The Pharma Innovation Journal 2019; 8(9): 438-442

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2019; 8(9): 438-442

www.thepharmajournal.com
Received: 28-07-2019
Accepted: 30-08-2019

AJ Shankare Gowda
Assistant Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Hassan, Karnataka, India

M Devaraj
Former Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Bangalore, Karnataka, India

Correspondence
AJ Shankare Gowda
Assistant Professor and Head, Department of Veterinary Gynaecology and Obstetrics, Veterinary College, KVAFSU, Hassan, Karnataka, India

The body condition of periparturient dairy cattle fed with propylene glycol, bypass fat-and protein

AJ Shankare Gowda and M Devaraj

Abstract
The present study was under taken to evaluate the influence of propylene glycol, bypass fat and bypass protein on body condition in early lactating cows. A total of twenty eight postpartum dairy cows were randomly allotted to four groups with seven animals in each group. The Group-I (T^0) animals served as control without being fed any feed supplement. Group-II (T^1) animals received propylene glycol once daily as a drench at the rate of 300 ml per head while Group-III (T^2) and Group-IV ($T^{3)}$ animals were fed 100 and 200 g of commercially available bypass fat and bypass protein respectively. In all the experimental groups, the mean body condition score (BCS) remained unaltered on day 14 and 7 prepartum and reduced immediate to calving (day 0). Subsequent to calving, the mean BCS reduced to reach lowest score on day 56 postpartum in T^0, T^1 and T^3 while, it was lowest on day 42 postpartum in T^2 animals with no further reduction by day 63 postpartum. BCS showed no significant ($P \leq 0.05$) stage variation between groups up to day 35 postpartum. BCS tended to be low in control and T^2 animals from day 42 postpartum with no significant difference between groups on day 56 and 63 postpartum. The mean BCS recorded at different stages of the study both in treatment and control animals appears to be normal as it was within the recommended range.

Keywords: Bypass protein, bypass fat, propylene glycol, body condition, dairy cattle

Introduction
Over the last several decades, large increases in milk production capability among dairy cows have been associated with declining fertility. Milk production increases faster than energy intake in the first 4 to 6 weeks after calving [1]. This results in an increased mobilization of body adipose tissue to meet the energy deficit. As the deficit in energy is greatest in high producing cows, a compensatory response related to adipose tissue, liver, muscle and bone is triggered involving processes of increased lipolysis, gluconeogenesis, glycogenolysis and mobilization of protein and mineral reserves. Energy deficit or negative energy balance (NEB) is very common among dairy cattle during early periparturient period characterized by a loss of body weight and mobilization of body reserves in the form of fat and protein and usually begins about one week before calving as a result of reduced feed intake [2]. It becomes visible during early lactation as a loss in body condition and reaches its nadir about two months postpartum [1].

Body condition score (BCS) is considered as an effective indicator for both reproductive performance and cow health and is a subjective measure of body tissue reserves which are commonly used to monitor energy balance during lactation [3]. Negative energy balance (NEB) in early lactation requires cows to mobilize body tissue in support of lactation. NEB and excessive body tissue mobilization are associated with increased incidence of metabolic disorders and poor fertility.

In the first two to three weeks of lactation, energy from any source is important for the onset of ovarian activity and for uterine involution [4]. Energy deficiency leads to acyclicity, silent heat, delayed ovulations and follicular cysts. Significant correlations exist between fertility and weight loss or body condition, as indicators of NEB in the first weeks after calving and also embryonic mortality in cows with energy deficiency [5].

Drastic weight and BCS losses caused by inadequate feeding or disease are associated with anovulation and anestrus in dairy cattle. Cows with low BCS at 65 day postpartum are more likely to be anovulars which compromises reproductive success at first postpartum insemination. Extended postpartum anovulation or anestrus extends the period from calving to first artificial insemination (AI) and reduces fertility during the first postpartum service [6].

Anovulator cows not only have reduced estrus detection and conception rates, but also have compromised embryo survival [7].

Nutritional strategies have been centered on increasing the nutrient density of periparturient cow diets to counter the detrimental effects associated with the decline in dry matter intake, which occurs as parturition approaches [8]. Important energy yielding nutrients are fatty acids, glucose and amino acids. These nutrients are either used as fuel or to supply precursors needed for the synthesis of fat, protein and carbohydrates in body or milk. Energy yielding nutrients are being distinguished as lipogenic, glucogenic and aminogenic nutrients and some interconversion is possible between the three types of nutrients in that, part of the aminogenic energy can also be used to supply glucogenic precursors for the synthesis of glucose in the liver [9]. These days, the recommendation of bypass protein and bypass fat in dairy cattle ration is still debatable. Further, the increased interest is being observed among dairy farmers, veterinarians and advisors in using propylene glycol as a feed additive [10].

Propylene glycol (PG), also known as 1,2-propanediol, is a 3-carbon compound ($C_3H_8O_2$) derived from propylene. PG is frequently used as an oral drench in order to increase the molar percentage of ruminal propionate in the treatment of ketosis in postpartum dairy cattle probably because of its ability to lower non-esterified fatty acid concentrations [11] and found to have beneficial effects on carbohydrate and fat metabolism during early lactation [12]. The response of PG in dairy cattle has been quite variable. Some authors have reported significant increase of mean BCS in PG supplemented cows [13] while no significant effect was observed on BCS in PG treated cows [14].

Development of rumen protected products (RPP) using fat encapsulation or coatings to deliver limiting nutrients post ruminally, where absorption occurs and rumen microbes will not degrade the nutrients, has become option for decreasing methane/waste excretion due to feeding excess nutrient in the diet. Rumen protected nutrients such as fatty acids, amino acids and vitamins can correct nutrient gap in diets and feed ingredients by allowing addition of specific nutrients instead of raw ingredients such as groups which supply a range of nutrients but with same in excess and others in deficient [15].

Increasing the energy density of the diet through the addition of fat is gaining wide acceptance as a means of modulating the extent of mobilization of body reserves [16]. The term 'protected fat' is defined as 'fat sources specifically designed to resist bio-hydrogenation by ruminal microbes and modify fatty acid profile of body tissues and milk' [17]. Wehrman [18] observed no significant changes in BCS of cows fed with bypass fat. Similarly, the types of protein sources which resist degradation by the ruminal microbes and reach the abomasum basically unaltered are termed as 'protected protein' or bypass protein [19] and their supplementation in dairy cattle ration has resulted in significant improvement in body condition [20]. However, Kolver and Muller, [21] have documented no significant changes in BCS of cows fed with bypass protein. Still so far literature was traceable with regard to influence of feeding these three nutrients viz. propylene glycol, bypass fat and bypass protein in a single study, the present work was designed to evaluate the impact of feeding these three nutrients on body condition in early lactating cows.

Materials and Methods

The study was conducted utilizing Holstein Friesian crossbred dairy cows of different parities, varying from two to seven, maintained at Military Dairy Farm, Bangalore. The animals were dried at the completion of 7^{th} month of pregnancy, shifted to individual calving pens at least 15 days prior to the expected date of calving and closely monitored for the onset of calving. During the experimental period all the cows were fed a basal standard diet (concentrates) based on the quantity of milk produced. In addition, the cows were fed on pasture, guinea grass, Punjab-18 variety hybrid Napier and subabul.

A total of twenty eight animals which had no difficulty and no disease diagnosed at the time of parturition or seven days postpartum and considered normal [22] were randomly allotted to four groups with seven animals in each group. The T^0 animals which served as control were managed and received basal herd ration routinely practiced in the farm. The T^1animals received propylene glycol once daily as a drench at the rate of 300 ml per head in addition to the standard feeding and management received by the T^0 animals. The propylene glycol was drenched to these animals 90 minutes after concentrate feeding in the morning hours. The T^2 animals in addition to standard management and feeding routinely practiced, also received once daily 100 g of commercially available bypass fat (NUTRI JOULE, M/s Vetcare Ltd., Bangalore) with routinely fed concentrates at the time of morning milking. The T^3 cows in addition to routine management and feeding also received once daily 200 g of commercially available bypass protein (NUTRI PRO, M/s Vetcare Ltd., Bangalore) with routinely fed concentrates at the time of morning milking. The T^1 animals received propylene glycol for a period of 35 days during day 7 and 42 postpartum whereas, T^2 and T^3 animals received bypass fat and bypass protein respectively for a period of 60 days starting from day 7 postpartum. The calves were weaned a day after birth. All the animals under control and treatment groups were subjected to body condition scoring at weekly intervals from two weeks prior to calving till two months postpartum.

Body condition scoring

The body condition of all the animals under study was determined at weekly intervals during two weeks prepartum to around 60 days postpartum as per the method described by Edmonson [23]. After, all the check points were observed by vision and palpation, the scores were recorded and an average BCS was assigned to the cow by allocating point in one to five scale with quarter point division increments (1=emaciated, 2=thin, 3=average, 4=fat and 5 =obese).

Statistical Analysis

The collected data was analyzed by using SAS-16.50 version [24]. Data were transformed by using Arc $\sin^{-1} \sqrt{x}$ transformation. Due to small sample size (df<12), 1.5 times of standard deviation was added to the original values. Multiple linear models were employed to draw the significant inference (LSD). Two-way ANOVA was employed to assess stage variation within a group and between the groups to ascertain the effect of supplementation on body condition.

Results

In the present study, the control animals (T^0), which were managed on routine practices of the farm, the BCS remained unaltered on day 14 and 7 prepartum and reduced immediate to calving (day 0). Subsequent to calving, the body condition decreased slowly with lowest level reaching on day 56 postpartum with no further reduction by day 63 postpartum. Further, the BCS recorded from day 42 onwards was also low with no significant (P≥0.05) difference up to completion of experimental period (Table 1).

In T^1 cows, which received supplementation of PG, the mean BCS was same on day 14 and 7 prepartum. The BCS reduced immediate to calving (day 0) and continued to decrease marginally from stage to stage to reach lowest scoring on day 56 postpartum with no further decrease. The body condition score recorded from day 42 postpartum was apparently low with significant (P≥0.05) lower values on day 56 and 63 postpartum compared to previous stages

The mean BCS reduced on day 0 from prepartum values in T^2 cows which received supplementation of bypass fat. Subsequent to day 0, the mean BCS continued to reduce from stage to stage to reach lowest score on day 42 postpartum. The mean BCS recorded from day 42 to 63 postpartum was identical (Table 1).

Similar to other Groups, the body condition remained same on day 14 and 7 prepartum in T^3 cows which received bypass protein supplementation. The mean BCS showed decrease on day 0 and reducing trend continued with lowest score reaching on day 56 postpartum. The body condition was apparently low with no significant difference from day 49 to 63 postpartum. The BCS recorded during late pregnancy (day 14 and day 7 prepartum), immediate to calving (0 day) and up to 35 days postpartum showed no significant (P≥0.05) stage variation between groups (Table 1). The BCS tended to be low in control and T^2 animals from day 42 postpartum compared to the BCS recorded in T^1 and T^3 animals. Further, no significant difference in body condition score was seen between the groups on day 56 and 63 postpartum.

Table 1: Effect of supplementation of propylene glycol, bypass fat and bypass protein on body condition in dairy cows.

Days relative to calving	Body condition score (Least square mean ± SE)			
	Control (Group - I)	Propylene glycol (Group - II)	Bypass fat (Group - III)	Bypass protein (Group - IV)
-14	4.39±0.09[bcde]	4.50±0.11[bc]	4.32±0.16[b]	4.36±0.14[bcd]
-7	4.39±0.09[bcde]	4.50±0.11[bc]	4.32±0.16[b]	4.36±0.14[abcd]
0	3.29±0.10[bc]	3.39±0.07[abcd]	3.29±0.07[b]	3.43±0.11[b]
7	3.29±0.10[bc]	3.39±0.07[b]	3.29±0.07[b]	3.43±0.11[b]
14	3.29±0.10[bcd]	3.32±0.07[b]	3.18±0.05[ab]	3.43±0.11[b]
21	3.14±0.07[b]	3.25±0.00[bc]	3.18±0.05[bc]	3.25±0.08[b]
28	3.04±0.10[b]	3.21±0.04[bc]	3.14±0.07[b]	3.21±0.10[ab]
35	2.96±0.11[ab]	3.21±0.04[bcd]	3.11±0.09[ab]	3.18±0.12[bc]
42	2.89±0.07[a]	2.93±0.14[b]	2.82±0.12[a]	3.00±0.08[b]
49	2.79±0.09[a]	2.89±0.05[b]	2.82±0.07[a]	2.89±0.07[ab]
56	2.75±0.08[a]	2.86±0.05[a]	2.82±0.07[a]	2.82±0.07[a]
63	2.75±0.08[a]	2.86±0.05[a]	2.82±0.07[a]	2.82±0.07[a]
P-value	0.216	0.0311*	0.0268*	0.0362*

Means bearing different superscripts between rows/columns differ significantly ($P \leq 0.05$)

*→ Significant at 5% level

Discussion

In the present study both T^0 and T^1 cows lost body condition immediate to calving (day 0 postpartum) when compared to BCS recorded during late pregnancy. The body condition lost from prepartum to 0 day postpartum was almost identical and the scoring was 3.29±0.10 and 3.39±0.07 respectively in T^0 and T^1 cows. In both the groups, further loss of body condition from week to week was minimum reaching lowest value around 50 days postcalving with no further reduction. These results confirmed the notion that post parturient dairy cows usually go into a period of NEB [25]. Excessive loss of body condition in early lactation and low BCS at the start of the breeding season have been related to poor cow fertility [26].

In the current study, BCS declined during the first 6 weeks of lactation to a similar extent in both PG supplemented and unsupplemented cows despite the potential of anti-lipolytic effects of higher (induced by PG) systemic serum glucose concentrations. Perhaps the transitory increase in serum glucose concentration was insufficient to appreciably alter lipogenic pathways and adipocytes may require constant positive stimulus [27]. It is possible that, optimum body condition recorded around 40-50 days postpartum in T^1 animals fed PG might favoured resumption of early ovarian activity and occurrence of first estrus.

The BCS recorded during late pregnancy (day 14 and day 7 prepartum), immediate to calving (0 day postpartum) and up to 35 days postpartum showed no significant (P≥0.05) difference between control and propylene glycol supplemented groups. The body condition score recorded on day 42 and 49 postpartum in T^1 animals was significantly ($P \leq 0.05$) higher than the score recorded in the control group. Further, no difference in body condition score was seen between control and PG supplemented group on day 56 and 63 postpartum (Table 1; Fig. 1). while, no effect on BCS was reported by Pickett [29].

In T^2 animals supplemented with bypass fat, the BCS decreased linearly up to day 42 postpartum with no further change up to day 63 postpartum. The low BCS in this group was seen on day 42 postpartum compared to earlier stages. But, the BCS recorded in this group did not vary significantly at all stages including pre-partum and postpartum period with that of control group. It appears that feeding of rumen inert fat did not influence the energy status of the cows probably because of depression in DMI [30]. Inspite of no changes in the body weight of the cows supplemented with calcium salts of long chain fatty acids they still showed improved conception rate [31].

In T^3 cows, fed with bypass protein, the BCS remained unaltered from day 0 to day 14 postpartum. Subsequently, it showed minimal stage to stage reduction to reach lowest score on day 56 postpartum with no further reduction on day 63 postpartum. The body condition score tended to be low in control group at all stages of postpartum compared to the BCS recorded in bypass protein supplemented (T^3) cows. Non-significant increase in BCS on supplementing bypass protein was reported by Hibberd [32]. From day 0 to 63 postpartum did not reveal difference between groups at majority of the stages studied. In all the groups, the stage wise reduction in BCS was seen with lowest value on day 56 postpartum which did not decrease further on day 63 postpartum. It appears that the body condition score has shown similar trend in its reduction in all the groups and with lowest scoring on day 56 and 63 postpartum. This may be due to peak NEB with increasing milk yield. The Present study was according to Gearhart [33] opined that the optimum BCS at calving is 3.00 to 3.75 and at the peak yield it should be 2.25 to 2.75.

Conclusion

From the present study, it can be concluded that the supplementation of propylene glycol, bypass fat and bypass protein in early lactating period favoured the body condition and resulted in optimum BCS during peak yield.

Acknowledgements

The authors acknowledge M/s Vetcare Ltd., Bangalore for the supply of bypass fat (NUTRI JOULE) and bypass protein (NUTRI PRO) to conduct this research work. The authors wish to thank Dr. Dhuvan, Lt Cornel, Military dairy Farm Hebbal, Bangalore for facility provided to conduct the trail.

Ethical Matters: The Present study was a part of Ph.D. Programme, indicating no ethical issues.

Conflict of interest: All the authors declares that they have no conflict of interest.

References

1. Butler WR. Nutritional interactions with reproductive performance in dairy cattle. Anim. Reprod. Sci. 2000; 60-61:449-457.
2. Bauman DE, Currie WB. Partitioning of nutrients during pregnancy and lactation: A review of mechanisms involving homeostasis and homeorhesis. J Dairy Sci. 1980; 63(9):1514-1529.
3. Wildman EE, Jones GM, Wagner PE, Boman RL, Trout HF, Lesch TN. A dairy cow body condition scoring system and its relationship to selected production variables in high producing Holstein dairy cattle. J Dairy Sci. 1982; 65:495-501.
4. Godoy A, Hughes TL, Emery RS, Chapin LT, Fogwell, RL. Association between energy balance and luteal function in lactating dairy cows. J Dairy Sci. 1988; 71:1063-1069.
5. Rutter LM, Randel RD. Post-partum nutrient intake and body condition: effect on pituitary function and onset of estrus in beef cattle, J Anim Sci. 1984; 58:265-274.
6. Santos JE, Bilby TR, Thatcher W, Staples CR, Silvestre FT. Long chain fatty acids of diet as factors influencing reproduction in cattle. Reprod. Dom. Anim. 2008; 43(2):23-30.
7. Santos JE, Thatcher W, Chebel, RC, Cerri RL, Galvao KN. The effect of embryonic death rates in cattle on the efficacy of estrous synchronization programs. Anim. Reprod. Sci. 2008; 82(83):513-535.
8. Park AF, Shirley JE, Titgemeyer EC, Meyer MJ, Vanbaale MJ, Vandehaar MJ. Effect of protein level in prepartum diets on metabolism and performance of dairy cows. J Dairy Sci. 2002; 85:1815-1828
9. Tamminga S. The effect of the supply of rumen degradable protein and metabolisable protein on negative energy balance and fertility in dairy cows. Anim. Reprod. Sci. Banglore, November 24th to 26th. 2006, 26-32(96):227-239.
10. Sampath KT, Chandrasekharaih M, Thulasi A. Proceedings of V Biennial conference of animal Nutrition Association held at National Institute of Animal Nutrition and Physiology (NIANP), Banglore, 24th to 26th, 2004, 26-32.
11. Grummer RR, Winkler JC, Bertics SJ, Studer VA. Effect of propylene glycol dosage during feed restriction on metabolites in blood of peripartum Holstein heifers. J Dairy Sci. 1994; 77:3618-3623
12. Nielsen NI, Ingvartsen KL. Propylene glycol for dairy cows a review of the metabolism of propylene glycol and its effects on physiological parameters, feed intake, milk production and risk of ketosis. Anim. Feed Sci. Technol. 2004; 115:191-213
13. Lien TF, Chang LB, Horng YM. Effects of Propylene Glycol on Milk Production, Serum Metabolites and Reproductive Performance during the Transition Period of Dairy Cows. Asian-Aust. J Anim. Sci. 2010; 23(3):372-378.
14. Lomander H, Frossling, J, Ingvartsen KL, Gustafsson TH, Svensson C. Supplemental feeding with glycerol or propylene glycol of dairy cows in early lactation Effects on metabolic status, body condition, and milk yield. J Dairy Sci. 2012; 95:2397-2408.
15. Sakkers M. Stability of rumen protected nutrients supplementation in lactating Jersey cows, *Thesis* submitted to university of Pretoria, Pretoria. 2012.
16. Jenkins TC, Palmquist DL. Effect of fatty acids or calcium soaps on rumen and total nutrient digestibility of dairy rations. J Dairy Sci. 1984; 67:978-986.
17. Tyagi N, Thakur SS, Shelke SS. Effect of bypass fat supplementation on productive and reproductive performance in crossbred cows. Trop. Anim. Health. Prod. 2010; 41: 1749-1755.
18. Wehrman ME, Welsh TH, Williams GL. Diet-induced hyperlipidemia in cattle modifies the intrafollicular cholesterol environment, modulates ovarian follicular dynamics, and hastens the onset of postpartum luteal activity. Biol. Reprod. 1991; 45:514-522.
19. Merchen NR, Titgemeyer EC. Manipulation of amino acid supply to the growing ruminant. J Anim. Sci. 1992; 70:3238-3247.
20. Anderson LP, Patterson JA, Ansotegui RP, Cecava M, Schmutz W. The effects of degradable and un degradable intake protein on the performance of lactating first-calf heifers. J Anim. Sci. 2001; 79:2224-2232.
21. Kolver ES, Muller LD. Performance and nutrient intake of high producing Holstein cows consuming pasture or a total mixed ration. J Dairy Sci. 1998; 81:1403-141
22. Morrow DA, Roberts SJ, Mcentee K. review of postpartum ovarian activity and involution of the uterus and cervix in cattle. Cornell Vet. 1999; 59(1):134-154.
23. Edmonson AJ, Lean IJ, Weaver LD, Farver T, Webster G. A body condition scoring chart for Holstein dairy cows. J Dairy Sci. 1989; 72:68-78.
24. SAS. User's Guide: Statistics, Version 16.50. SAS Inst., Inc., Cary, NC, 2011.
25. Harrison RO, Ford SP, Young JW, Conley AJ, Freeman AE. Increased milk production versus reproductive and energy status of high producing dairy cows. J Dairy Sci. 1990; 73:2749-2758.
26. Domecq JJ, Skidmore AL, Lloyd JW, Kaneene JB. Relationship between body condition scores and

conception at first AI in a large dairy herd of high yielding Holstein cows. J Dairy Sci. 1997; 80:113-120.
27. Smith SB, Prior RL, Mersmann HJ. Inter- relationships between insulin and lipid metabolism in normal and alloxan diabetic cattle. J Nutr. 1983; 113:1002-1015.
28. Bors SL, Gheorghe S, Alinavlad S. Effects of propylene glycol supplementation on blood indicators of hepatic function, body condition score, milk fat-protein concentration and reproductive performance of dairy cows. Acta Vet. Brno. 2012. 83:027-032.
29. Pickett MM, Piepenbrink MS, Overton TR. Effects of propylene glycol or fat drench on plasma metabolites, liver composition, and production of dairy cows during the periparturient period. J Dairy Sci. 2003. 86:2113-2121.
30. Jerred MJ, Carroll DJ, Combs DK. Effects of fat supplementation and immature alfalfa to concentrate ratio on nutrient utilization and lactation performance of dairy cattle. J Dairy Sci. 1990; 73:2842-2854.
31. Romo GA, Casper DP, Erdman RA, Teter BB. Abomasal infusion of cis or trans fatty acid isomers and energy metabolism of lactating dairy cows. J Dairy Sci. 1996; 79:2005-2015.
32. Hibberd CA, Scott RR, Trautman BD, Worthington C. Bypass protein supplementation of fall-calving beef cows grazing dormant native range. Anim. Sci. Research Report, 1988, 82-84.
33. Gearhart MA, Curtis CR, Chase LE. Relationship of changes in condition score to cow health in Holsteins. J Dairy Sci. 73:3132-3140.