RESEARCH ARTICLE

Effect of Supplementation of Bypass Fat and Mineral Mixture on Uterine Involution and Fertility in Gir Cows

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Abstract

The study was carried out on 18 advanced pregnant Gir cows, under two treatment (Group I, II) and control (Group III) groups, 6 cows in each. The cows under Group III were maintained as per routine farm feeding schedule, while cows under Group I and II were supplemented with mineral mixture containing rumen protected methionine and lysine @ 50 g/day/head. Additionally, animals in group I were supplemented with bypass fat @ at least 100 g/d/h during 30 days prepartum till 60 days postpartum. The postpartum reproductive events were monitored by USG (5-10 MHz linear array transducer). The mean cervical diameter and wall thickness in cows under control Group III were the highest on all days postpartum as compared to nutrient supplemented groups I & II. The values on day 7 were highest in all three groups and decreased gradually ($p<0.01$) on days 14 and 28/42 postpartum. The mean diameter and wall thickness of gravid uterine horn were not influenced by the nutrient supplementation in cows, and the values in all groups decreased gradually ($p<0.01$) from day 7 to 14 till day 28 postpartum, which thereafter did not vary much. The mean period of uterine involution and days for first estrus postpartum in treated Group I and II were significantly ($p<0.05$) lower than control Group III, with inverse finding on mean service period and conception rate (83.33, 33.33 and 16.66% in Gr I, II, III, resp) by day 120 postpartum. The bypass fat and mineral mixture supplementation had positive effects on uterine involution, early onset of postpartum estrus, better conception rate and reduced service period.

Key word: Bypass fat, Cattle, Conception rate, Involution, Mineral supplement, Peripartum.

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Introduction

The puerperium activities such as shrinking of the uterus with regular myometrial contractions that promote the elimination of lochia, which consists of placental fluids, blood tissue debris and endometrial exudates, overall reduce the smooth muscle mass (Slama *et al*., 1991). The structure of the endometrium and deeper layers of the uterine wall is restored along with resumption of ovarian activity and elimination of bacterial contamination (Noakes *et al*., 2001). Uterine involution and diameter of uterine horns can be monitored using the transrectal ultrasonography (Parikh *et al*., 2017). Supplementation of bypass fat in periparturient period could reduce the detrimental effects of negative energy balance (NEB), which could improve reproductive performance, milk production and the persistency of lactation. Oldick *et al.* (1997) reported that the days postpartum till first ovulation were reduced after feeding extra-glycogenic nutrients. Also, the days required for complete uterine involution were reduced by extra-supplementation of bypass fat in buffaloes (Ramteke *et al.,* 2014). Therefore, it was planned to make use of this knowledge and incorporate macro-micronutrients as well as bypass fat in the ration during the transition period to hasten the uterine involutionary changes and fertility post-calving in Gir cows of an organized farm.

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Materials and Methods

Eighteen advanced pregnant Gir cows maintained in standard condition were selected from the Muniseva ashram farm, Goraj, Waghodiya (Gujarat) and randomly distributed equally under three groups, each of 6 cows. Group III (control) animals were managed as per routine farm feeding schedule. The ration of animals of group I and II was supplemented with mineral mixture containing rumen protected methionine and lysine @ 50 g/day/head for 30 days prepartum and 60 days postpartum, in addition to routine farm feeding schedule. Moreover, animals in group I were also supplemented with by-pass fat @ 100 g per day with concentrates for 4 weeks prepartum and up to 2 weeks postpartum, and then it was increased as per the milk production @ 10 g/litre of milk produced, with maximum 150 g/head/day till 60 days postpartum. The transrectal ultrasonography (5-10 MHz linear array transducer designed for intra-rectal placement) was carried out on 7th, 14th, 28th, 42nd and 60th day postpartum in all selected animals to observe the cervical diameter (cm), cervical wall thickness (cm), gravid and non-gravid uterine horn diameter (cm) and wall thickness (cm). The animals exhibiting estrus were bred by natural service and followed up to 120 days for postpartum for reproductive traits, *viz.,* uterine involution, first estrus and fertile estrus postpartum/conception.

The data generated on the involutionary changes in cervix and uterus, postpartum fertility parameters were analysed by ANOVA and Duncan's *post hoc* Multiple Range Test using SPSS 20.0 software.

Results and Discussion

In the present study, the mean cervical diameter in cows under control Group III was the highest on all days postpartum compared to nutrient supplemented groups I and II, though it did not vary significantly at any interval. Further, the values decreased gradually and significantly (p<0.01) from day 7 to days 14 and 28/42 postpartum, and thereafter it got stabilized. The mean thickness of cervical wall in the cows of all three groups were identical on all postpartum intervals, and the values reduced (p<0.01) gradually from day 7 up to day 28 postpartum, with no appreciable changes thereafter (Table 1). The observed trends of reduction in the mean cervical diameter on different days postpartum in the present study were in agreement with the findings of Jadhav (2005) in Gir cows.

The perusal of the data of cervical wall thickness in all the groups including control and treatment, revealed that the nutrient supplementation had no any appreciable effect on this parameter, and the wall thickness was reduced significantly from day 7 till day 28 postpartum in all groups, without further appreciable reduction. This is a sign of completion of uterine involution by 28 days, however, the fact remains that the involution process was still in progress since the cervical wall thickness continued to decrease until 42 days after delivery (Table 1). The decreasing trend in wall thickness of cervix observed corroborated well with the findings of Sutaria *et al*. (2014) in Kankrej cows.

The ultrasonographic measurements of diameter of gravid uterine horn evinced a decreasing trend from day 7 to day 60 postpartum in cows under all 3 groups. The mean diameters of gravid uterine horn in the treated Gir cows (Group I, II) were observed to be significantly lower (p<0.05) on days 14 and 28 postpartum as compared to the cows under Group III (Table 2), suggesting enhanced uterine involution in supplemented groups. The observed trend of diameter of gravid uterine horn in the present study concurred well by the finding of Jadhav (2005) in Gir cows.

Table 1: Mean ultrasonographic measurements (cm) of cervical diameter and wall thickness in postpartum cows under nutrient supplemented (treatment) and control groups

Days post-partum	Cervical diameter (cm)			Cervical wall thickness (cm)		
	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group I (n=6)	Group II (n=6)	Group III (n=6)
7	4.45^{a} ±0.22	4.57^{a} ±0.23	5.05^{a} ±0.19	1.34^{a} ±0.06	1.52^{a} ±0.14	1.54^{a} ±0.11
14	3.55^{b} ±0.26	3.54^{b} ±0.14	4.01^{b} ±0.17	0.98^{b} ±0.04	1.07^{b} ±0.05	1.08^{b} ±0.07
28	2.82^{c} ±0.31	2.95^{c} ±0.16	3.22^{c} ±0.19	0.68^{c} ±0.04	0.65^{c} ±0.05	0.71^{c} ±0.05
42	2.43^{cd} ±0.24	2.56^{cd} ±0.13	2.66^{d} ±0.17	0.60^{cd} ±0.04	0.54^{c} ±0.03	0.63^{c} ±0.05
60	2.05^{d} ±0.13	2.31^{d} ±0.09	2.40^{d} ±0.21	0.55^{d} ±0.03	0.50^{c} ±0.03	0.58^{c} ±0.03

n= Number of animals; Means bearing uncommon superscript within the column (a,b,c) differ significantly (P<0.01).

Table 2: Mean ultrasonographic measurements (cm) of gravid uterus diameter and wall thickness in postpartum Gir cows under nutrient supplemented (treatment I, II) and control (III) groups

Days post-partum	Gravid uterus diameter (cm)			Gravid uterus wall thickness (cm)		
	Group I (n=6)	Group II (n=6)	Group III (n=6)	Group I (n=6)	Group II (n=6)	Group III (n=6)
7	5.42^{a} ±0.05	5.42^{a} ±0.05	5.33^{a} ±0.03	1.67^{a}± 0.03	1.68^{a} ±0.03	1.71^{a} ±0.04
14	3.68^{bq} ±0.05	3.68^{bq} ±0.05	3.85^{bp} ±0.04	0.97^{b}± 0.05	0.99^{b} ±0.02	1.08^{b} ±0.05
28	2.07^{cq} ±0.08	2.14^{cq} ±0.08	2.31^{cp} ±0.05	0.65^{c}± 0.02	0.66^{c} ±0.02	0.69^{c} ±0.03
42	1.64^{d} ±0.03	1.64^{d} ±0.03	1.69^{d} ±0.04	0.52^{d}± 0.02	0.53^{d} ±0.01	0.53^{d} ±0.02
60	1.61^{d} ±0.02	1.62^{d} ±0.02	1.62^{d} ±0.03	0.50^{d}± 0.01	0.50^{d} ±0.01	0.50^{d} ±0.01

n= Number of animals; Means bearing uncommon superscript within the column (a, b, c, d) differ significantly (P<0.01); Means bearing uncommon superscript within the row (p, q) differ significantly (P<0.05).

Table 3: Mean reproductive parameters (days) in postpartum Gir cows under nutrient supplemented (treatment) and control groups

Groups	Postpartum reproductive parameters				
	Uterine involution period (days)	First postpartum oestrus (days)	Service period (days)	Per cent conception	
				<120 D	>120 D
Group I (n=6)	31.67 ± 1.31^{q}	54.83 ± 2.86^{q}	97.67 ± 8.55^{q}	83.33(5/6)	17.67(1/6)
Group II (n=6)	33.00 ± 1.34^{q}	55.33 ± 2.51^{q}	121.17 ± 8.80^{q}	33.33(2/6)	66.67(4/6)
Group III (n=6)	38.17 ± 2.29^{p}	65.17 ± 2.21^{p}	154.17 ± 11.77^{p}	16.66(1/6)	83.33(5/6)
Overall (n=18)	**34.28±1.15**	**58.44±1.80**	**124.33±7.74**	**44.44**	**63.66**

n= Number of animals; Means bearing uncommon superscript within the column (p, q) differ significantly (P<0.05).

The mean wall thickness of gravid uterine horns observed during different days postpartum was found to be statistically similar between all the three groups. The mean values of wall thicknesses of gravid uterine horn in the cows under all three 3 groups reduced gradually and highly significantly (p<0.01) from day 7 up to day 42 postpartum with slightly larger values in control group III. Thereafter, no appreciable changes in the mean thickness of the uterine horn were observed (Table 2). These findings revealed a progressive reducing trend in wall thickness of gravid uterine horn throughout the period of observations in Gir cows concomitant with the rate of uterine involution. These findings were in agreement with the observations reported by Sutaria *et al*. (2014) in Kankrej cows.

The mean diameters and wall thickness of non-gravid uterine horns in cows under all three groups followed the same trend as those of gravid horns, with somewhat faster reduction in values as compared to the contralateral gravid horns. The present findings corroborated well with the observations made by Lin *et al*. (2021) in Chinese Holstein cows.

The mean period needed for the uterine involution was found to be significantly lower (p<0.05) in the cows under Group I and II than that in Group III, however, the difference between the means of treatment groups being non-significant. Comparatively shorter involution period recorded in the Gir cows under treatment groups can be ascribed to the positive effect of supplementing the cow during their postpartum period with bypass fat and mineral mixture together or mineral mixture alone. The present findings supported well the earlier observations made by Nirwan *et al*. (2003) in crossbred cows, who reported that the providing feed supplementation/ bypass fat to the animals improved the uterine involution process.

The mean interval for occurrence of first postpartum estrus was significantly longer (p<0.05) in control cows under Group III as compared to the treated cows under Group I and II, with the difference between the later groups being non-significant (Table 3). The reduced interval for first postpartum estrus obtained in the present study for nutrient supplemented cows (Group I, II) as compared to the control cows (Group III), clearly indicated that peripartum supplementation of nutrient had a positive effect on the interval required for onset of first postpartum estrus. The present findings of mean interval for onset of first postpartum estrus in treated cows were in agreement with the reports of Karimi *et al*. (2023) in Holstein cows.

The mean service period was recorded to be the highest (p<0.05) in cows under control Group III followed by Group II and I, with the difference between the later two groups being statistically non-significant. The comparatively lower mean service period recorded in the cows supplemented with nutrients (Group I, II) than the control, clearly indicated that peripartum supplementation of nutrient had a positive effect on reducing the service period. Further, the Gir cows covered under Group I supplemented with bypass fat and mineral mixture with rumen protected essential amino acids had apparently reduced service period than the cows under Group II supplemented with mineral mixture alone, firmly suggestive of contributory effect of feeding the bypass fat. The present findings of mean service period corroborated well with the results reported by Khalil *et al.* (2012) in lactating cows.

The conception rates by 120 days postpartum observed in the Gir cows under Group I and II and Group III in the present study were 83.33, 33.33 and 16.66 %, respectively. These results were in agreement with the findings of Theodore *et al*. (2016) in HF crossbred cows. The methionine plus lysine at higher amounts to rations of the cows at transition periods is shown to protect the animals against liver lipid accumulation, increase milk production and protect cows against the development of the periparturient diseases Grummer (1993) as seen in the present study.

The additional supplementation of fat increases basal serum insulin concentrations in dairy cows (Palmquist and Moser, 1981), which plays a role in mediating increased follicular growth, either directly through its own receptor or indirectly by modulating granulosa cell IGF-I production which is required for follicle development (Rahbar *et al*., 2014). The positive and beneficial effect observed may be due to the improvement in energy status and synthesis of precursors like insulin and IGF-I in the Gir cows for ultimate production of hormones such as steroids and $PGF_2\alpha$.

Conclusion

It can be summarised that the Gir cows supplemented with a combination of bypass fat and mineral mixture fortified with rumen protected methionine and lysine had a beneficial effects with regards to shorter intervals required for uterine involution, the earlier resumption of ovarian activity, higher conception rate and curtailed service periods as compared to control Gir cows, that were maintained only on routine farm feeding.

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