International Journal of Veterinary Sciences and Animal Husbandry 2024; 9(1): 1169-1172

ISSN: 2456-2912
VET 2024; 9(1): 1169-1172

www.veterinarypaper.com
Received: 03-12-2023
Accepted: 11-01-2024

SG Narale
Department of Animal Nutrition, Bombay Veterinary College, Parel, Mumbai, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

GM Gadegaonkar
Department of Animal Nutrition, College of Veterinary & Animal Sciences, Udgir, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

BN Ramteke
Department of Animal Nutrition, Nagpur Veterinary College, Nagpur, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

NR Karambele
Department of Animal Nutrition, Bombay Veterinary College, Parel, Mumbai, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

PM Kapale
Department of Veterinary Biochemistry, PGIVAS, Akola, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

SY Shirale
Department of Veterinary Parasitology, College of Veterinary & Animal Sciences, Udgir, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

AP Dhok
Department of Animal Nutrition, Nagpur Veterinary College, Nagpur, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

Karnsai Pawankar
Department of of Livestock Production Management, College of Veterinary and Animal Sciences, Udgir.Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

Corresponding Author:
GM Gadegaonkar
Department of Animal Nutrition, College of Veterinary & Animal Sciences, Udgir, Maharashtra Animal and Fishery Sciences University (MAFSU), Nagpur, Maharashtra, India

Influence of bypass protein with or without bypass fat on lactation performance of crossbred cows

SG Narale, GM Gadegaonkar, BN Ramteke, NR Karambele, PM Kapale, SY Shirale, AP Dhok and Karnsai Pawankar

Abstract
The experiment involved eighteen crossbred cows (Gir x Holstein Friesian and Gir x Jersey), divided into three equal groups of six each: T_0, T_1, and T_2. The control group, T_0, received the standard concentrate mixture based on the farm's routine practice. Treatment group T_1 was provided with the same concentrate mixture as T_0 but supplemented with bypass protein, replacing an equivalent amount of concentrate mixture at a rate of 500 g per animal per day. Treatment group T_2, in addition to the T_1 diet, received supplementation with bypass fat at a rate of 100 g per animal per day. The trial spanned thirteen weeks. Results indicated that the average dry matter intake (DMI) of cows from the treatment groups was significantly higher (p<0.01) compared to the control group. The T_2 group exhibited the highest average daily milk yield and FCM yield, significantly outperforming both the T_1 group and the control group (p<0.01). Moreover, the average nutrient intake, feed efficiency of milk production, and milk composition, particularly in terms of fat content, were significantly higher (p<0.01) in the T_2 group compared to the control group. The average body condition score (BCS) also showed a significant increase (p<0.01) in the treatment groups. Economically, the study revealed a net extra profit of Rs. 11.60 and Rs. 16.20 in groups T_1 and T_2, respectively, over the control group. These findings underscore the positive impact of supplementing bypass protein and fat on the overall performance, milk production, and economic returns in crossbred cows.

Keywords: Bypass fat, bypass protein, crossbred cow, lactation, milk composition

Introduction

Bypass protein stands as the second most crucial source of amino acids, addressing the heightened demand in early lactating and rapidly growing animals. Its supplementation results in an augmented feed intake, consequently enhancing the supply of total nutrients and providing additional amino acids for productive and reproductive purposes in ruminants. This supplementation, particularly in the diets of lactating animals, leads to an increase in milk yield due to a proportional rise in amino acid supply to the host post-ruminally. Utilizing bypass protein supplementation can effectively optimize the efficiency of proteins fed to animals.

The addition of bypass fat not only amplifies energy intake but also elevates the unsaturated fatty acid content in milk, generating more economic returns for dairy farmers (Parnerkar *et al.*, 2010) [13]. Diets enriched with supplemental fat tend to stimulate increased milk production, attributed to heightened energy intake, improved energy utilization efficiency, or a combination of both. Bypass fat, especially in the form of calcium salts of fatty acids such as palm oil, has been recognized for boosting the energy density of rations without adversely affecting dry matter intake and digestibility. Additionally, it contributes to an increase in both milk yield and milk fat percentage.

Previous studies, like those by Shelke *et al*. (2011) [14], have demonstrated a significant increase in milk yield and composition in lactating buffaloes when fed rumen-protected fat and protein. Incorporating protected protein into diets with supplemental fat has shown promise in mitigating the decrease in milk protein percentage associated with fat supplementation. Bearing these findings in mind, the present experiment was conducted to investigate the impact of bypass protein supplementation, with or without bypass fat, on milk yield and its composition in lactating cows.

Materials and Methods

In this research, eighteen crossbred cows (Gir × Holstein Friesian and Gir × Jersey) were carefully chosen based on breed, daily milk yield, lactation stage, and parity. The selected animals, exhibiting an average daily milk yield of 8-9 kg/day/animal and ranging from 2^{nd} to 5^{th} parity, were divided into three groups: T_0 (control), T_1 (treatment I), and T_2 (treatment II), each comprising six cows. Group T_0 received the farm's routine concentrate mixture, while Group T_1 was supplemented with 500 g of bypass protein, replacing an equal quantity of concentrate mixture. Group T_2 received the same as Group T_1 but with an additional supplementation of 100 g/d/animal bypass fat. Roughages, including chopped green Para grass (*Brachiaria Mutica*), sugarcane (*Saccharum Officinarum*), and soy straw, were utilized across all groups.

Commercial bypass protein and bypass fat products in free-flowing powder form were obtained from the market and incorporated into the cows' diets through the daily concentrate mixture. The bypass protein supplement utilized in this study contained 40% crude protein (CP), 25% rumen degradable protein (RDP), and 75% undegradable protein (UDP). The bypass fat used contained 85% fat and 9% calcium.

Throughout the 13-week experiment, conventional feeding practices were maintained, involving separate feeding of concentrate mixture and roughages. The concentrate mixture, prepared fresh daily according to NRC (2001) guidelines, underwent hand mixing on the farm and soaking in water for 4 to 5 hours before being fed in two installments. Standard hygiene, management, feeding practices, vaccination, and deworming programs were adhered to for all experimental cows. Weights of all cows were recorded at the start of the experiment and monthly thereafter. At the trial's conclusion, a seven-day digestibility trial using the total collection method was conducted.

Feed samples were analyzed for proximate principles and phosphorus according to A.O.A.C. (2005) [1] standards, while calcium (Ca) estimation followed Talapatra *et al.*'s (1940) [18] methodology. Milk composition, encompassing fat, protein, total solids, and specific gravity, was assessed fortnightly using the Milkoscan Complete Milk Analyzer. Total ash was estimated gravimetrically, and solids-not-fat (SNF) was calculated by difference. The fat-corrected (4%) milk yield was determined using Gain's formula. Fortnightly body condition scores (BCS) were recorded using a 1 to 5 point scale with 0.25 increments for Holstein Friesian cows, following Ferguson *et al*. (1994) [3] and Elanco's (1997) [2] guidelines. Statistical analysis of all parameters was conducted according to Snedecor and Cochran (1994) [17] using a Randomized Block Design.

Results and Discussion

The percent ingredient composition of concentrate mixture used for feeding experimental animals is presented in Table 1.

Table 1: Percent Ingredient composition of concentrate mixture

Ingredients	Percent composition
Maize	25.00
Cotton seed cake	30.00
Wheat bran	20.00
Pulses by-product	22.00
Mineral mixture	02.00
Salt	01.00
Total	100.00

The average chemical composition of concentrate mixture, para grass, sugarcane and soy straw is presented in Table 1.

Table 2: Average chemical composition (%DMB) of concentrate mixture, para grass, sugarcane and soy straw

Nutrient	Concentrate mixture	Para Grass	Sugarcane	Soy straw
Dry matter	88	17	25.8	88.45
Organic matter	95	88.08	89.19	86.22
Crude protein	18	11.3	2.3	7.88
Ether extract	3.1	2.8	1.9	1.25
Crude fibre	13	28.28	28.1	38.10
N.F.E.	60.09	45.7	56.89	38.99
Total Ash	5	11.92	10.81	13.78
AIA	1.08	3.2	2.4	3.9
Calcium	0.85	0.55	2.02	0.61
Phosphorus	0.36	0.32	0.30	0.41

The overall performance of the cows from various experimental groups is given in Table 2.

Dry matter intake (DMI)

The average dry matter intake (DMI) of cows in the treatment groups showed a significant increase ($p<0.01$) compared to the control group, suggesting that the addition of bypass protein and bypass fat did not adversely impact the palatability of the concentrate mixture. Notably, the average DMI of cows in groups T_1 and T_2 was similar. These findings align with the results reported by Mishra *et al*. (2004) [11]. In contrast, Shelke *et al*. (2011) [14] observed comparable DMI in Murrah buffaloes supplemented with rumen-protected fat and protein, diverging from the outcomes of the present study.

Milk yield and 4% FCM: The average milk yield and 4% FCM yields in cows from groups T_1 and T_2 were notably higher than the control group, with statistical significance ($p<0.01$). Additionally, it was observed that the average daily milk yield in cows from group T_2 was significantly ($p<0.01$) higher than in group T_1. These results imply that the supplementation of bypass protein alone or in combination with bypass fat in lactating cows has a beneficial impact on increasing milk production. The heightened milk yield in cows supplemented with bypass protein may be attributed to an increased supply of amino acids for absorption in the small intestine. On the other hand, in cows supplemented with bypass protein-fat, the increase in milk yield may be linked to higher crude protein (CP) and metabolizable energy (ME) intake through rumen-protected protein-fat. These findings align with Mishra *et al*. (2006) [12] and Kuen *et al*. (2002) [8]. In contrast, Holter *et al*. (1993) [7] reported no effect of protein-fat bypass supplementation on milk yield in lactating dairy cows.

TDN and DCP intake
The average Total Digestible Nutrients (TDN) and Digestible Crude Protein (DCP) intake in cows from the treatment groups were significantly higher ($p<0.01$) than in the control group. However, the TDN intake in groups T_1 and T_2 was comparable. Notably, the average DCP intake in cows from group T_2 was significantly higher ($p<0.01$) than in group T_1. These findings align with the results of Shelke *et al.* (2011) [14], who reported a higher ($p<0.01$) average TDN intake in Murrah buffaloes due to the supplementation of rumen-protected fat and protein.

Efficiency of feed utilization
The efficiency of feed utilization, measured by the average Dry Matter (DM) and Total Digestible Nutrients (TDN) required per kilogram of Fat Corrected Milk (FCM) yield, was significantly better ($p<0.01$) in cows from the treatment groups compared to the control group. Moreover, within the treatment groups, the efficiency was significantly better ($p<0.01$) in group T_2, which received supplementation with bypass protein-fat. The utilization of Digestible Crude Protein (DCP) was also significantly better ($p<0.05$) in the treatment groups, although it was comparable between the treatment groups. In contrast to the present study, Sirohi *et al.* (2010) [15] reported a non-significant difference in dry matter intake per kilogram of FCM in lactating crossbred cows.

Milk composition
The average milk protein and total solids percentage were significantly higher ($p<0.01$) in both treatment groups compared to the control group. Additionally, there was a significant difference between the treatment groups, with group T_2 exhibiting a higher percentage than group T_1. These findings align with Garg *et al.* (2002) [4], who reported a significantly higher milk protein percentage in cows and buffaloes supplemented with rumen-protected protein-fat.

In terms of average milk fat percentage, the treatment groups showed a significant increase ($p<0.01$) compared to the control group. Moreover, between the treatment groups, the milk fat percentage in group T_2 was significantly higher ($p<0.01$) than in group T_1. This observation is consistent with the results of Kuen *et al.* (2002) [8], who recorded a significant increase ($p<0.05$) in milk fat yield in cows fed protected fat and heat-extruded soybean meal. However, Garg *et al.* (2003) [5] found no significant effect on milk fat in crossbred cows supplemented with rumen-protected protein-fat.

The average specific gravity and solids-not-fat percentage of milk showed a non-significant effect of feed treatments for cows from different experimental groups.

Body condition score
The body condition score was significantly higher ($p<0.01$) in cows from the treatment groups. However, between the treatment groups, the body condition score was comparable. This aligns with similar findings reported by Vahora *et al.* (2013) [19], who observed a significant improvement ($p<0.01$) in the average daily weight gain in buffaloes supplemented with bypass fat and bypass protein. In contrast to the present study, Kuen *et al.* (2002) [8] observed no significant differences in body weights in cows supplemented with protected fat and heat-extruded soybean meal.

Table 3: Overall performance of cows from different groups

Parameters	Groups			Significance
	T_0	T_1	T_2	
DMI (kg)	11.53^a	11.63^b	11.65^b	**
TDN %	64.37	66.39	67.04	-
TDN intake (kg)	7.42^a	7.72^b	7.81^c	**
DCP %	8.37	9.20	9.54	-
DCP intake (kg)	0.965^a	1.004^b	1.046^c	**
Milk yield (kg)	10.10^a	10.64^b	10.91^c	**
FCM yield (kg)	9.07^a	9.79^a	10.13^c	**
DMI (kg)/ kg FCM yield	1.27^c	1.19^b	1.15^a	**
TDN intake (kg)/ kg FCM yield	0.818^c	0.788^b	0.770^a	**
DCP intake (kg)/ kg FCM yield	0.106^b	0.102^a	0.103^a	*
Milk protein %	3.38^a	3.60^b	3.53^b	**
Milk fat %	3.33^a	3.48^b	3.53^c	**
Milk SNF %	8.22	8.24	8.24	NS
Total solid %	11.55^a	11.72^b	11.77^b	**
Specific gravity	1.029	1.029	1.029	NS
BCS	3.07^a	3.36^b	3.39^b	**
Extra profit over control (₹/cow)	-	11.60	16.20	

$^{a-c}$ Mean values within a row with unlike superscript letters were significantly different for each dietary treatment ($p<0.05$).

**- Significant at 1% level, *- Significant at 5% level, NS- Non significant

Digestibility trial
Upon concluding the study, a seven-day digestibility trial using the total collection method was conducted. The results indicated a significant improvement ($P<0.01$) in the digestibility of Dry Matter (DM), Organic Matter (OM), Crude Protein (CP), Ether Extract (EE), and Nitrogen-Free Extract (NFE) in the groups supplemented with both bypass protein and bypass fat compared to the control group (Table 3). Specifically, the digestibility of DM, OM, CP, and EE was significantly higher in group T_1 than in the control group. However, the digestibility of Crude Fiber (CF) and NFE showed comparability between the control group and group T_1. Consequently, these improvements led to higher Total Digestible Nutrients (TDN) and Digestible Crude Protein (DCP) contents in the groups supplemented with bypass protein alone or in combination with bypass fat. These findings align with the results of Sirohi *et al.* (2010) [15], who reported higher TDN and DCP values in cows for groups supplemented with bypass protein along with fat.
bypass protein along with fat.

Table 4: The percent digestibility coefficients of nutrients of different feed treatments

Nutrients (%)	Treatments			
	T_0	T_1	T_2	Significance
Dry matter	68.74±0.19^a	70.44±0.26^b	71.82±0.27^c	**
Organic matter	69.46±0.14 ^{a}	70.21±0.14^b	72.44±0.18^c	**
Crude protein	66.86±0.22^a	68.22±0.10^b	68.82±0.1^c	**
Ether extract	71.42±0.18^a	72.72±0.10^b	74.28±0.16^c	**
Crude fibre	61.44±0.24^a	62.82±0.22^a	63.44±0.16^b	**
Nitrogen free extract	70.68±0.21^a	72.42±0.20^a	72.68±0.22^b	**

$^{a-c}$ Mean values within a row with unlike superscript letters were significantly different for each dietary treatment ($p<0.05$)

** Significant at 1% level

The economic analysis of the study revealed additional profits of ₹11.6 and ₹16.2 in treatment groups T_1 and T_2, respectively, compared to the control group. This signifies the cost-effectiveness of supplementing bypass protein or bypass protein-fat in the treatment groups as opposed to the control group.

Conclusion

Based on the comprehensive findings of this study, it can be concluded that the supplementation strategy involving 500 g of bypass protein, replacing an equivalent amount of concentrate mixture, along with 100 g of bypass fat per cow per day, proves advantageous in enhancing various aspects of dairy farming. These benefits include improvements in milk production, milk composition, nutrient intake, feed efficiency, digestibility of nutrients, and overall cost-effectiveness.

Acknowledgement

We thank the Chief Executive Officer, Bombay Gowrakshak Mandala, Kandivali, Mumbai (East), Maharashtra for providing necessary facilities for carrying out this research work.

Conflict of interest: The authors affirm that they do not possess any known competing financial interests or personal relationships that could be perceived to impact the integrity of the work reported in this paper.

References

1. AOAC. Association of Analytical Chemist. Official method of Analysis. 18th ed. Washington, D.C., USA; c2005.
2. Elanco Animal Health. Appendix A; c1997. p. 49-52.
3. Ferguson JD, Galligan DT, Thornsen N. Principal descriptors of body condition score in Holstein cows. J Dairy Sci. 1994;77(9):2695-2703.
4. Garg ML, Sherasia PL, Bhanderi BM, Gulati SK, Scott TW. Effect of feeding rumen protected nutrients on milk production in cows and buffaloes. Indian J Dairy Sci. 2002;58:420-425.
5. Garg MR, Sherasia PL, Bhanderi BM, Gulati SK, Scott TW. Effect of feeding formaldehyde treated guar meal on milk production in crossbred cows. Indian J Anim. Nutr. 2003;20(3):334-338.
6. Grummer RR, Slark K, Bertics SJ, Luck ML, Barmore JA. Soybeans versus animal sources of rumen-undergradable protein and fat for early lactation dairy cows. J Dairy Sci. 1996;79(10):1809-1816.
7. Holter JB, Hayes HH, Kierstead N, Whitehouse J. Protein-fat bypass supplement for lactating dairy cows. J Dairy Sci. 1993;76(5):1342-1352.
8. Kuen CJ, Jan DF, ChiouP WS, Yang DW. Effects of dietary heat extruded soybean meal and protected fat supplement on the production, blood and ruminal characteristics of Holstein cows. Asian-Austra. J Anim. Sci. 2002;(6):821-827.
9. Kunju PJG, Mehta AK, Garg MR. Effect of feeding of bypass protein to crossbred cows in India on straw-based ration. Asian-Austra. J Anim Sci. 1990;5(1):107-112.
10. Maiga HA, Schingoethe DJ. Optimizing the utilization of animal fat and ruminal bypass proteins in the diets of lactating dairy cows. J Dairy Sci. 1997;80(2):343-352.
11. Mishra S, Thakur SS, Raikwar R. Milk production and composition in crossbred cows fed calcium salts of mustard oil fatty acids. J Anim Nutri. 2004;21(1):22-25.
12. Mishra BB, Swain RK, Sahu BK, Samantaray DP. Effect of bypass protein supplementation on nutrient utilization, milk production and its composition in crossbred cows on paddy straw based ration. Anim Nutri & Feed Tech. 2006;6:123-133.
13. Parnerkar S, Kumar D, Shankhpal SS, Thube H. Effect of feeding bypass fat to lactating buffaloes during early lactation. Proceedings of VII Biennial Animal Nutri Asso Conf. OUAT, Bhubaneswar, India. 2010 Dec; 126:17-19.
14. Shelke SK, Thakur SS, Amrutkar SA. Effect of feeding protected fat and proteins on milk production, composition and nutrient utilization in Murrah buffaloes (*Bubalus Bubalis*). Anim Feed Sci Tech. 2011;171(2):98-107.
15. Sirohi SK, Walli TK, Mohanta RK. Supplementation effect of bypass fat on production performance of lactating crossbred cows. Indian J Anim Sci. 2010;80(8):733-736.
16. Sirohi SK, Walli TK, Garg MR, Kumar B. Effect of formaldehyde treated mustard cake on nutrient utilization and milk production performance in crossbred cows fed wheat straw-based diet. Indian J Anim. Nutri. 2013;30(1):5-11.
17. Snedecor GM, Cochran GW. Statistical methods. 8th ed. Affiliated East West Press Iowa State University press, USA. Published by Oxford and IBN Publishing Co. Kolkatta-16; c1994.
18. Talapatra SK, Ray SN, Sen KC. The analysis of mineral constituents in biological material Part-I. Estimation of P, Ca, Cl, Mg, Na and K in feedstuffs. Indian J Vet. Sci. Anim. Husb. 1940;10:243.
19. Vahora SG, Parnerkar S, Kore KB. Productive efficiency of lactating buffaloes fed bypass fat under field conditions: effect on milk yield, milk composition, body weight and economics. Indian J Anim. Sci. 2013;3(1):53-58.