RESEARCH ARTICLE

Herbal Teat Care: Effects on Bacterial Count of Milk and Teat Condition

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Abstract

This study aimed to evaluate the efficacy of diverse herbal teat dipping agents on milk pH and bacterial counts (*Staphylococcus*, *Streptococcus* and *E. coli*), alongside teat condition scoring in 28 days involving 25 lactating HF crossbred cows, aged 6 to 8 years. The cows were housed in a loose housing system and categorized into five groups: T1 (Control - water), T2 (1% potassium iodide), T3 (*Aloe vera* gel), T4 (turmeric paste) and T5 (neem oil), each comprising five cows. The cow' milk pH, initially averaging 6.46, remained within the acceptable range (6.5-6.7) post-dipping with herbal agents. *Aloe vera* treatment showed the most significant pH improvement. Bacterial counts did not significantly differ on day 7. Still, by day 28, *Staphylococcus* counts were significantly lower in neem oil-dipped cows and *E. coli* counts were lower in all treated groups compared to the control. Teat condition scoring indicated that *Aloe vera* and potassium iodide positively affected teat skin condition, while neem oil and turmeric paste improved it without significant differences. Teat orifice condition scores remained consistent across groups. The study suggests these herbal agents can be safely used as teat dips without adversely affecting milk pH or teat condition. The findings contribute to understanding the potential of natural substances for maintaining udder health in dairy cows.

Key words: Bacterial count, Herbal agents, Milk pH, Teat condition score, Teat dips.

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Introduction

Mastitis, an ailment affecting dairy cattle, remains a pressing economic concern for farmers, exerting detrimental effects on both milk quality and yield. Addressing this challenge is intricate, as a lack of comprehensive understanding of its underlying mechanisms in the subclinical stage often leads to its progression into the more visible clinical form (Awale *et al*., 2012). Regrettably, diagnostic assessments, while essential for accurate detection, may prove infeasible when considering practicality at the field level.

In light of this, the primary emphasis in combating mastitis effectively shifts towards prevention strategies. Among the quintessential components of a comprehensive mastitis control program is post-milking teat disinfection (Rather *et al*., 2020). Although an array of chemical teat dips are available commercially, the allure of herbal alternatives lies in their user-friendliness, ready availability, and economic viability for farmers. Diving into the realm of herbal solutions, noteworthy mentions include polyherbal teat dips like "mastidip liquid", which boasts chief ingredients such as *Berberis lyceum*, *Curcuma longa* and *Eucalyptus globulus* and has demonstrated efficacy in mitigating mastitis (Waghmare *et al*., 2013). Furthermore, a formulation comprising *Aloe vera*, turmeric powder, and lime has showcased its prowess in curbing mastitis incidence (Thangadhurai *et al*., 2017). However, while the collective efficacy of herbal agents like turmeric, *Aloe vera* and neem oil in attenuating mastitis is established, the spotlight remains on the limited information available regarding the direct utilization of individual herbal agents by farmers within their operations. Additionally, there is a crucial need for insights into the safety aspects of these agents for udder health. Consequently, this study embarks on a journey to bridge these knowledge gaps. Its focal point is an exploration of individual herbal agents' safety and potential impacts based on milk pH, bacterial count and teat condition score.

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Materials and Methods

The study was carried out in 2019 at the Department of Livestock Research Complex, Veterinary College, Bengaluru (India). All the procedures followed in the experiment were approved by the Institutional Animal Ethics Committee vide IAEC No. VCH/IAEC/2019/99.

Experimental Design

The study covered 25 HF crossbred cows, aged between 6 and 8 years, in their fourth to sixth lactation with an average daily milk yield of 6 kg. Through random assignment, these cows were evenly distributed into five different treatment groups: T1 (Control - provided with fresh clean water), T2 (1% Potassium iodide), T3 (*Aloe vera* gel), T4 (Turmeric paste), and T5 (Neem oil). Each treatment group comprised five cows. Post-milking teat dips were administered following the method outlined by Oliver *et al*. (1990), within one minute after milking. This comprehensive experimental trial spanned 28 days.

Management of Animals

The chosen cows were managed under a loose housing system. Daily, each cow received 3 kg of concentrates while being milked. Their diet consisted of 20 kg of maize and Napier grass as fresh fodder, along with 5 kg of ragi straw for dry fodder, all provided twice daily. Additionally, the experimental cows grazed in the fields for 3 hours daily. They had constant access to clean and secure drinking water. Milking took place twice daily at 5:15 a.m. and 4:45 p.m. in a milking parlour, using machine milking. The cows were cleansed once daily after the morning milking session. Regular sanitation was maintained for the shed and manger, with regular removal of dung and leftover fodder. To ensure a controlled milking environment, the cows' legs were restrained, teats wiped before milking, and teat cups were appropriately placed. All equipment used for milking, along with the milking parlour, underwent thorough cleaning after each session.

Parameters Studied

Milk pH was determined using a digital pH meter as per Tomar *et al*. (2018). Teat swabs collected on day 1 and day 28 were cultured for enumeration of important mastitis-causing bacteria like *Staphylococcus*, *Streptococcus* and *E. coli* using specific media (Himedia). Mannitol salt agar was used for *Staphylococcus*, modified Edwards agar for *Streptococcus* and Eosin-methylene blue agar was used for *E. coli*, according to the procedures of Gleeson *et al*. (2009). Swabs were kept in sterile tubes containing peptone water. Before swabbing, the teat ends were wiped with a clean sterile cloth and were swabbed around the teat orifice and put back into the peptone water and stored under refrigeration temperature. Serial dilutions of the collected samples were done. 10 µL of each dilution was placed in a specific agar medium for each organism. Agar plates were incubated at 37°C for 24 h. After incubation, bacterial colony counting was done using a colony counter. Number of colonies counted was expressed as Colony Forming Units/mL (CFU/mL).

Teat condition scoring, *i.e.,* teat skin condition scoring and teat end orifice roughness/ hyperkeratosis scores, was done according to Neijenhuis (2004) on days 1, 7, 14, 21 and 28, based on visual and tactile observations. The scales followed for teat end orifice roughness/hyperkeratosis scoring and teat skin condition scoring are mentioned in Table 1.

Each animal was considered as one experimental unit for the statistical analysis. A pair-wise comparison of estimated marginal means of data pertaining to milk pH was done using Univariate tests in the General Linear model by including the data pertaining to the observations of day one as a covariate. Data pertaining to bacterial counts were analysed by one way Analysis of Variance by Tukey's test. All the means were compared at 0.05 level of significance. The statistical analysis was done using IBM SPSS Statistics software.

Results and Discussion

Milk pH stands as a pivotal parameter in assessing udder health within dairy animals. For dairy cows, the normal pH range of milk lies between 6.5 and 6.7. The impact of various teat dips on milk pH levels at different time intervals is detailed in Table 2. Initially, the average milk pH across all groups started at 6.46. Following the teat dipping process, a notable reduction was observed in the *Aloe vera* group at day 28 compared to other treatment groups, suggesting

Table 1: Teat orifice and skin condition scores with their description

Score	Teat orifice condition description	Teat skin condition description
1	Smooth teat end and sphincter with no evidence of roughness	Teat skin is smooth, supple, free from scales, cracks, or chapping
2	Slight irregularities or fringes of roughness near orifice	Slight drying of skin with superficial flaking
3	Teat end sphincter is moderately roughened with radial cracks	More severe drying with early cracks present and skin cracks do not have severe red fissures at the base
4	Teat orifice is significantly roughened with pronounced cracking	Teat skin is chapped with pronounced cracking present and redness, indicating inflammation, some scabbed, healing lesions
5	Teat end is severely roughened with deep irregular calluses	Severe skin damage with deep chaps and open ulcerative lesions or scabs

the super effectiveness of *Aloe vera* in improving milk pH. Importantly, the use of diverse herbal agents for teat dipping did not cause any deviations in milk pH beyond the healthy range. This finding aligns with Rathaur *et al*. (2020), where a herbal paste containing *Aloe vera*, turmeric powder, lemon, and castor oil was employed. Similar results were observed by Tomar *et al*. (2018) and Thangadurai *et al*. (2017), where *Aloe vera* was part of the treatment, leading to reduced milk pH. The constituents of milk responsible for pH include casein, citrate, phosphate, and dissolved CO_2 bicarbonates, balanced with the permeability of udder cells to blood capillaries. In cases of mastitis due to mammary gland infection, increased permeability of udder tissue to blood components, such as bicarbonate ions, results in a higher milk pH value (Waghmare *et al*., 2013). The subsequent findings reveal a decline in bacterial load when employing *Aloe vera* as a teat dip. This reduction in bacterial load may result in lower infection rates, consequently contributing to the enhancement of milk pH.

The results concerning the impact of teat dips on bacterial counts (CFU/mL) are presented in Table 3. No significant differences ($p>0.05$) were noted in *Staphylococcus*, *Streptococcus* and *E. coli* counts on day 1. However, by day 28, the control group exhibited significantly higher *Staphylococcus* counts compared to the neem oil-treated group. Furthermore, on day 28, the control group displayed significantly elevated *E. coli* counts compared to all treated groups. On the same day, *Streptococcus* counts remained relatively stable among all groups. Our findings regarding *Staphylococcus* counts due to potassium iodide dipping align with Gleeson *et al*. (2009). However, contrasts can be drawn with Eberhart *et al*. (1983), where a commercial iodine preparation significantly reduced *Staphylococcus* counts. The present study concurs with Gleeson *et al*. (2009) regarding *Streptococcus* counts but opposes Fitzpatrick *et al*. (2019), which reported a reduction using iodine-based dips. *E. coli* count reduction found in all treatment groups resonates with Fitzpatrick *et al*. (2019). However, no significant effects were reported by

Table 2: Effect of various herbal agents as post-milking teat dips on pH on day 7, 14, 21 and 28 in lactating dairy cattle

Description		Milk pH			
		Day 7	Day 14	Day 21	Day 28
T1	Control-fresh clean water	6.59±0.05^{b}	6.66±0.06^{b}	6.64±0.06^{ab}	6.64±0.10^{ab}
T2	1% Potassium Iodide	6.69±0.05^{ab}	6.64±0.06^{b}	6.64±0.06^{ab}	6.55±0.10^{ab}
T3	*Aloe vera* gel	6.57±0.05^{b}	6.53±0.06^{b}	6.51±0.06^{b}	6.42±0.11^{b}
T4	Turmeric paste	6.78±0.05^{a}	6.86±0.06^{a}	6.74±0.06^{a}	6.78±0.11^{a}
T5	Neem oil	6.57±0.07^{ab}	6.49±0.08^{b}	6.48±0.08^{b}	6.52±0.15^{ab}

Covariates appearing in the model are evaluated at this value of milk pH on day 1 = 6.4624. Means with different superscripts in the same column vary significantly ($p\leq0.05$).

Table 3: Effect of various herbal agents as post-milking teat dips on bacterial counts (CFU/mL) on days 1 and 28 in lactating dairy cattle

Treatment	$\log_{10}$ *Staphylococcus* (CFU/ml)		$\log_{10}$ *Streptococcus* (CFU/ml)		$\log_{10}$ *E. coli* (CFU/ml)	
	Day 1	Day 28	Day 1	Day 28	Day 1	Day 28
T1	4.28±0.14	4.23±0.14^{a}	4.39±0.25	4.28±0.15	4.25±0.07	4.24±0.04^{a}
T2	4.39±0.12	3.89±0.06^{ab}	4.41±0.07	4.37±0.04	4.56±0.09	3.51±0.21^{b}
T3	4.45±0.19	3.87±0.05^{ab}	4.46±0.20	4.44±0.10	4.37±0.04	3.40±0.13^{b}
T4	4.37±0.13	4.03±0.07^{ab}	4.37±0.15	4.19±0.15	4.53±0.16	3.49±0.11^{b}
T5	4.06±0.21	3.78±0.10^{b}	4.62±0.20	4.59±0.12	4.39±0.03	3.24±0.13^{b}

Means with different superscripts in the same column vary significantly ($p\leq0.05$).

Table 4: Effect of various herbal agents as post-milking teat dips on teat orifice and skin condition score on day 7, 14, 21 and 28 in lactating dairy cattle

Treatment	Teat orifice condition scores				Teat skin condition scores			
	Day 7	Day 14	Day 21	Day 28	Day 7	Day 14	Day 21	Day 28
T1	1.06±0.19	1.24±0.17	1.34±0.12	1.13±0.10	1.32±0.13^{ab}	1.33±0.24	1.25±0.20	1.56±0.15^{a}
T2	1.29±0.21	1.31±0.19	1.31±0.14	1.14±0.11	1.48±0.13^{ab}	1.47±0.24	1.55±0.20	1.03±0.15^{b}
T3	1.60±0.19	1.20±0.17	1.00±0.12	1.00±0.10	1.12±0.13^{b}	1.23±0.24	1.05±0.20	1.05±0.15^{b}
T4	1.40±0.19	1.00±0.17	1.20±0.12	1.00±0.10	1.68±0.13^{a}	1.27±0.24	1.35±0.20	1.14±0.15^{ab}
T5	1.06±0.19	1.04±0.17	1.14±0.12	1.03±0.10	1.20±0.13^{b}	1.40±0.24	1.20±0.20	1.20±0.15^{ab}

Covariates appearing in the model are evaluated at this teat orifice condition score on day 1 = 1.2000, and teat skin condition score on day 1= 1.4000; Means with different superscripts in the same column vary significantly ($p\leq0.05$).

Eberhart *et al*. (1983) and Gleeson *et al*. (2009). Literature regarding the individual effects of *Aloe vera* gel, neem oil, and turmeric paste on bacterial counts is scarce. The decline in *E. coli* counts across treatments can be attributed to the antibacterial properties of the agents. *Streptococcal* counts remained largely unaffected, while neem oil exhibited antibacterial effects on *Staphylococcus* counts, indicating its potential efficacy against *Staphylococcal* infections.

Table 4 provides mean teat orifice and skin condition scores. Teat orifice condition scores showed no significant variations within or between treatment groups. Literature regarding neem oil, *Aloe vera* gel, and turmeric paste on teat orifice conditions is lacking. Across various studies, teat dipping exhibited minimal influence on teat orifice conditions, indicating a neutral role. In contrast, teat skin condition scores in the potassium iodide and *Aloe vera* groups showed significant improvement compared to the control group. However, no significant variations were observed in other treated groups. These results resonate with Matti and Timms (2015) and Foret *et al*. (2005), where iodine-based teat dips did not yield significant improvements. Limited literature exists on the effects of neem oil, *Aloe vera* gel and turmeric paste on teat skin condition scores. Notably, *Aloe vera* gel and potassium iodide had a soothing effect on teat skin compared to the control, while neem oil and turmeric paste enhanced skin condition without significant differences.

Conclusion

In conclusion, the study highlights the potential of herbal teat dipping agents in maintaining milk pH and udder health. *Aloe vera's* effectiveness, neem oil's antibacterial properties, and improvements in teat skin condition are noteworthy. These findings suggest the safe utilization of herbal agents for teat care. Future research could explore optimal formulations and concentrations for maximum benefits, enhancing the well-being of dairy cattle and milk quality.

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