SECTION 6. FOOD TECHNOLOGY

6.1 Characteristics of plant raw materials as a functional and technological ingredient for dairy products

6.1.1 Characteristics of plant raw materials as a functional and technological ingredient for dairy products

In recent years, there has been a sharp trend in the creation of products in which the milk base is combined with raw materials of plant origin. This allows, on the one hand, to increase the nutritional value of the product, on the other - to partially reduce the existing deficiency of protein, polyunsaturated fatty acids, vitamins and minerals [85, 86].

Plant raw materialshave become widespread in the food industry - due to their high nutritional and biological value. The scheme of application of vegetable raw materials for products of various branches of the food industry is presented in Figure 1.

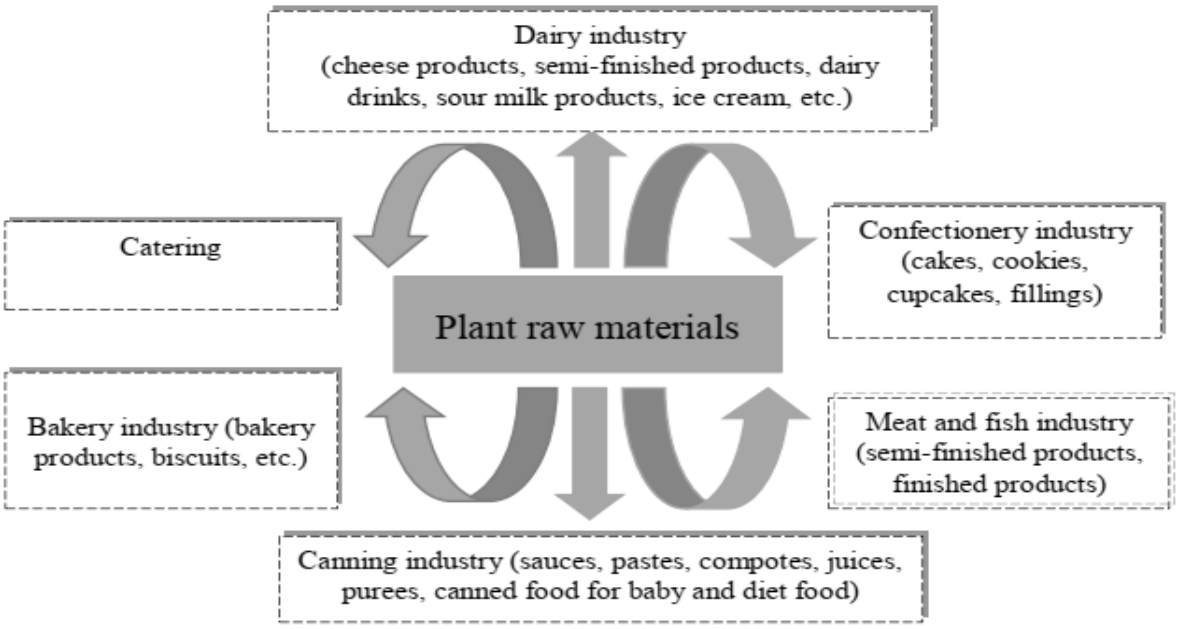

Figure 1. The use of plant materials

To ensure a balanced diet, new dairy products are being developed that contain, in addition to traditional ingredients, plant raw materials that are carriers of vitamins, macro- and microelements and other substances essential for the normal functioning of

the body.In the dairy industry, vegetable raw materials are usually used in crushed form, in the form of purees, powders, extracts, juices, as a filler and coagulant of milk proteins in the production of cheese products. To determine the suitability for use in the dairy industry, it is advisable to familiarize yourself with the properties of domestic vegetable raw materials.

Plant raw materials - a source of biologically active substances, especially organic acids, in easily digestible form and raw materials for the food industry. Biologically active substances contained in plants are able to remove heavy metals, radionuclides from the body, as well as neutralize their negative effects. Pectins form complexes that bind heavy metals and radioactive elements, and vitamins C and P have anti-radiant effects [87].

Ukraine grows a large number of crops, including wildflowers, which can be used as raw materials (additives) in the production of dairy products, including cheese products [88, 89]. The development of dairy-based products with plant raw materials is relevant for the use of functional and technological properties of medicinal plants and optimization of products for vitamins. Insufficient research on the use of plants as a natural coagulant to obtain protein-berry clots - the basis of cheese products [90]. According to literary data [91] there are significant deviations in the diet of almost all groups of the population, which has a negative impact on health.

Recently, the trend of curd products, in which the milk base is combined with various plant and grain additives, has been clearly defined. Their introduction allows to enrich traditional products with essential nutrients, thereby ensuring a high level of balance in amino acid, fatty acid, mineral, vitamin composition and increase the body's overall resistance to adverse environmental factors [92, 93].

There are a variety of cheese products with vegetable fillers: melon meal and pollen; wheat grain and dried apricots; sugar, vanilla and raisins, or fruit and berry powder; sea buckthorn; millet groats and mashed berries or vegetables; citrus fillers [94, 95].

The technology of obtaining curd mass with dried sea buckthorn fruits has been developed. To saturate the taste and aroma, dried sea buckthorn, blanched in syrup,

with a dry matter content of at least 30% at the stage of mixing the protein base with sugar in the amount of 6% of the total weight was added. Herbal supplement does not affect microbiological parameters and allows you to get a product with new taste characteristics and shelf life up to 72 g [96].

The introduction of berry powders leads to changes in the quality of cheese products, shown in Figure 2 [97].

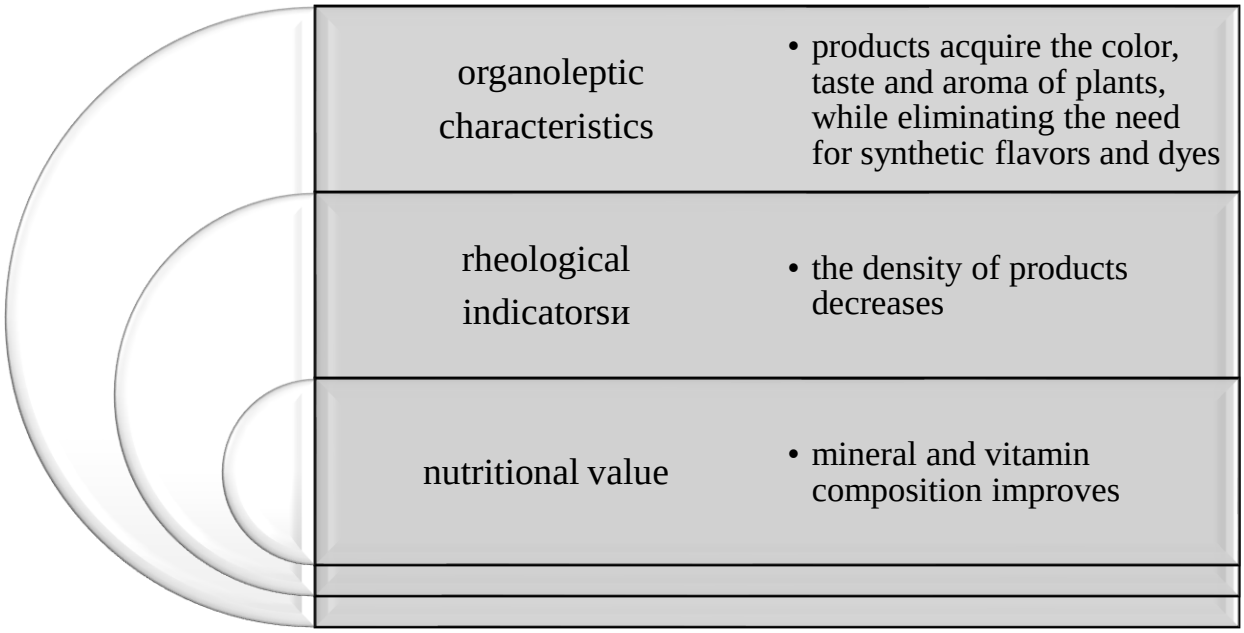

Figure 2. Changes in the quality of cheese products with plant additives

The possibility of using blueberry powder in quantities of: 3%, 5%, 7%, 10%, 15% as an enriching additive for low-fat cottage cheese is considered. The obtained samples of curd product were evaluated by organoleptic parameters on a 10-point scale.A sample of sour milk cheese with a powder content of 7% received a low score for a pronounced sour taste, the color of this sample was deep purple. The sample with the introduction of blueberry powder 10% had an excessively sour taste and a heterogeneous dry consistency. The lowest score was obtained with a content of blueberry powder 15% - for sour taste, dry texture and dark purple color. Subsequently, samples of cottage cheese with blueberry powder content of 5% and 7% were investigated [98].

A study was conducted to obtain a crude product by an acidic method with the addition of black currant berries. The purpose of the berry component is increased to

increase the acidity of milk to form a clot and change of organoleptic indices of the crude product. As a berry component used juice and crushed after freezing black currants. In the milk, a leaven and a berry component in an amount from 5% to 25% in a step of 5% were added.When the berry component is introduced in an amount of 15% and 20%, the yield of the crude product increases, and when added 25% begins to decrease. The acidity of the cheese product increases with an increase in the percentage of the berry component. When increasing the amount of berry component, the quality of grain is reduced. The maximum yield of the crust product was achieved with the extruded berries of black currants. The best organoleptic parameters were samples containing 10% and 15% of the berry component.

The possibility of using berries of aronia (black sorbitas) in the technology of production of crop products has been studied. As a raw material, a sour milk cheese was used, made in two ways: acidic and acid-saturated. The berries were introduced in an amount from 5% to 25% in a 5% step. According to organoleptic estimates, the best composition of the cheese of sour milk and printed rowan in the ratio: 80% cheese and 20% of berries. It is established the possibility of prolonging the implementation of the combined product with the Black Rainbow product up to 8 days [99].

The use of Fejoa as a filler in the technology of obtaining crude products is proposed. A distinctive feature of Fejoa is a high content of water-soluble compounds of iodine 0.2 - 1 mg in 100 g of product. The feature of technology is that in a finished cheese add a filler in the form of a mixture of smattered pulp and sugar in a ratio of 1: 1 and a dry skin powder. Dosage of syrup varied from 1% to 10%, dry filler - from 0.5% to 3.5%. The mixture of fillers was introduced into a finished cheese product in a ratio of Fejoa syrup and dry peel powder 8: 1.5. The antioxidant activity of the syrup Fejoa 1.963 mg / dm^3 is determined [100].

With the taking into account of the chemical composition and taste properties of the good raw materials, the technology and formulations of a crude dessert with the introduction into the silk base of additives in the form of powders of IR drying were developed. After cooking, the samples were cooled to a temperature of 4 ± 2°C. and kept to jellify the structure. With an increase in the concentration of powders up to 2%

(sea buckthorn up to 1.5%) there is a decrease in densber density due to organic acids and pectins that contribute to foaming. When administering additives at a concentration of 2% and the ratio of berry and vegetable powders 70:30 products were obtained with the corresponding organoleptic parameters.

In the production of grass desserts as a multivitamin functional additive, cranberries and sea buckthorn were used. Product from milk with the addition of berry mashed potatoes is obtained. The method involves the preparation of a milk-berry mixture of normalized pasteurized cow's milk and berry mashed potatoes and simultaneous treatment by heating, mechanical treatment and structural formation by continuous dispersion of a milk-berry mixture before the completion of its complete coagulation. The berries are black, white and red currants, cranberries, cranberries are blanked in water at a temperature of 90-100 °C, with an exposure of 3-8 minutes, the amount of water is 10-15%.Berries with a gentle consistency of pulp - raspberry, blackberry, blueberries - do not bless, but rub fresh immediately after thermal treatment. It consists in selling the berry mass through the holes in the walls of a perforated drum under the action of centrifugal force. The product is divided into two fractions: liquid, consisting of crushed pulp and solid, comprising seeds, peel and stones. Milk is normalized by the mass fraction of fat, pasteurize, cooled, make a bacterial leaven for cheese sour milk and a fruit component, which use fruit mash in an amount of 5-8% by weight of the mixture.The mixture is stirred, maintained to dry to form a fluid consistency without separation of serum or with a serum separation from a clump up to 30% until a dense dairy product is obtained. The effect of making berry puree - the operation of processing the mixture by squashing is found faster than without the introduction of a berry component, and the yield of the cluster increases. The introduction of a berry component in an amount of 5-8% of the mixture of the mixture is optimal.

The possibility of using mashed berries and cranberries for the production of a thermocoucular crude product is investigated. The introduction of mashed potatoes and cranberries, due to high acidity, will allow to form a clot, and due to the content of dry substances to increase the yield of the product. In addition, berries contain dyes that

allow the product of a pink or light purple shade depending on the components that make it possible to expand the range of soft thermal acid cheeses.

As raw material for the production of grass desserts, a raw root root can be used or processed by any of the thermal methods.

The widespread use of the roots of the burdock is due, first of all, the content of a rich complex of polysaccharides, mainly inulin - up to 45%.

Inulin for patients with diabetes is better than fructose, which produces products for this category of patients. This is due to the fact that fructose that is in the body in the composition of food products is absorbed in the small intestine and enters the liver mainly. At the same time, fructose formed from inulin under the influence of enzymes of microflora of the large intestine enters immediately in a large circle of blood circulation and absorbed as a liver, but also by other tissues, in particular muscles.

Due to the fact that for patients with diabetes mellitus, it is very difficult to pick up the necessary desserts, the task of developing assortment of desserts using the root of the burdock, while preserving its main pharmacological properties is quite relevant.

According to modern meals science, protein products are of great importance for balanced nutrition. In this regard, the issue of expanding the assortment of the above products, namely - the development of technologies of grassworks with plant components is relevant. Based on a balanced composition due to the combination of raw materials of animal and plant origin, combine the consumer characteristics of traditional products.

6.1.2 Development of fillers with extracts of inulin-containing raw materials for the dairy industry

Inulin and its derivatives (inulin fructans) are natural components of cereals, fruits and vegetables. They are contained in many plants: wheat, topinamburi, onions, bananas, chicory, etc. Recently, it is convincingly shown in research on volunteers that inulin and oligophructose improves lipid metabolism. In patients suffering from cancer and intestinal polyposis, different markers associated with these diseases are suppressed. Other physiological effects of inulinic fructans are involved in regulation of appetite, reducing the deposition of fat.

Industrial source of inulin and its derivatives is the root of chicory, from which they are obtained by hot extraction. At the same time, a good scientific and technical base of the production of bifidogenic substances from the topinambura was created.

It should be noted that chicory and topinambur are not only a valuable source of prebiotic components, but also contain a significant amount of vitamins, minerals, enzymes. To date, the resource-saving technologies of processing of topinamburus and chicory, which maintain biologically active components in practice are theoretically substantiated and implemented. Recycling products (powders, juice and mashes) can be used in nutrition both independently and by introducing into the formulations of other food products by providing them with functional properties.

From the point of view of food science, it is most advisable to develop new functional products based on fermented dairy products having high food and biological value.

6.1.3 Technological features of obtaining functional milk drinks with biologically active substances from vegetable raw materials

Given the prebiotic characteristics of inulin, its significant content in chicory (14-15%) and Topinamburi (11-12%) was an interesting study of their bifidogenic properties when used in the technology of fermented dairy drinks.

Studies have shown that with a powder of topinamburus in an amount to 1% to a mass of nutrient medium containing bifido or lactic acid bacteria, increased the optical density density in comparison with solutions without the addition of topinamburium by an average of 30-40% of the final measurement point. Probably this is due to the introduction of water-soluble nutrients and inulin Topinambura, which positively affect the growth of microorganisms. However, the beginning of intensive growth of bacteria was uneven for different cultures - for lactic acid sticks after 6 hours of fermentation, for bifidobacteria - after 10 hours, which is due to various biotechnological properties of microorganisms.

Unlike the powder of the Topinambur, the use of chicory powder did not lead to a significant change in the optical density of nutrient media cultivated by probiotic cultures. The value of the indicator of the optical density coefficient (%) in control and

experimental samples at the end point were practically the same and comparable to the experience of experience. It is noted that growth of cultures on an environment with chicory components began later an average of 3 hours for lactic acid cultures and 12 hours for bifidobacteria. Obviously, it is with adaptation of cultures to an environment containing chicory components.

The study of the process of propagating the samples of normalized milk by probiotic leaven showed that with an increase in the percentage of the acid-introduced component, the process of acid formation slightly slowed down. The introduction of chicory in an amount of 1-2% slightly influenced the process of drying milk against control samples without chicory.The process of fermentation lasted 6-8 hours and was accompanied by the process of increasing acidity in characteristic of each type of leaven range. The introduction of chicory influenced the viscosity of samples, reducing this index directly proportional to the amount of chicory.In this connection, it is necessary to use leaven with a microflora that produces viscous polysaccharides or introduce stabilizers to provide the necessary organoleptic properties of a fermented drink. According to the results of the study for further product development, a sample containing 2% chicory obtained using a comprehensive leaven "Bifit" was selected.

When drying normalized milk containing 1 to 3% powder of the Topinambura, the dynamics of an increase in acidity acidity, for all samples in comparison with control samples has not changed. The resulting clots had a homogeneous dense consistency, an acidity of 70-90 °T, depending on the desktop used.

Dynamics of changing inulin content when drying milk containing powder of Topinamburu 3% and chicory powder 2% using probiotic crops are reflected in Figure 1.

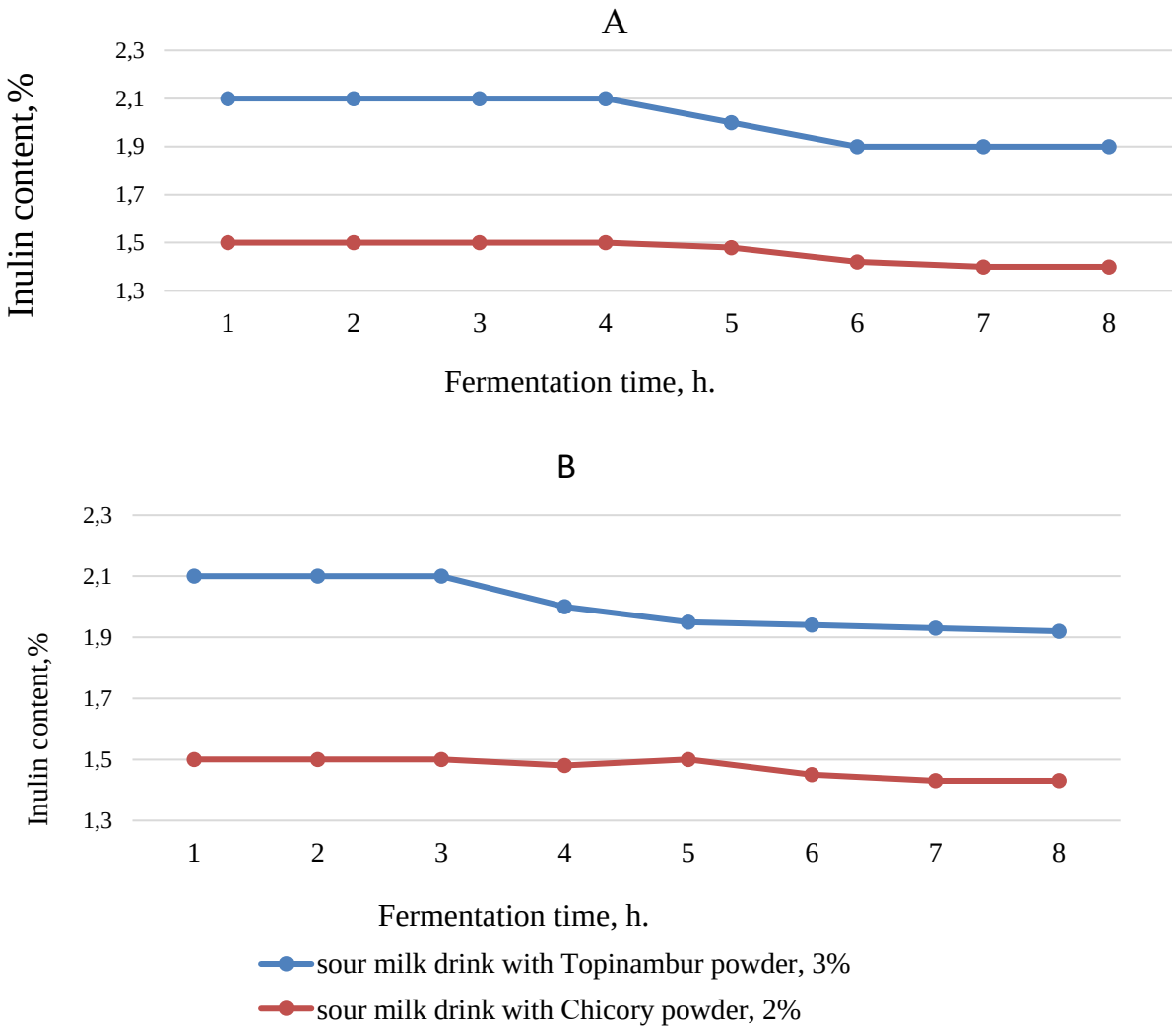

Figure 3. Changing the content of inulin in samples of sour-milk drinks using the leaven "Bifit" (A) and Biomatrix (b)

As the results show, at the beginning of the fermentation process of both samples, the inulin content does not change. After 5-6 hours there is a decrease in inulin content before the end of the process. In general, the inulin content is reduced by 9.52% and 5.96% for samples with Jerusalem artichoke and chicory powder, respectively. When using the leaven "BioMatrix" inulin content decreased by 7.5% for the sample with Jerusalem artichoke powder and 3.86% for the sample with chicory powder.

Thus, in the fermentation of raw milk containing dry powders of vegetable raw materials, there is the utilization of inulin by the microflora of the yeast as a source of nutrition in vitro. In addition, fermented beverages remain sufficient inulin to obtain a bifidogenic effect in vitro.

Due to the specific organoleptic characteristics of the drink with chicory powder, the correction of its formulation was carried out with the introduction of stevia powder and pectin.

Stevia was used as a natural sweetener of intensive type, the total sweetness of stevioside which ranges from 200 to 300 sweetness of sucrose. Stevia has not only low energy value, but also has a therapeutic effect on the body [101]. For the experiment, several recipes for beverages with stevia content from 0 to 0.12% were prepared. Stevia was added to the heat treatment normalized mixture.

The addition of pectin powder to pasteurization in an amount of 1 to 2% naturally increased the viscosity of fermented milk drinks (table 1). Samples with a pectin content of 1.25% by weight had acceptable rheological characteristics.

Table 1.

Dynamic viscosity of fermented milk drinks, mPa · s

The leaven used	Mass fraction of pectin, %				
	1.0	1.25	1.5	1.75	2
Bifivit	72.4/73.2	90.1/90.6	92.2/94.31	102.1/104.2	106.1/110.2

Note: mass fraction of milk fat 2.5%

The technology of sour milk drinks with powders of vegetable raw materials is as follows: in part of the normalized milk heated to a temperature of 40-45 °C make Jerusalem artichoke powder in the amount of 3% or chicory in the amount of 2% of the total mass of milk. Stevia powder at the rate of 0.8 kg/1000 kg of finished product and dry pectin at the rate of 12.5 kg/1000 kg of product are additionally added to the milk-chicory mixture. After mixing and dissolving the components, the resulting milk-vegetable mixture is added to the main volume of milk and sent for heat treatment at a temperature of 92-95 °C for 2-8 minutes. Then the mixture is cooled to the fermentation temperature – 35-37 °C for sourdough "Bifivit" and 38-40 °C for sourdough "BioMatrix". Beverages are fermented at the fermentation temperature to form a dense clot.

Organoleptic characteristics of the obtained fermented beverages are shown in table 2.

Table 2.
Organoleptic indicators of fermented milk drinks with biologically active additives of vegetable raw materials

Sample drink	Appearance and consistency	Taste and smell	Color
Sour milk drink with chicory, stevia and pectin	Homogeneous, viscous consistency	Sour milk with a slight bitterness and chicory aroma, moderately sweet	Creme
Sour milk drink with Jerusalem artichoke (sourdough "Bifivit")	Homogeneous, moderately viscous consistency	Sour milk, tender	Creme
Sour milk drink with Jerusalem artichoke (sourdough "BioMatrix")	Homogeneous, viscous consistency	Sour milk, tender	Creme

Thus, the study of functional-technological and biotechnological properties of prebiotics, determination of rational doses and stages of introduction, study of technological features of fermentation allows to create scientifically sound technologies of functional dairy products of bifidogenic action. Therefore, chicory and Jerusalem artichoke powders are recommended for use in the production of fermented dairy products as prebiotic components without significant changes in the technology of fermented milk drinks.

6.1.4 The use of burdock roots and scorzonera in the technology of dairy desserts

Wild plants are recognized as one of the sources of dietary fiber. Dietary fiber has the ability not only to affect the metabolic process, but also to regulate the structural and mechanical properties of the products of which they are part. Their importance is especially important in the structure of high-calorie, high-fat food systems. In the diet of many peoples of the Pacific region, burdock root and scorzonera are integral components.

The roots of these plants contain up to 45% of inulin polysaccharide.

The physiological value of inulin is that, being a prebiotic, it serves as a substrate for profits, including bifidobacteria. Its use with food does not increase blood glucose and does not stimulate insulin production.

In the presence of sugar and protein, the structure-forming properties of inulin increase. Adding inulin to low-fat foods gives them a deeper, softer and more balanced taste. It increases the stability of foaming products and emulsions, shows synergism with other texturizing agents. Inulin is a promising ingredient for the production of dietary, functional, including protein-rich foods with low fat and sugar content [102].

In order to obtain a curd dessert with the best organoleptic characteristics and the maximum possible content in the dessert of burdock root, burdock root puree was introduced into desserts in the amount of 20-80% by weight of dessert. Studies have shown that burdock root puree significantly affected the structural and mechanical properties of cheese desserts. Figure 4 shows the dependence of the shear deformation of cheese desserts on the content of burdock root puree.

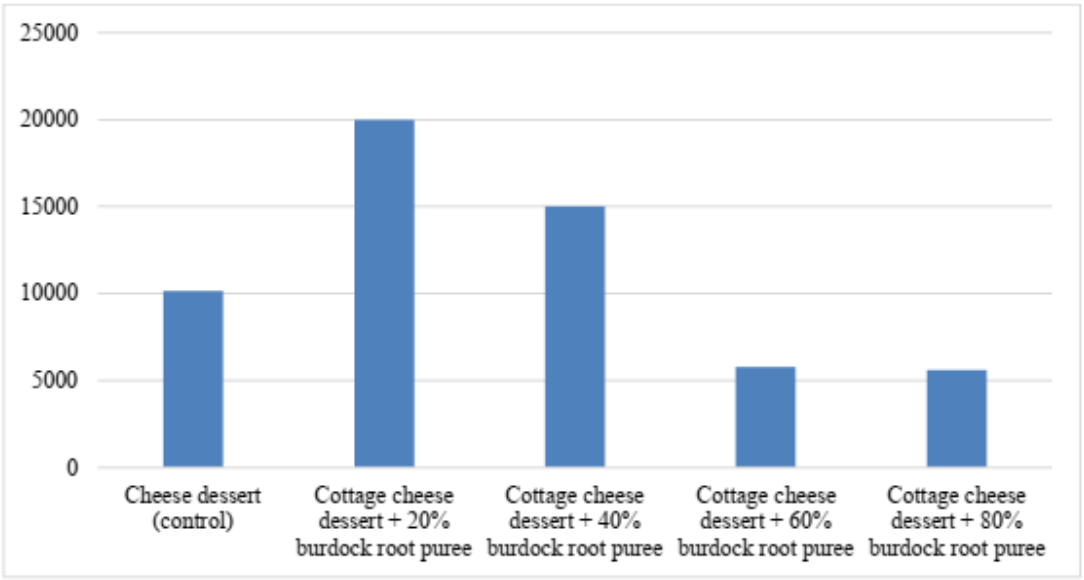

Figure 4. Dependence of shear deformation of cheese desserts on the content of burdock root puree in them

As can be seen from the results, the effect of puree on the deformation characteristics is complex. When keeping puree in dessert from 20 to 40% increases the stability of the structure of desserts, probably due to the mechanism of interaction of dietary fiber and milk protein cheese. Increasing the proportion of puree to 60% leads to the dilution of desserts and reduce this interaction by reducing the proportion

of protein by 2.3 times compared to control samples. When kept in desserts up to 60% of burdock root puree increases their viscosity. Probably due to the fact that when reducing the strength of desserts, they are more saturated with air during whipping, which leads to an increase in their dynamic viscosity.

The results of the dynamic viscosity of gray desserts are presented in Figure 5.

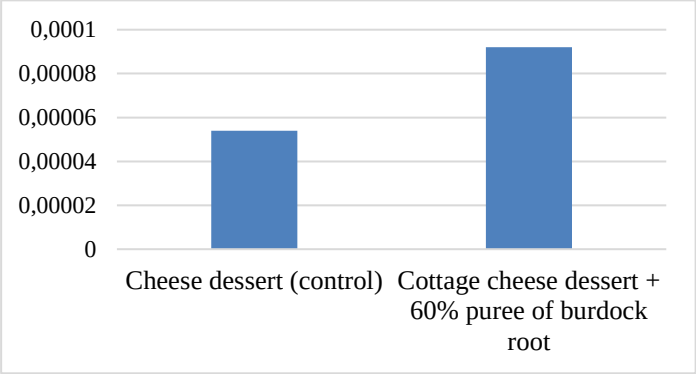

Figure 5. Dynamic viscosity of cheese desserts, Pa · p

With the improvement of the structure of curd desserts containing up to 40% of burdock root puree, their organoleptic characteristics change almost little compared to the control sample. The structure of desserts is lush, porous, but since the cheese itself has a light grain, the inclusion of small dietary fibers of burdock root is not felt in the overall structure of the dessert. The content in the dessert of up to 60% puree leads not only to the formation of a more porous structure, but also to a noticeable change in its color - from white to light beige, the taste is light burdock, which does not impair the taste of cheese dessert. When you increase the amount of burdock puree to 65%, the taste of burdock becomes more pronounced, which affects the unpleasant aftertaste. Based on this, the recipe for a cheese dessert containing burdock root puree in the amount of 60% was chosen.

Thus, in the course of research, it was experimentally established that burdock root puree in the amount of up to 60% improves the structural and mechanical properties of the product and allows you to get a cheese dessert with a lush structure and high organoleptic characteristics.

To expand the range of fermented milk products, giving them functional properties, we proposed to use the developed multifunctional food composition (dairy-plant extract scorzonera) in the production of yogurt drinks.

To obtain a milk-plant extract, dried scorzonera roots were used, which are characterized by a high content of inulin polysaccharide (up to 12%). The dry matter of unpeeled tubers scorzonera also contains dietary fiber, in particular, pectin (up to 4%) and fiber (up to 2%), which act as a sorbent and remove toxins from the body, as well as polysaccharide starch (up to 1%). Of particular importance among the physiologically valuable nutrients scorzonera belongs to the amino acids that regulate various metabolic processes. Scorzonera roots have a valuable mineral composition, which is represented by calcium, potassium, sodium, phosphorus, magnesium, iron, manganese, copper, zinc.

The developed recipe for thermized yogurt drink provides for the complete replacement of sucrose and water with milk-vegetable extract of scorzonera. The use of apple puree as a filler improves the organoleptic and rheological properties of the finished product.

In the production of yogurt drink as a protective hydrocolloid that allows the mixing of milk base and acidic agent with subsequent heating, selected pectin. It is adsorbed on the surface of casein particles, "fixing" their size and preventing the connection of protein particles in large formations, preventing the precipitation and separation of serum [103, 104].

For the formation of a milk clot used sourdough direct application of Yo-FLEXMILD 1.0, which includes lactic acid bacteria (S. thermophilus and L. bulgaricum). This leaven due to the ability to synthesize exopolysaccharides forms a stable clot, preventing syneresis in the finished product.

The composition and properties of the produced product were studied (table 3).

Table 3.
Chemical composition and nutritional value of yogurt drink with scorzonera extract

Nutrient	Mass fraction,%	Nutritional value,% satisfaction of daily human needs
Dry matter, g	11, 20	-
Carbohydrates	8,9	1,78
incl. inulin, g	1,9	15,8

Continuation of table 3

reducing sugars, g	7,0	17,0
incl. fructose	6,68	26,70
Amino acids,%	1,9	2,2
arginine	0,074	1,21
lysine	0,128	3,12
tyrosine	0,048	
phenylalanine	0,067	2,61
histidine	0,041	1,95
leucine	0,152	3,3
isoleucine	0,050	2,5
methionine	0,003	0,17
valine	0,096	3,84
proline	0,166	3,69
threonine	0,067	2,79
serine	0,087	1,05
alanine	0,059	0,89
glycine	0,051	1,46
cysteine	Less 0,001	-
glutamic acid	0,358	2,63
aspartic acid	0,0161	1,32
Fat, g	1,8	1,8
Macronutrients,%		
Ca	0,1	0,01
P	0,07	0,01
Trace elements, mg%:		
Fe	0,16	0,01
Cu	0,04	0,04
Zn	1,28	0,10
Vitamin C, mg	3,66	5,23
Antioxidants, mg / dm^3 in terms of quercetin	12,13	20,20
The content of lactic acid microorganisms CFU / cm^3		$1,1 \cdot 10^{10}$
Energy value, kCal / 100 g		30

Its high antioxidant activity is due to the presence of methionine, serine, cysteine and vitamin C.

Developed yogurt drink can be classified as functional in inulin, antioxidants, reducing sugars and fructose. The product is characterized by synbiotic properties, as it contains prebiotics (inulin, pectin) and probiotics (lactic acid microorganisms). This is confirmed by the results of analysis of prebiotic activity. The content of live lactic acid microorganisms in the developed product at the end of the shelf life is 1000 times higher than in yogurt drinks obtained by traditional technology.

The product is produced according to the scheme shown in Figure 6.

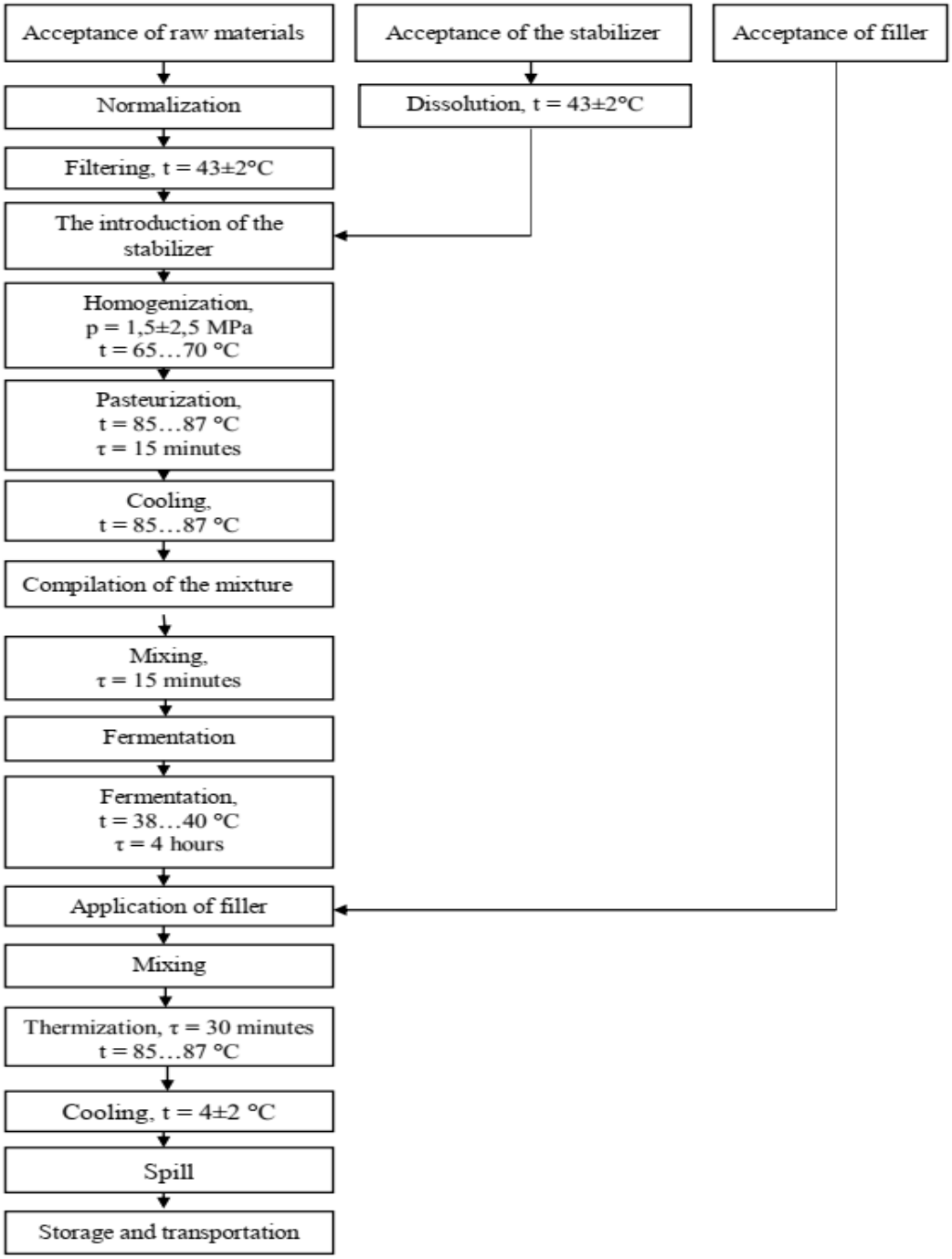

Figure 6. Technological scheme of production of yogurt drink with scorzonera extract

Improving production technology is the introduction of additional operations related to the preparation of basic prescription components and obtaining milk-vegetable extract scorzonera.

Implementation of this technological scheme will expand the range of fermented milk drinks, make maximum use of raw milk nutrients and obtain a multi-component

product of high nutritional value, containing physiologically functional ingredients: inulin, antioxidants, reducing sugar and fructose.

Thus, the developed recipe for thermized yogurt drink provides a complete replacement of sucrose and water with milk-vegetable extract scorzonera. The use of apple puree as a filler improves the organoleptic and rheological properties of the finished product.

In order to obtain a curd dessert with the best organoleptic characteristics and the maximum possible content of burdock root, burdock root puree was administered in an amount of 60% by weight of dessert.