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Postpartum reproductive efficiency in cows supplemented with rumen bypass fat*

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Abstract

Postpartum infertility due to negative energy balance is a major problem among the high producing cows, incurring a huge economic loss. The present study was aimed to evaluate the effect of supplementation of bypass fat on the reproduction and production parameters of high yielding crossbred cows with or without postpartum hormonal induction of oestrus. The trial was conducted with four experimental groups of six cows each (GI – control, GII- 200 g bypass fat, GIII – 200 g bypass fat daily + Ovsynch protocol, GIV – Ovsynch protocol alone). The animals in GII and GIII were observed to be superior in milk production parameters viz. peak yield (P<0.05), and day of attaining peak yield (P<0.01).There was a significant increase in conception rate in GII and GIII (animals fed with bypass fat) compared to GI and GIV (p<0.05). The calving to conception interval was significantly reduced in those animals fed with bypass fat. The relative economic benefit in animals fed with bypass fat (GII and GIII) was higher compared to others. It was observed that bypass fat feeding is an economically viable and environment-friendly recommendation for improving the productive and reproductive performance of dairy animals.

Keywords: *Crossbred cows, Ovsynch, conception rate, Techno-economics*

In the global scenario, India ranks top in milk production but the reproductive parameters are not at par with global standards. Anoestrus and repeat breeding are two of the major reproductive problems affecting 30 to 40 per cent of total cattle and buffalo population of India. Infertility due

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to negative energy balance in high producing cows during the postpartum period is a major problem in the country. Hormonal induction of oestrus using Prostaglandin F2α (PGF2α) and Gonadotropin-releasing hormone (GnRH) has been found to be beneficial in enhancing reproductive efficiency in cross-bred cows in the postpartum period under field conditions.

Preliminary studies on the effect of supplementation of bypass fat on production have been carried out earlier, but a detailed study on the improvement in the economic parameters of reproduction and techno-economic analysis of supplementation of bypass fat in crossbred cows of Kerala has not been studied in detail.

Hence the present study aimed to evaluate the reproductive performance of high producing crossbred cows supplemented with bypass fat and subjected to hormonal induction of oestrus during the early postpartum period. The techno-economic variables of supplementation of bypass fat have also been calculated and compared.

Materials and Methods

A total of 24 apparently healthy, normally calved, crossbred cattle of similar age and parity with a body score of 3 to 3.5 out of 5 were selected from University Livestock Farm and Fodder Research Station, Mannuthy for the study.

The animals were randomly allotted to four groups of six cows each. All the animals in these four groups were fed as per standard feeding practices based on ICAR recommendations (ICAR, 2013). Animals in Group I was not given any supplementation and kept as control.

The animals in Group II were fed with 200g bypass fat per day (Calcium salt of the long chain fatty acid, supplied by National Dairy Development Board) from 5 days after calving till 90th day along with compounded cattle feed, every morning.

The animals in Group III were fed 200g of bypass fat per day from 5thday of calving till 90thday along with compounded cattle feed every morning. In addition, they were subjected to Ovsynch protocol on day 45 of calving as described earlier (Hagen *et al*., 2015). Briefly, 10 µg of GnRH analog (Buserelin acetate - *Receptal, Intervet*, *India*) were administered intramuscularly (i/m) on day 45 postpartum followed by 500 µg Cloprostenol (*Pragma, Neovet, India*) on day 52 postpartum. A second dose of GnRH analog, 10 µg i/m on day 54 was administered, followed by timed artificial insemination at 16 h after the second dose of GnRH.

Animals in Group IV were not supplemented with bypass fat. But they were subjected to Ovsynch protocol on day 45 postpartum. All the animals in Groups I and II were inseminated during natural oestrus exhibited after day 45 postpartum. Animals in Groups III and IV were subjected for timed AI.

Pregnancy was diagnosed on day 30 post-breeding by ultrasonography and confirmed on day 45 by per rectal examination. Embryonic loss if any was also ascertained. Number of AI for conception, day of achieving peak yield, peak yield (in Kg), cost of hormone and professional charges, cost of feeding bypass fat were calculated. The standardmilk yields of animals were estimated using the regression formula, (Lactation yield = Peak yield x 215.5) developed by Kerala Veterinary and Animal Sciences university (KVASU, 2016).

The techno-economic impact of bypass fat supplementation by virtue of improvement on reproductive performance and enhancement on production was also analyzed. The data recorded were analyzed statistically (Snedecor and Cochran, 1994) using statistical software SPSS (*SPSS, Version 14, USA*).

Results and Discussion

Conception rate of animals

Conception rate the in the first insemination is furnished in Table 1. There was a significant increase in conception rate in GII and GIII (animals fed with bypass fat) compared to GI and GIV ($p<0.05$).

Among those animals not supplemented with bypass fat (group I and IV), only one animal each conceived, and the service period was 80 and 54 days, respectively. Among those animals supplemented with bypass fat, more than fifty percent animals conceived before 60 days. The service periods of all the experimental animals are given in Table 2.

Calving to conception interval

At the same time, the conception rate was higher for the III group than the other three groups. There was a considerable reduction in calving to conception interval in animals fed with bypass fat with respect to first insemination pregnancy outcomes. It is noteworthy that animals under hormonal treatment alone without bypass fat feeding did not provide any considerable results.

Table 1. Conception rate observed in selected animals

S. No.	Group (n=6)	Pregnant	
		No.	%
1	I	1	16.67
2	II	3	50
3	III	4	66.67
4	IV	1	16.67

Table 2. The calving to conception interval (CCI) in different groups

S. No.	Animal No.	Days of conception			
		GI	GII	GIII	GIV
1	1	80	57	54	Nil
2	2	Nil	46	54	Nil
3	3	Nil	Nil	54	Nil
4	4	Nil	49	Nil	Nil
5	5	Nil	Nil	54	54
6	6	Nil	Nil	Nil	Nil

Table 3. Milk production parameters of animals

S. No.	Group (n=6)	Day of achieving peak yield (Mean ± SE)	Peak yield obtained (Kg) (Mean ± SE)	Total Lactation Milk Yield* (Kg)
1	I	40.5 ± 3.60	14.08 ± 1.77	3034.24
2	II	18.17 ± 3.32	15.13 ± 1.34	3260.52
3	III	28.17 ± 5.02	15.10 ± 1.28	3254.05
4	IV	32.17 ± 3.77	14.68 ± 1.07	3163.54

*Calculated based on the regression formula as per KVASU package of practices

Table4. The relative cost benefit analysis of feeding bypass fat in different groups

S. No.	Item	GI	GII	GIII	GIV
I	**Relative cost incurred** (GI as standard)				
a	Cost of bypass fat (85 days @ 200 g daily - Rs. 240 per Kg	0	4080	4080	0
b	Cost of Hormones (GnRH and PGF2α)	0	0	510	510
c	Professional charges (3 visits)	0	0	600	600
	Total relative cost	**0**	**4080**	**5190**	**1110**
II	**Relative Savings (GI as standard)**				
a	Savings on conception (In GI – 5000; GII-15000; GIII-20000; GIV – 5000)	0	10000	15000	0
b	Savings from extra milk yield (Groups without fat feeding were taken as standard and the extra yield (Kg) in GII – 226.28; GIII – 219.81; GIV – 129.3)	0	9730.04	9451.83	5559.9
	Total savings	**0**	**19730.04**	**24451.83**	**5559.9**
III	**Relative benefit of fat feeding (Group)**	**0**	**15650.04**	**19261.83**	**4449.9**
	Relative benefit of fat feeding (Per Animal)	**0**	**2608.34**	**3210.31**	**741.65**

Previously, Ferguson *et al*. (1990), Sklan and Tinsly (1993) and McNamara *et al*. (2003) recognized considerable improvement in conception rate in animals supplemented with bypass fat. Among crossbred cows also, Kaur and Arora (1995) observed that supplementation of bypass fat has considerably increased the conception rate and minimized the days open.

Two theories are reported in animals responsible for improving the conception rate through dietary supplementation of bypass fat. The important postulation is that obviously, fat feeding improves the energy status of animals, which augment the secretion of gonadotropins from the pituitary and promoting follicular growth (Mattos *et al*., 2000). Generally, cows in negative energy balance have prolonged postpartum anestrus (Randel, 1990) and reduced frequency of LH pulses, which is essential for the development of graffian follicles (Schillo, 1992). The increased energy provided by the dietary supplementation of fat improves the LH secretion, thereby improving the reproductive performance (Hightshoe *et al*., 1991; Sklan *et al*., 1993). Another hypothesis is that improvement in reproductive performance is independent of the energy status of animals. It was reported that fat supplementation increased a total number of follicles and increased the size of preovulatory follicles (Wehrman *et al*., 1991; Lammoglia *et al*., 1996) irrespective of the energy status of animals (Mattos *et al*., 2000). Our studies are concomitant to both the hypotheses, where the energy status of animals enhanced, which considerably improves the reproductive performance of animals.

Embryonic Loss

The incidence of embryonic loss was not noticed in any of the animals in GI, GII, and GIII, whereas as in GIV, one animal confirmed pregnant by ultrasonographic examination on day 30, was observed to be negative for pregnancy on day 60. Hence embryonic loss was confirmed in the animal which might be resulted from the negative energy balance in the animal, as reported earlier by Parmar *et al.* (2016).

Peak milk production parameters

The mean days on which the animals came to peak production in group I, II, III, and IV were 40.5, 18.17, 28.17 and 32.17, respectively. Animals in group II and III achieved peak yield significantly earlier compared to group I and IV ($p<0.05$). Similarly, the peak yield obtained were significantly higher in animals fed with bypass fat feed, compared to those did not feed bypass fat. The total lactation milk yield estimated using the regression formula developed by KVASU indicated that bypass fat feeding is beneficial in terms of total milk production also (Table 3).

The results of present are inconsistent with the earlier observations of Fahey *et al*. (2002), Schroeder *et al*. (2002), McNamara *et al*. (2003) and Tyagi *et al*. (2010) in cows and Pollidori *et al*. (1997) and Tyagi *et al*. (2009) in buffaloes which reported improvement of milk production in animals supplemented with rumen-protected fat.

Techno-economics of bypass fat supplementation

The economic advantages of different treatments were compared taking the non-fat feeding, non-hormonal treated group (GI) as standard. For estimating different cost benefit factors, the following values were considered. Cost of bypass fat – Rs. 240 per Kg; Cost of GnRH (5 ml) – Rs. 350; Cost of PGF2α (2 ml) – Rs. 160; Professional charges for one visit – Rs. 200; Cost of milk – Rs. 43 per Kg; Savings on conception – Rs. 5000 per animal if conceived within study period.

The total cost incurred and the benefits of feeding bypass fat are summarized in Table 4. From the table, it can be seen that feeding bypass fat has a financial advantage over the other group. Same time it was also observed that feeding bypass fat alone is comparable to that combined with hormonal treatment in an economical point of view. On the other hand, the animals in group IV, which were undergone hormonal treatment alone did not yield considerable economic benefit.

These results are in concomitant

with earlier study reports of Yadav *et al*. (2015) and (Mane *et al.,* 2016) who observed better economic benefits from feeding bypass fat to dairy animals.

The results of present study indicate that bypass fat feeding improves the production and reproduction performance of postpartum dairy animals. It can be concluded that bypass fat feeding is an economical and environment-friendly recommendation for improving the reproductive efficiency of high producing crossbred cows.

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