Full Length Article

BIOCHEMICAL AND MINERAL CHANGES DURING PERIPARTURIENT PERIOD IN MURRAH BUFFALOES: A STUDY TO ASSESS PARTURITION STRESS

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ABSTRACT

The objective of the present study was to assess changes in biochemical and mineral parameters during prepartum and postpartum period in Murrah buffaloes. Eight healthy pregnant Murrah buffaloes of four to six years of age were randomly selected for the study. Same animals were used as self control and divided in to two groups, G I: pre-partum (n=8) and G II: post-partum (n=8). Whole blood was collected one week before and one week after calving by venipuncture. Plasma was separated and used for estimation of biochemical and mineral parameters. Significant differences between groups were analyzed using paired t-test. The total protein, albumin, globulins, cholesterol, calcium and phosphorous levels were significantly (P<0.05) lower during post-partum compared to pre-partum period. No significant difference (P>0.05) between pre-partum and post-partum was noticed with respect to BUN and creatinine concentration. Significantly lower levels of protein profile, cholesterol, calcium and phosphorus is indicative of negative energy balance and susceptibility of dam to metabolic diseases. Thus, ameliorative nutritional strategies might be adapted to optimize animal health and production.

Key words: Periparturient period; Murrah buffaloes; biochemical; minerals; parturition stress

INTRODUCTION

The contribution of buffalo population to the Indian economy is significant owing to the fact that 49 per cent of milk production is from buffaloes and India is largest producer of Kara beef in the world (BAHS, 2019). On the other hand several factors including nutrition (Chaidanya *et al.,* 2020), disease (Bareille *et al.,* 2003), management (Haque *et al.,* 2017) environment (Purohit *et al.,* 2020), postpartum anestrus (Saikiran *et al.,* 2020) and periparturient/transition stress (Vasantha *et al.,* 2020) adversely affect animals' innate potential to be expressed. All these stressors cumulatively impair animal health and contribute to significant economic loss. Except for the periparturient stress, the above mentioned stressors may be overcome by

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one or the other ways whereas, periparturient stress is an unavoidable stage in the life cycle of female animals which is associated with susceptibility of animals to production diseases and thus evaluation of periparturient stress is of outmost significance.

Periparturient period is defined as the period between 3 weeks before to 3 weeks after parturition. During pre-partum the maternal body system is focused on deviation of energy substrates to ensure fetus growth and development (Arfuso *et al.,* 2016) while with the onset of parturition the maternal system is focused on deviation of substrates for lactogenesis and galactopoiesis (Goff, 2004). Periparturient period is characterized by increased energy demands (Herdt, 2000) that makes the animal highly susceptible to negative energy balance (NEB) (Abdulkareem, 2013). In response to NEB, numerous endocrine changes Operate at hematological, biochemical, hormonal and metabolic (Abdelrazek *et al.,* 2018) level to assist in partitioning of nutrients for maintenance of pregnancy/lactation. These changes are much more pronounced in postpartum compared to the pre-partum as the nutrient requirement of the mammary gland is several times higher than that of the pregnancy (Tharwat *et al.,* 2012). Finally as a result of mismatch between net energy produced and energy required the lactating animals ends up in production diseases such as milk fever, ketosis, fatty liver (Goff and Horst, 1997) etc. Thus, alterations in hemato-biochemical, metabolic and mineral parameters are important to understand the physiological adjustments made by the dairy animals during periparturient period and also to adopt necessary nutritional and managemental strategies to minimize stress and to optimize buffalo production. In view of these considerations the present study was aimed to evaluate the biochemical and mineral changes one week before and one week after parturition in Murrah buffaloes.

MATERIALS AND METHODS

Animals and management

The present study was carried out at Livestock Farm Complex, NTR College of Veterinary Science, Gannavaram, A.P, India. Laboratory profiling of different analytes was performed at Department of Veterinary Physiology. Eight healthy pregnant Murrah buffaloes of four to six years of age were randomly selected for the study. The animals were placed in well ventilated shed with appropriate facilities for feeding and watering. The animals were fed as per ICAR feeding standards (Ranjhan, 1998) with concentrates and roughage fed in-house. The study was carried out during the months of October - December 2019.

Experimental design and sampling

The selected buffalo cows were used as self control and divided in to two groups, G I: pre-partum (n=8) and G II: post-partum (n=8). Whole blood was collected from buffalo cows one week before and one week after calving by venipuncture into heparinised vacutainers. Immediately after blood collection the plasma was separated by centrifugation at 3500 rpm for 10 minutes at room temperature and stored at -20 °C for estimation of biochemical parameters and mineral concentration.

Biochemical and mineral assay

Biochemical parameters such as total protein (biuret method, Doumas *et al.,* 1971), albumin (bromocresol green, Doumas *et al.,* 1971), globulin (calculated as total protein-albumin), cholesterol (phenol amino antipyrine method, Richmond, 1973), urea (GLDH-urease method, Young, 1990) and creatinine (Jaffe's method, Bowers, 1980) were determined photometrically in a microplate reader (Thermo Scientific, Finland). Minerals such as calcium (o-cresol phenolphthalein complex one method, Baginski, 1973) and phosphorous (ammonium molybdate method, Wang, 1983) concentration was also determined photometrically.

Statistical analysis

All the values obtained were expressed as mean ± standard error of the mean (SEM). The significant difference between groups was analyzed by paired t-test (Snedecor and Cochran, 1994) using computerized software programme SPSS. Ver.25.

RESULTS AND DISCUSSION

Periparturient period is one of the most critical period in the life cycle of dairy animals which is associated with high energy demands in the process during they undergo numerous physiological, hematological, biochemical and enzymatic changes to prepare themselves for the onset of lactation (Elshahawy and Abdullaziz, 2017). While, imbalance between net energy produced and energy required results in production diseases in ruminants. Hence forth estimation of hemato-biochemical profile is of great significance to evaluate the physiological alterations as well as health status of the animals. Moreover, hemato-biochemical profiling of dairy cattle during periparturient period has been considered as a reliable method to monitor animal health and to predict herd's susceptibility to production diseases (Kevin and Ellen, 2012). In the present study, we evaluated the alterations in few biochemical parameters during pre and post-partum in Murrah buffaloes. The total protein, albumin and globulin concentration recorded in the present study was significantly ($P<0.05$) lower in postpartum compared to prepartum period (Fig. 1). The present findings were in agreement with other reports where the protein profile was significantly lower in postpartum compared to prepartum (Elshahawy and Abdullaziz, 2017; Fiore *et al.,* 2017). The decrease in protein profile during post-partum period may be due to mobilization of proteins to support mammary metabolism (Castillo *et al.,* 2006) or to meet maternal requirement of proteins for milk and immunoglobulin production (Mohri *et al.,* 2007; Piccione *et al.,* 2010). Contradictory to our findings no significant difference in protein concentration between pre and post-partum was noticed (Piccione *et al.,* 2010; Vasantha *et al.,* 2020) which may be related to animals innate ability to minimize physiological alteration which is an adaptability characteristic. The total cholesterol was significantly ($P<0.05$) lower in post-partum compared to pre-partum period (Fig. 2). Similar to our findings, a lower cholesterol concentration towards post-partum was recorded (Tharwat *et al.,* 2012 Elshahawy and Abdullaziz, 2017; Vasantha *et al.,* 2020). In contrary, no significant difference in cholesterol concentration was observed between pre and post-partum in HF

cows (Tharwat *et al.,* 2012). With the onset of lactation the plasma cholesterol levels usually increases throughout the post-partum period as a result of high energy requirement for milk production. The increase in energy demand mobilizes fats in the form of HDL and LDL which contain cholesterol (Bruss, 1997); whereas, in the present study, the decrease in cholesterol concentration could be due to utilization of cholesterol precursors for mammary metabolism due to high demand. The study revealed no significance ($P>0.05$) between pre and post-partum period in BUN and creatinine concentration (Fig. 3) which is in line with the findings of other researchers (Tharwat *et al.,* 2012; Elshahawy and Abdullaziz, 2017; Vasantha *et al.,* 2020). Contrary to our findings, significantly higher BUN and creatinine was recorded in postpartum (Piccione *et al.,* 2010; Abdelrazek *et al.,* 2018). BUN and creatinine concentration is used as an indicator of kidney function. It determines the renal ability to excrete urea effectively. Periparturient period is associated with renal malfunction due to excess protein load due to high feed/protein intake. Usually BUN and creatinine levels were higher during pre-partum compared to post-partum (Khan *et al.,* 2011) which was associated with increased feed intake and fat mobilization (Grasso *et al.,* 2004). However, in the present study no significant ($P<0.05$) difference was noticed in BUN and creatinine concentration between pre and post-partum period which is indicative of no protein overload and abnormal renal function. In the present study, the calcium and phosphorus concentration was significantly ($P<0.05$) lower during post-partum compared to pre-partum (Fig. 4). Similar observation was made in other studies where calcium and phosphorus was lower in postpartum compared to prepartum (Piccione *et al.,* 2010 Tharwat *et al.,* 2012; Elshahawy and Abdullaziz, 2017; Vasantha *et al.,* 2020). The drop in calcium and phosphorus concentration occurs at parturition due to onset of lactation, where calcium and phosphorus is drained in colostrum and milk (Goff, 2004). Overall, a significant decrease in protein profile, cholesterol, calcium and phosphorous concentration during post-partum compared to pre-partum period is indicative of mobilization of energy substrates for milk production and/or due to lack of substrates associated with depressed feed intake that occurs during the last weeks of gestation (Fiore *et al.,* 2017). However, the mean values of biochemical parameters of the present study were within the reference range which is further indicative of adjustments within the physiological limits which is an adaptability characteristic. From these findings it is presumed that the study animals were under NEB, thus necessary managemental and nutritional strategies must be adopted to maintain animal health and to optimize production.

CONCLUSION

Periparturient period is the most stressful in the lifecycle of a dairy animal. This has been evidenced in our study on buffaloes with significantly lower levels of protein profile, cholesterol, calcium and phosphorus, which is indicative of negative energy balance and susceptibility of dam to metabolic diseases. Thus, ameliorative nutritional strategies might be adapted to optimize animal health and production.

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DISCLOSURE STATEMENT

The authors declare that there is no any conflict of interest for this manuscript.

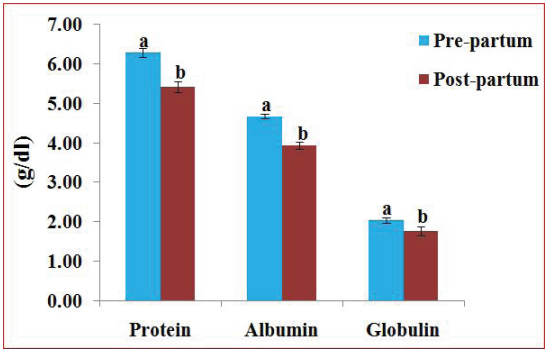

Fig. 1. Changes in total plasma protein, albumin and globulin concentration between pre-partum and post-partum periods in Murrah buffaloes.

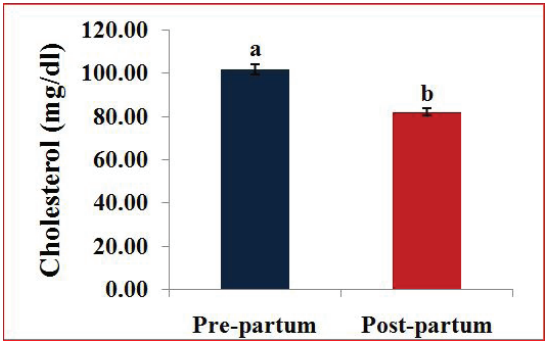

Fig. 2. Changes in total plasma cholesterol concentration between pre-partum and post-partum periods in Murrah buffaloes.

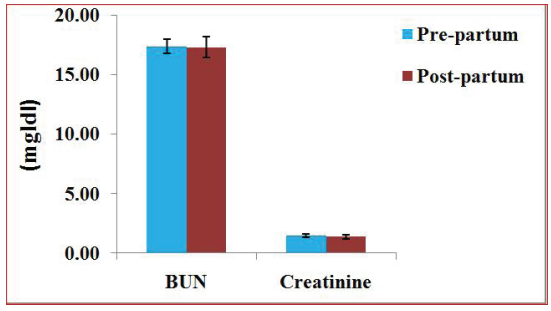

Fig. 3. Changes in plasma BUN and creatinine concentration between pre-partum and post-partum periods in Murrah buffaloes.

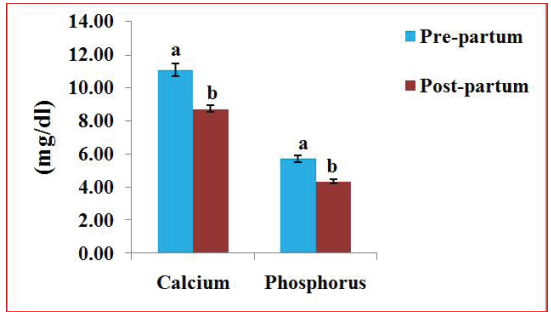

Fig. 4. Changes in plasma calcium and phosphorus concentration between pre-partum and post-partum periods in Murrah buffaloes.

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