

Review article

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HYGIENE PROCEDURES BEFORE, DURING AND AFTER COW MILKING

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Abstract

In this review paper, hygienic procedures before, during and after cow milking are discussed. The procedures for maintaining hygienic udders before and after milking, as well as maintaining the hygiene of milking units are described. The description includes the maintenance of milker's hand hygiene, udder disinfection and udder disinfection after milking. It is pointed out that these milking procedures should be carried out in a clean environment and without any disturbance to cows. In addition, the need to control the implementation of these hygiene measures is emphasized. A proper way of carrying out the hygienic procedures essentially contributes to reduction of the number of microorganisms and the number of somatic cells in milk, the frequency of occurrence of mastitis, which significantly affects quality of milk and health of milking cows.

Key words: dairy cows, milking hygiene, premilking procedures, post-milking procedures

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HIGIJENSKI POSTUPCI PRE, TOKOM I POSLE MUŽE KRAVA

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Kratak sadržaj

U ovom preglednom radu razmatraju se higijenski postupci pre, za vreme i posle muže krava. Opisani su postupci pre i posle muže, kao i čistoća opreme za mužu. U opis je uključena higijena ruku mužača, dezinfekcija sisa pre muže, suvo pranje, uklanjanje nečistoće, čišćenje ili sušenje sisa, kao i postupci dezinfekcije posle muže. Ističe se da se ovi postupci kod muže treba da odvijaju u čistom okruženju i bez uznemiravanja krava. Pored toga, navodi se i potreba kontrole sprovođenja tih higijenskih postupaka. Pravilan način sprovođenja ovih higijenskih procedura suštinski doprinosi smanjenju broja mikroorganizama i broja somatskih ćelija u mleku, učestalosti pojave mastitisa, što značajno utiče na kvalitet mleka, kao i opšte zdravstveno stanje krava muzara.

Ključne reči: muzne krave, higijena muže, postupci pre muže, postupci posle muže

INTRODUCTION

Hygienic procedures before, during and after milking of cows are of great importance for milk hygiene and quality. Cow milking hygiene includes the procedures for maintaining udder hygiene before and after milking, as well as maintaining the hygiene of milking units. The procedures for maintaining cow udder hygiene before milking include the following: proper hygiene of milker's hands, udder disinfection before milking, dry washing, pre-milking test, washing and wiping the teats, especially the tips of the teats. These milking procedures should be carried out in a clean parlour or a barn and without any disturbance to cows. The proper manner of carrying out these procedures

essentially contributes to the reduction of the number of microorganisms, number of somatic cells in milk and the frequency of occurrence of mastitis, which significantly affects the quality of cow milk. The paper aims to look into the most important hygiene procedures before, during and after cow milking.

PREMILKING HYGIENE PROCEDURES

Knowledge and practices of hygienic milk production among dairy farmers are very important for hygiene and quality of milk (Ahmed et al., 2020). Premilking hygienic procedures must be carried out regularly and properly. Detailed reviews of failures in carrying out hygienic procedures during the milking of cows are given in the paper by Hristov et al. (2017). One of the most important procedures is the hygiene of the milker's hands. Cow milkers should wear appropriate gloves, which can significantly contribute to preventing the transmission of the causative agents of mastitis from one cow to another. These gloves should be washed and disinfected properly when they become soiled with milk or any other organic substances. Also, care should be taken to ensure that torn gloves are immediately removed and properly replaced (Mihajlović et al., 2022).

In the management and prevention of mastitis, a multifactorial approach with the focus on milking should be taken into account (Hristov and Relić, 2003; De Vliegher et al., 2018). Of great importance is the impact of applying hygienic practices at a farm on the bacteriological quality and somatic cell count of raw milk (Hristov et al., 2002; Riekerink et al., 2012; Williamson and Lacy-Hulbert, 2013; Pandey et al., 2014, Jónás et al., 2018, Mihajlović et al., 2022). Milkers should familiarize themselves with the most important aspects in the application of cow udder disinfection (Hristov and Stanković, 2002), the disinfection of udders and milking equipment (Hristov et al., 1995), as well as the disinfection of cow udders before and after milking (Hristov et al., 1997). It is very important to carry out a regular assessment of cow, udder, and teat hygiene (Reneau et al., 2005; Cook and Reinemann, 2007; Hristov et al., 2017). Also, it should be borne in mind that the premilking test is an essential procedure that detects abnormalities in milk, and the first signs of clinical mastitis, removes the contaminated residual milk from the teat canal, and activates the oxytocin reflex thereby achieving a good milk flow during milking (Hristov et al., 2017; Mihajlović et al., 2022).

The effect of premilking teat foam disinfection on the prevention of new mastitis rates in early lactation is discussed in detail by Fitzpatrick et al. (2021). The effect of premilking teat sanitation on milk composition, somatic cell count and test-day milk yield in Holstein cows was studied by Jónás et al. (2018).

A review of test protocols for the evaluation of teat disinfectants is presented in the paper by Fitzpatrick et al. (2021). Milkers should disinfect the udder teats before milking by immersing them in an approved disinfectant in order to reduce bacterial counts on the teat skin (Hristov et al., 2002; Gleeson et al., 2009; Baumberger et al., 2016; Fitzpatrick et al., 2018; Gleeson et al., 2018; Fitzpatrick et al., 2021). Nowadays, numerous preparations (iodine, chlorine, chlorhexidine – based and others) are available for disinfecting udder teats before cow milking. Disinfectant before milking should remain in contact with the skin of the teat for 30 seconds in order to enable effective disinfection. In the literature, the use of teat immersion in a disinfectant solution is recommended in relation to the application of disinfectant by spraying because it has been established that spraying the teats does not always result in equal coverage of the teats with the disinfectant (Pankey, 1989; Relić et al., 2006). Commercial preparations available for the disinfection of teats before milking have high free iodine content (2 to 3 ppm). They destroy 99.99% of bacteria on the surface of the skin of the teats when applied for 15 to 30 seconds. They are stable at high pH values and can be used without addition of emollients. The addition of emollients reduces their bactericidal power and thus the effectiveness of submerging teats (Gleeson et al., 2009; Gleeson et al., 2018). Various interferences during spraying can prevent the complete wetting of teats, the most common of which are partially blocked sprayer openings (Hristov and Stanković, 2002; Relić et al., 2006; Hristov et al., 2017). In recent times, automatic teat disinfection systems are installed at the exit of the milking parlour of modern dairy farms. These systems are constantly being improved, but so far they have not been nearly as effective as the immersion method (Paliy et al., 2021).

The effect of teat disinfection before milking on the number of microorganisms on the udder teats and the rates of new mammary gland infections were discussed by Gleeson et al. in 2009 and in 2018. Washing the udder and premilking is very important for the hygienic quality of the milk. The occurrence of new infections of the quarters is significantly reduced if, immediately before washing the udders, a few jets are milked in front of the milker, as this eliminates any microorganisms that might be found in the udder (Pandey et al., 2014). Although a much more limited effect was found compared to the effect of disinfection after milking, disinfection of teats before milking is important, as already emphasized, for reducing the occurrence of environmental mastitis (Pankey, 1989; Relić et al., 2006). Studies of the impact of teat sanitation before milking on milk composition, number of somatic cells and milk yield on the day of testing in Holstein cows were also carried out (Jónás et al., 2018). Of special importance is the routine control of disinfection of cow udders and milking equipment (Hristov et al., 1995; Reneau, 1997; Hristov et al., 2003).

Disinfection before milking should be performed after pre-milking test and wiping the teats or washing and wiping them. The minimum contact time should be 30 seconds. This time is necessary for thorough soaking of the teats with disinfectant and their complete penetration, which is also a very effective way to remove dirt and debris from their skin, through washing and wiping. Like with teat disinfection after milking, contamination of the applicator with faeces should be prevented. The speed of disinfection of teats before and after milking is significant (Fitzpatrick et al., 2021).

POSTMILKING HYGIENE PROCEDURES

The most important aspects of the application of cow udder disinfection and milking apparatus were described in detail by Hristov and Stanković (2002) and Relić et al. (2006), disinfection of udders and milking apparatus by Hristov et al. (1995), and disinfection of cow udders before and after milking by Hristov et al. (1997). Disinfection of teats after removal of milking units is used in order to prevent new udder infections caused by contagious microorganisms. Disinfectants after milking contain high concentrations of active substances and emollients that prevent drying and cracking of teats. Higher concentrations of the active substance of the disinfectant also contribute to prevention of the occurrence of environmental mastitis, since the teat duct remains open for the next 60 minutes or longer after cow milking. Disinfectant after milking should be applied in such a way as to cover the entire teat including the tip of the teat (Hristov and Stanković, 2002; Relić et al., 2006; Williamson and Lacy-Hulbert, 2013).

Williamson and Lacy-Hulbert (2013) looked into the effect of teat disinfection after milking or before and after milking on intramammary infection and somatic cell count. The quality of milk and occurrence of mastitis largely depend on the level of udder hygiene. Excellent results in the prevention of new infections are achieved by immersing teats in disinfectant solutions, which is one of the basic measures in modern mastitis control and suppression programs, especially those caused by staphylococci and streptococci (Hristov and Relić, 2003; Hristov et al., 1997; Relić et al., 2006). The growing importance of Coliform microorganisms in causing mastitis creates a need to find new disinfectants (Hristov et al. 1995). Basically, care must be taken that the disinfectant has a suitable chemical composition so that it does not irritate the skin and that it is prepared properly, i.e., it must not be too diluted, but it should not remain too concentrated either.

Disinfection of teats after milking removes bacteria that are transferred during the milking process and therefore represents one of the most important measures for the prevention of contagious mastitis (Hristov et al., 1997; Relić et al., 2006). This disinfection should be applied immediately after removing the suction cups because then the teat canal is still open. Applied disinfection, immediately after cow milking, allows the disinfectant to penetrate through the external orifice of the teat canal and establish contact with bacteria that have already entered the teat canal. Thus, if a suitable disinfectant is applied, the destruction of pathogenic bacteria is ensured. Postponing the application of disinfection after removing the teat cups allows microorganisms, such as *Corynebacterium bovis*, to reproduce in the teat canal, which leads to an increase in the number of somatic cells in the milk (Hristov et al., 2002; Hristov and Stanković, 2002; Williamson and Lacy-Hulbert, 2013). Macro and micro lesions on the skin of the teats, which are infected with bacteria, heal slowly. Disinfection of the teats removes bacteria from the surface of these lesions and thus speeds up their healing process. Uneven or cracked teat skin can also be a reservoir for pathogens causing mastitis, such as *Staphylococcus aureus* and *Streptococcus dysgalactiae*. Because of all this, disinfection must cover the teats as a whole (Zhang et al., 2021). There are relatively few sebaceous glands on the skin of the teats. Frequent washing and exposure of wet teats to cold and wind can remove protective fatty acids and lead to cracking of the skin. For these reasons, emollients, most commonly lanolin and glycerine, are added to disinfectant preparations in an amount of up to 10%. When disinfectants are used, emollients should be added immediately before each milking (Zigo et al., 2021). Most pathogenic bacteria from the environment (the causative agents of environmental mastitis) reach the teat tips between milkings and move through the teat canal during milking. Since post-milking disinfectants have a relatively short persistence period (1-2 hours after application), they have a limited effect on the causative agents of mastitis from cows' environment.

Numerous disinfectants for immersing teats are used in practice (iodine, chlorine dioxide, hydrogen peroxide, chlorhexidine, sodium hypochlorite, quaternary ammonia, etc.). It is stated in the literature that the most popular application of iodine in a concentration of 1% is by dipping the teats after milking. Iodine preparations have well-expressed disinfection properties because they are created in the form of iodophors. In addition to iodine, iodophors contain some stabilizing agents that prevent iodine molecules from binding to each other so that they remain free and effectively participate in the disinfection of teat skin (Hristov et al., 1995; Hristov et al., 1997; Reneau, 1997; Hristov and Stanković, 2002; Relić et al., 2006; Zhang et al., 2021).

Maintaining optimal mammary gland health and prevention of mastitis is very important for profitable production in dairy cattle (Hristov and Relić, 2003; Zigo et al., 2021). In order to protect teats from infection by pathogenic microorganisms for a long period of time, barrier teat dips were designed. With barrier teat dip, the disinfectant is retained for a longer period of time and remains active when the cows return to the stalls after milking (Zhang et al., 2021). Automatic back-flush units are available and may be beneficial in certain dairy herds. The procedure of back-flushing of the milking unit contributes to the reduction of the transmission of mastitis pathogens from one cow to another through the milking unit. Back-flushing the milking unit with 30 to 50 ppm of iodine will reduce but not eliminate mastitis-causing organisms (Riekerink et al., 2012).

The choice of a disinfectant for udder disinfection should be based on the determination of pathogenic microorganisms that cause mastitis on the farm of dairy cows, and on examining the condition of teat skin. In addition, the link between the inadequacy of routine disinfection before and after milking and the properties of the disinfectant used, including its concentration and method of storage should be taken into account. A detailed review of test protocols for the evaluation of teat disinfectants is given by Fitzpatrick et al. (2018). Numerous protocols found on the website of The National Mastitis Council (NMC) can be of invaluable help in evaluating the effectiveness of udder disinfection. It is very useful to select teat dips according to the data found in the NMC bibliography. In addition, dairy farms with a high incidence of contagious mastitis should focus on choosing a disinfectant after cow milking, while dairy farms with environmental mastitis should focus on choosing a disinfectant to apply before milking cows (Schukken et al., 2013).

CONCLUSION

Based on the presented literature data on hygiene procedures before and after cow milking, the following can be concluded:

- Attitude and knowledge of the milker about pre and post milking hygienic procedures are of critical importance for maintaining optimal mammary gland health and prevention of mastitis.
- Hygienic procedures before and after milking should be carried out regularly, properly and systematically because they affect the hygiene and quality of milk.
- Out of all these procedures, maintaining the hygiene of the milker's hands, dry washing before milking and disinfection of teats after milking are particularly significant.

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Author’s Contribution:

SH and BS made contributions to the idea of the publication, organisation of work and writing the manuscript; LjS, and DOA were involved in the writing of the manuscript, DN reviewed the manuscript; SH and BS gave the final approval of the manuscript to be published.

Competing interest

The authors declare that they have no competing interests.

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