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Impact of polyherbal supplementation on milk composition in dairy cows

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Abstract
This study investigates the impact of polyherbal supplementation on milk composition in dairy cows. Twenty lactating Holstein Friesian cows were randomly divided into two groups: T_1 (control) and T_2 (treatment with polyherbal mixture). The experiment spanned 90 days, during which production parameters (milk yield and composition) and reproductive parameters were recorded fortnightly.
Results indicated that the milk fat percentage was slightly higher in the T_2 group (3.73±0.06%) compared to the T_1 group (3.63±0.045%), with the highest value observed on the 45th day (4.00%). Although this difference was not statistically significant, it suggests a potential positive effect of polyherbal supplementation. Protein and lactose contents were consistently higher in the T_2 group throughout the study, peaking at day 45 with values of 3.34% and 4.73%, respectively. Similarly, the Solids-Not-Fat (SNF) content reached a peak of 8.15% in T_1 and 8.22% in T_2 on the 45th day.

Keywords: Milk composition, Holstein Friesian, milk fat percentage, protein content, lactose content, Solids-Not-Fat (SNF)

Introduction
In India, approximately 70% of the population depends on agriculture and livestock for their livelihood. The livestock sector is crucial for the health and prosperity of India's rural population. As the world's largest milk producer, India has seen a 6.75% growth in the number of milch animals (including in-milk and dry cows and buffaloes), increasing from 111.09 million to 118.59 million, according to the 19th Livestock Census (2012). The country also has a total cattle population of 192.49 million, contributing 35.94% of the total livestock as per the 20th Census.
In India, Holsteins have been extensively used in crossbreeding programs with indigenous cattle to improve milk yield, resulting in Holstein Friesian (HF) crossbreds. These crossbreds are widely reared across the country and have significantly contributed to India's position as the largest global milk producer. On average, crossbred Holsteins in India can produce around 20 to 25 liters of milk per day under optimal feeding and management conditions (Kumar *et al.*, 2017) [4].
Milk production in dairy cows is influenced by both external and internal factors, with the transition period being particularly crucial. This period, which spans three weeks before and three weeks after parturition, has the greatest impact on the cow's internal factors. During this time, cows undergo significant physiological, nutritional, metabolic, and immunological changes as they transition from non-lactating gestation to milk formation and secretion (Drackley, 1999) [3]. Nutritional demand and supply gaps during this phase can cause significant fluctuations in food composition and daily dry matter intake (DMI), necessitating metabolic adaptation and management (Ametaj, 2014) [1].
India has a rich tradition of herbal medicine, with Ayurveda being a centuries-old healthcare practice that relies on herbal remedies. Ayurvedic herbs are believed to enhance health, milk production, and reproduction in both humans and animals. Polyherbal mixtures, which consist of various medicinal plants, are known for their bioactive compounds with antioxidative, anti-inflammatory, and immune-modulatory properties. These qualities have been linked to improved digestion, metabolic function, and lactation success in dairy cows. Specifically,

polyherbal mixtures are proposed to enhance milk composition, including fat, protein, and lactose content, while also promoting the overall health and growth of lactating cows.

Unlike traditional feed additives, which may leave residues in milk or have long-term negative effects on animal health, herbal-based supplements are seen as a natural and sustainable approach to animal nutrition. Previous studies have shown that polyherbal combinations can improve milk output and quality in dairy cows without causing adverse side effects (Singh *et al.*, 2018) [7]. These natural feed additives align with the growing demand for environmentally friendly agricultural practices and the production of high-quality, safe dairy products.

Materials and Methodology

The present investigation was conducted to assess the "Impact of Polyherbal Supplementation on Milk Composition in Dairy Cows" during winter season on milk composition.

Place of work

The present study was conducted on lactating Holstein crossbred cows reared Dairy Farm, Department of Animal Husbandry and Dairy Science, Dr. Sharadchandra Pawar College of Agriculture, Baramati, between October 2023 to December,2023 (90 days post-partum) during winter season. Geographically Dairy farm is situated at 18°165' "North latitude and 74°491' "East longitude. The climate of the dairy farm is sub-tropical in nature. All the experimental animals were reared under similar climatic and managemental conditions.

Selection of animals

Twenty lactating Holstein Friesian cows in lactating cows were selected for the experiment. At the end of acclimatisation period all the cows were randomly divided into two groups T_1 (control) and T_2 (Treatment) of 10 in each group on basis of nearest in their body weight, number of lactation and milk yield of average per day. The dietary treatments were formulated and offered to each group of animals randomly to following feed supplements/treatments: -

T_1 (Control)- The group animals were maintained on conventional diet jowar kadbi (*Sorghum bicolor*) ad lib as a dry fodder and maize silage (*Zea mays*) as a fermented green fodder and concentrate mixture readymade feed will be fed.

T2 (Treatment) - The treatment group will be offered conventional jowar kadbi (*Sorghum bicolor*) ad lib as a dry fodder and maize silage (*Zea mays*) as a fermented green fodder mixture and concentrate mixture readymade feed was fed + Shatavari, Methi, Jeera (50 g each) + Dalchini and Tulsi (25 g each) + along with this mixture jaggery (250 g)/head/day/for 90 days.

Duration of experiment

The duration of experiment was between October 2023 to December 2023 during winter season, during which all the production (milk yield and milk composition) were recorded fortnightly for 90 days and reproductive parameters were recorded (90 days) for further studies. During which all parameters will be recorded 15 days interval (0, 15, 30, 45, 60, 75, 90) for studies.

Housing and management of experimental animals

All the cows were housed in a well-ventilated shed having concrete floor with individual feeding arrangement and tied with rope having tail to tail arrangement during adaptation period of 10 days as well as during experimental feeding period of 90 days. The cows were tied at such a distance that they had freedom for free movement and preventing them for getting access to the manger of other calves. The animals were let loose to open enclosure between 8:00 A.M. to 9:00 A.M. daily during feeding trial to have exercise and access to fresh drinking water.

All the cows included in the study had their identification number on ear. The byre was washed and cleaned daily. They were cleaned regularly by splashing with water. Proper hygienic conditions and healthy surroundings were maintained in the shed throughout the experimental feeding period.

Feeding of experimental animals

All cows will be fed jowar kadbi (*Sorghum bicolor*) ad lib as a dry fodder and maize silage (*Zea mays*) as a fermented green fodder during experiment. The concentrate as concentrate mixture readymade feed were fed. The animals were fed in the morning as per their requirement. The experimental animal had free access to clean and fresh drinking water during the experimental period.

Preparation and dosing of Polyherbal supplementation

Polyherbo-mineral formulation used for this study contained 6 ingredients are mentioned below and the mixture was added to the concentrate feed and given daily for 90 days.

Results and Discussion

Fat (%)

The data pertaining to milk yield as influenced by polyherbal mixture is represented in table 1 and graphically shown in figure 1 the given data was in the form of average mean ± SE and computed fortnight interval.

The per cent milk fat ranged from 3.51 to 3.84 in T_1 and 3.58 to 4.00 in T_2 during the fortnights after initiation of lactation. During the overall average milk fat per cent during the experimental period in T_1 (control) and T_2 groups were 3.63±0.045 and 3.73±0.06 respectively. The milk fat per cent did not significantly (p>0.05) although quantitatively greater in the T_2. In T_2 group fat per cent was increased fortnight interval and highest at 45th day (4.00%) and decreased onward which natural process in lactating.

These results were similar to the earlier reports of milk fat content in lactating crossbred cows (Singh *et al.*, 2012, Veena *et al*., 2013) [8, 9].

Protein (%)

Protein is the most important component of milk and also the most constant component of milk. Table 2 contains data on milk yield as impacted by a polyherbal mixture, which is graphically showed in figure 2. The data was presented as an average mean ± SE, and has a computed fortnight interval (0, 15, 30, 45, 60, 75, and 90 days).

The overall mean ± standard error for T_1 and T_2 were 3.21 ± 0.023% and 3.27 ± 0.02%, respectively. The initial protein percentages at day 0 were 3.12% and 3.18% for T_1 and T_2, respectively, with T_2 starting at a slightly higher baseline. At day 45, the milk protein levels reached their peak at 3.31% for T_1 and 3.34% for T_2. The similar result also found by (Dibya, 2010) [2] that the effect of shatavari root powder containing ration on milk protein percent 3.41, 3.58, 3.66, 3.77 and 3.67% in T_1, T_2, T_3, T_4 and T_5 respectively.

The herbs used in the study are known for their positive effects on digestion, nutrient absorption, and metabolic processes, which likely contributed to the improved protein synthesis in the treatment group. *Methi* and *Jeera* are both known to improve digestive efficiency and protein metabolism, which may have further contributed to the higher protein content in milk (Rao *et al*., 2017) [6].

Lactose (%)

The data pertaining to lactose as influenced by polyherbal mixture is represented in table 3 and graphically shown in Figure 3. The given data was in the form of average mean ± SE and computed fortnight interval.

The milk lactose content in lactating crossbred cows was recorded under two different treatments, T_1 (control) and T_2, over a 90-day period. The following table 3 summarizes the lactose percentages at different time points (0, 15, 30, 45, 60, 75, and 90 days). The overall mean ± standard error and standard deviation for T_1 and T_2 were 4.71 ± 0.08% and 4.76 ± 0.02%. The per cent milk lactose ranged from 4.62%to 4.79% in T_1 and 4.71% to 4.84% in T_2 during the fortnights after initiation of lactation.

At day 0, the lactose content in T_1 was 4.62% and in T_2 was 4.71%. The lactose percentage gradually increased in both groups up to day 45, where the maximum lactose content was recorded: 4.79% in T1 and 4.84% in T2. After day 45, a slight decline was observed in both groups, with lactose levels returning to initial values by day 90 (4.68% in T_1 and 4.73% in T_2). There were no significant ($P > 0.05$) differences between T_1 (control) and T_2 groups in lactose content of milk. However, the T_2 group had a numerically larger value than the T_1 (control) group, which is probably due to the higher milk yield.

Herb like Jeera (cumin) and Dalchini (cinnamon) are both known to enhance insulin sensitivity, improving glucose uptake in the mammary gland, which is crucial for lactose production (Rao *et al.,* 2017) [6]. The physicochemical analysis of milk lactose levels of Shatavari supplemented milk did not differ significantly ($P>0.05$) compared to control (Veena *et al.* 2013) [9]. The results were in similar with (Dibya, 2010) [2].

Milk Solid Not Fat (SNF)

The data pertaining to Milk solid not fat as influenced by polyherbal mixture is represented in table 4 and graphically shown in Figure 4. The given data was in the form of average mean ± SE and computed fortnight interval.

The SNF percentages were recorded for two treatment groups: T_1 (control) and T_2 (herbal mixture supplemented with jaggery) at intervals of 0, 15, 30, 45, 60, 75, and 90 days. The overall mean ± standard error for SNF content was 7.99± 0.16% for T_1 and 8.10 ± 0.14% for T_2.

At the beginning of the study (day 0), the SNF content was nearly similar between the two groups, with T_1 having 7.82% and T_2 having 7.99%. By day 45, the SNF content had reached a peak of 8.15% in T_1 and 8.22% in T_2, indicating that the herbal supplementation supported a more pronounced increase in the non-fat solids of milk compared to the control group. After this peak, the SNF values slightly decreased in both groups but remained above the baseline, stabilizing at 7.90% in T_1 and 8.00% in T_2 by day 90.

SNF content varied within the fortnights ($P< 0.05$) as SNF content in milk remain inversely equivalent to milk yield. Kumar *et al*. (2018) also found significantly effect of the herbal fed on the SNF% in crossbred cows. Kumari, (2015) [5] found that, the polyherbal mineral mixture supplementation improved milk yield without affecting the milk SNF (%).

Table 1: Effect of feeding poly herbal feed mixture supplement on fat (%) in crossbred cow

.Days	Treatment	
	T_1	T_2
0	3.51	3.58
15	3.61	3.69
30	3.70	3.78
45	3.84	4.00
60	3.67	3.82
75	3.60	3.71
90	3.48	3.58
Overall mean ± S.E (0.05%)	3.63±0.045	3.73±0.06
Standard Deviation	0.12	0.14

Table 2: Effect of feeding poly herbal feed mixture supplement on protein (%) in crossbred cow

Days	Treatment	
	T_1	T_2
0	3.12	3.18
15	3.19	3.23
30	3.24	3.29
45	3.31	3.34
60	3.26	3.31
75	3.23	3.30
90	3.18	3.27
Overall mean ± S.E (0.05%)	3.21 ±0.023	3.27 ±0.02
Standard Deviation	0.06	0.05

Table 3: Effect of feeding poly herbal feed mixture supplement on lactose (%) in crossbred cow

Days	Treatment	
	T_1	T_2
0	4.62	4.71
15	4.71	4.75
30	4.74	4.8
45	4.79	4.84
60	4.76	4.78
75	4.70	4.76
90	4.68	4.73
Overall mean ± S.E (0.05%)	4.71±0.08	4.76±0.02
Standard Deviation	0.057	0.045

Table 4: Effect of feeding poly herbal feed mixture supplement on milk solid not fat (SNF) (%) in crossbred cow

Days	Treatment	
	T_1	T_2
0	7.82	7.99
15	7.96	8.06
30	8.01	8.15
45	8.15	8.22
60	8.12	8.18
75	8.00	8.10
90	7.90	8.00
Overall mean ± S.E (0.05%)	7.99 ±0.04	8.1 ±0.03
Standard Deviation	0.013	0.89

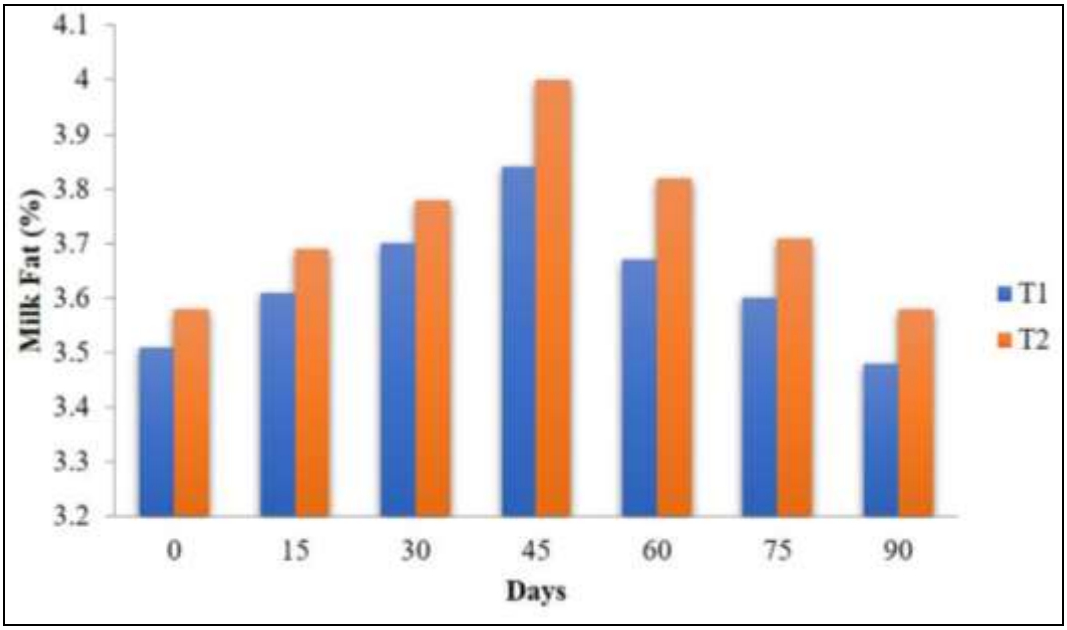

Fig 1: Effect of feeding poly herbal feed mixture supplement on fat (%) in crossbred cow

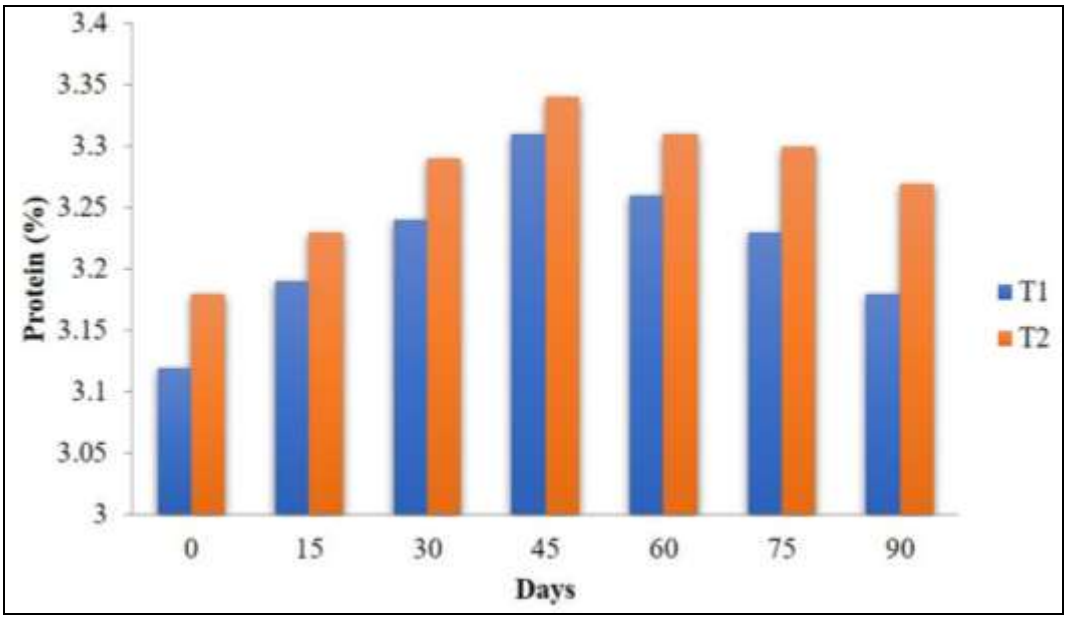

Fig 2: Effect of feeding poly herbal feed mixture supplement on protein (%) in crossbred cow

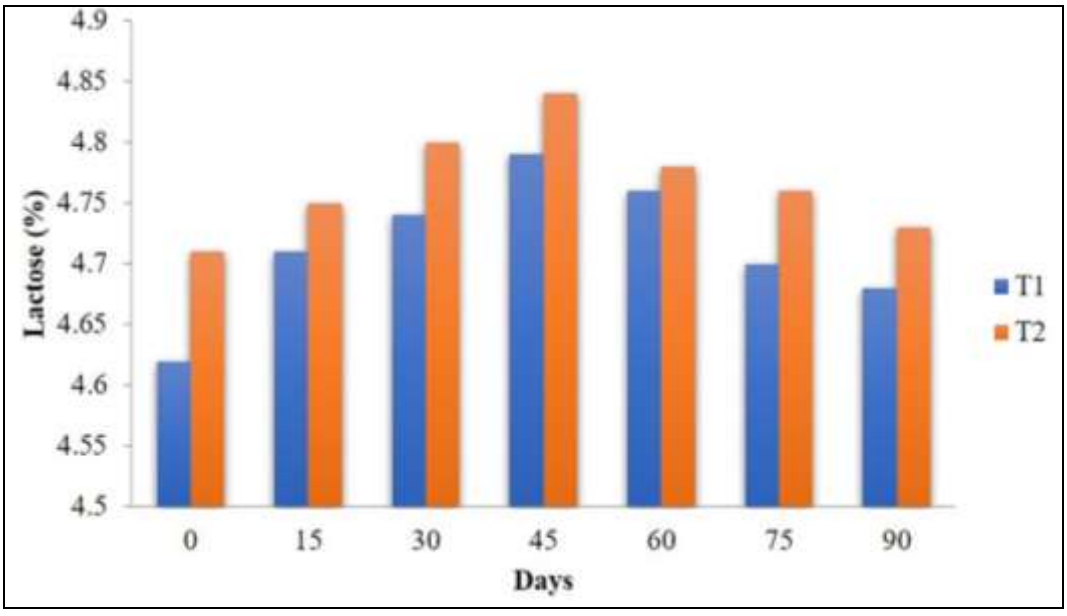

Fig 3: Effect of feeding poly herbal feed mixture supplement on lactose (%) in crossbred cow

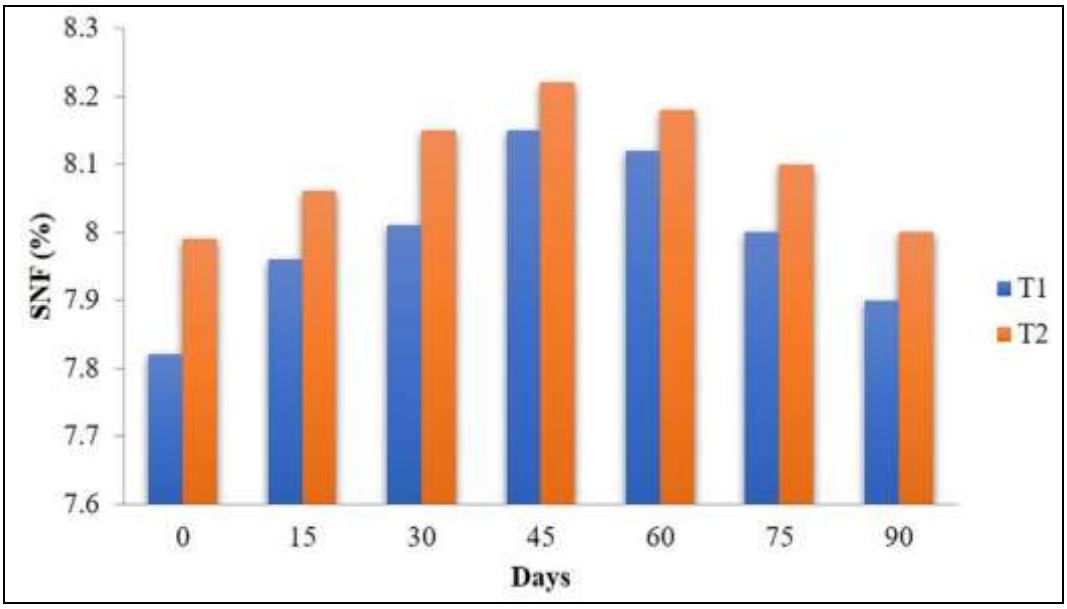

Fig 4: Effect of feeding poly herbal feed mixture supplement on SNF (%) in crossbred cow.

Conclusion

The supplementation of a poly herbal mixture combined with jaggery significantly improved various performance metrics in lactating Crossbred Holstein cows. Specifically, T2 exhibited milk composition (including fat, protein, and lactose).

Overall, the findings suggest that incorporating a poly herbal mixture with jaggery can enhance milk quality, as well as improve the health and nutritional status of lactating cows. This supports the potential benefits of using such herbal supplements in dairy farming practices.

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