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DEVELOPMENT OF TECHNOLOGY OF SEMI-FINISHED DESSERT PRODUCTS BASED ON DAIRY AND FRUIT-BERRY RAW MATERIALS USING THE PRINCIPLES OF COLLOID STABILIZATION OF MILK

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Abstract

There was realized the analysis of priority directions in the production technology of combined products, based on milk and fruit-berry raw materials. It was determined, that the common use of these components is rather limited from the point of view of providing colloid stability of the system without its stratification that is conditioned by the low pH values and influence of high temperatures at pasteurization of products. There was offered the method of milk stabilization at low pH values by decreasing the ionic calcium content to 40 % of its initial content. It was proved, that the process of milk decalcification by using sodium alginate allows to increase its acid tolerance and thermal tolerance that becomes a precondition for creating dessert semi-products, based on milk and fruit-berry raw materials. Using methods of the system analysis, there was elaborated the model of the technological system of dessert semi-products, which presents a final product as an integral technological system A, detailed to subsystems D_1,…D_n, B, C, according to the developed technological process. There was established an interconnection between separate subsystems and its elements, studied ways of its functioning at macro- (interaction with the external environment) and micro-levels (study of internal characteristics). There was realized the organoleptic evaluation of the quality of products by the descriptive (qualitative) method and by the method of profile analysis (quantitative one). At that the notion of each organoleptic parameter (consistence, taste, smell and so on) is presented as a totality of components (descriptors), evaluated in the determined order by quality and intensity. The characteristic of organoleptic parameters by scales of intensity of separate signs is presented as profile diagrams. There were determined ways of using semi-products in the composition of dessert products. There was developed the principal technological scheme of their production. There was proved the effectiveness of introducing new products in institutions of restaurant economy and food industry.

Keywords: colloid stability, decalcification, ionic calcium, milk raw material, fruit-berry raw material, model of technology, dessert products, consumption properties.

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1. Introduction

Activation of the competitive fight at the food market needs from producers of milk products to introduce new economically profitable and competitive technologies of food products. It is realized by optimization of the assortment of products according to consumers' requirements, introduction of innovative technologies, directed of improving the effective functioning of enterprise of this branch.

The priority directions in food production, based on milk raw materials include directionality to satisfying needs of the defined contingent of consumers in deficit nutrients. It is interesting in theoretical and practical aspects to create probiotic and prebiotic types of products for mass and health nutrition [1]. It is achieved at the expanse of using polycomponent leavens [2], lacto- and bifidobacteria [3, 4], food fibers [5] and so on.

The prospective direction is also development of the technology of combined milk dessert products with fruit-berry and vegetable raw materials. For today literary sources present data as to developed technologies of the following dessert products, based on milk raw materials: jelly-like milk desserts [6], mousses and soufflés, based on milk raw materials, produced using membrane technologies [7, 8], beverages, based on whey and vegetable components [9, 10].

The aforesaid data testify that technologies, which recipe composition provides using fruit-berry raw materials, milk raw material with the low value of active acidity is offered by scientists to be used. The last fact is substantiated, from one side, by properties of milk raw materials,

and, from the other one, results in fact that the potential of functional properties of casein proteins at low pH values is rather limited. Its increase is possible at the expanse of new technological solutions.

Unfortunately, there are only few scientific solutions, directed on increasing the resource potential of raw materials by regulating their technical properties, and creation of new products is realized in the other area: use of food additives, additional recipe components. Undoubtedly, such approaches allow to solve a certain circle of questions as to widening the assortment, decreasing the cost price and so on.

But such typical approach doesn't allow to consider milk as a raw material that has essential thermodynamic and chemical potentials. That is why it is urgent to form the new view on functional-technological properties of milk as a system. Under conditions of developing ways and approaches to milk stabilization at low pH values, it gives a possibility to develop technologies of dessert semi-products based on milk and fruit-berry raw materials with high indices of colloid stability at lowered pH values.

The aim of the work is to develop a technology of dessert semi-products based on milk and fruit-berry raw materials, based on principles of milk colloid stability at lowered pH values at high temperatures.

2. Materials and Methods

The subjects of the study were:

– skimmed milk, supplied by CSC "Zmiyvsky milk plant" (city Zmiyv, Ukraine);

– a complex-creator – sodium alginate (AlgNa) FD-157 (made by "Danisco», Denmark), allowed for using by the Central executive agency of health protection of Ukraine;

– skimmed milk with different calcium contents, achieved by sorbtion of ionic calcium by sodium alginate;

– dessert semi-products based on milk and fruit-berry raw materials.

At the technology modeling, we used methods of the system analysis that allow to present food products technologies as an integral technological system, to establish the interconnection between separate subsystems and its elements[11], to study ways of its functioning at macro- (interaction with the external environment) and micro-levels (study of internal characteristics).

The development of recipes and technology of dessert semi-products and desserts with their use was realized according to classic methods and algorithms [12, 13].

The organoleptic evaluation of the quality of products was realized by two methods - the descriptive (qualitative) method and by the method of profile analysis (quantitative one) [14]. No less than fifty experts, who used the method of sensor evaluation, took part in the study. The descriptive method was used at regulating organoleptic indices of quality in normative documents, the profile one – at developing new products. Its essence is that the complicated notion of one (or several) organoleptic parameter (consistence, taste, smell and so on) is presented as a totality of components (descriptors), evaluated by experts in the determined order by quality and intensity. The scales of intensity of separate signs were used for the evaluation. They were presented as profile diagrams.

3. Results

From the point of view of milk importance in food at studies realization, the author has the principal position, which essence is in fact that the use of milk as a technological medium for the technological transformation of food components must not change its food and biological value. And as substances-modifiers of functional-technological properties of the technological system "milk" there can be used substances that are in a phase, separate relative to milk, and can be easily excreted from it. At that being in a phase state with a certain intact level in milk, these substances are able to decreasing undesirable potentials of milk. As a result a possibility of directed technological management of milk appears. It allows to create technological situations, able to intensify its stabilization processes essentially.

It is known, that one of factors, able to decrease milk colloid stability is accumulation of ionic calcium. At that the exceed of its critical level results in disturbing balance of system stratification in two phases. The main stabilization principle of milk is in its decalcification to 40 % of the initial calcium content. This decalcification level is conditioned by the ratio between the obtained effect and process duration. The correspondent decalcification level increase needs by 40 % more

additional technological time. At that there is no essential effect of milk stabilization. The decalcification process is realized by using the complex-creator as sodium alginate that sorbs ionic calcium in milk as a result of the ion exchange.

There was experimentally proved, that decalcification of milk as a polydisperse system by lowering pH from 6,6 to pH 5,0–5,5 leads to the change of the balanced interconnection between phases and within them, especially to the disturbance of balance between the true soluble and colloid states of components of the salt system and, as a result, increase of the content of ionized calcium.

Binding Ca^{2+} by sodium alginate and their elimination from the skimmed milk mixture results in the increase of dispersity of casein micelles, so in thermostability increase of skimmed milk. The last fact is a precondition for creating dessert semi-products with milk raw materials (skimmed milk, cream butter, dry skimmed milk) and at the same time fruit-berry ones (concentrates of juices, puree) that can be subjected to the influence of high temperatures without losing colloid stability.

Realization of the offered principles allowed to develop the model of the technological system of dessert semi-products, based on milk with the regulated calcium content and fruit-berry raw materials (**Fig. 1**).

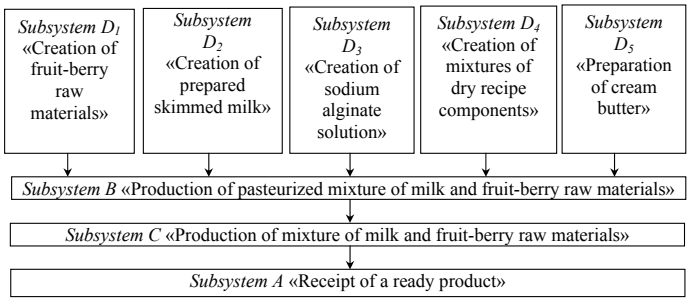

Fig. 1. The model of the technological system of dessert semi-products

The technology of dessert semi-products provides:

– Use of fruit-berry raw materials in amount, from one side, necessary for enriching dessert products with vitamins, mineral substances, non-assimilated polysaccharides, from the other one, necessary for providing the technological influence on the colloid state of skimmed milk;

– Regulation of composition and provision of balance of the salt system of the mixture of skimmed milk and fruit-berry raw materials for providing its thermal stability;

– Formation of new consumption and technological properties of semi-products, necessary for dessert products.

The analytic synthesis and study of functioning of separate subsystems were realized according to the following succession $(D_1, D_2, D_3, D_4, D_5) \rightarrow C \rightarrow B \rightarrow A$. Within subsystems D_1 "Creation of fruit-berry raw materials" and D_2 «Creation of skimmed prepared milk", there were determined and grounded technological operations for preparing main recipe components. For getting a semi-product, skimmed milk is cleaned from mechanical pollution and admixtures by filtration and dosed.

Technological operations, realized within the subsystem D_3 are directed on creating a semi-product "Sodium alginate solution". For this aim sodium alginate is dissolved in determined concentrations in demineralized drinking water at the temperature 18–20 °C till the homogenous consistence and left for $24 \cdot 60^2$ s for complete dissolution of hydrocolloid.

The important component of a new product is the taste components (white sugar, vanillin), stabilization system and dry skimmed milk that regulate structural-mechanical and organoleptic parameters of a ready product. The technological process within the subsystem D_4 provides sifting for eliminating side admixtures and deagglomeration of separate particles under conditions of using the mechanical equipment and intermixing for getting a mixture with evenly distributed dry recipe components.

The functioning of the subsystem D_5 «Preparation of cream butter" is conditioned by the necessity and expedience to form the assortment series of semi-products taking into account the fat content (milk and cream). At preparation, cream butter is cleaned and cut in pieces with the mass 0,2–0,5 kg for facilitating its further introduction in the recipe mixture.

The aim of the system C is to get the mixture of skimmed milk and concentrated juice. Under usual conditions at common pasteurization of milk and fruit-berry raw materials, coagulation of the protein component (casein fraction) takes place as a result of increased acidity and Ca^{2+} accumulation. As it was indicated earlier, calcium content regulation in milk by using the complex-creator – sodium alginate, able to bind calcium ions, creating calcium alginate gel, allows to realize common pasteurization. The experimental studies established the expedience of realizing the process at the temperature 2–6 °C in two stages, where each duration is (58–60)·60 s. During this time there takes place the decrease of Ca^{2+} content by 10,0–15,0 % in the mixture. Elimination of AlgCa granules from the mixture is realized by filtration, after which it can be used as granules in food production that provides economic efficiency of semi-products manufacturing.

The technological subsystem B provides the combination of the mixture of skimmed milk and concentrated juice, mixture of dry recipe components and cream butter with further heating at continuous intermixing for even distribution of previously prepared semi-products. along the whole volume of the recipe mixture Taking into account the presence of milk fat in semi-products, it is expedient to realize homogenization at the temperature 73–77 °C and pressure 12,5–15,0 MPa for providing high dispersity of fat ball, after which they are pasteurized (t = 73–77 °C, τ=(15–20)·60 s;). The mixture processing is realized in the continuous flow, without air access, that provides the high effectiveness of pasteurization, conservation of aromatic substances and also vitamins. The parameters of processes realization within the subsystem B are typical for dessert products manufacturing.

The functioning of the subsystem A is directed on getting a final product as dessert semi-products and provides preparation to realization and realization itself within the term no more than 48×60^2 s at the temperature 2–6 °C. For this aim dessert semi-products are cooled to the temperature 2–6 °C and packed in consumption packages for preventing microbiological processes development.

The use of skimmed milk and concentrated juice allows to create semi-products for the wide assortment of dessert products. The projects of the recipe mixture for semi-products must be realized to form not only organoleptic properties but taking into account their technological properties realization.

The study of organoleptic parameters was realized based on the elaborated scale of sensor evaluation of semi-products on the example of the semi-product "Milk-currant", which results are graphically presented as profiles of the look and consistence, taste, smell and color (**Fig. 2**). At the same time the descriptor presents the importance of each parameter within a concrete characteristic as the occupied area.

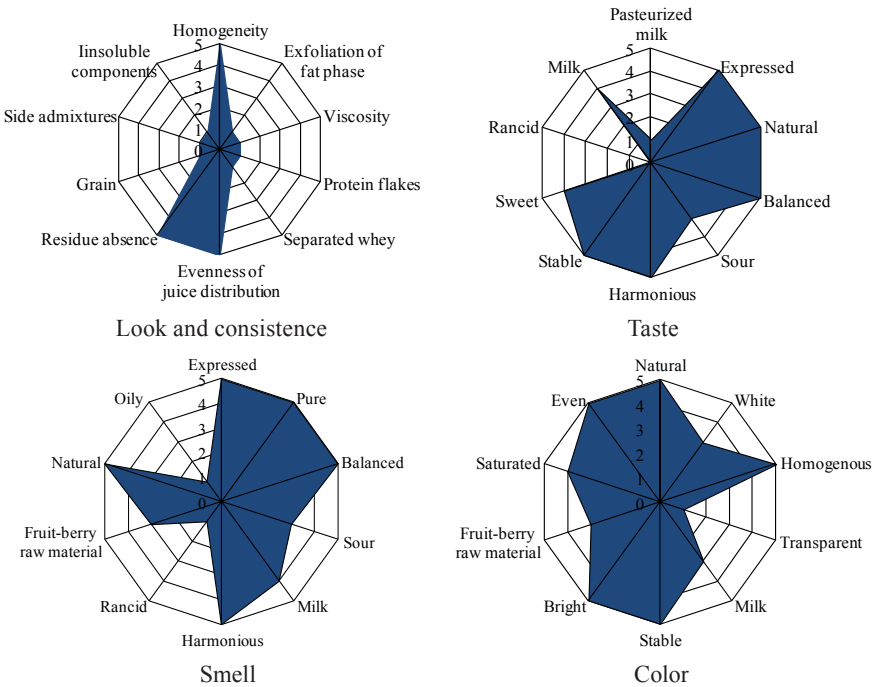

Fig. 2. Profilograms of organoleptic evaluation of "Milk-currant" semi-product

At the studies it was established, that the most important factors in formation of organoleptic parameters are:

– for the look and consistence – absence of residues and grains, presence of protein flakes and exfoliation of fat phase (the high point mark by these parameters indicates colloid stability of milk raw material at fruit-berry components during the thermal processing and provides homogeneity of the texture of semi-products);

– for the taste – balance and expressiveness of the milk taste, combined with the taste of fruit-berry raw materials, absence of the rancid taste and one of pasteurized milk;

– for the smell – balance, pureness and expressiveness that provides the harmonious perception of taste-aromatic properties of the semi-product;

– for the color –evenness, homogeneity and stability of color under the influence of thermal processing that is important in the aspect of the esthetic perception of the final product.

Based on the realized studies, there were formulated organoleptic parameters of semi-products, presented in **table 1.**

Table 1

Organoleptic parameters of "Milk-currant" dessert semi-product

Name of parameter	Characteristic
Look	**Homogenous dense liquid**
Consistence	Viscous, without grains of insoluble components, without exfoliation of a fat phase, protein flakes and separated whey, residue and side admixtures with even distribution of concentrated currant juice
Color	Natural, harmonious, saturated, from light-violet to violet, homogenous and even by the whole volume
Smell and taste	Balanced, natural, stable, expressed, pure, milk, sour-sweet, with expressed currant taste and smell, without side taste and smell

Based on the analytic studies, there were prognosticated ways of using dessert semi-products in restaurant institutions. The scheme, presented on **Fig. 3** shows that dessert semi-products can be used in compositions of soft ice-cream, mousses, cocktails and so on. At that the correction of recipe compositions can be realized by replacing some recipe components, included to dessert products. The use of semi-products allows to facilitate the technological process of semi-products manufacturing at the expanse of absence of technological operations for regulating the content of skimmed milk salt system, creation of the recipe mixture, its homogenization, pasteurization, cooling and so on.

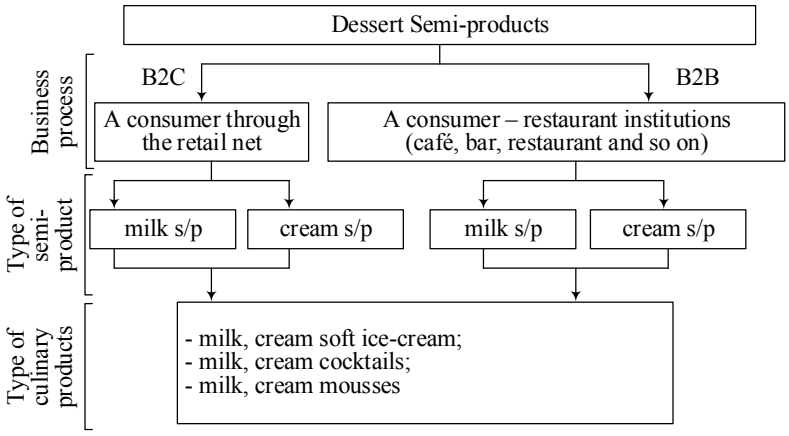

Fig. 3. Ways of using dessert semi-products

The assortment of culinary products with using dessert semi-products is following:
– cocktails (milk and cream with different types of the fruit-berry component);
– ice-cream (milk and cream with different types of the fruit-berry component);
– mousses (milk and cream with different types of the fruit-berry component).

At technological studies, there was elaborated the recipe composition and technologies of dessert products, based on semi-products, which principal production scheme is presented on **Fig. 4**. It provides the technological operations depending on dessert products' type – milling, beating, cooling, preparation to realization, where additional recipe components are used, realization.

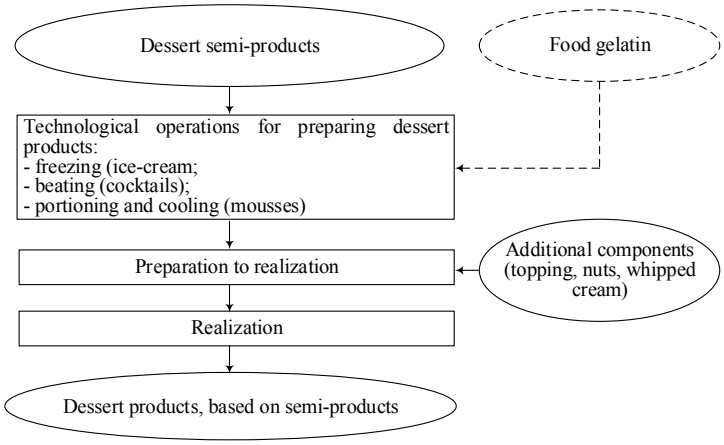

Fig. 4. The principal technological scheme of dessert products, based on semi-products

Thus, it must be taken into account that realization of the offered principles of milk raw material stabilization by its decalcification by sodium alginate allows to get semi-products, based on milk and fruit-berry raw materials, at lowered pH values, preserving colloid stability of the system.

The use of developed semi-products at culinary production at restaurant institutions allows to widen the assortment, to offer high-quality products with new consumption properties, to raise effectiveness of restaurant institutions' functioning at the expanse of using semi-products with the high readiness degree.

4. Conclusions

There was proved the research conception, that the change of qualitative and quantitative composition of the skimmed milk salt system by calcium transformation in the insoluble state (decalcification) provides the increase of its colloid stability, thermo- and acid tolerance. The obtained effect was realized in the technology of semi-products for dessert products, based on milk and fruit-berry raw materials. Within the developed technologies, there was proved a possibility of the synchronous use of milk raw materials and fruit stuff that essentially decrease pH of the system at increased temperatures without stratification of systems and with saving their colloid stability. There was elaborated the assortment series of semi-products for dessert products, their organoleptic parameters were determined. It was proved, that introduction of developed semi-products in technological processes of restaurant economy allows to increase effectiveness of their functioning, to widen the assortment series of ready products.

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