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Efficacy of Supplementary Feeding of Bypass Fat and Area Specific Mineral Mixture on the Production and Reproductive Performance in Milch Buffaloes

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ABSTRACT

Background: Bypass fat, also called rumen-protected fat, boosts dairy animals′energy for better milk production and health. Mineral deficiency is a leading cause of poor growth, weakened immunity, lower milk yield and reproductive issues in dairy animals. Considering the aforementioned details, an on farm trial was undertaken at farmer's field to assess the effectiveness of bypass fat and mineral mixture on overall performance of milch buffalo.

Methods: Twenty lactating Murrah buffaloes reared under farmer′s field were selected and distributed equally in two groups of ten buffaloes in each group, *i.e.* T_1 (control) and T_2 (supplementation bypass fat @ 100 g and minerals mixture @ 50 g/day/buffalo beside the farmer practices).

Result: The outcome of study revealed that the additional of bypass fat and a mineral mixture had no effect on the weights of the buffaloes undergoing the experiment. Supplementation of bypass fat and mineral mixture did not influence the DM intake (in terms of kg/d and DMI %) in lactating buffalo. The mean milk yield during supplementation period was determined 10.19±0.36 and 12.13±0.43 l/day in group T_1 and T_2, respectively; which was 19.04 per cent higher in group T_2 than the control. The average length of the postpartum estrus cycle (62.20±5.86 days) and service period (82.49±7.46 days) was significantly (P<0.05) reduced in supplemented group than control (86.40±11.57 days and 131.00±12.33 days, respectively) at farmer′s field. AI per conception was also observed to be significantly (P<0.05) higher in non-supplemented group than the supplemented group. AI per conceptions in supplemented group and control group was recorded 1.39±0.33 and 2.71±0.44, respectively. It could be inferred from the observations that the feeding of bypass fat and area-specific mineral mixture in the diet significantly (P<0.05) improved the yield of milk and its composition as well as postpartum reproductive performance in milch buffalo at farmer's field.

Key words: Area specific mineral mixture, Buffalo, Bypass fat, Milk, Service period.

INTRODUCTION

India is predominantly an agrarian society where dairy animals are the backbone of the rural economy and can be a influential tool for eradicating rural poverty, especially in the semi-arid ecosystem. The crop residues, forages and mature grass are the primary sources of livestock feeding during most of the year in almost all parts of the country. These feed and fodder don't meet the needs of dairy animals in terms of nutrients, optimal reproductive function and long-term milk production (Khadda *et al*., 2014). High-yielding dairy animals, such as cows and buffaloes, require a high-energy diet during initial phase of lactation to support their milk yield, but supply is not appropriate with demand, thus influencing the production potential of animal. Bypass fat, also recognized as rumen-protected fat, is a dietary supplement feeding dairy animals to provide an additional energy source and improve their milk production and overall health. It is called "bypass" fat because it is formulated to bypass the rumen and get absorbed in the intestine, where the animal can more effectively utilize it. The main benefits of bypass fat for dairy animals are that it provides a concentrated source of energy, which can help increase milk production and maintain body condition and it also contains essential fatty acids that support overall health and fertility. In lactating dairy animals are fed bypass fat during the early stages of lactation, the harmful effects of negative energy balance might be mitigated, resulting increase milk production (Mobeen *et al.,* 2019;

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Hifzulrahman *et al*., 2020; Roy and Singh, 2020). Mineral deficiency in dairy animals is the foremost cause of poor growth rate; suppress body immunity, decreased milk yield and various reproductive disorders (Bindari *et al*., 2013). Majority of study was carried out at farm level and separately for bypass fat or mineral mixture supplementation. There is a need to assess the impact of both supplementary feeding (bypass fat and mineral mixture supplementation) feed together to dairy animals at farmer′s field. Considering the aforementioned details, the effectiveness of supplementary feeding of bypass fat and area specific mineral mixture on milch buffalo and scarcity of findings on such aspects under field conditions, an attempt was made to evaluate the effect of bypass fat and area specific mineral mixture on the overall performance of milch buffalo and also determined the cost-effectiveness of supplements under field conditions of Punjab, India.

MATERIALS AND METHODS

A research trial was undertaken at farmer's field to assess the effectiveness bypass fat and area specific mineral mixture on overall performance of milch buffalo under the project of assessment, refinement, validation and adoption of frontline technologies and researchable issue through KVK′s during 2022-23. Twenty Murrah buffaloes in early phase of lactation were selected and were divided equally in two groups of 10 buffaloes in each group, *i.e.* T_1 (control) and T2 (supplementation bypass fat @ 100 g and area specific mineral mixture supplementation @ 50 g/day/ buffalo beside the farmer practices). All animals were managed under farmers' own traditional feeding and managerial system. The buffaloes were selected at nearly the same body weight, parity, lactation stage and milk yield. KVK scientists organized training to benefited livestock keepers. The bypass fat and area-specific mineral mixture was procured from the Department of Animal Nutrition, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. In the treatment group (T_2), consistent supplies of bypass fat and area-specific mineral mixture as supplementations were offered without interruption during the entire period of study. To manage internal parasites, fenbendazole was used to deworm every animal prior to the experiment's commencement. The buffaloes were fed the feed separately and the percentage intake per head per day was also recorded. The drinking water was offered *ad-lib*. The data recording of trial was carried out for 150 days. The milk recording was conducted in the morning and evening time fortnightly. Milk samples from each buffalo were taken fortnightly at milking time and examined for milk composition *i.e.* SNF, milk fat, total solid, milk protein and lactose by milk scanner and 6% fat correct milk was computed using the formula (Rice *et al*., 1970):

6% FCM yield (kg)=

$$0.308 \times \text{total milk (kg)} + 11.54 \times \text{total fat (kg)}$$

Reproductive performance concerning the onset of post-partum estrus, service period and AI per conception was also recorded. The significance of the difference between treatment means was evaluated using the Student's t-test after statistically analyzing the data in a completely randomized design (Snedecor and Cochran, 1989).

RESULTS AND DISCUSSION

The proximate composition of feed and forage consumed by the buffalo while studying is presented in Table 1. The organic matter (OM), crude protein (CP), ether extract (EE), cellulose, neutral detergent fiber (NDF), acid detergent fiber (ADF), Hemi cellulose, acid detergent lignin (ADL) and ash content in the concentrate mixture were 90.50, 21.40, 5.10, 12.30, 34.50, 16.30, 18.20, 5.40 and 10.10 per cent, respectively. The proximate composition of feed and fodder consumed by buffalo was more or less similar to that reported by Khadda *et al*. (2023).

Effect on body weight and feed intake

The addition of bypass fat and mineral mixture did not alter the body weights of the buffaloes under experimentation (Table 2). The data related to dry matter intake during the study period was found to be 13.40±0.04 and 13.84±0.06 kg/d in T_1 and T_2 groups, respectively (Table 2). Supplementary feeding of bypass fat and area-specific mineral mixture did not influenced the DM intake (in terms of kg/d and DMI %) in lactating buffaloes which could be attributed to inertness of the added fat in the rumen

Table 1: Chemical composition of feedstuffs used during the on farm trial (% on DM basis).

Particular	Concentrate mixture	Wheat straw	Green maize fodder
OM	90.50	91.40	95.00
CP	21.40	3.60	8.10
EE	5.10	0.83	2.28
Cellulose	12.30	41.00	35.10
NDF	34.50	79.20	62.30
ADF	16.30	59.80	38.60
Hemi cellulose	18.20	19.40	23.70
ADL	5.40	7.50	4.00
Total ash	10.10	8.10	4.94

because of its low solubility. More or less similar results were also published by Sadrasaniya *et al.* (2022) and Mane *et al.* (2017) for dairy animals.

Effect on yield and composition of milk

The findings from supplementary feeding showed that while both groups initially had similar milk yields, the average milk production during the supplementation period was 10.19±0.36 and 12.13±0.43 liters/day in groups T_1 and T_2, respectively; which represented a 19.04% increase in group T_2 compared to the control group (Table 3). The results indicated that buffaloes under supplementing group (T_2) produced significantly (P<0.05) higher average daily milk yield and 6 % FCM yield in contrast to the check. Buffaloes in group T_2 produced 23.83 per cent higher 6% FCM than control (T_1). More FCM production in buffalo indicated better utilization of nutrients due to bypass fat and area-specific mineral mixture supplementation. The enhance in milk yield resulting from the supplementation of bypass fat and area-specific mineral mixture could largely be attributed to improved energy balance without affecting digestion and by stimulating the basket cells or myoepithelial cells of the udder thereby increasing the lactation performance (Mervat-Foda *et al.* 2009). Milk fat was significantly (P<0.05) higher in group T_2 (7.21±0.46) as compared with control. Kirovski *et al.* (2015) also reported increased milk fat content as a consequence of feeding protected fat. The average lactometer reading of milk was higher in group T_2 than control. There was no discernible difference in SNF, milk protein and lactose content among the treatment which indicated that SNF, milk protein and lactose content was unaffected by supplementation of bypass fat and mineral mixture in lactating buffaloes. Whereas, in case of total solid analysis of data revealed that the total solid content in milk was significantly higher in treatment group than control.

Effect on reproductive performance

The postpartum estrus period, service period and number of AI per conception under treatments and control groups are given in Table 4. The average length of postpartum estrus period (62.20±5.86 days) and service period (82.49±7.46 days) was decreased significantly (P<0.05) in supplemented group than control (86.40±11.57 days and 131.00±12.33 days, respectively) at farmers field. The services per conception was also observed to be

Table 2: Effect of supplementary feeding on body weight and feed intake of lactating buffalo.

Particulars	T_1 (Control)	T_2 (*Bypass fat + ASMM*)
Initial body weight (kg)	498.2±6.39	499.2±8.47
Final body weight (kg)	505.8±9.54	509.1±7.84
DMI (kg/d)	13.49±0.04	13.64±0.06
DMI (% of BW)	2.67±0.02	2.68±0.03

Table 3: Effect of Bypass fat and Area specific mineral mixture supplementation on production performance of milch buffalo.

Particulars	T_1 (Control)	T_2 (*Bypass fat + ASMM*)
Initial milk yield (l/d)	10.10±0.42	10.08 ±0.34
Av. milk yield (l/d)	10.19b±0.36	12.13a±0.43
6FCM yield (l /d)	11.83b±0.43	14.65a±0.46
% Increase in milk yield	-	19.04
% increase in FCM yield	-	23.83
Fat %	6.57b±0.53	7.19a±0.49
Total fat (kg/d)	0.69	0.87
Lactometer reading	29.92±1.23	30.78±1.11
Milk protein (%)	3.89±0.03	3.88±0.04
Lactose (%)	5.31±0.04	5.29±0.03
SNF %	9.81±0.21	9.84±0.31
Total solid %	16.38b±0.19	17.03a ±0.24

Group mean with different superscripts differed significantly (p<0.05).

Table 4: Effect of supplementary feeding on reproductive performance of lactating buffalo.

Particulars	T_1 (Control)	T_2 (*Bypass fat + ASMM*)
Post-partum oestrus (days)	86.40b±11.57	62.20a±5.86
Service period (days)	131b.00±12.33	82.49a±7.46
No. of services (AI) per conception	2.71b ±0.44	1.39a ±0.33

Group mean with different superscripts differed significantly (p<0.05).

Table 5: Feed economics of supplementary feeding on lactating buffalo.

Particulars	T_1 (Control)	T_4 (*Bypass fat + ASMM*)
Av. milk yield (l/d)	10.19	12.13
Additional increase in milk yield (l/d)	-	1.94
Av. feeding cost (Rs./day)	190	211.50
Additional cost of supplementary feeding (Rs./day)	-	21.50
Av. feeding cost/lit. milk production (Rs.)	18.65	17.44
Reduction in cost of milk production/ lit. (%)	-	6.94
Gross return from sale of milk (Rs./ day)	611.40	727.80
Additional income from supplementary feeding (Rs./day)	-	116.40
Net return (Rs./day)	421.40	516.30
B:C ratio	3.18	3.44
Additional B:C ratio from supplementary feeding	-	5.41

significantly (P<0.05) higher in non-supplemented group than the supplemented group. The number of AI per conceptions in supplemented group and control group was recorded 1.39±0.33 and 2.71±0.44, respectively. The results showed that supplementation of bypass fat and area-specific mineral mixture in the diet significantly (P<0.05) influenced the postpartum reproductive performance in milch buffalo. The results of the present study corroborate with the findings of (Butani *et al*., 2016, Khadda *et al*., 2016 and Patel *et al*., 2020) reported that the supplementary feeding of bypass fat and area-specific mineral mixture improved the reproductive performance of dairy animals reared on straw based diets. Enhancement in reproductive efficiency in these dairy animals supplemented with bypass fat and area-specific mineral mixture containing calcium, phosphorus, iodine, zinc, copper, sulphur, fluorine, lead, arsenic and silica has been attributed to various factors. Minerals have a beneficial role on endocrine system and play an significant role in resumption of follicular growth and fertility in dairy animals. Phosphorus is linked with energy metabolism and its deficiency results in delayed sexual maturity, anestrous, repeat breeding and irregular estrous cycle. Hence, the favorable effects of energy and mineral supplements on the neuro-endocrine axis and reproductive functions may be responsible for the improvement in reproductive efficiency seen in the present study.

Economics of supplementary feeding

A fractional budget analysis approach was applied to those incomes and expense elements. As a result, the market price of concentrate, bypass fat, fodder and area-specific mineral mixture have all been taken into account (Khadda *et al*., 2023). The family members were used to manage the buffaloes in both groups, so, the cost of labor was not taken into account in the computation. The price of used inputs was computation on the base of the market rates prevailing during the study period. The bypass fat and area-specific mineral mixture procured from Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana @ Rs. 170/- and 90/- per kg, respectively. Marketing price of milk received by respondents during trial period was taken Rs. 60/lit. The average feeding cost per liter of milk produced in the treatment and control groups was found to be Rs. 17.44 and Rs. 18.65, respectively, which indicates that, in field conditions, dietary supplementation with bypass fat and area-specific mineral mixture significantly decreased the cost of producing milk (Table 5). Net return over feed cost of milk yield per day per animal in T1 and T2 group was found to be Rs. 421.40 and 516.30, respectively. Additional cost and income of supplementary feeding to milch buffalo was found Rs.21.50 and 116.40 day/ buffalo, respectively. The supplementation of bypass fat and area-specific mineral mixture to milch buffalo was found to be give additional profit of Rs. 94.90/ - per buffalo /day. Benefit-cost ratio of 1: 3.44 was obtained during the trial period with bypass fat and area-specific mineral mixture supplementation, which seems to be quite profitable compared to traditional feeding methods.

CONCLUSION

It could be inferred from the observations that the supplementary feeding of bypass fat and area-specific mineral mixture improved the milk yield and its composition as well as postpartum reproductive performance in milch buffalo at farmer's field. All the farmers readily accepted this practice for dairy animals and are also willing to continue.

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Conflict of interest

On the behalf of all authors of the manuscript, I declare that we have no conflict of interest.

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