Innov Biosyst Bioeng, 2023, vol. 7, no. 2, 22–31
doi: 10.20535/ibb.2023.7.2.268976

Original article

EFFECT OF HERBAL EXTRACTS UPON ENHANCING THE QUALITY OF LOW-FAT COTTAGE CHEESE

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Received 13 December 2022; Accepted 17 July 2023

Background. Alkaloids, glycosides, saponins, mucus, tannins, volatile oils, phytoncides, and other chemical compounds found in plants possess medicinal properties and act as biogenic stimulants. These substances are formed in isolated tissues of animal and plant origin during their adapting to adverse environmental conditions, exhibiting biological activity. Biogenic stimulants include plant extracts utilized in pharmacology and dairy cattle breeding to enhance immunity, prevent animal infertility, increase productivity, and elevate the level of protein and fat components in milk. This suggests the potential application of plant biopreparations in the dairy industry, particularly in the technology of low-fat cottage cheese, to enhance its protein content.
Objective. The present study aims to investigate the effect of biological preparations used in low-fat cottage cheese production on its quality and assess the feasibility of the said preparation.
Methods. The quality parameters and biological value were evaluated for low-fat cottage milk cheese made from low-fat cow's milk prepared for curdling, as well as the lactating enzyme preparation "Fromaza" in the amount of 0.1 g for each batch of the product dissolved in plant extracts-based biopreparations "Biosvit" and "Megasvit". In samples of raw milk, the mass fraction of fat, protein, and solids and density were determined. Physicochemical and biochemical parameters, as well as the amino acid composition of protein in milk, were determined using standardized methods.
Results. The study revealed that the use of "Biosvit" increased the mass fraction of total protein in the pilot cheese batch by 0.4%, while "Megasvit" led to a decrease in total protein content by 0.52%. Additionally, "Biosvit" and "Megasvit" reduced the mass fraction of non-casein protein in the pilot cheese batches by 0.25% and 1.82%, respectively, and increased the level of casein protein by 0.65% and 1.43%, respectively, compared to the control. The cheese yield from every 100 kg of processed raw milk increased by 2.8% and 4.5%, respectively, when using "Biosvit" and "Megasvit" preparations, compared to the control.
Conclusions. The effectiveness of the biological preparation "Megasvit", used to dissolve the enzyme "Fromaza", in improving the quality and biological value of low-fat cottage cheese has been confirmed.

Keywords: biological preparations; milk-coagulating enzyme preparation; protein content; cottage cheese.

Introduction

Plants are known to supply necessary organic substances for the life of living beings. Among the said substances are alkaloids, glycosides, saponins, mucus, tannins, volatile oils, phytoncides, and others, the content of which determines their medicinal value of plant preparations [1].

There are scarce sources about the use of the healing properties of plants in the manufacture of cottage cheese, which is in demand among the consumers of Ukraine. The influence of plants introduced into the production process of fermented milk products on the replacement of cow's milk components, the duration of raw milk fermentation process, on the state and structure of the resulting clot was studied.

It is shown that at a ratio of 70–55% cow and 30–45% vegetable protein in the fermented mixture, the system coagulates better, possesses and acquires susceptible sensorial characteristics.

All this served as the basis for drawing up technological schemes for the production of the fermented milk cheese with probiotic properties [2].

Therefore, the use of the healing properties of plant extracts in the dairy industry, in particular, in the production of low-fat cottage cheese, is relevant. These are biogenic stimulants that is the substances formed in isolated tissues of animal and plant origin in the process of adapting them to adverse environmental conditions (changes in temperature, altitude, etc.) and possessing biological activity. These substances stimulate the metabolism, activate the protective and regenerative func-

tions of the body. Biogenic stimulants have a positive effect on metabolic processes in the body, in particular protein biosynthesis and its immunological reactivity [3–6] including the activity against various gram-positive *Bacillus subtilis*, *Micrococcus luteus*, *Staphylococcus aureus*, gram-negative bacteria *Escherichia coli*, *Candida albicans*, *C. parapsilosis*, *Aspergillus fumigatus*, *A. terreus* were shown by *Bidens tripartita* flowers [7].

Convincing results have been achieved in the use of humic preparations as biologically active additives leading to the formation of growth phytohormones and improving the physiological parameters [8, 9].

Currently a lot of preparations based on biogenic stimulants are available. These are aloe and kalanchoe (*Kalanchoe*) juice (prepared from fresh leaves and lateral shoots), "Biosed" of orpine (*Hylotelephium telephium* subsp. *maxima*), placenta extract for injection "Polybiolin" (extraction from blood serum), "FIBS" for injection (prepared on the basis of cinnamic acid and coumarins), "Torfot" (peat distillation product), as well as preparations from medicinal plant materials of Ginseng (*Panax ginseng*), Chinese magnolia vine (*Schisandra chinensis*), purple coneflower (*Echinacea purpurea*) and eleuthero (*Eleutherococcus senticosus*). Preparations containing biogenic stimulants in their composition mainly have one mechanism of action, that is, similar pharmacodynamics. First of all, they increase the intensity of metabolic processes in the cells of the body and this leads to an increase in enzyme activity, activation of the hypothalamus-pituitary-adrenal cortex, thyroid and pancreas systems [10].

In the technologies for the manufacturing of functional products, biologically active additives based on medicinal plants are widely used to stimulate the body's nonspecific resistance, prevent allergic and cardiovascular diseases, and normalize the activity of the gastrointestinal tract [11–13].

A natural, plant-based sweetener stevia (*Stevia rebaudiana*) is virtually calorie-free and does not increase blood glucose levels. Jerusalem artichoke (*Helianthus tuberosus*) raw materials are considered to be the main source of inulin. The inulin can also be obtained by extraction from chicory (*Cichorium intybus*) roots [14]. Licorice (*Glycyrrhiza glabra*) root syrup and melissa (*Melissa*) are used to formulate the enriched yogurt for diabetics [15].

The biostimulator "Biosvit" was made by extracting herbal raw materials from seven components growing in Thailand: ginseng root (*Pánax ginseng*), extract of winter jasmine (*Jasminum nudiflorum*), ginger root (*Zīngiber officinale*), Indian snakeroot (*Rauvylfia serpentına*), Eucommi root (Du Zhong) *(Eucommia ulmoides*), Anaxagoras (*Anaxagorea luzonensis* A. Gray), Angelica (*Angelica archangelica*), and "Megasvit" was made in the form of an extract from a mixture of plants collected in Ukraine: branches and leaves of cherry (*Prunus cerasus*), Seeds and leaves of dill (*Anethum graveolens*), Leaves of fireweed (*Chamaenérion angustifolium*), Angelica roots (*Angelica archangelica*), Flowers of medical chamomile (*Matricaria recutita*), Stevia leaves (*Stévia*), Liquorice root (*Glycyrrhiza glabra*). The chemical composition of biological products is represented by flavonoids, essential oils, carotene, saponins, B and C vitamins, organic acids, mineral salts, etc. Both types of extracts were prepared according to the Filatov method under sterile conditions in a specialized laboratory [16, 17].

Amino acids of plant origin are easily absorbed and are in concentrations biologically available to the human body, so the study of their composition and the determination of the content of amino acids in herbal preparations is of great importance. One of the most important biologically active substances synthesizing plants is a complex of amino acids, both free and in the composition of vegetable protein. These are nitrogen-containing carboxylic acids, simultaneously containing amino) and carboxyl groups and a carbon skeleton [18]. For example, the results obtained indicate the promise of using an extract from dry marigold grass as a potential source of biologically active substances of the type [19].

The quark cheese (cottage cheese) is a type of fresh dairy product manufactured by warming of soured milk until curdling, without aging. It is classified as fresh acid-set cheese and has a relatively soft texture. Traditionally, quark is processed as a dairy food in Northern European countries. Although quark cheese was originally manufactured without any protease, producers recently began adding small amounts of rennet. Many investigators have studied the physiochemical properties of quark cheese during its processing [20]. Cottage cheese is a valuable source of calcium, vitamins and minerals. This product plays an important role in the health of teeth, bones, as well as in the prevention of osteoporosis. It also helps regulate blood pressure and may even play a role in the prevention of certain types of cancer [21]. Many researchers studied the diversification of cheese products by adding various ingredients including herbs to increase biofunctionality [22, 23]. However, there is still no research on the effects of gin-

seng extract-supplemented quark cheese as a new cheese product.

Low fat cottage cheese is widely used domestically as dietary nutrition dairy product so this as well as the low-fat milk as a principal raw material used for its manufacturing shall be studied minutely to improve their consumer (nutritional value, sensorial profile, etc.) and technological traits. The aim of the research is to determine the effect of herbal biopreparations on improving physical, chemical and sensorial parameters of the quality of low-fat cottage cheese.

Materials and methods

The general design of the study included the following

First, determining the effect of two types of plant biological preparations (conditional names were "Biosvit" and "Megasvit") on changes in the protein component of a low-fat cheese. Plant biological preparations were used as a solvent for the milk-clotting enzyme preparation (MCE) "Fromaza". In this way, two pilot batches of cheese (E1 and E2, respectively) were obtained. In the control experiment (C), water was used as a solvent. Secondly, determining the time of formation of dense clots suitable for mechanical processing and the output of the product from 100 kg of milk. Thirdly, physical and chemical, as well as sensory evaluation of the control and pilot batches of the product in accordance with the requirements of international and national standards.

Both types of biopreparations "Biosvit" and "Megasvit" have been manufactured by "Smart BioLab" LLC, Kharkiv, Ukraine.

Sampling

Milk samples were filtered, cooled to a temperature of 6 ± 2 °C, stored and separated on the farm, preliminary heated to 40–45 °C. The difference in the technology of the pilot batches of cheese from the traditional one was the use of biological preparations in the amount of 100 cm^3 each for every 100 kg of milk, as a solvent for every 0.1 g of MCE "Fromase".

Sampling of dairy products was carried out in accordance with the requirements of ISO 707:2008 "Milk and milk products – Guidance on sampling".

Analyzing

Physical and chemical parameters of low-fat milk and cheese samples were determined according to the requirements of the following norms in forth:

– appearance, consistency and color of the product were evaluated visually, and taste and smell – using sensorial technique;

– temperature – according to the national standard of Ukraine – DSTU 6066:2008 "Milk and milk products. Methods for determining temperature and the net mass";

– density – according to the national standard of Ukraine – DSTU 6082:2009 "Milk and milk products. Density determination methods";

– acidity – by titrimetric method;

– water and dry matter content (by mass) in cheese – according to the national standard of Ukraine – DSTU 8552:2015 "Milk and milk products. Methods for determining moisture and dry matter content".

Biochemical methods for the analysis of milk and cheese produced thereof

The biochemical parameters of the research objects were determined according to the requirements set forth in the following standards:

– fat content (by mass) was determined according to ISO 11870:2009 "Milk and milk products – Determination of fat content – General guidance on the use of butyrometric methods" and ISO 23318:2022 "Milk, dried milk products and cream – Determination of fat content – Gravimetric method";

– the total protein content was determined according to Kjeldahl method in accordance with the requirements of ISO 8968-1:2014 "Milk and milk products – Determination of nitrogen content – Part 1: Kjeldahl principle and crude protein calculation" and ISO 8968-4:2016 "Milk and milk products — Determination of nitrogen content — Part 4: Determination of protein and non-protein nitrogen content and true protein content calculation (Reference method)";

– the content (by mass) of non-protein nitrogen-containing compounds in the product was determined according to [24];

– the content (by mass) of pure casein was determined in accordance with the requirements of ISO 8968-2:2001 "Milk – Determination of nitrogen content – Part 2: Block-digestion method (Macro method)", ISO 17997-1:2004 "Milk – Determination of casein-nitrogen content – Part 1: Indirect method (Reference method)", and ISO 5545:2008 "Rennet caseins and caseinates – Determination of ash (Reference method)";

– the content of nitrogen fractions in fermented milk cheese was determined according to ISO 8968-4:2016 "Milk and milk products – Determination of nitrogen content – Part 4: Determination of protein and non-protein nitrogen content and true protein content calculation (Reference method)".

Non-casein nitrogen content (by mass) was determined by the difference between total protein and casein.

Equipment

In the selected samples of milk, the content (by mass) of fat and protein and dry matter as well as density were determined instrumentally with the use of Bentley-150 Infrared Milk Analyzer (Bentley Instruments, USA).

Experiments within this research were performed in three replications.

Results

Sensorial and physical, chemical characteristics of two types of biological products "Biosvit" and "Megasvit" are presented in Table 1.

From the data in Table 1, it can be seen that the biological products that combine both types were characterized by the presence of a specific taste and aroma of flowers and almost the same active acidity of 5.39 and 5.46 pH.

However, the introduction of a mixture of domestic plants of licorice root into the formulation determined the sweetish taste of "Megasvit".

Table 2 shows the amino acid composition the amino acid composition of two types of biopreparations "Biosvit" and "Megasvit".

Table 2 shows that 5 essential amino acids were identified in the "Biosvit" sample, that is 4 amino acids less than in the "Megasvit" sample.

Table 1: Sensorial and physical, chemical characteristics of "Biosvit" and "Megasvit"

Parameters	"Biosvit"	"Megasvit"
Taste and aroma	Pleasant with the specific aroma of flourishing plants	Sweetish with the specific aroma of flourishing plants
Consistence	Transparent liquid	Transparent liquid
Colour	Purple	Red
Active acidity, pH	5.39	5.46

Table 2: Amino acids content of "Biosvit" and "Megasvit"

Amino acids	Concentration, mg/100 g	
	"Biosvit"	"Megasvit"
Essential amino acids		
Histidine	0.16 ± 0.01	0.39 ± 0.02
Threonine	0.02 ± 0.001	0.55 ± 0.02
Arginine	0.27 ± 0.01	2.57 ± 0.10
Valine	–	0.76 ± 0.03
Methionine	0.01 ± 0.001	0.01 ± 0.001
Isoleucine	–	0.39 ± 0.02
Leucine	–	0.33 ± 0.01
Lysine	–	0.23 ± 0.01
Phenylalanine	0.09 ± 0.004	1.02 ± 0.04
Total content of essential amino acids	0.55 ± 0.02	6.25 ± 0.25
Non-essential amino acids		
Aspartic acid	0.30 ± 0.01	3.53 ± 0.14
Glutamic acid	0.03 ± 0.001	2.79 ± 0.11
Serene	0.11 ± 0.004	1.30 ± 0.05
Glycine	0.03 ± 0.001	0.07 ± 0.003
Alanine	0.16 ± 0.01	1.14 ± 0.05
Tyrosine	0.18 ± 0.01	0.85 ± 0.03
Proline	0.03 ± 0.001	7.91 ± 0.32
Total content of non-essential amino acids	0.84 ± 0.03	17.59 ± 0.70
Total content of amino acids	1.39 ± 0.06	23.84 ± 0.95

According to the results obtained, it was found that the highest total content of essential amino acids was in the composition of the "Megasvit" biological product, which was 6.25 mg/100 g, among which almost 50% was occupied by arginine – 2.57 mg/100 g and phenylalanine – 1.02 mg/100g.

In the pilot samples of the "Megasvit", the amount of essential amino acids was 11.3 times higher compared to the same indicator in the biopreparation "Biosvit".

The amount of non-essential amino acids in the samples of the biological product "Megasvit" exceeded the same indicator in the samples of the biological product "Biosvit" by 20.9 times.

The data of the results of studies of the biochemical composition of biological products indicate a high content of amino acids, which makes it possible to assert the possibility of their influence on the increase in the protein component in the pilot batches of cheese. The data also show the advantages of the biopreparation "Megasvit", made on the basis of domestic plants, over the biopreparation "Biosvit", which was based on herbs of foreign origin.

For the manufacture of the control and the pilot batches of low-fat cottage cheese, low-fat cow's milk of the same physical and chemical parameters was used.

The results of studies of the said parameters of low-fat milk raw materials are as follows: mass fraction of fat – 0.05%; titrated acidity 18 °T; density 29.8 °A, content of dry matter (by mass) – 12.8%.

The Amino acids content of the low-fat milk used is specified in Table 3.

For the manufacture of each of the three batches of cheese the same (100 kg) amount of milk was used.

The control and two pilot batches of cottage cheese (hereinafter referred to as cheese) were produced under semi-industrial conditions by the department of production and standardization of livestock products of the State Biotechnological University, according to [17] and the national standard of Ukraine – DSTU 4554:2006 "Curds. Specifications".

Pasteurization of the prepared raw materials is carried out at the optimum temperature 78 ± 2 °C with a holding time of 20–30 s. This mode provides coagulation of heat-labile whey proteins and, accordingly, increases the yield of the product. Pasteurized milk is cooled in the warm and cold seasons to a temperature of 28–30 °C.

Table 3: Amino acids content of the low-fat milk used for manufacturing of cottage cheese

Amino acids	Content, g/100 g of milk
Essential amino acids	
Valine	0.18 ± 0.06
Isoleucine	0.14 ± 0.02
Leucine	0.23 ± 0.02
Lysine	0.21 ± 0.05
Methionine + cysteine	0.07 ± 0.00
Threonine	0.13 ± 0.05
Phenylalanine + threonine	0.19 ± 0.05
Total content of essential amino acids	1.15 ± 0.04
Non-essential amino acids	
Alanine	0.09 ± 0.04
Arginine	0.12 ± 0.02
Aspartic acid	0.11 ± 0.02
Histidine	0.09 ± 0.00
Glycine	0.07 ± 0.00
Glutamic acid	0.38 ± 0.02
Proline	0.17 ± 0.07
Serene	0.13 ± 0.01
Tyrosine	0.12 ± 0.05
Cysteine	0.03 ± 0.00
Total content of non-essential amino acids	1.31 ± 0.04
Total content of amino acids	2.48 ± 0.05

Note. Ratio between essential and non-essential amino acids – 0.9

The above temperature regimes are optimal for the development of the main starter microorganisms that provide active acid formation from the beginning of the fermentation process – mesophilic lactic acid lactococci (*Lac. lactis*, *Lac. cremoris*, *Lac. diacetilactis*). The duration of milk fermentation is 8–10 h, the required amount of enzyme is 1.5 g per 100 liters of milk.

The dose of the enzyme with an activity of 100,000 ME is 0.1 g of MCE "Fromase" per 100 kg of low-fat milk according to the manufacturer's recommendations.

In the acid-rennet method of cheese production, the end of curing is determined by the state of clot formation (a dense clot that, after cutting with a spatula, releases light green whey) and has an acidity of about 75 ± 5 °T.

After fermentation, measures are taken to accelerate the extraction of whey: the finished clot is cut with special wire knives into cubes about 2 cm in size along the edge.

The cut clot is left alone for 40–60 min to build up acidity and for more intensive removal of whey.

Then the whey is partially removed from the bath with a siphon or through a fitting and collected in a separate container for further processing. The difference in technology between the control and the pilot batches of cheese was the use of two types of biological products as solvents for the preparation of a 0.1% solution of MCE "Fromase". Temperature 20 ± 2 °C was used as a diluent for MCE.

For pilot (E1 and E2) batches of cheese, respectively, the biological product "Biosvit" and "Megasvit" at the above temperature.

For the final removal of whey from the clot and obtaining cottage cheese with a standard moisture content, self-advancement and then forced pressing are used.

The clot is poured into calico bags 40×80 cm in size, which are filled to three quarters with a weight of 7–9 kg.

For self-pressing and pressing, bags with a bunch are evenly decomposed into a press trolley and covered with a plate, which creates the pressure of the press screw through a special frame.

Pressed cottage cheese must be cooled as soon as possible to 3–8 °C to stop lactic acid fermentation.

When using pouches, pressing was combined with cooling by placing the press trolley in a cold store. The process lasted 10 h.

The results of the physicochemical and biochemical composition of cheese, the control (C) and two pilot batches of cheese (E1 and E2) made using two types of biological products "Biosvit" and "Megasvit" respectively, are shown in Table 4.

Table 4 shows that under the influence of the biopreparation "Biosvit" the mass fraction of total protein in the the pilot batches of the product increased by 0.4 g/100 g of cheese. But, under the influence of domestic product it decreased by 0.52 g/100 g of cheese. Although, both biological products affected the decrease in the mass fraction of non-casein protein by 0.25 and 1.82 g/100 g of cheese, respectively. This contributed to an increase in the content of casein protein (an indicator responsible for the formation of a quality clot) by 0.65 and 1.3 g/100 g of cheese, respectively, compared with the control. The mass fraction of total protein and non-casein in the pilot batch (E1) of cheese was higher – by 0.92 and 1.57 g/100 g of cheese compared with the same indicators in the pilot batch of the product (E2). However, the mass fraction of casein protein in the pilot (E2) cheese batch turned out to be 0.65 g/100 g of cheese higher compared to the same indicator in the product batch (E1).

Differences between the mass fraction of moisture in the control and two pilot batches of cheese were not observed. The mass fraction of fat in the pilot batches of cheese (E1 and E2) was higher by 0.05 and 0.1% compared to the control (C). The difference between the above indicators for two pilot batches of cheese (E2 and E1) was 0.05% in favor of the batch with "Megasvit" biological product. The titrated acidity in the pilot batches of cheese (E1 and E2) was 4 °T and 6 °T higher compared to the control (C). However, the

Table 4: Biochemical characteristics of low-fat cottage cheese

Parameters	Protein content (by mass), g/100 g of cheese			Content (by mass), %		Titratable acidity, °T
	Overall	Non-casein	Casein	Fat	Water	
Control (C)	19.66 ± 0.07	5.49 ± 0.07	14.17 ± 0.03	0.50 ± 0.01	64.8 ± 0.08	190 ± 1.15
Pilot (E1)	20.06 ± 0.10	5.24 ± 0.03	14.82 ± 0.02	0.55 ± 0.01	64.9 ± 0.07	194 ± 0.58
Pilot (E2)	19.14 ± 0.08	3.67 ± 0.03	15.47 ± 0.02	0.60 ± 0.01	65.0 ± 0.06	196 ± 0.58

members of the tasting committee noted that there was no difference in sensorial (the presence of a sourer taste) parameters of the three batches of the product. Table 5 shows the milk consumption rates for the manufacture of 1 kg of cheese and the product yield from 100 kg of low-fat milk.

It was found that the consumption rates of milk per 1 kg of cheese in two pilot batches of the product were less by 0.18 and 0.29 kg, respectively, compared with the control. Changes in the protein component of the product under the influence of both types of biological products contributed to an increase in the yield of the pilot batches of cheese from 100 kg of raw milk (E1 and E2) by 0.4 and 0.64 kg, respectively, compared with the same parameter (C) of the control batch of the product. Considering the fact that in the control experiment 14.2 kg of cheese was obtained from 100 kg of raw milk, the yield of cheese in the experimental pilot series increased by 2.8% and 4.5%, respectively. A clot suitable for further mechanical processing in the pilot batches of cheese (E1 and E2) was formed 1 and 1.5 hours, respectively, earlier compared to (C) the control. Sensorial parameters of the control and the pilot samples of cottage cheese are given in Table 6.

From the data in Table 6 it can be seen that the use of biological products as a solvent for MCE in the technology of fermented milk cheese contributed to the emergence of new commodity characteristics in the pilot batches of cheese (E1 and E2): the sense of a floral aroma after the taste. The pilot batches of the product (E1 and E2) differed to the best in density and dense consistency in comparison with the control.

Discussion

The pilot batch of the product (E2) differed to the best in density and dense consistency in comparison with the control. This is due to successful selection of the plants of domestic origin growing in the eastern part of Ukraine, in particular, in Mala Danylivka village, Dergachivsky district, Kharkiv region, used to manufacture biological products. According to [25], biogenic stimulants were defined as chemical compounds that are being part of plants have medicinal properties to suppress or kill pathogenic microorganisms. Plants are successfully used in the manufacture of alcoholic tinctures (motherwort extracts with a sedative effect) and plants containing essential oils can be used as an antimicrobial and antifungal agent [26, 6].

There are convincing results of the effectiveness of use of cell and tissue therapy drugs known in surgery as a tool for bone growth [9, 27]. Moreover, the action of the so-called biogenic preparations in the form of extracts and juices of aloe, kalanchoe, from the placenta and extraction from blood serum, etc., contribute to an increase in metabolic processes in the cells of the body [10]. A number of technologies for the preparation of plant extracts have become known from scientific sources. Well-known technologies for obtaining extracts differ only in the types of herbal ingredient and solvent (aqueous, whey or alcohol), and the temperature exposure during extraction [13–15, 28]. Recently, convincing positive results have been achieved in the use of humic preparations as biologically active phytoadditives. The developers of the biostimulant called "Biosvit" used "11 Tigers"

Table 5: Milk necessary for the manufacture of 1 kg of cheese and product yield from 100 kg of milk

Parameters	Milk consumption rate per 1 kg of cheese, kg	Finished product yield, from 100 kg of milk, kg	Clot formation time, hour
Control (C)	6.98 ± 0.01	14.30 ± 0.03	8.0 ± 0.02
Pilot (E1)	6.80 ± 0.02	14.70 ± 0.03	7.0 ± 0.02
Pilot (E2)	6.69 ± 0.01	14.94 ± 0.02	6.5 ± 0.01

Table 6: Sensorial parameters of the control and the pilot samples of cheese

Parameters	Analyzing results of cottage cheese samples		
	Control (C)	Pilot (E1)	Pilot (E2)
Taste and aroma	Clear sour milk, flavor and aroma of pasteurization	Clear sour milk, flower aftertaste	Clear sour milk, flower aftertaste
Consistence	Rather dense	Rather dense	Rather dense
Color	White	White	White

herbal tea, delivered from Thailand, as its basis. A sterile-treated extract made from the above tea was injected into the jugular region of the piglets' necks. The above biostimulator contributed to the increase in their immunity [9]. However, the delivery expenses of herbal tea "11 Tigers" from Thailand had a negative impact on the cost of the biological product "Biosvit".

Therapeutic and prophylactic properties of plant extracts have attracted the attention of developers of dairy products technologies. A number of technologies have been created using medicinal plants.

Researchers have proven the positive effect of two types of biological products "Biosvit" and "Megasvit" on the physiological, morphological and biochemical parameters of the blood of cows of the Ukrainian Black-and-White dairy breed, as well as increasing the productivity of cows and also increasing the content of fat and protein in milk [16, 17].

Since the positive effect of the preparation on improving the physical and chemical parameters of milk from dairy cows has already been proven, the task of the research was to establish the feasibility of introducing such preparations into the production process of low-fat cottage cheese.

There are only single reports on the use of the healing properties of plants in the manufacture of cottage cheese, which is in demand among the population of Ukraine. Thus, the introduction of 30% bean milk to 70% cow's milk increases the coagulation properties of milk and improves its sensorial properties [2].

However, studies on the effect of plant extracts, including two well-known biological products "Biosvit" and "Megasvit", whose action could be aimed at increasing the nutritional and biological value (in particular, increasing the casein fraction responsible for the yield of cheese from 100 kg of milk) has not yet been found in the scientific literature.

Therefore, in the experiments on the processing of milk into cottage cheese, two types of plant biological products (water extracts) were used, one of which was made on the basis of 7 dry herbs (tea "11 Tigers") grown in Thailand, and the the other one was made of mixtures of 7 plants of domestic origin growing in Mala Danylivka village, Dergachivsky district, Kharkiv region.

It is known that one of the most important biologically active substances synthesizing plants is a complex of amino acids, which are free and in the composition of vegetable protein. These are nitrogen-containing carboxylic acids, simultaneously containing amino and carboxyl groups and a carbon skeleton.

Studies have shown a valuable amino acid composition of marigold extract, which includes both essential and non-essential amino acids [18]. Therefore, our efforts were directed to the studies of the amino acid composition of the two above-mentioned biopreparations "Biosvit" and "Megasvit", and it was decided to use these in the experiments for pilot batches of cheese production.

An increase in the casein fraction of cottage cheese in experimental samples of the product under the influence of 2 types of biostimulant, including, with greater efficiency under the influence of the domestic bistimulant "Megasvit", affects its technological properties, that is, an increase in the yield of the product from a unit of raw milk. Since the concept of cottage cheese quality is not specified, therefore, an increase in the yield (amount of cottage cheese) from 100 kg of low-fat milk under the action of biostimulants and an increase in physical and chemical indicators can be considered an indicator of quality.

From a review of the literature, the disadvantages of other technologies for dairy products enriched with plant components are:

1. The use of individual ingredients (alfalfa hay, lupine flour, beans, artichoke, stevia, etc.) instead of using a complex of plants that are components of a 7 plants mixture, on the basis of which the extracts are made.

2. The amino acid composition of most of the listed plants, under the influence of which an increase in the protein component in the pilot batches of cheese is possible, has not been determined.

Thanks to the use of biological preparations of plant origin, it was possible to positively influence the casein fraction of the protein, which improved the physicochemical properties of sour milk cheese, its organoleptic properties, in particular taste, and the nutritional value of the product.

Conclusions

Biological products "Biosvit" and "Megasvit" (aqueous extracts of plants of foreign and domestic origin), respectively, were introduced into the technology of low-fat cheese of fermented milk rennet-acid production method as a solvent for MCE "Fromase", that provided the pilot batches of cheese with the aroma of flowers after the taste and contributed to a more dense consistency of the final product with "Megasvit" compared to the control.

Under the action of biological preparations, the time of clot formation in the pilot batches of cheese was reduced by 1.0–1.5 hours.

It was established that under the influence of "Biosvit", the mass fraction of total protein in the pilot batches of the product increased by 0.4 g/100 g of cheese, but under the influence of "Megasvit", it decreased by 0.52 g/100 g of cheese.

However, both biological products affected the decrease in the mass fraction of non-casein protein by 0.25 g/100 g of protein and 1.82/100 g of cheese and, as a result of such changes in the protein component of the pilot batches of the product, there was an increase in the content of casein protein by 0.65 g/100 g of cheese and 1.43 g/100 g of cheese respectively compared to the control.

An increase in the mass fraction of casein protein contributed to an increase in the yield of the pilot batches of cheese from 100 kg of raw milk (E1 and E2) by 2.8% and 4.5%, respectively.

Therefore, on the basis of the obtained research results, the expediency of using "Megasvit" biological product in the technology of low-fat cottage cheese has been established.

The results obtained confirm that the use of biological products studied enhances the quality of low-fat cottage cheese including its physical, chemical and sensorial traits.

Interests disclosure

The authors declare no conflicts of interest to disclose.

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ВПЛИВ РОСЛИННИХ ЕКСТРАКТІВ НА ПІДВИЩЕННЯ ЯКОСТІ НЕЖИРНОГО СИРУ

Проблематика. Алкалоїди, глікозиди, сапоніни, слизи, дубильні речовини, ефірні олії, фітонциди та інші хімічні сполуки, що входять до складу рослин, мають лікувальні властивості та є біогенними стимуляторами. Ці речовини утворюються в ізольованих тканинах тваринного та рослинного походження у процесі пристосування їх до несприятливих умов довкілля та характеризуються біологічною активністю. До біогенних стимуляторів належать рослинні екстракти, що застосовуються у фармакології, молочному скотарстві для підвищення імунітету, профілактики безплідності тварин, підвищення їх продуктивності та підвищення рівня білково-жирових компонентів у молоці. Зазначене вище вказує на перспективність використанняя рослинних біопрепаратів у молочній промисловості, зокрема в технології знежиреного кисломолочного сиру для підвищення у ньому вмісту білка.
Мета. Вивчити вплив біопрепаратів, що використовуються під час виробництва знежиреного кисломолочного сиру, на його якість та оцінити доцільність застосування цих препаратів.
Методика реалізації. Показники якості та біологічну цінність оцінювали для знежиреного кисломолочного сиру, виготовленого зі знежиреного коров'ячого молока, підготовленого для зсідання, а також молокозсідального ферментного препарату “Фромаза” у кількості 0,1 г на кожну досліджувану партію продукту, розчиненого в біопрепаратах “Біосвіт” і “Мегасвіт” на основі рослинних екстрактів. У пробах сирого молока визначали масову частку жиру, білка, сухих речовин і густину. Фізико-хімічні та біохімічні показники, а також амінокислотний склад білка в молоці визначали стандартизованими методами.
Результати. Показано, що під впливом “Біосвіту” масова частка загального білка в дослідній партії сиру збільшилася на 0,4 %, а застосування “Мегасвіту” сприяло зниженню білка на 0,52 %. Також “Біосвіт” і “Мегасвіт” вплинули на зниження масової частки неказеїнового білка в дослідних партіях сиру на 0,25 та 1,82 % відповідно і підвищили рівень казеїнового білка на 0,65 та 1,43 % відповідно порівняно з контролем. Вихід сиру з кожних 100 кг переробленого сирого молока при застосуванні препаратів “Біосвіт” і “Мегасвіт” збільшився порівняно з контролем на 2,8 і 4,5%, відповідно.
Висновки. Доведено ефективність біопрепарату “Мегасвіт”, застосовуваного для розчинення ферменту “Фромаза”, для підвищення якості та біологічної цінності знежиреного кисломолочного сиру.

Ключові слова: біопрепарати; молокозгортаольний ферментний препарат; вміст білка; сир кисломолочний.