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Cleansing agents for nursing cows' udders

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Abstract

Prevention of intramammary infections, maintaining cow production, and enhancing milk quality all need implementation of the "Milking Protocol" on the farm. Most dairy farms use udder hygiene products as a preventative udder care treatment. Effectiveness data required for veterinary medication registration should guide the selection of an antiseptic agent for udder health. The goal of the research was to review the existing literature on the topic of udder care products for breastfeeding cows. In order to write this paper, we familiarized ourselves with the findings of recent scientific studies, analyzed and theoretically justified them, and compiled the data we gathered on the topic of sanitizing the udders of milking cows utilizing hygiene practices. Science-Direct and PubMed were utilized for this purpose together with money from the Polissia National University scientific library. Therefore, it follows that maintaining sanitary conditions in the mammary gland is essential for healthy breasts. Iodine, chlorhexidine, and organic acids are listed as ingredients in Ukrainian prescription medications. The cosmetic surfactants included in hygienic products work to soften the skin and create a hydrating hydrophilic layer to keep it that way. The danger of chemical components entering the milk is increased when employing udder hygiene means since these products are often of chemical origin. Probiotic-based solutions, on the other hand, are better for the environment and are completely safe for animals. Medicinal plants are used as raw materials to prepare infusions, decoctions, water extracts, alcohol- and oil-based solutions, which are then offered to the specialists of the dairy industry for the disinfection of cow udders in times of war and economic difficulties. The anti-mastitis program includes dipping as one of its preventative strategies. When deciding how to disinfect udders after milking, it's important to think about how infections are spreading throughout the herd and how the environment will affect the final product. In this respect, I think that studying the impact of nanotechnology on the health of the udder of milking cows and using probiotics as a dip as an alternative to substances of chemical origin is a promising avenue of scientific research.

Keywords: hygiene products; udder health; udder disinfection; lactating cows; mastitis; dipping; bacterial load.

1. Introduction

When it comes to the production of foods derived from animals, dairy farming is a major economic driver. It is becoming more necessary to give a chance to ensure the production of high-quality and value food products, since the dairy sector in Ukraine is now suffering due to the conflict and raising cattle on a broad area under demanding military operations. The state's overall economic and social growth is dependent on the milk industry's health.Regulation (EU) No. 853/2004 on particular standards for the cleanliness of food items, including raw milk, was adopted by Ukraine as part of its commitments under the Association Agreement with the European Union. A national regulation document titled "Raw milk of cows. Specifications" (SSTC 3662:2018) governs the quality of this raw material.High-quality raw milk is characterized by a lack of human pathogenic microorganisms and poisonous chemicals, a low number of somatic cells, and little bacterial in- semination (Barkema et al., 2015; Ndahetue et al., 2019). There is significance in the condition of the udder in breastfeeding cows (Breen, 2019). The implementation of the "Milking Protocol" on the farm, whereby compliance with a specific sequence of acts is a required requirement for avoiding mammary gland diseases, has been corroborated by both international and local experience and practice (Sokoluk et al., 2022). Udder hygiene practices, such as pre-dipping the udder with detergent solutions before to milking and dipping the teat canal with film-forming agents to prevent clogging, get a lot of focus. This is a component of the Integrated Strategy for the Prevention and Treatment of Mastitis in Cows (Geary et al., 2013).

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Despite the abundance of literature on the subject of studying the effect of disinfectants for sanitizing the skin of lactating cows on the animal body and the wide variety of udder hygiene products available on the market along with instructions for their use, recommendations and reviews from practitioners, and scientific publications, many questions remain unanswered (Muzyka et al., 2021). It's important to have clean milk, therefore questions about which disinfectants to use, how to regulate milk flow, whether or not they'll hurt the cows, and so on arise.The purpose of this study was to get familiar with the most up-to-date information available in the literature about the use of sanitary techniques to maintain the health of the udder in breastfeeding cows.

2. Materials and methods

While writing this review article, we got acquainted with the results of modern scientific research, conducted their analysis and theoretical justification, and summarized the data obtained on using hygienic means for sanitizing the udder of lactating cows. For this purpose, the Polissia National University scientific library funds, scientific search systems Science-Direct, and PubMed were used.

3. Results and discussion

In their research, Belage E. et al. (2017) studied which cow milking management methods have the most significantimpact on udder health. A national survey described the current extent of adoption of milking practices on Canadian dairy farms and identified factors associated with their use. After surveying 1,373 milk producers, scientists concluded that, in general, Canadian farmers follow recommendations for milking procedures. Cleaning of udders before and after milking, using disposable towels for each cow, and treating udders with a disinfectant after milking was widespread. At the same time, the use of gloves by milkers and treating udders with disinfectants before milking is practiced less. Adoption rates for several dairy farm practices were signifi- cantly related to the milking system, herd size, and country region.

The simultaneous effect of udder health management practices on the number of somatic cells in milk was studiedby S. Dufour et al. (2011). Based on the scientific literature analysis and their research data, the authors concluded that most practices with constant associations with the number ofsomatic cells were related to milking procedures. An essen- tial condition is gloves during milking, using means for treating udders, and milking problem cows last. It is neces- sary to conduct an annual inspection of the milking system and use equipment that ensures the standing position of the cows after milking. All these practices were consistentlyassociated with a decrease in the number of somatic cells in milk.

The research by Z. Deng et al. (2019) indicates multiple risk factors for mastitis in cows on a farm with automated and conventional milking systems, particularly concerning udder hygiene products. However, udder health requires more attention on larger complexes with automated milking systems than smaller farms.

T. Lam et al. (1995) believe that disinfection of udders after milking is effective against pathogens *Staphylococcus aureus* and *Streptococcus agalactiae* and is an essential part of standard preventive measures against mastitis in dairy cattle. However, there are discussions due to the effectiveness of the disinfection of cows against infections caused by environmental pathogens such as *Escherichia coli*. In some situations, an adverse effect is described. Despite this, scien- tists have concluded that treating udders with hygiene products is an effective preventive care measure among most dairy herds. The choice of disinfectant for udder health should be based on proven efficacy, which is necessary to register the drug as a veterinary medicinal product.

Rowe S. et al. (2018) conducted a prospective longitudi- nal study to examine herd udder hygiene and its association with clinical mastitis in lactating cows pasture-fed in North- ern Australia. The scientists conducted these studies in a previously published clinical trial of disinfecting udders before milking. Modeling the sampling strategy proved that at least eighty cows should be surveyed to achieve suffi- ciently accurate estimates of herd udder hygiene.

Research conducted by Pankey J. (1989), which included the processing of udders only before milking and processing after milking, showed that the interaction of various factors during the milking process requires in-depth study. In field trials among lactating cow herds, positive benefits of this procedure were noted, although considerable variation was observed between herds. Parity, intramammary infection (IMI), and season of the year significantly affected the ef- fectiveness of udder pretreatment. The interaction of these factors affected the incidence of mastitis in cows caused by environmental pathogens. Disinfection of udders reducedthe number of new disease cases, but some factors eliminat- ed these positive effects. Farming specialists need to deter- mine and study these factors in the conditions of their spe- cific

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production.

V. P. Muzyka et al. (2021) report that pre-milking treat-ment of the udder with detergents and disinfectants, follow- ing the correct milking procedure reduces the risks of masti-tis in cows and affects milk quality and productivity. Treat-ment of teats with disinfectants after milking creates an obstacle to the penetration of microbes into the teat canal.They must have an antiseptic effect for their practical use,keep the skin in good condition, and show cosmetic proper-ties. The drug can protect the udder and can be easily re-moved before the next milking; thoroughly cover the skin,and close the sphincter of the udder; the film should be easi-ly removed in order not to exclude the risk of getting intothe milk. The authors provide a list of drugs for udder treat-ment registered in Ukraine during their research. The de- clared composition of the registered drugs was iodine,chlorhexidine, dioxide, decamethoxine, and ethonium. Thedrugs often had different brands but were similar in compo-sition. Usually, soothing cosmetic surfactants such as thosethat soften the skin (lanolin) or that form a moisturizing,hydrophilic layer (glycerin, propylene glycol, polyvinylpyr- idone) are included in the composition of milk disinfectants. Cow udder skin can contaminate raw milk microflora (Doyle et al., 2016). There is a trend that the incidence of mastitis in cows increases with the increase in the number ofpathogenic microorganisms in the milk (Reugg, 2017). Ithas been proven that disinfection of the skin of cows beforeand after milking reduces the contamination of microorgan- isms from the environment (feed, premises, walking areas)to the cow or between animals. Treatment of udders beforemilking effectively reduces the incidence of mastitis causedby environmental bacteria such as *Streptococcus uberis*, Escherichia (Oliver et al., 1993). The dipping procedure prevents bacterial contamination of the udder from the envi-ronment (Hutchison et al., 2005). At the same time, disinfec-tion of udders after milking reduces the cases of mastitis in cows caused by *Staphylococcus aureus* (Williamson & Lacy-Hulbert, 2013), which could be transmitted during milking or through the milking machine (Barkema et al., 2015). In addition, this procedure was found to be less effec-tive against microflora from the environment, in particular *Escherichia coli* and some types of *Streptococci*.

After conducting fundamental research, scientists from different countries developed a comprehensive concept of fighting mastitis in cows (Comprehensive Plan of Mastitis Control). One of the six essential points is proper milking hygiene and treating udders with disinfectants before and after. Pre-milking disinfection of udders (pre-dipping) is to clean dirt, remove preservative residues before milking and destroy microorganisms, which reduces their colonization on the skin and contamination of the mammary gland. Means for treating the udder before milking contain deter- gent and disinfectant components of various types and are divided into ready-made and concentrated (Schukken et al., 2003). The following preparation stage for milking cows is drying and wiping the udders with disposable or reusable napkins. High-quality napkins have a water-resistant hydro- philic structure, which almost completely removes dirt and moisture from the surface of the udders, thereby preventing their injury during milking. It is a mandatory condition (Miseikiene et al., 2015) that the processing and udder of each subsequent animal must be carried out with a fresh napkin. After disinfection of teats (dipping), the milk duct is closed from the penetration of harmful microflora into the internal space of the udder. It should also be noted (Ibrahim et al., 2015) that the skin of cows after milking can serve asa place for the entry and development of pathogenic micro- flora. Manufacturers offer hygienic products with various active substances and concentrations based on iodine, chlor- hexidine, and organic acids (lactic, peracetic, formic, etc.).

The choice of means for disinfecting udders after milk- ing must be made depending on the circulation of pathogens in the herd. High requirements are placed on the prepara- tions for dipping: reliable protection of the milk duct from the penetration of pathogenic microflora, a beneficial effect on the skin, no irritation, a stable and prolonged effect, quick drying, and complete removal before the next milking.In addition, such products should exhibit cosmetic proper- ties, improve the condition of the skin of cows, and have a pleasant smell.

Naqvi S. V. et al. (2018) emphasize that when creating preparations for dipping procedures, which include several ingredients from different classes of chemical compounds, they should complement each other, be safe for human and animal health and not pollute the environment. Means should have a broad spectrum of antiseptic action against microorganisms and fungi, be characterized by a short latent period, high activity, and exhibit a preservative effect.

Other authors (Bohm et al., 2017) believe that the main requirement for disinfectants is the absence of an irritating effect on the skin of cows, minimal absorption from the site of their application, absence of allergic effects, and lowtoxicity. After milking, hygiene products for cow udder health are usually based on iodine, chlorhexidine, and lactic acid salts. One of the critical properties of complex prepara-tions for udder hygiene is the preservation of the milk duct and prolongation of the bactericidal effect until the next milking. Film-forming liquids are conventionally classified according to the thickness of the film formed on the skin. When a thick film is formed, the sphincter of the milk is mechanically closed, and the consumption of the product is, on average, 9–11 ml per treatment of one

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cow, which is not economically profitable. The applied drug dries for a long time, from 20 to 120 minutes, and some do not dry. Litter, grass, and straw stick to the ponds; we get additional pollu- tion risks instead of the desired hygiene. A thick film can cause a greenhouse effect and maceration (softening, wet- ting, and swelling) of the skin. Medium-film products are called “second skin”, as they form a reliable breathable film and mechanically close the teat sphincter. On average, 5–6 ml of the product treats one cow, drying quickly (in about 7–20 minutes).

It should be noted that if the drying time of the drug is more than 15 minutes, there is a risk of losing the integrity of the film if the animal lies down immediately after milk- ing. Thin-film products form a thin protective layer on the surface of the milk and are characterized by a small con- sumption (3–6 ml per treatment of one cow). At the same time, there are risks regarding their damage; thus, they do not provide any protection and hygiene of the udder.

According to the State Research Institute of Veterinary Medicines and Feed Additives (Lviv) data, 17 preparations for treating udder teats are currently registered in Ukraine (table No. 1, https://www.scivp.lviv.ua).

The above drugs' main components are iodine, chlorhex- idine, and organic acids. Usually, to increase the drug's effectiveness, other ingredients are added to its composition. Udder care products may contain a single drug or a combi- nation (Nagvi et al., 2018). The table shows drugs that often have different brands, but there are analogs regarding active substances.

It should be noted that the range of cow udder hygiene products available in Ukraine is much more extensive. The relevant bodies of the executive power, which control this process, must promptly respond to these challenges. Forexample, Ireland (an EU country) uses 96 commerciallyavailable means for disinfecting the skin of udders. Before a heat treatment can be used commercially, it must be regis- tered with the Department of Agriculture, Food and the Marine (DAFM), the Health Products Regulatory Authority (HPRA), and comply with European legislation. According to HPRA requirements, without medical claims, a disinfect- ant intended for application to the skin for hygienic treat- ment may be classified as a biocide and not a veterinary medicinal product (HPRA, 2019). It is subject to registrationfollowing the Regulation on biocidal products (EU Regula- tion No. 528 of 2012). Within the European Union, its member states must use a common standard to evaluate the means used to disinfect the udder. This European Standard (EN), or BSEN 1656, can be used to compare a range of udder health products (Lopez-Banevides et al., 2012; Garvey et al., 2017; Fitzpatrick et al., 2019). In Ireland, the causative agents of mastitis among cows are mainly Stafilo- coccus aureus, Streptococcus uberis, Escherichia coli (Keane et al., 2013). Treatment of udders with antiseptic agents reduces the level of infection by pathogens. It reduc- es the bacterial load on the surface of the udder skin, which is the main component of modern milking technology (Vijaya Kumar et al., 2012).

Table 1
Preparations for sanitary processing of the udder, registered in Ukraine

№	Name of the drug (manufacturer, country)	Declared composition of the drug	The use
1.	**Masodine** *Evans Vanodine International, Great Britain*	100 ml of the drug contain the active substance, wt.%: iodine – 2.15	For disinfection of teats after milking
2.	**Masofilm** *Evans Vanodine International, Great Britain*	100 g of the drug contains the active substance: iodine – 0.25 g	For disinfection of teats after milking
3.	**Pre-Dip** *Evans Vanodine International, Great Britain*	100 g of the drug contains the active substance: iodine – 0.1 g	For disinfection of teats before milking
4.	**Synodex** *Quat Chem Ltd, Great Britain*	100 ml of the drug contain the active substance (%): lactic acid – 5.6	For disinfection of teats before and after milking
5.	**Synodine** *Quat Chem Ltd, Great Britain*	100 ml of the drug contain active substances, %: lactic acid – 1.6; iodine – 0.3.	For disinfection of teats before and after milking
6.	**Iodesol** *PE Kronos Agro, Ukraine*	The drug contains active substances (%): iodine – 5.0; lactic acid – 0.4	For disinfection of teats after milking
7.	**Kenocid** *CID Lines NV/CA, Belgium*	1 g of the drug contains the active substance: chlor- hexidine digluconate – 5.0 mg	For disinfection of teats after milking
8.	**Kenostart** *CID Lines NV/CA, Belgium*	1 g of the drug contains the active substance: iodine – 3 mg	For disinfection of teats after milking
9.	**Kenolac** *CID Lines NV/CA, Belgium*	100 g of the drug contain active substance (%): lactic acid – 3.6	For disinfection of teats after milking
10.	**Keno Pure** *CID Lines NV/CA, Belgium*	100 ml of the drug contain the active substance (%): lactic acid – 8.0.	For disinfection of teats before milking
11.	**Lik-io 5500** *Ypred Sass, France*	100 ml of the product contains the active substance, (%): iodine – 0.55	For disinfection of teats before and after milking

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12.	**Prefoam plus** *Ypred Sass, France*	100 ml of the product contains the active substance, (%): lactic acid – 2.0; salicylic acid – 0.099	For disinfection of teats before milking
13.	**Filmadin** *Ypred Sass, France*	100 g of the drug contain the active substance (g) lactic acid 8.0	For disinfection of teats after milking
14.	**Yoderm 5000** *Ypred Sass, France*	100 g of the drug contain the active substance: iodine – 0.5 g	For disinfection of teats after milking
15.	**Blockade** *DeLaval NV, Belgium*	The drug contains the active substance: iodine – 0.25 %	For disinfection of teats after milking
16.	**Proactive** *DeLaval NV, Belgium*	100 ml of the drug contain the active substance: iodine – 0.15 %	For disinfection of teats after milking
17.	**Dipal Conc** *DeLaval NV, Belgium*	100 ml of the drug contain the active substance: iodine – 0.75 %	For disinfection of teats after milking

K. Wattenburger et al. (2020) studied the effect of four different methods of disinfection of teats on their contami- nation by microorganisms before taking milk samples from lactating cows. Treatment methods used before milk sam- pling included: 1 – no preparation; 2 – pre-milking disinfec- tion and one-time wiping of teats with a towel; 3 – pro- cessing of the milk only with alcohol; 4 – disinfection be- fore milking after a single wipe with a towel and treatment of the udders with alcohol. After taking milk samples from 168 cows, including 665 udder quarters, 1,614 isolates of microorganisms were sown and obtained. The first and sec- ond groups of cows had more contaminated milk samples than the third and fourth, while the third group had more microorganism contamination than the fourth. Most isolates of Pseudomonas spp. were identified in milk from the sec- ond group of cows. Thus, treatment of udders with alcohol, after preliminary disinfection before milking with an iodine-based agent and their drying, minimizes the contamination of milk by microorganisms during sampling.

There are many reports on iodine-based udder treatments(Enger et al., 2015; Martins et al., 2017). However, using preparations containing iodine can lead to high concentra- tions of this element in milk, which may be of particular concern to manufacturers of dairy baby food products (O'Brien et al., 2013). In Ireland, commercially available teat disinfectants contain iodine, chlorhexidine, chlorine dioxide, lactic and salicylic acids, or various combinations of these ingredients.Based on the research conducted (Lago et al., 2016), it was proved that iodine is an effective means of disinfecting milk cows against staphylococci. As expected, the concen- tration of the product's active substances does not always lead to a decrease in the highest level of the number of bac- teria. At the same time, when using and/or different concen- trations of ingredients, levels and strengths of additional ingredients, such as emollients, can affect the effectiveness of disinfection while making the skin more elastic.

The research carried out by Sliwinski B. et al. (2015) in- dicates that hygienic treatment of udders with means where iodine was used as a disinfectant additionally increases the content of this element in milk by approximately 15 μg/l,i.e., 35 % more than from cows of the control group.

Martins C. M. et al. (2017) investigated the effectivenessof a barrier disinfectant for udders with a high free iodine content to prevent new intramammary infections and clinical mastitis in lactating cows. In the control group of cows, a conventional agent without barrier properties and a low free iodine content was used as a disinfectant. It was established that the most common microorganisms in cow's milk were Streptococcus spp. (6.2 %) of the total milk quarters, fol- lowed by coagulase-negative staphylococci (3.6 %) and *Corynebacterium* spp. (1.5 %). Treatment of the skin of cows after milking with a product with barrier properties and a higher iodine content reduced the risk of clinical mas- titis in cows by 46 %.The influence of some factors on the high content of io- dine in milk was studied by G. Flachowsky et al. (2013). It was established that an essential source of this element is its content in the feed, although the treatment of udders with iodine-containing means also affects its level in milk. There-fore, with the aim of preventive consumer protection, the European Food Safety Agency proposed to limit the iodine content for lactating cows from 5 to 2 mg/kg of dry matterof feed.

Iodine-based disinfectants have a broad spectrum of an- timicrobial action, do not cause the habituation of pathogen- ic microflora, and have an anti-inflammatory effect. At the same time, it is rather challenging to combine with udder care products, emollients, moisturizers, and repellents, as itis very reactogenic. There is also a danger of individual sensitivity of animals to iodine-based preparations, with impaired kidney function, hypothyroidism, and thyroid disorders. It should be borne in mind that, with frequent use, iodine solutions can cause hyperkeratosis of the skin of the breasts. PVP-iodine is used in udder hygiene products, where the active substance is bound into a polymer com- plex. Iodine is slowly released and retains high antiseptic properties during an extended stay on the skin. PVP-iodine solutions are not toxic for long-term and frequent use, rarely cause allergic reactions, and are stable during storage (Baumberger

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et al., 2016).

The purpose of research by S. N. Godden et al. (2016) was to demonstrate the lack of superiority of a previously tested control iodine-based post-milking cow disinfectant compared to a new formulation containing glycolic acid. Three hundred lactating cows were involved in the experi- ment, which lasted twelve weeks. After milking, the udders of two groups of animals were treated by immersing them in dipping cups with an experimental product (EC) and posi- tive control (PC). The incidence of new infections partially differed between quarters of udders treated with EKS (3.9 %) compared to those treated with PC (4.2 %). Similar- ly, the prevalence of infection was generally low among quarters treated with ECS (3.92 %) compared to PC(5.03 %). There was no significant difference when evaluat- ing the number of somatic cells in milk from cows of both groups. Therefore, the means for treating udders based on glycolic acid after milking is effective and safe, as it does not irritate the skin and positively affects its condition.

Quirk T. et al. (Quirk et al., 2012) investigated the effec- tiveness of treating udders with iodine-containing prepara- tions after milking concerning coagulase-negative staphylo- cocci colonization of the milk duct and the frequency of intramammary infections. For the study, a split udder model was used for forty-three lactating cows of the Holstein breed. It was established that most IMIs in cows were caused by *Staphylococcus chromogens* (30 %) and *Strepto- coccus xylosus* (40 %). A noticeable decrease in the number of microorganisms on the skin of the udders after treatment was noted. It should also be noted that the effect of disinfec- tion of udders on IMI was not the same for all coagulase-negative *Staphylococci*. According to the authors, this af- fects the selection of hygiene products for udder health on each dairy farm.

The research by R. I. Anggraini et al. (2020) indicatesthe high effectiveness of antiseptic iodine-containing prod- ucts. At the same time, these drugs have their advantages and disadvantages. Every three months after using a hygien- ic product on the farm, it is necessary to rotate it due to the habituation of microorganisms and the formation of stable resistant forms in the dairy herd.

Other authors (Leslie et al., 2006) tested a 1 % iodoform udder disinfectant (Full-Bac) versus a control (Bobadin) against *Staphylococcus aureus* and *Streptococcus agalactiae* in an experiment. Studies were conducted on 41 lactating cows for ten weeks following the recommendations of the National Mastitis Council. The scientists found no signifi- cant difference between the study drug and the control in theoccurrence of new intramammary infections due to *Staphy- lococcus aureus*, which averaged 13.4 % in each group. There was no difference in new occurrences of mastitis caused by *Streptococcus agalactiae*, which averaged 8.5 % and 6.1% for both groups. The tested disinfectant for the treatment of udders showed similar bactericidal activity compared to the control, without harming the skin and con- dition of the udders in the warm period of the year.

The research by A. Whist et al. (2007) was to study the reduction of *Staphylococcus aureus* and *Streptococcus dis- galactiae* among lactating cows with the use of dry therapy and treatment of udders after milking. Iodine-based products (experimental group) and Dray Fextrade (control group) sealant for udders were used for two years. In milk samples from experimental cows, the level of *Streptococcus dis- galactiae* insemination increased from 14.2 % to 15.2 %. At the same time, from animals in the control group, the levelof *Staphylococcus aureus* insemination in milk decreased from 65.9 % to 54.9 % two years after the beginning of the research.

There are antiseptics with various active substances on the world market of veterinary drugs. Thus, disinfectants based on chlorhexidine provide an instant bactericidal ef- fect; simultaneously, it has a somewhat narrower spectrum of action than iodine. After some time, with the constant use of chlorhexidine, the pathogenic microflora becomes accus- tomed to it, which requires periodic replacement no more than three months later. At the end of clinical studies, it was established that chlorhexidine with a concentration of 0.5 %,or 5000 ppm. had a versatile effect. It is known that the bactericidal effect of chlorhexidine is manifested in a con- centration of more than 0.01 % (100 ppm.) already after 1 minute at a temperature of 22 °C against 99 % of gram- positive and gram-negative bacteria. Absorption of chlor- hexidine with intact skin is negligible and is no more than 5
%. However, its absorption can increase 100 times in case of skin damage. That is, the higher the concentration of chlor- hexidine in the product, the greater the probability of its entering the blood.

The authors also studied the efficacy of a 0.35 % chlor- hexidine milk treatment containing glycerin as an emollient to prevent IMI in cows. *Streptococcus agalactiae* was not detected in the dairy herd before the study, and the percent- age of *Staphylococcus aureus* was relatively low. New cases of infection with *Streptococcus uberis* and *Streptococcus disgalactiae* species occurred much less frequently in the udders of cows treated with chlorhexidine. The overall effi- ciency of using means for disinfecting udders against the main causative agents of mastitis was 50 %. A reduction of coagulase-negative staphylococci by 49 % and *Sorinobacte- rium bovis* by 65.2 % was noted. During the test, the disin- fectant showed a moisturizing and softening effect and did not cause side effects; that is, it had a positive effect on the health of the udders of lactating cows.In his research, Boddie R. L. et al. (2000) found that a teat

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disinfectant containing only chlorhexidine achieved one of the highest log reductions (82.5 %) against staphylococ- cal isolates on the skin of teats. It was proved (Bohm et al., 2017) that the drug with chlorhexidine reduces the numberof staphylococci on the skin of udders by 4.46 times, com- pared to washing and drying the udder.

Research conducted by Oliver S. P. et al. (1993) indicat- ed that treatment of udders after milking with a preparation containing perchloric acid and chlorine dioxide in a soluble polymer gel was effective in preventing new intramammary infections and against a variety of mastitis pathogens.

According to R. F. Sheldrake et al. (Sheldrake & Hoare, 1980), the disinfection of udders before milking using a 2 % chlorhexidine solution in a detergent base did not reduce the frequency of new cases of intramammary infections caused by *Staphylococcus aureus* in lactating cows. At the same time, treatment of udders after milking with a preparation containing 5000 mg/l of free iodine significantly reduced thestaphylococcal population of the udder skin and the inci- dence of mastitis in cows.

The purpose of research by S. R. Fitzpatrick et al. (2019)is to compare the reduction of bacterial populations on the skin of udders after using different commercial udder disin- fectants. Ten different udder treatments were applied to eachcow. Before the application of the disinfectant, staphylococ- cal isolates were the most common bacterial group detected on milk smears (49 %), followed by streptococcal (36 %)and coliform (15 %) species of microorganisms. The aver- age reduction of these bacteria on the skin of the udders was 76 %, 73 and 60 %, respectively. All tested udder disinfect- ants reduced bacterial udder load for all groups of microor- ganisms. The agent with the active ingredient 0.6 % diamine solution was the most effective against bacterial populations of staphylococcal and streptococcal isolates on the cows' skin, with a 90 % and 94 % reduction, respectively. Apply- ing a 0.5 % iodine solution resulted in a 91 % coliform re- duction. Research results show that specific bacterial loads on teats can be reduced by using different ingredients in disinfectants.

Research by Mondin A. et al. (2014) proved that diamineis the most effective against staphylococcal isolates. In addi- tion, this preparation was previously tested using the disk diffusion method, resulting in some of the lowest inhibition zones for *Staphylococcus aureus*. Diamine is known to be stable over a wide pH range and effective in the presence of heavy organic contamination of the cow's skin. This ex- plains why this ingredient is less affected by the organic substances on the cow's skin than other ingredients.

Previous studies (Miseikirne et al., 2015) showed the ef- fectiveness of lactic acid against streptococcal bacteria. A foaming solution containing only lactic acid reduces thenumber of Streptococcus uberis colonies on the skin of cowsby 3.5 times. In addition, treatment of udders with a 2 % lactic acid solution combined with a 0.1 % salicylic acid solution achieved a 63 % reduction in CFU/ml against strep- tococcal isolates naturally present on the skin of the udders.

A study was conducted by J. E. Hillerton et al. (2007) on the efficacy in preventing new intramammary infections of a teat dip containing acidified sodium chloride Udder Gold Platinum Germicidal Barrier Teat Dip (UGPt) compared with the licensed iodoform teat disinfectant Iosan Novartis Animal Health (INAH). In addition, they studied how the drugs affected the condition of the skin of the cows. At the end of the experiment, it was established that the number of clinical cases of mastitis was the same in each group of cows (n = 13), and the manifestation of subclinical infection was slightly lower in the UGPt group than in the INAH group (27 vs. 31, respectively). The obtained results indicatethat both agents do not differ in their ability to prevent the new occurrence of IMI and positively affect the condition ofudders.

The effect of a multi-ingredient post-milking udder dis- infectant on skin condition, bacterial colonization, and udderhealth was studied by M. D. Rasmussen and H. D. Larsen (Rasmussen & Larsen, 1998). Spray for treatment of udders after milking with 10 % glycerin improved skin condition($P < 0.1$), compared to no treatment. A product with a chlo- rine dioxide content of 120 ppm. Did not affect the condi- tion of the skin of the girls. At the same time, these compo- nents did not affect the number of bacteria on the skin of cows after infection with *Staphylococcus aureus* and *Strep- tococcus uberis*. However, the half-life of Staphylococcus aureus on untreated milk was the most extended ($P < 0.5$). According to the authors, the condition of healthy skin of cows (scores 1-4) does not affect the colonization of bacteriain the absence of cracks and ulcers (scores 5-6).

C. Vissio et al. (2020) studied the efficacy of ZkinCu, a copper-zinc-containing udder disinfectant, to prevent natural udder infections in robotic milking cows. As a control, the drug Ocean Blu was used, the active substance of which is glycolic acid. After conducting tests, it was established that the practical means for udders ZkinCu could be more practi- cal for preventing intramammary infections.

S. P. Oliver et al. reported the effectiveness of a disin- fectant for milking cows containing a combination of phe- nols (Oliver et al., 2001). Disinfection of udders with this agent, combined with proper preparation of udders and their treatment after milking, reduces new intramammary infec- tions caused by numerous mastitis pathogens

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during lacta- tion.

A. M. Shevchenko et al. (2020) found that complex preparations of Forticept for cow udder hygiene have a high preventive efficiency (96 %) for the subclinical form ofmastitis. The use of the means has a beneficial effect on the physiological state of the mammary gland; in particular, it reduces the number of manifestations of hyperkeratosis of the udders by 25 % and prevents the appearance of newcases the disease. At the same time, dipping procedurespositively affect milk's physicochemical and microbiological characteristics, significantly improving its quality and nutri- tional value. Yu. V. Zhuk et al. (2017) studied the effective- ness of treating cow's udders with Forticept Udder Forte compared to preparations where the active substances were chlorhexidine and iodine. Using the drug, Forticept reduced the incidence of cows with subclinical mastitis by 30–40 %. The product had a cosmetic effect; the dugs' skin became softer and more elastic. In two research groups where chlor- hexidine and iodine-based preparations were used as hy- giene products, the incidence of subclinical mastitis de- creased by 20.1 % and 13.0 %, respectively.

Research conducted by O. R. Paladiychuk (2019) indi- cates that freezing pre-dips and dips predictably reduces the occurrence of mastitis among cow herds by 35–45 %. Pre- milking treatment of the skin of the heifers was carried out with a 1 % solution of Kenopur strong (Belgium), which includes lactic acid, non-iodized sulfactants, and glycerin. To preserve the udder of cows after milking, Senso Dip 5(GEA, Germany) is used on the farm; the active substance is chlorhexidine, glycerin, and lanolin. Every three months, this remedy was changed using Kenocidin 100 (Belgium), which includes chlorhexidine, allantoin, lanolin, peppermint,glycerin, and sorbitol.

Means for udder hygiene, as a rule, are products of chemical origin, usually based on iodine and chlorhexidine, less often organic acids. These drugs sometimes raise con- cerns about the risk of chemical residues entering the milk. Probiotic-based products can serve as an alternative to these potentially dangerous risks. These are bacterial preparations based on live microbial cultures, which are not harmful to the animal body and are environmentally friendly. The latest concepts of mastitis prevention were proposed by A. El- Sayed and M. Kamel (El-Sayed & Kamel, 2021). They include, in particular, the use of nanotechnologies as means for the health of the udder of probiotics as an alternative to substances of a chemical nature.

The effectiveness of a new disinfectant for dairy cows based on probiotic bacteria was studied by Yu J. et al. (2017) on changes in the number of somatic cells in milk and profiling of bacterial microflora. For this purpose, sin- gle-molecule real-time sequencing technology (SMRT) of bacteria was used, using the treatment of the skin of cows with the preparation of probiotic lactic acid bacteria (LAB) and commercial disinfectants (CD). The number of somatic cells in the milk gradually decreased from the beginning of the use of the drugs. Still, their number (LAB) was slightly lower in the cows where probiotics were used than in the group where commercial disinfectants were used. Sequenc- ing results indicate that milk obtained from cows in both groups contained a quantitative and specific microbial popu- lation that changed during the study.

Therefore, the obtained data indicate that the agent basedon probiotic bacteria reduces the number of microorganisms that cause mastitis and eases the microbial load on the udderskin. This can be an alternative to using chemical disinfect- ants before and after milking for udder health. Pacific Bio- sciences SMRT full-length 16S ribosomal RNA sequencing has also been shown to be an essential component in moni- toring changes in bacterial populations while using udder hygiene products.

Data obtained by Alawneh J. I. et al. (2020) confirm the effectiveness of lactobacilli-based products used to treat udders after milking. The latter was compared with com- mercial disinfectants for udders based on iodine. The effect of both types of udder treatments on the number of somatic cells in milk was evaluated using a multivariate linear re- gression model. A tendency was noted to decrease the num- ber of somatic cells in cows' milk where probiotic cultures (lactobacteria) were used compared to cows where an indus-trial disinfectant was used. The use of preparation based on lactobacilli for the treatment of udders can reduce the mi- crobial load, improve the function of the sphincter of the milk duct, and positively affect the overall health of the udder.

Morton J. M. et al. (2014) studied the feasibility of treat- ing udders before milking cows in dairy herds on pastures and its effect on the occurrence of new udder infections. During the research, weather conditions were considered, particularly the amount of precipitation during this period. The trial was conducted on five dairy herds in Australia. Each herd was divided into two groups of cows: experi- mental (disinfection of udders before milking) and control(no pretreatment of udders). It was found that the total num- ber of cows in the risk group of clinical mastitis was the same. However, the clinical forms of the disease were lower in experimental cows (incidence rate equal to 0.34), and the incidence of new infections in this herd was equal to the rateof 0.42. It should be noted that the amount of precipitation during the studied period was lower than the long-term av- erage for the region where the herd grazed. The scientists concluded that disinfection of teats before milking cows on pastures might be appropriate when the udder is heavily contaminated and the frequency of clinical mastitis

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due to environmental pathogens is very high.

The purpose of research by Enger B. D. et al. (2015) was to study the sensitivity of mastitis pathogens to disinfectants for udders and to determine the optimal time of contact ofthe drug with the skin. Four commercially available disin- fectants were used for the experiment: (A – 1 % H2O2 solu- tion; B – 1 % chlorine dioxide solution; C – 1 % iodophor solution; D – 0.5 % iodophor solution). Significant differ- ences were established in the sensitivity of strains to disin- fectants in the form of pathogens: *Staphylococcus aureus*, *Staphylococcus haemolyticus*, and *Streptococcus uberis*. Specific characteristics of microorganisms were revealed; in particular, a 97.9 % decrease in *Mycoplasma bovis* was recorded, and on the contrary, a 71.4 % decrease in *Staphy- lococcus haemolyticus*, the most resistant to disinfectants. In the second experiment, three commercially available disin- fectants were used: A, D, and E (0.25 % iodophor solution). The studies showed that the duration of contact of disinfect- ants D and E with the skin of cows 30 s and 45 s is equally effective in reducing the number of bacteria. There were no differences with the evaluated bacteria between the tested contact times after treatment with preparation A. Thus, itcan be concluded that different species of mastitis pathogensand strains of each species may have different sensitivitiesto disinfectants for dairy cows. This is important when choosing hygiene products for udder health on dairy farms. In addition, a 30-second contact period for pre-milking preparations containing iodoform and 15 seconds for hydro- gen peroxide preparations may be optimal for reducing the pathogen burden in the shortest possible time. Reducing the period of pre-milking treatment of the udder can improvethe efficiency of using the milking parlor on the farm.

The definition of standard protocols for studying the ef- fectiveness of a post-milking cow disinfectant was studiedby Y. H. Schukken et al. (2013). The authors established that the protocols define both negative and positive controls. For negative control trials, the protocol states that the udder disinfectant effectively reduces new cases of intramammary infections by at least 40 %. For positive control trials, it is necessary to prove that the test product reduces new IMIs byat least 70 %. New static analysis methods have been de- fined; in particular, the frequency of cases of this pathology can be analyzed using general mixed linear models. When testing antiseptic agents for udder health, the sanitary condi- tion of the skin of the udders is monitored. Usually, it is performed according to the indicator of total microbial con- tamination of the udder skin. Research is carried out in la- boratory conditions, no later than three hours after taking washings, which are taken from the skin of cows on an area of 10 cm^2 using sterile swabs soaked in saline in test tubes. After carefully squeezing the tampon against the wall of the test tube, make successive dilutions with distilled water 1:10, 1:100, 1:1000, and 1:10000. From the last three dilu-tions, 1 cm^3 is sown on meat-peptone agar in bacteriological cups and placed in a thermostat at a temperature of 37 ºC for24–48 hours. Only cups with no continuous growth and at least ten colonies have grown are considered. The degree of dilution is taken into account, and the average number of bacteria in 1 cm^3 of washing, which is 1 cm^2 of the skin of the cows, is deduced.

Gleeson D. et al. (2009) conducted a study on two dairy farms in Ireland regarding the effectiveness of the pre- milking treatment of udders. This practice was effective against the environmental bacteria *Escherichia coli* and *Streptococcus uberis*. It was also established that the effec- tiveness of the disinfectant for dairy cows varies depending on the milk production technology, the year's season, andthe specific causative agent of mastitis that progresses in the dairy herd.

According to G. Keefe et al. (2012), the main route ofthe spread of Staphylococcus aureus and *Streptococcus agalactiae* is cow-to-cow infection. Prevention should focus on biosecurity within and between herds to reduce or elimi- nate the reservoir of infection. Since the milking time is the main period for acquiring new intramammary infections, itis the focus of most preventive measures. A key factor is thedisinfection of the skin of the milking cows before and after milking the cows. It has also been proven that using gloves during milking is integral to fighting infectious mastitis and obtaining high-quality milk. Prioritizing the “closed herd” principle, or at least following well-defined biosecurity protocols, is critical to reducing the risk of disease in cows.

The authors (MacKey & Miller, 2003) claim that prepa- rations containing aloe and allantoin have a therapeutic effect on the healing of wounds and cracks on the udders, thereby improving the health of cows' udders.

In the conditions of war and economic troubles, special- ists from the “Uman Labs” laboratory offer herbal prepara- tions for the disinfection of udders (http://umanlabs.org/uk). Medicinal plants are used as raw materials for preparing infusions, decoctions, water extracts, and aqueous solutions of dry or liquid extracts-concentrates; they are also suggest- ed to be used on an alcohol and oil basis. Means for pro- cessing the udder are used depending on the properties ofthe active substance, given that their effect is somewhat weaker compared to chemotherapeutic drugs. Extracts and decoctions of thyme, eucalyptus leaves, plantain, sage, St. John's wort, calendula flowers, pine buds, and galangal rhizomes have an antimicrobial effect. The advantage of herbal preparations is their physiological nature, presence of natural components (vitamins, carbohydrates, macro- and

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microelements, enzymes), stimulating effect, long-term effectiveness and safety, availability, and economic attrac- tiveness. The laboratory conducts studies of the effective- ness and safety of medicinal forms of hygiene products of plant origin concerning field strains of microorganisms that cause mastitis. The proposed solutions are relevant for cow udder health in wartime and may also be attractive in every- day life among milk producers.

Conclusions

1. The dairy farm management system certifies that the in-troduction of the "Milking Protocol" in the farm, compliance with a precise sequence of actions, is a mandatory condition for preventing intramammary infections, maintaining the productivity of cows, and improving the quality of milk.
2. Treatment of udders with hygiene products is an effec-tive preventive measure for the care of the mammary gland among most dairy cattle herds. The choice of an antiseptic agent for udder health should be based on its proven effec- tiveness, which is necessary to register the drug as a veteri- nary medicinal product.
3. According to the requirements of the European Union,before the preparation for treating the udder can be used for commercial purposes, it must be registered according to the current legislation. Within the EU, its member states must use a common standard to evaluate the means used to disin- fect the udder.
4. Means for sanitation of the mammary gland should have an antiseptic effect and maintain the breasts in good condition. Declared composition of registered drugs in Ukraine: iodine, chlorhexidine, organic acids. Hygienic products include cosmetic surfactants that soften the skin and form a moisturizing hydrophilic layer on the skin.
5. Means for the hygiene of the udder, as a rule, are products of chemical origin, and when using these drugs, there is a possible risk of chemical elements entering the milk. An alternative to these potential dangers can be probi- otic-based products that are environmentally friendly and harmless to the animal body. In the conditions of war and economic troubles, animal husbandry specialists are offered preparations of plant origin to disinfect the cows' udders, where medicinal plants are used as raw materials, from which infusions, decoctions, water extracts, alcohol- or oil- based solutions are prepared.

Thus, compliance with a set of rules during milking al- lows to obtain high-quality milk and minimize the microbial load on the mammary gland. The use of disinfectants for processing the skin of udders is an essential factor in pre- venting mastitis. In this regard, the relevance of using hy- gienic means to preserve the health of the udder of lactating cows is increasing.

Maintaining the health of the udders of lactating cows is an essential task of the veterinary service of milk productionfarms. Applying dipping procedures is an integral part of thepreventive measures of the anti-mastitis program. The choice of means for disinfecting udders after milking must be made depending on the circulation of pathogens in the herd and consider all factors in the conditions of specific products.

References

Alawneh, J. I., James, A.S., Phillips, N., Fraser, B., Jury, K., Soust,M., & Olchowy, T. W. J. (2020). Efficacy of a Lactobacillus- Based Teat Spray on Udder Health in Lactating Dairy Cows. *Frontiers in Veterinary Science*, 7, 584436.
[Crossref] [Google Scholar]

Anggraini, R., Anwar, D., & Rozimela, Y. (2020). The Effects of Collaborative Writing on EFL Learners' Writing Skills and Their Perception of the Strategy. *Journal of Language Teach- ing and Research*, 11(2), 335–341.
[Crossref] [Google Scholar]

Barkema, H. W., von Keyserlingk, M. A., Kastelic, J. P., Lam, T. J., Luby, C., Roy, J. P., LeBlanc, S. J., Keefe, G. P., & Kelton,
D. F. (2015). Invited review: changes in the dairy industry af- fecting dairy cattle health and welfare. *Journal* of *Dairy Sci- ence*, 98(11), 7426–7445.
[Crossref] [Google Scholar]Baumberger, C., Guarín, J. F., & Ruegg, P. L. (2016). Effect of 2 different pre-milking teat sanitation routines on reduction of bacterial counts on teat skin of cows on commercial dairyfarms. *Journal of Dairy Science*, 99(4), 2915–2929.
[Crossref] [Google Scholar]

Belage, E., Dufour, S., Bauman, C., Jones-Bitton, A., & Kelton, D.
F. (2017). The Canadian National Dairy Study 2015-Adoption of milking practices in Canadian dairy herds. *Journal of Dairy Science*, 100(5), 3839–3849.
[Crossref] [Google Scholar]

Boddie, R. L., Nickerson, S. C., & Adkinson, R. W. (2000). Effica- cies of Chlorine Dioxide and Iodophor Teat Dips During Ex- perimental Challenge with Staphylococcus Aureus and Strep-tococcus Agalactiae. *Journal* of *Dairy Science,* 83(12), 2975– 2979.
[Crossref] [Google Scholar]

Böhm, F., Klocke, D., Paduch, J. H., & Krömker, V. (2017). Pilot study on the influence of premilking

Indo-American Journal of Agricultural and Veterinary Sciences
ISSN 2321–9602 www.iajavs.com

iodine-based teat disinfec- tion on milk iodine content. *Milk Science International – Milchwissenschaft*, 70(1), 2–5. [Abstract] [Google Scholar]

Bohm, F., Wente, N., & Kromker, V. (2017). The efficacy of a foaming iodine-based premilking teat disinfectant. *Milk Sci- ence International – Milchwissenschaft*, 70(2), 6–9. [Abstract] [Google Scholar]

Breen, J. (2019). The Importance of Teat Disinfection in Mastitis Control. *Livestock*, 24, 122–128. [Crossref] [Google Scholar]

Deng, Z., Koop, G., Lam, T. J. G. M., van der Lans, I. A., Ver- nooij, J. C. M., & Hogeveen, H. (2019). Farm-level risk factorsfor bovine mastitis in Dutch automatic milking dairy herds. *Journal of Dairy Science*, 102(5), 4522–4535. [Crossref] [Google Scholar]

Doyle, C. J., Gleeson, D., Toole, P. W., & Cotter, P. D. (2016). High-throughput sequencing highlights the significant influ-ence of seasonal housing and teat preparation on the raw milkmicrobiota. *Applied Environ Microbiol*, 83(2), e2694–16. [Crossref] [Google Scholar]

Dufour, S., Fréchette, A., Barkema, H.W., Mussell, A., & Scholl,D T. (2011). Invited review: effect of udder health manage- ment practices on herd somatic cell count. *Journal of Dairy Science*, 94(2), 563–579. [Crossref] [Google Scholar]

El-Sayed, A., & Kamel, M. (2021). Bovine mastitis prevention and control in the post-antibiotic era. *Tropical Animal Health and Production,* 53(2), 236. [Crossref] [Google Scholar]

Enger, B. D., Fox, L. K., Gay, J. M., & Johnson, K. A. (2015). Reduction of teat skin mastitis pathogen loads: diferences be- tween strains, dips and contact times. *Journal of Dairy Science,* 98(2), 1354–1361. [Crossref] [Google Scholar]

Fitzpatrick, S. R., Garvey, M., Flynn, J., Jordan, K., & Gleeson, D. (2019). Are some teat disinfectant formulations more effective against specific bacteria isolated on teat skin than others? *Acta Veterinaria Scandinavica*, 61(1), 21. [Crossref] [Google Scholar]

Fitzpatrick, S., Garvey, M., Flynn, J., Jordan, K., O' Brien, B., & Gleeson, D. (2019). Screening Commercial Teat Disinfectants against Bacteria Isolated from Bovine Milk Using Disk Diffu- sion. *Veterinary World*, 12, 629–637. [Crossref] [Google Scholar]

Flachowsky, G., Meyer, U., Franke, K., & Leiterer, M. (2013). Influencing factors on iodine content of cow milk. *November European Journal of Nutrition*, 53(2), 351–365. [Crossref] [Google Scholar]

Garvey, M., Curran, D., & Savage, M. (2017). Efficacy Testing of Teat Dip Solutions Used as Disinfectants for the Dairy Indus- try: Antimicrobial Properties. *International Journal of Dairy Technology*, 70, 179–187.Geary, U., Lopez-Villalobos, N., O' Brien, B., Garrick, D., & Shalloo, L. (2013). Examining the Impact of Mastitis on the Profitability of the Irish Dairy Industry. *Irish Journal of Agri- cultural and Food Research*, 52, 135–149. [Article] [Google Scholar]

Gleeson, D., O'Brien, B., Flynn, J., O'Callaghan, E., & Galli, F. (2009). Effect of pre-milking teat preparation procedures onthe microbial count on teats prior to cluster application. *Irish Veterinary Journal*, 62, 461. [Crossref] [Google Scholar]

Godden, S. M., Royster, E., Knauer, W., Sor, J., Lopez-Benavides, M., Schukken, Y., Leibowitz, S., & French, E. A. (2016). Ran- domized noninferiority study evaluating the efficacy of a post- milking teat disinfectant for the prevention of naturally occur- ring intramammary infections. *Journal of Dairy Science,* 99(5),3675–3687. [Crossref] [Google Scholar]

Hillerton, J.E., Cooper, J., & Morelli, J. (2007). Preventing bovine mastitis by a postmilking teat disinfectant containing acidified sodium chlorite. *Journal of Dairy Science,* 90(3), 1201–1208. [Crossref] [Google Scholar]

HPRA (2019). Guide to Definition of an Animal Remedy and the Classification Process: Health Products Regualtory Authority. [Article]

Hutchison, M. L., Thomas, D. J. I., Moore, A., Jackson, D. R., & Ohnstad, I. (2005). An evaluation of raw milk microorganisms as markers of on-farm hygiene practices related to milking. *Journal of Food Protection,* 68(4),764–772. [Crossref] [Google Scholar]

Ibrahim, A. I., Bada-Alambedji, R., Duprez, J. N., Moula, N., Bardiau, M., & Mainil, J. G. (2015). Efficacy of antisepsis measures during manual milking on the prevalence of bacterial Mastitis at the Sahelian experimental station of Toukounous, Niger. *African Journal of Microbiology Research*, 9(6), 348– 354. [Crossref] [Google Scholar]

Keane, O. M., Budd, K. E., Flynn, J., & McCoy, F. (2013). Patho-gen profile of clinical mastitis in irish milk-recording herds re-veals a complex aetiology. *Veterinary Record*, 173(1), 17. [Crossref] [Google Scholar]

Keefe, G. (2012). Update on control of Staphylococcus aureus and Streptococcus agalactiae for management of mastitis. *Veterinary Clinics of North America: Food Animal Practice*, 28(2), 203–216. [Crossref] [Google Scholar]

Lago, A., Bruno, D. R., Lopez-Benavides, M., & Leibowitz, S. (2016). Short communication: efficacy of glycolic acid-based and iodine-based postmilking barrier teat disinfectants for pre- vention of new intramammary infections in dairy cattle. *Jour- nal of Dairy Science*, 99, 7467–7472. [Google Scholar]

Indo-American Journal of Agricultural and Veterinary Sciences
ISSN 2321–9602 www.iajavs.com

Lam, T. J., van Vliet, J. H., & Schukken, Y. H. (1995). Udder disinfection and mastitis in cattle: a literature review. *Tijdschr Diergeneeskd*, 120(13), 392–399. [Abstract] [Google Scholar]

Leslie, K. E., Vernooy, E., Bashiri, A., & Dingwell, R. T. (2006). Efficacy of two hydrogen peroxide teat disinfectants against Staphylococcus aureus and Streptococcus agalactiae. *Journal of Dairy Science,* 89(9), 3696–3701. [Crossref] [Google Scholar]

Lopez-Benavides, M., LeJune, D., Mateus, C., Faltynowski, A., & Hemling, T. C. (2012). In Vitro Efficacy of Non-Iodine Teat Disinfectants. In: Proceedings of 51st National Mastitis Coun- cil Annual Meetin; St. Pete Beach, Florida, USA. [Google Scholar]

MacKay, D., & Miller, A. L. (2003). Nutritional support for wound healing. *Alternative Medicine Review*, 8(4), 359–377. [Abstract] [Google Scholar]

Martins, C. M. M. R., Pinheiro, E. S. C., Gentilini, M., Benavides,
M. L., & Santos, M. V. (2017). Efficacy of a high free iodine barrier teat disinfectant for the prevention of naturally occur- ring new intramammary infections and clinical mastitis in dairycows. *Journal of Dairy Science*, 100(5), 3930–3939. [Crossref] [Google Scholar]