

Original Research Article

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Assessment of Mineral Status during the Peri-partum Period in Crossbred Cows

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ABSTRACT

The whole study was conducted on six adult pregnant, apparently healthy, Crossbred cows during Peripartum period i.e. from 45 days before parturition to 45 days after parturition. Nine ml of whole blood from each experimental animal was collected from jugular vein in heparinized vacutainer. Plasma from the blood samples was separated and analyzed for mineral parameters. Concentration of calcium and zinc were observed to be significantly ($P<0.05$) lower on day 3 after parturition. Whereas, the concentration of magnesium and inorganic phosphorous were not differed significantly between pre-partum and post-partum period. Also the concentration of copper and Iron were observed to be significantly ($P<0.05$) lower on the day of parturition than any other days of the peri-partum period.

Keywords

Cow, Mineral, Peripartum

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Introduction

The metabolic adaptation occurs during the transition period include a complex interaction between the energy supply, the protein indicators and the necessary minerals to guarantee structural functions, the restart of reproductive activity and the dynamism of the immune system. This generates homeostasis, which allows production and preservation of health (Leblanc, 2010). Adequate amount of trace minerals and vitamins, nutrition during the peripartum period is essential for an

effective antioxidant defence system. It plays an important role in optimizing the immune responses and in helping the dairy cows to cope up with the stress of early lactation (Spears and Weiss 2008).

Peripartum cows with inadequate calcium (Ca), phosphorus (P) and magnesium (Mg) concentrations in their blood experience loss of muscular and nerve function, decrease in food intake, low ruminal activity and decline of intestinal motility (Goff, 2006). Calcium plays an important role in utilization of

cholesterol by mitochondria or by stimulating the conversion of pregnenolone to progesterone. GnRH stimulates LH release from pituitary cells involves a Ca-dependent mechanism. Phosphorus is often associated with reproductive abnormalities in cattle. The role of calcium and phospholipid-dependent protein kinase and c-AMP-dependent protein kinase may be crucial in mediating hormone action. Magnesium is equally essential in all enzyme reactions catalyzed by ATP and in maintaining the physical integrity of RNA-DNA (Patel *et al*, 2015). In view of the above facts an investigation was planned to assess the status of some crucial minerals during peripartum period on Crossbred cows.

Materials and Methods

The whole study was conducted on six adult pregnant, apparently healthy, Crossbred cows during Peripartum period i.e. from 45 days before parturition to 45 days after parturition. The research was approved by the Institutional animal Ethics Committee (IAEC.No.235/VBC/2016). The experimental animals were reared in semi-open housing system which is made up of concrete floor under asbestos roofed housing system constructed east west direction and well covered with trees. These experimental cows were not separated from other cows. The experimental animals were maintained on ICAR feeding standard (1998).

Nine ml of whole blood from each experimental animal was collected from jugular vein in heparinized vacutainer. The blood was collected from 45 days before parturition at weekly interval i.e. -45day, -38day, -31day, -24day, -17day, -10day, -3 day, on the day of parturition and upto 45 days after parturition i.e. on +3day, +7day, +10day, +15day, +30day and +45day in accordance with the probable date of parturition. Plasma from the blood samples was separated by

centrifugation at 3000rpm for 15 minutes and stored in deep freeze at -20°C until analyzed for mineral parameters. Plasma mineral estimation were carried using Diagnostic kits manufactured by Crest Biosystems, Coral Clinical Systems, Goa, by Spectrophotometer (model Visiscan 167). The data obtained in the present study was statistically analyzed by the Completely Randomised Design (CRD). The statistical model for CRD with one observation per unit

$$Y_{ij} = \mu + t_i + e_{ij}$$

μ = overall mean effect

t_i = true effect of the i
th treatment

e_{ij} = error term of the j th unit receiving i th treatment

Results and Discussion

A number of trace minerals are required for functioning of enzymes involved in the antioxidant defence system. Certain trace minerals may also affect immune cells via mechanisms distinct from antioxidant properties. So, different mineral levels were measured in dairy cows during prepartum and postpartum period. Mean \pm SE values of all Minerals were presented in Table 1.

The observed overall mean value of calcium (mg/dl) in crossbred cows was 8.725 ± 0.31 which ranged from 6.45 ± 0.25 to 10.25 ± 0.66 during the peripartum period. The level of calcium was lowest on day 3 after calving as compared to all other peri-partum days. The concentration of calcium was found to be highest on 45 days before calving. It decreased significantly ($P < 0.05$) on 38 days before calving, then the values started increasing non-significantly from 31 days to 3 days before calving. On the day of parturition the calcium level started decreasing significantly ($P < 0.05$) reaching the lowest value on day 3 and remained low upto day 10.

From day 15 onwards the level of calcium differed non-significantly during the whole post-partum period.

Results of present experiment were in consonance with observations of Nessim (2010) in Baladi cows and Piccione *et al.*, (2012) in Holstein Friesian cows. However, Alameen and Abdelatif (2012) observed that the serum Calcium level was not affected significantly by season and stage of pregnancy. While, Onia and Coliber (2009) reported high level of calcium 5-6 days after parturition in HF cows. Reduction in serum Ca in at or soon after parturition might be an unavoidable mechanism in dairy cows, especially in aged cows (Horst *et al.*, 1994; Goff *et al.*, 1991) due to the expeditious loss of Ca by milk synthesis, and less efficiency of Ca absorption by the intestinal transcellular pathway (Horst *et al.*, 1994) and inactivation of the bone Ca resorption pathway.

The observed overall mean value of copper ($\mu\text{g}/\text{dl}$) in crossbred cows was 84.64 ± 4.71 which ranged from 55.69 ± 3.52 to 113.10 ± 12.89 during the peripartum period. The level of copper was lowest on the day of parturition as compared to all other peripartum days. During the pre-partum period the changes in the concentration of the copper values were non-significant. The concentration of copper was significantly ($P < 0.05$) decreased on the day of parturition and significantly ($P < 0.05$) increased on day 15 as compared to any other peri-partum day.

Results that are obtained from the present study were in consonance with the observation of Maurya *et al.*, (2014) in crossbred Karan Fries cows. Whereas Jayachandran *et al.*, (2013) did not observe any significant differences in copper levels between anestrus and regularly cyclic buffaloes. However, Chandra and Agarwal (2009) observed that if the crossbred cows are

supplemented with α -tocopherol acetate during the dry period copper levels were significantly higher in the animals during the peripartum period. Setia *et al.*, (1994) reported that copper level was little lower during early lactation than at calving or late lactation. However, Mehere *et al.*, (2002) and Jacob *et al.*, (2003), observed rising level of copper from day of calving till 4-6 weeks postpartum. The lower concentration of copper recorded at parturition followed by increasing trend after 4-5 weeks postpartum could be due to increased transfer of this nutrient across the placenta and haemodilution during late pregnancy and at calving, together with initiation of ovarian follicular activity postpartum, leading to high circulating estrogens which stimulates binding of copper with proteins in liver thereby increased concentration in plasma (Mehere *et al.*, 2002).

The observed overall mean value of iron ($\mu\text{g}/\text{dl}$) in crossbred cows was 200.46 ± 6.20 which ranged from 170.61 ± 6.32 to 235.48 ± 8.07 during the peri-partum period. The level of iron was lower during pre-partum period in comparison to the post-partum period. The variations in the concentrations of iron during the pre-partum period including the day of parturition were non-significant. After parturition the level of iron started increasing significantly ($P < 0.05$) from 3 day onwards reaching the highest value on 45 day of peri-partum period.

The results of the present experiment were in consonance with the observation of Maurya *et al.*, (2014) in crossbred Karan Fries cows. Whereas Chandra and Aggarwal (2009) reported that the Iron concentrations in the peripartum period also differ significantly in summer and winter. The iron in blood is present mainly as haemoglobin (Hb) in erythrocytes and as transferring in the blood plasma. Iron plays an important role in

oxygen delivery to the tissues, and as a cofactor with several enzymes involved in energy metabolism and thermoregulation. The recorded decline in serum Fe during late pregnancy could be related to the great demand for this element by the foetus (Swenson *et al.*, 1993). This is because Hb levels decrease during pregnancy due to transfer of Hb across the placenta and haemodilution. The mean serum iron concentration differed significantly in prepartum period and postpartum period. There was decreasing tendency of iron towards parturition. This may be because of utilization of iron by mammary gland. Azab and Maksoud (1999) also reported similar findings in Baladi goat.

The observed overall mean value of magnesium (mg/dl) in crossbred cows was 1.93 ± 0.04 which ranged from 1.62 ± 0.08 to 2.11 ± 0.23 during the peripartum period. The magnesium level was observed to be slightly decreased on the day of parturition than any other day during the peri-partum period, but the decrease in the level of magnesium was non-significant. A slight variation in the magnesium value was observed throughout the peri-partum period but these variations were non-significant.

Results of present study were in consonance with observations of Oniia and Colibar (2009) in HF cows, Patel *et al.*, (2015) also observed that in post-partum period the magnesium level of anestrus and subestrus cows did not differ significantly. Alameen and Abdelatif (2012) found that stage of pregnancy had no significant effect on magnesium level in crossbred dairy cows. Whereas Piccione *et al.*, (2012) found that the physiological phase such as late gestation, post-partum, early lactation and late lactation have a significant effect on the magnesium levels in Holstein Friesian cows. However, Ghanem *et al.*, (2012) observed a significant ($P < 0.05$)

decrease in magnesium concentration during the peri-parturient period of Friesian cows. In the present study a non-significant reduction in serum Mg level during late pregnancy and lactation was observed. Several factors associated with diet composition can influence utilization and bioavailability of serum minerals. Serum Mg concentration is influenced by dietary protein level as well as Ca and P in the diet (Underwood and Shuttle, 1999).

The observed overall mean value of zinc ($\mu\text{g/dl}$) in crossbred cows was 225.80 ± 6.25 which ranged from 180.85 ± 12.02 to 260.30 ± 28.46 during the peri-partum period. Zinc levels were significantly ($P < 0.05$) lowest on day 3 after calving as compared any other peri-partum days. The value of zinc was observed to be significantly ($P < 0.05$) higher on 3 days before calving of the peri-partum period. As compared with the pre-partum period the value of zinc was significantly ($P < 0.05$) low on the day of parturition. Lowest value of zinc was observed on day 3 which started increasing significantly ($P < 0.05$) from day 15 onwards reaching the pre-partum values by day 45.

The results of the present experiment were in consonance with the observation of Maurya *et al.*, (2014) in crossbred Karan Fries cows. Whereas Chandra and Aggarwal (2009) reported that the zinc concentrations in the peripartum period also differ significantly in summer and winter. However, Jayachandran *et al.*, (2013) reported that the zinc levels did not differ between anestrus and regular cyclic buffaloes in the post-partum period. At parturition, due to increased colostrogenesis, there is diversion of Zn from plasma pool towards mammary gland. Drop in serum Zn level at calving is also associated with an acute phase response due to inflammatory reaction in uterus. Stress at calving induces synthesis of metallothionein, a protein

associated with Zn distribution that may scavenge hydroxide radicals (Prasad *et al.*, 2004). As a consequence, Zn is redistributed from blood pool to other tissues such as liver

(Meglia *et al.*, 2001). All the facts explain why level of zinc is reduced around peri-partum period.

Table.1 Mean (\pm SEM) values of minerals in crossbred cows (n=6) during peripartum period

Days	Calcium (mg/dl)	Copper (μ g/dl)	Iron (μ g/dl)	Magnesium (mg/dl)	Zinc (μ g/dl)	Inorganic Phosphorous (mg/dl)
-45	10.25 ^a \pm 0.66	84.64 ^{cd} \pm 6.69	170.61 ^e \pm 6.32	2.11 \pm 0.23	236.07 ^{cde} \pm 18.79	8.06 \pm 0.27
-38	8.66 ^{cde} \pm 0.87	90.56 ^c \pm 11.60	184.34 ^{de} \pm 11.72	1.95 \pm 0.11	237.30 ^{bcd} \pm 19.05	7.74 \pm 0.43
-31	9.20 ^{bcd} \pm 0.60	73.70 ^{de} \pm 7.15	191.46 ^{cd} \pm 9.48	2.09 \pm 0.07	215.83 ^{ef} \pm 15.78	7.86 \pm 0.41
-24	9.93 ^{ab} \pm 0.42	93.99 ^{bc} \pm 8.35	190.40 ^{cde} \pm 10.28	1.73 \pm 0.04	223.76 ^{det} \pm 14.70	7.41 \pm 0.37
-17	9.98 ^{ab} \pm 0.35	64.31 ^{ef} \pm 7.62	175.81 ^{de} \pm 5.94	1.74 \pm 0.15	257.60 ^{ab} \pm 5.69	7.19 \pm 0.40
-10	9.46 ^{abc} \pm 0.36	82.28 ^{cd} \pm 9.04	176.68 ^{de} \pm 9.09	1.97 \pm 0.21	233.32 ^{cde} \pm 15.25	7.32 \pm 0.40
-3	9.53 ^{abc} \pm 0.56	72.05 ^{de} \pm 9.10	185.09 ^{de} \pm 9.09	2.01 \pm 0.12	260.30 ^a \pm 28.46	7.09 \pm 0.52
0	8.28 ^{de} \pm 0.24	55.69 ^f \pm 3.52	186.11 ^{de} \pm 7.44	1.62 \pm 0.08	208.78 ^{fg} \pm 10.56	6.62 \pm 0.45
+3	6.45 ^f \pm 0.25	64.35 ^{ef} \pm 3.35	212.14 ^b \pm 6.23	1.70 \pm 0.06	180.85 ^h \pm 12.02	6.91 \pm 0.78
+7	6.66 ^f \pm 0.35	91.80 ^c \pm 10.04	229.14 ^{ab} \pm 6.56	2.01 \pm 0.08	191.01 ^{gh} \pm 24.82	7.61 \pm 0.67
+10	7.80 ^e \pm 0.74	82.21 ^{cd} \pm 8.35	235.48 ^a \pm 8.07	2.06 \pm 0.11	209.63 ^{fg} \pm 23.73	7.62 \pm 0.60
+15	8.75 ^{cde} \pm 0.89	113.10 ^a \pm 12.89	209.55 ^{bc} \pm 11.09	2.00 \pm 0.08	222.92 ^{det} \pm 12.38	7.89 \pm 0.59
+30	8.35 ^{de} \pm 0.45	108.55 ^{ab} \pm 3.93	224.07 ^{ab} \pm 10.38	2.06 \pm 0.05	231.97 ^{cde} \pm 5.87	8.01 \pm 0.56
+45	8.75 ^{cde} \pm 0.36	107.78 ^{ab} \pm 6.83	235.53 ^a \pm 9.40	2.05 \pm 0.06	251.89 ^{abc} \pm 7.07	8.24 \pm 0.59
GM	8.72 \pm 0.31	84.64 \pm 4.71	200.46 \pm 6.20	1.93 \pm 0.04	225.80 \pm 6.25	7.53 \pm 0.12
CD	1.56	23.18	25.41	NS	47.24	NS
CV %	15.59	23.78	11.03	15.33	18.75	16.96

Values having different superscripts differed significantly ($P < 0.05$) within column

The observed overall mean value of inorganic phosphorous (mg/dl) in crossbred cows was 7.53 ± 0.125 which ranged from 6.62 ± 0.45 to 8.24 ± 0.59 during the peri-partum period. The variation in the value of inorganic phosphorous was observed to be non-significant. The concentration of phosphorous was decreased slightly from 3 day before to day 3 post-partum but the changes were non-significant.

The results of the present experiment were in

consonance with the observation of Roy *et al.*, (2010) in cows. Whereas, Nessim (2010) reported that the Phosphorous levels increased significantly after calving in Baladi cows, Patel *et al.*, (2015) observed that the level of phosphorous increased linearly throughout the post-partum period in subestrus HF cows. However, Alameen and Abdelatif (2012) found that phosphorous level was significantly ($P < 0.01$) lower in winter in empty, early, mid and late pregnancy states and significantly ($P < 0.05$) lower in mid and

late pregnancy during summer in crossbred dairy cows. Ghanem *et al.*, (2012) reported a significant ($P<0.05$) decrease in phosphorous concentrations during the peri-parturient period. This study results demonstrated no alterations in inorganic phosphorus values during the research period, which suggests that homeostatic mechanisms were effective.

Summary and conclusion are as follows:

Concentration of calcium and zinc were observed to be significantly ($P<0.05$) lower on day 3 after parturition. Whereas, the concentration of magnesium and inorganic phosphorous were not differed significantly between pre-partum and post-partum period. Also the concentration of copper and Iron were observed to be significantly ($P<0.05$) lower on the day of parturition than any other days of the peri-partum period.

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