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Effectiveness of Detergents and Disinfectants in the Production of Cow's Milk

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Abstract. The relevance of this study is conditioned upon the need to improve the hygiene of milking cows by selecting detergents and disinfectants with different component compositions that ensure the quality and safety of dairy products. The purpose of this paper was to investigate the effectiveness of solutions of modern chlorine-containing and chlorine-free detergents and disinfectants on the test cultures of microorganisms, the sanitary and hygienic condition of the milking parlour, parts of milking equipment, and the skin of the udder teats of cows. The total number of bacteria was determined according to the requirements of DSTU ISO 15214:2007, by inoculating 1 cm^3 of the test material on meat-peptone agar followed by incubation at an average temperature of 36°C for 24-48 h. Cultivation was performed in a thermostat at 37°C. After incubation, colonies of grown microorganisms were counted, and the number of colony-forming units was determined. Detergents and disinfectants "Chloramine B", "Sanalcalin" and "Neochlor" have a detrimental effect on the growth of test cultures of *E. coli, S. aureus* and *P. aeruginosa*. "Desmol" suppresses the growth of test cultures of *E. coli* and *P. aeruginosa* after 20 minutes. The number of colonies of microorganisms in the air of the milking parlour is minimal at the beginning and greatest at the end of milking. 0.5% solution has a detrimental effect on *E. coli* and *S. aureus*, and slightly affects the growth of *Salmonella spp*. At the same time, this product is effective against microbial contamination of the skin of the udder teats of cows for its use in pre-milking disinfection. During the treatment of milking equipment with a 0.5% "Gralan Gel" solution, the total bacterial inoculation of the milking gum is reduced by 94.1%, the collector – by 98.4%, the milk hose – by 96.5%, the tank of the milking machine – by 97.4% compared to the indicators before processing the milking equipment with detergents and disinfectants. According to the results of the study, the best efficiency in reducing the general bacterial contamination of milking equipment, the harmful effect on opportunistic microflora and microbial contamination of the skin of the udders of cows when used in pre-milking disinfection at milk production enterprises shows a 0.5% solution of the alkaline detergent and disinfectant "Gralan Gel". Thus, it is advisable to use a 0.5% solution of alkaline detergent and disinfectant "Gralan Gel" for producers of cow's raw milk to reduce the total bacterial contamination of milking equipment and cow udders

Keywords: industrial cattle breeding, disinfection, bactericidal properties, microbial contamination

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Introduction

Providing the population with high-quality food products, including milk and dairy products, is one of the principal tasks in solving the food problem in the country. Presently, modern dairy complexes use intensive integrated technologies in compliance with hygienic and veterinary and sanitary requirements for farms. However, a considerable part of farms still uses partially converted cowsheds and auxiliary production facilities that meet the standards of the 1960s and 1970s. In such farms, the most common is the use of milking equipment such as "Maiga" and others, when portable milking machines are used, and conditions are created that contribute to the development of saprophytic, and sometimes pathogenic microorganisms. These conditions include elevated temperature, humidity, significant dust content in the air, insufficient ultraviolet radiation, and crowding of animals.

The number of microorganisms in the air of premises for cattle varies significantly – from 12 to 100 thousand microbial bodies per 1 m^3. Therewith, animals are significant sources of bioaerosols. Thus, among the thirty-four isolated strains of staphylococcus, *S. equorum* (35%), *S. succinus* (26%) and *S. xylosus* (15%) were the most common and resistant to macrolides (erythromycin), lincosamides (clindamycin), and methicillin. Therefore, it is necessary to support proper sanitary conditions and hygiene of premises for keeping animals [1].

Furthermore, the intensification of animal husbandry, the transfer to an industrial basis due to the large concentration of cows on dairy farms led to hypodynamia, metabolic disorders, and an increase in cases of mastitis. The intensification of production and the widespread use of machine-type cow milking has led to the spread of this disease in all countries of the world, and a decrease in the quality of milk [2]. Therewith, the quality of milk and dairy products depends on the hygienic conditions of keeping lactating animals [3].

One of the principal requirements listed in regulatory documents is the requirements for air hygiene of livestock premises where lactating animals are constantly located, and with which they are in constant contact. At the same time, saprophytic and sometimes pathogenic microorganisms have the main influence on the living organism of the polluted air of livestock premises. Pathogens of many diseases are spread by air, predominantly by its convection currents. The aerogenic route of disease transmission becomes essential in conditions of high concentrations of animals [4].

Therefore, adequate management of the dangerous factor that can appear in food products, namely milk, at any link in the food chain, is an important task for producers. To solve this, the International Organization for Standardization developed ISO 22000:2005 "Food safety management systems. Requirements for any organizations of the food chain", which has been in force in Ukraine since April 2007, as DSTU ISO 22000:2007 [5].

Thus, obtaining milk of high sanitary quality is of great social importance. Over the past 5 years, considerable attention has been paid to udder sanitation, which substantially affects the bacterial contamination of milk and contributes to improving its quality and safety. Therewith, maintaining the hygiene of the udder of cows, which includes cleaning, washing, and disinfection, primarily aimed at reducing the risk of the disease [6].

Several disinfectants are currently recommended for sanitary treatment of the udder. These are preparations of iodine monochloride, chlorine, Desmol, Vesan, calcium hypochlorite, quaternary ammonium salts, an aqueous suspension of hexochlorophene and triethanolamine, and an antiseptic emulsion [7; 8]. When choosing a disinfectant or a method of disinfection, it is necessary to consider that its disinfection effect depends on several factors, namely: the degree of endurance of microorganisms; concentration of the solution; solution temperature; pH of the medium; the physical and chemical nature of the object of disinfection; spectrum of antimicrobial action. Today, based on their effectiveness in reducing the total bacterial contamination of milk, combined detergent-disinfectants are most often used, which include: "Desmol", "Chloramine B", "Sanalcalin", "Neochlor" and "Gralan Gel".

The purpose of this study is to investigate the bactericidal properties of chlorine – containing detergents and disinfectants: "Desmol", "Chloramine B", "Sanalcalin", "Neochlor", to assess microbial contamination of the milking parlour, the skin of the udder teats of cows and the rubber of milking cups, as well as the general bacterial contamination of parts of milking equipment during the production of cow milk using 0.5% solutions of soda ash, "Desmol" and alkaline detergent and disinfectant "Gralan Gel".

Literature Review

Recently, milk producers have been using environmentally friendly products. During their application, the antimicrobial component (ozone) is created from atmospheric oxygen and quickly disintegrates with the end of the disinfection event, without polluting the object and atmosphere with residual products. That is why ozonation in comparison with traditional disinfection methods can substantially reduce the consumption of biologically pure water, energy, as well as the costs associated with transportation and storage of disinfectant [9].

One of the reasons for the deterioration of milk quality and safety is the disease of cows with subclinical mastitis. Subclinical mastitis is infectious in nature, although the trigger in the disease is an economic cause. Microflora is one of the main and principal factors in subclinical mastitis in cows. Due to the contamination of milk with pathogenic microorganisms, it can cause human diseases. The causative agents of subclinical mastitis are more often pathogenic forms of cocci, which are found both in the external environment and on the skin of the udder of animals. When milking cows, milking machines, with any milking system, are used without disinfection. If a cow with an infected udder enters the milking process, direct infection from one animal to another occurs. Therefore, subclinical mastitis is widespread in the herd. To break this pathogenic chain, it is necessary to conduct sanitary and hygienic measures, one of which is disinfection [10; 11].

Currently, several disinfectants of domestic and foreign production are used in the veterinary practice of Ukraine. Most of them do not fully meet the requirements of versatility, stability during transportation, degree of dissolution in water, bactericidal action, and safety for living

organisms. Therefore, there is a need to develop other combined-acting disinfectants. A mandatory condition for the introduction of a disinfectant in Ukraine is practical testing, during which the disinfectant in real conditions of use has the possibility of contact with populations of microorganisms [12].

A promising area in veterinary medicine is the creation of new and improvement of available disinfectants. The purpose of their creation is to expand the spectrum of antimicrobial activity and the ability to counteract the formation of resistant strains of microorganisms. The effect of such disinfectants should be harmful to viruses and fungi and environmentally safe. One of these means is an ozone-air mixture – the use of ozone technologies is an alternative to conventional disinfectants and antibacterial agents [13].

Currently, in Ukraine, the assessment of the quality of disinfection includes visual control of the sanitary condition and bacteriological control. Bacteriological control is exercised by specialists of accredited laboratories, by sampling flushes from livestock facilities and evaluating the hygienic condition according to the indicators of general bacterial contamination, colour titre, and the presence of pathogenic and conditionally pathogenic microflora [14].

Thus, the main factor in the system of ensuring food safety and quality is the sanitary preparation of animals, premises, and equipment for obtaining high-quality milk.

Materials and Methods

The research was conducted in 2021 at the I.S. Zagaievskyi Department of Veterinary and Sanitary Expertise, Hygiene of Livestock Products and Anatomical Pathology of the Bila Tserkva National Agrarian University, Laboratories of Svitlovodsk and Bashtanka creameries of the Dnipropetrovsk region. Scientific and economic experiments were performed in the following milk production farms: Agrofirma Piatykhatska LLC, Progres LLC, Zarichne LLC and Agrofirma Mariampolska LLC.

In experimental farms, the method of milking in portable milking machines is used. When determining the bactericidal properties of detergents and disinfectants, they were used at different concentrations and chlorine content: 0.25% and 0.5% solution – "Desmol" (chlorine content – 120, 250 mg/dm^3), 0.25% and 0.5% solutions – "Chloramine B" (chlorine content – 120 mg/dm^3, 250 and 500 mg/dm^3) and "Sanalcalin" (chlorine content – 250 and 500 mg/dm^3), and 0.25%, 0.5% and 0.7% solution – "Neochlor" (chlorine content – 250 and 500 mg/dm^3). Therewith, the temperature of these solutions is different: "Desmol" – 50 ± 5°C, "Chloramine B" – 16 ± 2°C and "Neochlor" – 16 ± 2°C. For these laboratory studies, test cultures of *E. coli* (strain No. 078), *S. aureus* (strain No. 209-P), and *P. aeruginosa* (strain No. 27.99) were used.

The antimicrobial effect of the alkaline detergent and disinfectant "Gralan Gel" (Germany) was investigated. This is a complex detergent and disinfectant that contains a complex of special protective components: glycerine, lanolin, allantoin, and other special additives. These components allow disinfecting any premises, as well as keeping the skin of the udder and teat soft, smooth, and prevent pathogens from entering the teat canal. The antimicrobial effect of the alkaline detergent and disinfectant "Gralan Gel" was evaluated by the effect on the dynamics of microbial air pollution in the milking unit, as well as in samples of flushes from the walls of the milking parlour, the skin of the udder teats of cows and from the rubber of milking cups. At the beginning of the study, after wet cleaning of the milking parlour, the room air was treated with a 0.5% solution of Gralan Gel. 15 minutes after airing the room, milking of cows began.

The study was conducted in three stages. At the first stage, the bactericidal properties of these detergents and disinfectants were investigated.

At the second stage, the dynamics of the general bacterial contamination of the milking parlour air, flushes from the walls of the milking parlour, from the rubber of milking cups and the skin of the udder teats of cows during the milking period (lasts 6 minutes) were established – at its beginning, in the middle (after 2-3 minutes), and at the end. The total number of bacteria was determined according to DSTU ISO 15214:2007 [15], by inoculating 1 cm^3 of the test material on meat-peptone agar (MPA) followed by incubation at 36 ± 2°C for 24-48 h. Cultivation was performed in a thermostat at 37°C. The nature of microflora growth on the media was determined after 24 and 48 hours [16-18].

The cultures of microorganisms isolated in washings from milking equipment were identified based on morphological, tinctorial, cultural, and biochemical data using Bergey's bacteria identifier [19; 20].

At the third stage, microbiological studies of flushes from milking equipment were performed using various detergents and disinfectants. For this purpose, after incubation, colonies of grown microorganisms were counted and the number of colony-forming units per unit volume of the test material (CFU/cm^3) was determined [17; 18].

Statistical processing of the obtained results was performed using the Microsoft Office Excel 2007 software and the Fischer-Student method. Therewith, the values of arithmetic mean values and their statistical error were considered. The probability of the difference between the obtained indicators, by comparing them, the arithmetic mean (M) and the standard error of the arithmetic mean (m) were determined. The difference between the values of indicators was considered statistically significant at a level of more than 95% ($P < 0.05$).

Results and Discussion

The results of the study of the bactericidal properties of detergents and disinfectants are presented in Table 1.

Table 1. Bactericidal properties of detergents and disinfectants, n = 5

Means, solution temperature	Solution concentration (%)	Active chlorine content (mg/l)	Exposure (min) test cultures								
			S. aureus			*E. coli*			*P. aeruginosa*		
			5	10	20	5	10	20	5	15	20
"Desmol", t 50 ± 5°C	0.25	120	+	+	+	+	+	+	+	+	+
	0.5	250	+	+	+	+	+	–	+	+	–

Table 1, Continued

Means, solution temperature	Solution concentration (%)	Active chlorine content (mg/l)	Exposure (min) test cultures								
			S. aureus			*E. coli*			*P. aeruginosa*		
			5	10	20	5	10	20	5	15	20
"Chloramine B", t 16 ± 2°C	0.25	120	+	–	–	–	–	–	–	–	–
	0.5	250	–	–	–	–	–	–	–	–	–
	0.7	500	–	–	–	–	–	–	–	–	–
"Sanalcalin", t 16 ± 2°C	0.25	250	–	–	–	–	–	–	–	–	–
	0.5	500	–	–	–	–	–	–	–	–	–
"Neochlor", t 16 ± 2°C	0.25	250	–	–	–	–	–	–	–	–	–
	0.5	500	–	–	–	–	–	–	–	–	–

Note: "+" – available growth, "–" – no growth

The results presented in Table 1 show that a 0.25% solution of the detergent and disinfectant "Desmol" with an active chlorine content of 120 mg/dm^3, with an exposure of 20 minutes, did not stop the growth of the test culture of *E. coli*, *S. aureus*, and *P. aeruginosa*. At the same time, when using a 0.5% "Desmol" solution with a chlorine content of up to 250 mg/l, no growth of the *E. coli* and *P. aeruginosa* test culture was detected 20 minutes in. Therewith, the test culture of *S. aureus* is less sensitive to this disinfectant. During the study, the disinfectant "Chloramine B" in all applied concentrations effectively acted on test cultures of microorganisms. However, the activity of this disinfectant against *S. aureus* was manifested only after 10 minutes at an active chlorine content of 120 mg/dm^3.

At the same time, 0.25 and 0.5% solutions of detergents and disinfectants – "Sanalcalin" and "Neochlor" with an active chlorine content of 250 and 500 mg/dm^3 of the solution had a detrimental effect on the growth of test cultures (Table 1). Thus, the test cultures of *S. aureus* turned out to be less sensitive to the effect of the tested detergents and disinfectants. In general, for the treatment of livestock premises, it is necessary to carefully select detergents and disinfectants according to their concentration and exposure. Other scientists have proven that microorganisms isolated from dairy equipment form high- and medium-density biofilms that protect them during disinfection of dairy equipment [6]. Furthermore, it is necessary to consider the sensitivity of microorganisms to different temperature ranges [7].

It is possible to obtain high-quality and safe milk only from healthy cows and in compliance with sanitary and hygienic requirements during its production. One of these requirements is to eliminate the possibility of bacterial contamination during milking. The main sources of contamination at the milking stage are the sanitary cleanliness of udders and dairy equipment. For sanitary treatment of milking equipment, chemical disinfectants are most often used in the form of solutions, emulsions, and suspensions of various concentrations and aerosols, and gases – for disinfection of dairy equipment and care items [6; 8]. At the same time, milk producers strive to reduce the number of chemical treatments, which is economically feasible, reduces risks to animal health and preserves the quality of products. Thus, when evaluating the functional state of the udder of cows, it is necessary to monitor the content of somatic cells in milk. Depending on the result, it becomes possible to adjust the frequency of treatment with detergents and disinfectants for both the udder and dairy equipment [21]. When milking cows kept in a stall/tie-up housing into portable milking buckets, it is difficult to obtain quality indicators of extra or higher-grade milk according to the requirements of the current national standard DSTU 3662:2018 "Raw cow milk. Technical conditions" [22].

Therefore, it is important to evaluate the sanitary condition of the milking parlour regarding the dynamics of general bacterial contamination during the milking period – at its beginning, in the middle, and at the end. It was found that at the beginning of milking, the number of colonies of microorganisms in the air of the milking parlour was insignificant (up to 70 thousand/m^3) (Fig. 1).

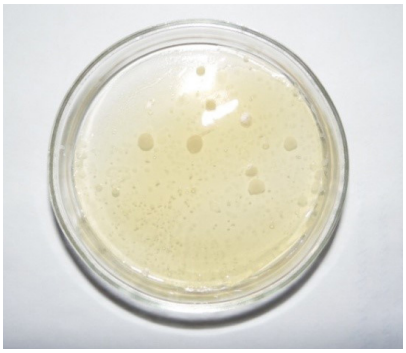

Figure 1. Total number of bacteria in the milking parlour air at the beginning of milking

Figure 2 shows that the number of colonies that have grown on the MPA increases to 235 thousand/m^3 in the middle of milking.

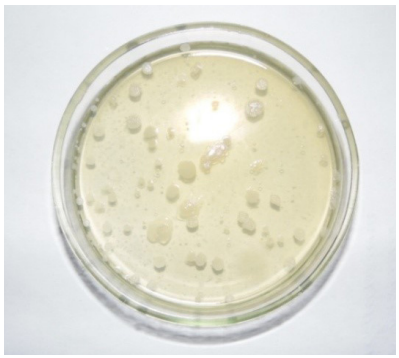

Figure 2. Total number of bacteria in the milking parlour air in the middle of milking

This is explained by the fact that cows are not sanitized before being moved to the milking parlour. The unsatisfactory condition of the skin of cows leads to the accumulation of microorganisms in the room, which can get on the dairy equipment, specifically in the milk glasses, and from there in the milk. Figure 3 shows that the number of colonies at the end of milking increased significantly (up to 485 thousand/m^3) compared to its beginning and middle.

Figure 3. Total number of bacteria in the milking parlour air at the end of milking

The fluctuation of the air leads to the fact that microorganisms, together with the air currents, fall onto the udder already prepared for milking and into the milking cups. And, as a result, they increase the bacterial contamination of milk by 1.5-2 times. Therefore, milking machines should be connected immediately after sanitary preparation of the udder for milking, and not after some time. Typically, especially with the method of tie-up housing and milking in portable milking machines, machine milking operators often wash the udders of several cows together, and only then connect the milking machine.

Such actions lead to the spread of microorganisms among animals. It is known that the lower the microbial contamination of milk, the longer the period when milk meets the requirements of the current national standard in terms of sanitary and hygienic indicators [22].

Therewith, the authors of this paper conducted a microbiological study of the sanitary condition of the milking parlour, the skin of the udder teats of cows and the rubber of milking cups during the entire milking period. The results are presented in Table 2.

Table 2. Dynamics of microbial contamination of samples without the use of detergents and disinfectants, n = 5

Sample		*E. coli*	*Salmonella spp.*	*S. aureus.*
Air in the milking unit	at the beginning of milking	+	–	–
	in the middle of milking	+	+/–	+/–
	at the end of milking	+	+	+
Flushes from the walls of the milking parlour	at the beginning of milking	+	–	–
	in the middle of milking	+	+	+
	at the end of milking	+	+	+
Washes from the skin of cows' udders	before washing	+	+	+
	after washing	+/–	–	+/–
Flushing from the rubber of milking cups	at the beginning of milking	+	–	–
	in the middle of milking	+	+	+
	at the end of milking	+	+	+

Based on the results presented in Table 2, it follows that the sanitary condition of the milking parlour at the beginning of milking and at the end has significant differences. In the air of the milking parlour at the beginning of milking, the growth of *E. coli* and in some cases *Salmonella spp*. was detected; on the other hand, the pathogen *S. aureus* was absent. However, in the middle of the milking period and at the end, the growth of *E. coli*, *Salmonella spp*. and *S. aureus* was found in the air of the milking parlour. Comparable results were obtained when finding the microbial contamination of flushes from the walls of the milking parlour. At the beginning of milking, only *E. coli* and *Salmonella spp*. and *S. aureus* were not detected, but later, in some samples, the growth of colonies of these pathogens appeared. After washing the udder and teats with water, the growth of *E. coli* was detected in some samples, and *S. aureus* or their association in some samples.

According to the study of the sanitary condition of the rubber of milking cups, it was found that at the beginning of milking it contained only *E. coli*, while *Salmonella spp*. and *S. aureus* were absent. However, in the middle of the milking period, *E. coli*, *Salmonella spp*., and *S. aureus* were detected.

Thus, the obtained results suggest that the sanitary condition of the milking parlour, even with satisfactory pre-milking preparation, changes substantially. The sanitary condition of this room is substantially affected by the cleanliness of the skin of animals, namely the udder, and the presence of mastitis. Thus, according to the data of other authors [23], 62.0% of cows are diagnosed with subclinical mastitis, and *S. aureus* is isolated from most milk samples examined for bacterial insemination. Therewith, scientists have proven that the risk factors are contaminated udders and limbs in cows, the lactation period, non-compliance with the requirements for the hygiene of the milking area and the lack of milking of the first portions of milk before milking.

The results of the study of the dynamics of microbial contamination of the selected air samples in the milking block, washings from the walls of the milking parlour, the skin of the milking cows, the udders of cows, and from the rubber of the milking cups with the use of the cleaning and disinfecting agent "Gralan Gel" are presented in Table 3.

Table 3. Dynamics of microbial contamination of samples with the use of detergent and disinfectant "Gralan Gel", n = 5

Sample		*E. coli*	*Salmonella spp.*	*S. aureus*
Air in the milking unit	at the beginning of milking	–	+/–	–
	in the middle of milking	–	+/–	–
	at the end of milking	+	+/–	+
Flushes from the walls of the milking parlour	at the beginning of milking	–	+/–	–
	in the middle of milking	–	+	–
	at the end of milking	–	+	–
Washes from the skin of cows' udders	before disinfection	+	+	+
	after disinfection	–	+/–	–
Flushing from the rubber of milking cups	at the beginning of milking	–	–	–
	in the middle of milking	+/–	+	+/–
	at the end of milking	+	+	+

The results presented in Table 3 suggest that the growth of *E. coli* and *S. aureus* was not detected in the air of the milking parlour, but in some cases, there was a positive result for the growth of *Salmonella spp.* After the end of the milking period, all identified microorganisms were detected in the air of the milking parlour.

On the other hand, based on the evaluation of samples washed from the walls of the milking hall, it was established that a 0.5% solution of the detergent and disinfectant "Gralan Gel" has a harmful effect on *E. coli* and *S. aureus* and has a weak effect on *Salmonella spp*. This product has a detrimental effect on microbial contamination of the skin of the udder teats of cows for its use in pre-milking disinfection.

Thus, before milking, without performing disinfection, all differentiated sanitary-indicative microorganisms were detected on the skin of the udder of cows. After disinfection, *E. coli* and *S. aureus* were not detected on the skin of the udders of cows, but in some cases *Salmonella spp.* was found. Microbial contamination of the rubber of milking cups had the same dynamics regarding bacterial contamination. Thus, at the beginning of milking, the growth of microorganisms was not observed, but in the middle of the milking period in some samples, and at the end – in all samples, the above-mentioned microorganisms were detected.

Analysis of the results showed that the use of a 0.5% solution of the detergent and disinfectant "Gralan Gel" positively affects the sanitary condition of the milking room, milking equipment, and the skin of the cows' udders.

During the determination of microbial contamination of milking equipment, this study was aimed at comparing the effectiveness of the detergents and disinfectants under study in relation to its various parts (Table 4).

Table 4. General bacterial contamination of milking equipment parts during the use of various detergents and disinfectants, M ± m, n = 5

Product, solution concentration	Washout sampling time	Parts of milking equipment			
		Milking rubber	Collector	Milk hose	Milking machine tank
Before processing milking equipment, thous. CFU/cm^3		371.32 ± 12.4	262.53 ± 10.1	278.48 ± 6.7	231.81 ± 5.7
Soda ash, 0.5%	after treatment. thous.CFU/cm^3	128.15 ± 9.2*	133.56 ± 7.6*	138.62 ± 11.7*	95.35 ± 15.2*
"Desmol", 0.5%	after treatment. thous.CFU/cm^3	58.51 ± 8.2*	25.31 ± 4.7*	47.57 ± 5.9*	35.21 ± 8.1*
"Gralan Gel", 0.5%	after treatment. thous.CFU/cm^3	22.05 ± 2.2*	4.31 ± 1.1*	9.73 ± 2.2*	6.11 ± 0.2*

Note: * P < 0.001, significant compared to pre-treatment indicators for milking equipment

The results presented in Table 4 show that during the application of a 0.5% solution of soda ash, the total bacterial inoculation of the milk gum decreased by 65.5% (P < 0.001), the collector – by 49.1% (P < 0.001), the milk hose – by 5.2% (P < 0.001), the tank of the milking machine – by 58.9% (P < 0.001) compared to the indicators before processing the milking equipment.

At the same time, when using the treatment of dairy equipment with 0.5% "Desmol" solution, the total bacterial contamination of milking rubber decreased by 84.2% (P < 0.001), the collector – by 90.4% (P < 0.001), the milk hose – by 82.9% (P < 0.001), the tank of the milking machine – by 84.8% (P < 0.001) compared to the indicators before the treatment of milking equipment.

Therewith, when using the treatment of dairy equipment with 0.5% "Gralan Gel" solution, the total bacterial contamination of milking rubber decreased by 94.1% (P < 0.001), the collector – by 98.4% (P < 0.001), the

milk hose – by 96.5% (P < 0.001), the tank of the milking machine – by 97.4% (P < 0.001) compared to the indicators before the treatment of milking equipment.

Based on the results of general bacterial contamination of dairy equipment for sanitary treatment, it was also found that the most contaminated was milking rubber (see Table 4). After sanitary treatment of milking rubber with the detergents and disinfectants under study, its total bacterial inoculation decreased by 3.0 times (P < 0.001) – after treatment with a 0.5% solution of soda ash, 6.3 times – after treatment with a 0.5% solution of "Desmol" and 16.8 times – after treatment with 0.5% "Gralan Gel" solution, but it was still the greatest. Obviously, the reason for the high bacterial contamination of milking rubber is that it comes into direct contact with the skin of the udder, which does not always meet veterinary and sanitary requirements, and the environment of the livestock room in which milking is carried out. For a thorough investigation of microbial contamination of the udder skin, it is necessary to use sampling protocols from its various parts and the teat duct. Therewith, varied materials and equipment should be used. This approach allows stating that the microorganisms, which are inside and outside the udders and on the skin of the udder of cattle, differ in their taxonomic composition and number between its different anatomical parts [24].

In previous years, milking tires and milk hoses were replaced four times a year, i.e., once a quarter. Presently, these requirements are not met in farms, which leads to the emergence of cracks that microorganisms can penetrate and multiply. Therewith, according to the study results presented in Table 4, the most effective sanitary treatment of milking equipment occurs when using a 0.5% solution of alkaline detergent and disinfectant "Gralan Gel".

Conclusions

Bactericidal properties of detergents and disinfectants: 0.25% and 0.5% solutions of "Chloramine B", "Sanalcalin", "Neochlor" with active chlorine content – 120 mg/dm^3, 250 and 500 mg/dm^3 have a detrimental effect on the growth of test cultures of *E. coli*, *S. aureus*, and *P. aeruginosa*. 0.5% Desmol solution with an active chlorine content of up to 250 mg/dm^3 had a detrimental effect on the growth of test cultures of *E. coli* and *P. aeruginosa* only 20 minutes in.

The number of microbial colonies in the air of the milking parlour changes during the milking period of cows. Therewith, it is minimal at the beginning and the largest at the end of milking. The dynamics of microbial contamination of the condition of the milking parlour, the skin of milking cows, the udder of cows, and the rubber of milking cups without the use of detergents and disinfectants leads to the detection of *E. coli*, *Salmonella spp.*, and *S. aureus*.

The use of a 0.5% solution of the alkaline detergent and disinfectant "Gralan Gel" resulted in a detrimental effect on *E. coli* and *S. aureus* and a minor effect on *Salmonella spp.* This product has a detrimental effect on microbial contamination of the skin of the udder teats of cows for its use in pre-milking disinfection.

Thus, treatment of milking equipment with a 0.5% "Gralan Gel" solution leads to a reduction of the total bacterial inoculation of the milking rubber by 94.1%, the collector – by 98.4%, the milk hose – by 96.5%, the tank of the milking machine – by 97.4% compared to the indicators before the treatment of milking equipment with detergents and disinfectants.

Future studies aim to investigate the use of various concentrations (1-10%) of the alkaline detergent and disinfectant "Gralan Gel" with different degrees of contamination of the udder of cows.

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Ефективність застосування мийно-дезінфікуючих засобів під час виробництва молока корів

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Анотація. Актуальність дослідження зумовлена необхідністю покращення гігієни доїння корів, шляхом підбору мийно-дезінфікуючих засобів із різним компонентним складом, що забезпечує якість і безпечність молочних продуктів. Мета цієї роботи полягала у дослідженні ефективності дії розчинів сучасних мийно-дезінфікуючих засобів, що містять в своєму складі активний хлор і безхлорних, на тест-культури мікроорганізмів, санітарно-гігієнічний стан доїльної зали, частини доїльного обладнання та шкіру дійок вим'я корів. Визначали загальну кількість бактерій за вимогами ДСТУ ISO 15214:2007, шляхом посів у 1 см^3 дослідного матеріалу на м›ясо-пептонний агар з наступною інкубацією за середньої температури 36 ºС упродовж 24-48 год. Культивування проводили в термостаті за температури 37 ºС. Після інкубації здійснювали підрахунок колоній мікроорганізмів, що виросли, та визначали кількість колонієутворюючих одиниць. Мийно-дезінфікуючі засоби «Хлорамін Б», «Sanalcalin» і «Неохлор» згубно діють на ріст тест-культур *E. coli*, *S. aureus* і *P. aeruginosa*. «Дезмол» пригнічує ріст тест-культур *E. coli* і *P. aeruginosa* через 20 хв. Кількість колоній мікроорганізмів в повітрі доїльної зали мінімальна на початку та найбільша – в

кінці доїння. 0,5 % розчин згубно діє на *E. coli* та *S. aureus* і незначно впливає на ріст *Salmonella spp*. Водночас цей засіб виявляє ефективність щодо мікробного забруднення шкіри дійок вимені корів за його використання у переддоїльній дезінфекції. Під час обробки доїльного обладнання 0,5 % розчином «Gralan Gel» загальне бактеріальне обсіменіння дійкової гуми зменшується на 94,1 %, колектору – на 98,4 %, молочного шлангу – на 96,5 %, бачку доїльного апарату – на 97,4 % порівняно з показниками до обробки доїльного обладнання мийно-дезінфікуючими засобами. За результатами дослідження найкращу ефективність щодо зниження загального бактеріального забруднення доїльного обладнання, згубної дії на умовно-патогенну мікрофлору і мікробне забруднення шкіри дійок вимені корів за використання у переддоїльній дезінфекції на підприємствах з виробництва молока виявляє 0,5 % розчин лужного мийно-дезінфікуючого засобу «Gralan Gel». Таким чином, 0,5 % розчин лужного мийно-дезінфікуючого засобу «Gralan Gel» доцільно використовувати виробникам молока-сировини коров'ячого для зменшення загального бактеріального обсіменіння доїльного обладнання та вим'я корів

Ключові слова: промислове скотарство, дезінфекція, бактерицидні властивості, мікробне забруднення