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Effects of peripartum bypass fat supplementation on production performance in dairy cattle

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Abstract
The aim of the present investigation was to study the effect of bypass fat on production parameters (milk yield and milk fat percentage). A total of 40 advance pregnant crossbred dairy cows of 2nd to 5th parity were randomly divided into two groups, control (n=10) and treatment (n=30). The control animals were maintained on a routine standard feeding schedule. The treatment animals in addition to routine standard feeding schedule were supplemented orally daily with extra 100 g of bypass fat (Enerfat, Kemin) for about 2 weeks before expected date of calving and continued one week after calving. The level of bypass fat was then increased as per the milk production @ 10 gram per litre of milk produced until 60 days postpartum limiting to a maximum of 250 gram/day. Average milk yield and fat percentage of the experimental animals were recorded fortnightly up to 60 days of lactation (excluding first 5 days postpartum). Bypass fat supplementation significantly (P<0.05) increased milk fat percentage but had no effect on average milk yield. In this study It was concluded that bypass fat supplementation did not show any beneficial effect on average milk yield but significantly increased milk in fat percentage.

Keywords: Bypass fat, lactation, fat percentage, milk yield

Introduction
Earlier studies have shown that high yielding dairy cows cannot consume adequate nutrients in early lactation to support the level of milk yield. The peak milk production, at about 5-8 weeks postpartum occurs earlier than maximum feed consumption causing cows to be in negative energy balance and to mobilize fat from adipose tissue in early lactation (Bell, 1995; Rukkwamsuk *et al*., 1998; Miyoshi *et al*., 2001; Gutierrez *et al*., 2009) [1, 14, 8, 5]. The difference between the energy supplied with the feed and what is required for maintenance and milk synthesis is referred to as the energy balance and in early lactation it is often negative (Tamminga, 2006) [17].
Role of the bypass fat in the rations of the high producing dairy animals is very crucial for enhancing the energy density of ration (National Research Council, 2001) [10]. Dietary fat, that resists lipolysis and bio-hydrogenation in the rumen by rumen microorganisms, but gets digested in the lower digestive tract, is known as bypass fat or rumen protected fat or inert fat. Considerable literature is also available regarding the daily supplementation of bypass fat that improved milk yield with improved body condition score (BCS) in cross bred cows during early lactation (Wadhwa *et al*., 2012; Gowda *et al*., 2013) [22, 4]. Supplementation of bypass fat to lactating animals either increase milk fat percentage (Thakur and Shelke, 2010; Sirohi *et al*., 2010) [18, 16] or fat is not altered (Naik *et al*., 2009b; Tyagi *et al*., 2009) [9, 20].

Materials and Methods
Experimental design
The experimental cows (n=40) were randomly divided into two groups, control (n=10) and treatment (n=30). The control animals were maintained on a routine standard feeding schedule. The treatment animals in addition to routine standard feeding schedule were supplemented orally daily with extra 100 g of bypass fat (Enerfat, Kemin) for about 2 weeks before expected date of calving and continued one week after calving. The level of bypass fat was then increased as per the milk production @ 10 gram per litre of milk produced until 60 days postpartum limiting to the maximum of 250 gram/day. Average daily milk yield and fat percentage of the experimental animals were recorded fortnightly up to 60 days of lactation. For estimation of milk fat percentage 150 ml milk was sent to laboratory.

Statistical analysis
Data will be statistically analyzed by using't' test (Snedecor and Cocharan, 1994) [17].

Results and Discussion

Milk yield
The average daily milk yield recorded at fortnightly intervals up to day 60 postpartum, are presented in table 1. In the present study, overall mean milk yield between the groups varied non-significantly, that is in agreement with the reports of (Parnerkar *et al*., 2011; Wadhwa *et al*., 2012) [11, 22]. Milk yield was not affected by the dietary supplementation of Ca salts of long chain fatty acids in lactating animals (Castaneda-Gutierrez *et al*., 2005) [3]. Average daily milk production ranged from 13.75±0.71 to 16.7±0.62 kg/d in control and 13.62±0.41 to 17.09±0.38kg/d in treatment group in different fortnights of the experiment. In the control group, milk yield increased significantly up to 3rd fortnight of experiment then increased non-significantly. Same trend was followed by treatment group in different fortnights studied. Fortnightly variations in milk yield between both the groups were non-significant.

Table 1: Fortnightly mean (±SE) milk yield (kg/day/head) (excluding first 5 days postpartum).

Fortnight	Mean milk yield (kg/day/head)	
	Control (n=10)	Treatment (n=30)
1	13.75±0.71^{a}	13.62±0.41^{a}
2	15.0±0.66^{b}	15.26±0.38^{b}
3	16.62±0.67^{c}	16.56±0.39^{c}
4	16.7±0.62^{c}	17.09±0.38^{c}
Overall mean	15.52±0.38	15.63±0.23

Note: Means having different superscripts within column differ significantly (P<0.05).

However, (McNamara *et al*., 2003; Tyagi *et al.*, 2010; Gowda *et al.*, 2013) [7, 21, 4] reported significantly higher average milk yield in bypass supplemented group than non supplemented group. (Yadav *et al.*, 2015) [24] Observed significantly higher overall mean milk yield in prilled fat supplemented group then control group cows.
On the contrary, (Loor *et al*., 2002) [6] noticed reduction in milk yield on feeding calcium salts of long chain fatty acids. While, non-significant increase in mean milk yield on supplementation of bypass fat was reported by (West and Hill, 1990) [23].

Milk fat percentage
The average milk fat percentage recorded at fortnightly intervals up to day 60 postpartum are presented in table 2.

Table 2: Milk fat percentage (mean±SE) at fortnight intervals (excluding first 5 days postpartum).

Fortnight	Mean milk fat percentage	
	Control (n=10)	Treatment (n=30)
1	3.94±0.07^{A}	4.13±0.08^{B}
2	3.88±0.05^{A}	4.10±0.05^{B}
3	3.97±0.06^{A}	4.15±0.06^{B}
4	3.91±0.04^{A}	4.20±0.07^{B}
Overall mean	3.93±0.03^{A}	4.15±0.03^{B}

Note: Means having different superscripts within row differ significantly (P<0.05).

In the present study, overall average milk fat percentage was 3.93±0.03 in control and 4.15±0.03 in treatment group which was significantly higher (P<0.05) in treatment cows over that of control cows. The results of the present study are in agreement with those of previous researchers who reported significant improvement in milk fat content on addition of bypass fat (Thakur and Shelke, 2010; Sirohi *et al.*, 2010; Parnerkar *et al.*, 2011; Rajesh, 2013, Yadav *et al.*, 2015) [19, 16, 11, 13, 24]. The increased milk fat in the supplemented group was probably due to availability of more fatty acids (saturated and unsaturated fatty acids) for absorption in intestine due to protection of fat and these fatty acids are directly incorporated in milk fat after absorption from intestine, leading to increase in milk fat (Shelke *et al*., 2012) [15].
Whereas, some previous researcher did not find any change in milk fat percentage on supplementation of bypass fat supplementation (Purushothaman *et al.*, 2008; Tyagi *et al*., 2009; Shelke *et al*., 2012; Wadhwa *et al.*, 2012) [12, 20, 15, 22].

Conclusion

The result of this study revealed that Bypass fat supplementation significantly (P<0.05) increased milk fat percentage but had no effect on average milk yield. In this study, it was concluded that bypass fat supplementation did not show any beneficial effect on average milk yield but significantly increased milk in fat percentage.

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