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Effect of Bypass Fat Supplementation on the Productive Performance of Crossbred Cows

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ABSTRACT

A Trial was carried out at the Livestock Experiment Station, University of Agriculture, Faisalabad, to find out the effect of feeding bypass fat on dry matter intake, dry matter digestibility, milk production and composition, and body condition score in crossbred cows. For this purpose, 12 early lactating crossbred cows of almost the same stage of lactation and milk production were chosen and divided into four groups. ProLac-100, a product of Zibal Global Animal Nutrition, UAE, was used as by bypass fat. This product was supplemented in Group one (LBFS) @ @100gm/day/animal, Group two (MBFS) @ 150 gm/day/animal, and Group three (HBFS) @ 200 gm/day/ animal. Cows of Group four (NBFS) act as control (without rumen inert fat). Animals were fed individually. The study duration was nine weeks, including a one-week adaptation phase and eight weeks for data collection. There was no significant effect on dry matter intake and digestibility due to bypass fat supplementation. As such, milk yield significantly increased (11.04 to 12.17kg) in supplemented groups as compared to 9.85kg in control cows. Similarly, FCM yield was maximum in MBFS (12.17kg) followed by HBFS (12.09 kg) and LBFS (10.75 kg), and minimum in NBFS (9.49kg). There was no significant difference in the milk yield of cows fed MBFS and HBFS. Milk fat contents increased with the supplementation of bypass fat. Maximum fat percentage was found in HBFS (4.19 %) followed by MBFS (4.00 %) and LBFS (3.88 %). However, a minimum fat of 3.84% was found in control cows. Milk protein contents and total solids in all cows ranged from 3.36 to 3.45 and 12.82 to 13.08 percent, respectively, but this difference was statistically non-significant. A significant improvement in body condition score in treated cows was found. Maximum BCS was in HBFS (3.16), followed by MBFS (2.87) and LBFS (2.77). Minimum was observed in control cows (2.65).

INTRODUCTION

Adaptation of advanced technologies is the need of the hour to enhance the productivity of dairy animals. High level of fat in the feed of dairy animals to meet up their energy supplies may be added. However, the ability of rumen micro-organisms to digest lipid is harshly limited. The lipid content of average ruminant diets is 3-5 percent on dry matter basis. If it is increased above 10 percent, the activity of rumen microbes is reduced, the fermentation of fiber is retarded (since fatty acids are adsorbed on their surface) and feed intake falls. To keep away from such undesirable effects, fat has been 'protected' in the rumen from getting fermented and thus made rumen 'inert' (Ansar *et al.*, 2014). During early lactation, feed intake of the animals decreased but receive more energy necessary for safeguarding of body tissues and milk production (Goff and Horst, 1997). As a result, body fat reserves mobilized to fulfill the energy demand and animal may have to face metabolic disorders. To prevail over this problem, rumen inert fats are usually fed to dairy animals (Arif, *et al.*, 2014). It has been reported that supplementation of bypass fat increased fat corrected milk yield (Erickson *et al.*, 1992, Rodriguez *et al.*,1997) and milk fat contents (Sklanet *et al.*, 1992; Elliott *et al.*,1996) without disturbing the digestibility of nutrients in dairy cows (Klusmeyer *et al.*, 1991). Feeding rumen bypass fat prevents the nutrients from degradation and bio-hydrogenation in rumen along with increase in energy density of the ration. It allows the animals to meet up their energy and important fatty acid necessities resulting to enhancement of milk production potential to the optimal level (Krishna *et al.*, 2009).

Bypass fat does not have any negative effect on rumen fermentation. It provides additional energy to the dairy animals used for enhanced milk production after being digested in small intestine (Bobe *et al.*, 2007). It also

increased unsaturated fatty acids in milk resulting to produce softer butter and safer milk especially for heart patients (Garg*et al*., 2008). Milk production and enhancement in the effectiveness of energy consumption improved by rumen bypass fat supplementation (Maiga and Schingoethe, 1997; Parnerkar *et al*., 2010).
It is undeniable fact that many studies have already been done on bypass fat supplementation in dairy animals but local research-based information are severely lacking. The current study has therefore been executed to establish the effect of rumen bypass fat (Prolac-100) supplementation on the productive performance of crossbred cows.

MATERIALS AND METHODS

The study was conducted at Livestock Experiment Station, University of Agriculture, Faisalabad, Pakistan. For this purpose, twelve early lactating crossbred cows having same stage of lactation and milk yield were selected and divided into four groups. ProLac-100, a product of Zibal Global Animal Nutrition, UAE, was used as by pass fat. It contains total fatty matter 99.82%, total fatty acid 99.68 %, iodine value 5.12; unsap matter 0.21%, palmic acid 95% and stearic acid 4.18 %. Prolac-100 was supplemented @100gm, 150gm and 200gm/day in the diet of treated cows divided in three groups namely LBFS, MBFS and HBFS respectively. Cows in group four kept as control i.e. without bypass fat. Study was carried out in the summer during June to August. Before start of trial, deworming was done with Nawazan @ 1ml/2kg body weight. Animals were fed individually. The study period was nine weeks including one week adaptation period and eight weeks for data collection.
Green fodder (sorghum) and concentrate already being fed to the lactating animals at the farm were used as a diet for the experimental cows. Green fodder was offered ad libitum twice a day. Fresh water was offered thrice a day. Concentrate having 30 % Maize oil cake, 29 % maize gluten, 15 % molasses, 25 % wheat bran and 1 % DCP was offered @ 1kg/ 2.5 liter Fat Corrected Milk yield. Chemical composition of fodder and concentrate was determined by proximate analysis. Milking was done twice daily (4.a.m. and 4 p.m.) and yield was recorded.
On weekly basis, milk samples were taken for analysis. These samples were analyzed in the Dairy Laboratory, Institute of Dairy Sciences, University of Agriculture, Faisalabad, for fat (Aggarwala and Sharma, 1961), protein (Davide, 1977), total solids and solids not fat (Fleischmann's formula).
The condition score of the cows was subjectively assessed on a scale of 1-5 with 0.5 point increments by assessing the amount of fat covering the rump and tail head area on weekly basis (Edmonson *et al*., 1989). Digestibility trial was conducted at the end of trial by using Total Collection Method (Khan *et al*., 2003). The Data recorded were analyzed under Completely Randomized Design using computer software MINITAB (2000). Duncan' s Multiple Range (DMR) test at 0.05 probability level was used to compare the differences among treatment means (Steel, *et. al*., 1997).

Table1
Chemical Composition of Fodder (Sorghum) and Concentrate (dry matter basis)

Items	Fodder	Concentrate
Dry matter	37.24	86.89
Crude protein	7.61	17.13
Crude Fiber	32.5	8.9
Ether Extract	4.5	3.1
Ash	5.9	3.9

RESULTS AND DISCUSSION

Dry matter intake and digestibility

Dry matter intake (DMI) in cows of different groups varied from 12.71 to 13.40kg. Bypass fat supplementation decreased the DMI as compared to control cows but the difference was non-significant statistically (Table 2). No doubt, a very slight decrease occurred in DMI/cow/day due to Prolac-100 supplementation but it may minimize cost of feeding to some extent. Dry matter digestibility in cows of different groups varied from 63.39to 64.66 %. Statistically, there was non-significant ($p>0.05$) effect on digestibility due to bypass fat supplementation. The outcomes of present study are in accordance with Ramteke *et al.* (2014), Patel *et al.* (2013), Garg*et al.* (2012, Singh *et al.* (2014) found no significant variation in dry matter intake by the addition of bypass fat in the ration of lactating cows.
The mechanism by which supplemental fat does not affect DMI are not apparent although involve negative effects on ruminal fermentation and gut motility, release of gut hormones, oxidation of fat in the liver and palatability of diets containing added fat. The reasons of DMI depression from feeding inert fat to lactating cows has been identified in three possible areas: palatability and ruminal/gastro-intestinal motility effects (Loftenand Cornelius, 2004).
The possible reason may be that the inert fat is unavailable in the rumen due to its low solubility and high melting point. It does not impair fiber digestibility in the rumen and avoids an increase in gut fill that may limit dry matter intake. The results of present study are in accordance with Voigt *et al* (*2006*), Thakur and Shelke (2010) and Sirohi *et al* (2010). Schauff and Clark (1989) reported that there was increase in the digestibility of crude protein, when bypass fat (Ca-LCFA) was fed to the dairy animals.
In the present study, no effect on dry matter digestibility might be due to the non-interference and relatively stable nature of bypass fat.

Table 2
Effect of Bypass Fat Supplementation on Dry Matter Intake and Digestibility in Crossbred Cows.

Treatments	By Pass Fat (g/day)	Dry matter intake (kg)	Dry matter digestibility (%)
LBFS	100	12.71	64.66
MBFS	150	13.00	64.30
HBFS	200	13.31	63.42
NBFS	0	13.40	63.39

LBFS low bypass fat supplementation, MBFS moderate bypass fat supplementation, HBFS high bypass fat supplementation, NBFS no bypass fat supplementation.

Milk Yield and Composition

Milk yield in cows of different groups varied from 11.04 to 12.17 kg in treated groups as compared to 9.85 kg in control cows. Statistically, there was a non-significant ($p>0.05$) effect in the milk yield of cows fed MBFS and HBFS. However, cows fed bypass fat @150 g produced significantly ($p<0.05$) more milk as compared to other cows. Fat corrected milk yield was maximum in MBFS (12.17 kg) followed by HBFS (12.09 kg) and LBFS (10.75 kg) and minimum (9.49 kg) in control cows (Table 2). The results of present study are in accordance with Kirovski *et al.* (2015), Nam *et al.* (2014), Arif *et al.* (2014), Ramteke *et al.* (2014) and Rajesh *et al.* (2014). They pointed out that addition of bypass fat in the diet of dairy animals increased milk yield. The higher milk production in treated cows might be attributed to more energy intake in conjunction with protected fat which increased the energy density of ration and reduced deleterious effect of negative energy balance. Grummer and carrol (1993) reported that improvement in milk yield associated with supplemented fat can largely be attributed to an improvement in energy balance. West and Hill (1990) and Lounglawan *et al. (*2007) found no difference in milk yield of cows by calcium salts of fatty acids (CSFA) feeding. However, Sklan *et al*. (1989) reported that fat corrected milk yield increased with Ca salts of fatty acid (bypass fat) supplementation. No improvement in milk yield and milk fat content by bypass fat feeding could be due to different degree of inertness and amount of dietary fat offered to cows (Klusmeyer et *al.*, l991; Sklan *et al.*, 1992; Elliott *et al.*,1996). Milk yield and fat percentage showed a clear cut increase due to bypass fat supplementation but no change in protein contents. This study has made it graphic that cows in early lactation and even fed poor quality fodder obligatory required bypass fat supplement in diet to enhance their productivity. In some studies, bypass fat supplementation did not respond to increase milk yield. It could be due to selection of cows in late lactation and already in positive energy balance. However, fat supplementation is very imperative in our farming system because our dairy animals have to face the problem of negative energy balance due to no concentrate feeding during dry period and early days post calving.

Table 3
Effect of Bypass Fat Supplementation on Milk Yield and Fat Contents in Crossbred Cows.

Treatments	Quantity supplemented (g/day)	As such, milk yield(kg)	FAT (%)	Fat-corrected milk yield(kg)
LBFS	100	11.04 ^{b}	3.88 ^{b}	10.75 ^{b}
MBFS	150	12.17^{a}	4.00 ^{ab}	12.17^{a}
HBFS	200	11.76 ^{a}	4.19 ^{a}	12.09 ^{a}
NBFS	0	9.85 ^{c}	3.84 ^{b}	9.49^{c}
LSD		0.486	0.219	0.466
S.E.		0.172	7.769	0.165

LBFS= low bypass fat supplementation, MBFS= moderate bypass fat supplementation, HBFS= high bypass fat supplementation, NBFS= no bypass fat supplementation

Milk fat contents increased significantly ($p<0.05$) with the supplementation of rumen by-pass fat. Maximum fat percentage was found due to HBFS (4.19 %) and MBFS (4.00 %) (table 2). These results are in consistent with the findings of Kirovski *et al.* (2015), Nasim *et al.* (2014), Nam *et al.* (2014), Arif *et al.* (2014), Ramteke *et al.* (2014), Rajesh *et al.* (2014), Vahora *et al.* (2013) who pointed out that addition of rumen bypass fat increased milk fat contents significantly. The increase in milk fat yield might be due to higher proportion of fatty acid intake that was directly transferred to the milk fat. Gulati *et al*., (2003) reported that increase in milk fat content in supplemented cows was due to availability of more fatty acid to the mammary gland and their incorporation into milk fat. It is fact that marked changes in energy balance, as the cow progresses through lactation, can influence the extent to which added dietary lipid is partitioned between adipose tissue and milk.

Some researchers reported a reduction in milk fat and protein contents due to bypass fat supplementation in the diet of dairy cows (Piperova *et al*, 2004; Rodriguez et al, 1997). Reduction in milk protein contents might be a result of decreasing microbial protein production or insufficient essential amino acids to meet the need of dairy cows for milk production.

In the present study, protein contents did not change due to bypass fat supplementation (Fig 1). It was also supported by Piperova *et al*., (2004); Palmquist and Griinari (2006) who reported that milk protein contents remained unaffected by the addition of bypass fat.

There was significant ($p<0.05$) increase in body condition score in treated cows. Maximum BCS was in HBFS (3.16) followed by MBFS (2.87) and LBFS (2.77) cows (Table 4.5.1). However, minimum BCS was observed in control (2.65) cows. In cows kept on NBFS, area on the sides of tail head further sunken and became hollow. The ribs in control cows were also very graphic. However, body condition score of all treated cows improved. These cows gained flesh on either side of tail and backbone did not stand out. The results of present study are in conformity with Wadhwa *et al.* (2012), Vahora *et al.* (2013), Kirovski *et al.* (2015). who reported better recovery in body weight and body condition score in crossbred cows fed diets supplemented with bypass fat. The body weight of the animals improved considerably in the bypass fat supplemented groups.

Figure 1
Effect of Bypass Fat Supplementation on Milk Protein Contents in Crossbred Cows.

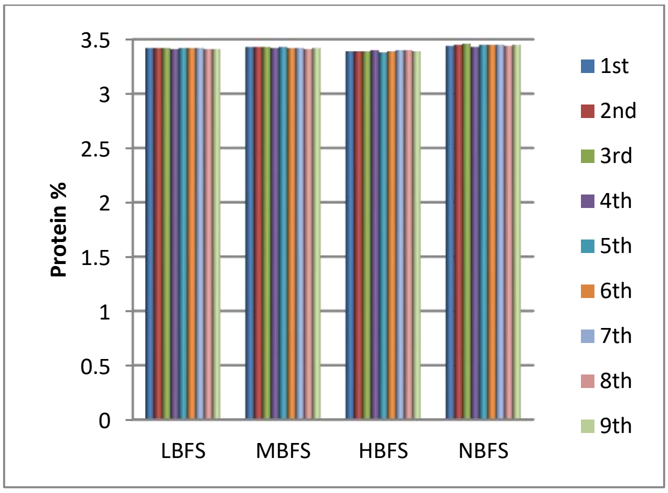
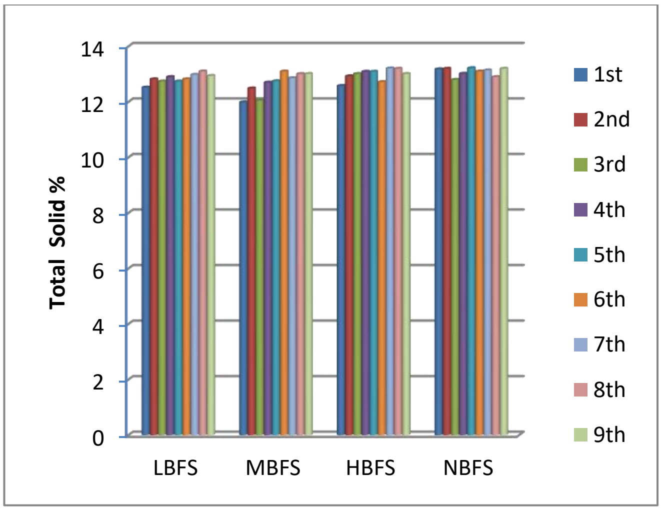


Table 4
Effect of Bypass Fat Supplementation on Body Condition Score and Body Weight in Crossbred Cows.

Treatments	By Pass Fat (g/day)	Body Condition Score
LBFS	100	2.70 b
MBFS	150	2.97 a
HBFS	200	3.16 a
NBFS	0	2.15 c
S.E.		0.162
LSD		0.425

Figure 2
Effect of Bypass Fat Supplementation on Total Solids in Crossbred Cows.



Critical Value = 20.74 %
LBFS= low bypass fat supplementation, MBFS= moderate bypass fat supplementation HBFS= high bypass fat supplementation, NBFS= no bypass fat supplementation

CONCLUSION

Supplementation of bypass fat has positive impact on the production performance of crossbred cows as it significantly increased milk production, fat percentage and body condition score without any increase in dry matter intake. A level of 150g by pass fat/cow/day was found the best level for supplementation in the diet of crossbred cows. However, long term trials in different seasons, species, breeds and locations needed to confirm this claim.

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