Subclinical Mastitis in Dairy Cows: Essential Oils as a Sustainable and Effective Alternative

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ABSTRACT

Subclinical mastitis is one of the most economically significant diseases affecting dairy cattle worldwide. Unlike clinical mastitis, it does not show visible symptoms, making early detection difficult. This condition leads to reduced milk yield, poor milk quality, and substantial financial losses for dairy farmers. Conventional control measures such as antibiotics and chemical disinfectants have limitations, including antimicrobial resistance and milk contamination. Recently, essential oils derived from plants have emerged as a promising, natural, and eco-friendly alternative. This article explores the causes, impacts, and management of subclinical mastitis, with a focus on the application of essential oils in dairy farming.

INTRODUCTION

Dairy farming plays a crucial role in rural livelihoods and agricultural economies, especially in countries like India. However, diseases such as mastitis pose a serious threat to productivity and profitability. Mastitis is an inflammation of the mammary gland, primarily caused by microbial infections. Among its forms,

subclinical mastitis is particularly challenging because it lacks visible symptoms such as swelling, redness, or abnormal milk.

Despite the absence of obvious signs, subclinical mastitis significantly reduces milk production and alters milk composition. It is estimated that subclinical mastitis causes losses that are several times higher than clinical mastitis due to its hidden nature (Seegers *et al*., 2003).

Etiology and Pathophysiology

Subclinical mastitis is mainly caused by bacterial pathogens such as *Staphylococcus aureus*, *Streptococcus agalactiae*, and *Escherichia coli*. These microorganisms enter the udder through the teat canal and multiply within the mammary tissue.

The infection triggers an immune response, leading to an increase in **Somatic Cell Count (SCC)** in milk. SCC is a key indicator of udder health and milk quality. Elevated SCC negatively affects milk components such as fat, protein, and lactose, thereby reducing its market value (Sharma *et al.*, 2011).

Economic Impact

Subclinical mastitis causes significant economic losses in dairy farming due to multiple interconnected factors. It leads to a reduction in milk yield and deterioration in milk quality, which directly affects the overall productivity of dairy animals. Additionally, milk with a high somatic cell count (SCC) often receives a lower market price, further reducing farmers' income. The condition also increases veterinary expenses and treatment costs, placing an additional financial burden on dairy producers. If left unmanaged, subclinical mastitis can progress to clinical mastitis, resulting in even greater losses. On a global scale, mastitis is considered one of the most expensive diseases in dairy production systems, accounting for billions of dollars in annual losses (Halasa *et al.,* 2007).

Limitations of Conventional Treatment

Traditional mastitis control strategies primarily rely on antibiotic therapy, iodine-based teat dips, and various chemical disinfectants. While these methods are generally effective in managing infections, they are associated with several important limitations. Prolonged or indiscriminate use of antibiotics can contribute to the development of antimicrobial resistance, posing a serious threat to both animal and public health. Additionally, the presence of antibiotic residues in milk can affect its safety and marketability. Chemical disinfectants, including iodine-based products, may cause adverse effects such as teat skin irritation and can negatively impact animal welfare. There are also growing environmental concerns linked to the repeated use of synthetic chemicals. Owing to these challenges, there is an increasing need for alternative approaches that are sustainable, safe, and free from harmful residues.

Essential Oils: A Natural Alternative

Definition and Properties

Essential oils are volatile, aromatic compounds extracted from plants that exhibit a wide range of biological activities. They possess antimicrobial, anti-inflammatory, antifungal, and antioxidant properties, which contribute to their therapeutic potential. These combined effects make essential oils particularly effective in controlling pathogens responsible for mastitis, thereby offering a promising natural alternative for udder health management in dairy animals.

Mechanism of Action

Essential oils are plant-derived, volatile compounds with antimicrobial, anti-inflammatory, antifungal, and antioxidant

properties, making them effective against mastitis-causing pathogens. They act through multiple mechanisms, such as disrupting microbial cell membranes, interfering with enzyme systems, and inhibiting microbial growth. Due to this multi-targeted action, the risk of developing resistance is lower compared to conventional antibiotics (Burt, 2004).

Commonly Used Essential Oils in Dairy Farming

- Eucalyptus oil
- Lavender oil
- Peppermint oil
- Tea tree oil

These oils have shown strong antimicrobial activity against common mastitis pathogens.

Benefits of Essential Oils in Mastitis Control

Regular application of essential oils as teat sprays or dips after milking offers several advantages:

Udder Health Improvement

The application of essential oil-based products also plays an important role in improving udder health and hygiene. It helps in reducing the bacterial load on the teat surface, thereby minimizing the risk of infection. Additionally, it aids in the prevention of new intramammary infections by creating a protective barrier. These formulations also promote faster healing of minor teat injuries, ensuring better teat condition and reducing the chances of pathogen entry (Mendake *et al.,* 2025).

Milk Quality Enhancement

The use of essential oil-based interventions contributes significantly to milk quality enhancement in dairy animals. It helps in reducing the somatic cell count (SCC) (Mendake *et al.,* 2025), which is a key indicator of udder health and milk hygiene. Additionally, it improves the nutritional composition of milk by enhancing fat, protein, and lactose levels. These improvements are often accompanied by the restoration of normal milk pH, indicating better udder health and overall milk quality.

Animal Welfare

- Reduced irritation compared to chemical disinfectants
- Improved skin condition of teats

Productivity Gains

- Increased milk yield
- Reduced disease incidence

Studies have demonstrated that essential oil-based formulations can significantly reduce mastitis prevalence and improve milk production.

Importance of Hygiene and Management Practices

The effectiveness of essential oil-based interventions largely depends on maintaining proper hygiene and sound farm management practices. Regular cleaning of udders before milking, the use of clean and dry bedding, and adherence to proper milking techniques are essential to minimize contamination and infection risk. Additionally, post-milking teat dipping plays a crucial role in protecting the teat canal from pathogen entry. Therefore, an integrated approach that combines good hygiene practices with natural treatments provides the most effective strategy for controlling mastitis and improving udder health.

Economic Benefits for Farmers

Adopting essential oil-based mastitis control strategies can provide multiple economic advantages:

- Lower expenditure on antibiotics and veterinary care
- Reduced milk rejection due to lower SCC
- Higher income due to improved milk quality
- Increased consumer trust in chemical-free dairy products

CONCLUSION

Subclinical mastitis is a hidden yet significant problem in dairy farming, affecting both milk yield and quality. Essential oils provide a natural and sustainable alternative to conventional treatments due to their antimicrobial properties, low risk of resistance, and absence of harmful residues. When combined with proper hygiene and management practices, they can effectively enhance udder health, improve milk quality, and increase farm profitability

Healthy Udder – Healthy Herd – Sustainable Dairy Farming!

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