Indian Journal of Animal Sciences **89**(6): 645–647, June 2019/Short communication
https://doi.org/10.56093/ijans.v89i6.91135

Circulating levels of adipokines and hormones in periparturient primiparous Sahiwal cows

VIJAY PANDEY[1], RAJESH NIGAM[2], SATYENDRA PAL SINGH[3], DEEPAK SHARMA[4], MADHU TIWARI[5] and SOUMEN CHAUDHARY[6]

DUVASU, Mathura, Uttar Pradesh 281 001 India

Received: 5 October 2018; Accepted: 12 November 2018

Key words: Adiponectin, Cows, Leptin, Primiparous, Resistin, Sahiwal

Adipose tissue (AT) is metabolically dynamic tissue that synthesizes and secretes several distinct biologically active compounds called adipokines/adipocytokines. Out of these, adiponectin and resistin are important adipokines in the circulation which significantly affect glucose metabolism in tissues by influencing insulin sensitivity (Michael *et al.* 2003). Since these adipokines affect glucose metabolism hence circulating levels of these expected to vary during periparturient period due to significant change in energy status in cows. Thus present study was designed to appraise the interplay of adipokines and other hormones during transition from late pregnancy to mid lactation in primiparous cows.

In present investigation, 6 primiparous pregnant cows of 5 to 6 years age and similar body condition score (BCS, 2.80±0.06) were selected. The selected animals were provided clean drinking water *ad lib.* and same balanced ration throughout the study period as per the recommendations (NRC 2001). Blood samples were collected from expected –30 days pre-prepartum to +90 days post-partum at 15 days interval. Milk yield of animals were recorded fortnightly for calculating the average milk yield per day (AMY). BCS of each animal was also recorded on the day of blood sampling according to a 5-point scale (1, lean; 5, fat) as previously described (Edmonson *et al.* 1989). All the procedures were carried out as per the guidelines and proper approval from Institutional Animal Ethics Committee (IAEC) (68/IAEC/2015 dated 03/02/2016) and CPCSEA (Reg. No. 386/PO/ReBi/SL/01/CPCSEA). Plasma samples were analyzed (in duplicate) for levels of adiponectin (ADIPOQ), resistin (RETN), leptin (LEP), insulin, estradiol and progesterone hormones by Bovine specific ELISA kits (Cusabio, GenxBio) having <10% coefficients of variation (CV) for both intra-assay and inter-assay. The data obtained are presented as mean±SEM and P value <0.05 was considered statistically significant. The statistical differences among the groups were analyzed by one-way analysis of variance (ANOVA) along with Duncan's Multiple Range Test (DMRT) and correlations between the variables were analyzed by calculating Pearson correlations coefficient using SPSS (version 16.0).

The plasma levels of ADIPOQ, LEP and progesterone revealed sharp decline in levels from pregnancy to parturition and thereafter increased gradually to prepartum levels while levels of RETN, insulin and estrogen, increased from pregnancy to parturition and thereafter slowly reduced to prepartum levels (Table 1). The levels of ADIPOQ revealed significant positive correlation with levels of LEP (r=0.42) and AMY (r=0.51) and negative correlation with estradiol (r=–0.32). The levels of RETN revealed significant positive correlation with levels of LEP (r=0.30) and estradiol (r=0.33), and negative correlation with AMY (r=–0.44). The plasma levels of LEP revealed significant positive alliance with levels of ADIPOQ (r=0.42) and RETN (r=0.30) and negative correlation with levels of estradiol (r=–0.39) (Table 2).

Similar trend of plasma ADIPOQ levels were also reported earlier in different breeds of dairy cows (Giesy *et al.* 2012, Singh *et al.* 2014) support the present findings. The levels of ADIPOQ showed positive correlation with LEP in present study which was also reported by Krumm *et al.* (2017) in cows up to 4 weeks after parturition. It may be due to the fact that LEP and ADIPOQ share several metabolic properties (enhanced insulin sensitivity, fatty acid oxidation, thermogenesis, and weight loss), and some of the effects classically attributed to ADIPOQ which may be indirectly mediated or amplified by a rise in LEP levels (Delporte *et al.* 2004).

The trend of plasma RETN levels in present study were in agreement with the trend reported by Reverchon *et al.* (2014) in Holstein dairy cows. In addition they also reported higher RETN mRNA and protein levels in adipose tissue

Present address: [1]Associate Professor (drvijaypandey@gmail.com), [2]Professor (dr_rajesh2005@rediffmail.com), Department of Veterinary Biochemistry; [3,5]Assistant Professor (satsinpal21@gmail.com, drmtiwari110978@yahoo.co.in), [4]Associate Professor (drdeepakivri@gmail.com), Department of Animal Genetics and Breeding; [6]Assistant Professor (smnpharma@gmail.com), Department of Pharmacology and Toxicology, College of Veterinary Science and Animal Husbandry.

Table 1. BCS, AMY and circulating levels of adipokines and other hormones during periparturient period (–30 to +90 days) in Sahiwal cows

Hormone days	BCS	ADIPOQ (µg/ml)	RETN (ng/ml)	Leptin (ng/ml)	Insulin (µU/l)	Progesterone (ng/ml)	Estradiol (pg/ml)	AMY (L/day)
–30 day	2.80^{bcde}±0.06	12.64^{c}±1.47	37.13^{ab}±4.10	5.01^{b}±0.58	6.64^{a}±0.19	6.91^{a}±0.70	189.00^{b}±28.95	
–15 day	2.90^{de}±0.07	9.20^{abc}±1.50	44.27^{ab}±4.96	4.03^{ab}±0.47	7.15^{ab}±0.30	6.43^{a}±0.46	190.55^{b}±33.56	
0 day	2.95^{e}±0.07	6.25^{a}±1.10	54.05^{b}±7.67	2.39^{a}±0.21	8.25^{c}±0.27	1.19^{bcd}±0.06	487.67^{a}±22.29	
+15 day	2.67^{abcd}±0.06	6.74^{ab}±0.56	39.71^{ab}±7.64	4.31^{ab}±0.59	6.53^{a}±0.15	0.03^{d}±0.00	22.29^{b}±4.30	3.22^{a}±0.49
+30 day	2.50^{a}±0.05	11.99^{c}±0.99	36.04^{ab}±6.05	4.76^{b}±0.36	6.40^{a}±0.36	0.78^{cd}±0.06	$20.09^{b\pm}$3.80	4.59^{b}±0.38
+45 day	2.57^{ab}±0.04	13.02^{c}±1.04	30.29^{a}±3.17	5.03^{b}±0.49	$7.18^{ab\pm}$0.17	1.34^{bed}±0.12	21.97^{b}±4.81	5.38^{bc}±0.27
+60 day	2.65^{abc}±0.04	11.75^{bc}±0.98	28.53^{a}±2.65	4.35^{ab}±0.34	7.41^{ab}±0.32	1.08^{bcd}±0.12	17.91^{b}±2.61	5.53^{bc}±0.30
+75 day	2.75^{bcde}±0.04	11.59^{bc}±0.68	31.13^{ab}±3.69	5.27^{b}±0.63	$7.62^{ab\pm}$0.29	2.26^{b}±0.32	22.12^{b}±4.60	5.84^{c}±0.33
+90 day	2.87^{cde}±0.05	12.72^{c}±1.03	38.10^{ab}±3.39	4.55^{ab}±0.43	7.46^{ab}±0.33	2.06^{bc}±0.13	$25.31^{b\pm}$7.00	5.45^{bc}±0.24
Over all mean	2.74±0.03	10.65±0.48	37.77±1.88	4.41±0.18	7.18±0.11	2.45±0.34	110.77±24.29	5.00±0.20

Means bearing same superscript in a column differ non-significantly (P≥0.05).

Table 2. Correlation coefficient of plasma adipokines with BCS, AMY and other circulating hormones in Sahiwal cows

Parameter	Adiponectin	Resistin	Leptin
BCS	–0.16	0.25	–0.16
AMY	0.51^{*}	$–0.44^{**}$	0.20
ADIPOQ	1.00	–0.10	0.42^{**}
RETN	–0.10	1.00	0.30^{**}
LEP	$0\ .42^{**}$	0.30^{**}	1.00
Insulin	–0.16	0.21	–0.19
Progesterone	0.08	0.03	0.03
Estradiol	$–0.33^{*}$	0.33^{*}	$–0.39^{**}$

Correlation coefficient bearing asterisk (*) exhibiting significant correlation (P<0.05).

one week post partum than at five months of gestation, which corroborated the present report. Analogous to this study, positive association between plasma levels of RETN and LEP was also reported by Zhang *et al.* (2015). Similar pattern of LEP levels as observed in this study were also reported in different breeds of cows during periparturient period (Block *et al.* 2001, Vaidya *et al.* 2015, Pandey *et al.* 2016).

In order to prepare for parturition and lactogenesis, dairy cows encounter dramatic changes in energy status along with tremendous alterations in endocrine response during peri-parturient period. Since adipokines are involved in feed intake and regulation of energy metabolism, thus their levels are expected to be changed during peri-parturient period. The high levels of insulin during pregnancy cause reduction in ADIPOQ receptors (Kadowaki and Yamauchi 2005) and thus reducing the ADIPOQ sensitivity. This may be compensated by increased levels of ADIPOQ during pregnancy (Mazaki-Tovi *et al.* 2007). The high LEP concentrations during pre-partum may be a result of the high energy intake in pregnancy which is necessary for faetal growth in final phase of pregnancy and for the coming lactation. The postpartum reduction in plasma concentration of ADIPOQ and LEP observed in dairy cows may be due to the fact that the onset of lactation generally results into development of NEB in cows that consequently bring about mobilization of fat reserves. Some reports suggested that the NEB during lactation decreases adiponectin mRNA levels in mammary glands (Ohtani *et al.* 2011) and adipose tissues (Singh *et al.* 2014) reducing serum ADIPOQ concentrations. Similarly, reduced synthesis of LEP in WAT is largely responsible for the lower concentration of plasma LEP in early lactating dairy cows (Vargova and Kovac 2016) which lead to fewer signals for reducing food intake. This reduction in LEP could benefit early lactating dairy cows by promoting a faster increase in feed intake and by diverting energy from non-vital functions such as reproduction to lactogenesis (Block *et al.* 2001).

The abrupt rise in insulin observed at parturition may be in response to sudden rise in blood glucose levels on day of calving which may occur due to enhanced secretion of stress hormones namely catecholamines and glucocorticoids owing to parturition stress and also to prioritize the use of glucose by the mammary gland (Park *et al.* 2010). The comparable decrease in insulin levels during early lactation compared to levels in pregnancy observed in this study was also reported by Vargova and Kovac (2016) in cows.

The progesterone in prepartum period is secreted in moderate quantities by the corpus luteum (CL) at the beginning of pregnancy and later in tremendous quantities by the placenta. The lowest value observed on the day of calving in this study, was suggestive of complete luteolysis at parturition. Similar to the present findings, gradual increase in plasma estradiol 17β one day before parturition and gradual decrease in progesterone level over the last week of gestation with an abrupt fall 1–2 days before parturition was also reported in buffaloes.

Furthermore it has been postulated that the estrogen-to-progesterone ratio increases sufficiently toward the end of pregnancy which may account for onset of parturition. This rise in estrogen levels stimulate the production of PGF2α by the uterus and increase the number of oxytocin receptors in the uterus. In response to increase in both PGF2α and oxytocin hormones, the contractions in the uterus begin for successful expulsion of foetus.

In conclusion, the present study provides data on the circulating levels of adipokines during transition from late pregnancy to mid lactation that may be useful for clinical and experimental interpretation. Since this study showed significant association between adipokines and milk yield thus the results of this investigation form an important draft for understanding the physiological role of the adipokines in transition cows. Further studies are required to elucidate the mechanisms by which adiponectin and resistin influences the lactogenesis, one of the complicated phenomenons inside mammary epithelium in dairy animals.

SUMMARY

The circulating levels of adipokines and other hormones were determined in periparturient Sahiwal cows. Blood samples were collected from 6 Sahiwal cows during periparturient period (–30 to +90 days) at 15 days interval. The results revealed decrease in adiponectin, leptin and progesterone levels from pregnancy to parturition which subsequently increased to prepartum levels. The resistin and estrogen levels increased from pregnancy to parturition and reduced to prepartum levels during lactation. Adiponectin levels showed positive association with average milk yield (AMY) and leptin while negative association with estrogen; resistin revealed positive association with estrogen and negative with AMY and leptin and leptin showed positive association with AMY, adiponectin and resistin and negative with estrogen. In conclusion, the study provides data on plasma levels of adipokines in primiparous periparturient cows that may be useful for clinical and experimental interpretation and significant association among adipokines, lipid profile and AMY indicating their significant role in lactogenesis.

ACKNOWLEDGEMENTS

Authors are thankful to Vice Chancellor, Veterinary University (DUVASU), Mathura and Dean, College of Veterinary Science, Mathura, for providing necessary facilities to carry out this work.

REFERENCES

Block S S, Butler W R, Ehrhardt R A, Bella W, Vanamburgh M E and Boisclair Y R. 2001. Decreased concentration of plasma leptin in periparturient dairy cows is caused by negative energy balance. *Journal of Endocrinology* **171**: 339–48.

Delporte M L, El-Mkadem S A, Quisquater M and Brichard S M. 2004. Leptin treatment markedly increased plasma adiponectin but barely decreased plasma resistin of ob/ob mice. *American Journal of Physiology, Endocrinology and Metabolism* **287**: E446-53.

Edmonson A J, Lean I J, Weaver L D, Farver T and Webster G. 1989. A body condition scoring chart for Holstein dairy cows. *Journal of Dairy Science* **72**: 68–78.

Giesy S L, Yoon B, Currie W B, Kim J W and Boisclair Y R. 2012. Adiponectin deficit during the precarious glucose economy of early lactation in dairy cows. *Endocrinology* **153**: 5834–44.

Kadowaki T T and Yamauchi T. 2005. Adiponectin and adiponectin receptors. *Endocrine Reviews* **26**: 439–51.

Krumm C S, Giesy S L, Caixeta L S, Butler W R, Sauerwein H, Kim J W and Boisclair Y R. 2017. Effect of hormonal and energy-related factors on plasma adiponectin in transition dairy cows. *Journal of Dairy Science* **100**: 9418–27.

Mazaki-Tovi S, Kanety H, Pariente C, Hemi R, Wiser A and Schiff E. 2007. Maternal serum adiponectin levels during human pregnancy. *Journal of Perinatology* **27**: 77–81.

Michael W R, Silvana O, Philipp E S and Luciano R. 2003. Adipose-derived resistin and gut-derived resistin-like molecule-b selectively impair insulin action on glucose production. *Journal of Clinical Investigation* **111**(2): 225–30.

NRC. 2001. *Nutrient Requirements of Dairy Cattle*. 7th Revised edn. National Academies Press, Washington, DC.

Ohtani Y T, Yonezawa S H, Song T, Takahashi A, Ardiyanti K and Sato A. 2011. Gene expression and hormonal regulation of adiponectin and its receptors in bovine mammary gland and mammary epithelial cells. *Animal Science Journal* **82**: 99–106.

Pandey V, Nigam R, Rambachan, Singh P, Singh S P and Madan A K. 2016. Plasma leptin and biochemical profile around parturition in primiparous Sahiwal cows. *Ruminant Science* **5**(2): 227–33.

Park A F, Shirley J E and Titgemeyer E C. 2010. Characterization of plasma metabolites in Holstein dairy cows during periparturient period. *Journal of Dairy Science* **5**: 253–63.

Reverchon M, Rame C, Cognie J, Briant E and Elis S. 2014. Resistin in dairy cows: Plasma concentrations during early lactation, expression and potential role in adipose tissue. *PLoS One* **9**(3): e93198.

Singh S P, Häussler S, Gross J J, Schwarz F J, Bruckmaier R M and Sauerwein H. 2014 Circulating and milk adiponectin change differently during energy deficiency at different stages of lactation in dairy cows. *Journal of Dairy Science* **97**: 1535–42.

Vaidya M M, Singh V R, Beena M and Upadhyay R C. 2015. Plasma profile of hormones and energy metabolites during peri-parturient period in low and high producing Karan Fries (*Holstein Friesian* × *Tharparkar*) cows during different seasons. *Indian Journal of Animal Sciences* **85**(7): 736–43.

Vargova M and Kovac G. 2016. Periparturient period in terms of body condition score and selected parameters of hormonal profile. *Folia Veterinaria* **60**(1): 63–69.

Zhang J, Pronyuk K H O, Kuliesh O V and Chenghe S. 2015. Adiponectin, resistin and leptin: Possible markers of metabolic syndrome. *Endocrinology and Metabolic Syndrome* **4**(4): 212.