

## Effectiveness of Antimicrobial Preparations for the Sanitation of the Udder of Dairy Cows

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### ABSTRACT

Subclinical mastitis prevention in dairy cows necessitates the use of effective pre- and post-milking udder preparations. Many imported post-milking udder treatments have proven ineffective and costly, prompting the exploration of composite preparations based on chemical compounds. This study aims to assess the bactericidal properties of Promixan, a preparation based on Anavidin and its impact on subclinical mastitis prevention and milk quality under production conditions. The experimental study took place at two Republic of Kazakhstan farms. Three groups of cows, comprising those with subclinical mastitis (for disease treatment) and healthy cows (for disease prevention), were selected. To evaluate the bactericidal efficacy of post-milking udder treatments, microbial concentration dynamics were observed every two hours until the subsequent milking. Promixan exhibited 98.1 and 96.7% effectiveness in preventing subclinical mastitis in healthy cows at the Adal Agro-Industrial Complex farm and E.S. Aidarbayev farm, respectively, after 4 hours of exposure. In the group of sick cows, it demonstrated effectiveness rates of 95.3 and 94.3%, respectively. These results indicate that Promixan matches or surpasses the bactericidal properties of analogs. When used on sick cows, Promixan outperformed Blockade and Vet Clean I-Film by 2.1 and 2.2%, respectively, indicating its comparable effectiveness. Experimental studies revealed that Promixan's bactericidal properties surpassed those of Blockade and Vet Clean I-Film by 3.4 and 3.3%, respectively. Promixan effectively forms a bacteriological protective film on cow udder teats, preventing microbial penetration into the skin, and proves to be a viable alternative to existing treatments for subclinical mastitis prevention in dairy cows under production conditions.

**Key words:** Sanitary treatment, Subclinical mastitis, Bacteriological protection, Udder teat, Mastitis prevention, Bacterial contamination.

### INTRODUCTION

The most important problem of dairy farming in the Republic of Kazakhstan is mastitis in cows, characterized by widespread prevalence, massive character, and huge economic damage (Mukhamadieva et al. 2022; Abdalhamed et al. 2023). The total damage caused by diseases consists of a decrease in milk productivity by 50% and milk quality by 10% and an increase in loss of offspring by 10%, treatment costs by 15%, and premature culling of animals by 15%. According to some researchers, the incidence of this disease among cows averages 20-40% and is mainly due to the lack of comfortable conditions for

keeping cows on farms (Tagaev 2010; Tanbayeva et al. 2016; Myrzabekov et al. 2020; Reshetnikova and Krylova 2023; Sattarova et al. 2023). In addition, farm owners do not have a systematic approach to solving this problem (Barakhov et al. 2019; Ledo et al. 2021).

Currently, regardless of the keeping conditions and the milking equipment, it is impossible to improve the quality of milk without the use of a complex of means that ensure high-quality treatment of the skin and udder teats before and after milking (Andrew et al. 2021). Improper udder care can provoke the development of lacteous gland inflammation and cracked skin on the teats. Effective pre-milking udder treatment is an affordable method of

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reducing the accumulation of microbial and mechanical contaminants in milk (Kumari et al. 2018; Smulski et al. 2020). According to researchers, the content of bacteria on the skin of the teats varies greatly. Depending on their mechanical contamination, it ranges from 5 thousand to 1 million colony-forming units (CFU) from 1 ml of wash sample and depends on the keeping conditions of the animals (Bogush et al. 2013; Molineri et al. 2021).

Special attention should be paid to the treatment of the udder after milking. It is important to perform it immediately after milking since the teat canal remains open from 30 minutes to 1 hour, and it is necessary to ensure its protection from contamination by pathogenic microflora until the next milking (Komarov 2016). Products for udder treatment after milking should provide protection against pathogenic microorganisms, form an active ultra-thin protective film, prevent the entrance of bacteria into the teat canal, enhance local protective mechanisms and stimulate the regeneration of small wounds and cracks (Narbayeva et al. 2016; Korotkiy et al. 2023). Thus, the use of preparations requires careful wiping of the udder teats with a clean towel after sanitary treatment to exclude the ingress of any disinfectant residue into the milk (Beishova et al. 2019; Filatova et al. 2021; Issabekov et al. 2022).

During machine milking, sanitary treatment of udder teats with disinfectants before and after milking can significantly reduce the incidence of lacteous gland diseases in cows and improve the sanitary quality of milk (Kolchina et al. 2012; Thompson-Crispi et al. 2014).

In recent years, the requirements for the sanitary quality of produced milk have increased. The quality of milk and its safety depend on various factors and are determined by a variety of indicators (Blowey and Edmondson 2010; de Jong et al. 2018; Babich et al. 2022; Aitpayeva et al. 2024). The most important sanitary indicators are the degree of purity, bacterial contamination, the number of somatic cells, and the presence of subclinical mastitis (Karpenko 2015; Javed et al. 2021; Beishova et al. 2023). Preparations for sanitary treatment directly affect the degree of cleanliness of the udder and teats. The cleanliness of the udder and teats is a fundamental factor in obtaining high-quality milk. In addition, it is a prophylaxis against various types of mastitis (Cook and Reinemann 2007).

Considering the urgent problems, the purpose of our work was to evaluate the effectiveness of the developed preparation Promixan based on Anavidin for the treatment of udder teats after milking and to determine the dynamics of teat contamination by microorganisms before the next milking and their impact on milk quality.

To achieve this purpose, we planned the following stages of the study:

1. Determination of the dynamics of the concentration of microorganisms after sanitary treatment of the udder teats.
2. Determination of the udder teat cleanliness level and a sanitary assessment.
3. Comparative evaluation of the effectiveness of the therapeutic effect of various preparations used for sanitary treatment.
4. Determination of the impact of udder sanitation measures on the quality of produced milk.

## MATERIALS AND METHODS

The experiments and the methods used for research on laboratory animals complied with the requirements of biological safety and ethical principles of experimentation on animals set out in the European Convention for the Protection of Vertebrates Used for Experimental and Other Scientific Purposes (Strasbourg 1987) (Conclusion of the Bioethics Commission of the Kazakh National Agrarian Research University dated October 7, 2021).

The scientific research was conducted at the bases of the Kazakh National Agrarian Research University (Faculty of Veterinary Medicine, Department of Veterinary and Sanitary Expertise and Hygiene), Scientific Research Institute of Animal Husbandry and Feed Production, E.S. Aidarbayev farm, and Adal Agro-Industrial Complex located in the Almaty region, Enbekshikazakh district in 2020-2021.

In the selected two farms, three groups (180 heads each) were formed from cows aged 4-8 years: one experimental group and two control groups. The animals in the experimental groups were treated with Promixan (Tanbaeva et al. 2018). In the 1st control group, we used Vet Clean I-Film (E.S. Aidarbayev farm) and Blockade (Adal AIC), and in the 2<sup>nd</sup> control group, the udder teats were not treated and were washed only with warm water. All study groups consisted of two subgroups: cows with subclinical mastitis (90 heads) and healthy cows (90 heads).

To evaluate the significance of differences observed in the results, the Mann-Whitney U test was utilized across various comparisons. The Mann-Whitney U test was selected due to its applicability to independent samples where the normal distribution assumption cannot be verified. It is particularly useful in agricultural and veterinary studies where sample sizes may be limited and data distributions unknown. This non-parametric test compares the medians between two independent groups to determine if one group tends to have higher values than the other, without assuming a normal distribution of the data. A p-value of less than 0.05 was considered indicative of a statistically significant difference between groups, highlighting the effectiveness of certain treatments over others or affirming the lack of significant difference where applicable.

### Antimicrobial agents used in the experimental studies

Promixan is a liquid solution based on Anavidin (20%) for the sanitary treatment of cows' udders after milking, which includes such active ingredients as glycerin, methyluracil, and polyvinyl alcohol. The product protects the skin of the udder teats in the intervals between milking and prevents the active pathogen from entering the milk due to the formation of a bactericidal film on the skin. It is produced by the Kazakh National Agrarian Research University (Kazakhstan).

Blockade is a preparation in the form of a solution intended for antiseptic treatment of cow udder teats after milking to prevent the occurrence and transfer of mastitis. The preparation contains free (molecular) iodine as an active substance. It is produced by DeLaval (Sweden).

Vet Clean I-Film is an antibacterial and antiseptic agent for udder treatment after milking. It is a complex solution for skin care (moisturizing, softening, and wound

healing components). The composition includes functional additives, iodine-polymer complex, and deionized water. It is produced by InterHimmet (Russia).

#### **Dynamics of the concentration of microorganisms after sanitary treatment of the udder teats**

All animal groups were monitored daily. The duration of the experiment was 30 days. Every 2 hours, wash samples were taken with sterile cotton swabs from the surface of the udder teats to determine the bacteriological contamination. Milking was carried out 3 times a day, every 8 hours. The liquid of the wash samples in the amount of 1 ml was sown into a nutrient medium and placed in a thermostat, and after the expiration of time, the number of colonies grown was recorded. Milk samples were collected in special sterile containers intended for biological fluid.

#### **Assessment of udder cleanliness**

Udder hygiene indicators were assessed during milk sampling in the milking parlor using the previously described method (Schreiner and Ruegg 2002). The udders of the studied animals were compared with control animals, and scores were given based on the following categories:

- 1) completely free from dirt or with very little dirt
- 2) slightly dirty
- 3) mostly covered with dirt
- 4) completely covered with dirt, caked dirt.

Scores were recorded (based on the results of a bacteriological study and the number of somatic cells) and determined by one person throughout the study.

#### **Evaluation of the effectiveness of medicinal preparations**

During the test, the areas of the studied surfaces were seeded with selective pathogenic microorganisms. Medicinal preparations were applied to the seeded surfaces for a certain exposure time, after which the residual microbiological contamination was checked. The number of pathogenic microorganisms extracted from the test surfaces (exposed to medicinal preparations) was compared with the number of pathogenic microorganisms extracted from the corresponding control surface sample (with the results of other preparations). A successful comparative evaluation allowed us to consider medicinal preparations suitable for use.

The determination of the number of somatic cells was carried out using the Somatos B device, manufactured by KOSTIP (Russia). According to the principle of operation of the analyzer, the specified volumetric quantities of milk and an aqueous solution of a sulfanol-based preparation Mastoprim (Sibagropribor Military-Industrial Complex, Russia) are mixed, and then the conditional viscosity of the mixed samples is determined according to the leakage times of their identical parts by volume through the capillary. The analyzer measures the outflow times of the same weight (calibration weight) parts of the samples, using a tensoelectric weighing device (TWD). Using the CombiFoss FT+ milk analyzer by Foss (Denmark) (includes the milk composition analyzer MilkosanFT+, the somatic cell analyzer FossomaticFT+, a common conveyor, and a computer), the indicators of fat, protein, density and nonfat milk solids (NFMS) in milk were established.

The animals were constantly monitored for a month and control milking for latent mastitis was carried out using a Promastit express diagnostic kit (Barakhov et al. 2017) every 14 days. In case of a positive result of the mastitis test, repeated testing was carried out after 24 hours and with a repeated positive result, latent mastitis was diagnosed.

Promastit is an express diagnostic kit designed to determine the number of somatic cells in milk and diagnose mastitis in cows. The preparation contains anionic surfactants, preservatives, color indicators, and purified water. It is produced by the Kazakh National Agrarian Research University (Kazakhstan).

Descriptive statistical analysis was performed using SPSS for Windows 13.0 by SPSS Inc (USA). The  $\chi^2$  test was used to analyze the prevalence of the difference between the dilutions of the medium (Kimura et al. 2004).

## **RESULTS**

#### **Dynamics of the concentration of microorganisms after sanitary treatment of the udder teats**

The results of the work on determining the dynamics of the concentration of microorganisms after the sanitary treatment of the udder of dairy cows are shown in Table 1.

In the experimental group, the udders of cows were treated with Promixan. After a 2-hour exposure, bacterial contamination at the Adal AIC reached  $3.6 \pm 2.1 \times 10^5$  CFU/ml (55.7% lower), and after 4 hours of exposure, it decreased to  $1.2 \pm 0.4 \times 10^4$  CFU/ml. Thus, the effectiveness equaled 98.1%. After a 6-hour exposure, a small increase in microorganisms was observed, and after an 8-hour exposure, the increase was  $5.2 \pm 1.8 \times 10^4$  CFU/ml.

When cows with subclinical mastitis were treated with Promixan, after 4 hours of exposure, bacterial contamination was  $3.9 \pm 1.3 \times 10^4$  CFU/ml, and the effectiveness was 95.3%. In subsequent exposures, the number of microorganisms increased.

When the udders of cows were treated with the same preparation at the E.S. Aidarbayev farm, after 4 hours of exposure, positive results were obtained equaling  $2.3 \pm 0.7 \times 10^4$  CFU/ml, and the effectiveness of the preparation increased, reaching 96.7%. When the udders of cows with subclinical mastitis were treated with the preparation, the number of microorganisms was  $4.6 \pm 2.2 \times 10^4$  CFU/ml, and the effectiveness was 94.3%.

In the 1st control group, the udders of cows were treated with Blockade. After a 4-hour exposure, bacterial contamination at the Adal AIC reached  $2.1 \pm 0.8 \times 10^4$  CFU/ml, with an effectiveness of 96.5%. In the case of treatment of the udders of cows with subclinical mastitis, after 4 hours of exposure, the number of microorganisms was  $5.1 \pm 1.9 \times 10^4$  CFU/ml, and the effectiveness was 93.2%.

With the treatment of the udders of healthy cows with Vet Clean I-Film at the E.S. Aidarbayev farm, after a 4-hour exposure, positive results were obtained ( $3.4 \pm 2.2 \times 10^4$  CFU/ml), and after the treatment of the udders of cows with subclinical mastitis, the number of microorganisms was  $6.7 \pm 3.8 \times 10^4$  CFU/ml. The effectiveness of the preparations was 95.0 and 92.1%, respectively.

In the 2<sup>nd</sup> control group, where the cow teats were not treated with any preparation at the Adal AIC after 4 hours of exposure, the number of microorganisms was  $1.8 \pm 4.2 \times 10^5$  CFU/ml, and the effectiveness was 77.2%.

**Table 1:** Dynamics of the concentration of microorganisms after sanitary treatment of udder teats

No. Preparations	Animal group	Total number of microorganisms, CFU/ml	Bacteriological sampling after udder treatment, hour			
			2	4	6	8
Adal AIC						
1 Promixan (experimental)	healthy	6.5±3.4x10 <sup>5</sup>	3.1±2.1x10 <sup>5</sup>	1.2±0.4x10 <sup>4</sup>	3.0±1.1x10 <sup>4</sup>	5.2±1.8x10 <sup>4</sup>
	sick*	8.4±3.4x10 <sup>5</sup>	4.0±2.0x10 <sup>5</sup>	3.9±1.3x10 <sup>4</sup>	5.5±1.9x10 <sup>4</sup>	6.4±2.2x10 <sup>4</sup>
2 Blockade (1st control)	healthy	6.2±3.3x10 <sup>5</sup>	3.1±2.4x10 <sup>5</sup>	2.1±0.8x10 <sup>4</sup>	4.2±1.4x10 <sup>4</sup>	7.0±1.8x10 <sup>4</sup>
	sick*	7.6±3.0x10 <sup>5</sup>	3.8±2.2x10 <sup>5</sup>	5.1±1.9x10 <sup>4</sup>	7.4±2.0x10 <sup>4</sup>	9.6±2.6x10 <sup>4</sup>
3 No treatment (2 <sup>nd</sup> control)	healthy	8.3±3.3x10 <sup>5</sup>	5.4±2.8x10 <sup>5</sup>	1.8±4.2x10 <sup>5</sup>	2.5±2.0x10 <sup>5</sup>	6.9±2.0x10 <sup>5</sup>
	sick*	9.5±3.4x10 <sup>5</sup>	5.8±2.8x10 <sup>5</sup>	3.3±2.0x10 <sup>5</sup>	6.5±3.1x10 <sup>5</sup>	8.1±3.0x10 <sup>5</sup>
E.S. Aidarbayev farm						
1 Promixan (experimental)	healthy	7.1±3.7x10 <sup>5</sup>	3.0±2.1x10 <sup>5</sup>	2.3±0.7x10 <sup>4</sup>	4.4±2.1x10 <sup>4</sup>	6.0±2.0x10 <sup>4</sup>
	sick*	8.2±3.5x10 <sup>5</sup>	4.8±2.6x10 <sup>5</sup>	4.6±2.2x10 <sup>4</sup>	7.1±3.2x10 <sup>4</sup>	9.2±3.8x10 <sup>4</sup>
2 Vet Clean I-Film (1st control)	healthy	6.8±3.2x10 <sup>5</sup>	2.8±3.5x10 <sup>5</sup>	3.4±2.2x10 <sup>4</sup>	5.7±2.4x10 <sup>4</sup>	9.5±1.8x10 <sup>4</sup>
	sick*	8.5±3.8x10 <sup>5</sup>	4.4±2.8x10 <sup>5</sup>	6.7±3.8x10 <sup>4</sup>	8.0±3.7x10 <sup>4</sup>	9.1±3.6x10 <sup>4</sup>
3 No treatment (2 <sup>nd</sup> control)	healthy	8.0±3.1x10 <sup>5</sup>	4.2±2.5x10 <sup>5</sup>	2.1±3.0x10 <sup>5</sup>	3.7±2.6x10 <sup>5</sup>	7.4±3.2x10 <sup>5</sup>
	sick*	9.1±3.3x10 <sup>5</sup>	4.9±2.6x10 <sup>5</sup>	5.6±3.4x10 <sup>5</sup>	6.8±3.0x10 <sup>5</sup>	8.4±3.7x10 <sup>5</sup>

\*dairy cows with subclinical mastitis

After treatment of the udders of cows with subclinical mastitis, after 4 hours of exposure, the number of microorganisms was  $3.3\pm 2.0 \times 10^5$  CFU/ml and the effectiveness was 64.6%

At the E.S. Aidarbayev farm, microbial contamination of udder teats in healthy cows decreased to 73.4%, and in sick cows, to 62.6%.

According to the experimental data, the natural resistance of animals is not enough to resist udder diseases and promote the production of high-quality milk. There is a need for preventive measures for cow udder treatment,

As a result, the greatest effectiveness of Promixan was 98.1%, which is 1.6% higher than that of Blockade, 3.1% higher than Vet Clean I-Film, and 20.9% higher compared to the group where the udder teats were not treated with any preparations.

#### Udder teat cleanliness and a sanitary assessment

The results of determining the degree of udder cleanliness are shown in Table 2.

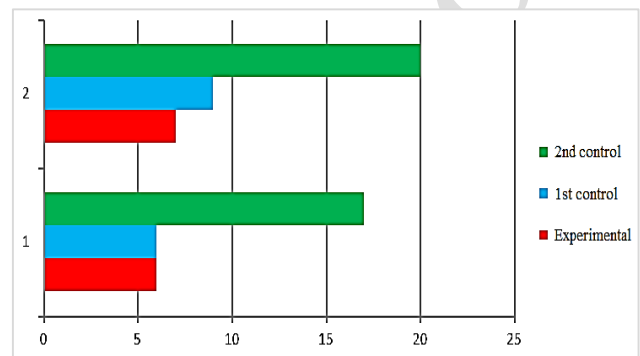
As our results show, after the sanitary treatment of the udder before the next milking, bacterial contamination increases significantly. When treated with the tested preparations in the experimental group and the 1st control group, the degree of cleanliness of the teats showed the 2<sup>nd</sup> category, and in the 2<sup>nd</sup> control group, the degree of cleanliness of the teats showed the 3<sup>rd</sup> category, which greatly increases the risk of mastitis spread.

In general, the 3<sup>rd</sup> and 4<sup>th</sup> category cows had a high probability of subclinical mastitis, so special attention should be paid to the sanitary treatment of the udder after milking the cows. Based on the digital data, a comparative analysis diagram was constructed (Fig. 1).

According to Fig. 1, the degree of cleanliness of the udder teats of the 2<sup>nd</sup> control group was slightly higher compared to other groups.

#### Comparative evaluation of the effectiveness of the therapeutic effect of preparations used in sanitary treatment

The results of the work on determining the therapeutic efficacy of antimicrobial agents are shown in Table 3. For Table 3, evaluating the therapeutic effectiveness of Promixan compared to Blockade and no treatment for healthy cows at the Adal AIC farm, the Mann-Whitney U test provided the following results:



**Fig. 1:** Cleanliness level of udders and teats of dairy cows. Between Promixan and Blockade: U statistic=6.0; P-value=0.096. Between Promixan and No treatment: U statistic=10.0; P-value=0.027.

These results suggest that there is a statistically significant difference in the therapeutic effectiveness of Promixan compared to no treatment ( $p < 0.05$ ), indicating that Promixan is more effective. However, the comparison between Promixan and Blockade did not reach statistical significance at the 0.05 threshold ( $p = 0.096$ ), suggesting no clear difference in effectiveness between these two treatments under the simplified analysis conditions.

According to our results, at both farms, Promixan showed a positive effect, and its effectiveness was not inferior to foreign analogs. However, the results at the E.S. Aidarbayev farm were much lower than at the Adal AIC. This is explained by the level of cow keeping (principles of the manure removal system, increased productivity of the zone of automatic drinking fountains, litter contamination, etc.), as well as the degree of cleanliness of the teats and udders of dairy cows.

Based on the numerical data of Table 3, Fig. 2 was compiled.

According to Fig. 2, the effectiveness of Promixan was slightly higher than that of the analogs. Thus, it was proved that with timely disinfection of udder teats after milking, the incidence of cows with subclinical mastitis is significantly reduced.

#### Impact of udder sanitation measures on the quality of milk

The results concerning the effect of antimicrobial agents for udder treatment on milk quality are shown in Table 4.

**Table 2:** Assessment of the level of udder teat cleanliness in dairy cows

Degree of cleanliness	Adal AIC			E.S. Aidarbayev farm		
	Animal group (average values)					
	Experimental	1 <sup>st</sup> control	2 <sup>nd</sup> control	Experimental	1 <sup>st</sup> control	2 <sup>nd</sup> control
CATEGORY 1	-	-	-	-	-	-
Clean, no dirt						
CATEGORY 2	5-7	5-7	-	6-8	8-10	-
Slightly contaminated, 2-10% of the surface	(6)	(6)		(7)	(9)	
CATEGORY 3	-	-	15-20	-	-	17-22
Average degree of contamination, 10-30% of the surface			(17)			(20)
CATEGORY 4	-	-	-	-	-	-
Heavy contamination, > 30% of the surface						

Note: "-" means the absence of cleanliness degree.

**Table 3:** Results of evaluation of therapeutic effectiveness of the preparations

No.	Preparations	Animal group	Number of heads	Number of cases (subclinical mastitis)	Therapeutic effect, %
Adal AIC					
1	Promixan (experimental)	Healthy cows	15	2	86.7
		Sick cows	15	4	73.4
2	Blockade (1st control)	Healthy cows	15	3	80.0
		Sick cows	15	4	73.4
3	No treatment (2 <sup>nd</sup> control)	Healthy cows	15	5	66.7
		Sick cows	15	7	53.4
E.S. Aidarbayev farm					
1	Promixan (experimental)	Healthy cows	15	3	80.0
		Sick cows	15	5	66.7
2	Vet Clean I-Film (1st control)	Healthy cows	15	4	73.4
		Sick cows	15	5	66.7
3	No treatment (2 <sup>nd</sup> control)	Healthy cows	15	6	60.0
		Sick cows	15	8	46.7

**Table 4:** The effect of preparations for the treatment of teats on the quality of milk

Indicators	Animal group (average values)					
	Experimental		1 <sup>st</sup> control		2 <sup>nd</sup> control	
	Beginning of the experiment	End of the experiment	Beginning of the experiment	End of the experiment	Beginning of the experiment	End of the experiment
Adal AIC						
Mass fraction of fat, %	2.89±0.8	3.70±1.2	2.91±1.0	3.62±1.2	2.88±0.8	2.92±1.0
Mass fraction of protein, %	3.00±0.02	3.16±0.04	3.00±0.02	3.18±0.06	3.01±0.02	3.00±0.02
Density, kg/m <sup>3</sup>	29.8±0.4	30.4±0.5	29.2±0.5	30.2±0.2	29.6±0.4	29.8±0.3
NFMS	8.0±0.14	8.5±0.18	8.1±0.12	8.5±0.18	8.0±0.14	8.0±0.14
Somatic cells, thousand/ml	715±8.6	355±6.9	723±8.7	380±7.4	718±8.6	606±7.5
E.S. Aidarbayev farm						
Mass fraction of fat, %	2.90±1.2	3.75±1.5	2.95±1.2	3.72±1.4	2.91±1.2	3.00±1.3
Mass fraction of protein, %	3.01±0.03	3.20±0.04	3.00±0.02	3.18±0.04	3.00±0.02	2.99±0.01
Density, kg/m <sup>3</sup>	28.8±0.1	30.0±0.2	29.0±0.2	30.3±0.3	28.6±0.1	29.4±0.2
NFMS	7.9±0.10	8.2±0.14	8.0±0.12	8.4±0.16	8.0±0.12	8.1±0.13
Somatic cells, thousand/ml	722±8.4	292±4.8	716±8.2	306±6.4	706±8.0	615±7.2

Note: M±m is the error of the arithmetic mean.

In the experimental group, the fat content of milk at the Adal AIC increased from 2.89±0.8 to 3.70±1.2%, and at the E.S. Aidarbayev farm, from 2.90±1.2 to 3.75±1.5%.

In the 1<sup>st</sup> control group, at the Adal AIC, the fat content of milk at the beginning of the experiment was 2.91±1.0%, and at the end of the experiment, it increased to 3.62±1.2%. At the E.S. Aidarbayev farm, the fat content of milk increased from 2.95±1.2 to 3.72±1.4%.

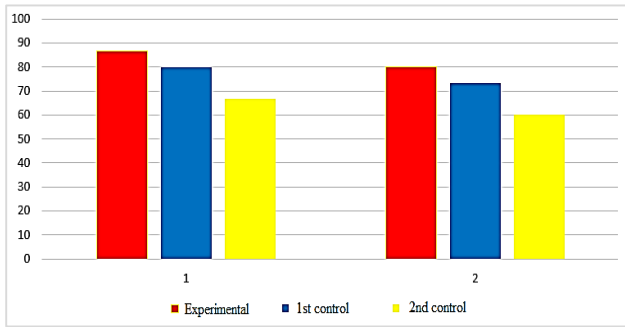
In the 2<sup>nd</sup> control group, at the Adal AIC, the fat content of milk at the beginning of the experiment was 2.88±0.8% and at the end of the experiment, there was a slight increase to 2.92±1.0%. The same situation was observed at the E.S. Aidarbayev farm (2.91±1.2:3.00±1.3%).

One of the important indicators of milk quality is the number of somatic cells. In the experimental group, at the Adal AIC, the number of somatic cells was 715±8.6

thousand/ml, and by the end of the experiment, it decreased to 355±6.9 thousand/ml, while at the E.S. Aidarbayev farm, the number of somatic cells decreased from 722±8.4 to 292±4.8 thousand/ml.

In the 1<sup>st</sup> control group, at both farms by the end of the experiment, the number of somatic cells was normal (at the Adal AIC, 380±7.4 thousand/ml and at the E.S. Aidarbayev farm, 306±6.4 thousand/ml).

In the 2<sup>nd</sup> control group, at the Adal AIC at the beginning of the experiment, somatic cells were in the range of 718±8.6 thousand /ml, and at the end of the experiment, 606±7.5 thousand/ml, which is higher than normal. The same pattern was observed at the E.S. Aidarbayev farm (706±8.0:615±7.2 thousand/ml). Milk with such reduced quality indicators is unsuitable for processing enterprises.



**Fig. 2:** Therapeutic effectiveness of teat treatment preparations after milking.

## DISCUSSION

As a result of the conducted studies comparing the effectiveness of Promixan with Blockade and Vet Clean I-Film, we found that this preparation was 2.2% more effective and is not inferior to analogs. After milking, during 4 hours of exposure, with the use of Promixan, the degree of contamination of the udder and teats with microorganisms was reduced by 98.1%. According to the bactericidal properties, the effectiveness of Promixan on average ranged from 94.3 to 98.1%, and it affected all types of microorganisms. In studies conducted in this field, the average effectiveness of the used preparations increased to 80.3-88.8% (Narbayeva et al. 2016). In works by some scientists, no effect was found to reduce the number of *Candida* yeast fungi (Mišeikienė et al. 2015).

The results of the use of Promixan in the experimental group in terms of bactericidal properties are not inferior to the results of modern preparations Blockade and Vet Clean I-Film. An improvement in the quality of the obtained milk was established and ensured, together with the prevention of subclinical mastitis. In our studies, the level of cleanliness of the udder and skin increased to 17-20%, while the results of other scientists' research in this field show that it ranges from 22-30%, which creates the possibility of mastitis (Schreiner and Ruegg 2003; de Pinho Manzi et al. 2012).

When comparing the therapeutic effectiveness of the results of preparations used in the prevention of subclinical mastitis, the therapeutic effectiveness of Promixan was 13.3%, which is 6.7% higher than Blockade and 13.3% higher than Vet Clean I-Film. The efficacy of Promixan, developed with our participation, averaged 86.7%. Compared with research by many scientists (90-90.4%), it was possible to verify that there was no significant difference (Reshetka and Koba 2015; Tanbayeva et al. 2016).

In the experimental group, as a result of the sanitary treatment of milk of dairy cows with Promixan, the composition of the resulting milk had significantly better indicators compared to the other preparations. We found that the fat content of milk samples from dairy cows with subclinical mastitis in the experimental group decreased to  $2.88 \pm 0.8\%$  before the study and increased to  $3.7 \pm 1.2\%$  by the end of the study. In other studies, there was an increased compliance from  $2.89 \pm 0.7$  to  $4.2 \pm 1.6\%$  (Bagri et al. 2018). We found that the number of somatic cells in milk decreased from  $722 \pm 8.4$  to  $292 \pm 4.8$  thousand/ml and

improved by up to 2.4 times. In other works in this field, the number of somatic cells decreased from  $603.23 \pm 29.6$  to  $494.57 \pm 57.6$  thousand/ml and improved by only 1.2 times (Zelenko and Kobozev 2003).

## Conclusions

As a result of determining the effectiveness of Promixan in the prevention of microbial contamination of the udder teats of cows with subclinical mastitis after milking, a high bactericidal index was established compared with the control preparations. The maximum effectiveness of the preparation was achieved with an exposure of 4 hours.

When assessing the degree of cleanliness of the teats and udders of dairy cows of the experimental and the 1st control group, in both farms, the indicators corresponded to the 2<sup>nd</sup> category, and in the 2nd control group (not treated with preparations), the dairy cows belonged to the 3<sup>rd</sup> category, which means an increased possibility of mastitis for cows.

The therapeutic effectiveness of the developed preparation Promixan was 3.4% higher than Blockade, 3.3% higher than Vet Clean I-Film, and 20-46.7% higher compared to no treatment. Besides, the quality of the milk had significantly improved after the sanitary treatment of the udder with the developed preparation.

Based on our results in production conditions, it can be concluded that the developed preparation can be used at livestock facilities.

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