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PRODUCTION OF FERMENTED MILK FROM RECONSTITUTED SKIMMED MILK

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Fermented milk products produce with application of different lactic acid bacteria, these products are widely used by millions in the world. The consumption of milk products has decreased during last years; this tendency has caused the development of new generation dairy products with reduced energy value and increased functionality. The majority of fermented milk products has high-energy value as many ingredients (sugar, fruit additives, grains, seed sand nuts, chocolate, etc.) are added during production. The study results revealed that higher milk solids non-fat positively contributed to strengthening the organoleptic and structural properties of fermented milk. Skimmed milk powder should be a suitable alternative to raw skimmed milk in reconstituted dairy products production.

Key words: dairy products, fermented milk, reconstituted, skimmed milk.

ПРОИЗВОДСТВО КИСЛОМОЛОЧНЫХ ПРОДУКТОВ ИЗ ВОССТАНОВЛЕННОГО ОБЕЗЖИРЕННОГО МОЛОКА

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Кисломолочные продукты производят с применением различных молочнокислых бактерий, эти продукты широко используются миллионами людей во всем мире. В последние годы потребление молочных продуктов снизилось, что привело к появлению молочных продуктов нового поколения с пониженной энергетической ценностью и повышенной функциональностью. Большинство кисломолочных продуктов имеет высокую энергетическую ценность, как и многие ингредиенты (сахар, фруктовые добавки, зерновые, семена орехов, шоколад и др.).) добавляются в процессе производства. Результаты исследования показали, что более высокое содержание сухих нежирных веществ в молоке положительно влияет на усиление органолептических и структурных свойств кисломолочных продуктов. Сухое обезжиренное молоко должно быть подходящей альтернативой сырому обезжиренному молоку при производстве восстановленных молочных продуктов.

Ключевые слова: молочные продукты, кисломолочные продукты, восстановленное молоко, обезжиренное молоко.

ҚАЛПЫНА КЕЛТІРІЛГЕН МАЙСЫЗДАНДЫРЫЛҒАН СҮТТЕН СҮТ ҚЫШҚЫЛДЫ ӨНІМДЕРДІ ӨНДІРУ

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Сүт қышықылды өнімдер түрлі сүт қышқылды бактерияларды қолдану арқылы өндіріледі, бұл өнімдерді бүкіл әлемде миллиондаған адамдар кеңінен тұтынады. Соңғы жылдары

сүт өнімдерін тұтыну төмендеді, бұл энергетикалық құндылығы төмен және қызметі жоғары жаңа буын сүт өнімдерінің пайда болуына әкелді. Сүт қышқылды өнімдердің көпшілігіне көптеген энергетикалық құндылығы жоғары ингредиенттер (қант, жемісқоспалары, дәнді дақылдар, жаңғақ, шоколад және т.б.).) өндіріс процесінде қосылады. Зерттеу нәтижелері сүттегі құрғақ майсыз заттардың жоғары құрамы сүт қышқылды өнімдердің органолептикалық және құрылымдық қасиеттерінің жақсаруына оң әсер ететінін көрсетті. Құрғақ майсыздандырылған сүт қалпына келтірілген сүт өнімдерін өндіру кезінде шикі майсыздандырылған сүтке қолайлы балама болуы тиіс.

Негізгі сөздер: сүт өнімдері, сүт қышқылды өнімдер, қалпына келтірілген сүт, майсыз сүт.

Introduction

Dairy products are essential foods in human diet. They are protein and fatsource in nutrition, providing 20 percent ofthe protein and over 30 percent of the fatsdaily [1].

In recent years, there has been an overall growth in demand for healthy food products. Consumers prefer products whose main characterristics are not only appropriate appearance and pleasant taste, but also functionality and high nutritional value [3].

They represent a great source of bioactive compounds, as well viable lactic acid bacteria compete with undesirable microorganisms and metabolites that contribute to consumer healthand well-being [5].Products have pleasant, slightly fresh, acidic taste, they stimulate appetite and improve the microbiota of the organism, as well as products enhance digestion and appetite, they have antitumor activity and LDL cholesterol reduction potential, etc.

Recently the volume of milk products produced using skimmed milk powder (SMP) is increased [4] .It is caused by seasonal variation of milk production or lack of raw milk in some world regions. The fortification of milk products produced from skimmed milk powder andstarter cultures allowsexpandingthe variety of functional products and strengthening the immunity of organism, and reduce the risk of environmentally harmful factors.Application of skimmed milk powder in fermented milk products production helps to regulate such sensory attributes as texture and viscosity [6]. The aim of the present study was to develop the technology of fermented milk using skimmed milk powder, lactic acid bacteria culture and plant oils.

Objects and methods of research

This study investigated the structural characteristics of fermented milk samples with various milk solids non-fat and plan oils.

Characteristics of materials

Skimmed milk powder (Kirgizstan) with the following indices in 100 g of product: proteins 33.2 g, fats 1 g, carbohydrates 52.6 g, energy value 362 kcal was used for the study.

Yoghurt starter culture (Каприна, Russia) with following composition *Streptococcus thermophillus* and *Lactobacillus delbrueckii subsp. Bulgaricus* was used for the experiments.

Fat improves the sensory perception offermented dairy products, therefor plant oils (olive, palm, wheat sprouts and walnuts) were used for fermented milk production in such concentrations 6.2 mg g^{-1} (olive), 2.9 mg g^{-1} (palm), 6.1 mg g^{-1} (wheat sprouts), 3.7 mg g^{-1} (walnuts).

Fermented milk preparation

Reconstituted skimmed milk was prepared with different milk solids non-fat concentration – 9, 12, 15% (w/w) at 45$\pm$5°C 15 min. After complete solubility of skimmed milk powder, plant oils were added in quantity of 1.5 to 2.5% (w/w). Samples were pasteurized at 94°C for 6 min, cooled to 45°C and inoculated with liquid starter (5%, v/v). Samples were fermented at 45°C at least 7 hours until reached 80-85°Th acidity, followed by gently mixing and coolingup to 20°C.

Methods of analysis

Milk solids non-fatconcentration was measured in reconstituted skimmed milk samples, as well as fermented milk samples were tested, analysing dynamic viscosity, whey separation, water-holding capacity (WHC) andorganoleptic properties.

Titratable acidity was determined by titration of sample with 0.1 M NOH at the presence of 1% (w/v) phenolphthalein till stable slightly pink colour (Walstra, Wouters, Geurts, 2006). Acidity was expressed in Therner degree.

Dynamic viscosity was analysed using capillary viscosimeter VPZh (Russia).

Milk solids non-fatwas evaluated at 20°C using refractometer.

Water-holding capacity was measured using centrifugation.Fermented milk samples (10

g) were centrifuged (Laboratory centrifuge for the dairy industry_Laboratory centrifuge for the dairy industry LCDI 12) for 30 min at 4500 rpm at 35°C. Precipitated whey (PW) was removed and weighed. The WHC was calculated as:

WHC (%) = 100 (S-PW)/S, where:

PW – precipitated whey, g;

S – sample weight, g (Akilin et al., 2021).

Organoleptic evaluation of samples of fermented milk products was carried out at the Department of Technology of food and animal products.

Data analysis

Data analyses were performed in two replications and results are showed as an average of two measurements.

Results and their discussion

The chemical composition, mainly total solids non-fat, protein, fat content and coagulum acidity affect textural properties of fermented milk products [8]. Nevertheless, skimmed milk powder can be a suitable alternative to raw skimmed milk, especially in countries with reduced milk production capacity. Organoleptic properties of developed fermented milk are presented in Table 1.

Table 1 - Organoleptic properties of developed fermented milk

Indices	Characteristics
Appearance	Firm without whey separation
Aroma and taste	Slightly acid taste and mild lactic acid aroma
Consistence	Firm, homogenous consistence
Colour	White with slightly bluish tone

The study results revealed that addition of plant oils from 1.5 to 2.5% does not cause changes in organoleptic properties. It is interesting to observe that addition of plant oilsdoes not differ in the acceptance of final product.

The structural properties of fermented milk samples are crucial in overall consumer acceptance of developed products [2]. The influence of milk solids non-faton dynamic viscosity of samples is shown in Figure 1.

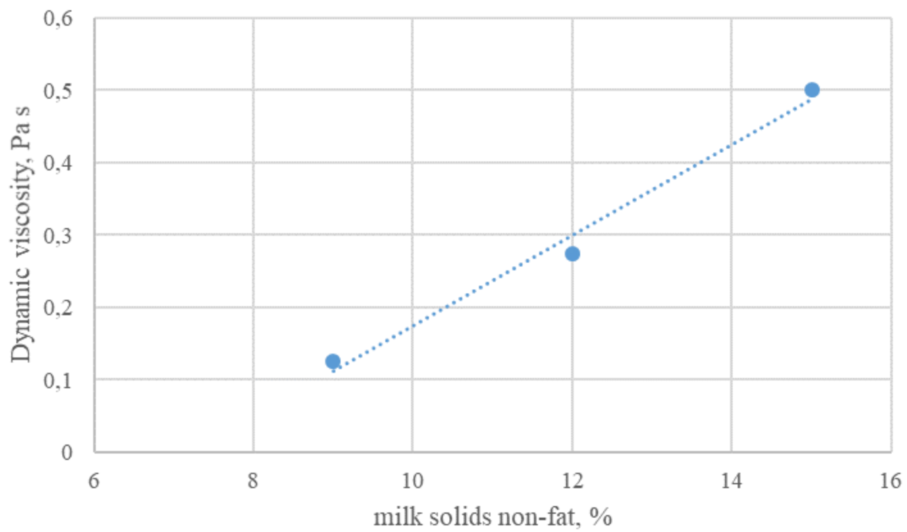

Figure 1. The influence of milk solids non-fat on fermented milk samples viscosity

The variations on dynamic viscosity were observed in the study. Differences in total solids content among analysed samples affect coagulum firmness, demonstrating that total solids and proteins have close relationship tothe final product textural characteristics.

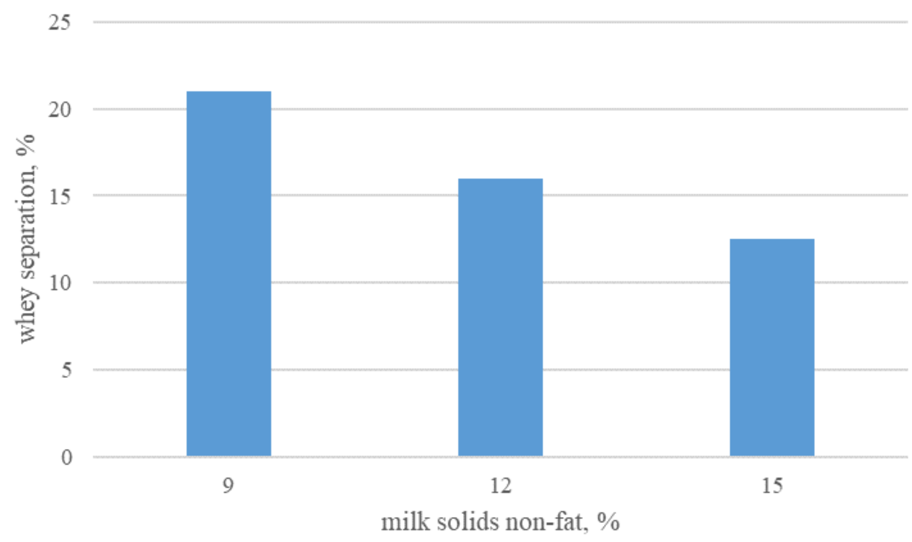

Figure 2. The influence of milk solids non-fat on whey separation in fermented milk samples

The syneresis of evaluated samples decreased when the milk solids non-fat were increased. Whey separation negatively affects consumer perception. Different approaches have been used to maintain fermented milk structural characteristics using stabilisers and thickeners, as well as increasing the total solids non-fat content in milk [11]. The separation of whey relates to an unstable coagulum, which we observed in sample with 9% of milk solids non-fat. The increased solids content also requires an additional acidity development by lactic acid bacteria starter to achieve a targetacidity; therefore 12% of milk solids non-fat in samples were set as more appropriate.

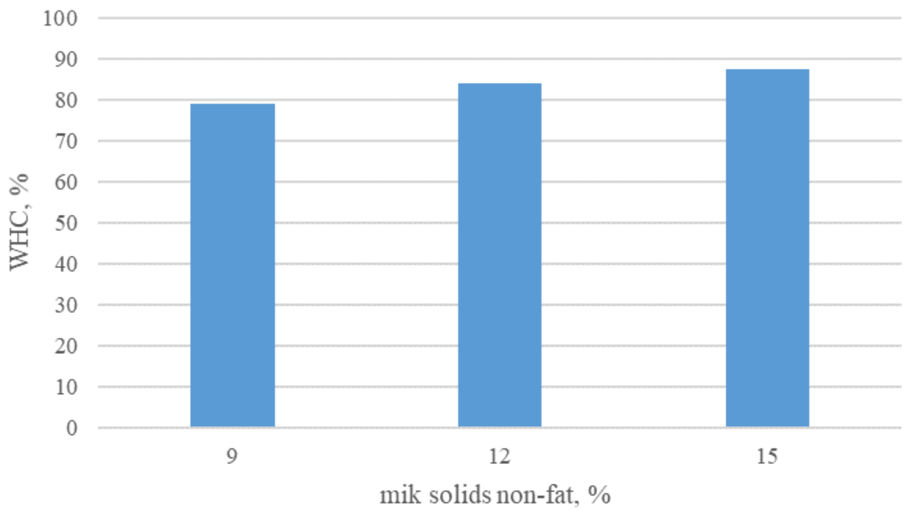

Figure 3. The influence of milk solids non-fat on water-holding capacity of developed product

Total solids and protein content also affects WHC; the higher milk protein content increases gel firmness, and consequently the WHC.

The analysis of organoleptic and structural properties have shown the possibility to maintain appropriate fermented milk consistence, taste and aroma at 12% of milk solids non-fat concentration.

During the study the technology of fermented milk product from reconstituted skimmed milk was developed. The technological flow is summarized in Table 2.

Table 2 Main processing steps in the manufacture of fermented milk

Operation	Parameters
Collection of raw materials and quality testing	According to standards/requirements of legislation/quality certificates
Reconstitution of skimmed milk powder	t=45±5ºC τ=15 min
Addition of plant oils into reconstituted milk, emulsion formulation	t=52±2ºC τ=15 min
Homogenisation	t=75±5ºC, p=12.5±2.5 MPa
Pasteurisation	t=94±2ºC, τ=6±2 min
Cooling to inoculation	t=32±1ºC
Fermentation	t=45±1ºC, τ=8±0.5 h till 80-85ºTh
Mixing and cooling	t=20±2ºC, τ=30 min
Packaging	
Cold store	t=4±2ºC, τ=5 days

The results suggested that the structural characteristics of fermented milk products can be improved by milk solids non-fat concentration and by the use of appropriate starter culture. The developed technology allows to increase function-nality and nutritional value of fermented product and to extend fermented milk products diversity. Addition of plan oils to reconstituted skimmed milk helps to increase valuable polyunsaturated (Ω=6) fatty acids which concentration in milk is insignificant.

Conclusions

1. The study results revealed that higher milk solids non-fat positively contributed to strengthening the organoleptic and structural properties of fermented milk.
2. Skimmed milk powder should be a suitable alternative to raw skimmed milk in reconstituted dairy products production.

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