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The study of nutritional value and microbiological characteristics of brine cheese with vegetable additive

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ABSTRACT

This article investigated brine cheeses' nutritional value and safety by adding vegetable additives (dry powder of white cabbage and coriander). Brynza brine cheese was used as the basis for the recipe. By the chemical composition of the cheese with vegetable, additives has a significantly higher protein content (26.27 g/100g), while the fat content is lower (14.98 g/100g). There is a high content of amino acids and fatty acids (PUFA 6%, MUFA 24%). During prolonged storage of brine cheese, water activity aw decreases in control from 0.997 to 0.990, mass fraction of moisture increases from 60% to 62.5%, in the brine cheese with vegetable additives aw from 0.998 to 0.991, mass fraction of moisture from 61.1% to 63.7%.The use of vegetable additives in the formulation of cheeses does not affect the deterioration of microbiological parameters compared to the control sample. As a result of experimental studies, the shelf life of brine cheese with vegetable additives is 8-10 days.

Keywords: brine, cheese, white cabbage, cilantro, water activity, shelf life

INTRODUCTION

The cheese market occupies a significant share of dairy products in the Republic of Kazakhstan of its high demand. Brine cheeses are the most prominent among other types of cheeses. Brine cheeses are made from different types of milk (cow, sheep, goat, buffalo) or their mixtures. They are ripened in brine, have a specific sharp-salty taste, and have a soft, flaky or slightly brittle consistency **[1]**. A crust on the surface does not characterize these cheeses. Brine cheeses include Brynza, Suluguni, Chanakh, Adygei, Georgian, Ossetian, Lori, Chechil, Aiman **[2]**.

Brynza is the most common brine cheese. It is produced from sheep or cow's milk by curdling with a lactic starter and rennet. The taste of brynza is sour milk, salty, the consistency is slightly brittle but not crumbly, and there is no pattern. Like all brine cheeses, it has no crust. The period of brynza ripening from pasteurized milk is 20 days, from raw milk – 60 days **[3], [4]**. The composition of brynza is well-balanced and has a particularly positive effect on the body. This product contains a lot of protein, which provides the body's cells with energy. The large amount of calcium, which is easily assimilated, helps to enrich the body with a daily rate of this mineral, and normalizes blood formation **[5]**, **[6]**.

The quality of raw materials and the processing technology determines cheese quality. The chemical composition, physical properties and microbiological parameters of processed milk determine the cheesiness of milk, i.e. its ability to clot, clot formation of proper consistency, as well as the ability to ferment and create the medium necessary for the development and activity of beneficial microorganisms, primarily lactic acid bacteria **[7]**, **[8]**.

Plant additives are appropriate to use as a source of biologically active substances in creating new technologies and formulations of milk products. One such plant additive is cilantro. Cilantro contains a lot of fiber, B vitamins and antioxidants. All the benefits are concentrated in the stem and leaves. The plant contains high amounts of minerals: iodine, and phosphorus. Potassium is high in cilantro, so it is often included in the diet of people with diseases of the cardiovascular system.

It contains biologically active components, mainly α-pinene, α-terpinene and limonene, as well as flavonoids, coumarins, phthalides and phenolic acids **[9]**, **[10]**. The addition of cilantro in food increases the content of antioxidants and has the potential to act as a natural antioxidant and thus prevent unwanted oxidative processes **[11]**, **[12]**. The results show that cilantro extract can be added to milk products as a natural food preservative to improve stability during storage **[13]**.

White cabbage (*Brassica oleracea* L. var. *capitata f. alba*) is a widely used green leafy vegetable of the cruciferous family, belonging to the Brassicaceae family **[14]**. White cabbage contains 16 free amino acids (among them tryptophan, lysine, methionine, tyrosine, histamine and others). Cabbage is rich in vitamins A, B1, B6, C, P, K, antiulcer vitamin U, salts of potassium and phosphorus, and trace elements: cobalt, copper, zinc, and magnesium. It contains sugars, fats, enzymes (lactose, protease, lipase), hormonal substances, and phytoncides **[15]**, **[16]**.

Cabbage leaves contain fibre, which prevents the development of atherosclerosis and improves the function of the gastrointestinal tract. The most important mineral salts are potassium salts, which activate the removal of excess fluid from the body, and sodium salts, which have the property of binding water **[17]**. Cabbage has anti-inflammatory properties. It has a stimulating effect on the body's metabolic processes, stimulates the production of gastric juice, and has a positive effect on cardiac activity. The product is useful for gout, kidney disease, cholelithiasis and ischemia **[18]**, **[19]**.

This work aims to study brine cheese's nutritional value and safety by adding vegetable additives.

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Scientific hypothesis

Incorporating white cabbage and cilantro into the recipe of brine cheeses increases the nutritional value, inhibits the growth of microorganisms, and does not adversely affect sensory properties.

MATERIAL AND METHODOLOGY

Samples

To produce brine cheese with vegetable additives, the following components are used:

- cow's milk, acidity not more than 19 T, density not less than 1030 kg/dm^3;
- White cabbage (*Brássica oleracea*) variety "Present", belongs to the cruciferous family;
- *Coriándrum sátivum* is an annual herbaceous plant of the cilantro genus (*Coriandrum*), of the Umbrella family (*Apiaceae*);
- Starter cultures of Bulgarian bacillus pure cultures, milk-enzymatic preparation of microbial origin "Renin".

Chemicals

Calcium chloride technical (E 509) (Labor Farma Limited Liability Partnership, Kazakhstan).
Chromocult Coliform Agar (Merck KGaA, Germany).
Chromocult Listeria Selective Agar (Merck KGaA, Germany).
Byrd-Parker agar (Sigma-Aldrich, USA).
Sabouraud Agar (Sigma-Aldrich, USA).
Kessler-GRM medium (Azimut, Russia).
Hexane (Labor Farma Limited Liability Partnership, Kazakhstan).
Ethyl alcohol (90%, Pharmacy 2010 Limited Liability Partnership, Kazakhstan).
Potassium hydroxide (Labor Farma Limited Liability Partnership, Kazakhstan).

Instruments

Microbial Colony Counter SKM-2 (Stegler Company, Russia).
Shaker (S-3L, producer (ELMI) Limited trade development, Latvia).
Drying chamber SNOL (Snol Company, Lithuania).
Mikmed-5 microscope (binocular) (LOMO Company, Russia).
Measuring flask (500 ml, producer (Altey Group) Limited liability company, Russia).
Armed HH-S4 water bath (Armed Company, Russia).
pH-meter pH-150MI (Measurement Technology Company, Russia).
Shimadzu Prominence LC-20 liquid chromatograph (HPLC, Shimadzu Corporation, Japan).

Agilent 7890A Gas Chromatograph (Agilent Technologies, USA).

Laboratory Methods

Determination of physicochemical and organoleptic indicators: Fat was determined by the methods specified in GOST 5867 **[20]**. Determination of moisture and dry matter was performed by GOST 3626 **[21]**. Determination of active acidity by GOST 32892 **[22]**. The method by GOST-32260 [23] was used for organoleptic evaluation of brine cheeses. Determination of amino acid composition was carried out by the method described in **[24]**. Fatty acid composition was determined by the method described in **[25]**.

Determination of water activity: The methodology for determining the water activity (a_w) is based on measuring the intensity of moisture exchange between the product surface and the environment by the product surface temperature during moisture evaporation and the temperature of the wet thermometer.

The water activity (aw) is determined by measuring and computing device. Calculation of the water activity (a_w) is made by the formula (2) **[26]**:

$$a_w = 1 - K\left[\frac{T_2 + T_3 + T_4}{3 - T_1}\right];$$

Where:
T_2, T_3, T_4 – product surface temperature, °C; T_1 – wet bulb temperature, °C; K – coefficient accounting for the barometric pressure in the measuring environment, which is equal: 760 mmHg - 0.070;755 mmHg - 0.069;750 mmHg - 0.068; 745 mmHg -0.067.

Preparation of samples for measurement was carried out as follows: samples of semi-hard cheese were cut in the form of a hollow cylinder 7 mm in length and 5 mm in diameter, equal to the diameter of the sensor of the device. It is necessary to note that tight contact of the product with the sensors must be guaranteed. The fourth sensor was wetted with distilled water and kept wet until the end of the measurement process **[26]**.

Determination of microbiological parameters: Determination of *Staphylococcus aureus, Salmonella, Listeria Monocytogenes,* yeasts and moulds of cheese products were determined following state standards of the Republic of Kazakhstan:

- GOST 30347-2016. Milk and dairy products. Methods of determination of *Staphylococcus aureus*.
- GOST 31659-2012. Food products. Method for the detection of bacteria of type *Salmonella*.
- GOST 32031-2012. Foodstuffs. Methods of detection of *Listeria Monocytogenes* bacteria.
- GOST 33566-2015. Milk and dairy products. Determination of yeasts and moulds.

Determination of coliform bacteria: Test procedure: 1 cm³ of the sample is inoculated into a test tube with 5 cm³ of liquid medium. The tube with inoculations is placed in the thermostat for 18-24 hours at 37 °C. After 24 hours, the tube is inspected, and the presence or absence of gas is visually determined. If there is gas formation, it is considered that coliform bacteria is found. If there is no outgassing, it is concluded that the coliform bacteria in the product is not detected, i.e. the product is safe for this indicator **[27]**.

Counting microbial colonies: Test procedures: 14 cm³ of nutrient medium is poured into a Petri dish and 0.1 cm³ of the sample is inoculated. After filling, the mixture is stirred thoroughly by gentle shaking to distribute the media evenly. After the medium has solidified in the Petri dish, it is turned upside down and placed in a thermostat at 30˚C for 72 hours. Results processing: after the time has passed, colony counting begins. The bottom of the Petri dish is divided into two to three sectors. In each sector, the number of colonies is counted. The formula calculates the number of mesophilic aerobic and facultatively anaerobic microorganisms X in 1 cm³ or 1 g of the product **[28]**.

$$X = n \cdot 10^m$$

Where:
n – the number of colonies counted on a Petri dish; m – the number of tenfold dilutions.

The arithmetic mean obtained for all dishes is taken as the final result of the analysis.

Description of the Experiment

Production of brine cheeses with vegetable additives: As a control sample, the traditional brine cheese "Brynza" without adding the vegetable mixture, following GOST R 53421-2009 "Brine cheeses" was used. Both control and experimental samples of brine cheeses were made in the milk enterprise "Aisha" (Semey city, Kazakhstan). The recipe composition of brine cheese is presented in Table 1.

Table 1 Recipe of brine cheese.

Ingredient	Consumption rate, kg/100 kg
Cow milk	100
Table salt	0.3
Water	20
Bacterial starter	0.4
Vegetable additives	0.3

Figure 1 Samples of brine cheese with plant additives.

Whole cow's milk with an acidity of 18-20 °T produces brine cheese. Milk must meet the physicochemical composition requirements specified by the cheese industry. In order to kill pathogenic bacteria and undesirable vegetative forms harmful to cheese microorganisms, milk is pasteurized at a temperature of (72-75) °C, holding (for 20-25) s. The pasteurized milk is then cooled to a temperature of 30 °C, and 1.5-2% starter is added. Starter cultures of Bulgarian bacillus pure cultures, milk-enzymatic preparation of microbial origin "Renin". The initial concentration of starter culture in brine cheese production was 2% (w/v) of the milk used for the cheese. Then rennet is added to the milk mass for milk coagulation during 35-40 minutes. The ready clot is cut into cubes of size 15×20 mm and is left at rest to fix the cheese grain for 5 min. Next, the cheese mixture is kneaded for 20-30 minutes. Then the whey is removed, and table salt at 300 g per 100 kg of the mixture and vegetable raw materials are added to the cheese mass. The mixture of cheese mass with a small amount of whey is evenly poured into pre-prepared forms. Then the cheese is self-pressed for 20-30 minutes. The cheese heads are turned over every 10 minutes. Then it is pressed for 25-40 minutes at a temperature of (18-22) °C. Next, the cheese is ripened for 24 h at (8-10) ºC. The finished cheese is packed in a shrinkable vacuum bag, labelled and sent for sale. The cheese is stored at a temperature of 8 ±2 °C, a humidity 85% 8-10 days (Figure 1).

Number of samples analyzed: To analyze the nutritional value and safety of brine cheeses, 30 samples of cheese were studied.

Number of repeated analyses: Each study was carried out 3 times, with the number of samples being 30, which amounted to 90 repeated analyses.

Number of experiment replication: The study was repeated three times, with the experimental data processed using mathematical statistics methods.

Design of the experiment: At the beginning of the experiment, we analyzed the organoleptic characteristics and physical and chemical properties of brine cheeses. The nutritional value, amino acid, fatty acid composition, microbiological characteristics, and water activite were studied. Based on the data obtained, determine the recipe for brine cheese with adding vegetable additives.

Statistical Analysis

The results of measurements were analyzed using Statistica 12 PL software (StatSoft, Inc., Tulsa, OK, USA). The differences between the samples were evaluated using a one-way ANOVA, $p < 0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

Plant proteins have a higher water-holding capacity compared to milk proteins. Therefore, the dose of plant components added to the cheese grain significantly impacts the curdling time and the clot's active and titratable acidity **[29]**, **[30]**. The main goal of brine cheese production is to obtain a quality and safe product. The organoleptic characteristics of produced samples are shown in Table 2 and compared with the organoleptic properties of Brynza brine cheese without additives. Physico-chemical characteristics of brine cheese in comparison with the control brine cheese "Brynza" from cow's milk are shown in Table 3.

Table 2 Organoleptic characteristics of brine cheese with vegetable additives.

Indicator	Brynza brine cheese (control)	Brine cheese with vegetable additives
Appearance	Low cylinder shape	Low cylinder shape
Taste and odor	Sour, with no extraneous flavors or odors	Sour, with no extraneous flavors and smells. With a slight taste of cilantro and cabbage greens
Consistency	Tender smeary, slightly crumbly. No pattern	Tender smeary, slightly crumbly. No pattern
Color	White, homogenous on the whole mass	White, homogenous over the whole mass. With flecks of plant additives throughout the mass

Table 3 Physical and chemical properties of brine cheese.

Indicator	Brynza brine cheese (control)	Brine cheese with vegetable additives
Mass fraction of moisture, %	62.1 ±0.71	63.7 ±0.85
Mass fraction of moisture in skimmed product, %	85.0 ±1.13	88.2 ±1.32
Mass fraction of table salt, %	2.60 ±0.04	1.25 ±0.02*
Mass fraction of fat in dry matter, %	80.1 ±1.4	76.6 ±1.0

Note: *$p < 0.05$.

At the next stage, we studied the microbiological parameters of brine cheese, which are presented in Table 4, the norms of which are regulated in the document TR CU 033/2013 "On the safety of milk and dairy products": Technical Regulation of the Customs Union: approved by the Commission of the Customs Union on October 9, 2013, No. 67 **[31]**.

Table 4 Microbiological analysis of brine cheese.

Name	Indicator	Result	Regulated parameter [25]
Brine cheese with plant additives	Coliform bacteria	Not detected in 0.001 g	Not allowed in 0.001 g
	Pathogens, including *Salmonella*	Not detected in 25 g	Not allowed in 25 g
	S. aureus	Not detected in 0.001 g	Not allowed in 0.001 g
	L. monocytogenes	Not detected in 25 g	Not allowed in 25 g

Cheese is a high-protein, biologically complete food product containing all essential amino acids in proteins. Nutritional and energy value of the brine cheese with vegetable additives compared with the brine cheese "Brynza" without additives are presented in Table 5.

Table 5 Nutritional and energy value of brine cheese with vegetable additives, %.

Indicator	Brynza brine cheese (control)	Brine cheese with vegetable additives
Nutritional value, g per 100g		
Protein	19.1 ±0.23	26.27 ±0.64*
Fats	21.6 ±0.36	14.98 ±0.22*
Carbohydrates	3.67 ±0.07	3.07 ±0.05*
Moisture	45.0 ±0.53	52.82 ±0.85*
Ash	3.10 ±0.05	2.86 ±0.05*
Energy value, in 100 g		
Kcal	271	252
KJ	1135	1054

Regarding the biological, nutritional and energy value of brine cheese, it is possible to recommend it for the diet of all age groups. To assess the biological value of cheese, we determined the amino acid and fatty acid composition. Analysis of the amino acid composition is presented in Table 6.

Table 6 Amino acid composition of brine cheese (mg/100 g protein)

Amino acid	Brine cheese with vegetable additives
Aspartic acid	1363.53 ±20.03
Glutamic acid	3964.26 ±55.51
Serine	1664.31 ±21.81
Histidine	4542.26 ±71.57
Glycine	236.52 ±2.79
Threonine	1163.13 ±21.80
Arginine	838.84 ±11.70
Alanine	496.49 ±9.42
Tyrosine	1385.00 ±10.84
Cysteine	505.94 ±6.19
Valine	4481.85 ±53.57
Methionine	739.33 ±7.34
Phenylalanine	407.80 ±5.56
Leucine	2026.40 ±26.89
Isoleucine	388.99 ±7.29
Lysine	324.49 ±4.11
Tryptophan	266.70 ±5.01
Proline	41.13 ±0.69

Analysis of the results shows a wide range of free amino acids in the experimental cheese. The protein of the cheese is well-balanced and contains all essential amino acids.

The results of the fatty acid composition of experimental brine cheese with vegetable additives are presented in Table 7.

The research results show that brine cheese with vegetable additives contains 6% polyunsaturated fatty acids and 24% monounsaturated fatty acids.

Table 7 Fatty acid composition of brine cheese with vegetable additives, %.

Fatty acid, %	Brine cheese with vegetable additives
Saturated fatty acids	
$C_{4:0}$ butyric acid	4.24 ±0.06
$C_{6:0}$ caproic acid	2.49 ±0.04
$C_{8:0}$ caprylic acid	1.39±0.03
$C_{10:0}$ caprinic acid	3.00 ±0.07
$C_{12:0}$ lauric acid	3.01 ±0.06
$C_{14:0}$ myristic acid	9.28 ±0.12
$C_{16:0}$ palmitic acid	26.92 ±0.50
$C_{18:0}$ stearic acid	12.75 ±0.21
$C_{22:0}$ behenic acid	0.52 ±0.01
$C_{20:0}$ arachidic acid	0.11 ±0.01
Monounsaturated fatty acids	
$C_{14:1}$ (cis-9) myristoleic acid	0.34 ±0.01
$C_{16:1}$(cis-9) palmitoleic acid	0.78 ±0.01
$C_{18:1n9c}$ oleic acid	22.74 ±0.33
Polyunsaturated fatty acids	
$C_{18:2n6c}$ linolic acid	4.07 ±0.03
$C_{18:3n3}$ linoleic acid	1.68 ±0.02

Determination of the shelf life of brine cheese

The main task in developing a new product is to determine the shelf life of the finished product. It is important to determine the microbiological parameters when validating the shelf life of brine cheese made of cow's milk **[32]**, **[33]**. The issues related to preserving quality and reducing food losses during long-term storage are among the most important tasks facing the processing industry workers. Determining the shelf life of cheese requires a detailed study of the influence of external factors (ambient temperature, relative humidity, etc.) on the change of cheese quality indicators **[34]**, **[35], [36]**. Currently, for all types of foodstuffs, there are standard storage times regulated by State Standard, which, however, do not consider the possible deviations of some parameters when changing storage conditions. In this regard, focusing only on the specified storage time of food products and not taking into account their state of moisture, it is impossible to accurately predict the high quality of food products during their storage **[37], [38]**.

Studies of cheese storage ability were conducted in laboratory conditions at storage temperature (8 ±2 °C) for 3, 5, 10, 12, and 15 days with a relative humidity of 80-85%. Brinza" brine cheese was used as a control.

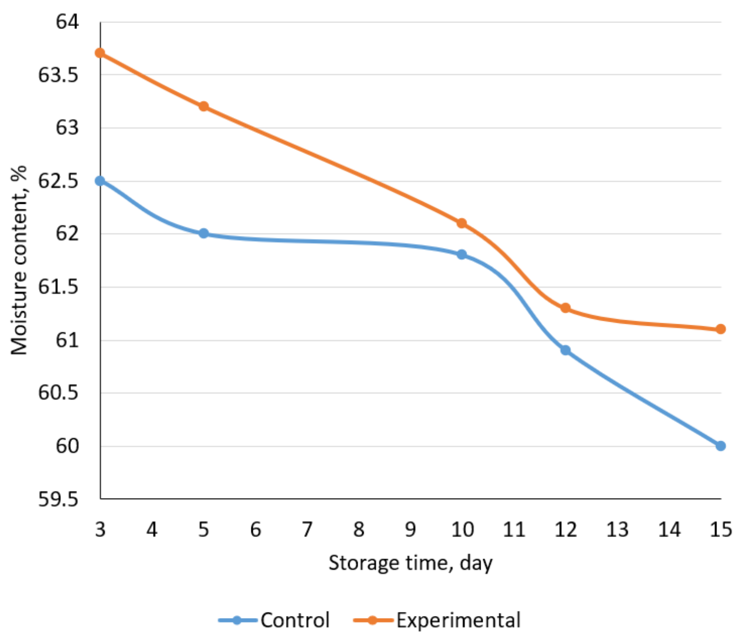

Figure 2 Changes in the mass fraction of moisture in brine cheeses depending on the storage time.

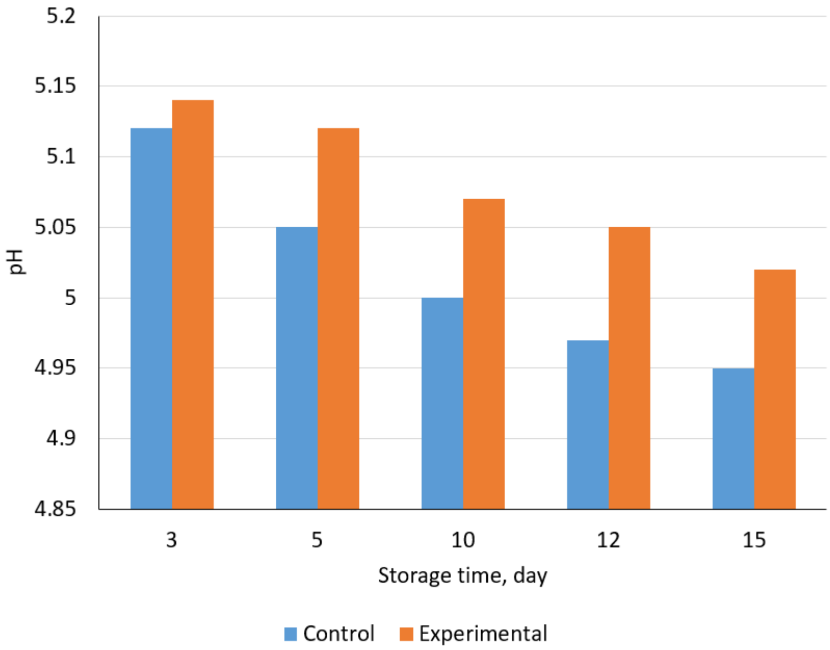

Figure 3 Changes in pH of brine cheeses depending on the storage time.

According to the result during storage, the moisture content of the experimental brine cheese compared to the control cheese did not significantly differ (Figure 2). However, during the storage of brine cheeses on the 10th day, there was a decrease in active acidity pH 5.12-4.95 (Figure 3).

WATER ACTIVITY

Water accounts for the largest proportion of fresh brine cheeses. Technological properties, consumer properties and shelf life of brine cheeses are determined largely by the properties of the contained water. The moisture in the product is associated with its dry weight, and the form and energy of the connection of this moisture are different.

As a component of food products, water significantly affects such important indicators as organoleptic and rheological properties, microbial spoilage, growth of pathogenic microorganisms and quality reduction as a result of physical, chemical and biochemical reactions **[39]**, **[40], [41]**. The product's vulnerability to bacterial spoilage depends on moisture and its physical state, which is estimated by the water activity aw. Determining water activity during product manufacture helps control the technological process and the yield and quality of the output products. In addition, water activity value shows microbial, enzymatic, chemical, and physical changes in food products **[42]**, **[43]**.

Both by the amount of moisture and water activity the following products are distinguished: products with high moisture (aw = 1.0-0.9); products with intermediate moisture (aw = 0.9-0.6); products with low moisture (aw = 0.6-0.0). The dried product's moisture interaction with air distinguishes the moisture as hygroscopic, equilibrium and free moisture **[44]**, **[45]**. Thus, by controlling the functional and technological parameters in the product and, in particular, the indicator "water activity", we can predict its ability to store, which will create "stability maps" of milk products and determine the optimal conditions for their storage. In this regard, we investigated the dynamics of changes in the water activity of brine cheese during ripening.

It is known that water activity and mass fraction of food products' moisture are among the main indicators determining such important properties as shelf life **[46]**, **[47]**. In this regard, studies were conducted to determine the optimal technological parameters of the studied products' water activity and mass fraction of moisture. The results of the study of the water activity of brine cheeses are presented in Figure 4.

It was found that during prolonged storage of brine cheese *aw* decreased in control from 0.997 to 0.990, the mass fraction of moisture increased from 60% to 62.5%, in the brine cheese with vegetable additives aw decreased from 0.998 to 0.991, the mass fraction of moisture increases from 61.1% to 63.7%.

The reduction of water activity is associated with table salt in the cheese product. The content of table salt reduces at the highest level of aw. This is due to the ability of sodium chloride to electrolytic dissociation, which increases by several times the effective concentration of particles **[48]**, **[49]**, **[50]**.

The main sugars in white cabbage are glucose and fructose. Regarding the glucose content (2.6%), white cabbage surpasses the most common vegetable crops: apples, oranges, and lemons. It surpasses potatoes (1.6

times) and beets, onions, and lemons for fructose content. Cilantro also contains small amounts of glucose, fructose and sucrose.

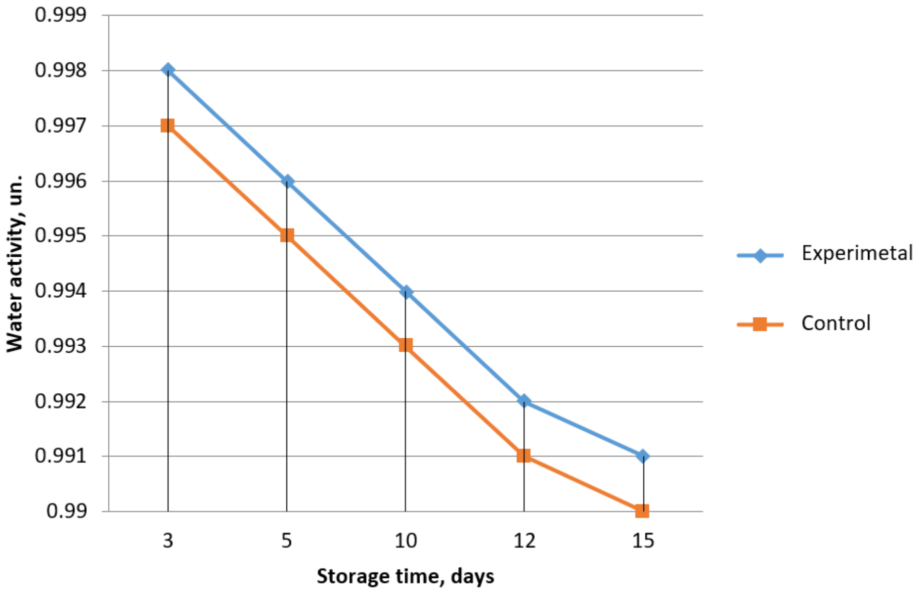

Figure 4 Change of water activity (a_w) of brine cheeses during storage.

The decrease in water activity is also due to sucrose, glucose and fructose, which can dissolve in the aqueous phase of the product, thereby increasing the osmotic concentration **[51]**, **[52]**. It is also possible to explain the reduction of water activity in cheese products by the fact that the reactions of the biochemical order occurring in products during storage are hydrolysis reactions, in which water retention occurs. As a result, there is a decrease in the free water content and accordingly, the indicator of water activity decreases.

For the microbiological safety criteria of brine cheeses with vegetables, additives were selected the following indicators: the titer of E. coli bacteria, the number of S.aureus bacteria belonging to the group of opportunistic pathogens, including Salmonella in 25 g of product (Figure 5).

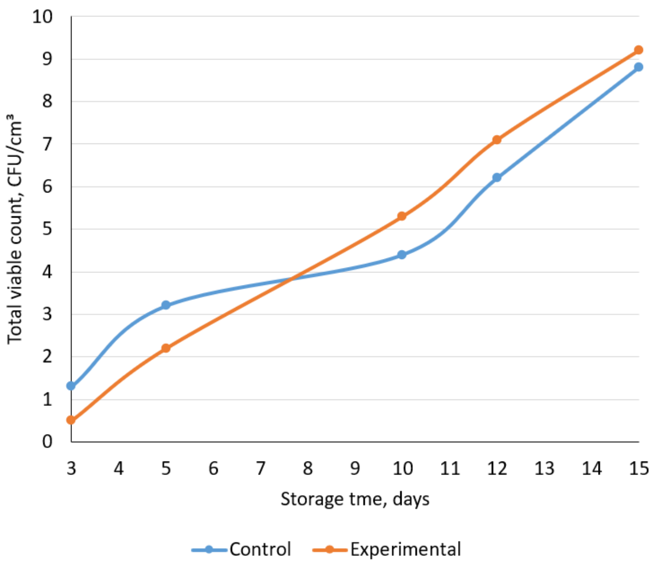

Figure 5 Changes in the total viable count of brine cheeses depending on the storage time.

When justifying the shelf life of new brine cheese, it is important to determine the content of microscopic fungi and yeasts, indicators of microbiological stability. It is known that fungi and yeasts can grow at low positive temperatures **[53]**, **[54]**. The development of mould fungi on the surface of brine cheeses decreases the marketable appearance and changes in protein and fat content since most fungi have lipolytic and proteolytic activities. The development of mold fungi in cheese is undesirable because it can lead to the penetration of toxins into the product to a depth of 2-4 cm **[55]**, **[56]**, **[57]**.

As a result of these studies, salmonella bacteria were not detected in any of the experimental samples. In experimental and control samples, the content of microscopic fungi and yeasts was determined, the total bacterial insemination in freshly produced cheese and the dynamics of their growth during storage. The results are presented in Table 8.

Table 8 Microbiological characteristics of brine cheese with vegetable additives.

Indicator	Storage time, day				
	3	**5**	**10**	**12**	**15**
Control brine cheese "Brynza"					
Total viable count, CFU/cm^3	1.3×10	3.2×10	4.4×10	6.2×10	8.8×10
Coliform bacteria, in 0.001 g of product weight	Not detected				
Pathogenic microorganisms, including *Salmonella* and *S. aureus*, in 25 g of product weight	Not detected				
Listeria monocytogenes, in 0.001 g of product mass	Not detected				
Yeast, CFU/g, in 0.1 g of product	-	-	1	1.3×10	2.9×10
Molds, CFU/g, in 0.1 g of product)	-	-	-	2	3.1×10
Brine cheese with vegetable additives					
Total viable count, CFU/cm^3	0.5×10	2.2×10	5.3×10	7.1×10	9.2×10
Coliform bacteria, in 0.001 g of product weight	Not detected				
Pathogenic microorganisms, including *Salmonella* and *S. aureus*, in 25 g of product weight	Not detected				
Listeria monocytogenes, in 0.001 g of product mass	Not detected				
Yeast, CFU/g, in 0.1 g of product	-	-	2	2.8×10	3.8×10
Molds, CFU/g, in 0.1 g of product)	-	-	-	2	3.1×10

It was found that during the entire storage period, microbiological parameters met the requirements of TR CU 033/2013 "On the safety of milk and dairy products. Obtained data of experimental samples of brine cheese with vegetable additives does not differ significantly from the control cheese "Brynza". This indicates that the use of vegetable additives does not affect microbiological parameters.

When conducting the organoleptic evaluation of the studied product at the end of the expected shelf life and similar freshly produced products, a slight change in the consistency of the product, which in general did not reduce the organoleptic assessment of its quality. On the 20th day, there was a slight decrease in the evaluation of organoleptic characteristics, the appearance of a sour taste, and slight bitterness.

CONCLUSION

This work has demonstrated the possibility of increasing the nutritional value of brine cheeses by adding vegetable additives (white cabbage, cilantro), rich in protein and fatty substances. An increase in protein, the balance of amino acids and fatty acids is noticeable in the experimental samples. Adding vegetables to brine cheese has led to an increase in protein content and a decrease in fat content and energy value. It can make the developed brine cheese a healthier option for individuals concerned about their fat and calorie intake. Both the control sample and the brine cheese with vegetable additives experienced decreased water activity and increased moisture content during storage. The addition of vegetables to the cheese does not result in a noticeable negative impact on its microbiological and physical characteristics. As a result of experimental studies, the shelf life of brine cheese with vegetable additives is 8-10 days.

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