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Effect of Essential Oil-based Teat Spray for Improvement of Teat Health in Dairy Cows

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ABSTRACT: This study aimed to evaluate the efficacy of essential oil–based teat spray formulations in improving teat skin and teat end condition in dairy cows affected with subclinical mastitis. The experiment was conducted for 90 days at Gorakshan Sabha, Dhantoli, Nagpur. A total of 71 mid-lactating cows were screened using the Modified California Mastitis Test (MCMT), and 24 cows positive for subclinical mastitis were selected. These animals were randomly assigned to three groups (T1, T2, and T3; n = 8 each). Group T1 received a 2% essential oil–based teat dip, T2 received a 2% essential oil–based teat spray, and T3 received a 1% essential oil–based teat spray post-milking. The formulation comprised eucalyptus, peppermint, lavender, and tea tree essential oils. The results revealed that the teat skin score (TSS) and teat end score (TES) improved in all groups over the 90-day period, with no significant differences ($P<0.05$) among treatments. By day 90, TSS values improved to 1.125 ± 0.125 (T1), 1.125 ± 0.18 (T2), and 1.250 ± 0.16 (T3). TES values improved to 1.375 ± 0.18 (T1), 1.125 ± 0.125 (T2), and 1.5 ± 0.1 (T3), with the best improvement observed in T2.

KEYWORDS: subclinical mastitis, essential oils, teat spray, teat dip, teat skin condition, teat end score, dairy cows, post-milking teat spray, mid-lactation

1. INTRODUCTION

Teat health is a critical determinant of udder integrity, milk quality, and productive efficiency in dairy cattle. Healthy teats act as a natural barrier against microbial invasion by maintaining intact skin and an effective teat canal sphincter. Any deterioration in teat condition, such as dryness, cracks, hyperkeratosis, or lesions, compromises this barrier and increases the risk of intramammary infections, ultimately predisposing animals to mastitis (Smolenski, 2018). Therefore, maintaining optimal teat condition is essential for sustainable dairy production.

Mastitis, particularly subclinical mastitis, continues to be one of the most economically significant diseases in dairy animals. Although India ranks first in global milk production, mastitis remains a major constraint due to its adverse effects on milk yield, quality, and farm profitability. Substantial economic losses occur due to reduced milk production, veterinary expenses, and treatment costs, with higher losses reported in high-yielding crossbred cows (Sinha et al., 2014; Wani et al., 2022). Poor teat and udder condition further aggravates these losses by increasing susceptibility to infection and causing discomfort during milking.

Teat condition is strongly influenced by milking hygiene, environmental management, and post-milking teat care. Post-milking teat disinfection is a vital step in clean milk production, as the teat canal remains open for a short period after milking, allowing pathogens to enter the mammary gland (Hemling et al., 2002). Conventional teat disinfectants such as iodine, chlorhexidine, and chlorine-based compounds are widely used; however, prolonged application may cause teat skin irritation, dryness, and residue concerns in milk (Nickerson, 2001; Boddie et al., 2002). Furthermore, the heavy reliance on antibiotics for mastitis control has raised serious concerns regarding antimicrobial resistance and public health risks (Cheng et al., 2020; WHO, 2024).

In recent years, essential oils have emerged as a promising natural alternative for teat care due to their antimicrobial, anti-inflammatory, antioxidant, and skin-conditioning properties (Adorjan and Buchbauer, 2010). Essential oils such as eucalyptus, peppermint, lavender, and tea tree have demonstrated effectiveness against major mastitis-causing pathogens without inducing bacterial resistance (Cavanagh and Wilkinson, 2002; Mahboubi and Kazempour, 2014; Sabo and Knezevic, 2019; Rasool et al., 2021). Their ability to improve teat skin integrity while reducing pathogen load makes them suitable for post-milking teat application.

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Considering the importance of teat condition in mastitis prevention and the need for sustainable alternatives to chemical disinfectants, the present study was undertaken to evaluate the effect of essential oil–based teat spray on teat condition, subclinical mastitis, and milk yield in dairy cows.

2. MATERIALS AND METHODS

Location of the Experiment: The present study was conducted at the Gorakshan Sabha Gaushala, Dhantoli, in Nagpur district, Maharashtra.

Experimental Design

T1: 2.0 ml EO-based teat dip post-milking
T2: 2.0 ml EO-based teat spray post-milking
T3: 1.0 ml EO-based teat spray post-milking

Teat Skin Score

Teat skin scores were recorded as per the guidelines of Goldberg and Timms Method (Smith and Timms, 2014) and represented in the below table 1

Table 1 Teat Skin Score (TSS)

Score	Description
0	Teat skin has been subjected to physical injury (stepped on/frostbite).
1	Teat skin is smooth, soft, and free of any scales, cracks, or chapping.
2	Teat skin shows some evidence of scaling especially when feeling (areas of dryness by feeling drag when sliding a gloved hand along the teat barrel &/or seeing areas of lower reflective sheen to the surface of the skin).
3	Teat skin is chapped. Chapping is where visible bits of skin are visibly peeling.
4	Teat skin is chapped and cracked. Redness, indicating inflammation, is evident.
5	Teat skin is severely damaged / ulcerated/open lesions.

Teat End Score (TES)

Teat end scores were recorded as per the guidelines of Porter *et al*, (2021) and represented in the below table 2

Table 2 Teat End Scoring Scale

Score	Description
1	**No ring** The teat-end is smooth with a small, even orifice This is typical of many teats soon after the start of lactation
2	**Smooth or slightly rough ring** A raised ring encircles the orifice The surface of the ring is smooth or it may feel slightly rough but no fronds of old keratin are evident.
3	**Rough ring** A raised, roughened ring with isolated fronds or mounds of old keratin extending 1-3 mm from the orifice
4	**Very rough ring** A raised ring with rough fronds or mounds of old keratin extending 4 mm or more from the orifice. The rim of the ring is rough and cracked, often giving the teat-end a ‘flowered’ appearance.

3. RESULTS

Teat Skin Score (TSS)

The results of the teat skin score (TSS) of dairy cows under the experimental trial are presented in Table 3. On day 0, the mean TSS values for treatment groups T1, T2, and T3 were 1.875 ± 0.22, 1.875 ± 0.22, and 1.75 ± 0.25, respectively. No significant difference ($P<0.05$) was observed among the treatment groups at the start of the experiment. Throughout the experimental period, all three groups exhibited non-significant differences ($P<0.05$) at day 15, 30, 45, 60, 75, and 90.

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On the 90th day, the TSS values for T1, T2, and T3 were 1.125 ± 0.125, 1.125 ± 0.18, and 1.250 ± 0.16, respectively. Although the differences among treatment groups remained non-significant, an overall improvement in teat skin condition was observed in all groups. Better teat skin scores were recorded in groups T1 and T2 compared to group T3 by the end of the experimental period.

Teat End Score (TES)

The teat end score (TES) results are presented in Table 4. On day 0, the mean TES values for groups T1, T2, and T3 were 1.875 ± 0.125, 1.75 ± 0.16, and 1.875 ± 0.125, respectively. No significant differences ($P<0.05$) were observed among the treatment groups on day 15, 30, 45, 60, 75, and 90.

By the 90th day, TES values improved to 1.375 ± 0.18 in T1, 1.125 ± 0.125 in T2, and 1.5 ± 0.1 in T3. The teat end scores remained between 1 and 2, indicating smooth teat ends with a small and even orifice. Although all groups showed improvement during the experimental period, the greatest improvement was observed in group T2, followed by T1 and T3.

4. DISCUSSION

Teat Skin Score (TSS)

The teat skin score (TSS) is an important indicator of teat health, as intact, smooth, and elastic teat skin serves as the primary physical barrier against pathogen entry into the mammary gland. In the present study, all treatment groups exhibited a gradual improvement in teat skin condition from day 0 to day 90, although the differences among treatment groups remained statistically non-significant. By the end of the experimental period, cows in groups T1 (2% essential oil–based teat dip) and T2 (2% essential oil–based teat spray) showed better TSS compared to group T3 (1% essential oil–based teat spray), indicating a beneficial effect of essential oil application on teat skin integrity.

These findings are consistent with Deshmukh (2023), who reported improved TSS in dairy cows treated with essential oil–based teat dip compared to iodine-based disinfectants. Aiemsaard et al. (2023) also demonstrated that post-milking application of essential oil spray effectively reduced bacterial contamination on teat skin, thereby supporting improved teat condition. Similarly, Rasool et al. (2021) observed notable improvement in teat condition in cows with subclinical mastitis treated with essential oil–based teat dip containing eucalyptus and lavender oils.

The improvement in teat skin condition observed in the present study may be attributed to the antimicrobial, anti-inflammatory, and soothing properties of essential oils, which help disinfect the teat surface while maintaining skin hydration and elasticity (Cavanagh et al., 2002; Hammer et al., 2006; Carson et al., 2006). A healthy teat skin with adequate lipid content and elasticity enhances the natural defence mechanism of the teat canal by promoting proper closure between milkings, thereby reducing the risk of pathogen invasion (Zigo et al., 2021). These properties likely contributed to the improved TSS observed in cows treated with higher concentrations of essential oil formulations.

Teat End Score (TES)

The teat end condition is a critical factor influencing susceptibility to intramammary infections, as the teat end serves as the final barrier preventing bacterial entry into the mammary gland. In the present study, all treatment groups showed improvement in TES over the experimental period, with the most pronounced improvement observed in group T2 (2% essential oil–based teat spray), followed by T1 and T3. By day 90, the teat end scores in all groups remained within the range of 1 to 2, indicating smooth teat ends with small, even orifices.

These results are in agreement with Rasool et al. (2021), who reported significant improvement in teat end condition in cows treated with essential oil–based post-milking teat dip. Burmeister et al. (1998) also observed improved TES following regular use of post-milking teat disinfectants. Maintenance of a smooth teat end is essential, as excessive keratinization and hyperkeratosis have been associated with increased risk of mastitis due to easier bacterial adherence and penetration into the teat canal (Jain, 1979; Kibebew, 2017).

The superior performance of the 2% essential oil–based teat spray observed in the present study may be attributed to its uniform mist application, which ensures better coverage and adherence of the active components to the teat end surface. This enhanced contact may improve the bactericidal action of essential oils and reduce keratin accumulation, thereby minimising teat end roughness and hyperkeratosis (Neculai-Valeanu and Ariton, 2022). Furthermore, the anti-inflammatory and tissue-soothing

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effects of essential oils may aid in maintaining teat end elasticity and structural integrity, contributing to improved teat end scores over time.

5. CONCLUSION

Post-milking application of essential oil–based teat formulations improved teat skin and teat end condition in dairy cows over the experimental period. Among the treatments, the 2% essential oil–based teat spray showed comparatively better improvement in teat skin score and teat end score than the 2% teat dip and 1% teat spray. The findings indicate that essential oil–based teat spray is an effective and sustainable option for maintaining teat health and udder hygiene in dairy cattle.

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