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Effect of Supplementing Rumen Protected Choline and Fat during Transition Period on Body Parameters of Periparturient Gir Cows

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ABSTRACT

The present experiment was carried out on 24 advanced pregnant Gir cows to evaluate the effect of peripartum supplementation of rumen protected choline (RPC) and rumen protected fat (RPF) alone and in combination on body parameters of Gir cows. The cows were divided into 4 treatment groups (n=6 in each) on the basis of their parity, body weight and previous lactation yield. Cows in T1 group (control) were fed basal diet, in T2, T3 and T4 groups were additionally supplemented with RPC @ 45 g/day, RPF @ 80 g/d and RPC @ 45 g/day + RPF @ 80 g/d along with basal diet, respectively starting from 30 ± 15 days before expected date of calving to 60 days postpartum. Overall mean fortnightly body weight (kg) and body condition score were significantly (P<0.001) higher in T2 and T3 groups as compared to T1 (control) group indicating that supplementation of RPC and RPF alone during peripartum period improves body weight and body condition score of periparturient Gir cows, while supplementing RPC and RPF in combination did not show any synergistic effect on body parameters.

KEYWORDS: Body weight, Body condition score, Rumen protected choline, Rumen protected fat, Transient Gir cows

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INTRODUCTION

Negative energy balance (NEB), an important characteristic of transi-tion cows is a normal adaptive mechanism in high yielding dairy cows which occurs due to the gap between the energy requirements and its availability particularly during peripartum period and in early lactation. Dairy cows mobilize their adipose tissue reserve through lipolysis to adapt with NEB resulting into loss in the body weight and condition (Hartwell et al., 2000). As a result of lipolysis, more non-esterified fatty acids are drained towards liver (Drackley et al., 2014) which gets re-esterified and accumulated as triacylglycerol in the liver (LeBlanc, 2010) and cow is likely to experience fatty liver syndrome (Bobe et al., 2004). Such conditions also predispose dairy cows to metabolic and microbial diseases such as milk fever, endometritis, ketosis, displaced abomasum and retained placenta (Duffield, 2000). Hence, managing cows during transition period and in early lactation plays a crucial roles in coping the deleterious effects of NEB or in reducing incidences of NEB which may be achieved by supplementing choline or fat in the diet of transient dairy animals. Choline is involved in the metabolism of fatty acids in the liver and serves as a methyl donor (Shahsavari et al., 2016). It contributes to fat export from the liver through synthesis of very low density lipoprotein (Acharya et al., 2019[b]), thereby improving the fat metabolism for better energy production. Choline present in most of the feedstuffs of dairy cattle get extensively degraded by rumen micro-organisms (Sharma and Erdman, 1989), it must be supplemented in rumen protected form (Elek et al., 2008). Supplementing fat in protected form to high producing lactating cows can enhance energy density of ration and energy intake in early lactation without compromising rumen cellulolytic bacterial activity (Thakur and Shelke,

2010) and reduces the deleterious effect of NEB during early lactation (Ganjkhanlou et al., 2009; Sirohi et al., 2010). Nutritional status of animal and their management for optimal performance can be assessed through body condition score (BCS), and at the time of calving BCS is reported to be a reliable indicator of reproductive performance of animal (Baruselli et al., 2001). Considering the role of choline and fat in rumen protected form for the transitional dairy cows, the present study was aimed to evaluate the effect of peripartum supplementation of rumen protected choline (RPC) and rumen protected fat (RPF) alone and in combination on body parameters in Gir cows.

MATERIAL AND METHODS

Present study was carried out at the Department of Animal Nutrition, College of Veterinary Science & Animal Husbandry, Kamdhenu University, Junagadh (21.5°N 70.4°E; 107 meter above sea level) in collaboration with Cattle Breeding Farm, Junagadh Agricultural University, Junagadh (India), following ethical approval by the Institutional Animal Ethics Committee of the college, vide approval No. JAU/JVC/ IAEC/LA/64/2020 dated 04/08/2020.

Selection of animals and design of experiment

Twenty-four advanced pregnant Gir cows in their first to third lactation were randomly divided into four treatment groups (n=6 in each) on the basis of their parity, body weight and previous lactation yield. Cows in T1 group (control) were fed control diet comprising of 250 g maize *bhardo* (ground maize), 10 kg green sorghum (*Sorghum bicolor*), mature mixed local pasture grass hay *ad lib*., and compound cattle feed and cotton seed cake to meet their nutrient requirement as per ICAR (2013) feeding standards. Additionally, cows in T2 group were supplemented with RPC @ 45 g/day, in T3 group with RPF @ 80 g/d and in T4 group with RPC @ 45 g/day + RPF @ 80 g/d, starting from 30 ± 15 days before expected date of calving to 60 days postpartum. All the cows were maintained in well ventilated hygienic sheds and wholesome drinking water was provided *ad lib* to them. Proximate composition of feeds and fodders offered to experimental cows is given in Table 1.

Table 1. Proximate composition of feed ingredients (% DM basis)

Nutrients	Compound cattle feed	Cotton seed cake	Maize bhardo	Sorghum green	Dry mixed mature pasture grass
DM	90.3	92.5	91.0	24.3	92.1
OM	87.6	94.2	97.4	92.1	91.3
CP	20.4	20.7	10.8	5.58	3.10
EE	3.65	8.43	3.41	2.90	1.16
CF	10.6	33.2	2.97	32.0	39.8
NFE	52.8	31.7	80.2	51.6	47.3
Total Ash	12.4	5.79	2.57	7.87	8.61

Observations recorded

Body weight

The experimental cows were weighed on an electronic platform balance for large animals having accuracy of ± 500 gm at every for two consecutive days before feeding and watering for entire experimental period and then the average value was taken for the record purpose.

Body condition score (BCS)

The BCS of the Gir cows was recorded at every fortnightly interval by using a simple 5-point scale visual technique developed by Edmonson et al. (1989). Cows having varying degrees of fat cover at eight different locations viz., spinous processes, depression between the spinous and transverse processes, transverse processes, overhanging shelf

formed by the transverse processes above the flank, tuber coxae (hooks) and tuber ischii (pin bones) body prominences, depression between the hook and pin bones, depression between the hooks, spinous and transverse process of the coccygeal vertebrae and ischiorectal fossa were scored a numerical value from 1 to 5. A score of one indicated an emaciated condition and a score of five indicated an obese condition.

Statistical analysis

The data were analyzed by two-way analysis of variance for treatment and period effects (Snedecor and Cochran, 1994). Pair-wise mean differences between groups were compared by Tukey's post-hoc test for significance at $p<0.05$.

RESULTS AND DISCUSSION

Body weight

The average fortnightly body weight (kg) in different treatment groups are given in Table 2. The overall average body weights for different groups were recorded as 371 ± 23.4, 413 ± 16.5, 431 ± 19.2 and 384 ± 20.3 kg for T1, T2, T3 and T4 group, respectively. Supplementation of RPC and RPF alone had significant ($p<0.001$) effect on body weight of cows, as body weight was significantly ($p<0.001$) higher in T2 and T3 group as compared to T1 and T4. The BW of T1 and T4 was comparable. The period effect was non-significant ($p>0.05$) on body weight of Gir cows during peripartum period.

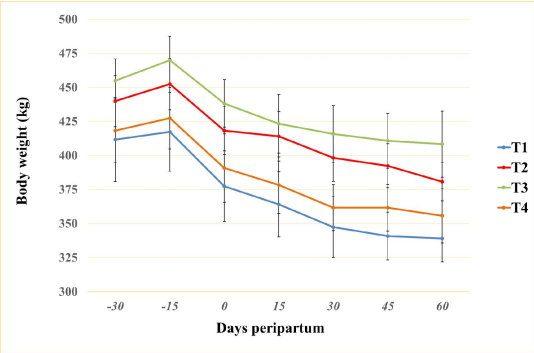
Table 2. Effect of RPC and RPF supplementation on body parameters of periparturient Gir cows

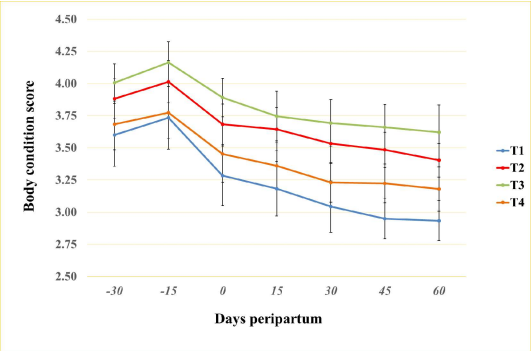
Peripartum Days	Dietary treatment groups			
	T1	T2	T3	T4
		Body weight (kg)		
-30	411.6 ± 30.92	440.0 ± 18.75	455.0 ± 16.02	418.3 ± 23.26
-15	417.5± 28.95	452.5 ± 18.83	470.0 ± 17.70	427.5 ± 22.54
0	377.5 ± 25.88	418.3 ± 17.64	438.3 ± 17.45	390.8 ± 25.05
15	364.1 ± 23.92	414.1 ± 18.14	423.3 ± 21.43	378.3 ± 20.68
30	347.5 ± 22.43	398.3 ± 17.35	415.8 ± 20.99	361.6 ± 16.87
45	340.8 ±17.58	392.5 ± 16.11	410.8 ± 20.10	361.6 ± 17.01
60	339.1 ± 17.34	380.8 ± 13.99	408.3 ± 24.18	355.8 ± 20.02
Overall***	371.1^{a}± 23.46	413.8^{b}±16.55	431.6^{b}±19.24	384.8^{a}±20.38
		Body condition score		
-30	3.60^{AB} ± 0.25	3.88± 0.16	4.01± 0.15	3.68± 0.20
-15	3.73^{B} ± 0.24	4.01± 0.17	4.16± 0.16	3.77± 0.20
0	3.28^{AB} ± 0.23	3.68± 0.16	3.89± 0.15	3.45± 0.22
15	3.18^{AB} ± 0.21	3.65± 0.17	3.75± 0.19	3.36± 0.18
30	3.04^{AB} ± 0.20	3.53± 0.15	3.69± 0.18	3.23± 0.15
45*	2.95^{aA} ± 0.16	3.48^{ab}± 0.14	3.66^{b}± 0.18	3.22^{ab}± 0.15
60*	$2.93^{a\,A}$ ± 0.16	3.40^{ab}± 0.13	3.62^{b}± 0.21	3.18^{ab}± 0.17
Overall***	3.25^{a}± 0.20	3.66^{bc}± 0.15	3.83^{b}± 0.17	3.42^{ac}± 0.18

T1 Control; T2 RPC; T3 RPF, T4 RPC + RPF. *$p<0.05$, ***$p<0.001$

Means bearing different small superscripts (a, b, c) within the row and capital superscripts (A, B) within the column differ significantly ($p<0.05$)

Figure 1. Effect of RPC and RPF supplementation on body parameters of periparturient Gir cows





The findings of the present study revealed significant positive effect on the body weight when RPC and RPF fed alone. Amrutkar et al. (2015) observed similar significant increase in the body weight gain post-calving in crossbred cows supplemented with RPC @ 54 g starting from 40 days before and 120 days after calving. Significant difference between the groups on the average body weight in dairy cattle supplemented with RPC was also reported by Davidson et al. (2008) and Pandurang (2012). Gupta et al. (2019) reported that supplementation of RPC before calving reduced post-calving body weight loss in RPC supplemented group than in control group. Peripartum supplementation of RPF was also reported to have beneficial effect on body weight where significantly ($p<0.05$) higher average body weight of supplemented cows in comparison to control group was recorded (Yadav et al. 2015). Similarly, Gowda et al. (2013) and, Mathew and Zachariah (2014) also reported supplementation of bypass fat to be effective in preventing weight loss in crossbred dairy cows during initial 90 days of lactation. However, in contrary some researchers did not find significant effect of supplementing either RPC (Zom et al., 2011; Leiva et al., 2015; Acharya et al., 2019[a]) or RPF (Wadhwa et al., 2012; Singh et al., 2014) on body weight in transient or early lactating dairy cows.

Body condition score (BCS)

The mean BCS in cows of all the groups were the highest at a fortnight before calving and then gradually reduced till 60 days postpartum. However, the differences were statistically significant ($p<0.05$) only in control T1 group 45th day onward postpartum. The overall mean BCS recorded for T1, T2, T3 and T4 groups were 3.25 ± 0.20, 3.66 ± 0.15, 3.83 ± 0.17 and 3.42 ± 0.18, respectively (Table 1). Significant ($p<0.001$) effect of supplementing RPC and RPF alone on BCS of cows was observed. It was higher ($p<0.05$) in T3 followed by T2 group as compared to control group. Mean BCS of T4 was at par with T1 and T2 group, while it was lower ($p<0.05$) than that of T3 group. Significant effect of the treatment on BCS was observed particularly from 45th day postpartum till the end of the experiment. Results indicated significant positive effect on the BCS of periparturient Gir cows when RPC and RPF fed alone, while its combination did not reveal any significant effect on BCS.

These results regarding improvement in BCS upon RPC supplementation are in agreement with Gupta et al. (2019) who reported that feeding of RPC during transition period improved BCS of the high yielding dairy cows as compared to control group. Similarly, Lima et al. (2007) also reported improvement in BCS of experimental cows supplemented with RPC @ 15 g/day. However, many researchers (Davidson et al., 2008; Zom et al., 2011; Pandurang, 2012; Amrutkar et al., 2015; Leiva et al., 2015; Acharya et al., 2019[a]) reported non-significant effect of RPC supplementation on BCS of periparturient dairy cows. Gowda et al., 2013; Mathew and Zachariah, 2014; Rajesh et al., 2014 and Mane et al., 2016 also reported higher BCS in the cows supplemented with bypass fat than that of non-supplemented cows during transition period.

Similarly, Singh et al. (2014) and Yadav et al. (2015) also reported significantly ($p<0.05$) higher BCS in the cows supplemented with prilled fat. However, Ganjkhanlou et al. (2009) and Naik et al. (2009) reported non-significant effect of supplemental bypass fat on BCS of lactating dairy cows.

CONCLUSION

On the basis of results obtained in the present study, it can be concluded that RPC and RPF can be supplemented individually during peripartum period to maintain Gir cows in desirable state during transition period and in early lactation. It is further inferred that combination of RPC and RPF does not have any synergistic effect on body parameters.

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