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Changes in Plasma Concentration of *Leptin, Adiponectin* and *Resistin* in Karan-Fries Cows of High and Medium Body Conditions During Winter and Summer Seasons

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ABSTRACT

The investigation was carried out to monitor changes in concentration of plasma adipokines in transition period of crossbred cows of high and medium body conditions during winter and summer seasons. For this study, 24 Karan-Fries cows, six each of medium body condition (MBC) and high body condition (HBC) were selected from National Dairy Research Institute (NDRI) livestock research centre in both the seasons. Blood samples were collected on 21st, 15th and 7th day prepartum, on day of calving and on 7th, 15th and 21st days postpartum. Concentration of leptin, adiponectin and resistin were estimated. Body condition score differed significantly ($p < 0.05$) between MBC and HBC cows in both the seasons. Body condition score (BCS) losses are higher in HBC cows as compared to MBC cows during early postpartum period in both the seasons. In winter as well as summer seasons, plasma levels of all the studied parameters were higher in HBC cows as compared to MBC cows. Plasma concentrations of leptin ($P = 0.03$) differed significantly between HBC and MBC cows. In summer mean value of adiponectin differed significantly ($P <0.05$) between day of calving and postpartum period in HBC cows but in case of MBC cows the mean differed significantly ($P < 0.05$) between prepartum, day of calving and postpartum. Resistin differed non-significantly between HBC and MBC cows in winter as well as summer.

Key words: Adipokines, Adiponectin, Body condition score, Leptin, Resistin.

INTRODUCTION

Transition from one season to another is the most stressful period in dairy cows both physiologically and metabolically. Leptin, a 16 kDa protein is synthesized by adipose tissue in regulation of feed intake, energy balance, fertility and immune functions. Energy deficit of periparturient cows causes a sustained reduction in plasma leptin. A linear relationship was demonstrated in well-fed lactating dairy cows between plasma leptin and body condition score (Villalobos *et al.,* 2007). Leptin affects energy homeostasis by decreasing food intake and by up-regulating fatty acid oxidation and down-regulating lipogenesis in peripheral tissues (Rabe *et al*., 2008) .Circulating leptin levels increased from early to mid pregnancy and remained elevated until late pregnancy in cattle (Liefers *et al*., 2003; Villalobes *et al*., 2007). Lemor *et al*. (2009) reported that in high yielding dairy cows plasma leptin level decreased postpartum (4.64 ± 2.24ng/ml) as compared to antepartum period (7.83 ± 2.84ng/ml). In early lactation, due to negative energy balance and reduction in synthesis of leptin by adipocytes the level reached its lowest concentration. The reason for reduced leptin during early lactation could be that as lactation progresses and body condition has not improved, mobilization of adipose tissue has led to considerable depletion of the cow's supply of white adipocytes, the source of leptin synthesis (Block *et al*., 2001; Kadokawa *et al*., 2000). Adiponectin plays an important role in energy homeostasis, with involvement in regulating glucose concentrations through reductions in insulin resistance and fatty acid breakdown. Mielenz *et al*. (2013) reported that in multiparous Holstein-Friesian dairy cows, plasma adiponectin concentration decreased from day -21 antepartum, reaching a trough at day 1 and increasing thereafter, with the highest values attained on day 14 postpartum. Decreasing adiponectin concentrations is important for accomplishing the adaptation to the rapidly increasing metabolic rates in early lactation. Resistin is an adipokine which is related to regulation of energy metabolism in rodents but has been little studied in dairy cows. Cools *et al.* (2013) reported that resistin hormone concentration gradually increases throughout the periparturient period. They reported that high BCS cows have a significantly lower overall antioxidant potential when compared with the normal BCS cows. So, high BCS cows use to suffer from oxidative stress without alteration of energy status. Keswan *et al*. (2012) reported that in high and low yielding cows TNF-α concentration in plasma was highest on the day of calving

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(1.52 ng/ml) and it declined significantly in low yielding cows up to 45th day (0.44 ng/ml), but it declined non-significantly in high yielding cows. The adipose tissue of obese animal produces more pro-inflammatory adipokines (TNF-α, IL6, leptin) and less anti-inflammatory adipokines (adiponectin). The most important consequences of the altered secretion of adipokines, as seen in obesity, are the induction of a pro-inflammatory state, cardiovascular damage and insulin resistance of the adipose tissue, the liver and the skeletal muscle (Cornier *et al*., 2008).

MATERIALS AND METHODS

For this study, 24 Karan-Fries dairy cows, six of medium body condition and six of high body condition groups were selected in winter as well as in summer from the herd of ICAR-National Dairy Research Institute (ICAR-NDRI), Karnal.

Body condition of the animals was scored using a score chart formulated by Shiv Prasad (1994) before the commencement of experiment. The animals were grouped as medium body condition, with body condition between 3-3.5 and as high body condition, with body condition between 4-5.

Blood samples were collected from high and medium BCS Karan-Fries cows (six each) at 9:00 A.M from jugular vein on 21st, 15th, 7th days before calving, 0 days (at the day of calving) and 7th, 15th, 21st days after calving. Blood samples were collected from jugular vein of Karan-Fries cows using sterile vacutainer tubes (EDTA). Immediately after collection the separation of plasma from blood was done by using centrifuge machine at 2500 rpm for 15 minutes. The plasma samples were stored at - 20°C for analysis of leptin, adiponectin and resistin.

Leptin was estimated in plasma using "Bovine Enzyme-linked Immunosorbent Assay Kit for Leptin (LEP)" (Catalog No. SEA084Bo) supplied by USCN. Adiponectin was determined in plasma using "Bovine Total Adiponectin (ADP) ELISA kit" (Catalog No. E11A0125) supplied by BlueGene Biotech. "Bovine Resistin (RETN) ELISA kit" (Catalog No. E11R0351) supplied by BlueGene Biotech was used for estimation of Resistin.

SPSS (Version 16) and Graphpad Prism (Version 5) were used for statistical analysis considering $P<0.05$ as the level of significance.

RESULTS AND DISCUSSION

Body condition score differed significantly ($P < 0.05$) between MBC and HBC cows during winter as well as summer (Fig 1). It was observed that in winter, BCS ranged from 3.70 ± 0.10 to 3.14 ± 0.19 in MBC cows and 4.75 ± 0.04 to 3.60 ± 0.21 in HBC cows from 21 days prepartum to 21 days postpartum, whereas, in summer BCS ranged from 3.74 ± 0.12 to 3.18 ± 0.21 in MBC cows and 4.85 ± 0.06 to 3.70 ± 0.23 in HBC cows from 21 days prepartum to 21 days postpartum. Block *et al.* (2001) also reported that relative to parturition change in body condition score were 3.6 (at 4 week) 3.7 (1 week) and before parturition and 3.4, 3.0, 2.9 at 1 week, 3 week and at 8 week, respectively after parturition. Reuslts showed that during winter, MBC and HBC cows lost 15.13% and 24.21% body condition score from 21 days prepartum to 21 days postpartum, whereas, in summer it was 14.97% and 23.71% in MBC and HBC cows, respectively. High rates of body condition score (BCS) loss in the early postpartum period are associated with a severe negative energy balance status, alterations in blood metabolites and hormone profiles (Wathes *et al.,* 2007). Leptin concentration during winter declined from prepartum to postpartum by 38.59% in HBC cows and 26.96% in MBC cows (Fig 2), whereas, it dropped to 37.21% in HBC and 27.08% in MBC cows in summer season. In winter and summer seasons the peak level of leptin was observed at 21 days prepartum in both the groups which declined at postpartum. During winter in HBC cows plasma leptin levels varied from 6.51 ± 1.51 to 14.66 ± 0.01 ng/ml, whereas, in MBC cows it varied from 3.90 ± 0.75 to 5.93 ± 1.49 ng/ml. During summer season, in HBC cows, plasma leptin level varied from 6.03 ± 0.79 to 12.80 ± 0.05 ng/ml, whereas, in MBC cows, it ranged from 5.80 ± 1.40 to 9.48 ± 2.27 ng/ml.

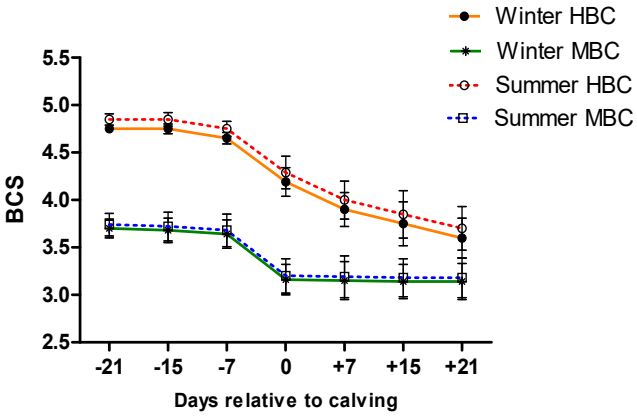

Fig 1: Body condition score (BCS) in high (n = 6) and medium body condition (n =6) Karan-Fries cows during winter and summer.

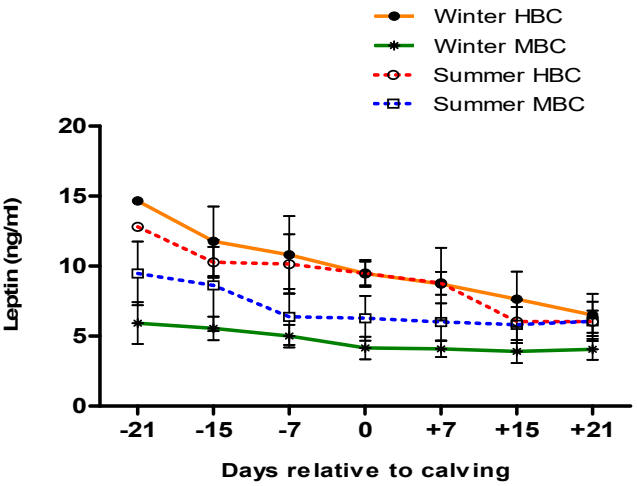

Fig 2: Plasma Leptin level (ng/ml) in medium (n=6) and high body condition (n=6) Karan-Fries cows during winter and summer seasons.

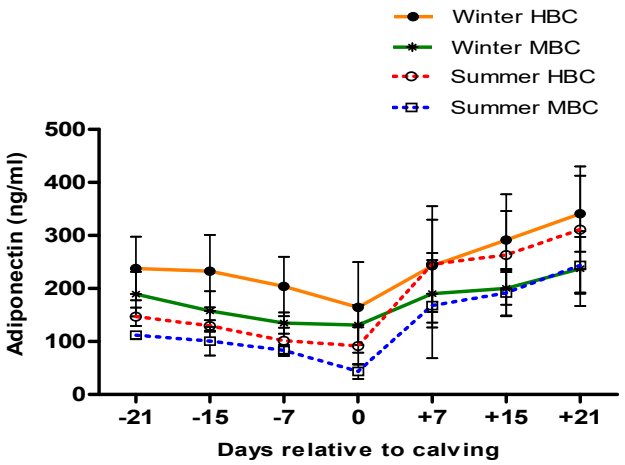

Fig 3: Plasma adiponectin level (ng/ml) in medium (n=6) and high body condition (n=6) KF cows during winter and summer seasons.

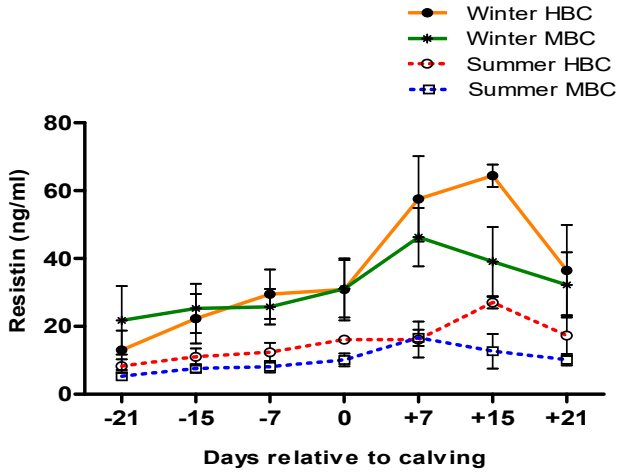

Fig 4: Plasma resistin level (ng/ml) in medium (n=6) and high body condition (n=6) KF cows during winter and summer seasons.

In winter leptin differed significantly during prepartum (P = 0.04) and at the day of calving (P = 0.008) between HBC and MBC cows, whereas, it was non-significant at postpartum. In summer, leptin concentration differed significantly (P = 0.04) between prepartum and postpartum in HBC cows. Block *et al.* (2001) also reported that periparturient dairy cows shows highest leptin level in late pregnancy as compared to postpartum period where 50% of the level dropped. Leptin levels began to declined between weeks 1 and 2 prepartum from an average of 5.8 to 5.5 ng/ml. During early lactation low level of leptin is observed because of draining of nutrients from the body ultimately mobilization of adipose tissue from white adipocytes which leads to loss in body condition (Block *et al*., 2001; Kadokawa *et al*., 2000). During winter the concentration of adiponectin ranged from 164.37 ± 85.30 to 341.00 ± 71.52 ng/ml and 131.18 ± 37.81 to 237.47 ± 70.45 ng/ml in MBC cows (Fig 3). In winter adiponectin concentration increased up to 29.86% in HBC and 30.29% in MBC cows, whereas, in summer it was 117.04% and 103.96% in HBC and MBC cows from prepartum to postpartum. In summer, the concentration of adiponectin varied from 91.64 ± 35.39 to 311.16 ± 118.97 ng/ml in HBC cows and 43.67 ± 14.09 to 243.69 ± 53.54 ng/ml in MBC cows. The lowest level of adiponectin in HBC and MBC cows were seen at day (day 0) of calving (164.37 ± 85.30; HBC and 131.18 ± 37.81 ng/ml; MBC) in winter and afterwards the level reached to peak at 21 days postpartum (341.00 ± 71.52; 200.31 ± 30.82 ng/ml) for both groups. Mielenz *et al*. (2013) also reported that in Holstein-Friesian dairy cows, plasma adiponectin concentration decreased from day "21 antepartum, reaching a lowest value at day 1 and increased thereafter, with the highest values attained on day 14 postpartum. Averaged level of adiponectin was higher in case of HBC cows while comparing with MBC cows during winter as well as summer but differed non-significantly. In summer mean value of adiponectin differed significantly (P <0.05) between day of calving and postpartum period in HBC cows but in case of MBC cows the mean differed significantly (P < 0.05) between prepartum, day of calving and postpartum. Singh *et al*. (2014) also reported that during early lactation decreasing adiponectin concentrations seems important for accomplishing the adaptation to the rapidly increasing metabolic rates. In winter group, peak concentration of resistin was observed at 15th days postpartum (64.4 ± 3.3 ng/ml) in HBC cows while in MBC cows at 7th days postpartum (46.3 ± 8.6 ng/ml) and afterwards the level declined in both the groups up to 21st days postpartum (Fig 4). In winter, resistin concentration increased to 144.58% in HBC and 61.31% in MBC cows from prepartum to postpartum, whereas, in summer it was 90.6% in HBC and 88% in MBC cows. In summer the resistin level (8.3 ± 2.0 ng/ml) increased from 21st days prior to calving up to 15th days postpartum (27.0 ± 1.7 ng/ml) in HBC cows, whereas, in MBC cows it increased from (5.3 ± 1.0 ng/ml) 21st days prior to calving up to 7 days postpartum (16.6 ± 2.4 ng/ml). Reverchon *et al.* (2014), also reported that plasma resistin level was high (75.10 ng/ml) at 1 to 2 wk postpartum. Resistin level at prepartum, day of calving (day 0) and postpartum differed non-significantly (P > 0.05) between HBC and MBC cows in both the seasons.

CONCLUSION

Body condition score (BCS) loss in early postpartum period are higher in HBC cows as compared to MBC cows in both the seasons. Higher reduction in plasma leptin concentration at postpartum in HBC cows indicates more reduction in body condition with increased negative energy balance which is opposite in MBC cows. So, MBC cows were better as compared to HBC cows.

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AUTHOR'S CONTRIBUTION

All the Co-authors helped during the thesis work and compilation of the paper.

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