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Evaluation of Neem Leaf Supplementation on Peak Yield and Persistency in Lactating Sahiwal Cows

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Abstract— *The present study was conducted to evaluate the effect of neem (Azadirachta indica) leaf supplementation on peak milk yield and lactation persistency in Sahiwal cows. Twelve cows were randomly divided into two groups: a control group and a neem leaf supplemented group, comprising six animals each. The experimental group received neem leaf supplementation, while the control group was maintained on a basal diet. Peak milk yield and lactation persistency were recorded and analyzed statistically. The mean peak milk yield was numerically higher in the neem leaf supplemented group (11.13 ± 1.26 kg) than in the control group (8.27 ± 0.64 kg). Similarly, lactation persistency was greater in the neem-supplemented cows (73.83 ± 2.48 days) compared to the control cows (66.50 ± 3.32 days). However, the differences observed in both parameters were statistically non-significant (P > 0.05). Despite the lack of statistical significance, the higher numerical values obtained in the neem-supplemented group suggest a favourable effect of neem leaves on milk production and maintenance of lactation. It may be concluded that neem leaf supplementation has the potential to improve peak milk yield and lactation persistency in Sahiwal cows, although further studies with larger sample sizes are required to confirm these effects.*

Keywords— ***Neem leaf, Sahiwal cow, Peak milk yield, Persistency, Lactation performance, Azadirachta indica.***

I. INTRODUCTION

Milk production in dairy cattle is a complex physiological process governed by an interplay of genetic potential, nutritional status, management practices, and health condition of the animal. Among the indigenous dairy breeds of the Indian subcontinent,

the Sahiwal cow occupies a position of considerable importance owing to its heat tolerance, disease resistance, and reasonably good milk-producing ability under tropical and subtropical conditions. However, the productive performance of Sahiwal cows, like that of other dairy breeds, remains closely tied to the adequacy and quality of nutrition provided, particularly with respect to protein supply, since protein is an expensive constituent of animal diet and price escalation of conventional protein sources such as groundnut cake and soybean cake has a direct bearing on the profitability of dairy farmers (Raj et al., 2016).

In recent years, there has been growing interest in the use of locally available medicinal plants and herbal feed additives as cost-effective and sustainable alternatives or adjuncts to conventional feeding and health management practices in dairy animals. Among these, neem (Azadirachta indica) has attracted particular attention due to its wide availability, low cost, and the diverse pharmacological properties attributed to its bioactive constituents, including azadirachtin, nimbin, nimbidin, and related limonoids (Moniruzzaman et al., 2022), as well as its rich tannin content, with condensed tannin levels in neem leaf reported to be as high as 10.66% on a dry matter basis (Taethaisong et al., 2023). Neem leaves have long been listed as a fodder tree in India and have traditionally been fed to ruminants in India and other parts of Asia during periods of feed scarcity, particularly the dry season (Adhana et al., 2023).

The rationale for supplementing neem leaf in dairy cattle diets rests on two complementary mechanisms. First, the condensed tannins present in neem leaf are believed to protect dietary protein from excessive degradation in the rumen, thereby increasing the flow of metabolizable and microbial protein to the lower digestive tract for absorption; supplementation of neem leaf along with polyethylene glycol in goats has been shown to increase feed intake, nutrient digestion, nitrogen utilization, and growth performance, while also favourably modulating rumen microbial populations (Taethaisong et al., 2023). Second, the anthelmintic properties of neem, attributed largely to azadirachtin, have been associated with a reduction in gastrointestinal parasitic burden in grazing and stall-fed ruminants, a factor that commonly compromises feed utilization efficiency, body condition, and consequently milk yield in dairy animals reared under field conditions (Moniruzzaman et al., 2022). Reduction of such parasitic stress, together with improved udder health as reflected in lower somatic cell counts, has been suggested as a contributing factor to sustained milk output over the course of lactation in cows supplemented with neem in combination with garlic as a herbal anthelmintic (Adhana et al., 2023).

Despite these promising indications from work conducted in various ruminant species and production systems, including lactating cows under traditional, straw-based feeding systems where neem leaf supplementation significantly increased average milk production (Moniruzzaman et al., 2022), crossbred dairy cows fed total mixed rations in which detoxified neem seed cake replaced soybean meal protein without adversely affecting milk yield, composition, or production efficiency (Raj et al., 2016), and goats supplemented with neem leaf in combination with the tannin-binding agent polyethylene glycol (Taethaisong et al., 2023), there remains a paucity of systematic information on the specific effects of neem leaf supplementation on the milk production performance of Sahiwal cows. In particular, parameters such as peak milk yield and lactation persistency, which together describe both the maximal productive capacity and the sustainability of milk output across the lactation curve, have not been adequately characterized in this breed in relation to neem leaf feeding. Given the importance of these two parameters in determining overall lactation yield and economic returns to the dairy farmer, an evaluation of the influence of neem leaf supplementation on peak yield and persistency in Sahiwal cows is warranted. The present study was therefore undertaken to investigate the effect of neem leaf supplementation on peak milk yield and lactation persistency in Sahiwal cows, with the objective of generating baseline information on the potential of this locally available, low-cost herbal feed additive to enhance milk production performance in this indigenous dairy breed.

II. MATERIALS AND METHODS

Experimental Site

The present investigation was conducted at the Bull Mother Experimental Farm (BMEF), College of Veterinary Science and Animal Husbandry, Anjora, Durg, Chhattisgarh, India. The region is located at an altitude of 317 m above mean sea level and experiences a tropical climate characterized by hot summers, moderate winters and seasonal monsoon rainfall.

Experimental Animals and Design

Twelve lactating purebred Sahiwal cows in early lactation were selected from the institute herd and randomly allocated into three groups (n = 6 per group) based on parity and body weight. Prior to the initiation of the experiment, all animals were dewormed with fenbendazole (7.5–10 mg/kg body weight).

The experimental groups were as follows:

T0 (Control): Basal diet only

T1: Basal diet + Neem leaf (200 mg/kg bw/day)

The feeding trial was conducted for a period of 90 days.

Feeding and Management

All experimental animals were maintained under identical housing and management conditions in a conventional double-row barn system with concrete flooring. The animals were fed a basal ration comprising green fodder, dry fodder and concentrate mixture according to the farm feeding schedule. The green fodder consisted mainly of Hybrid Napier, Sudan grass, Berseem and locally available grasses. In addition, animals were allowed grazing for approximately 4 h daily during the morning. Concentrate mixture was offered twice daily during milking. Fresh drinking water was made available ad libitum throughout the experimental period.

Peak yield: - peak milk is the highest amount of milk a cow produces in the first 150 days of lactation.

Persistency: - milk persistency in a cow is the ability of the cow to maintain a high level of milk production after reaching the peak of lactation.

Statistical Analysis

Data were analysed using SPSS statistical software. Treatment means were compared by one-way analysis of variance (ANOVA) as described by Snedecor and Cochran. Differences were considered statistically significant at $P < 0.05$.

III. RESULTS

Effect of Neem Leaf Supplementation on Reproductive Performance of Sahiwal Cows

The effect of neem leaf supplementation on peak milk yield is presented in Table 1. The mean peak milk yield was higher in the neem leaf supplemented group (11.13 ± 1.26 kg) compared to the control group (8.27 ± 0.64 kg). However, the difference between the groups was statistically non-significant ($P > 0.05$).

Despite the lack of statistical significance, cows receiving neem leaf supplementation exhibited a numerically greater peak milk yield than the control group, suggesting a positive influence of neem leaf supplementation on milk production performance.

The effect of neem leaf supplementation on lactation persistency is presented in Table 1. The mean persistency was numerically higher in the neem leaf supplemented group (73.83 ± 2.48 days) compared to the control group (66.50 ± 3.32 days). However, the difference between the two groups was statistically non-significant ($P > 0.05$).

Although statistical significance was not observed, the higher persistency recorded in the neem leaf supplemented cows suggests a tendency toward improved maintenance of milk production during lactation.

Table 1: Effect of Neem (Azadirachta indica) leaf supplementation Peak yield and Persistency of lactating Sahiwal cows.

Parameters	T0	T1	Significance
PEAK YEILD (kg)	8.68 ±0.91	11.13±1.02	NS
PERSISTENCY (days)	66.50±3.32	73.83±2.48	NS

IV. DISCUSSION

The present findings indicate that supplementation of neem leaf in the diet of Sahiwal cows resulted in a numerically higher peak milk yield (11.13 ± 1.26 kg) compared to the control group (8.27 ± 0.64 kg), although the difference did not reach statistical significance ($P > 0.05$). This trend is in broad agreement with several earlier reports that have documented a positive, often significant, galactopoietic effect of neem leaf supplementation in dairy animals. Moniruzzaman et al. (2022) reported that supplementation of neem leaves to lactating cows under traditional, straw-based feeding systems significantly increased average milk production from 2.909±0.087 to 3.093±0.084 litres/day, an effect attributed to reduced gastrointestinal parasitic burden and improved feed nutrient utilization following deworming. Within that same study, Sarker et al. (2016) were cited as having found that average milk production increased by 42.11%, 52.63%, and 78.95%, respectively, at days 7, 14, and 28 after feeding of neem leaves to lactating cows, while Raghavendra et al. (2002) were reported to have observed that feeding tree foliage from Azadirachta indica along with Prosopis cineraria and Bauhinia racemosa during grazing increased milk yield by 58%. Jin et al. (2008) was also cited as having found that supplementation with Chinese herbal medicine increased milk production by 18.89% compared to a control group during the treatment period, and by a further 21.42% in the two months following supplementation, lending support to the broader principle that phytogenic and herbal feed additives, including neem, can exert a measurable galactopoietic effect.

Taethaisong et al. (2023) demonstrated that in goats supplemented with 6% neem leaf combined with 15% polyethylene glycol, improvements in nutrient intake, digestibility, nitrogen utilization, and growth performance were observed, indicating that the tannins and other bioactive compounds present in neem leaf can favorably modulate rumen fermentation, protect dietary protein from excessive ruminal degradation, and enhance the flow of metabolizable protein to the lower gastrointestinal tract for absorption. This is consistent with the mechanism proposed by Wanapat et al. (2009), cited within that study, who described how condensed tannins decrease protein-producing rumen bacteria while simultaneously sparing dietary protein from ruminal degradation, thereby increasing microbial protein flow to the small intestine. Such improved post-ruminal protein and energy availability could plausibly translate into the comparatively higher peak yield observed in the present study, even though the magnitude of the effect did not attain statistical significance, possibly due to the smaller sample size, individual variation among cows, or a relatively short supplementation period relative to other studies reporting significant outcomes.

The numerically improved lactation persistency observed in the neem leaf supplemented group (73.83 ± 2.48 days) relative to the control (66.50 ± 3.32 days) further supports a favorable, though statistically non-significant, influence of neem leaf on sustained milk synthesis. Persistency of lactation is governed by the rate of decline in milk secretion following the peak, and is closely linked to the continuity of nutrient supply, udder health, and the absence of metabolic or parasitic stress during the lactation period. Adhana et al. (2023) reported comparable findings wherein a garlic and neem combination, administered as a herbal anthelmintic to Karan Fries cows, resulted in significantly higher daily milk yield from the fifth fortnight onward and a higher 120-day total milk yield compared with the control group, an effect partly linked to improved udder health, as evidenced by significantly lower somatic cell counts in the treated groups. Within that study, Gross et al. (1999) and Borman et al. (2016) were cited as having reported that anthelmintic treatment resulted in increased milk yield in dairy cows, while Prayitno et al. (2016) was reported to have observed that garlic extract combined with organic minerals increased milk yield and resulted in significantly lower somatic cell counts relative to control groups. Wang et al. (1996) and Turner et al. (2005) were further cited as having reported that milk production increased with increasing intake of tannins and saponins contained in Lotus corniculatus, reinforcing the plausibility that the condensed tannins present in neem leaf may similarly support more uniform feed intake and nutrient utilization across the lactation curve,

helping to sustain milk output over a longer duration rather than producing an early, sharp decline.

The anthelmintic and antimicrobial properties attributed to neem, primarily due to azadirachtin and related limonoids, have also been linked mechanistically to reduced parasitic burden. Qiao et al. (2013) and Veerakumari and Priya (2006), cited by Moniruzzaman et al. (2022), described how azadirachtin affects the central nervous system of parasites via inhibition of excitatory cholinergic transmission and partial blockade of calcium channels, resulting in expulsion of parasites from the host body. Such a reduction in parasitic load would be expected to improve nutrient availability for milk synthesis over the course of lactation, consistent with the trend toward improved persistency observed in the present study.

The lack of statistical significance in both peak yield and persistency in the present study, despite a clear numerical advantage, may be attributed to the relatively small number of experimental animals, variation in individual genetic potential and parity among the Sahiwal cows, and possibly an insufficient supplementation period or dose to elicit a measurable and significant galactopoietic response. It is also possible that the basal ration provided to the control group was already adequate in protein and energy, thereby narrowing the scope for a pronounced response to supplementation. Raj et al. (2016) similarly observed that incorporation of detoxified neem seed cake at the expense of 50% of soybean meal protein in total mixed rations of crossbred dairy cows did not produce statistically significant improvements in overall milk yield relative to certain compositional parameters, despite numerically favorable trends in fat yield, reinforcing the view that the response to neem-based supplementation can be inconsistent across studies depending on basal diet adequacy, breed, and physiological status of the animals. Notably, Noftsger and St-Pierre (2003), cited within that work, suggested that milk production in dairy cows can be increased by manipulating post-ruminal digestibility of rumen degradable protein and amino acid balance rather than rumen degradable protein content alone, a consideration that may help explain why responses to neem supplementation vary depending on the composition of the basal diet against which it is compared. Nevertheless, the consistent direction of the numerical differences across both peak yield and persistency parameters, both favouring the neem leaf supplemented group, lends biological plausibility to a genuine, if modest, positive effect of neem leaf in the diet. Further studies involving larger sample sizes, extended supplementation periods, and standardized dosing protocols are warranted to conclusively establish the production benefits and the underlying physiological and rumen fermentation mechanisms responsible for the observed trends in Sahiwal cows.

V. CONCLUSION

The present study revealed that supplementation of neem leaf in the diet of Sahiwal cows resulted in a numerically higher peak milk yield (11.13 ± 1.26 kg) and improved lactation persistency (73.83 ± 2.48 days) compared to the control group (8.27 ± 0.64 kg and 66.50 ± 3.32 days, respectively), although the differences between groups did not attain statistical significance ($P > 0.05$). The consistent upward trend observed across both parameters suggests a biologically favourable, if modest, influence of neem leaf supplementation on milk production performance in Sahiwal cows, possibly mediated through improved post-ruminal protein availability and reduced parasitic or metabolic stress, as reported in similar herbal supplementation studies in other dairy breeds and species. Based on these findings, neem leaf may be considered a promising, low-cost, and locally available feed supplement with potential to support milk yield and persistency in indigenous dairy cattle. However, further studies involving larger sample sizes and extended trial periods are recommended to confirm these trends and establish their statistical and economic significance under field conditions.

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