



Effect of Dietary Supplementation of Buffer and Application of Herbal Teat Dip on the Milk Composition of Lactating Rathii Cattle

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ABSTRACT

Background: Nowadays, there is an increasing demand among the consumers for clean milk or superior quality milk and milk products. The current scenario of dairy sector in India showcases a low productivity among the indigenous dairy breeds which requires the employment of nutritional and managerial interventions to improve the milk quality as well as performance of lactating cattle. The use of buffers like trisodium citrate and herbal post milking herbal teat dip are part of such interventions. The current study is aimed at evaluating the effect of such interventions on the milk quality of lactating Rathii cattle.

Methods: Twenty-four cattle were selected at LRS, Bikaner and divided into four treatment groups consisting of six cattle each. The experiment was conducted for 60 days, where T₁ group was used as control, T₂ group was given the basal diet along with oral supplementation of buffer trisodium citrate @ 30 mg/kg body weight, T₃ group received the basal diet along with the topical application of herbal teat dip (aloe vera, turmeric, lemon extract and castor oil) and T₄ group was given the basal diet along with a combination of oral supplementation of trisodium citrate @ 30 mg/kg body weight as well as the topical application. The milk samples of the experimental animals were examined for milk fat per cent, milk SNF per cent, milk lactose per cent and milk protein per cent.

Result: The results of the study revealed that there was a significant effect ($P < 0.05$) of buffer supplementation and application of herbal teat dip on milk fat per cent, whereas it was highly significant ($P < 0.01$) for milk SNF per cent between the control and treatment groups. There was no significant effect observed in milk lactose percent or milk protein per cent.

Key words: Herbal teat dip, Milk quality, Rathii, Trisodium citrate.

INTRODUCTION

The livestock sector in India is a significant contributor to the country's economy and plays a crucial role in the livelihoods of millions of people. When concentrating on the dairy subsector, it becomes even more apparent how important it is. India has the largest dairy sector in the world, where 23% of the world's milk is produced. The sector supports more than 8 crore farmers directly and provides 5% of the country's economic output (DAHD 2021). But the dairy industry faces its fair share of challenges in the form of growing demand and awareness among consumers regarding the quality of milk and milk products. This compiled with the low per capita productivity among the indigenous cattle which is 1777 kg when compared to the world average of 2699 kg (FAO statistics 2020), poses as a threat for the development of the Indian dairy sector.

One of the chief causes behind the reduced productivity of indigenous cattle is sub-clinical mastitis. Annual losses in the dairy industry due to mastitis was almost 2.37 thousand crore rupees in India. Out of this, sub-clinical mastitis accounted for approximately 70% of the loss (Lakshmi, 2016). According to Singh *et al.* (2014), higher yielding crossbred cows and buffaloes suffered greater economic losses per lactation than native cows and buffaloes (INR 868.34 and INR 1,272.36, respectively). In sub-clinical mastitis there are no clinical signs shown by the animal and only changes occur in milk constituents that

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can affect the shelf-life and quality of milk. This is one of the reasons why sub-clinical mastitis is much more of a complicity for the dairy farmers as it becomes a herd problem.

As per Yousaf *et al.* (2010), there is a need for well-designed therapeutic strategies to support suitable treatment regimens against mastitis. Alternative methods for the treatment and management of bovine health have been planned, keeping in mind the drawbacks of antibiotic therapy. Among such interventions, there has been the employment of buffers such as trisodium citrate and the use of herbs that not only improve the quality of milk by boosting its constituents but also combat the problem of sub-clinical

mastitis. The importance of trisodium citrate can be seen in its role as buffer agent for the udder that regulates its pH at 6.5 along with maintenance of the H^+ and Ca^{+2} homeostasis in udder (Shennan and Peaker, 2000). Studies have shown that trisodium citrate is helpful in improving the milk composition such as milk fat percent and milk SNF percent. Herbs on the other hand, have been known for their antibiotic, anti-inflammatory, analgesic and anti-pyretic properties. Beneficial effects of herbs in farm animals may arise from the activation of feed intake and the secretion of digestive secretions, immune stimulation and antibacterial activity (Bhargav *et al.*, 2021). These properties have been utilized to improve the udder health and boost milk quality. Plants that have essential oils may offer an affordable way to enhance milk production efficiency and improve the nutritional quality of milk in dairy cows (Bhargav *et al.*, 2021). As a vital aspect of prevention against diseases like sub-clinical mastitis is proper management and milking care, application of post-milking teat dip can be a good strategy. Poly-herbal mixtures are thought to help start, sustain, or boost milk production while also enhancing udder health (Subhash *et al.*, 2016). There is a considerable interest in developing new strategies to improve the milk quality of dairy cattle and enhance the clean milk production practices in the country.

Thus, the objective of the present study was to evaluate the effect of dietary supplementation of trisodium citrate and application of herbal post-milking teat dip on the milk quality of Rathu cattle.

MATERIALS AND METHODS

Experiment location

The study was conducted at the Livestock Research Station, Bikaner located at College of Veterinary and Animal Science, Bikaner, Rajasthan University of Veterinary and Animal Sciences, Bikaner.

Experimental design

The trial was conducted over a period of 60 days from Dec 2023 to February 2024 to study the effect of oral supplementation with buffer as well as the application of

herbal teat dip on the performance of lactating Rathu cattle. The twenty-four Rathu cattle utilized in the study were divided into four groups viz., T_1 , T_2 , T_3 and T_4 . The animals were divided based on their body weight; total lactation yield as well as peak yield. The T_1 group was the control group which was given the basal diet. T_2 group was supplemented with buffer Trisodium Citrate at the rate of 30 mg/kg BW once daily in evening at the time of milking along with concentrate mixture. The third treatment Group T_3 was given the topical application of Herbal Teat dip preparation containing Aloe vera gel (300 g), Turmeric (50 g), Castor oil (50 g) and Lemon extract (50 ml) twice daily post-milking. Lastly, the fourth treatment or Group T_4 received the combination of oral trisodium citrate as well as herbal teat dip at the time of milking. The nutritional requirements of cows were met as per NRC (2001) and clean freshwater was supplied ad libitum.

Measurements

Milk parameters

The milk parameters such as milk fat per cent, milk SNF percent, milk lactose percent and milk protein per cent were estimated at a 10-day interval.

Statistical analysis

The experimental data were subjected to statistical analysis (SPSS Ver. 24.0) using one way analysis of variance as described by Snedecor and Cochran (2004) to test for significant variation between treatment groups.

Probabilities values of less than 0.05 ($P < 0.05$) were considered significant. Wherever, the variance ratio (F-values) was found to be significant as 0.05 or 0.01 levels of probability the comparison of mean values was carried out by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Milk fat percent

The overall mean values of milk fat per cent as shown in Table 1 reveals milk fat per cent was highest for T_3 group (4.91%) and comparable with T_4 group (4.90%) followed by T_2 group (4.71%) along with T_1 (4.27%). The statistical

Table 1: Mean ($\pm$ SE) Milk Fat (%) of the control and treatment groups.

Day of study	Milk fat %			
	T_1	T_2	T_3	T_4
0	3.62 $\pm$ 0.41	4.77 $\pm$ 0.62	4.74 $\pm$ 0.49	4.32 $\pm$ 0.51
10 th	4.30 $\pm$ 0.56	4.44 $\pm$ 0.11	4.757 $\pm$ 0.20	4.41 $\pm$ 0.23
20 th	4.03 $\pm$ 0.13	4.56 $\pm$ 0.27	5.32 $\pm$ 0.52	4.82 $\pm$ 0.57
30 th	5.35 $\pm$ 0.33	4.59 $\pm$ 0.41	5.35 $\pm$ 0.47	4.85 $\pm$ 0.28
40 th	4.082 $\pm$ 0.29	4.46 $\pm$ 0.24	4.54 $\pm$ 0.18	4.99 $\pm$ 0.26
50 th	4.37 $\pm$ 0.51	5.06 $\pm$ 0.39	4.52 $\pm$ 0.52	5.38 $\pm$ 0.54
60 th	4.17 $\pm$ 0.63	5.08 $\pm$ 0.68	5.17 $\pm$ 0.45	5.55 $\pm$ 0.68
Overall mean $\pm$ SE	4.27 ^a $\pm$ 0.20	4.71 ^{ab} $\pm$ 0.10	4.91 ^b $\pm$ 0.14	4.90 ^b $\pm$ 0.17

Note: Means having different superscript (a,b,c) differ significantly in a row ($P < 0.05$).

analysis of overall mean values of milk fat percent showed a significant difference ($P<0.05$).

The results of the present study revealed that there was significant effect of oral supplementation of trisodium citrate and application of herbal teat dip as well as the combination of both on the overall milk fat per cent of lactating Rathi cattle. The results are similar to the findings of Rathaur *et al.* (2020) where they studied the effect of herbal udder paste as well as trisodium citrate supplementation on milk quality of cattle and revealed that the values of milk fat were higher for the treatment group receiving herbal udder paste as compared to the group receiving trisodium citrate supplementation. The values of both treatment groups were found to be higher than those of the control group. The study conducted by Biradar *et al.* (2022) also revealed similar results where the application of post-milking teat dips leads to a significant increase in the milk fat (%) of the treatment groups as compared to control. This could be because trisodium citrate serves as

a precursor of propionate which is a crucial compound for fatty acid synthesis in ruminants. Thus, the consequent improvement of fatty acids may also boost the milk fat per cent.

Milk SNF per cent

The highest overall mean value of milk SNF percent as shown in Table 2 was found to be of T_4 group (9.5%) followed by T_3 group (9.19%), T_2 group (9.16%) and T_1 group (8.93%). There was a highly significant difference ($P<0.01$) found in the overall mean values of milk SNF percent of the treatment groups and the control group. The overall mean values of T_1 , T_2 and T_3 groups were comparable. The results of the current study revealed that the combination of oral supplementation of trisodium citrate and application of the herbal teat dip has a significant effect on the milk SNF percent of lactating Rathi cattle. These findings are cohesive with the results of Biradar *et al.* (2022) where they revealed a significant effect of herbal teat dips on

Table 2: Mean ($\pm$ SE) milk SNF (%) of the control and treatment groups.

Day of study	Milk SNF (%)			
	T_1	T_2	T_3	T_4
0	9.26 $\pm$ 0.07	9.12 $\pm$ 0.36	9.89 $\pm$ 0.21	9.86 $\pm$ 0.14
10 th	9.13 $\pm$ 0.11	8.98 $\pm$ 0.20	9.18 $\pm$ 0.20	9.34 $\pm$ 0.22
20 th	8.97 $\pm$ 0.15	9.01 $\pm$ 0.22	9.30 $\pm$ 0.22	9.43 $\pm$ 0.13
30 th	8.89 ^a $\pm$ 0.16	9.06 ^a $\pm$ 0.30	9.44 ^{ab} $\pm$ 0.23	9.76 ^b $\pm$ 0.15
40 th	8.79 $\pm$ 0.13	9.08 $\pm$ 0.10	8.85 $\pm$ 0.22	9.26 $\pm$ 0.15
50 th	8.74 ^a $\pm$ 0.09	9.33 ^{ab} $\pm$ 0.12	8.85 ^{ab} $\pm$ 0.13	9.41 ^b $\pm$ 0.33
60 th	8.75 $\pm$ 0.08	9.50 $\pm$ 0.44	8.94 $\pm$ 0.09	9.44 $\pm$ 0.11
Overall mean $\pm$ SE	8.93 ^a $\pm$ 0.08	9.16 ^a $\pm$ 0.07	9.19 ^a $\pm$ 0.14	9.50 ^b $\pm$ 0.08

Note: Means having different superscript (a,b,c) differ significantly in a row ($P<0.01$).

Table 3: Mean ($\pm$ SE) milk lactose (%) of the control and treatment groups.

Day of study	Milk lactose %			
	T_1	T_2	T_3	T_4
0	4.58 $\pm$ 0.25	3.74 $\pm$ 0.40	4.26 $\pm$ 0.46	4.33 $\pm$ 0.46
15 th	4.65 $\pm$ 0.17	4.07 $\pm$ 0.49	4.71 $\pm$ 0.34	4.70 $\pm$ 0.41
30 th	4.60 $\pm$ 0.18	4.53 $\pm$ 0.43	4.69 $\pm$ 0.33	4.97 $\pm$ 0.25
45 th	4.87 $\pm$ 0.35	5.01 $\pm$ 0.41	5.1 $\pm$ 0.33	5.24 $\pm$ 0.22
60 th	4.87 $\pm$ 0.35	5.24 $\pm$ 0.52	4.89 $\pm$ 0.14	5.27 $\pm$ 0.37
Overall Mean $\pm$ SE	4.713 $\pm$ 0.07	4.518 $\pm$ 0.28	4.707 $\pm$ 0.13	4.901 $\pm$ 0.18

Table 4: Mean ($\pm$ SE) milk protein (%) of the control and treatment groups.

Days of study	Milk protein %			
	T_1	T_2	T_3	T_4
0	2.91 $\pm$ 0.27	3.14 $\pm$ 0.43	2.76 $\pm$ 0.34	3.33 $\pm$ 0.22
15 th	2.96 $\pm$ 0.29	3.17 $\pm$ 0.39	3.07 $\pm$ 0.29	3.45 $\pm$ 0.22
30 th	2.99 $\pm$ 0.29	3.24 $\pm$ 0.24	3.43 $\pm$ 0.18	3.42 $\pm$ 0.21
45 th	3.63 $\pm$ 0.36	4.08 $\pm$ 0.47	3.98 $\pm$ 0.34	4.22 $\pm$ 0.45
60 th	3.94 $\pm$ 0.37	4.15 $\pm$ 0.47	3.79 $\pm$ 0.29	4.19 $\pm$ 0.52
Overall mean $\pm$ SE	3.29 $\pm$ 0.21	3.56 $\pm$ 0.23	3.40 $\pm$ 0.23	3.72 $\pm$ 0.20

improvement of milk SNF per cent. Keshamoni-Ramesh *et al.* (2021) also reported higher values of milk SNF percent for the treatment groups supplemented with trisodium citrate as well as those receiving the herbal udder paste. The reason for this increased milk SNF per cent can be due to trisodium citrate as it supports the activity of enzymes like citrate synthase (an enzyme involved in Krebs cycle) that increases the metabolism of glucose which leads to an increased milk production. Additionally, the chelating properties of trisodium citrate for Ca^{+2} ions increase the enzyme activity for higher casein synthesis which increases the milk SNF per cent. The herbal teat dip maybe indirectly responsible in improving the milk SNF per cent by reducing the udder inflammation along with anti-bacterial action that improve the health status of animal and therefore increase milk production.

Milk lactose per cent

The data given in Table 3 show that the overall mean values of milk lactose (%) were recorded to be highest in T_4 group (4.90%) followed by T_1 group (4.71%), T_3 group (4.71%) and T_2 group (4.52%). The statistical analysis of the data showed that there was no significant effect ($P>0.05$) of the supplementation of buffer and application of herbal teat dip on the milk lactose (%) of the treatment groups as compared to the control group. However, the treatment groups showed an improvement trend in terms of milk lactose (%) in comparison to control. These findings are in accordance with the results obtained by Sahu *et al.* (2022) where the oral supplementation of trisodium citrate resulted in no significant change in the milk lactose (%) of the experimental animals.

Milk protein per cent

The data given in Table 4 show that overall mean values of milk protein (%) recorded were highest in T_4 group (3.72%) followed by T_2 group (3.56%), T_3 group (3.40%) and T_1 group (3.29%). The statistical analysis of the data showed that there was no significant effect ($P>0.05$) of the supplementation of buffer and application of herbal teat dip on the milk protein (%) of the treatment groups as compared to the control group. The treatment groups showed an improvement trend in terms of milk protein (%). This finding is in coherence with the findings of Dhillon *et al.* (1995), Singh *et al.* (1997) and Rathaur *et al.* (2020) and which showed that there was no significant effect in milk protein (%) of the treatment groups supplemented with trisodium citrate as well as those which received application of herbal teat dip separately. Lee *et al.* (2014) and Mbonwanayo *et al.* (2016) also reported no significant change in the milk protein of cattle supplemented with buffer although the treatment groups had a higher value of milk protein (%) as compared to the control group at the completion of the trial.

CONCLUSION

India's dairy sector is an important contributor to its economy where the changing trends of consumer demand for high-

quality milk and milk products should pave the way for development of newer strategies that improve the quality of milk among the indigenous dairy cattle. The results of present study have revealed that incorporation of buffers like trisodium citrate as well as the use of post milking herbal teat dips is helpful in improving milk fat percent and milk SNF per cent in lactating Rathi cattle. These strategies can therefore be utilized in dairy farms as they have proven to be vital in improving the milk quality. Further, such strategies can boost the clean milk production practices to improve the overall milk hygiene and milk productivity of lactating Rathi cattle.

Conflict of interest

It is declared by the authors that there is no conflict of interest or competing interests.

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