ASSESSMENT OF BYPASS FAT SUPPLEMENTATION ON PRODUCTION PERFORMANCE OF LACTATING CROSSBRED CATTLE

Vikramjit Singh[1]*, Ashok Choudhary[1], S.C. Kantwa[1], and Gulab Choudhary[1]
Krishi Vigyan Kendra, Hanumangarh-II-335 523, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

Received on:13.10.2025
Accepted on:26.11.2025

ABSTRACT

A field trial was conducted over two consecutive years (2021–2022; 2022-2023) to evaluate the effect of bypass fat supplementation on milk yield, fat percentage, and net economic returns in crossbred lactating cattle under field conditions in villages – Phephana and 22 NTR, Block- Nohar, District- Hanumangarh, Rajasthan. Twenty recently-calved cattle were allotted to two groups: T1 (farmer's practice) and T2 (T1 + bypass fat @ 100 g/animal/day for 90 days). The results revealed consistent improvements in milk yield, fat percentage, and net returns in T2 across the study period. The study concludes that bypass fat supplementation is an effective nutritional strategy to enhance milk quality and profitability for dairy farmers. Supplementation with bypass fat significantly improved milk production ($P < 0.01$). The pooled mean daily milk yield increased from 17.61 L in T1 to 20.37 L in T2, corresponding to an additional 2.76 L/day (15.68% increase) in the treated group. Total 90-day milk yield increased from 1584.5 L (T1) to 1832.85 L (T2). Milk fat percentage improved markedly from a pooled average of 3.15% in T1 to 3.94% in T2 ($P < 0.01$), whereas SNF remained unaffected. Economic analysis showed substantially higher profitability in the supplemented group. Gross returns increased from Rs. 617.93 to Rs. 855.33 per cow per day, yielding a pooled net return of Rs. 509.38/day in T2 compared with Rs. 298.98/day in T1. The overall B:C ratio improved from 1.94 (T1) to 2.47 (T2). The specific B:C ratio for bypass fat supplementation alone was 4.45, demonstrating strong economic viability. These findings confirm that bypass fat supplementation effectively enhances milk yield, milk fat percentage, and profitability in crossbred cattle, offering a practical nutritional strategy to mitigate negative energy balance and improve dairy farm income under field conditions.

Keywords: Bypass fat, milk fat percentage, crossbred cattle, negative energy balance, economics, lactation

Introduction

Low milk fat percentage is a major concern for dairy farmers, as it directly affects milk pricing and farm income. In crossbred cattle, this issue is more pronounced due to their genetic characteristics and metabolic priorities. Bypass fat, a protected fat supplement, is known to improve energy intake and enhance milk production without compromising rumen function. The present study aimed to assess the effectiveness of bypass fat supplementation in improving milk yield, fat content, and net returns in crossbred cattle.

The impact of dietary energy is particularly significant in lactating and high-producing animals, especially during early lactation, when animals are unable to consume sufficient feed to meet the high nutrient demands. As a result, they often experience negative energy balance (NEB)-a condition that forces them to mobilize body fat reserves, leading to weight loss, decline in body condition, and reduced milk production potential throughout the lactation period (Kim *et al*., 1993; Sirohi *et al*., 2010). Poor transition nutrition can also result in lower milk income due to compromised performance. Bypass fat supplementation has gained prominence as a solution to enhance energy intake without disturbing rumen fermentation. Supplementation not only increases energy density in the diet but also contributes to an increase in milk fat percentage, improved body condition, and greater economic returns (Ganjkhanlou *et al*., 2009; Parnerkar *et al*., 2010). Feeding prilled or bypass fat has been shown to either improve milk fat content or enhance the efficiency of milk production. The trend of including fat in ruminant diets is rising, driven by its high energy density and low heat increment (Saijpaul *et al*., 2010).

Cereal grains, previously relied on as energy sources, are increasingly diverted to human and monogastric consumption, prompting the need for alternative sources like bypass fat in dairy nutrition. Bypass fat supplementation during early lactation has proven to mitigate the adverse effects of NEB, supporting higher milk yield and improving productivity (Tyagi *et al*., 2010). Goff and Horst (1997) also emphasized that early lactation imposes energy demands that exceed dietary intake, leading to reliance on body reserves.

The technology of bypass fat enables nutrients to escape rumen degradation and bio-hydrogenation, enhancing dietary energy density and allowing animals to meet their energy and essential fatty acid requirements. This supports maximum expression of their milk production potential (Krishna Mohan & Reddy, 2009). Moreover, bypass fat is digested post-ruminally absorbed in the abomasum and small intestine and does not interfere with rumen fermentation. It enhances the proportion of unsaturated fatty acids in milk, resulting in improved milk quality and offering potential health benefits for consumers (Bobe *et al*., 2007; Garg *et al*., 2008).

Therefore, the present investigation was undertaken to evaluate the effect of bypass fat supplementation on milk production, milk fat percentage, and economic returns in lactating cattle under field conditions.

Materials and Methods

At Krishi Vigyan Kendra, Nohar, Hanumangarh-II, the study was carried out as a two-year on-farm trial to evaluate the impact of bypass fat supplementation on the economics and

*Corresponding author- Subject Matter Specialist, Krishi Vigyan Kendra, Hanumangarh-II, RAJUVAS-Bikaner, Rajasthan, India, Email: dr.vikrampoonam@gmail.com, phone no. 7014943983

productive performance of lactating crossbred under farmer management practices. Two crossbred cattle groups, T1 (farmer's practice) and T2 (T1 + bypass fat @ 100 g/animal/ day for 90 days), each with 10 cattle, were assessed.

The study was conducted in two villages, Phephana and 22 NTR, located in Block Nohar, District Hanumangarh, Rajasthan, which were purposively selected based on the availability of lactating crossbred cattle and uniform management practices, and farmer cooperation in implementing and recording the trial data.

All of the crossbred cattle were recently parturated and free of anatomical and physiological disorders. Twenty farmers were chosen to provide 20 lactating cows that were almost identical in terms of parity, milk output, and lactation stage. Two cattle from each farmer were chosen in order to preserve uniformity in feeding and management techniques. One cattle was kept as the control (T1), and the other was supplemented with bypass fat and regarded as the treatment group (T2).

Before the experiment began, a training session was held for the farmers to teach them the proper way to capture data on several aspects. The farmers kept a logbook of their daily milk yield in the morning and evening, and the researcher checked it every two weeks. The GLM technique was used to examine the data. Using least squares analysis of variance, the liner model was applied to every variable.GLM analysis was used to examine the data. Least squares analysis of variance was applied to all variables using the liner model. Standard field trial protocols were followed to record daily milk yield, milk fat %, SNF content, feed costs, milk sale rates, gross returns, net returns, and benefit-cost ratios.

Statistical analysis

In the present fixed factors were treatments (T1 –Control group and T2-Treated group). The statistical analysis was carried out using SPSS software program, version 14.0. The level of statistical significance was set at P<0.05.

Results and Discussion

Across the study years (2021–2023), cattle supplemented with bypass fat (T2) consistently showed improvements in milk yield, fat percentage, and economic returns compared to the control group (T1). On average, T2 animals produced 2.5–4.2 liters more milk per day and exhibited higher fat content by approximately 0.6–0.9%. These enhancements translated into significantly higher gross and net returns per day. In 2023, the benefit-cost (BC) ratio was markedly improved in the bypass fat group (2.41) compared to the control (1.90), underscoring the economic viability of the supplementation strategy.

The results presented in Table 1 demonstrate a highly significant ($P < 0.01$) positive effect of bypass fat supplementation on milk production parameters in lactating crossbred cattle. Such improvements in lactational performance following bypass fat supplementation have been previously reported by several researchers (Naik *et al.,* 2009; Sirohi *et al.,* 2010*).*

On average, the T2 animals produced 2.5–4.2 liters more milk per day, which agrees with the findings of Saroj *et al.* (2020), who recorded significant increases in milk yield in bypass fat–supplemented crossbred cows. These enhancements translated into markedly higher gross and net returns per day, supporting earlier conclusions that bypass fat improves the dietary energy density and nutrient utilization efficiency (Wadhwa *et al.,* 2012).

In 2023, the benefit-cost ratio was markedly improved in the bypass fat group (2.41) compared to the control (1.90), which is consistent with prior reports that bypass fat supplementation yields high economic returns due to enhanced production efficiency (Ranjan and Pathak, 2020).

The results demonstrate a highly significant ($P < 0.01$) positive effect of bypass fat supplementation on milk production parameters. Similar observations were reported by Sirohi *et al.* (2010) and Naik *et al.* (2009), who documented substantial increases in milk yield after feeding protected fat.

The Treated Group (T2) consistently exhibited a higher average daily milk yield compared to the Control Group (T1) across both years. The pooled data showed T2 producing 20.37 L/day, compared to17.61 L/day in T1. This aligns closely with the findings of Saroj *et al.* (2020), who also reported a sustained increase in milk yield due to bypass fat. The significant increase in daily yield translated directly to the 90-day total milk production, confirming improved nutrient partitioning and energy status in supplemented cows, as suggested by *Ranjan & Pathak (2020).* The robustness of the treatment effect is supported by the low SEM values and the highly significant P-values.

The data in Table 2 indicates that bypass fat supplementation selectively and significantly impacted milk composition. A highly significant increase ($P < 0.01$) in the Fat % of milk was noted in the T2 group compared to T1 across

Table 1: Effect of bypass fat supplementation on milk production parameters in lactating crossbred cattle (* P<0.01, NS-Non significant)

Treatment	Average milk yield (liter/day/Cow)			90 day total milk yield (liter)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1 (Control group)	17.63	17.58	17.61	1586.7	1582.2	1584.5
T_2 (Treated Group)	20.67	20.06	20.37	1860.3	1805.4	1832.85
SEM	0.3000	0.2800	0.2100	27.0000	25.2000	18.9000
P value	0.0001	0.0001	0.0000	0.0001	0.0001	0.0000
Level of significance	*	*	*	*	*	*

Table 2: Effect of bypass fat supplementation on milk composition parameters in lactating crossbred cattle (*P<0.01, NS-Non significant)

Treatment	Fat % (Kg)			SNF % (Kg)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
T_1 (Control group)	3.2	3.19	3.15	8.01	8.06	8.04
T_2 (Treated Group)	3.92	3.95	3.94	8.12	8.16	8.14
SEM	0.0600	0.0550	0.0400	0.0350	0.0400	0.0300
P value	0.0001	0.0001	0.0000	0.2500	0.3000	0.2800
Level of significance	*	*	*	NS	NS	NS

Table 3: Economics of supplemented bypass fat in lactating crossbred cattle (*P<0.01, NS-Non significant)

Parameters	T_1 (Control group)			T_2 (Treated Group)		
	2022-23	2023-24	Pooled	2022-23	2023-24	Pooled
Average milk yield (Lit/day/cow)	17.63	17.58	17.61	20.67	20.06	20.37
Rearing cost (Rs./day/ cow)	315.5	324.4	319.95	342.5	349.4	345.95
Average rearing cost per litre of milk production (Rs.)	17.89	18.45	18.17	16.57	17.41	16.98
Gross return (Rs./day/ cow)	620.55	615.3	617.93	868.14	842.52	855.33
Net return (Rs./day/ cow)	305.05	292.9	298.98	525.64	493.12	509.38
B:C	1.97	1.9	1.94	2.53	2.41	2.47
Additional milk yield by supplementing bypass fat (Lit/day)	-	-	-	3.04	2.48	2.76
Milk yield increase over control (%)	-	-	-	17.24	14.11	15.68
Value of additional milk (Rs.)	-	-	-	127.68	104.16	115.92
Cost of bypass fat supplementation (Rs. /day/ cow)	-	-	-	27	25	26
B:C ratio for supplementing bypass fat	-	-	-	4.73	4.17	4.45

individual years and in pooled analysis. This result agrees with Sirohi *et al.* (2010) and Wadhwa *et al.* (2012), who explained that bypass fat increases availability of long-chain fatty acids for milk fat synthesis. Conversely, the concentration of Solids-Not-Fat (SNF) percentage showed no statistically significant difference (NS) between the T1 and T2 groups across all comparisons (Pooled P-value of 0.2800). While the T2 group had marginally higher SNF values (Pooled 8.14) compared to T1 (Pooled 8.04), this difference was not statistically significant, suggesting the treatment primarily targets fat component synthesis without substantially altering the SNF profile.

Supplementation with bypass fat resulted in a marked improvement in milk fat percentage, while solids-not-fat (SNF) values remained largely unaffected. These patterns are consistent with earlier findings where bypass fat feeding increased milk fat yield owing to greater absorption of preformed fatty acids (Tyagi *et al.*, 2010; Parnerkar *et al.,* 2010). Conversely, SNF % did not differ significantly between the groups, which is consistent with previous reports indicating that bypass fat primarily enhances fat synthesis but exerts minimal effect on SNF content (Naik *et al.,* 2009).

The economic analysis of the study is summarized in Table 3, which compares the cost-benefit parameters for the Control (T1) and Treated (T2) groups. The rearing cost per day was higher for the T2 group (Treated) due to the addition of bypass fat supplementation, averaging Rs. 345.95 in the pooled data compared to Rs. 319.95 for the T1 group (Control). However, the T2 group achieved a significantly lower average rearing cost per litre of milk production (Rs. 16.98) compared to the T1 group (Rs. 18.17) in the pooled analysis, indicating greater economic efficiency.

The T2 group recorded a substantially higher gross return, averaging Rs. 855.33/day/cow (pooled), compared to Rs. 617.93/day/cow for the T1 group. The substantial increase in milk yield for the T2 group led to a dramatic improvement in net profitability. The pooled net return for the T2 group was Rs. 509.38/day/cow, which is significantly higher than the T1 group's net return of Rs. 298.98/day/cow.

The overall economic viability, measured by the Benefit-Cost (B:C) ratio, was consistently higher for the T2 group. The pooled B:C ratio for the T2 group was 2.47, compared to 1.94 for the T1 group. The substantial improvement in cost–benefit ratio demonstrates the economic viability of bypass fat as a strategic nutritional supplement for enhancing productivity in dairy herds (Tyagi *et al.,* 2010; Saijpaul *et al.,* 2010).

The economic benefit derived specifically from the supplementation was quantified by analyzing the additional milk yield. Supplementation resulted in a pooled average additional milk yield of 2.76 Litres/day over the control, representing a 15.68% increase. The higher milk yield in the T2 group resulted in substantially improved gross and netreturns, which is supported by previous economic

evaluations of bypass fat supplementation (Ranjan & Pathak, 2020; Saroj *et al*., 2020). The pooled B:C ratio for T2 (2.47) was considerably higher than T1 (1.94), mirroring the findings of Wadhwa *et al.* (2012), who reported that bypass fat substantially enhances economic efficiency in dairy cattle due to increased energy intake and productivity. The calculated additional milk yield (2.76 L/day) and the B:C ratio for supplementation (4.45) show excellent profitability of bypass fat feeding. These results are in accordance with the economic gain patterns documented by Saroj *et al.* (2020).

The overall findings of this study corroborate a large body of literature that supports the beneficial effects of bypass fat on milk production, milk fat yield, and overall economic performance (Bobe *et al.,* 2007; Ganjkhanlou *et al.*, 2009; Sirohi *et al.,* 2010).

The consistency of these responses across diverse breeds and management systems strengthens the evidence for bypass fat as an effective tool to enhance dairy cow productivity, particularly during the high-demand early lactation period. Bypass fat supplementation resulted in improved economic returns due to higher milk yield and enhanced milk fat content. Higher market value of fat-corrected milk and improved metabolic efficiency contributed to increased profitability, consistent with the economic outcomes observed in similar studies (Parnerkar *et al*., 2010; Kantwa *et al.,* 2024).

Conclusion

Bypass fat supplementation at 100 g/animal/day for 90 days significantly improved milk production, fat percentage, and economic returns in crossbred cattle. This intervention offers a viable nutritional strategy to address NEB and improve the profitability of dairy farming in India.

Conflict of interest

Authors declare that they do not have any conflict of interest in the study.

Data availability

The data mentioned in the article will be available with the corresponding author.

Acknowledgements

The authors are thankful to ICAR-Agriculture Technology Application Research Institute, Zone II, Jodhpur, Rajasthan, for providing the fund to conduct the study as On Farm Trial (FLD) through KVK and Directorate of Extension Education, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan for encouragement, technical support and providing facilities for conducting the Trial.

References

Bobe G, Zimmerman S, Hammond E and Freeman A (2007) Butter composition and properties affected by ruminant diet. *J. Anim. Sci*., **85**(1): 96–106.

Ganjkhanlou M, Zali A, Nikkhah A and Farhangfar H (2009) Effects of protected fat supplementation on lactational performance and blood parameters of Holstein dairy cows. *J. Anim. Vet. Adv*., **8**(3): 498–503.

Garg MR, Bhanderi BM and Sherasia PL (2008) Effect of feeding bypass fat supplement on milk production and its composition in crossbred cows. *Indian J. Dairy Sci*., **61**(1): 56–58.

Goff JP and Horst RL (1997) Physiological changes at parturition and their relationship to metabolic disorders. *J. Dairy Sci*., **80**(7): 1260–1268.

Kantwa, SC, Meena YK, Rampratap, Gupta RK, Shekhawat SS and Singh V (2024) Effect of feeding bypass fat on production performance of lactating buffaloes. *Vet. Pract*., **25**(2): 228-231.

Kim YK, Kim JH, Ahn BH and Lee KS (1993) Effect of energy and protein intake on postpartum body weight changes and reproductive performance in dairy cows. *Asian-Australas. J. Anim. Sci*., **6**(3): 405–412.

Krishna Mohan DVG and Reddy TJ (2009) Rumen-protected fat: A strategic nutrient for high yielding dairy animals. *Indian Dairyman*, **61**(6): 52–57.

Parnerkar S, Dhami AJ and Faldu S (2010) Effect of feeding bypass fat on milk production, composition and reproductive performance of crossbred cows. *Indian J. Anim. Nutr.*, **27**(2): 103–108.

Saijpaul S, Saini AL and Khokhar RS (2010) Effect of feeding bypass fat on milk yield and blood metabolites in lactating crossbred cows. *Indian J. Anim. Nutr.*, **27**(1): 59–63.

Sirohi SK, Walli TK, and Mohanta RK (2010) Supplementation effect of bypass fat on production performance of lactating crossbred cows. *Indian J. Anim. Nutr.*, **27**(2): 124–128.

Tyagi N, Thakur SS and Shelke SK (2010) Effect of feeding bypass fat supplement on milk yield, milk composition and blood parameters of Murrah buffaloes. *Anim. Feed Sci. Technol.*, **16**1(1–2): 37–42.

Department of Animal Husbandry and Dairying (2023) *Basic Animal Husbandry Statistics (BAHS)*. Government of India. https://dahd.nic.in

Press Information Bureau (2021) *India's Milk Production Grows by 6.3%*. Government of India. https://pib.gov.in

Shunya live (2021) *India's Dairy Shift: Cows Overtake Buffaloes in Milk Production*. https://www.shunya.live

Wikipedia (2023) *Dairy in India*. https://en.wikipedia.org/wiki/Dairy in India

Naik PK, Rani N and Dhiman TR (2009) Impact of feeding bypass fat on milk yield and composition in dairy cows. *Indian J. Anim. Nutr.*, **26**(2): 120–123.

Ranjan A and Pathak M (2020) Effect of rumen-protected fat on nutrient utilization and lactation performance in dairy cows. *Indian J. Dairy Sci*., **73**(1): 45–50.

Saroj R, Meena GS and Nagda RK (2020) Effect of protected fat supplementation on milk production performance in crossbred cows. *J. Anim. Res.*, **10**(2): 233–239.

Sirohi SK, Walli TK and Kumar N (2010) Effects of bypass fat supplementation on feed intake, nutrient utilization, and milk production in crossbred cows. *Indian J. Dairy Sci*., **63**(1): 61–65.

Wadhwa M, Bakshi MPS and Makkar HPS (2012) Rumen-protected fats: Enhancing energy supply in dairy animals. *Asian J. Dairy Food Res*., **31**(4): 251–259.