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Evaluation of Udder Condition and Hygiene in Dairy Cows Using Essential Oil-based Teat Spray

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Abstract

The present study was conducted to evaluate the effect of essential oil (EO)-based teat sprays on udder condition score (UCS) and cow cleanliness score (CCS) in dairy cows. The experiment was carried out for 90 days at Gorakshan Sabha, Dhanoli, Nagpur, involving 71 screened cows distributed among three treatment groups (T₁, T₂, and T₃). The initial UCS values in T₁, T₂, and T₃ were 7.75±0.25, 7.12±0.29, and 7.50±0.18, respectively, which increased to 8.62±0.18, 8.87±0.16, and 7.87±0.12 on day 90. Although no significant variation was observed among the groups initially, significant differences ($p < 0.05$) were recorded between T₁ and T₃ and between T₂ and T₃ on day 90, with T₁ and T₂ showing superior improvement. The initial CCS values of 2.37±0.18, 2.25±0.16, and 2.37±0.18 decreased to 1.62±0.26, 1.37±0.18, and 1.50±0.18, respectively, by day 90. Despite the absence of significant differences among treatments, all groups demonstrated progressive improvement in cleanliness. The beneficial response may be attributed to the antibacterial, anti-inflammatory, and skin-conditioning properties of essential oils, along with improved hygiene practices. Overall, EO-based teat sprays showed potential for improving teat and udder skin condition and supporting udder health in lactating dairy cows.

Keywords: Udder condition, dairy cows, Essential oils, teat spray

1. Introduction

Dairying is one of the most important components of Indian agriculture, serving as a major source of livelihood, nutrition, and income security for rural households. India is the largest milk producer in the world, and the demand for safe and high-quality milk continues to rise steadily. However, the productivity and profitability of dairy farming are heavily dependent on the health status of animals, particularly the udder health of lactating cows. Udder health not only influences milk yield and quality but also determines the susceptibility of cows to intramammary infections. Among these, mastitis remains one of the most economically significant diseases in the dairy sector. Subclinical mastitis, in particular, is of concern as it often goes unnoticed, leading to long-term reductions in milk yield, alterations in milk composition, and structural damage to the udder tissue. If left untreated, it may cause morphological changes such as fibrosis, redness, and inflammatory reactions that impair the functional capacity of the udder (Sargeant *et al.*, 1998) [26].

To maintain udder health and prevent mastitis, regular monitoring of udder and animal hygiene is essential. Udder condition score (UCS) and cow cleanliness score (CCS) have been widely used as reliable indicators of udder skin integrity and overall cleanliness of dairy animals, respectively. A good UCS reflects healthy and elastic udder skin, which minimizes the risk of pathogen invasion, while CCS indicates the extent of manure contamination on the body surface, particularly around the udder and hindquarters. Studies have shown that poor udder hygiene is strongly associated with a higher risk of intramammary infections, thereby linking management practices directly to animal health outcomes (Schreiner and Ruegg, 2003) [27].

Preventive measures such as teat dipping and spraying have been integrated into mastitis control programs globally. Conventionally, chemical disinfectants like iodine, chlorhexidine,

and quaternary ammonium compounds are widely used. While effective, these agents may have drawbacks, including irritation of the teat skin, residue concerns, and potential development of microbial resistance. Hence, there is growing interest in natural alternatives such as essential oils, which are known for their antimicrobial, anti-inflammatory, and skin-conditioning properties. Essential oils derived from plants contain bioactive compounds that inhibit bacterial growth, reduce inflammation, and improve skin texture and elasticity (Kumar *et al.*, 2011; Pazyar *et al.*, 2013) ^[13, 20].

Recent research supports the application of essential oils in dairy management. Deshmukh (2023) ^[8] reported improved udder condition scores in cows treated with essential oil-based teat dips after 45 days of use. Similarly, Shevchenko *et al.* (2020) ^[28] demonstrated improved udder skin health with Forticept, a teat-dipping solution containing benzalkonium chloride and extracts of *Matricaria recutita* and *Achillea millefolium*. These results show that essential oil blends have the potential to be sustainable substitutes for

synthetic goods.

In this context, the present study was undertaken to evaluate the effects of essential oil-based teat sprays on udder condition score and cow cleanliness score in dairy cows. The study aimed to assess whether regular application of essential oils could enhance udder skin condition, maintain better animal hygiene, and thereby contribute to improved udder health and mastitis prevention in dairy herds.

2. Methodology

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

2.2 Udder Condition Score: Udder condition scores were recorded as per the guidelines of the American Hereford Association (Macneil and Mott, 2006) and represented in Table 1 below

Table 1: Udder condition scoring

Score	Description
9	An ideal mammary system. The udder is held high up near the rear and is level in front. Teats are small.
8	Very good udder with a level attachment in front and high attachment in the rear with the desirable teats.
7	A sound and functional udder are fairly level with small, good teats.
6	A very functional and teats. This is a problem-free udder and teats but does not have the balance of udder scored 7, 8 or 9.
5	A functional udder and teats and labor free. Udder and teats scores of 5 or better should be "Labor Free".
4	An udder that could become a problem because of attachments and/or shape and size of teats.
3	A problem with the udder and teats. The udder will show tendencies of breaking down and the teats are too large and balloon-shaped.
2	A definite problem with the udder and teats. The udder is poorly attached in the front and back with weak suspension and the teats are large and balloon-shaped.
1	A very pendulous udder and balloon teats. These udders will cause frequent labour problems.

2.3 Cleanliness score scale

Table 2

Cleanliness score	At a fixed time twice a month
1	Completely clean, minor spatter of manure on the hoof.
2	Spatter of manure on the hoof, udder, and up to hock.
3	Several manure regions with dry manure on the udder, rump, and flanks
4	Several manure regions on the whole body.

Norberg (2012) ^[18].

3. Results and Discussion

3.1 Udder Condition Score

The results of the Udder Condition Score (UCS) for the dairy cows under trial are presented in Table 3. The result of the present study shows a non-significant difference ($p < 0.05$) in the UCS of the cows under different treatment groups on day 0th. On day 0, the results for Groups T₁, T₂, and T₃ were 7.75 ± 0.25 , 7.12 ± 0.29 , and 7.50 ± 0.18 , respectively. Similarly, a non-significant difference in UCS was observed on day 15th, day 30th, day 45th, day 60th, and day 75th. However, a significant difference ($p < 0.05$) in the values of the udder condition score was observed on day 90th between groups T₁ (8.62 ± 0.18) and T₂ (8.87 ± 0.12) and T₂ (8.87 ± 0.16) and T₃ (7.87 ± 0.12) whereas, no significant difference ($p < 0.05$) was observed between Groups T₁ (8.62 ± 0.18) and T₂ (8.87 ± 0.16) on day 90th. Further, throughout the experimentation period, the udder condition score of the cows exhibited progress in all the treatment groups. The values in Groups T₁, T₂, and T₃ on day 90th were observed to be 8.62 ± 0.18 , 8.87 ± 0.16 , and 7.87 ± 0.12 , respectively.

The observations within the Group T₁ reveal a non-significant

($p < 0.05$) difference within the treatment group till day 30. However, a significant increase $P < 0.05$ within group T₁ was observed between day 0 and day 45. No significant difference $p < 0.05$, was observed between day 45 and day 60 for group T₁. However, a significant difference ($p < 0.05$) was observed from day 60 onwards as compare to day 30. No significant difference, $p < 0.05$, was observed for UCS between day 60 to day 90 for group T₁.

For group T₂ a non-significant ($p < 0.05$) difference within the treatment group was observed between day 0, day 15 and day 30. However, a significant difference ($p < 0.05$) within group T₂ for UCS was observed between day 30 and day 45. Also, a non-significant difference ($p < 0.05$) was observed between day 45 and day 60. Similarly, a non-significant difference ($p < 0.05$) was also observed for group T₂ between day 60 onwards to day 90. However, a significant difference was observed between day 30 and day 60. The values for Group T₂ for day 0, 15, 30, 45, 60, 75, and 90 being 7.12 ± 0.29 , 7.25 ± 0.31 , 7.37 ± 0.26 , 8.12 ± 0.22 , 8.12 ± 0.22 , 8.50 ± 0.18 , 8.75 ± 0.16 , and 8.87 ± 0.16 , respectively. For group T₃ a non-significant ($p < 0.05$) difference within the treatment group was observed throughout the experimentation period between day

0 onwards to the day 90. The values for USC for Group T₃ for day 0, 15, 30, 45, 60, 75 and 90 being 7.50±0.18, 7.62±0.18, 7.62±0.32, 7.60±0.18, 7.82±0.22, 7.87±0.22, and 7.87±0.12, respectively.

The present findings are in line with the findings of Deshmukh (2023) [18] who had reported an improvement in udder condition score in the groups treated with teat dip of essential oil from the 45th day indicating positive results of Essential oil teat dip. Shevchenko *et al.* (2020) [28] also reported an improvement in the udders' physical condition on day 30th after using Forticept as a teat dipping solution pre- and post-milking in dairy cows as preventive measures in subclinical mastitis. If untreated, the cow with sub-clinical mastitis may precede morphological changes in the udder such as inflammatory signs, such as redness, fibrosis of the udder tissue, etc. (Sargeant *et al.*, 1998) [26].

The essential oils have antibacterial, anti-inflammatory activity, and conditioning effects on the skin. These qualities of essential oil are also reported by (Salvatori *et al.*, 2023, Kumar *et al.*, 2011, and Pazayar *et al.*, 2013) [25, 13, 20]. The improvement in the udder skin score can be attributed to the conditioning effect of essential oils on the skin.

3.2 Cow Cleanliness Score

Table 4 illustrates the cleanliness scores for the dairy cows in the various treatment groups. The study's findings showed that there was no significant difference ($p<0.05$) in the cleanliness score values for the cows in groups T₁, T₂, and T₃ on the first day of the experiment. Group T₁, Group T₂, and Group T₃ had values of 2.375±0.18, 2.25±0.16, and 2.375±0.18. Additionally, no significant difference ($p<0.05$) was seen at the end of the experiment; that is, groups T₁, T₂, and T₃ had cleanliness scores of 1.625±0.26, 1.375±0.18, and 1.50±0.18 on day 90.

Over the period of the experiment, all treatment groups—T₁, T₂, and T₃—show a steady improvement in the animals' cleanliness scores. On days 0, 15, 30, 45, 60, and 75, there was no discernible change in T₁. On day 90, however, a significant ($p<0.05$) difference was noted. Additionally, the cleanliness scores of groups T₂ and T₃ improved over the course of the experiment, with a notable improvement on day 90 relative to day 0. This indicates a steady increase in the cow cleanliness score across all experimental groups. The values were 2.37±0.18, 2.37±0.18, 2.25±0.16, 1.87±0.125, 1.75±0.25, 1.87±0.22, and 1.62±0.26 for Group T₁, 2.25±0.16, 2.12±0.125, 2.00±0.18, 1.50±0.18, 1.37±0.18, and 1.37±0.18 for Group T₃.

The cleanliness score ranged from 1 to 3, indicating that the animals were quite clean during the experiment, with only the animal's hock area covered in manure and excrement. Additionally, there was no spattering of manure and dung over the rump and flank area, suggesting that there was no microbial contamination with the results due to the dirt, dung, etc. The current results were consistent with those of Schreiner and Ruegg (2003) [27], who found a connection between dairy cattle's leg and udder hygiene scores and,

consequently, intramammary infection. According to their research, there was a strong correlation between intramammary infection and udder hygiene, and as the deterioration of the udder hygiene the chances of intramammary infection increased.

The current study's findings showed that the animals were cleaner throughout the experiment and that there were no significant differences ($p<0.05$) between the three treatment groups. Nonetheless, from the beginning to the end of the experiment, all three groups' cleanliness scores improved. This could be explained by the experimenter's heightened attention to detail and more effective labor management as the trial period progressed. The current study's findings were consistent with those of Norberg (2012) [18], who noted that the cleanliness scores of the H1A (cows in rubber floor area) and H2A (cows in concrete floor area) groups did not differ significantly. Nevertheless, their findings also showed that both groups' cleanliness improved. According to Ward *et al.* (2002) [32], clean cows improve the herd's general look and lower the risk of mastitis and somatic cell count. Animal health is impacted by the cleanliness of dairy animals, particularly the udder. Poor hygiene increases the risk of pathogen infection in dirty animals (Chetri *et al.*, 2024) [7].

As the experimentation progressed in the current study, the cleanliness score improved. This must have improved the animals' udder health and general building health, and it may have also improved the animals' udder health and production characteristics.

Summary and Conclusion

Effects on UCS and Cow Cleanliness Score

UCS: The results of the present study described that the UCS of the dairy cows under different treatment groups i.e., T₁, T₂, and T₃ on the day 0th were reported as 7.75±0.25, 7.12±0.29, and 7.50±0.18 respectively, and the final values on the 90th day were found to be 8.62±0.18, 8.87±0.16, and 7.87±0.12 respectively. At the start of the treatment, a non-significant difference was discovered. On the 90th day, however, there was a significant difference ($P<0.05$) in the UCS values between Group T₁ and Group T₃; however, there was no significant difference ($P<0.05$) between Group T₁ and Group T₂. The findings showed that, as comparison to Group T₃, the udder condition score in Groups T₂ and T₁ significantly improved ($p<0.05$). On the 90th day of the experiment, however, there was no discernible ($p<0.05$) difference between Group T₁ and Group T₂.

Cow Cleanliness Score: According to the cleanliness score results, the groups' beginning values for T₁, T₂, and T₃ were 2.37±0.18, 2.25±0.16, and 2.37±0.18, respectively. At the 90th day of the trial, the values were 1.62±0.26, 1.37±0.18, and 1.50±0.18, respectively. From day 0 to day 90, there were no discernible differences between the three experimental groups. Nonetheless, the findings showed that all of the experimental groups' cleanliness scores had progressively grown, and the animals had remained unclean over the trial.

Table 3: Mean ± SE values of dairy cows' udder condition score under different treatment groups

Groups	0 th Day	15 th Day	30 th Day	45 th Day	60 th Day	75 th Day	90 th Day	CD
T ₁	7.25 ^a ± 0.25	7.62 ^{ab} ± 0.18	7.75 ^{ab} ± 0.16	8.12 ^{bc} ± 0.22	8.37 ^c ± 0.18	8.50 ^c ± 0.18	8.62 ^{Ac} ± 0.18	0.346
T ₂	7.12 ^a ± 0.29	7.25 ^a ± 0.31	7.37 ^a ±0.26	8.12 ^b ±0.22	8.50 ^{bc} ± 0.18	8.75 ^c ± 0.16	8.87 ^{Ac} ± 0.16	0.372
T ₃	7.50± 0.18	7.62± 0.18	7.62± 0.32	7.60± 0.18	7.82± 0.22	7.87± 0.22	7.87 ^B ± 0.12	
CD							0.727	

The mean bearing different superscripts (A & B) within the column differ significantly ($p < 0.05$)

The mean bearing different superscripts (a, b & c) within the row differ significantly ($p < 0.05$)

Table 4: Mean $\pm$ SE values of dairy cows' Cleanliness Score under different treatment groups

Groups	0 th Day	15 th Day	30 th Day	45 th Day	60 th Day	75 th Day	90 th Day	CD
T ₁	2.37 ^b $\pm$ 0.18	2.37 ^b $\pm$ 0.18	2.25 ^{ab} $\pm$ 0.16	1.87 ^{ab} $\pm$ 0.125	1.75 ^{ab} $\pm$ 0.25	1.87 ^{ab} $\pm$ 0.22	1.62 ^a $\pm$ 0.26	0.25
T ₂	2.25 ^c $\pm$ 0.16	2.12 ^c $\pm$ 0.125	2.00 ^{cb} $\pm$ 0.18	1.75 ^{bc} $\pm$ 0.25	1.50 ^{ab} $\pm$ 0.18	1.37 ^a $\pm$ 0.18	1.37 ^a $\pm$ 0.18	0.25
T ₃	2.37 ^b $\pm$ 0.18	2.25 ^b $\pm$ 0.16	2.12 ^{ab} $\pm$ 0.22	2.00 ^{ab} $\pm$ 0.18	1.87 ^{ab} $\pm$ 0.22	1.75 ^{ab} $\pm$ 0.25	1.50 ^a $\pm$ 0.18	0.25

The mean bearing different superscript (a, b & c) within the row differ significantly ($p < 0.05$)

Conclusion

The present study demonstrated that the application of essential oil-based teat sprays had a positive impact on udder condition score (UCS) and cow cleanliness score (CCS) in dairy cows. Although no significant differences were observed between treatment groups during the initial stages of experimentation, a significant improvement in UCS was noted on the 90th day in groups T₁ and T₂ compared to T₃, highlighting the beneficial effects of essential oil formulations on udder skin health. The progressive improvement in CCS across all treatment groups further indicated that the cows remained relatively clean throughout the study period, thereby minimizing the risk of microbial contamination and udder infections. The findings suggest that essential oil-based teat sprays not only improve udder skin condition but also support better hygiene management in dairy herds. This improvement can be attributed to the antibacterial, anti-inflammatory, and skin-conditioning properties of essential oils. The outcomes are consistent with previous reports that emphasized the role of essential oils and plant-based formulations in maintaining udder health and reducing the risk of subclinical mastitis. Therefore, essential oil-based teat sprays can be considered as effective and sustainable alternatives to conventional chemical teat disinfectants. Their regular use in dairy management practices may enhance udder health, support mastitis prevention programs, and contribute to improved productivity and quality of milk.

Conflict of Interest

Not available

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