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# Effect of herbal teat dips on milk yield and composition in cattle with subclinical mastitis

**Ravishankar Biradar, Vivek M Patil, Mahadevappa D Gouri, SB Prasanna, Shankarappa Bhajantri and Shivaraj BM**

**Abstract**
Sub-clinical mastitis in dairy cattle is a major and silent problem, which causes higher economic losses to the farmers. The existing practice of treatment of udder infections using higher antibiotics leads to anti-microbial resistance and antibiotic residues in milk leading to public health concerns. Thus, the current study was conducted to study the efficacy of alternative, low-cost, post-milking herbal teat dips in different combinations against sub-clinical mastitis. A total of 16 lactating dairy HF crossbred cows in second and subsequent lactations were divided into four groups each having four cows; T1 (Control - fresh clean water), T2 (*Aloe vera* extract 5 grams, ozonated oil 2.5 grams, wood vinegar 7.5 grams, turmeric extract 0.5 grams, excipient q.s), T3 (*Aloe vera* extract 5 grams, ozonated oil 2.5 grams, wood vinegar 5.0 grams. turmeric extract 0.5 grams, excipient q.s.), and T4 (*Aloe vera* extract 5 grams, ozonated oil 2.5 grams, wood vinegar 2.5 grams. turmeric extract 0.5 grams, excipient q.s.). The study for a period of 60 days showed that treatment groups had significantly higher milk yield, fat yield, protein yield and lactose as compared to untreated animals. All three herbal combinations were effective in combating SCM. There was no significant improvement in milk yield or milk composition parameters beyond 30 days of treatment.

**Keywords:** Sub-clinical mastitis, herbal agents, milk yield, milk composition

## Introduction
In India, dairying is an important source of subsidiary income to small/marginal farmers and agricultural labourers. There is sustained growth in the availability of milk and milk products for our growing population. During 2019-20, India's milk production was 198.4 million tonnes which is around 20% of world milk production.

Sub-clinical mastitis in dairy cattle is a major and silent problem, which causes higher economic losses to the farmers. It is one of the major reasons for low yield and poor-quality milk and ranks first among the diseases that cause substantial loss to owners. Sub-clinical mastitis is defined as inflammation of parenchyma of mammary glands and is characterized by physical, chemical and usually bacteriological changes in milk and pathological changes in glandular tissues. It is a global problem and causes huge financial losses related to culling, decreased production, decreased fecundity, and treatment costs. It does not create visible changes in the milk or in the udder. Although the milk appears normal, cows with sub-clinical intramammary infections (IMI) produce less milk and with compromised quality. Sub-clinical mastitis can lead to a 10 to 20 per cent decrease in milk production. In addition, it has an undesirable effect on the constituents and nutritional value of the milk, rendering it of low quality and less fit for processing. The early detection of mastitis, especially sub-clinical mastitis, is difficult [2] as the changes in the udder tissue would have occurred before clinical signs are visible. For the detection, diagnostic tests need to be done which may not be practically feasible at field level. Hence the most important component of a mastitis control programme is its prevention.

Conventional antibiotic treatment is a proven method for prevention and control of mastitis. However, it is of public health importance on account of the indiscriminate usage of antibiotics, non-compliance with milk withdrawal period post-treatment leading to antibiotic residues in milk and related health issues, and incomplete duration of treatment and associated antimicrobial resistance. Herbal teat dips can greatly reduce the usage of antibiotics by the farmers, thus reducing occurrence of antimicrobial resistance in pathogenic bacteria and antibiotic residues in milk.

With the increasing awareness among public regarding the quality of milk and milk products, it is inevitable to improve our efforts to control sub-clinical mastitis through effective, sustainable and alternate control measures. The present study was conducted to test the effect of some herbal agents as post-milking teat disinfectants on the milk yield and composition in cattle suffering from sub-clinical mastitis.

**Materials and Methods**

The present study was conducted Nandagokula dairy farm at village Antarahalli, taluka Doddaballapura, district Bengaluru Rural, Karnataka, India. A total of sixteen Holstein-Friesian crossbred dairy cows in second and subsequent lactations were selected for the study. Each animal was identified with numbered plastic ear tags. The selected cows were in the mid-lactation and had a milk production of 7-10 lit/day. The presence of sub-clinical mastitis was ascertained by preliminary screening with California Mastitis Test and confirmation using a DeLaval cell counter; only cows with somatic cell count in the range 2.0-3.5 lakhs/ml were considered for the study.

The cows were maintained under conventional housing system and standard management conditions. Each cow was given adequate silage and dry fodder twice a day. Clean, safe drinking water was provided *ad libitum*. Cows were milked twice a day in a milking parlour using machine milking. During milking, the cows were offered required quantity of concentrates. Cows were washed once daily. The shed floor was made of cement concrete with adequate slope and drainage without rubber mat. Cleaning of the shed including manger was done every day. Dung and fodder residues were cleaned regularly. Milking machine and utensils used for milk collection were washed after every milking session and kept for drying in a clean area. The milking parlour was also washed and dried. Shed floor was washed twice daily with pressurized water sprays.

The cows were divided into four groups of four each based on parity, body weight, days in milk and daily milk yield, and subjected to different post-milking herbal teat disinfectants as per the details given in Table 1. The herbal teat disinfectants were taken in separate teat dip applicators and labelled accordingly. At the completion of the milking process, the teat dip applicator was raised onto each teat and squeezed gently to ensure that a coating of the herbal teat disinfectant was applied onto the teat (Plate 1). In T1 group (Control), teats were cleaned and dried with single service paper towel and no post-milking teat disinfectant was used. The study was conducted for a period of 60 days.

**Milk yield:** Average daily milk yield of all the cows was recorded in kilograms from day zero to day sixty. Soon after the milking, the milk collected was poured into the pre-weighed container kept on an electronic weighing balance and milk yield was recorded as kg/day.

**Milk composition:** Milk samples collected on day 0, 15, 30, 45 and 60 were subjected for analysis of milk composition parameters like milk fat, fat yield, lactose, protein, protein yield and SNF using automatic milk analyser (KSHEERAA-270A) as per procedure mentioned in manufacturer's instructions (Plate 2).

Each animal was considered as one experimental unit for the purpose of statistical analysis. The data pertaining to various parameters was analyzed using standard statistical packages in Microsoft Excel 2019 software. All the means were compared at 5 per cent level of significance.

**Results and Discussion**

**Milk yield:** The overall milk yield of T1, T2, T3 and T4 groups was 7.36±0.242, 9.31±0.241, 8.87±0.242 and 9.38±0.215 kg, respectively (Table 2). T2-4 had significantly ($P$<0.05) higher milk yield than T1 by day 45. T2-4 also had higher MY at day 30 as compared to day 0; however, the differences were not significant. In the absence of any herbal teat disinfectant in T1 group, there was a continuous decline in milk yield from day 0 to 60.

The results on day 45 are in agreement with [4, 10] who used Mastidip herbal teat dip and sprays which had *Curcuma longa* or turmeric as its component. Similar findings were reported by [3, 7, 11]. However, [8] reported no significant difference in milk yield on using the non-herbal product Dipal (®DeLaval).

Increase in average milk production may be due to the anti-inflammatory and anti-microbial properties of the herbal ingredients which might lead to a quick recovery of the mammary glands' inflammation. The decline in milk yield of herbal teat dip groups after day 30 could be due to advancement in stage of lactation.

**Milk fat and fat yield:** The overall milk fat (%) of T1, T2, T3 and T4 groups was 3.88, 4.07, 3.88 and 3.87, respectively (Table 3 and 4). The overall milk fat yield of T1, T2, T3 and T4 was 282.69, 377.86, 343.41 and 362.37 g, respectively. While, there was no significant increase in milk fat per cent among the groups during the experiment, milk fat yield was significantly higher in the herbal treated groups as compared to control by day 45. Though there were no significant differences in milk fat content and fat yield in any of the groups at different stages of the trial, an increasing trend was seen in the milk fat per cent in all groups; this could be explained by the decrease in milk yield in the control group, and better udder health in the treated groups. The milk fat yield showed a decreasing trend in the control group and an increasing trend in the treated groups.

The results were in agreement with [5], wherein, herbal combinations in gel and spray were used. Similar findings were reported by [4, 9], where combinations of turmeric and *Aloe vera* were used.

**Solids Not Fat (SNF):** The overall milk solids not fat in T1, T2, T3 and T4 groups was 8.16, 8.18, 8.42, and 8.69 per cent, respectively (Table 5). There were no significant differences between the groups at various stages of the trial. Among the groups, significantly ($P$<0.05) higher milk SNF was seen on day 45-60 as compared to day 0-15 in T4. In contrast, [6] reported increased SNF per cent in treatment groups in which *Aloe vera* was a component in the herbal paste along with turmeric powder and lemon. Similar findings were reported by [9], in which *Aloe vera* was component in the treatment applied.

Though there were no significant differences in SNF content in any of the groups at different stages of the trial, an increasing trend was seen in all groups; this could be explained by the decrease in milk yield in the control group, and better udder health in the treated groups.

**Milk protein and protein yield:** The overall milk protein in T1, T2, T3 and T4 groups was 3.33, 3.39, 3.40 and 3.36 per cent, respectively (Table 6 and 7). There were no significant

differences between the groups at various stages of the trial. Among the groups, significantly ($P$<0.05) higher milk protein was seen on day 45-60 as compared to day 0-15 in T2. A slight increase in milk protein was seen in the herbal teat dip groups as the trial progressed.

In contrast, [9] studied the efficacy of various combinations of herbal teat dips in which *Aloe vera* was a component and reported significant increase in milk protein. Similar findings were made by [5] where comparison was made between herbal gel and spray containing *Aloe vera* and turmeric.

The overall milk protein yield of T1, T2, T3 and T4 groups was 243.96, 315.31, 301.03 and 315.48 g, respectively. From day 30 onwards, there was a significant ($P$<0.05) increase in milk protein yield of herbal disinfectant groups as compared to untreated groups. Though, there were no significant differences in milk protein yield during the course of the trial, the herbal teat dip groups had an increasing milk protein yield as the experiment progressed. The increase in milk protein yield of the herbal treated groups could be explained by the increase in milk yield and better udder health of these groups.

**Milk lactose:** The overall milk lactose in T1, T2, T3 and T4 groups was 4.36, 4.56, 4.64 and 4.69, respectively (Table 8). There were no significant differences between the groups on day 0 and 15. From day 30 onwards, there was significantly ($P$<0.05) higher milk protein in herbal treated group as compared to untreated group. The results recorded with respect to the group dipped with herbal treatment in the present study are in accordance with [9] where they used combination of injection enrofloxacin and *Aloe vera* gel as a treatment. Similar findings were recorded by [6] wherein herbal paste containing *Aloe vera*, turmeric powder, lemon and castor oil was used. As change in somatic cell counts affects the milk compositional parameters, the increase in lactose per cent might be due to better udder health and decreased somatic cell counts in treated groups. Decreased lactose content in untreated control group might be due to reduced lactate production by udder tissues. Increase in somatic cell count and decrease in lactose concentration were directly related to the presence of bovine sub-clinical mastitis agents [1]; they suggested that changes in lactose content could be tracked as a diagnostic method in sub-clinical mastitis prevention in cow.

**Table 1:** Details of experimental groups and composition of the herbal teat dips

| Group | No. of animals | Description of the treatment |
|---|---|---|
| T1 (Control) | 4 | Teats were cleaned and dried with single service paper towel. |
| T2 | 4 | Application of herbal teat disinfectant comprising aloevera extract 5 grams, ozonated oil 5 grams, wood vinegar 7.5 grams, turmeric extract 0.5 grams, excipient q.s. to make 100 ml |
| T3 | 4 | Application of herbal teat disinfectant comprising aloevera extract 5 grams, ozonated oil 2.5 grams, wood vinegar 5.0 grams. turmeric extract 0.5 grams, excipient q.s. to make 100 ml |
| T4 | 4 | Application of herbal teat disinfectant comprising aloevera extract 5 grams, ozonated oil 2.5 grams, wood vinegar 2.5 grams. turmeric extract 0.5 grams, excipient q.s. to make 100 ml |

**Table 2:** Effect of herbal teat dips on daily milk yield (kg) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P-value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 8.09 | 7.48 | 7.40 | 7.11$^{a}$ | 6.72$^{a}$ | 7.36 | 0.520 |
| | SE | 0.582 | 0.332 | 0.538 | 0.721 | 0.504 | 0.242 | |
| T2 | Mean | 8.91 | 9.14 | 9.62 | 9.50$^{b}$ | 9.38$^{b}$ | 9.31 | 0.913 |
| | SE | 0.639 | 0.480 | 0.724 | 0.414 | 0.627 | 0.241 | |
| T3 | Mean | 8.51 | 8.73 | 9.16 | 9.02$^{b}$ | 8.93$^{b}$ | 8.87 | 0.944 |
| | SE | 0.527 | 0.576 | 0.614 | 0.620 | 0.628 | 0.242 | |
| T4 | Mean | 9.25 | 9.34 | 9.63 | 9.50$^{b}$ | 9.21$^{b}$ | 9.38 | 0.979 |
| | SE | 0.527 | 0.630 | 0.533 | 0.494 | 0.474 | 0.215 | |
| Overall | Mean | 8.69 | 8.67 | 8.95 | 8.78 | 8.56 | | |
| | SE | 0.279 | 0.297 | 0.360 | 0.361 | 0.375 | | |
| P-value | | 0.533 | 0.099 | 0.070 | 0.037 | 0.019 | | |

**Note:** Means within a column having different superscripts differ significantly ($P$<0.05). There were no significant differences among any of the row-wise means.

**Table 3:** Effect of herbal teat dips on milk fat (%) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 3.65 | 3.74 | 3.96 | 3.98 | 4.06 | 3.88 | 0.646 |
| | SE | 0.206 | 0.151 | 0.259 | 0.225 | 0.242 | 0.094 | |
| T2 | Mean | 3.83 | 4.02 | 4.04 | 4.18 | 4.31 | 4.07 | 0.271 |
| | SE | 0.154 | 0.113 | 0.189 | 0.091 | 0.186 | 0.071 | |
| T3 | Mean | 3.84 | 3.79 | 3.85 | 3.88 | 4.05 | 3.88 | 0.702 |
| | SE | 0.139 | 0.158 | 0.126 | 0.093 | 0.131 | 0.056 | |
| T4 | Mean | 3.69 | 3.81 | 3.87 | 3.90 | 4.10 | 3.87 | 0.112 |
| | SE | 0.082 | 0.122 | 0.130 | 0.075 | 0.075 | 0.050 | |
| Overall | Mean | 3.75 | 3.84 | 3.93 | 3.99 | 4.13 | | |
| | SE | 0.071 | 0.067 | 0.085 | 0.068 | 0.081 | | |
| P value | | 0.751 | 0.535 | 0.879 | 0.407 | 0.620 | | |

**Note:** There were no significant ($P$<0.05) differences among any of the row-wise or column wise means

**Table 4:** Effect of herbal teat dips on fat yield (g) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 293.36 | 278.74$^{b}$ | 291.03$^{b}$ | 279.45$^{b}$ | 270.86$^{b}$ | 282.69 | 0.867 |
| | SE | 19.253 | 8.599 | 18.873 | 17.435 | 17.534 | 6.948 | |
| T2 | Mean | 340.17 | 366.26$^{a}$ | 385.86$^{a}$ | 396.33$^{a}$ | 400.67$^{a}$ | 377.86 | 0.144 |
| | SE | 25.006 | 15.656 | 20.143 | 9.441 | 13.251 | 8.647 | |
| T3 | Mean | 326.17 | 330.34$^{ab}$ | 352.69$^{ab}$ | 348.86$^{a}$ | 358.98$^{a}$ | 343.41 | 0.769 |
| | SE | 21.586 | 22.213 | 26.236 | 19.765 | 15.686 | 8.991 | |
| T4 | Mean | 339.46 | 354.29$^{a}$ | 371.04$^{a}$ | 369.99$^{a}$ | 377.05$^{a}$ | 362.37 | 0.558 |
| | SE | 11.784 | 19.711 | 14.472 | 20.132 | 19.302 | 7.597 | |
| Overall | Mean | 324.79 | 332.41 | 350.15 | 348.66 | 351.89 | | |
| | SE | 10.201 | 11.628 | 13.033 | 13.592 | 14.682 | | |
| P value | | 0.351 | 0.018 | 0.030 | 0.003 | 0.001 | | |

**Note:** Means within a column having different superscripts differ significantly ($P$<0.05).
There were no significant differences among any of the row-wise means.

**Table 5:** Effect of herbal teat dips on milk solids not fat (%) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 7.95 | 7.98 | 8.07 | 8.38 | 8.41 | 8.16 | 0.392 |
| | SE | 0.171 | 0.354 | 0.190 | 0.141 | 0.114 | 0.096 | |
| T2 | Mean | 7.95 | 7.97 | 8.14 | 8.34 | 8.53 | 8.18 | 0.151 |
| | SE | 0.150 | 0.158 | 0.191 | 0.187 | 0.199 | 0.087 | |
| T3 | Mean | 8.15 | 8.16 | 8.36 | 8.66 | 8.77 | 8.42 | 0.512 |
| | SE | 0.387 | 0.260 | 0.239 | 0.328 | 0.341 | 0.138 | |
| T4 | Mean | 8.38$^{Z}$ | 8.50$^{YZ}$ | 8.77$^{XY}$ | 8.87$^{X}$ | 8.92$^{X}$ | 8.69 | 0.014 |
| | SE | 0.126 | 0.124 | 0.123 | 0.093 | 0.083 | 0.065 | |
| Overall | Mean | 8.11 | 8.15 | 8.33 | 8.56 | 8.66 | | |
| | SE | 0.114 | 0.122 | 0.111 | 0.108 | 0.107 | | |
| P value | | 0.534 | 0.393 | 0.089 | 0.277 | 0.355 | | |

**Note:** Means within a row having different superscripts differ significantly ($P$<0.05).
There were no significant differences among any of the column-wise means.

**Table 6:** Effect of herbal teat dips on milk protein (%) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P-value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 3.36 | 3.34 | 3.32 | 3.31 | 3.31 | 3.33 | 0.983 |
| | SE | 0.080 | 0.072 | 0.063 | 0.068 | 0.057 | 0.028 | |
| T2 | Mean | 3.32$^{Z}$ | 3.34$^{YZ}$ | 3.39$^{XY}$ | 3.43$^{X}$ | 3.45$^{X}$ | 3.39 | 0.004 |
| | SE | 0.013 | 0.009 | 0.034 | 0.024 | 0.024 | 0.015 | |
| T3 | Mean | 3.33 | 3.36 | 3.42 | 3.45 | 3.44 | 3.40 | 0.797 |
| | SE | 0.091 | 0.084 | 0.087 | 0.075 | 0.069 | 0.034 | |
| T4 | Mean | 3.32 | 3.33 | 3.37 | 3.40 | 3.40 | 3.36 | 0.412 |
| | SE | 0.045 | 0.048 | 0.034 | 0.032 | 0.027 | 0.017 | |
| Overall | Mean | 3.33 | 3.34 | 3.37 | 3.40 | 3.40 | | |
| | SE | 0.029 | 0.027 | 0.028 | 0.028 | 0.026 | | |
| P-value | | 0.969 | 0.995 | 0.640 | 0.336 | 0.193 | | |

**Note:** Means within a row having different superscripts differ significantly ($P$<0.05).
There were no significant differences among any of the column-wise means.

**Table 7:** Effect of herbal teat dips on milk protein yield (g) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P-value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 270.44 | 249.11 | 244.36$^{b}$ | 234.35$^{b}$ | 221.55$^{b}$ | 243.96 | 0.229 |
| | SE | 15.236 | 6.724 | 13.856 | 19.820 | 13.389 | 6.842 | |
| T2 | Mean | 295.65 | 305.69 | 325.90$^{a}$ | 325.56$^{a}$ | 323.74$^{a}$ | 315.31 | 0.745 |
| | SE | 21.510 | 16.375 | 23.963 | 13.704 | 21.778 | 8.378 | |
| T3 | Mean | 283.25 | 292.32 | 312.88$^{a}$ | 310.41$^{a}$ | 306.29$^{a}$ | 301.03 | 0.768 |
| | SE | 17.119 | 18.404 | 19.772 | 20.597 | 18.408 | 7.951 | |
| T4 | Mean | 306.05 | 310.80 | 324.53$^{a}$ | 322.56$^{a}$ | 313.44$^{a}$ | 315.48 | 0.922 |
| | SE | 14.715 | 18.666 | 17.535 | 16.398 | 15.868 | 6.826 | |
| Overall | Mean | 288.85 | 289.48 | 301.92 | 298.22 | 291.25 | | |
| | SE | 8.491 | 9.449 | 12.189 | 12.510 | 13.143 | | |
| P-value | | 0.523 | 0.065 | 0.032 | 0.011 | 0.005 | | |

**Note:** Means within a column having different superscripts differ significantly ($P$<0.05).
There were no significant differences among any of the row-wise means.

**Table 8:** Efficacy of herbal teat dips on milk lactose (%) at different intervals in dairy cattle

| Group | | Day 0 | Day 15 | Day 30 | Day 45 | Day 60 | Overall | P-value |
|---|---|---|---|---|---|---|---|---|
| T1 | Mean | 4.40 | 4.37 | $4.32^{b}$ | $4.40^{b}$ | $4.33^{b}$ | 4.36 | 0.863 |
| | SE | 0.072 | 0.089 | 0.036 | 0.078 | 0.045 | 0.028 | |
| T2 | Mean | $4.32^{Z}$ | $4.38^{YZ}$ | $4.65^{aXY}$ | $4.67^{aXY}$ | $4.76^{aX}$ | 4.56 | 0.025 |
| | SE | 0.049 | 0.145 | 0.119 | 0.094 | 0.053 | 0.056 | |
| T3 | Mean | $4.50^{Y}$ | $4.68^{X}$ | $4.63^{aXY}$ | $4.68^{aX}$ | $4.71^{aX}$ | 4.64 | 0.029 |
| | SE | 0.056 | 0.046 | 0.027 | 0.045 | 0.038 | 0.024 | |
| T4 | Mean | $4.52^{Y}$ | $4.56^{Y}$ | $4.75^{aX}$ | $4.80^{aX}$ | $4.83^{aX}$ | 4.69 | 0.000 |
| | SE | 0.053 | 0.038 | 0.051 | 0.022 | 0.042 | 0.034 | |
| Overall | Mean | 4.44 | 4.50 | 4.59 | 4.64 | 4.65 | | |
| | SE | 0.033 | 0.052 | 0.052 | 0.049 | 0.054 | | |
| P-value | | 0.111 | 0.085 | 0.005 | 0.006 | 0.000 | | |

**Note:** Means within a column ($^{abc}$) or row ($^{WXYZ}$) having different superscripts differ significantly ($P<0.05$).

**Plate 1:** Application of herbal teat dip

**Plate 2:** Estimation of milk composition using KSHEERAA-270A automatic milk analyzer

## Conclusion

The public health importance of sub-clinical mastitis is of vital importance as the disease usually goes unnoticed in spite of considerable alterations in the compositional and microbial quality of milk. The existing practice of treatment of udder infections, whether sub-clinical level or clinical mastitis involves the use of higher antibiotics causing anti-microbial resistance and residues in milk leading to public health concerns. Herbal teat dips comprising of various levels of *Aloe vera* extract, ozonated oil, wood vinegar and turmeric extract were found to be effective in controlling SCM in crossbred cattle. The treatment groups had significantly higher milk yield, fat yield, protein yield and lactose as compared to untreated animals. All three herbal combinations were effective in combating SCM. There was no significant improvement in milk yield or milk composition parameters beyond 30 days of treatment.

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