented milk products from camel milk;

- influence of carbohydrate composition with prebiotic properties on food, biological and energy value of fermented milk drinks based on camel milk, on increasing shelf life;

- influence of fermented milk drink made from camel milk on increasing the antioxidant properties of the body.

The main research results and conclusions:

1. An analysis of the physicochemical and functional-technological characteristics showed that camel milk has a high nutritional and biological value, is a balanced basis for the production of fermented milk products.

2. Experimentally selected symbiotic industrial sourdough developed by VNIMI. The optimal dose of sourdough is 10%, fermentation time: 5-6 hours. Reducing the duration of the technological operation leads to lower energy costs.

3. It was found that the optimal amount of a carbohydrate composition with prebiotic properties added to a fermented milk drink is 5%. The results of the study to determine the optimal content of a carbohydrate composition with prebiotic properties are confirmed by the patent for a utility model of the Republic of Kazakhstan "Method for producing yogurt with prebiotic properties based on camel milk".

4. A scheme of the biotechnological process for the production of lactic acid drinks with prebiotic properties based on camel milk has been developed. It was revealed that the classic devices for the production of yogurt do not require additional settings when adding a sweetening composition with prebiotic properties.

5. It was shown that the total amino acid content in fermented milk drinks with prebiotic properties increases by 0.35 g/100 g compared to the control sample, the amount of essential amino acids increases by 0.23 g / 100 g.

6. It was found that when enriching a sour-milk drink with a carbohydrate composition, the mass fraction of protein increases by 0.35 %, and the hydrocarbon by 2.5 %. The energy value of the new product is 77.61 kcal/324.93 kJ. The shelf life of the product (4 ± 2) °C is 7 days.

7. Normative documents of ST LLP 161140015749-4-2019 on biotechnology for the production of lactic acid drinks under industrial conditions have been developed, as well as production testing of drinks by LF Company LLP has been carried out.

8. The results of preclinical studies to study the immunobiological and antioxidant properties of a lactic acid drink with prebiotic properties based on camel milk showed that in mice fed a fermented milk drink for 1 month, the number of IgM-ATM in the spleen was 32.4×10^3 , which 1.3 times less than in mice that did not receive the product. The content of antioxidant enzymes increases when fed with a sour-milk drink.

Personal contribution of the author. All the results of the dissertation research were carried out with the personal participation of the author. The author

of the work made a personal contribution to the analysis of the literature on the topic, to the selection of the object and the development of the research concept, the definition of the goals and objectives of the work, the planning and conduct of experimental research, personally collected and analyzed the data obtained, as well as writing a dissertation. Scientific results, the main conclusions were obtained as a result of the dissertation research.

Connection with the plan of basic scientific work. The dissertation work was carried out as a continuation of the 2012-2014 project. funded by the Ministry of Education and Science of the Republic of Kazakhstan No. 0531 / GF-13 on the topic "Development and implementation of innovative technologies for deep processing of milk of agricultural animals (cow, goat, mare, camel, sheep milk)" No. 0112RK00545 (2012-2014) in which the doctoral student took participation as a research assistant.

The main results of the dissertation were reported: The main results of the dissertation were reported at the International scientific and practical conferences:

- At the International Conference of Students, Graduate Students and Young Scientists "Food Products and Human Health" (Kemerovo, 2016).

- At the All-Russian Scientific and Practical Conference with international participation "Actual issues of the economy, commodity science and the safety of goods" (Kolomna, 2018).

- At the IV international scientific and practical. Conference "Biotechnology: a look into the future" (Stavropol, 2018).

- At the VI International Scientific and Practical Conference "Science and Education in the Modern World: Challenges of the XXI Century" (Nur-Sultan, 2020).

- At the VI International scientific and practical conference "Biotechnology: a look into the future" (Stavropol, 2020).

Publications. The main content of the dissertation is reflected in 15 publications, including 1 articles in journals with impact factor, cited in Scopus databases; 5 articles in republican scientific journals recommended by the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan; 6 abstracts in collections of international scientific and practical conferences. Based on the research results, 2 patents of the Republic of Kazakhstan, 1 patent for a utility model of the Republic of Kazakhstan were obtained.

The structure of the dissertation. The text of the dissertation consists of 154 pages, including normative references, definitions and abbreviations, introduction, literature review, research objects and methods, research results and their analysis, conclusion, list of references and applications. The list of references contains 246 sources. Results and data are presented in 29 figures, 21 tables and 5 appendices.