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TECHNOLOGY OF SOUR MILK DESSERTS BASED ON BUTTERMLK

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ТЕХНОЛОГІЯ КИСЛОМОЛОЧНИХ ДЕСЕРТІВ НА ОСНОВІ СКОЛОТИН

Objective. *Development of the technology of whipped sour-milk desserts based on buttermilk and determination of their quality.*

Methods. *Standard, generally accepted and special research methods were used in the work, which ensured the fulfillment of the assigned tasks. Sampling and preparation for research was carried out according to DSTU ISO 6498:2006. The mass fraction of dry substances was determined by the refractometric method. The mass fraction of protein was determined by the Kjeldahl method. Determination of the mass fraction of fat was carried out by the Soxhlet extraction-weighing method in Rushkovsky's modification. The mass fraction of carbohydrates was determined by the Bertrand-Bierri centrifuge method. Determination of the mass fraction of mineral substances was carried out by the X-ray fluorescence method using the Spectroscan spectrometer.*

Results. *The expediency of using secondary dairy raw materials, in particular scotch, in the technology of whipped sour-milk desserts is substantiated. The technological scheme of their production was developed. In the developed technology, a milk-protein concentrate of buttermilk is used as a sour milk base, liquid base is buttermilk, and the structure-forming component is xampane biopolymer. The nutritional value of whipped sour-milk desserts based on buttermilk was studied. It has been proven that the developed desserts are not inferior in terms of organoleptic indicators and nutritional value to desserts made according to traditional technology on the basis of low-fat sour milk cheese. The proposed technology will make it possible to make the most complete use of the nutritional potential of milk and expand the range of low-calorie sour-milk desserts with improved quality characteristics.*

Keywords: *secondary dairy raw materials, buttermilk, milk-protein concentrate, sour-milk desserts, organoleptic indicators, nutritional value.*

Formulation of the problem. In modern conditions, the development of any branch of the food industry is inextricably linked to the implementation of the concept of greening - the rational use of natural resources based on the principles of low- and zero-waste technologies.

With the traditional technology of industrial processing of milk into butter, cheeses and caseinates, by-products are obtained: skimmed milk, buttermilk, milk whey, which are classified as secondary resources of the dairy industry with the general name - protein-carbohydrate dairy raw materials. 50...73% of dry matter goes to it - almost the entire protein, carbohydrate and mineral complex of whole milk [1, 2].

The total resources of secondary dairy raw materials (SDRM) in Ukraine make up 70% of the volume of processed milk and reach 2.9...3.2 million tons every year. The significant volume and high nutritional value of the SDRM determine the need for its full collection and rational use in the production of food products.

Therefore, taking into account today the limitations of natural food resources, the need for rational use of the biopotential of domestic secondary dairy raw materials (buttermilk, skimmed milk, whey), the problem of finding directions for its inclusion in the diet and its use in food production technologies becomes dominant.

Analysis of recent research and publications. The research of many domestic and foreign scientists is dedicated to the creation of scientific and practical principles for the use of secondary dairy raw materials in food technology: Hnitsevich V. A., Grinchenko O. A., Deinichenko G. V., Zolotukhina I. V., Polishchuk G. E., Romanchuk I. O., Solomon A. M., Tkachenko N. A., Trubnikova A. A., Chagarovsky O. P., Yudina T. I., Misselwitz B. and others [3-13].

Despite the large number of scientific studies, work in this direction is constantly continued and, on the one hand, lies in the area of the use of food additives and their mixtures, and, on the other hand, involves the involvement of new raw materials in the technological cycle, which are a natural source of essential substances and has a wide range of technological properties. Therefore, it is of scientific and practical interest to develop innovative technologies for food products, in particular sour-milk desserts based on secondary dairy raw materials.

Desserts play an important role in supplying the human body with the necessary nutrients, contribute to the feeling of satiety, but due to the increased content of fats and carbohydrates, they belong to the group of high-calorie dishes.

A large group of dairy sweet dishes are desserts that contain fermented milk products as a milk base: sour milk cheese, sour cream, yoghurt, acidophilic milk, koumiss, etc. This group of sweet dishes in a composition with different fillers makes up a wide variety of desserts.

One of the types of secondary dairy raw materials, which is formed at the stage of curdling or separation of cream during the production of butter, is buttermilk. The nutritional potential of buttermilk and its functional properties meet all the requirements for raw materials for protein structured dairy products. When this type of secondary dairy raw material is obtained, 80-90% of milk proteins, 0.4-0.7% of milk fat, a significant part of minerals and water-soluble vitamins go into its composition [1, 5]. It should be noted that the mineral substances in the flakes are in well-balanced proportions for the average adult consumer and in an easily digestible form.

The biological value of buttermilk is due to the presence in them of a biologically active complex of antisclerotic substances – lecithin. Buttermilk meet the requirements of lipotropicity, having a high biological value with a low energy value of the product and are recommended for wide implementation in the practice of nutrition of the population leading an active lifestyle, as well as people in a state of hypokinesia.

The functional properties of buttermilk proteins are the ability to emulsify milk fat, stabilize fat emulsion, increase the water-binding and water-absorbing capabilities of food systems, which contributes to the production of stable fine-porous foams [1, 5]. Buttermilk is a great reserve for the production of structured (whipped) low-fat sour-milk desserts.

The objective of the article. The objective of this article is the development of the technology of whipped sour-milk desserts based on buttermilk and determination of their quality.

Presentation of the main research material. According to traditional technology, low-fat sour-milk desserts are a multi-component mixture, whipped by aeration, consisting of the following components: skimmed milk base, fruit and berry filler, sweetener, emulsifier, foaming agent, structure

stabilizer, flavouring and aromatic substances, food dyes. The listed components are used in various combinations and ratios.

Milk-protein concentrate (MPC) of buttermilk obtained by thermo-acid coagulation [1, 5, 6] is used as the sour-milk base of the whipped dessert based on buttermilk. This product is a new non-traditional type of raw material, which according to organoleptic indicators resembles low-fat fermented milk cheese, but has increased nutritional value. Thus, milk-protein concentrate from buttermilk contains 15...20% more proteins than sour-milk cheese, which is due to the increased content of valuable whey proteins. Milk fat content containing biologically valuable fat acids: linoleic, linolenic, arachidonic, exceeds almost 2 times their content in low-fat sour milk cheese. The homogeneous consistency of MPC made of buttermilk makes it possible to use it as a basis for structured products.

The liquid base is made from buttermilk obtained by churning cream on non-stop butter makers. As a structure-forming component, the biopolymer xampan is used, which is a domestic analogue of the well-known structure-former – xanthan. The choice of this hydrocolloid is determined by its foam-forming and foam-stabilizing properties in wide temperature ranges.

Flavour and aroma fillers, which are usually added to whipped milk desserts, give them a specific taste and aroma, stimulants act on the nervous and digestive systems, contribute to their better assimilation. In addition, their use allows you to significantly expand the range of dairy desserts. The following are used as recipe components of flavouring and aromatic substances: cocoa powder and strawberry puree. Granulated sugar is used as the main sweetener.

On the basis of a series of preliminary experiments and taking into account the experience of domestic and foreign researchers, a technological scheme for the production of sour-milk dessert based on buttermilk was developed (fig. 1). According to this scheme, the preparation of recipe components includes the reception and grinding of the main types of raw materials, cleaning from mechanical impurities (sugar sieving).

According to its physical properties, xampan is a substance that dissolves in water at room temperature, but the process of dissolving the stabilizer in the buttermilk is complicated by the presence of additional substances (milk fat, proteins, carbohydrates, etc.). Therefore, the optimal temperature regime was determined, which affects the aggregate state of milk fats and proteins, reducing the viscosity of the low-fat milk system with an increase in the thermal movement of molecules, which, in turn, has a positive effect on the process of dissolving xampan in the buttermilk. It was established that the dissolution of polysaccharide in the buttermilk when the temperature of the liquid phase is increased to 35...40ºC shortens the dissolution time to (80...90)·60 s.

On the basis of previously conducted experiments on model dairy systems [5-8], rational concentrations of xampan in the buttermilk were determined to obtain a foam-like structure with a maximum shelf life. The results of these studies showed that the optimal concentration of the xampan structuring agent in the buttermilk is 0.7%. This concentration allows you to get a lush, thin foam with a measurable "lifetime", which breaks down slightly during storage.

Pasteurization of the mixture of buttermilk and xampan is necessary to give them the necessary organoleptic and medical-biological properties. As a result of experimental studies, it was found that pasteurization at a temperature of 84...86 ºC for a duration of (3...5)·60 s kills pathogenic microorganisms and gives the chips good organoleptic properties.

Cooling to a temperature of 2...4ºC, which allows to mix buttermilk with other recipe components, further cooling of the product allows to inhibit the possible development of pathogenic microorganisms.

To obtain a foam structure, the most widespread method of mechanical mixing of the mixture is used. The mechanism of foam formation according to this method assumes that upon entering the dispersed medium, the blade of the whisk leaves an air trail in the surface layer, the mouth of this air chamber closes and a certain amount of air is drawn into the product. That way a certain cycle occurs and the air is dispersed in the product, acquiring the required consistency.

Portioning and selling to consumers is the last stage of the technological process of the production of whipped sour-milk dessert based on buttermilk.

The organoleptic indicators of whipped sour-milk desserts based on crumbs are given in Table 2.

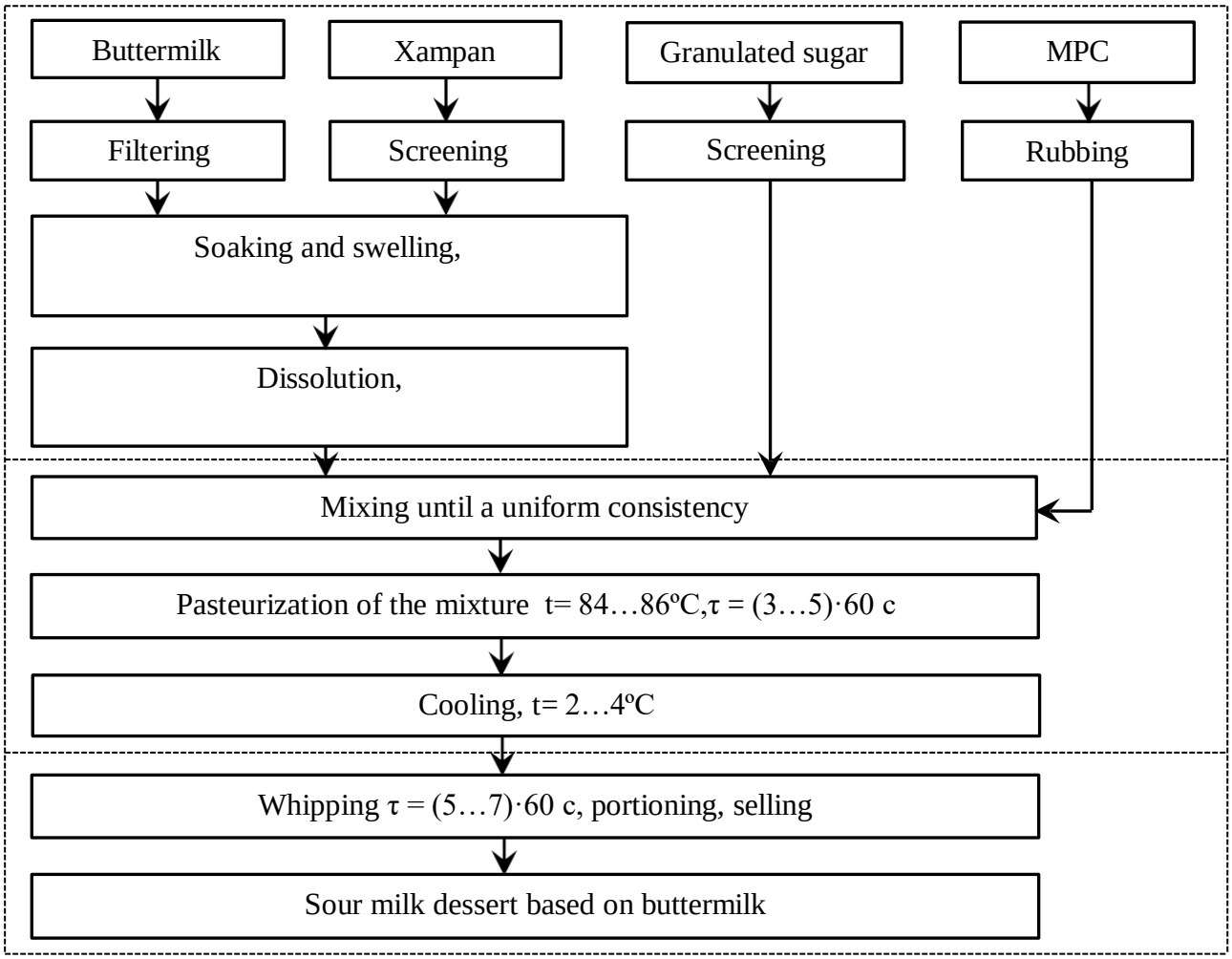

Figure 1 – Technological diagram of the production of a whipped sour-milk dessert based on buttermilk

Table 1 – Organoleptic indicators of whipped sour-milk desserts based on buttermilk

Name of indicators	Characteristics of indicators
Appearance	A foamy, delicate mass with a glossy surface without coarse inclusions, without delamination of the structure and visible release of liquid
Consistency	Soft, foamy, creamy
Taste	Sweet, characteristic of dairy products, with a taste of flavour filler
Smell	Pleasant, characteristic of dairy products, without extraneous odors
Colour	Homogeneous, characteristic of the colour of the filler

Table 2 presents the estimated chemical composition [14, 15] of the new products, which shows that the structured dessert products developed on the basis of buttermilk mainly exceed the control of the content of proteins, minerals and vitamins. This corresponds to the previously formulated task of developing products with a low caloric content along with an increased content of biologically active substances.

The developed technology makes it possible to obtain whipped sour-milk desserts, the organoleptic indicators and nutritional value of which are not inferior to desserts made according to traditional technology on the basis of low-fat sour-milk cheese. Desserts based on buttermilk are recommended to be used in dietary and medical and preventive nutrition.

Table 2 – Nutritional value of whipped sour-milk desserts based on buttermilk (n=5, P≤0,05)

Indicator	Sour milk dessert based on buttermilk	Cheese dessert (control)
Proteins, g	16.9	14.7
Fats, g	1.1	1.78
Carbohydrates, g	28.9	32.7
Mineral substances, mg		
Calcium	167.8	147.4
Magnesium	48.3	24.6
Phosphorus	240.7	165.7
Ferum	0.38	0.72
Vitamins, mg		
A (retinol)	0.2	0.02
B_1 (thiamine)	0.1	0.06
B_2 (riboflavin)	0.2	0.22
PP (niacin)	0.7	0.4

Conclusions. Thus, as a result of the conducted research, the recipe components and parameters of the technological process of the production of whipped sour-milk desserts based on buttermilk were determined and substantiated. The new technology will make it possible to make the most complete use of the nutritional potential of milk and expand the range of low-calorie sour-milk desserts with improved quality characteristics.

References

1. Yudina, T. I. (2016). *Naukove obgruntuvannya tekhnolohiy strukturovanoyi kulinarnoyi produktsiyi z vykorystannyam kontsentratu skolotyn: dys. ... dokt. tekhn. nauk* [Scientific substantiation of technologies of structured culinary products with the use of buttermilk concentrate: dissertation], Kyiv, 405 p.

2. Moshkovs′ka, O. A. (2019). *Analysis of the current state of the dairy complex of Ukraine, the problems of its development and ways to solve them* [Analiz suchasnoho stanu molokoproduktovoho kompleksu Ukrayiny, problemy yoho rozvytku ta shlyakhiv yikh vyrishennya], Ahrosvit [*Agrosvit*], no. 18, pp. 16–23.

3. Gnitsevich, V., Yudina, T., Gonchar, Y. (2018). *Tekhnolohiya napivfabrykatu na osnovi nyz'kolaktoznoyi molochnoyi syrovatky ta m"yakoti harbuza* [Semi-finished product technology based on low-lactose whey and pumpkin pulp], *Tovary i rynky* [Goods and markets], no. 4, pp. 105-114.

4. Grynchenko, N. G., Pyvovarov, P. P., Grynchenko, O. O., Tyutyukova, D. O., Plotnikova, R. V. (2018). *Vplyv tekhnolohichnykh chynnykiv na strukturno-mekhanichni ta tekhnolohichni vlastyvosti napivfabrykativ iz syru kyslomolochnoho* [The influence of technological factors on the structural, mechanical and technological properties of semi-finished products from sour milk cheese], *Tekhnichni nauky ta tekhnolohii* [Technical sciences and technologies], 2 (12), pp. 204-215.

5. Dejnychenko, H. ets. (2019). *Innovatsijni tekhnolohii kharchovoi produktsii* [Innovative technologies of food products]: monograph. Kharkiv: Fakt, 248 p.

6. Zolotukhina, I. V. (2021). *Naukove obgruntuvannya tekhnolohiy napivfabrykativ na osnovi tsil'ovoho vykorystannya nutriyentiv bilkovo-vuhlevodnoyi molochnoyi syrovyny: dys. ... dokt. tekhn. nauk* [Scientific substantiation of technologies of semi-finished products on the basis of target use of nutrients of protein-carbohydrate dairy raw materials: dissertation], Kharkiv, 400 p.

7. Romanchuk, I. O. Minorova, A. V. Rudakova, T. V. Moiseyeva, L. O. (2020). *Zakonomirnosti fermentatyvnoho hidrolizu laktozy v molochniy syrovyni* [Regularities of enzymatic hydrolysis of lactose in raw milk], *Prodovol'chi resursy* [Food resources], no.14. pp. 165-174.

8. Grek, O. V., Polishchuk, G. E., Onopriychuk, O. O. (2011). *Tekhnolohiya produktiv zi znezhyrenoho moloka, molochnoyi syrovatky i maslyanky* [Technology of products from skim milk, whey and buttermilk], Kyiv, 258 p.

9. Solomon A., Bondar M., Dyakonova A. (2019). Substantiation of technology of fermented sour-milk desserts with bifidogenic properties, *Eastern European Journal of Enterprise technologies. Technology and equipment of food production,* 1/11 (97), pp. 6-16.

10. Didukh, N. A., Romanchenko, S. V. (2012). *Naukovi osnovy vyrobnytstva napoyu kyslomolochnoho dlya dytyachoho kharchuvannya z podovzhenym terminom zberihannya* [Scientific bases of production of sour-milk drink for children's food with extended term of storage], *Naukovi pratsi Odes'koyi natsional'noyi akademiyi kharchovykh tekhnolohiy* [Scientific works of Odessa national academy of food technologies], 42 (2), pp. 251-259.

11. Trubnikova, A. A. (2019). *Rozroblennya tekhnolohiyi bezlaktoznoho kontsentratu maslyanky iz zadamy skladom nutriyentiv: dys. ... kand. tekhn. nauk* [Development of technology of lactose-free buttermilk concentrate with nutrients in nutrients: dissertation], Odessa, 253 p.

12. Chaharovs′kyy, O. P., Pohosyan, A. S. (2006). *Hidroliz laktozy preparatamy b-halaktozydazy – novyy napryamok pidvyshchennya efektyvnosti vyrobnytstva morozyva i zamorozhenykh desertiv* [Hydrolysis of lactose by β-galactosidase preparations – a new direction of increasing the efficiency of production of ice cream and frozen desserts], *Svit morozyva ta kholodu* [World of ice cream and cold], 5 (17), pp. 36-39.

13. Misselwitz, B., Pohl, D., Frühauf, H., Fried, M., Vavricka, S. R., Fox, M. (2013). Lactose malabsorption and intolerance: pathogenesis, diagnosis and treatment. *United European gastroenterology journal*, 1 (3), pp. 151–159.

14. *Khimichnyy sklad i fizychni kharakterystyky molochnyk hproduktiv. Dovidnyk* [Chemical composition and physical characteristics of dairy products. Handbook] (2012) / Skarboviychuk, O. M., Kochubey-Lytvynenko, O. V., Chernyushok, O. A., Fedorov, V. H. Kyiv, 311 p.

15. *Zbirnyk retseptur natsionalnykh strav ta kulinarnykh vyrobiv: dlia pidpryiemstv hromad. kharchuvannia vsikh form vlasnosti* [A collection of recipes for national dishes and culinary products: for community enterprises. nutrition of all forms of ownership] (2007) / O. V. Shalimov, T. P. Dyatchenko, L. O. Kravchenko et al. K.: A.S.K., 2007. 848 p.

Список літератури

1. Юдіна Т. І. Наукове обґрунтування технологій структурованої кулінарної продукції з використанням концентрату сколотин: дис. … докт. техн. наук: 05.18.16 / Київський національний торговельно-економічний університет. Київ, 2016. 405 с.

2. Мошковська О. А. Аналіз сучасного стану молокопродуктового комплексу України, проблеми його розвитку та шляхів їх вирішення. *Агросвіт*. 2019. №18. С. 16-23.

3. Гніцевич В. Технологія напівфабрикату на основі низьколактозної молочної сироватки та м’якоті гарбуза / В. Гніцевич, Т. Юдіна, Ю. Гонча. *Товари і ринки*. 2018. №4. С. 105–114.

4. Гринченко Н. Г., Пивоваров П. П., Гринченко О. О., Тютюкова Д. О., Плотнікова, Р. В. Вплив технологічних чинників на структурно-механічні та технологічні властивості напівфабрикатів із сиру кисломолочного. *Технічні науки та технології*. 2018. 2(12). С. 204-215.

5. Інноваційні технології харчової продукції: колективна монографія / за заг. ред. Г. В. Дейниченка. Харків: Факт, 2019. 248 с.

6. Золотухіна І. В. Наукове обґрунтування технологій напівфабрикатів на основі цільового використання нутрієнтів білково-вуглеводної молочної сировини: дис. … докт. техн. наук: 05.18.16 / Харківський державний університет харчування та торгівлі. Харків, 2021. 400 с.

7. Романчук І. О. Мінорова А. В. Рудакова Т. В. Моісеєва Л. О. Закономірності ферментативного гідролізу лактози в молочній сировині. *Продовольчі ресурси*. 2020. № 14. С. 165-174.

8. Грек О. В., Поліщук Г. Є., Онопрійчук О. О. Технологія продуктів зі знежиреного молока, молочної сироватки і маслянки: навч. посіб. Київ: НУХТ, 2011. 258 с.

9. Solomon A., Bondar M., Dyakonova A. Substantiation of technology of fermented sour-milk desserts with bifidogenic properties. *Eastern European Journal of Enterprise technologies. Technology and equipment of food production.* 2019. №1/11 (97). С. 6-16.

10. Дідух Н. А., Романченко С. В. Наукові основи виробництва напою кисломолочного для дитячого харчування з подовженим терміном зберігання. *Наукові праці Одеської національної академії харчових технологій.* 2012. №. 42(2). С. 251-259.

11. Трубнікова А. А. Розроблення технології безлактозного концентрату маслянки із задами складом нутрієнтів: дис. … канд. техн. наук: 05.18.04 / Одеська національна академія харчових технологій. Одеса, 2019. 253 с.

12. Чагаровський О. П., Погосян А. С. Гідроліз лактози препаратами β-галактозидази – новий напрямок підвищення ефективності виробництва морозива і заморожених десертів. *Світ морозива та холоду*. 2006. №5 (17). С. 36-39.

13. Misselwitz B., Pohl D., Frühauf H., Fried M., Vavricka S. R., Fox M. Lactose malabsorption and intolerance: pathogenesis, diagnosis and treatment. *United European gastroenterology journal.* 2013. Т. 1. № 3. P. 151–159.

14. Хімічний склад і фізичні характеристики молочних продуктів: довідник / О. М. Скарбовійчук, О. В. Кочубей-Литвиненко, О. А. Чернюшок, В. Г. Федоров. Київ: НУХТ, 2012. 311 с.

15. Збірник рецептур національних страв та кулінарних виробів: для підприємств громад. харчування всіх форм власності / О. В. Шалімов, Т. П. Дятченко, Л. О. Кравченко та ін. К.: А.С.К., 2007. 848 с.

Мета. *Розроблення технології збитих кисломолочних десертів на основі сколотин та визначення їх якості.*

Методи. *У роботі використано стандартні загальноприйняті та спеціальні методи досліджень, які забезпечили виконання поставлених завдань. Відбір проб і підготовку їх до дослідження здійснювали за ДСТУ ISO 6498:2006. Масову частку сухих речовин визначали рефрактометричним методом. Масову частку білку визначали методом К'єльдаля. Визначення масової частки жиру проводили екстракційно-ваговим методом Сокслета в модифікації Рушковського. Масову частку вуглеводів визначали центрифужним метод Бертрана-Б'єррі. Визначення масової частки мінеральних речовин проводили рентгенофлуоресцентним методом за допомогою спектрометра «Спектроскан».*

Результати. *Обґрунтовано доцільність використання вторинної молочної сировини, зокрема сколотин, у технології збитих кисломолочних десертів. Розроблено технологічну схему їх виробництва. У розробленій технології в якості кисломолочної основи використано молочно-білковий концентрат сколотин, рідинної основи – сколотини, структуроутворюючого компонента – біополімер ксампан. Досліджено харчову цінність збитих кисломолочних десертів на основі сколотин. Доведено, що розроблені десерти за органолептичними показниками та харчовою цінністю не поступаються десертам, що виготовлені за традиційною технологією на основі знежиреного кисломолочного сиру. Запропонована технологія дозволить найбільш повно використовувати харчовий потенціал молока та розширити асортимент низькокалорійних кисломолочних десертів з покращеними якісними характеристиками.*

Ключові слова: *вторинна молочна сировина, сколотини, молочно-білковий концентрат, кисломолочні десерти, органолептичні показники, харчова цінність.*