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Effect of Bypass Fat Supplementation on Productive and Reproductive Performance of Crossbred Cows

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ABSTRACT

Objective of this study was to examine the effects of dietary bypass fat supplementation on the productive and reproductive performance of lactating cattle. Eighteen lactating crossbred (Holstein Friesian × Haryana × Sahiwal) cattle yielding 14±2.0 kg milk per day and 10-15 days in milk were divided into three groups on the basis of milk yield and parity. Group T_1 was fed control diet. Concentrate mixture in groupT_2 was added with 2.15 % vegetable oil while that of T_3 was supplemented with 2.5% bypass fat. The DMI was similar in all 3 groups. Digestibility of dry matter, ether extract and organic matter were significantly (P<0.05) higher in group T_3. Digestible fat, organic matter and TDN intake were significantly (P<0.05) more in group T_3. Average daily milk production was higher by 8.72% in group T_2 and 18.02% in group T_3 as compared group T_1. Average daily 4% fat corrected milk production in group T_3 was 21.37% higher than in group T_1. Fat content in milk was higher (P<0.05) in group T_3 than T_2 and T_1, however, milk protein content remained unaffected. Bypass fat in the diet had positive effect on reproductive parameters. Net return over feed cost of 4% FCM yield was 30.37% higher in group T_3. It was concluded that supplementation of diet with bypass fat in early lactating crossbred cows increased milk and milk fat yield leading to higher net returns.

Key words: Bypass fat, Cattle, Economics, Production, Reproduction

INTRODUCTION

Adequacy of nutrient supply to the lactating cows is a prerequisite for their successful productive and reproduction. Sixty to seventy percent of total input of dairy farming is attributed to feed and fodder charges (Jadhav *et al.,* 2014). Exhaustion of body reserves during early lactation (Butler, 2001) can substantially affect milk yield and conception rate. Supplemental lipids are often included to increase dietary energy density (Staples *et al.,* 1998) to keep the animals in positive energy balance and thus improving the ovarian physiological processes (Beam and Butler, 1997). Animals have to be provided with protected fat which increases availability of energy to animal without compromising rumen dynamics because adding unprotected fat/oil may further decrease fibre digestion (Devendra and Lewis, 1974). Rumen protected fats are absorbed readily from the lower digestive tract without harming forage utilization in rumen (Hightshoe *et al.,* 1990). In view of the above facts, the present investigation was carried out to assess the economics of feeding protected fat in lactating crossbred cattle.

MATERIALS AND METHODS

The study was conducted at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana, India. Eighteen lactating crossbred cattle yielding 14±2.0 kg milk/day and 10-15 days in milk of 1st to 4th parity were selected and divided into three equal groups *viz.* T_1 (control), T_2 and T_3 on the basis of milk yield and parity. Cows were kept in well ventilated feeding stall having arrangement for individual feeding. Nutrient requirements of experimental cows were met as per ICAR (2013). Concentrate mixture comprised of maize (40 parts), soybean meal (10 parts), groundnut cake (30 parts), wheat bran (17 parts), mineral mixture (02 parts) and common salt (01 part). Cows in group T_1 were fed control diet (concentrate mixture + wheat straw + green fodder), while those in groups T_2 were fed concentrate mixture having 2.15% vegetable oil and those in group T_3 which were fed bypass fat at 10 g per kg milk yield per day by adding 2.5% bypass fat in concentrate mixture. The diets were made iso-caloric

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by adjusting the amount of oil or bypass fat.

Feed intake was recorded at fortnightly intervals on two consecutive days. Daily milk yield (morning plus evening) was recorded using digital balance. Milk samples were collected at intervals of fifteen days and mixed before estimation of milk composition. Fat and protein percentage were estimated with the help of automatic milk analyzer machine (MRC Lab Milk Analyzer, India Model: MIA-S-30, S/N: 9166). Fat corrected milk was calculated by the formula: 4% FCM (kg) = 0.4 × total milk (kg) + 15 × total fat (Tyrrel and Reid, 1965).

Reproductive parameters (period from calving to first estrus, service period, calving interval, number of insemination per conception and conception rate) were recorded for individual animal. A digestion trial of five days collection period was conducted, during which an accurate account of amounts of feeds offered, residue (if any), and faeces voided were recorded. The samples of feed offered, refusals and feces were analyzed for proximate principles (AOAC, 2005). Economics of supplementing bypass fat in concentrate mixture of crossbred lactating cattle was calculated. Data were subjected to statistical analysis, using SAS, 9.3.1 (2011) version by following one-way analysis of variance according to Snedecor and Cochran (1989). Treatment means were separated by Duncan multiple range test and were considered significant if P<0.05.

RESULTS AND DISCUSSION

The chemical composition of the feeds and fodder are presented in Table 1. The ether extract content of the concentrate mixture of T_1, T_2 and T_3 was 3.87, 6.25 and 6.18%, respectively. Total fat content in bypass fat supplement was 85.01%. The DM intake was similar in all the groups (Table 2) which could be ascribed to inertness of the added fat in the rumen because of its low solubility. Intake of CP was also not affected due to supplementation of protected fat or vegetable oil in the diet of lactating crossbred cattle. Similar findings were also reported by Singh *et al.* (2014); Sonttakke *et al.* (2014) and Ramteke *et al.* (2014).

The results of the study revealed that the digestibility of DM, EE and OM were significantly (P<0.05) higher in cattle fed bypass fat as compared to non-supplemented groups (Table 2). Similarly, Len *et al.* (2016) reported that dietary supplementation of fat showed positive effects that resulted in the improvement of digestibility of EE and OM in Murrah buffalo calves. Digestible fat, organic matter and total digestible nutrients intake were significantly (P<0.05) augmented in experimental lactating cattle fed diet with protected fat.

Average daily milk yield and FCM yield were significantly higher in group T_3 as compared to control (T_1), whereas, the values were intermediary in group

Table 1. Chemical composition of concentrate mixture and fodder fed to experimental animals

Ingredient	Attribute						
	DM	On % DM basis					
		OM	CP	EE	CF	NFE	Total ash
*Concentrate mixture							
T_1	92.47	92.01	21.06	3.87	5.89	61.19	7.99
T_2	92.35	92.15	20.92	6.25	5.76	59.22	7.85
T_3	92.50	92.08	20.95	6.18	5.79	59.16	7.92
Wheat Straw	94.46	87.92	2.59	0.97	37.24	48.12	11.08
Maize green	22.94	87.97	7.85	3.11	27.42	49.59	12.03
Berseem	14.24	87.17	15.43	3.24	18.67	49.83	12.83

DM, dry matter; OM, organic matter; CP, crude protein; EE, ether extract; CF, crude fibre; NFE, nitrogen free extract; *T_1: Control, T_2: 2.20 kg vegetable oil/100 kg; T_3: 2.60 kg bypass fat/100 kg.

Table 2. Nutrients' intake and digestibility of nutrients in different groups

Parameter	Treatment group*		
	T_1	T_2	T_3
Nutrient intake			
DMI (kg/d)	12.68±0.13	12.80±0.19	12.77±0.09
DCPI (g/d)	1504.42±9.67	1500.31±17.16	1539.99±13.16
DEEI (g/d)	297.20^{a}±3.78	405.06^{b}±2.28	457.03^{c}±1.16
DOMI (kg/d)	7.83^{a}±0.10	7.89^{a}±0.10	8.20^{b}±0.11
TDNI (kg/d)	8.21^{a}±0.11	8.35^{ab}±0.10	8.62^{b}±0.09
Digestibility (%)			
DM	67.96^{a}±0.38	67.57^{a}±0.51	69.44^{b}±0.51
CP	70.25±0.37	70.28±0.41	71.47±0.35
EE	71.09^{a}±0.63	75.14^{b}±0.56	78.98^{c}±0.32
CF	58.48±0.43	57.51±0.49	58.16±0.48
OM	68.77^{a}±0.38	69.28^{a}±0.45	71.17^{b}±0.16
NFE	70.57±0.82	71.66±1.27	73.17±0.62

DMI, average daily dry matter intake; DCPI, average daily digestible crude protein intake; DEEI, average daily digestible ether extract intake; DOMI, average daily digestible organic matter intake; TDNI, average daily total digestible nutrient intake; DM, dry matter; CP, crude protein; EE, ether extract; CF, crude fibre; OM, organic matter; FE, nitrogen free extract; ^{a,b} Mean values bearing different superscripts within row differ significantly (P<0.05); *T_1: Control, T_2: 2.20 kg vegetable oil/100 kg; T_3: 2.60 kg bypass fat/100 kg.

T_2 (Table 3). The increase in milk production on supplementation of protected fat could largely be attributed to improved energy balance without affecting digestion. The cows in group T_3 produced 21.37% higher 4% FCM than group T_1. More FCM production in crossbred cows indicated better utilization of

Table 3. Milk yield, feed conversation efficiency and economics of feeding bypass fat to cattle during experimental period

Parameter	Treatment Group*			±SEM
	T_1	T_2	T_3	
Milk yield, kg/d (%increase)	13.54^{a}	14.72^{ab} (8.72)	15.98^{b} (18.02)	0.49
FCM yield, kg/d (%increase)	13.71^{a}	15.04^{a} (9.70)	16.64^{b} (21.37)	0.50
Milk fat (%)	4.12^{a}	4.19^{b}	4.28^{c}	0.02
Milk protein (%)	3.55	3.58	3.61	0.04
FCE	1.10^{a}	1.18^{b}	1.30^{c}	0.05
DMI/kg FCM (kg)	0.96^{a}	0.91^{b}	0.82^{c}	0.03
Cost/kg FCM (₹)	15.63	15.26	14.71	-
4% FCM yield (₹)	3361.31	3678.90	4058.52	-
Total feed cost (₹)	51659.30	53748.60	57637.00	-
Gross income (₹)	100839.50	110367.00	121755.70	-
Net Return (₹)	49180.20	56618.40	64118.70	-
Saving per day (₹)	201.50	232.00	262.80	-

FCM, 4% fat corrected milk, FCE, feed conversion efficiency; DMI, average daily dry matter intake. *T_1: Control, T_2: 2.20 kg vegetable oil/100 kg; T_3: 2.60 kg bypass fat/100 kg; ^{a,b}Mean values bearing different superscripts within row differ significantly (P<0.05)

Table 4. Effect of dietary supplementation of bypass fat on reproductive performance in crossbred cattle

Parameter	Group		
	T_1	T_2	T_3
First estrus (d)	37.16±4.7	42.66±2.78	34.83±3.51
First AI, (d)	51.66±1.87	54.66±1.35	53.00±1.81
Service period (d)	68.50±8.14	69.16±6.33	62.50±3.69
AI/ conception (d)	1.66±0.33	1.66±0.33	1.30±0.22
Days in lactation	259.16±8.55	273.00±13.87	269.50±5.38
Calving interval (d)	343.83±4.52	350.66±8.66	337.00±3.99
Dry period (d)	80.00±3.43	77.66±6.93	67.50±6.37
Birth wt of calf, kg	27.20±0.91	28.25±0.68	27.80±0.73

*T_1: Control, T_2: 2.20 kg vegetable oil/100 kg; T_3: 2.60 kg bypass fat/100 kg

nutrients due to bypass fat supplementation. Yadav *et al.* (2015) also observed significantly higher milk yield in the animals fed bypass fat supplement. Similarly, other research workers (Garg *et al.,* 2012; Dhulipalla *et al.,* 2013; Vahora *et al.,* 2013; Grewal *et al.* 2014; Nam *et al.,* 2014) also reported significantly increased milk yield in cattle by feeding of bypass fat and protein alone or in combination. Sontakke *et al.* (2014) and Ramteke *et al.* (2014) reported increased FCM yield due to feeding of bypass fat. The milk fat content was higher (P<0.05) in group T_3 (4.28) as compared groups T_2 (4.19) and T_1 (4.12). Kirovski *et al.* (2015) also reported increased milk fat content as a consequence of feeding protected fat. In this experiment, CP content of milk was not affected due to supplementation of bypass fat.

The feed conversion efficiency was the best (P<0.05) in cattle fed bypass fat followed by oil supplemental group as compared to control. The cost of feeding for 1 kg 4% FCM production in T_2 (15.26) and T_3 (14.71) was lower as compared to control T_1 (₹ 15.63). The net return over feed cost of 4% FCM yield was 30.37% higher when their diet was supplemented with bypass fat at 10g per kg milk yield as compared to control diet.

The reproductive performance of dairy cattle measured in terms of artificial insemination (AI) per conception, reduced service period, calving interval, dry period and; increased days in lactation were improved due to feeding of supplemental fat, best response was obtained whilst protected fat was fed.

CONCLUSIONS

This study showed that digestibility of dry matter, ether extract and, organic matter; and intake of total digestible nutrients, digestible ether extract and digestible organic matter improved significantly (P<0.05) on dietary supplementation of bypass fat resulting in increased milk yield, 4% FCM yield and fat content. Feed conversion ratio improved in terms of 4% FCM production in addition to improved reproductive performance of the animals and higher net returns.

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