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Effects of bypass fat on milk production and biochemical parameters (Calcium and phosphorous) in dairy cattle

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Abstract
The objective of the research was to determine how bypass fat affected the blood's biochemical profile, particularly the levels of calcium and phosphorus, and milk production levels. 40 advanced pregnant crossbred dairy cows with 2nd to 5th parity were randomly divided into two groups; control group (n=10) and treatment group (n=30). The regular feeding schedule for the control animals was followed regularly. For approximately two weeks prior to the expected date of calving and a week more after that following calving, the treatment animals were given daily oral supplements in addition to their regular diet containing an additional 100 g of bypass fat (Enerfat, Kemin). After that, the amount of bypass fat was increased in accordance with milk production, starting at 10 grams per liter of milk produced and continuing for 60 days postpartum, with a daily maximum of 250 grams. Two weeks prior to the expected date of calving (-14), blood samples were collected from each animal on days 0, 10, 20, and 30 of calving, for the estimation of the levels of calcium and phosphorus. The experimental animals' average milk production was recorded every two weeks up to 60 days during lactation. Supplementing with bypass fat did not impact the average milk production. According to the study's findings, supplementing with bypass fat had no positive effects on milk production. Over the following postpartum days, there was an unchanged but non-significant increase in the mean serum levels of calcium and phosphorus.

Keywords: Bypass fat, milk production, biochemical parameters, calcium, phosphorous, dairy cattle

Introduction
Early lactation causes cows to be in negative energy balance and mobilize fat from adipose tissue because peak milk production occurs between 5-8 weeks postpartum, which is earlier than maximum feed consumption (Bell, 1995; Rukkwamsuk *et al*., 1998; and Gutierrez *et al*., 2009) [1, 2, 3]. Due to atony or hypotony of the uterus, the fundamental cause of late uterine involution and the cleansing process might be related to negative energy balance (Kaczmarowski *et al*., 2006) [4]. The significance of fats in metabolism has been better understood recently, and this presents new options to enhance cow reproductive, health, and productivity. Including lipids in the diet during the peripartum period has been shown to enhance the quality of reproduction (Thatcher *et al*., 2006; De Veth *et al*., 2009) [5, 6]. Enhancing the energy density of the diets supplied to dairy animals with high yields is mostly dependent on the bypass fat (National Research Council, 2001) [24]. Without reducing rumen cellulolytic bacterial activity, feeding bypass fat to high-yielding cows can enhance ration energy density and early lactation energy consumption (Jenkins and Palmquist, 1984) [7]. Therefore, the detrimental effects of acute negative energy balance on lactation can be avoided.

Materials and Methods
Location and animals of the experiment
The current study was conducted at an organized dairy farm in Bikaner and department of Veterinary Gynaecology and Obstetrics, collage of Veterinary and Animal science, Bikaner. Forty advance pregnant crossbred dairy cows with parities ranging from second to fifth were included in the study. Gyneco-clinical testing and breeding records were utilized to diagnose the animals selected for the study with advanced pregnancy.

Management of the animals

All of the pregnant cows were kept in hygienic, comfortable sheds and fed green pasture, hay or straw, and formulated concentrate according with their usual feeding schedule. The management, feeding, and hygienic conditions of these animals' accommodations were all the same. Two times a day, at 5:30 a.m. and 5:30 p.m., each cow was milked by a milking machine, and the amount of milk each one produced was recorded. The calves were weaned as soon as they were born.

Experimental design

Two groups, control (n = 10) and treatment (n = 30), were randomly assigned to the experimental cows (n = 40). The routine feeding schedule for the control animals was followed consistently. The treated animals received an extra 100 g of bypass fat (Enerfat, Kemin) orally every day for approximately two weeks prior to the expected date of calving and for an additional week following calving, on addition of their regular standard feeding the schedule. After that, the amount of bypass fat was increased in accordance with milk production, starting at 10 grams per liter of milk produced and continuing for 60 days postpartum, with a daily maximum of 250 grams. Over the following postpartum days, there was an unchanged but non-significant increase in the mean serum levels of calcium and phosphorus.

Bypass fat

Bypass fat used in this study was procured from Kemin Industries South Asia Pvt. Ltd. The product name is EnerFat^{TM} Plus Dry. It is a high-energy supplement made of calcium salts of long-chain fatty acids that come from palm oil. It doesn't harm the ruminal microbiota and is protected from ruminal activity.

Collection of Blood sample

Using sterile vials, jugular vein punctures were used to collect blood samples from each animal. Two weeks prior to the expected date of calving (-14), blood samples were collected from each animal on days 0, 10, 20, and 30 of calving. Soon after the blood was collected, the serum was separated by centrifuging the samples for ten minutes at 3000 rpm. At -20 °C, the serum was kept in sterile plastic storage vials until it was examined for levels of calcium and phosphorous.

Statistical evaluation

A statistical analysis was performed once the data were gathered, organized and revealed. The data were analyzed following standard protocols, as previously mentioned.

Results and Discussion

The outcomes of this study on the impact of supplementing with bypass fat on changes in milk production and levels of calcium and phosphorus.

Milk yield

The average milk production of the experimental animals was recorded every two weeks up to 60 days of lactation. Overall average milk production was 15.52±0.38 kg/d in control and 15.63±0.23 kg/d in treatment group and the difference was no significant (Parnerkar *et al*., 2011; Wadhwa *et al*., 2012) [14, 8]. Throughout the experiment's fortnights, the treatment group's average daily milk production ranged from 13.62±0.41 to 17.09±0.38 kg/d, while the control group's average daily milk production was 13.75±0.71 to 16.7±0.62 kg/d. In the control group, milk production increased significantly until the third fortnight of the trial, at which point it increase non-significantly. The treatment group in each of the trial fortnights adhered to the same schedule. The milk production difference every two weeks between the two groups was not statistically significant. Compared to the non-supplemented group, the bypass supplemented group's average milk production was noticeably higher (McNamara *et al*., 2003; Tyagi *et al*., 2010; Gowda *et al*., 2013) [9, 10, 11]. The mean milk output of the plucked fat supplemented group of cows is observed to be considerably higher than that of the control group (Yadav *et al*., 2015) [12]. Conversely, feeding calcium salts of long-chain fatty acids resulted in a decrease in milk supply (Loor *et al*., 2002) [13]. On the contrary, a non-significant increase in the average milk production following bypass fat addition (West and Hill, 1990) [15].

Serum calcium

At all stages, there was non-significant variation in the mean serum calcium level between the two groups and within each group are in agreement with the reports of Gowda *et al*. 2014 [11]; Waghmare *et al*. 2016 [17]. From day 14 prepartum to the day of calving, the mean plasma calcium levels in the cows in both groups decreased non-significantly (p>0.05). The subsequent postpartum days revealed a progressive but non-significant increase in these levels. The treatment group's mean plasma calcium values have been observed to be significantly higher than those of the control group. According to the present study, supplementation with bypass fat had no discernible effect on the level of blood calcium in cows throughout lactation. The blood's calcium concentration was well within the typical physiological range (8–11 mg/dl). In present findings, the mean serum calcium was in normal physiological limits in both groups, corroborated with normal ovarian cyclicity and uterine involution in both groups. However, non-significantly higher plasma calcium level in bypass fat supplemented group and also reported blood calcium increased with the advancement in lactation in treatment group supplemented with bypass fat (Wadhwa *et al*. 2012) [8].

Serum phosphorus

During the peripartum period, there was a non-significant difference in the mean serum phosphorus level between the control and treatment group cows at all stages of the study is corroborating with the reports of Gowda *et al*. (2014) [11] and Sahoo *et al*. (2016) [18]. From day 14 prepartum to the day of calving, the mean serum phosphorus levels in the cows in both groups decreased non-significantly (p>0.05). The subsequent postpartum days revealed an increasing but non-significant increase in these levels. The treatment group's mean plasma phosphorus values were found to be somewhat higher than those of the control group. There is a partial trend in the mean plasma level of inorganic phosphorus from prepartum to calving and subsequently up to day 30 postpartum (Dhami *et al*., 2005; Gowda, 2014; Theodore *et al*., 2017) [19, 11].

In the present findings, the mean serum phosphorus was in normal physiological limits in both groups, corroborated with normal ovarian cyclicity and uterine involution in both group. Infertility caused by phosphorus insufficiency typically appears after other symptoms of the deficiency are clearly visible. However, phosphorus is frequently associated to reproductive problems in cattle (Pugh *et al*., 1985) [21]. Reduced ovarian activity, irregular estrus, anestrous, a higher prevalence of cystic follicles, a decreased conception rate and

generally lower fertility are all caused by phosphorus deficiency (Maynard *et al*., 1979; Morrow, 1980; Pugh *et al*., 1985) [21]. Wadhwa *et al*. (2012) [8] reported plasma phosphorus levels were non-significantly higher in the group supplemented with bypass fat, while they were considerably higher in the late lactation.

Conclusion

It has been found that supplementing with bypass fat did not increase milk production. Over the subsequent postpartum days, the mean serum levels of calcium and phosphorus increased slightly but not significantly.

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