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Effect of feeding bypass fat on intake, production performance and economics of lactating crossbred cows: A field trial

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Abstract
A field trail was conducted at farmer's dairy farm belonging to Purnea district of Bihar with an objective to see the effect of supplementation of bypass fat in the ration of lactating crossbred cow on economics of dairy farming. The thirty crossbred lactating cows were randomly divided into three equal groups having ten in each in such a way that the parity and average milk yield of cows of three treatment groups were almost similar. Group-I (Farmer's practice) was fed with a basal diet without any supplement of bypass fat, groups-II and group-III were fed with basal diet supplemented with bypass fat @100g/day/animal and 150g/day/animal, respectively for 60 days. The representative samples of feed offered was subjected to dry matter determination to find out daily dry matter intake of the cows. Milk yield from individual cow was recorded daily during milking i.e. morning and evening for 60 days regularly. Milk samples were analysed daily for milk composition in lactoscan milk analyser. Analysis of variance had significance influence on almost all the economic traits under study. There was a progressive increase in all the economic traits with the increase of level of bypass fat in the diet of lactating cows. The average milk yield and 4% fat corrected milk (FCM) 11.90±0.28 and 11.35±0.21, 12.60±0.43 and 13.09±0.44 and 13.20±0.42 and 14.05±0.45 Kg/cow/day were recorded in group I, II and III, respectively. The total return/cow/day from sale of milk was found to be Rs. 340.53±6.23, 392.63±13.07 and 421.45±13.52 in group I, II and III, respectively. The corresponding net return/cow/day was Rs. 159.71±3.63, 192.75±12.09 and 212.10±16.07, respectively.

Keywords: Bypass fat, economics, milk composition, milk yield

1. Introduction
During early lactation, milk yield increases more rapidly than dry matter intake (DMI). The demand for energy is therefore higher than the amount of energy consumed (Goff and Horst, 1997) [3]. Thus, the cow mobilizes body reserves and losses weight due to negative energy balance which adversely affects production, resulting in lower yield (Kim *et al.*, 1993) [7]. Energy deficit in high producing cows during early lactation can be met by Cereal grains and fats but due to use of cereals for human consumption and monogastric animals the alternate source of energy in dairy ration is supplemental fat (Saijpaul *et al.*, 2010) [17]. Inclusion of unprotected fat in dairy ration is limited to 3% of dry matter (DM) intake, beyond which digestibility of DM and fibre are reduced (NRC, 2001) [12]. Besides, unprotected fat has depressing effect on rumen cellulolytic microbial activity (Ranjan *et al.*, 2010) [15]. To counteract the undesirable effect of unsaturated fatty acids on the ruminal fermentation, these have been fed as salts of calcium (Chalupa *et al.*, 1986) [1]. By protecting the fats from ruminal degradation, the fat content of the ration can be increased up to 6-7% of the DM intake. It is stated that supplementing ration of lactating animals with bypass fat enhances energy intake in early lactation which reduces deleterious effect of acute negative energy balance on lactation (Tyagi *et al.* 2010) [26]. Hence, the present study was planed with an objective to determine the effect of bypass fat feeding on milk yield, milk composition and economics of feeding in early-mid lactating crossbred cows under field condition.

2. Materials and Methods
2.1 Treatment details
The field trial was conducted at farmer's dairy farm of Purnea District, Bihar to study the effect of supplementation of bypass fat on DMI, production performance and economics of

lactating crossbred cows for the period of two months. Thirty cross bred cows in their early to mid-lactation stage (lactation number 2 to 4) and having an average daily two-week pretrial milk yield of groups (ten animals in each group) in such a way that the order of lactation and average milk yield of three groups were more or less similar. All the animals were dewormed and disinfested for ectoparasites before the start of the experiment. Group-I (Farmer's practice) was fed with a basal diet (green maize, wheat straw and conventional concentrate mixture) without any supplement and treatment groups-II and group-III were fed with basal diet supplemented with bypass fat @100g/day/animal and 150g/day/animal, respectively. Bypass fat was added and mixed in concentrate mixture uniformly in morning and fed individually to each animals of treatment group. For two weeks preliminary trial period, only control ration was fed. After two weeks preliminary period bypass fat was supplemented with concentrate mixture and fed to two experimental groups of lactating cows continuously for 60 days. The representative samples of feed offered was subjected to dry matter determination to find out daily dry matter intake of the cows. Milk yield from individual cow was recorded daily during milking i.e. morning and evening for 60 days regularly. Milk samples were analysed daily for milk composition in lactoscan milk analyser available at milk collection centre. For the conversion of whole milk into 4% fat corrected milk (FCM), the equation derived by Gains (1928) [2] was used:

4% FCM (kg) 0.4 x milk yield (kg) + 15 x fat yield (kg)

2.2 Statistical Analysis

The data were analysed statistically using standard methods (Snedecor and Cochran, 1994) [22]. The data were expressed as Mean±SE and were analysed by one-way ANOVA using one factor analysis of OPSTAT and Duncan's multiple range tests was applied to test the significance.

3. Result and Discussions

Analysis of variance presented in Table-1 indicated significant effect of bypass fat feeding on average daily milk yield and all of their milk constituents under study except protein and SNF percentage. Further average values presented in Table-2 revealed progressive increase of all economic parameters with the increase in level of bypass fat in the diet of lactating crossbred cows. Critical review of findings indicated significantly higher average daily milk yield in group-III followed by group-II and lowest in group-I. However, group-II did not differ significantly neither from group-I nor from group-III. These results are in agreement with Naik *et al.* (2009) [11], Tyagi *et al*. (2009) [25], Thakur and Shelke (2010) [24], Sirohi *et al.* (2010) [20], Gowda *et al*. (2013) [4], Parnerkar *et al*. (2011) [13], Wadhwa *et al*. (2012) [27], Purshothaman (2004) [14] who also observed 5.5 to 24.0% increase in milk yield in bypass fat supplemented group of dairy cows. Increased milk yield observed in bypass fat group may be attributed to increased energy density of the ration resulting in reducing the deleterious effect of negative energy balance (Shelke and Thakur 2011) [19].

Similarly, milk fat and total solid percentage both have increased progressively with the increase of bypass fat in the ration, difference being significant statistically among all the three experimental groups. However, significantly higher 4% FCM and total fat were observed in group-III and group-II than group-I. Although the difference between latter two groups were non-significant statistically but higher value of 4% FCM and total fat were recorded in group-III in compression to group-II. The above finding clearly indicated positive effect of feeding of bypass fat to lactating cows with respect to almost all economic traits under study. The result of this study corroborated with the results of Sklan *et al*. (1991) [21], Thakur and Shelke (2010) [24], Sirohi *et al.* (2010) [20], Parnerkar *et al.* (2011) [13] who also reported that milk fat percentage increased on supplementation of bypass fat to lactating animals. Being highly saturated in its composition and direct relationship of dietary fatty acids with milk fat, bypass fat caused increased milk fat synthesis. The probable reason for increased milk fat percentage might be the linear relationship between dietary, plasma and milk fatty acid (Sarwar *et al.* 2003) [18]. Another reason for increased milk fat percentage was that increased dietary fat enhanced supply of fatty acid to mammary gland from feed, which resulted in lower proportion of *De Novo* fat synthesis. The cows fed Berga fat (2.5 to 4.5%) had higher 4% FCM yield (Sarwar *et al.* 2003) [18] and similar results reported by Johnson *et al.* (1988) [5] and Maiga *et al.* (1995) [9]. Weiss and Wyatt (2000) [28] reported increased FCM yield, when high oil corn silage was added in diet. Rohila *et al.* (2017) [16] reported that the difference among milk protein and SNF% were non-significant indicating that milk protein and SNF% were unaffected by supplementation of rumen protected fat to lactating Murrah buffaloes. Naik *et al*. (2009) [11], Tyagi *et al.* (2009) [25], Thakur and Shelke (2010) [24], Sirohi *et al*. (2010) [20] also found similar observations. Rohila *et al.* (2017) [16] reported that total solid content in milk was increased by supplementation of rumen protected fat to lactating buffaloes.

Table 1: Analysis of Variance showing effect of bypass fat feeding on daily milk yield and their constituents

Source of Variation	d.f.	Mean Squares						
		Daily Milk Yield (Kg)	Milk Fat (%)	4%FCM	Total fat (g)	Protein (%)	SNF (%)	Total Solid (%)
Between bypass fat group	2	4.233*	1.459**	18.680**	54644.03**	0.002^{NS}	0.002^{NS}	1.465**
Within bypass fat group	27	1.241	0.026	1.453	2506.144	0.046	0.049	0.045

NS- Non significant; *- *P*<0.05; **-*P*<0.01

Table 2: Effect of feeding bypass fat on milk yield and composition

Components	Group-I	Group-II	Group-III	CD Value
Av. Milk yield (kg)	11.90±0.28^{a}	12.60±0.43^{ab}	13.20±0.42^{b}	1.02
Milk fat (%)	3.70±0.05^{a}	4.26±0.05^{b}	4.43±0.06^{c}	0.15
4%FCM (kg)	11.35±0.21^{a}	13.09±0.44^{b}	14.05±0.45^{b}	1.11
Total fat (g)	439.4±6.92^{a}	536.5±17.99^{b}	584.5±19.51^{b}	46.18
Protein (%)	3.22±0.06^{a}	3.25±0.07^{a}	3.24±0.06^{a}	-
SNF (%)	8.82±0.07^{a}	8.80±0.06^{a}	8.83±0.08^{a}	-
Total Solid (%)	12.52±0.06^{a}	13.06±0.07^{b}	13.26±0.08^{c}	0.19

Mean under same superscript in a row did not differ significantly; Each value is the average of 10 observations; C.D.- Critical difference

Table-3 indicated significant effect of bypass fat feeding on all the economic traits except average daily dry matter intake (DMI). Although the effect of bypass fat feeding on daily DMI had non-significant influence but the DMI increased progressively with the increase in level of bypass fat in the ration of lactating cows. Similarly, Tackett *et al.* (1996) [23], Jones *et al.* (2000) [6] and Mudgal *et al.* (2012) [10] reported that supplementation of fat did not have any effect on dry matter intake of cows. Table-4 showed significantly higher daily cost of feeding (DCF) and total return from sale of milk in group-III and group-II than those of group-I. Higher feed cost was on account of feeding bypass fat. Similarly, significantly higher net return/cow/day from sale of milk was obtained in group-III (Rs. 212.10±16.07) followed by group-II (Rs. 192.75±12.09) and group -I (Rs. 159.71±3.63). However, group-II did not differ significantly from group-I and group-III both. These results are in agreement with Kumari *et. al.* (2018) [8] who reported that significantly higher daily feed cost and total return from sale of milk were recorded in bypass supplemented group in lactating cows. The present findings have indicative of direct beneficial effect of use of bypass fat in lactating cow ration. At the same time, health of lactating cow will also be expected to be better in bypass fat fed lactating cow resulted into healthy birth of calf coupled with better milk production in successive lactation.

Table 3: Analysis of Variance showing the effect of bypass fat feeding on economics of milk production

Source of Variation	d.f.	Mean Squares			
		DMI	DCF	Total return	Net Return
Between bypass fat group	2	0.416^{NS}	2107.425^{**}	16812.22^{**}	7019.384^{*}
Within bypass fat group	27	0.883	198.590	1307.72	1392.512

NS- Non significant; *- $P<0.05$; **-$P<0.01$

Table 4: Effect of feeding bypass fat on economics of milk production

Components	Group-I	Group-II	Group-III	CD Value
Average DMI (kg)	12.06 ± 0.28^{a}	12.33 ± 0.30^{a}	12.46 ± 0.32^{a}	-
DCF/animal (Rs)	180.83 ± 4.16^{a}	199.88 ± 4.43^{b}	209.33 ± 4.75^{b}	12.93
Total Return /animal/day (Rs.)	340.53 ± 6.23^{a}	392.63 ± 13.07^{b}	421.45 ± 13.52^{b}	33.19
Net return /animal/day (Rs.)	159.71 ± 3.63^{a}	192.75 ± 12.09^{ab}	212.10 ± 16.07^{b}	34.24

Mean under same superscript in a row did not differ significantly; Each value is the average of 10 observations

4. Conclusion

The inclusion of bypass fat in the diet of lactating cows significantly increased the milk yield and their different components without affecting the dry matter intake. It is a great benefit to cow keepers because they will get more milk by feeding seme quantities of feed. It was also concluded that there was a progressive increase in milk yield and their components with the increase in the level of bypass fat in the basal diet of lactating cows. On the basis of current findings, it was suggested to supplement bypass fat @ 150 g/day/animal in the basal diet of lactating cow. It was also advice to continue the study further, by supplementing more than 150 g/day/animal bypass fat in the basal diet of lactating cows to know the optimum level of bypass fat in the diet

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