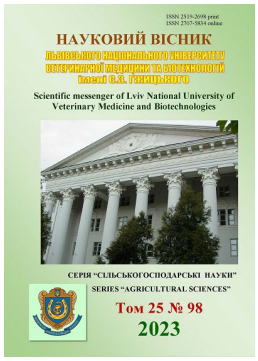

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The influence of antibiotics in milk on the action of sourdough using cheese technology

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Brynza occupies an important place among cheeses in Ukraine. Brynza is a highly concentrated polydisperse system, the features of which are determined by the size of the particles of the dispersed phase. It has a white (close to white) color, uniform throughout the mass. The taste and smell of cottage cheese are sour-milk, moderately salty. Physicochemical, biochemical and microbiological processes in cheese and their intensity depend on the concentration and quality of rennet enzymes. Renal enzymes during cheese ripening inhibit the vital activity of putrefactive bacteria in cheese, while in certain concentrations they contribute to the development of lactic acid microflora of leavening preparations and their production of amino acids. Studies show that cheese contains a wide range of microflora such as Lactococcus spp., Lactobacillus spp., Leuconostoc spp., Enterococcus spp. and contaminating bacterial cells. Pasteurization of raw milk not only has a positive effect on the yield of cheese, but also protects the consumer from pathogenic microflora. Milk after pasteurization was used for the experiment. The mass fraction of fat in milk was 3.2 %, the acidity was at the level of 18.5 °T. For the experiment, 5 groups of milk samples of 100.0 cm³ each were formed. Fermentation of milk was carried out with the help of sourdough starter for cheese and rennet enzyme. The antimicrobial drug streptomycin was used to inactivate cells of yeast microorganisms and active centers of rennet enzymes. Weighed 1.0 g was dissolved in 1500 ml of distilled water. Milk with an antibiotic content of 2.0 to 4.0 U/cm³ after fermentation with sourdough and rennet enzyme had 2.6–2.9 times lower titrated acidity than in the control. A regularity was revealed that with the increase in the content of streptomycin sulfate in milk, the titrated acidity of the final product decreases. When the largest amount of antibiotic was added to milk (IV and V experimental groups of samples), the effect of leaven and enzyme preparation was not manifested, as a result of which the final product of fermentation did not differ much from fresh milk in terms of titrated acidity.

Key words: *milk processing, rennet enzyme, inhibitors.*

Introduction

Currently, an important place in people's diets is occupied by cheeses, which are the product of the complex technological processing of milk, which results in the concentration of its main components with their subsequent fermentation (Tsisaryk, 2013; Johnson, 2017). Cheeses are food products obtained by concentration and biotransformation of the main components of milk under the influence of enzymes, microorganisms and physicochemical factors (Ozturk et al., 2018; Merzlov et al., 2019).

Brynza occupies an important place among cheeses in Ukraine. Brynza is a highly concentrated polydisperse system, the features of which are determined by the size of the particles of the dispersed phase (Ardo et al., 2002). It has a white (close to white) color, uniform throughout the mass. The taste and smell of cottage cheese are sour milk, and moderately salty. The consistency is moderately dense, often hard, slightly brittle, without a tendency to crumble. There is no drawing on the section, the presence of a small number of holes and voids of an irregular shape is allowed (Bos et al., 2003; Chuang et al., 2005). The mass fraction of fat in the dry matter of cheese must be at least 40 %; moisture before salting – 51–61 %, moisture in mature cheese – 53 %; sodium chloride – 3–5 %; the optimal pH value of cheese before salting is 5.3–5.4, of mature cheese – 5.20–5.35; the duration of cheese ripening is 20 days (Venher & Mishchenko, 2011).

Brynza is usually made from whole pasteurized cow's milk. The production of cheese from unpasteurized milk is allowed as an exception on pasture pastures at small factories, subject to the mandatory aging (ripening) of it at enterprises for at least 60 days (Chuang et al., 2005; Kapreliants & Iorhachova, 2013).

On average, the fat content of cheese is 40 %. But cheese with a mass fraction of fat of 50 % is considered the tastiest (Borshch et al., 2019). Keep cheese for no more than 7 days. If it is stored in brine, the storage period is extended to 2 weeks (Melina et al., 2016).

Physicochemical, biochemical, and microbiological processes in cheese and their intensity depend on the concentration and quality of rennet enzymes. Renal enzymes during cheese ripening inhibit the vital activity of putrefactive bacteria in cheese, while in certain concentrations they contribute to the development of lactic acid microflora of leavening preparations and their production of amino acids. Studies show that cheese contains a wide range of microflora such as Lactococcus spp., *Lactobacillus* spp., *Leuconostoc* spp., *Enterococcus* spp. and contaminating bacterial cells. Pasteurization of raw milk not only has a positive effect on the yield of cheese, but also protects the consumer from pathogenic microflora (Bilyi & Merzlov, 2022). In terms of hygiene, the milk used to make cheese must be clean (free from mud particles). It should curdle when alcohol is added to it, not contain soda or any preservatives. Regarding microflora, milk has particularly high requirements – it must not contain extraneous microorganisms that can change the normal course of cheese ripening and cause defects. The process of obtaining high-quality cheeses largely depends on the biological quality of milk, the development of lactic acid bacteria can be inhibited by the insufficient content or absence of digestible substances, necessary amino acids, vitamins, and trace elements in milk (Bilyi et al., 2021).

Salted cheeses are the most popular in Ukraine, and for many, including people with impaired carbohydrate metabolism, a daily product. Cheese is a source of complete proteins, calcium, magnesium and vitamins (Bilyi & Merzlov, 2022). Soft cheeses occupy a special place among rennet cheeses. As a result of the biochemical processes that occur during the ripening of cheeses, a large number of peptides and amino acids are formed in them in a shorter time compared to semi-hard and hard cheeses, which allows soft cheeses to be classified as dietary products. The wide taste range of soft cheeses fully satisfies the needs of consumers with any preferences (Park, 2001; Semko et al., 2018).

The aim of the study

The purpose of the study: to investigate the effect of antibiotics in milk on the action of different leavens.

Material and methods

Milk after pasteurization was used for the experiment. The mass fraction of fat in milk was 3.2 %, the acidity was at the level of 18.5 °T. For the experiment, 5 groups of milk samples of 100.0 cm³ each were formed. Fermentation of milk was carried out with the help of sourdough starter for cheese and rennet enzyme. The antimicrobial drug streptomycin was used to inactivate cells of yeast microorganisms and active centers of rennet enzymes. Weighed 1.0 g was dissolved in 1500 ml of distilled water.

Milk samples from the control group did not contain the antibiotic. 0.1 cm³ of streptomycin solution was added to the milk from the first group of samples, which was 0.5 units/cm³.

Table 1
The scheme of introducing an antibiotic into milk

A group of samples	Volume of milk, cm³	Volume of streptomycin sulfate solution, cm3	The content of the active ingredient streptomycin in milk, units/cm³
Control	100.0	-	-
I experimental	100.0	0.1	0.5
II experimental	100.0	0.4	2.0
III experimental	100.0	0.8	4.0
IV experimental	100.0	1.2	6.0
V experimental	100.0	1.6	8.0

Fermentation of milk samples with sourdough and subsequent introduction of an enzyme preparation was carried out in a thermostat at a temperature of 37 ± 0.5 °C. Fermentation lasted 45 minutes. Sensory analysis was performed according to the standards (DSTU 7065:2009).

Results and discussion

In order to determine the effect of antibiotics on the sourdough starter for cheese, milk was fermented with different doses of the antibiotic with the help of thermostating.

After 45 minutes of fermentation in the control samples (the milk did not contain antibiotics), the formed clot had a pleasant milky taste. The clot was dense, homogeneous. After processing the clot, the separation of the serum from the clot was noted. Extraneous, non-specific aftertastes were not noted.

At a content of 0.5 units of antibiotics in one cm³ of milk, the final product was in the form of an unformed, loose clot of white color. The taste was milky, less pronounced, compared to the control. Adding an antibiotic to milk in the amount of 2.0 units/cm³ had a negative effect on the action of the leaven compared to the control. The

curd of milk after fermentation was liquid and did not meet the standards. The taste was weakly milky (Table 2).

Increasing the content of streptomycin in milk to 4.0 units/cm^3 caused the final product to be in the form of a white liquid with single strands of protein formations. The presence of in the milk of 0.5 to 4.0 U/cm^3 of the antibiotic gradually inactivated the yeast microorganisms and the active centers of enzyme preparations, which is confirmed by the similarity of the organoleptic indicators of the final product with slightly sour milk, without any protein formations.

In the samples from the IV and V research groups, the product tasted like stale milk after fermentation. The consistency was identified as a white liquid without clots and strings. The final product, which was made from milk containing 8.0 U/cm^3 streptomycin, tasted like fresh pasteurized milk.

The milk with which the study was conducted had titrated acidity at the level of 18.4 ˚T. The curd was made without adding streptomycin to the milk and had a titrated acidity of 24.0 ˚T. The presence of streptomycin in milk in the amount of 0.5 units/cm^3 led to a decrease in the titrated acidity of the final product by 14.7 %, compared to the control. An increase in the antibiotic content to 2.0 U/cm^3 of milk was accompanied by a decrease in the titrated acidity of the product by 9.9 % relative to the control.

The presence of streptomycin in milk in the amount of 1.5 units/cm^3 causes a decrease in the titrated acidity of the final product by 2.08 times compared to the control data (table 3).

Table 2
Results of the analysis of organoleptic indicators after fermentation

A group of samples	The taste of the product	Appearance of the product after fermentation
Control	Pleasant milky. No unnatural flavors were noted	Moderately dense, homogeneous clot of white color. Separation of serum was noted during processing
I experimental	Lactic. No unnatural flavors were noted	Loose clot of white color
II experimental	Lactic. No unnatural flavors were noted	A very thin, poorly formed clot
III experimental	No unnatural flavors were noted	Single formations of protein strands in the liquid
IV experimental	Fresh milk. No unnatural flavors were noted	The liquid is white, without clots and strings
V experimental	Fresh milk. No unnatural flavors were noted	The liquid is white, without clots and strings

Table 3
Titrated acidity of milk and final product after fermentation (M ± m, n = 4)

A group of samples	Index of titrated acidity of milk before the introduction of leaven and enzyme, ˚T	Acidity after fermentation, ˚T
Control	18.4	24.0 ± 3.11
I experimental	18.4	22.1 ± 1.85
II experimental	18.4	20.7 ± 2.45
III experimental	18.4	18.9 ± 1.09
IV experimental	18.4	18.4 ± 0.87
V experimental	18.4	18.4 ± 1.67

Milk with an antibiotic content of 2.0 to 4.0 U/cm^3 after fermentation with sourdough and rennet enzyme had 2.6–2.9 times lower titrated acidity than in the control. A regularity was revealed that with the increase in the content of streptomycin sulfate in milk, the titrated acidity of the final product decreases.

When the largest amount of antibiotic was added to milk (IV and V experimental groups of samples), the effect of leaven and enzyme preparation was not manifested, as a result of which the final product of fermentation did not differ much from fresh milk in terms of titrated acidity.

Conclusions

So, under the conditions of streptomycin sulfate entering the milk of cows at a concentration of 0.5 units/cm^3, the technology of raw material fermentation with sourdough starter for cottage cheese and rennet enzyme preparation is violated. The presence of an antibiotic in the raw material of more than 2 units/cm^3 makes it impossible to obtain a curd curd with the use of leaven and enzyme. Production of the product using sourdough for cheese and an enzyme preparation is possible if the content of streptomycin sulfate in milk is less than 0.5 units/cm^3.

Conflict of interest

The authors declare that there is no conflict of interest.

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