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Solomon A.M., Candidate of Technical Sciences, Associate Professor
Bondar M.M., Postgraduate
Vinnytsia National Agrarian University

FERMENTED DESSERTS OF FUNCTIONAL PURPOSE USING VEGETABLE FILLERS

Functional products are received by innovative technologies and are considered not only as sources of plastic substances and energy, but also as complex not a medical complex that meets the physiological needs of the human body and has pronounced therapeutic, preventive or improving properties. An important component of the market for functional products are dairy products, which in Ukraine and Europe make up about 65% from its total capacity. More than 80% market of the dairy for functional purposes (MDFP) is represented by products with pro- and / or prebiotics, 8% - products with BAA, about 12% are other products. The first group of the MDFP is the most dynamically developing and constantly replenished with new products, as on a dysbacteriosis in Ukraine, according to statistical data, 65.75% of the population are sick. Analysis of these products indicates that in most of them, the influence of the probiotic is due to the regulated amount of lactobacteria (LB), whereas the number of viable cells of bifidobacteria (BB) in foods often does not meet the requirements of regulatory documents, which reduces their functional impact on the human body. Other categories of functional food products on a dairy basis (diabetical without adding sugar substitutes, products with increased immunomodulatory, antioxidant, sorption properties, etc.) in the consumer market of the country, which is caused by the lack of scientifically substantiated and clinically proven technologies for their production. The need to expand the range of the MDFP range is dictated today by the demographic situation in Ukraine (part of the elderly people in the general structure of the population is 20.5%, according to the forecasts of the Institute of Gerontology of the Academy of Medical Sciences of Ukraine until 2050 it will grow to 38.1%), an increase in the number of people with cardiovascular diseases, (up to 24.5 and 3.8%, respectively), the spread of secondary immunodeficient conditions complicated by gastrointestinal disturbances to half of the country's population. Therefore, the development of a new assortment of scientifically based MDFP technologies enriched with the complexes of lactoid cultures of bifidobacteria, biologically active substances (BAA), prebiotics is relevant for Ukraine and needs to be addressed.

Keywords: *pro- and prebiotics, Sinbacterium, Bifidobacterium, Lactobacterium, vegetable fillers, biological value*

Tab. 2. Ref. 15.

Fermented dairy products are the main suppliers of probiotic microorganisms that contribute to the restoration of human microbial ecology. The following types of bifidobacteria and laktobacilli as Lactobacillus acidophilus, Lactobacillus casei, Bifidobacterium spp. (B. adolescentis, B. animalis ssp. lactis, B. bifidum, B. longum, B. breve) belong to probiotic cultures that have a positive impact on the consumer and normalize the composition and functions of the bacterial flora of the gastrointestinal tract.

Bifidobacteria – one of the most important groups of intestinal microorganisms that dominate in the anaerobic flora of the colon [1, 2]. International Dairy Federation

considers that biobased products are compounds, which contain at least 1 106-bifidobacteria in 1 cm^3 [3, 4]. It should be noted that milk is an unfavorable environment for the development of the majority of microorganisms-representatives of normal bacterial flora of the human intestinal tract. This is due to the fact that milk does not contain the low-molecular weight compounds needful for the development of microorganisms such as free amino acids, monosaccharides, etc., as well as the fact that the majority of bacteria of the genus Lactobacillus, Lactococcus and Bifidobacterium refer to the obligate anaerobes, affected negatively by the dissolved oxygen in milk [5, 6, 7]. That is why bifidobacteria that belong to anaerobic bacteria develops very slowly in milk.

The experts examined the possibility of combined use of bifidobacteria and lactobacilli. It was determined that a significant number of lactic-acid streptococci and bacilli stimulate the growth of bifidobacterim flora in milk, contribute to the increasing of number of active cells of bifidobacteria and contribute to the intensive accumulation of their metabolism products [8].

Bifidobacteria regulate qualitative and quantitative composition of the normal intestinal flora, hinder growth and prevent reproduction of pathogenic, putrefactive and aerogenic bacterial flora, restore the damaged structure of the mucous membrane of the intestine. Together with other representatives of the normal intestinal flora, bifidobacteria are involved in the digestion and absorption, synthesis of B vitamins, vitamin D, folic and nicotinic acid, they promote the synthesis of essential amino acids, better absorption of vitamin D and calcium, stimulate the activity of lysozyme and synthesis of antibodies, increasing the body's function of immunity protection [9].

An effective way of normalization of intestinal bacterial flora is a creation of synbiotics (complex of pro- and prebiotics) and manufacturing of the products on their basis, which will allow stimulating the development of its own intestinal bacterial flora and increasing the protective functions of the body.

In Ukraine, the fermented dairy desserts of functional orientation are very popular. In the process of their production a wide range of flavors and stabilizers is used which regulates the processes of structure formation that prevents denaturation of proteins during thermal conditioning of the milk-based mixtures improving the nutritional and biological value of the dessert product.

The development of technologies of dairy lacto- and bifidobacteria-based desserts, using vegetable fillers enriching foods with vitamins, minerals, polyphenols substances makes it possible to increase significantly the biological value and expand the range of functional dessert products. As a filler, a variety of fruit and berry juices is used, such as juices, purees, syrups, natural fruits and berries in a candied or in a frozen form.

The aim. Creation of symbiotic of functional products with the use of prebiotics - ingredients of natural origin, that is able to stimulate development of cultures of probiotics behaves to perspective directions of expansion of assortment of functional foodstuffs [8, 13].

The methods of research. The aim of this work is a scientific justification of composition and development of technologies of fermented dairy dessert products of functional purpose, enriched with biologically active substances of plant origin.

Our analysis of the lactic acid bacteria by the lactose digestion level finds that lactococci and streptococci are characterized by a high degree of acid-formation, but lactobacilli L. delbrueckii ssp. bulgaricus and Lactobacillus acidophilus exceed other lactic acid bacteria by the level of acid. According to experts, strains of lactic streptococci Lactococcus lactis ssp. lactis, Lactococcus lactis ssp. cremoris, S. thermophilus, Lactobacillus acidophilus produce mainly L (+) – lactic acid, which is physiologically more beneficial for the human body. Acidophilic bacilli Lactobacillus acidophilus inhibit harmful bacterial flora - salmonella, staphylococci, etc., due to the ability to produce antibiotics lactocidin and acidophilus, which are amplified in contact with the lactic acid [8, 15].

Assessment of protein cleavage by lactic acid bacteria mentioned above was determined by the increase in the number of free amino acids in plasma after deposition of milk proteins by 5.0% solution of trichloroacetic acid, relative to control – content of free amino acids in sterilized milk before the fermentation process.

Bifidobacterium bifidum 791, Bifidobacterium longum ssp. longum In M 379, Bifidobacterium adolescentis B-1 were selected aiming to obtain symbiotic systems and to use them in the development of fermented dairy dessert of functional purpose .

The results of research. It was found that the selected strains of bifidobacteria in the development process are resistant to high concentrations of bile, phenol, they are developed in the environment of low and high pH, they do not form catalase and hydrogen sulfide, do not restore nitrates and nitrites and do not dissolve gelatin [15].

The consortium of selected bifidobacteria in the ratio of 1: 1: 1 was evaluated for resistance under conditions close to the medium of the stomach (HC1 pH 2-3) during 5 hours, and under conditions close to the storage of finished dairy dessert products (lactic acid pH 3-4) during 24 hours. It was found that in contact with the hydrochloric acid at pH 3 the number of viable cells of bifidobacterium of the consortium was reduced by 5.2% when pH is 2-9.8%. When storing dairy products in contact with lactic acid at pH 4 the number of viable cells of bifidobacteria was decreased by 3.4% at pH 3-6.2%.

Based on the experimental data we can predict that the bifidobacteria activity preservation while passing through the gastrointestinal tract gives the opportunity to predict the survival of the bifidobacteria in the composition of fermented dairy dessert during storage of finished products before the experimental deadline.

The research of technological properties change of the consortium of the adapted lactobacilli and bifidobacteria and their composition within 6 hours of storage was conducted (Table 1).

Table 1

Technological properties of microorganism compositions

Microorganism compositions	Active Acidity (pH),	Energy of acid-formation during fermentation, °T	Number of viable cells in the bunch, Lg CFU / cm^3	
			Bacteria	Lactobacili
Consortium of lactobacilli (Lb.acidophilus + Str. thermophilus) (1:1)	4,5±0,2	73±0,5	–	7,2±0,2
Consortium of bifidobacteria (B.bifidum + B.longum + B.adolescentis) (1:1:1)	4,7±0,2	66±0,3	8,9±0,2	–
Composition (consortium of bifidobacteria and consortium of lactobacilli) (2: 1)	4,6±0,2	69±0,5	9,5±0,3	8,0±0,2

Energy of acid-formation of the composition of laktobacilli and bifidobacteria consortium compared to the bifidobacteria consortium increases, but decreases in comparison with the lactobacilli consortium, which is a favorable factor for the growth of bifidobacteria. In the development of bifidobacteria nutrients play an important role which are accumulated as a result of the vital activity of the strains of lactic acid bacteria, increasing the number of bifidobacteria viable cells.

We used bifidobacteria probiotics as growth and development factors, – fructose, lactulose, concentrate of artichoke as a source of inulin, as a stabilizing systems - pectin, gelatin, starch and cereals - rice and oat flour.

During the fermentation of sterilized skim milk, the bifidobacteria consortium within 6 hours of active acidity of milk coagulum in contact with the bifitostimulator of fructose reaches pH – 4.64, lactulose – pH 4.6, inulin – 4.5 without stimulators for bifidobacteria – 4.7, while titrated acidity is, respectively, 68, 72, 74 and 52%. In contact with bifidostymulators the product has a lower active acidity and significantly increased volumetric acidity, which can be explained by the increase in bifidobacteria activity and the formation of acetic acid, which is quite strong electrolyte.

Nonfat dry milk (NFDM) is used to determine the rational concentration of milk solids non-fat (MSNF) in milk base of dairy products. Milk base increase in MSNF contributes to an increase of the number of contacts between the caseins during coagulation per unit volume of the dispersion medium and leads to their intense interaction. As a result, the viscosity of the product increases and its consistency improves. It is also known that MSNF concentration increasing in a nutrient medium significantly stimulates the growth and development of bifidobacteria by increasing in sulfur-containing amino acids. [10]. Improving of their content in milk base increases the titer of bifidobacteria and the increase in caseinate-calcium phosphate complex (CCPC) in milk base – forms a buffer system

that inhibits the growth of acidity while biomass increasing. As a stabilizer of dairy dessert product structure, pectin, gelatin, starch, oat and rice flour are used.

Pectin activates the development of bifidobacteria; it is a breeding ground for the growth of normal bacterial flora of the gastrointestinal tract and it has a detoxifying and radioprotective properties [12]. In contact with pectin a number of viable cells within 24 hours of bifidobacteria increases from 1·104 CFU/cm^3 to 2.5 108 CFU/cm^3, compared with the control, in which the number of bifidobacteria increases from 1·104 CFU/cm^3 to 1·107 CFU/cm^3.

Gelatin as a protein substance in the acidic environment has a positive effect; it binds moisture and forms a solid gel at low pH. The gelatin ability to bind free moisture and to form dense coagulum and gels through the formation of three-dimensional mesh structure is important in the dairy industry because it reduces the risk of synaeresis in manufactured products; as a result, the output increases, prime cost reduces and quality of the finished product improves [13].

Starch is a neutral polysaccharide, which serves as a structure-directing agent and as a stabilizer of the obtained structures. Starch increases the water-retaining capacity of dairy base, but it affects the acid-formation ability of bifidobacteria. In the control sample without the starch the acidity of derived structures is almost 88^{0}T, in samples with the starch content 5.0% – the acidity is less than 76^{0}T [15].

We can assume that the starch as a neutral hydrocolloid does not directly affect the fermentation process, but it binds moisture and increases the viscosity, which hinders the development of starter cultures and slows down the fermentation process.

It is found that the use of stabilizers: pectin – 0.3% gelatin – 3% starch – 4%, gives a possibility to get a structure peculiar to the fermented-milk products, to provide the necessary moisture and viscosity, to increase the number of viable cells of bifidobacteria and to prevent milk protein aggregation using fruit and berry fillers.

As we stabilizer we used oat and rice flour intended for infant food, without the enzyme lipase. Rice flour differs from the oat flour in higher content of starch, minerals and fewer content of proteins and fats. Starch rice flour swells well, its volume increases in 5-7 times compared with the oat flour starch, the volume of which increased only in 4.5 times [14]. We used a mixture of rice flour and oatmeal in the ratio 1:1. Oat flour enriches the mixture with the proteins and fats, and rice flour starch provides high water-retaining capacity.

Specified component structure of stabilizing system gives a possibility to get a structure that has a delicate, homogeneous, gelling consistency with glossy surface, typical for dairy dessert products like pastes and puddings. After 18 hours of fermentation, the titrated acidity of control samples is 82ºT, active acidity – 4.5 in test samples, respectively, 88 and 4.4ºT. Coagulum begin to form after 12 hours of fermentation, when titrated acidity of control and test samples is up, respectively, 72 and 76ºT and active acidity – 4.7 and 4.6. A mixture of oat and rice flour stimulates growth and proliferation of bifidobacteria, increasing the number of viable cells during fermentation from 1 102 to 1 109 CFU/cm^3.

It was found that for pasteurization of symbiotic milk base, protein and fat normalized, it's appropriate to use the mode (90±2)°C with an exposure of 2 min. Given that in milk and grain basis using a mixture of oat and rice flour spore forms of microorganicms can be present, pasteurization temperature set at (95±2)°C at interval of 5 minutes.

In the production of milk-based desserts in MSNF and fat normalized skim milk, they added the mixture of prepared stimulators for bifidobacteria and stabilizers in the prescribed rational number. The end of the fermentation process in contact with milk-based composition of bifidobacteria and lactobacilli was determined by volumetric parameters and active acidity. Gel formation process starts from the third hour of the fermentation. Lag-phase duration takes 1 hour, which indicates a properly selected quantitative and qualitative composition of stimulators for bifidobacteria. The sharp increase in volumetric decline and the reduction of active acidity starts from the third hour of fermentation, and in six hours titrated acidity of test samples of milky-based desserts reaches 72ºT, of control samples – 85ºT active acidity, respectively, 4.7 and 4.5, on milky grain basis - titrated acidity reaches, respectively, 78 and 82ºT active acidity – 4.4 and 4.5.

The content of bifidobacteria in milk-based experimental samples during 6 hours of fermentation is 10,3 Lg CFU/cm^3, lactobacillus – 8,5 Lg CFU/cm^3, in con-control samples, respectively, – 8,1 Lg CFU/cm^3 and 8, Lg 6 CFU/cm^3, in milk-based grain content of viable cells of Bifidobacteria is 10,5 Lg CFU/cm^3, lactobacillus – 10,3 Lg CFU/cm^3, in control samples – 8.3 Lg CFU/cm^3 and 8.7 Lg CFU/cm^3, respectively [15].

It was found that the process of structure formation of sweet milk-based products is almost completed at the viscosity level of 1.65 102 Pas, while the process of structure-formation of milk-grain based products is slower and after 5 hours the viscosity reaches to 1,85 102 Pas. [14].

While adding fruit and berry fillers, we have to consider that they have low acidity and as a result can occur a compaction of three dimensional structural mesh of protein gel, disruption of sweet fermented products structure and the emergence of synaeresis.

We experimentally found that during the production of sweet fermented products, set way should be used and adding a fruit and berry filler should be done after adding starter, while stirring. Adding stabilizers and sodium solt three replaced which maintains pH at optimum level and increases the buffer capacity of dairy products, prevents the emergence of synaeresis process. The results of the research of fermented desserts with fruit fillers immediately after the cooling to storage temperature (3±1)°C are shown in table 2.

The process of fermentation takes place 5-6 hours. Coagulums of symbiotic product are dense; the texture is homogeneous, delicate, gelatin-like and moderately viscous. The taste is clean, pleasant, with a taste and smell of fruit – berry filler.

Table 2

Characteristic of dessert products with fruit and berry filling

Indexes	Milk-based		Milk and grain base	
	Control	Test	Control	Test
Activ acidity, vol.un pH	4,5±0,1	4,67±0,1	4,52±0,1	4.64±0,1
Titrated acidity, °T	77,5±0,2	75.2±0,2	78±0,2	78,8±0,2
Number of cell viability of bifidobacteria, Lg CFU / cm^3	9,2±2	9,8±2	10,1±2	10,5±2
Time of the coagulus emerfence, hour.	5,0±0,5	5,5±0,5	5,0±05	5,5±0,5
Viscosoty, $\eta\ 10^3$, Pas	1,89±0,2	1,93±0,2	1,91±0,2	1,95±0,2
Syneresis, cm^3	Absent	Absent	Absent	Absent

The results of experimental studies were the basis for the development of new formulas and technologies of fermented dairy product dessert of functional orientation.

A study of changes on the content of viable bifidobacteria during storage of the finished product during 25 days at the temperature (4±2)°C was conducted. It was found that within 10 days the quantity of viable bifidobacteria is almost unchanged over the next 5 days begins a gradual death of bifidobacteria cells, but their content in products remains high – 102-103 Lg CFU/cm^3.

The research of rheological properties changes of milk and milky-grain basis products during storage showed that during the first five days of storage, obtained structures thicken and viscosity of fermented dessert products increases in the result of process of complex formation of hydrocolloids with proteins and with each other [11] and through adsorption of polyphenolic substances of fruit and berry raw on the surface of proteins and polysaccharides with the forming of complex structures, thickening the structure [12].

Conclusions. It is found that the structure of control samples of desserts is unchanged for 15 days, of test samples – for 20 days, followed by a gradual destruction of the structure and there is little separation of moisture in separate drops. After 25 days, synaeresis of sweet milk-based products is 1.2 cm^3, of milk and grain basis – 0.8 cm^3 was noted. Probiotic properties of both control and test samples for 20 days of storage are not lower than 1 109 CFU/cm^3, but considering that after 10 days of storage bifidobacteria cell death starts, the storage time of fermented sweet products was limited to 15 days.

So we have developed the formula and technologies of fermented desserts milk and milky-grain-based product using bifidobacteria and lactobacilli, bifidostimulators, structure-formants and fruit-berry fillers that remain high biological value, delicate texture, taste and aroma over 15 days, inherent to used fruit and berry fillers.

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АННОТАЦІЯ
ФЕРМЕНТОВАНІ ПРОДУКТИ ФУНКЦІОНАЛЬНОГО ПРИЗНАЧЕННЯ З ВИКОРИСТАННЯМ РОСЛИННИХ НАПОВНЮВАЧІВ

Соломон А.М., *кандидат технічних наук, доцент*
Бондар М.М., *аспірант*
Вінницький національний аграрний університет

Функціональні продукти отримують за інноваційними технологіями і розглядають не лише як джерела пластичних речовин і енергії, але і як складно не медикаментозний комплекс, який відповідає фізіологічним потребам організму людини і має яскраво виражені лікувальні, профілактичні або оздоровчі властивості. Важливою складовою ринку продуктів функціонального призначення є молочні продукти, які в Україні і країнах Європи складають близько 65% від його загальної місткості. Більше 80% ринку молочних продуктів функціонального призначення (МПФН) представлений продуктами з про- та пребіотиками, 8% – продуктами з БАД, близько 12% складають інші продукти. Перша група МПФН найдинамічніше розвивається і постійно поповнюється новими продуктами, оскільки на дисбактеріоз в Україні, за статистичними даними, хворіє 65,75% населення. Аналіз цих продуктів свідчить про те, що у більшості вплив пробіотика обумовлений регламентованою кількістю лактобактерій (ЛБ), тоді як кількість життєздатних клітин біфідобактерій (ББ) в продуктах часто не відповідає вимогам нормативних документів, що знижує їх функціональний вплив на організм людини.

Необхідність розширення асортиментного ряду МПФН диктується сьогодні демографічною ситуацією в Україні (частина людей похилого віку у загальній структурі населення складає 20,5%, за прогнозами Інституту геронтології АМН України до 2050 року вона виросте до 38,1%), збільшенням кількості людей з серцево-судинними захворюваннями, цукровим діабетом (до 24,5 і 3,8%, відповідно), поширенням вторинних імунно дефіцитних станів, ускладнених порушеннями шлунково-кишкового тракту в половини населення країни. Тому розробка нового асортименту науково обгрунтованих технологій МПФН, збагачених комплексами культур пробіотиків лакто- та біфідобактерій, біологічно активними речовинами (БАД), пребіотиками є актуальним для України.

Ключові слова: *про- і пребіотики, синбиотики, біфідобактерії, лактобактерії, рослинні наповнювачі, біологічна цінність*

Табл. 2. Літ. 15.

АННОТАЦИЯ
ФЕРМЕНТОВАННЫЕ ПРОДУКТЫ ФУНКЦИОНАЛЬНОГО НАЗНАЧЕНИЯ С ИСПОЛЬЗОВАНИЕМ РАСТИТЕЛЬНЫХ НАПОЛНИТЕЛЕЙ

Соломон А.М*., кандидат технических наук, доцент*
Бондар М.М., *аспирант*
Винницкий национальный аграрный университет

Функциональные продукты получают по инновационным технологиям и рассматривают не только как источники пластических веществ и энергии, но и как сложно не медикаментозный комплекс, который отвечает физиологическим потребностям организма человека и имеет ярко выраженные лечебные, профилактические или оздоровительные свойства. Важной составляющей рынка продуктов функционального назначения являются молочные продукты, которые в Украине и странах Европы составляют около 65% от его общей емкости. Более 80% рынка молочных продуктов функционального назначения (МПФН) представлено продуктами с про- и/или пребиотиками, 8% – продуктами с БАД, около 12% составляют другие продукты. Первая группа МПФН наиболее динамично развивается и постоянно пополняется новыми продуктами, поскольку от дисбактериоза в Украине, по статистическим данным, страдает 65,75% населения. Анализ этих продуктов свидетельствует о том, что в большинстве влияние пробиотика обусловлено регламентированным количеством лактобактерий (ЛБ), тогда как количество житзнеспособных клеток бифидобактерий (ББ) в продуктах часто не отвечает требованиям нормативных документов, что снижает их функциональное влияние на организм человека.

Необходимость расширения ассортиментного ряда МПФН диктуется сегодня демографической ситуацией в Украине (часть людей преклонных лет в общей структуре населения составляет 20,5%, по прогнозам Института геронтологии АМН Украины до 2050 года она вырастет до 38,1%), увеличением количества людей с сердечно-сосудистыми заболеваниями, сахарным диабетом (до 24,5 и 3,8%, соответственно), распространением вторичных имунно дефицитных состояний, усложненных нарушениями болезни желудочно-кишечного тракта у половины населения страны. Поэтому разработка нового ассортимента научно обоснованных технологий МПФН, обогащенных комплексами культур пробиотиков лакто- и бифидобактерий, биологически активными веществами (БАД), пребиотиками, является актуальным для Украины и нуждается в решении.

Ключевые слова*: про- и пребиотики, синбиотики, бифидобактерии, лактобактерии, растительные наполнители, биологическая ценность*

Табл. 2. Лит. 15.

Інформація про авторів

СОЛОМОН Алла Миколаївна, *кандидат технічних наук, доцент кафедри харчових технології та мікробіології Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3; e-mail: Soloalla78@ukr.net).*

БОНДАР Мар'яна Михайлівна, *аспірантка кафедри харчових технології та мікробіології Вінницького національного аграрного університету (21008, м. Вінниця, вул. Сонячна 3; e-mail: bondar_mar@vsau.vin.ua).*

СОЛОМОН Алла Николаевна, *кандидат технических наук, доцент кафедры пищевых технологий и микробиологии Винницкого национального аграрного университета (21008, г. Винница, ул. Солнечная 3; e-mail: Soloalla78@ukr.net).*

БОНДАРЬ Марьяна Михайловна, *аспирантка кафедры пищевых технологий и микробиологии Винницкого национального аграрного университета (21008, г. Винница, ул. Солнечная 3; e-mail: bondar_mar@vsau.vin.ua).*

SOLOMON Alla, *Candidate of Technical Sciences, Associate Professor, department of Food technologies and microbiology, Vinnitsa National Agrarian University (21008, 3, Soniachna Str., Vinnytsia; e-mail: Soloalla78@ukr.net).*

BONDAR Mariana *postgraduate, department of meat processing technology, milk and Microbiology, Vinnitsa National Agrarian University (21008, 3, Soniachna Str., Vinnytsia; e-mail: bondar_mar@vsau.vin.ua).*