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Effect of supplementing bypass fat on the performance of high yielding crossbred cows

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ABSTRACT

The study was taken up to assess the effect of strategic supplementation of bypass fat (BPF) on the performance of high yielding crossbred cows. Crossbred cows (15) in early lactation, producing more than 10 kg milk/d were used. Based on the body weight, milk yield, stage of lactation and parity, the animals were divided into 2 equal groups. The animals in the control group (C) were offered *ad lib.* homemade concentrate mixture and non-leguminous green fodder for 180 days. The animals in the experimental group were offered *ad lib.* control diet, supplemented daily with 150–200g BPF i.e. calcium salts of rice bran fatty acid oil. The BPF supplementation did not have any significant impact on blood profile except an increase in triglyceride (TG) level. The plasma progesterone concentration was higher on day 15 of the observed oestrus cycle (7.50 vs 6.15 ng/dl) as well as at 30 days of pregnancy (9.18 vs. 6.93 ng/dl) in BPF supplemented group as compared to control group. Concentration of blood urea nitrogen (BUN), TG and phosphorus declined, while that of albumin and calcium increased with the advancement in lactation.

The average daily milk yield was improved by 1.13 kg/d (21.55 vs. 20.42 kg/d) in BPF supplemented group as compared to control group with an increase in protein, lactose and SNF content in milk, without effecting milk fat content as compared to control group. The advancement in the stage of lactation did not have any significant effect on these parameters. Supplementation of BPF showed no effect on milk urea nitrogen (MUN), but it declined with the advancement in the stage of lactation. The body weight of the animals was improved considerably in BPF group as compared to control (551 vs. 508 kg) group, but was not affected by stage of lactation. It was concluded that supplementation of 150–200 g bypass fat/d improved the milk yield, its composition and health of the crossbred cows.

Key words: Blood profile, Bypass fat, Crossbred cattle, Milk composition, Milk yield, Reproductive performance

The negative energy balance in early lactation causes delayed post partum ovarian activity (Garnsworthy and Webb 1999), apart from affecting peak milk yield and overall lactation yield. Grewal *et al.* (2011) assessed the nutritional status of lactating crossbred cattle in the central plain zone of Punjab state in India and revealed a shortfall of TDN intake vis-à-vis requirement. The high yielding crossbred animals in early lactation should be fed either higher level of cereal grains or fed on diet supplemented with bypass nutrients to meet their energy requirement. But excess of cereal grains in the diet can cause rumen acidosis predisposing the animals to ill health, animal goes off feed, leading to drop in milk yield. No such problem was observed in cows fed diet supplemented with bypass nutrients (Holter *et al.* 1993). Singh *et al*. (2003) revealed that elevated feeding at 120% NRC (1989), 60 days pre-partum to 120 days post-partum improved the productive and reproductive performance of high yielding crossbred cattle. However, little information is available on the effect of supplementing bypass fat on the productive and reproductive performance of lactating cows, specifically under field conditions. Therefore, a closely monitored field trial was conducted to assess the effect of bypass fat on the performance of lactating crossbred cows in early lactation.

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MATERIALS AND METHODS

Crossbred cows (15) in early lactation (10–15 days after parturition) producing more than 10 litre milk/d were selected from 2 farm houses. The heart girth and body length of animals were measured to calculate body weight of animals by using the Shaeffered's formula (Sastry *et al.* 1994). Depending on the body weight, milk yield, stage of lactation and parity, the animals were divided into 2 equal groups. The animals in the control group (C) were offered *ad lib.* homemade concentrate mixture and non-leguminous green fodder. Wheat straw was offered only when leguminous green fodder (berseem) was fed to the animals. The animals in the experimental group were offered *ad lib.* control diet supplemented daily with 150–200g bypass fat (BPF) i.e. calcium salts of rice bran fatty acid oil prepared by fusion method in this department (Naik *et al*. 2007). The milk yield was recorded at weekly interval for 180 days. The feed and fodder samples were collected at 15 day interval. Body measurements were recorded and blood, milk and spot urine samples were collected at 30 day interval. Samples of feed stuffs were ground to pass through 1 mm sieve and analyzed for nitrogen and total ash (AOAC 1995) and cell wall constituents (Robertson and Van Soest 1981). The urine samples were analyzed for nitrogen content only. The milk samples (35 ml/vial) were preserved with an 8 mg sodium azide tablet/vial. The milk samples were centrifuged at 2800g for 15 min at 4°C to separate the fat layer. The defatted milk was de-proteinized by equal volumes of 3% TCA and centrifuged at 21 000g for 20 min at 4°C. The supernatant was analyzed for urea-N by using commercial kits. The serum samples were analyzed for total proteins (Henry *et al.* 1974), albumin (Doumas *et al.* 1975), glucose (Trinder 1969) and urea-N (Evans 1968). Globulin was calculated by difference between total protein and albumin. The plasma progesterone concentration was assessed by chemiluminescence immuno assay by using reader. The urine sample (10 ml) stored in a vial containing 0.5 ml of 20% H_2SO_4 was analyzed for allantoin (Young and Conway 1942), uric acid (Trivedi *et al.* 1978) and creatinine (Folin and Wu 1919). Purines absorbed were calculated from the daily urinary purine derivatives (PD) excreted (IAEA 1997). The data were analyzed in a factorial design (Snedecor and Cochran 1994) by using SPSS version 12 (SPSS 1996) and differences in mean were assessed by using Tukey's b test.

RESULTS AND DISCUSSION

The animals on an average consumed 8–9 kg concentrate mixture and about 35 kg green fodder in both the groups. The roughage to concentrate ratio in the diet offered was observed to be 45.3: 54.7. The home made concentrate mixture and green fodder contained 90.1 and 89.8% OM, 17.9 and 16.6% CP, 5.8 and 2.5% EE, 30.7 and 48.4% NDF, respectively. The supplementation of BPF did not affect daily DM intake. Irrespective of stage of lactation, the average daily milk yield was increased by 1.13 kg/d (20.42 vs. 21.55 kg/d) in the BPF supplemented group as compared to control group (Table 1), confirming the earlier report of 19% increase in milk yield of crossbred cows in early lactation (Naik *et al*. 2009), which is mainly because of improved energy status of the animals especially in early lactation. The BPF supplementation increased (P<0.05) the protein, lactose and SNF content in milk, confirming the earlier reports (Sklan *et al*. 1994, Naik *et al*. 2009). The BPF supplementation did not show any impact on milk fat, confirming the earlier report

Table 1. Effect of bypass fat supplemented diets on milk yield, its composition and body weight in high yielding crossbred cows

Parameter	Type of diet		Stage of lactation		PSE
	C	C+BPF	Early	Late	
Milk yield, kg/d	20.42	21.55	21.0	20.97	1.24
Fat,%	4.54	4.22	4.63	4.12	2.20
SNF*,%	8.75[a]	9.43[b]	8.79	9.40	0.17
Protein*,%	3.00[a]	3.36[b]	3.06	3.30	0.95
Lactose*,%	4.65[a]	5.24[b]	4.77	5.12	0.15
MUN, mg/dl	25.70	27.41	29.34[B]	23.76[A]	1.64
Allantoin, mM/d	28.40	29.43	21.16[A]	36.68[B]	2.89
Uric acid, mM/d	2.91	1.08	1.80	2.18	0.84
Purine derivatives*, mM/d	31.31	30.51	22.96[A]	30.51[B]	3.47
Allantoin,%	92.38	97.60	94.90	95.08	1.77
Uric acid,%	7.62	2.40	5.10	4.92	1.77
Body weight changes, kg					
Body weight	507.68	550.57	528.52	529.72	23.32

C, control group; BPF, bypass fat supplemented group; Early, 10 to15 days after parturition; Late, 180 days after start of experiment; PSE, pooled SE.

Figures with different superscripts[a,b] for different diets and superscripts[A,B] for stage of lactation in a row differ significantly *P<0.05.

(Rodriguez *et al.* 1997, Naik *et al*. 2009). But reports are also available indicating increase (Sklan *et al*. 1991) or decrease (Chouinard *et al*. 1997) in fat content and negative impact on milk protein content (Chouinard *et al*. 1998). In present study the advancement in the stage of lactation did not have any effect on these parameters. However, Naik (2011) observed that impact of BPF supplementation on milk yield and its composition is influenced by stage of lactation. The total PD secreted in milk were comparable in both the groups, but increased (P<0.05) with the advancement in lactation. The MUN was comparable in control and BPF supplemented groups (25.7 vs. 27.41 mg/dl), confirming the earlier report (Mahecha *et al*. 2008). The average MUN was much higher than that recommended level of 11–16 mg/dl for well-fed lactating crossbred dairy cattle (Wadhwa *et al.* 2005) indicating that the animals in both the groups were overfed, specifically with respect to protein. The MUN declined (P<0.05) with the advancement in lactation. The body weight of the animals improved considerably in the BPF supplemented group as compared to control (551 vs. 508 kg), but the differences were non- significant. Naik *et al*. (2009) also reported better recovery in the body weight and body condition score in crossbred cows during early lactation in BPF supplemented group. The stage of lactation did not have any effect on body weight.

The dietary supplementation of BPF, irrespective of stage of lactation did not show any significant impact on blood profile (Table 2) except on triglyceride (TG) level, which was improved (P<0.01) in the BPF supplemented group. The

Table 2. Effect of bypass fat supplemented diets on the blood profile of high yielding cross bred cows

Parameter	Type of diet		Stage of lactation		PSE
	C	C+BPF	early	late	
Glucose	55.84	58.59	57.23	57.20	1.39
Protein, g/dl	9.21	8.88	8.55	9.53	0.44
Albumin (A)*, g/dl	3.24	3.43	3.18^{A}	3.50^{B}	0.10
Globulin (G), g/dl	5.96	5.45	5.38	6.03	0.46
A/G	0.58	0.89	0.60	0.86	0.19
Blood urea-N*	26.24	26.72	29.21^{B}	23.74^{A}	1.48
Creatinine	1.13	1.16	1.14	1.15	0.05
Uric acid**	6.16	9.22	9.22	6.16	0.60
Triglycerides**/*	51.34^{a}	69.70^{b}	67.39^{B}	53.65^{A}	3.58
Cholesterol	170.85	200.39	193.71	177.54	17.29
Calcium**	10.31	11.24	8.85^{A}	12.69^{B}	0.44
Phosphorus*	8.78	9.54	10.32^{B}	8.00^{A}	0.54

Note: As in Table 1

Table 3. Effect of bypass fat supplemented diets on the urinary excretion of purine derivatives in high yielding cross bred cows

Parameter	Type of diet		Stage of lactation		PSE
	C	C+BPF	Early	Late	
Allantoin, mM/d	1221.03	1096.54	1042.74	1274.83	92.59
Uric acid, mM/d	242.35^{b}	139.44^{a}	248.70^{B}	133.09^{A}	23.45
Purine derivatives, mM/d	1463.38	1235.98	1291.44	1407.92	108.19
Purines absorbed, mM/d	1673.23	1402.76	1469.51	1606.47	126.30
Purine nitrogen index	0.364	0.292	0.286	0.37	0.05
MNS, g/d	1216.51	1019.87	1068.40	1167.98	92.24

Note: As in Table 1.

nonsignificantly higher cholesterol level may have favourable effect on the synthesis of reproductive hormones and in turn may affect the reproductive performance of animals in the BPF supplemented group. The plasma progesterone concentration was higher on day 15 of the observed oestrus cycle (7.50 vs. 6.15 ng/dl) as well as at 30 days of pregnancy (9.18 vs. 6.93 ng/dl) in BPF supplemented group as compared to control group, which may result in improved reproductive performance of crossbred cattle. The blood urea nitrogen (BUN), TG and phosphorus concentration in the blood declined ($P<0.05$), while that of albumin and calcium concentration in blood increased ($P<0.05$) with the advancement in the stage of lactation. The concentration of all the parameters in the blood was well within the normal physiological limits.

The urinary excretion of allantoin was higher ($P<0.01$) in control as compared to animals in BPF supplemented group (Table 3), similar trend was observed in the urinary excretion of total purine derivatives. The numeric values of purine absorbed, purine nitrogen index (an indicator of efficiency of microbial protein synthesis) and microbial protein synthesis in the BPF supplemented group were comparable with that of control group. Similar trend was observed by Maeng *et al.* (1993). Irrespective of type of diet, the urinary excretion of allantoin increased, while that of uric acid decreased ($P<0.01$) resulting in increased excretion of purine derivatives with the advancement in the stage of lactation. The purines absorbed and efficiency of microbial protein synthesis (PNI) improved resulting in higher microbial protein synthesis with the advancement in stage of lactation. It was concluded that daily supplementation of 150–200g bypass fat improved the milk yield, its composition and health of the high yielding crossbred cattle.

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