This work investigates the quality indicators of pasteurized milk with the addition of taxifolin, which form its properties and affect the storage capacity of the product. Current market requires increased guarantees of product quality during its supply and sale in retail chains. Pasteurized milk has a limited shelf life, which predetermines search for new solutions to warrant its quality to the end consumer. The use of plant-based ingredients that have antioxidant and antibacterial properties in traditional products makes it possible to improve their quality and safety indicators, expand the range of dairy products with high biological activity.

This study examines the influence of the bioflavonoid taxifolin on the development of the microbiota in pasteurized milk and the extension of its storage period. Positive dynamics in the decrease in the quantity of mesophilic aerobic and facultative anaerobic microorganisms in pasteurized milk with taxifolin have been noted. It was proven that the introduction of taxifolin inhibits the progress of microbiological processes. An increase in the number of microorganisms above the normalized value of 1x105 CFU/cm^3 was registered after 35 days of whole milk storage, and after 14 days of low-fat milk storage.

Based on the results of organoleptic, physicochemical, and microbiological characteristics, the guaranteed shelf life of pasteurized milk with taxifolin for consumption was established. It was proven that for low-fat pasteurized milk with taxifolin, the shelf life was extended by 7 days, for whole pasteurized milk with taxifolin – by 14 days. The positive effect of the bioflavonoid taxifolin on extending the specified shelf life of pasteurized milk was confirmed, provided that the taste characteristics, quality indicators, and product safety were preserved.

This study's results could be used at milk processing enterprises when introducing the technology of pasteurized milk production

Keywords: pasteurized milk, taxifolin, milk quality indicators, safety indicators, shelf life

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DETERMINING THE INFLUENCE OF TAXIFOLIN ON PASTEURIZED MILK STORAGE

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1. Introduction

In the food industry, there is a need to extend the shelf life of products by preventing the growth of microorganisms that cause spoilage and pose a threat to the health of consumers. This task is solved by using high-temperature processing, sterilization, or by using synthetic antibacterial drugs [1]. However, the use of potential chemical preservatives raises consumer concerns about their use and side effects on health [2].

Therefore, the search for safe natural compounds that can successfully compete with chemically synthesized antioxidants and antibacterial drugs is of great practical importance. Natural flavonoids have demonstrated high antibacterial activity against pathogenic microorganisms that cause spoilage of food products, which indicates their potential for use in the food industry as promising herbal additives [3].

Taxifolin (3,5,7,3,4-pentahydroxyflavanone) or dihydroquercetin is a natural flavonoid with a wide range of biological activities and is commonly used as a nutraceutical ingredient to improve patient health [4]. Studies have shown that taxifolin has potent antioxidant properties [5] compared to other antioxidant compounds [6, 7].

Given that taxifolin has high biological activity and thus can affect the course of processes that occur during food storage, it is relevant to study its impact on quality indicators that determine the storage capacity of the finished product. For manufacturers, extending the shelf life of products, and in particular pasteurized milk, is an important task to ensure the sale of safe and high-quality products in the retail network. The problem of milk spoilage, which is caused by the development of microorganisms that remain after heat treatment, is also inherent in the case of using higher heat treatment temperatures. Therefore, research aimed at finding opportunities to inhibit the development of bacteria through the use of natural compounds is one of the ways to extend the shelf life of products and improve their nutritional value.

2. Literature review and problem statement

Due to large-scale medical research, the use of the bioflavonoid taxifolin has primarily become widespread in the pharmaceutical industry. It is used in various commercial preparations [4, 8].

A review of the results of studies on the use of taxifolin for the treatment of diseases of various systems of the human body, such as the nervous, immune, and digestive systems, is given in [5]. However, there is no information on the practical use of taxifolin in food products.

An analysis of publications in the context of the use of taxifolin in the food industry reveals a limited number of them. A technique of using the food ingredient is known [9], which involves adding dihydroquercetin (taxifolin), arabinogalactan, or a combination thereof to a food product in order to maintain its stability and improve organoleptic properties without changing the nature, composition, and quality of the product. The food ingredient acts as an antioxidant, extends shelf life, protects against oxidation and spoilage by microorganisms, and facilitates the transportation and storage of the product as well. However, the cited work [9] did not specifically investigate the mono-effect of taxifolin on the organoleptic properties, composition, and quality of the food product during storage.

A highly effective combined food supplement [10] fortified with biologically active substances has been designed. The proposed combined food supplement contains 54–65% dihydroquercetin and 35–46% vitamin C, is safe and non-toxic, does not cause side effects and is characterized by high antioxidant activity. The food supplement can not only replace existing food antioxidants but has an increased ability to neutralize free radicals and, at the same time, has high nutritional value and could be used to make food and health products. Taxifolin in [10] is represented in the composition of the food supplement; the focus of the study is the ability of the food supplement to neutralize free radicals. However, work [10] lacks detailed data on the influence of the food supplement on quality indicators, in particular, organoleptic, and physicochemical properties of food products during storage.

A new technique for increasing the oxidative stability of food products has been devised in [11]. Its essence is that the combination of the antioxidant dihydroquercetin with an emulsifier provides more effective protection of food products from oxidation than the use of the antioxidant alone. In [11], the effect of the composition of dihydroquercetin with an emulsifier on the oxidative stability of food products was studied but there is no information on investigating the effect of dihydroquercetin on other indicators of food quality.

Paper [12] describes novel compositions containing two or more natural preservatives. The natural preservatives used include rosmarinic, caffeic, ferulic, isoferulic, p-coumaric, cinnamic, orselinic, 4-hydroxybenzoic, and 5-hydroxyferulic acids, dihydroquercetin, kaempferol, apigenin, orcinol, shizocenin, kaempferide, curcumin, acacetin, rutin, quercetin and hesperidin. The invention relates to techniques for preserving food products and beverages, which involve mixing the above compositions with appropriate food systems. However, such systems contain two or more natural preservatives.

In [13], the authors found that taxifolin has increased antioxidant activity compared to quercetin, vitamin C, and vitamin E. The use of blueberry puree and taxifolin in soy yogurt allows for the production of a functional fermented product that has a positive effect on human health. The authors conducted comparative studies on the antioxidant activity of taxifolin and other bioflavonoids, but there are no studies on the changes in the quality indicators of soy yogurt during product storage.

Analysis of studies on the use of taxifolin in dairy products confirms the positive effect on medical indicators of the health of patients who consumed such products. Thus, it was proven in [14] that the devised formula of goat milk powder has the ability to reduce blood pressure and blood lipid levels. The data reported in [15] relate to a high-protein low-carbohydrate milk shake with dihydroquercetin, which showed high activity in neutralizing free radicals, anti-inflammatory properties and stimulating neuronal growth.

In [16], the antibacterial activity and mechanism of action of taxifolin on two bacteria transmitted through food products – *E. coli* and *S. aureus* – were investigated. The effect of taxifolin on microbiological indicators of milk was also tested. However, there is no information on changes in indicators during storage.

The feasibility of combining dihydroquercetin and other components of plant origin (chia, quinoa, and flax seeds) on the microbiological stability of functional curd pastes was substantiated in [17]. The authors emphasize the increase in the biological value of the dairy product. The use of dihydroquercetin makes it possible to combine antimicrobial action with the preservation of the useful functional properties of the seeds, which makes curd pastes a product of increased biological value and safety.

The possibility of using the antioxidant taxifolin in dairy dessert formulations to extend their shelf life was studied in [18]. Based on the organoleptic, physicochemical, and microbiological indicators of dairy desserts during storage, it was established that the shelf life of desserts could be extended by 7 days by adding taxifolin.

Milk processing technologies involve the use of different heat treatment modes. During heating, important structural and chemical changes occur in milk components that affect its technological properties. First of all, this applies to protein components, among which whey proteins and casein are the main ones [19, 20]. Therefore, in practice, it is likely to use different processing temperatures depending on the specifics of the target product technology. The choice of heating modes should ensure a level of neutralization of microorganisms that would meet certain criteria. This also applies to the production of pasteurized milk.

Thus, ensuring the quality of dairy products is quite possible by introducing ingredients with high biological activity and specific properties into traditional products. In this sense, research on the use of the natural flavonoid taxifolin as an ingredient for the production of dairy products deserves attention.

European food legislation allows the expansion of the application of extracts fortified with taxifolin as ingredients for dairy products [21]. The use of taxifolin, which has antioxidant and antibacterial properties, for the production of pasteurized milk provides grounds for improving its quality indicators and extending the shelf life by suppressing the development of residual microbiota.

Therefore, it is advisable to conduct research on improving the pasteurized milk technology by using the bioflavonoid taxifolin.

3. The aim and objectives of the study

The purpose of our study is to determine the influence of taxifolin on the quality indicators of pasteurized milk and its storage capacity. This will make it possible to improve the technology of pasteurized milk production and, as a result, extend the shelf life of the product.

To achieve this goal, the following tasks were set:

– to investigate the influence of taxifolin on microbiological indicators: the content of the quantity of mesophilic aerobic and facultative anaerobic microorganisms, the number of yeast, mold fungi, and bacteria of the *Escherichia coli* group during storage;

– to investigate the influence of taxifolin on the dynamics of titrated and active acidity of pasteurized milk during storage;

– to investigate the influence of taxifolin on the organoleptic indicators of pasteurized milk during storage;

– to analyze the permissible values of changes in the indicators of pasteurized milk with taxifolin and establish its warranty period of shelf life for consumption.

4. The study materials and methods

4. 1. Research hypothesis

The object of our research is the quality indicators of pasteurized milk with the addition of taxifolin, which form its properties and affect the storage capacity of the product.

The principal hypothesis assumes that the use of taxifolin, as a natural flavonoid with antibacterial activity, could make it possible to suppress the development of residual microbiota in pasteurized milk, which is the main factor in spoilage and deterioration of the quality of the finished product.

It is expected that the introduction of taxifolin would ensure the predicted stability of organoleptic, physicochemical, and microbiological indicators of pasteurized milk with taxifolin during storage due to its antioxidant and antibacterial activity.

When planning and conducting the research, the following assumptions were adopted: microbiological indicators for the content of mesophilic aerobic and facultatively anaerobic microorganisms, yeast, fungi, *Escherichia coli* bacteria are a priority criterion when establishing the shelf life of dairy products for consumption.

The following simplifications were accepted:

– during the study, the emphasis was on determining the effect of taxifolin on the organoleptic characteristics and the dynamics of titrated and active acidity, without taking into account the determination of fat oxidation indicators in products during storage;

– the evaluation of organoleptic indicators was carried out according to such characteristics as consistency, color, and taste, which corresponds to generally accepted methods for evaluating pasteurized milk.

4. 2. Materials under study

We investigated samples of low-fat pasteurized cow's milk (fat content 0.5%, control) and whole pasteurized cow's milk (fat content 3.8%, control) and low-fat and whole pasteurized milk with taxifolin and similar fat content. The requirements for the quality and safety indicators of the bioflavonoid taxifolin are specified by the market operator TOV "BioFlavid" (Ukraine) in document TU U 20.1–44291462-003:2025 "Extract, rich in taxifolin (taxifolin-rich extract). Specifications". The suitability of the taxifolin preparation for use in food products and the dose of application complied with current standards [21].

Experimental samples of pasteurized milk with different fat contents were made using taxifolin: low-fat (with a mass fraction of fat of 0.5%) and whole (with a mass fraction of fat of 3.8%). Samples of low-fat pasteurized cow's milk (with a mass fraction of fat of 0.5%) and whole pasteurized cow's milk with a mass fraction of fat of 3.8% without taxifolin served as controls. Taxifolin was added according to the recommendations [21] in an amount of 0.002% before pasteurization of milk.

The technological process of making experimental samples of pasteurized milk with taxifolin was carried out according to the following technological scheme: milk reception, heating to (43 ± 2) °C, separation, normalization, introduction of taxifolin, pasteurization at a temperature of (85 ± 2) °C for 30 seconds, packaging, storage. Pasteurized milk was stored at a temperature of (4 ± 2) °C in hermetic packaging for 56 days. In order to establish the guaranteed shelf life of pasteurized milk with taxifolin, freshly produced samples and samples stored for 7, 14, 21, 28, 35, 42, 49, 56 days were examined for organoleptic, physicochemical, and microbiological indicators.

4. 3. Research methodology and methods

The storage capacity of experimental and control milk samples was determined based on factual data of physicochemical, microbiological, and sensory characteristics. Microbiological indicators were evaluated by the quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM), yeast, mold fungi, and bacteria of the *E. coli* group. The QMAFAnM was determined according to DSTU IDF 100B:2003, yeast and fungi – according to DSTU ISO 6611/IDF 94:2007, *E. coli* bacteria – according to DSTU IDF 73A:2003, titrated acidity – according to DSTU ISO 6092:2007.

The active acidity of the samples was determined by a standardized potentiometric method using a high-precision laboratory pH meter (model "MP 512", China). The final result of the active acidity measurements was the arithmetic mean values of two parallel measurements of active acidity in pasteurized milk with taxifolin and control samples obtained under repeatability conditions. When studying the dynamics of the titrated and active acidity of pasteurized milk, the indicators established by current standards were used as normative. In particular, the titrated acidity should not exceed 21.0°T, the active acidity should be within 6.5–6.6 pH units.

The mass fraction of fat was determined by a standardized acid method based on the separation of fat from milk under the action of concentrated sulfuric acid and isoamyl alcohol with subsequent centrifugation and measurement of the fat volume in the graduated part of the butyrometer. The final result was taken as the arithmetic mean of the results from two parallel measurements of one sample, the permissible differences between which did not exceed 0.5%, provided that the results were within one of the smallest divisions of the butyrometer scale.

5. Results of studies on the effect of taxifolin on the safety and quality indicators of pasteurized milk during storage

5. 1. Studies on the effect of taxifolin on microbiological indicators

The shelf life of dairy products is established depending on the quality of raw materials, production technology, packaging conditions, and properties of packaging materials. According to the current requirements of standards for pasteurized milk, the quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM) should not exceed 1×10^5 CFU/cm^3. Yeast, mold fungi, and bacteria of the *Escherichia coli* group should be absent during storage. The results of the studies serve as the basis for establishing the guaranteed shelf life of the product for consumption.

The criterion for assessing the effect of taxifolin on the residual microbiota of milk that was processed at a pasteurization temperature of 85°C was the ability of microorganisms to develop during long-term storage at a temperature of 4°C.

Microbiological indicators of low-fat and whole milk of pasteurized and control samples during storage are shown in Fig. 1, 2.

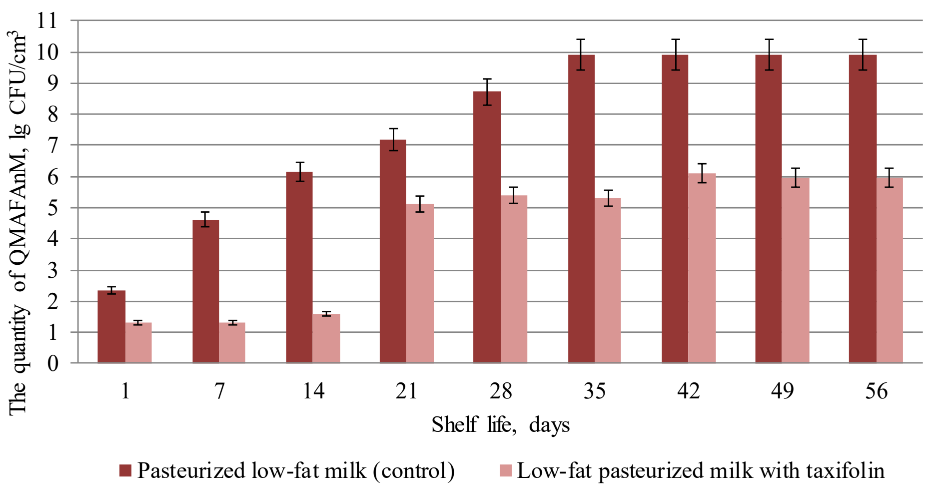

Fig. 1. Dynamics in the quantity of mesophilic aerobic and facultative anaerobic microorganisms in pasteurized low-fat milk (control) and low-fat milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

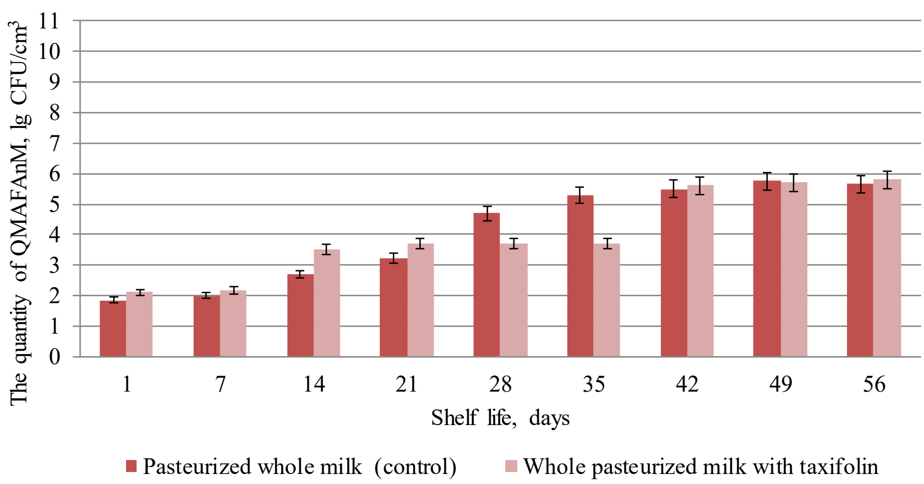

Fig. 2. Dynamics in the quantity of mesophilic aerobic and facultative anaerobic microorganisms in pasteurized whole milk (control) and whole pasteurized milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

It was noted that yeast, mold fungi, and bacteria of the *E. coli* group were absent in both experimental and control samples throughout the entire period of the study. Analysis of the patterns of changes in the quantity of mesophilic aerobic and facultative anaerobic microorganisms in milk samples with taxifolin reveals the suppression of their development during storage. An increase in QMAFAnM above the normalized value of 1x10^5 CFU/cm^3 was recorded after 35 days of whole milk storage, and after 14 days of low-fat milk storage. In control milk samples, such an increase occurred earlier. In whole milk after 28 days, in low-fat milk after 7 days. It was noted that the course of microbiological processes in low-fat milk occurred more intensively than in whole milk. The QMAFAnM indicator in samples of low-fat milk with taxifolin exceeded the critical value ten times compared to the corresponding indicator in whole milk.

5. 2. Investigating the influence of taxifolin on the dynamics of titrated and active acidity of pasteurized milk during storage

The acidity of the product has one of the decisive influences on the taste characteristics of a dairy product when consumers choose it. A study of physicochemical indicators, in particular the titrated and active acidity of pasteurized milk with taxifolin during storage, was conducted.

The dynamics of titrated acidity values in pasteurized milk with taxifolin and control samples during storage (56 days) was studied. The research results are shown in Fig. 3, 4.

It was established (Fig. 3, 4) that for experimental samples of low-fat and whole pasteurized milk with taxifolin, the titrated acidity indicators exceeded the established regulatory values after 49 days. For control samples of low-fat and whole pasteurized milk, the titrated acidity indicator reached this value after 21 days and 35 days, respectively. It is obvious that the increase in acidity in the experimental and control samples occurred with the participation of microorganisms that remained after heat treatment of milk. Thus, it can be assumed that taxifolin slows down the increase in acidity caused by the formation of lactic acid by bacteria.

The effect of taxifolin on the dynamics of active acidity indicators of low-fat and whole pasteurized milk with taxifolin and control samples during storage was studied. The results are shown in Fig. 5, 6.

It was established (Fig. 5, 6) that the active acidity in low-fat milk with taxifolin met the requirements for 28 days of storage, in whole milk with taxifolin – for 35 days, in contrast to the control samples, where the active acidity met the requirements for 14 days and 28 days, respectively. That is, changes in the active acidity indicators occurred in low-fat pasteurized milk with taxifolin – after 14 days, in pasteurized milk with taxifolin – after 7 days compared to the control samples.

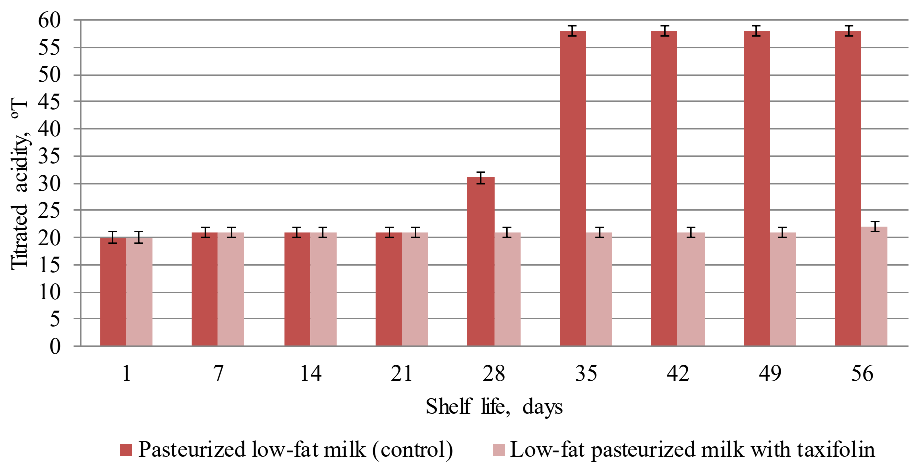

Fig. 3. Dynamics of titrated acidity indicators in low-fat pasteurized milk (control) and low-fat pasteurized milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

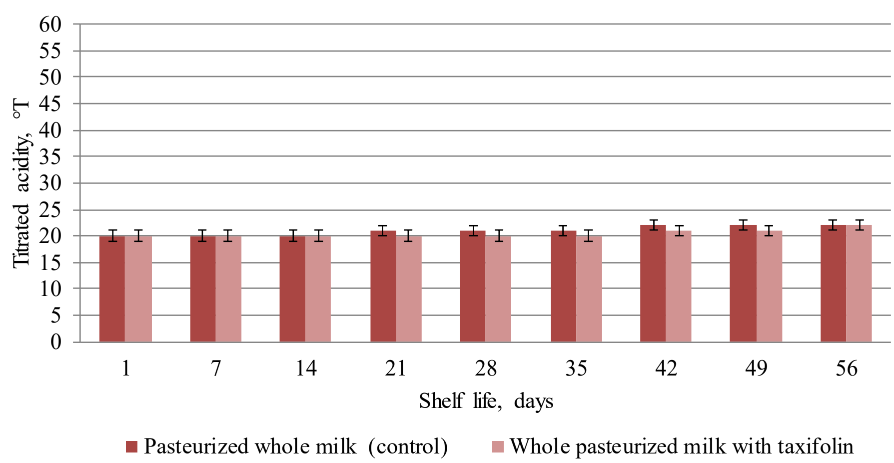

Fig. 4. Dynamics of titrated acidity indicators in whole pasteurized milk (control) and whole pasteurized milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

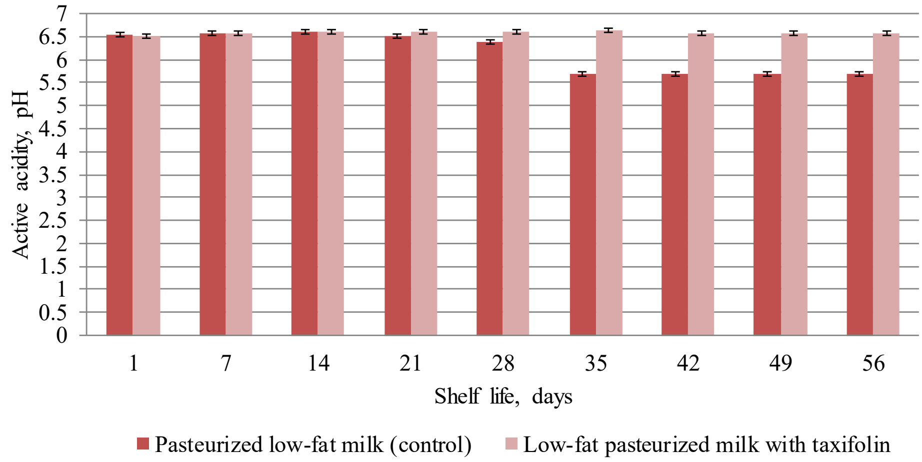

Fig. 5. Dynamics of active acidity indicators in low-fat pasteurized milk (control) and low-fat pasteurized milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

Fig. 6. Dynamics of active acidity indicators in whole pasteurized milk (control) and whole pasteurized milk with taxifolin during storage (mean ± standard error, $n = 3$, $p < 0.05$)

Thus, studies on the dynamics of titrated and active acidity indicators indirectly indicate that the introduction of taxifolin affects the course of microbiological processes associated with the development of residual microflora.

5. 3. Investigating the effect of taxifolin on the organoleptic indicators of pasteurized milk during storage

We investigated the effect of taxifolin on the sensory characteristics of low-fat and whole pasteurized milk with taxifolin and control samples of the product within the established factual changes in microbiological and physicochemical indicators during storage.

The results of the organoleptic indicators of the product are given in Table 1.

Studies of organoleptic indicators of experimental and control samples of the product showed that the introduction of taxifolin did not lead to a deterioration in the organoleptic properties of pasteurized milk. The effectiveness of taxifolin during a long storage period was manifested in whole milk samples. Thus, in low-fat pasteurized milk with taxifolin, a bitter taste was detected after 28 days, unlike low-fat pasteurized milk (control), where this defect was recorded after 14 days. As for whole pasteurized milk with taxifolin and whole pasteurized milk (control), the visual fixation of the presence of protein flakes occurred after 42 days and 28 days of storage, respectively. In whole pasteurized milk with taxifolin and the corresponding control sample, no bitter taste was observed during the entire storage period (56 days).

Table 1

Organoleptic characteristics of low-fat and whole pasteurized milk with taxifolin and control samples during storage

Product name	Analysis time, in 24 hours	Taste and smell	Consistency
1	2	3	4
Non-fat pasteurized milk (control)	1	Clean, typical of low-fat milk, without foreign, non-milk-specific flavors and odors. With a slight aftertaste of pasteurization	Homogeneous liquid without sediment and protein flakes
	7		
	14	Taste is bitter	Homogeneous liquid without sediment and protein flakes

Continuation Table 1

1	2	3	4
Low-fat pasteurized milk with taxifolin	1	Clean, typical of low-fat milk, without foreign, non-milk-specific flavors and odors. With a slight aftertaste of pasteurization	Homogeneous liquid without sediment and protein flakes
	7		
	14		
	21		
	28	Taste is bitter	Homogeneous liquid without sediment and protein flakes
Whole pasteurized milk (control)	1	Clean, without foreign flavors and odors not inherent in fresh milk. With a slight taste of pasteurization	Homogeneous liquid without sediment, protein flakes, and fat lumps
	7		
	14		
	21		
	28	Clean, without foreign flavors and odors not inherent in fresh milk. With a slight taste of pasteurization	Protein flakes are present
	35		
	42		
	49		
	56		
Whole milk pasteurized with taxifolin	1	Clean, without foreign flavors and odors not inherent in fresh milk. With a slight taste of pasteurization	Homogeneous liquid without sediment, protein flakes, and fat lumps
	7		
	14		
	21		
	28		
	35		
	42	Clean, without foreign flavors and odors not inherent in fresh milk. With a slight taste of pasteurization	Protein flakes are present
	49		
	56		

5. 4. Analysis of permissible values of quality and safety indicators and determining the shelf life of milk with taxifolin

Based on the results of our studies of organoleptic, physicochemical, and microbiological indicators of low-fat and whole milk with taxifolin and control samples during 56 days of storage, we summarized the data on the compliance of the shelf lives of the studied samples with the regulated values (Table 2).

It is noted (Table 2) that the shelf life of the control samples of pasteurized low-fat and whole milk was 7 days and 21 days, respectively. For the experimental samples of low-fat and whole pasteurized milk with taxifolin, the shelf life was 14 days and 35 days, respectively.

Taking into account our results (Table 2), it can be concluded that the guaranteed shelf life before consumption of low-fat pasteurized milk with taxifolin can be 14 days, and of whole pasteurized milk with taxifolin – 35 days. That is, the shelf life of low-fat pasteurized milk with taxifolin compared to low-fat pasteurized milk is extended by 7 days. For whole pasteurized milk with taxifolin compared to whole pasteurized milk, the shelf life is extended by 14 days.

6. Discussion of results based on investigating the influence of taxifolin on the quality and safety indicators of pasteurized milk during storage

Analysis of our results has confirmed the positive effect of the use of taxifolin on the quality indicators of milk, which affect its storage capacity. The results of microbiological studies indicate the inhibition of the development of the group of mesophilic aerobic and facultative anaerobic microorganisms in the experimental samples with taxifolin (Fig. 1, 2). This pattern is accompanied by a slowdown in the acid-forming activity of microorganisms in the experimental samples of pasteurized milk with taxifolin. Namely, for low-fat milk (Fig. 3) and whole milk (Fig. 4) with taxifolin, the titrated acidity indicators exceeded the established regulatory values after 49 days. For the control samples of low-fat and whole pasteurized milk, the titrated acidity indicator reached this value after 21 days and 35 days, respectively. It is obvious that taxifolin causes a bacteriostatic effect, since in the experimental samples at the end of the study period an increase in QMAFAnM was noted above 1×10^6 CFU/cm^3.

Table 2

Values of organoleptic, physicochemical, and microbiological indicators during milk storage

Product	Pasteurized low-fat milk (control)	Low-fat pasteurized milk with taxifolin	Pasteurized whole milk (control)	Whole milk pasteurized with taxifolin
Organoleptic indicators, corresponding to regulated values, on day	7	21	21	35
Titrated acidity, °T, corresponds to regulated values, on day	21	49	35	49
Active acidity, pH, corresponds to regulated values, on day	14	28	28	35
The quantity of mesophilic aerobic and facultative anaerobic microorganisms (QMAFAnM), CFU/cm^3, corresponds to the regulated values, on day	7	14	21	35
Expiration date, days	7	14	21	35

The differences in the dynamics of microbiological processes in the experimental samples, in which the development of microorganisms in low-fat milk occurred more intensively than in whole milk, indicate a significant influence of the composition of the medium, in particular, the fat phase. The QMAFAnM indicator in samples of low-fat milk with taxifolin exceeded the critical value ten times in comparison with the corresponding indicator of whole milk (Fig. 1, 2).

It was established that due to taxifolin, the acid-forming ability of microorganisms in the experimental samples was lower. Thus, the active acidity in the experimental samples was within 6.5–6.6 pH units for 14 days longer compared to low-fat pasteurized milk without taxifolin (Fig. 5, 6). In whole pasteurized milk with taxifolin (Table 2), the active acidity met the requirements for 7 days longer (28 and 35 days, respectively), compared with whole pasteurized milk (control). These data were consistent with the sensory evaluation data of the experimental and control samples (Table 2). It is obvious that such changes are caused by a decrease in the metabolic activity of microorganisms to utilize lactose. However, the results of studies on the increase in active and titrated acidity may indirectly indicate the influence of taxifolin on the dynamics of microbiological processes in pasteurized milk.

Compared with the data reported in work [17] on the use of dihydroquercetin in the amount of 0.012% in the recipe of curd pastes, in pasteurized milk a similar effect of antimicrobial action was found when adding a dose of taxifolin in the amount of 0.002%. Such a dose ensures the preservation of organoleptic, physicochemical, and microbiological indicators of milk during the established storage period (Table 2). In this regard, it would be informative to study the loss of lactose in milk. Therefore, further studies may include research into the effect of taxifolin on the dynamics of lactose content in milk during storage.

7. Conclusions

1. The introduction of taxifolin slows down the development of microorganisms in the experimental milk samples in comparison with the corresponding control samples. Thus, the QMAFAnM indicator exceeded the permissible level of 1×10^5 CFU/cm^3 in the experimental sample of low-fat pasteurized milk after 14 days; in whole pasteurized milk, after 35 days of storage. At the same time, in both control samples, QMAFAnM reached the regulated value after 7 days and 21 days of storage.

2. It was established that during storage, the dynamics of titrated and active acidity in the experimental milk samples with taxifolin slowed down in comparison with the control samples. Apparently, this was due to the suppression by taxifolin of the development of residual microbiota, which causes acid formation.

3. The introduction of taxifolin had a positive effect on the preservation of the organoleptic properties of low-fat and whole pasteurized milk compared to control samples without taxifolin.

4. Analysis of the set of quality indicators of pasteurized milk allowed us to determine that the shelf life of low-fat pasteurized milk with taxifolin is 14 days; and whole pasteurized milk with taxifolin is 35 days. It has been proven that for low-fat pasteurized milk with taxifolin, compared to low-fat pasteurized milk, the shelf life is extended by 7 days. For whole pasteurized milk with taxifolin, compared to whole pasteurized milk, the shelf life is extended by 14 days.

Conflicts of interest

The authors declare that they have no conflicts of interest in relation to the current study, including financial, personal, authorship, or any other, that could affect the study and the results reported in this paper.

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Data availability

All data are available in the main text of the manuscript.

Use of artificial intelligence

In the process of writing the manuscript, the authors used the artificial intelligence tool ChatGPT (version GPT-5) to check grammar, spelling, punctuation without changing the text, and search for sources using keywords and criteria.

The entire text of the manuscript, including the statement of the goal, objectives, description of materials and methods, presentation of research results, their discussion, and conclusions, was written by the authors independently based on their own experimental data.

All authors have read and agreed to the published version of the manuscript and are jointly responsible for the reliability, accuracy, and integrity of the data and research results reported in the paper.

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