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Evaluation of physio-biochemical changes in pre-partum stage of transition Deoni cows

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Abstract

The present study was undertaken to determine the physiological status in pre-partum stage of transition Deoni cows. Animals were screened and selected on the basis of artificial insemination and pregnancy records maintained at the Instructional Livestock Farm Complex (ILFC) and Sub centre, College of Veterinary and Animal Sciences, Udgir (M.S.). Total eighteen transition (3 weeks-prepartum) Deoni cows, of between eight to twelve years of age, were selected for the study and maintained on similar management practices. Biochemical variables including calcium, phosphorus, Ca:P ratio, magnesium, glucose, total protein, albumin, globulin, A/G ration, urea, creatinine, total bilirubin were estimated in pre-partum transition Deoni cows and were compared with healthy non-pregnant control. The haematological indices like white blood cells (WBC), lymphocytes, monocytes, neutrophils, eosinophils, basophils, red blood cells (RBC), were determined and compared with healthy non pregnant control. Result of study revealed that mineral status such as serum calcium and phosphorus was significantly (P<0.01) reduced in prepartum transition animals when compared to the healthy non pregnant (control) group. Energy status in terms of blood glucose level was significantly (P<0.01) reduced in prepartum transition animal as compared to control. It was concluded that there may be a metabolic shift in the level of haemato-biochemical parameters in the transient period of Deoni cows. Therefore, henceforth in the ration of transition (pre-partum) Deoni cows, inclusion of soluble carbohydrates and mineral mixture would be beneficial in preventing the development of negative energy balance (NEB).

Keywords: *Transition animals, biochemical variables, physiological indices, negative energy balance*

Deoni is well recognised as a dual purpose breed of cattle located in different regions of Maharashtra with an average milk yield of 868 kg per lactation (NBGAR). The native breeding

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tract of Deoni cattle includes Latur, Beed, Omanabad, Aurangabad and Parbhani districts. The age at first calving of Deoni cow ranges from 107.80±17.17days (Chakravarthi *et al*., 2002) to 1533 days (Deshpande and Singh, 1977). The term transition period is defined as the period three weeks pre-partum to three weeks postpartum in dairy cows (Kocila *et al*., 2013; Folnozic *et al*., 2015; Duricic *et al*., 2020). The transition period is very important due to its influence on the health and performance of dairy cows, owing to the significant metabolic and physiological changes during this period (Piccione *et al*., 2012; Turk et al., 2016; Kovacs et al., 2020). The transition period is important in terms of physio-biochemical changes that occur during prepartum stage in dairy animals. Bell, (1996) expressed that the pre-partum stage (three weeks prior to patruration) is more crucial because of increased nutrient requirement of developing foetus. The estimations of blood biochemical parameters and physiological inidces are essential in transition period of cows. The increase in the demands of the foetus, developing mammary glands, the initiation of milk synthesis leads to the excessive withdrawal of nutrients from cow's system. Bell *et al*. (1995) estimated that the daily demands for foetal and placental growth in the last three weeks of gestation were 360 g of metabolizable protein and 3 to 5 Mcal of Net energy.

As a result of deprived state of energy satus, advanced pregnant cows may enter into negative energy balance (NEB) which could lead to the development of quite a number of metabolic disorders during the post-partum state. The magnitude of the negative energy balance in the pre-partum period appears to be a variable that can be mitigated through application of nutritional strategies at farms. Additionally, the negative energy balance and resulting increase of plasma non-esterified fatty acids (NEFA), if they are sufficiently high, may contribute to the development of fatty liver, which itself is a major contributing factor to various metabolic disorders during the postpartum period (Grummer, 1995; Dyk and Emery, 1996). This poses an enormous challenge for the liver that has to synthesize all this glucose from propionate and amino acids as well as a challenge for other tissues and organs that have to adapt to a reduction of glucose availability. Glucose is an equally important energy source for the ovary and the reduced glucose availability in the beginning of lactation can negatively impact the re-establishment of ovarian activity after calving (Rabiee *et al*., 1999). A study to explore the influence of different dietary protein levels (crude protein @12 %, 14 %, 16 % and 18% with total mixed ration) on serum biochemical parameters of dairy cows during the transition period revealed that levels of biochemical parameters (albumin, glucose, beta hydroxy butyrate) except total protein and serum glucose under observation remained unaffected in all treatment combinations, whereas the values of NEFA (Non esterified fatty acids) were below the normal range (Sreemol *et al.,* 2021).

It is now well recognised that dry matter intake (DMI) decreases as the pregnant animal approaches calving. Dry matter intake decrease from 2 % of body weight (BW) in the first few weeks of the dry period to 1.4 % BW in the last seven to ten days before calving. However, 30 % decrease in DMI seems to occur very rapidly in the transition period (Bertics *et al.,* 1992; Hayirli *et al.,* 1998; Robinson and Garrett, 1999). During the period from 3 week after calving DMI may increase at the rate of 1.5 to 2.5 kg /wk (Grant and Albright, 1995). This increase is more rapid in multiparous cows than primiparous cows (Kertz *et al.,* 1991; Robinson and Garrett, 1999).

Glucose is an essential body fuel that plays a significant role in all living individuals. In the last week of gestation, demand for energy of foetus tremendously increases which results in utilisation of 46 % glucose from their dam's womb (Bell, 1995). Additionally, a cow producing 30 kg of milk/d has the ability to make use of at least 2 kg of blood glucose for the synthesis of milk lactose (Bell, 1996). Hence, at the end of pregnancy and the beginning of lactation there is an increased need of glucose for dam's metabolism.

Very little research has been conducted in India with regard to Deoni cows in the pre-partum transition phase. Therefore, the present study was undertaken to determine the changes

in biochemical parameters and haematological indices in pre-partum stage of transition Deoni and to use baseline parameters in identification of sub-clinical metabolic disorders in transition cows.

Materials and methods

A total of 18 of Deoni cows at the pre-partum stage of transition phase were selected from Instructional Livestock farm Complex and Sub Centre, Udgir. The animals were selected with the age ranging from 6-12 years and average milk yield was 2 to 4 liter on daily basis. Similarly, 18 non-pregnant cows were selected as control for the the present study. During the study, transition phase was confirmed by date of insemination and pregnancy records maintained at farm .The blood samples were collected from 8 month and above pregnant Deoni cows at their pre-partum transition phase (3 weeks before parturition).

The study was carried out during the period of May 2017 to December 2019, in the Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Maharashtra Animal and Fishery Sciences, Udgir.

Blood samples were collected from jugular vein using vacutainer tubes. During the work, serum samples were separated and stored in Eppendorf tubes at – 20 ^{0}C until the analysis. Haematological indices were determined on the same day using Automatic 5 part hematology analyser at Department of Veterinary Physiology. Haematological indices were determined including *viz*., white blood cells (WBC), lymphocytes, monocytes, neutrophils, eosinophil's, basophils, red blood cells (RBC), haemoglobin, haematocrit (PCV), MCV, MCH, MCHC and platelets. Serum samples were subjected to the estimation of biochemical variables including viz. calcium, phosphorous, Ca: P ratio, magnesium, glucose, total protein, albumin, globulin, A/G ratio, urea, creatinine and bilirubin using biochemical Semi-automatic analyser at Department of Veterinary Biochemistry, College of Veterinary and Animal Sciences, Udgir (M.S).

Unpaired t test was used for statistical analysis of biochemical and haematological changes in pre-partum transition Deoni cows as compared to control.

Results and discussion

Observations were recorded and subjected to the statistical analysis of data by using unpaired t- test. Changes in biochemical variables (Table 1) and haematologic indices (Table 2) were evaluated in prepartum transition Deoni cows and compared to control group.

The serum level of inorganic phosphorus was significantly (P<0.01) decreased in pre-partum transition cows (group I) when compared to non- pregnant

Table 1. Determination of mean values (Mean ± SE) of biochemical variables in pre-partum stage of transition Deoni cow in comparison with healthy non-pregnant control group

Sl. No.	Parameters	Control	Pre-partum (group- I)
1.	Calcium (mg/dl)	8.85±0.14^a	7.48±0.09^b
2.	Phosphorus (mg/dl)	4.1±0.08^a	3.38±0.09^b
3.	Ca:P ratio	2.15±0.06^a	2.25±0.06^a
4.	Magnesium (mg/dl)	1.68±0.05^b	2.31±0.22^a
5.	Glucose (mg/dl)	43.84±0.65^a	38.54±0.81^b
6.	Total protein (g/dl)	6.76±0.12^b	9.96±0.24^a
7.	Albumin (g/dl)	3.31±0.05^b	4.18±0.20^a
8.	Globulin (g/dl)	3.36±0.26^b	6.14±0.29^a
9.	A/G ration	0.97±0.06^a	0.71±0.06^b
10.	Urea (mg/dl)	33.38±0.98^b	44.17±1.55^a
11.	Creatinine (mg/dl)	1.26±0.087^a	1.41±0.14^a
12.	Total bilirubin (mg/dl)	0.55±0.04^a	0.89±0.12^a

Mean values with dissimilar superscript differ significantly (P value <0.01)

Table 2. Determination of mean values (Mean ± SE) of haematologic indices in pre-partum stage of transition Deoni cow in comparison with healthy non-pregnant control group

Sr. No.	Parameters	Control	Pre-partum (group- I)
1.	WBC (X 10^3 cells)	8.02±0.51[a]	8.72±0.73[a]
2.	Lymphocytes (X 10^3 cells)	5±0.32[a]	5.46±0.48[a]
3.	Monocytes (X 10^3 cells)	1.2±0.11[a]	0.88±0.45[a]
4.	Neutrophils (X 10^3 cells)	3.13±0.17[a]	2.82±0.30[a]
5.	Eosinophils (X 10^3 cells)	0.40±0.05[a]	0.34±0.07[a]
6.	Basophils (X 10^3 cells)	0.04±0.02[a]	0.03±0.008[a]
7.	RBC (X 10^6 cells)	6.91±0.33[a]	6.17±0.23[a]
8.	Haemoglobin (g %)	9.55±0.57[a]	7.78±0.22[a]
9.	Haematocrit (%)	38.19±1.46[a]	27.38±2.24[b]
10.	MCV (%)	3.13±0.17[a]	2.82±0.30[a]
11.	MCH (g %)	14.88±0.34[a]	14.19±0.32[a]
12.	MCHC (g %)	28.55±1.05[a]	30.30±0.66[a]
13.	Platelets (X 10^3 cells	363.61±63.68[a]	270.16±20[a]

Mean values with dissimilar superscript differ significantly (P value <0.01)

cows (control). Serum calcium concentration in pre partum transition cows was significantly decreased (P <0.01) when compared with control and low calcium and this was suggestive of physiological hypocalcemia due to excess drain of calcium towards growth of developing foetus in dam's womb, these findings were in agreement with Pal and Acharya (2013) and Sateesh *et al.* (2018). The reduced values of phosphorus at first three weeks before parturition might be due to drain of phosphorus towards foetal circulation due to increase in the demand of ATPs synthesis in developing foetus (Jacob *et al.,* 2002) as well as enhanced carbohydrate metabolism (Sahukar *et al.,* 1984) in dam as observed in pre-partum transition cows (group I).

However, mean level of magnesium was significantly increased when compared to control group. Contrary to these findings, significant decrease in the concentration of magnesium was reported in cross bred cattle on 7th day at post partum stage by Yousuf *et al*. (2016). The mean serum level of total protein, albumin and globulin were significantly increased when compared to control. Amongst these, albumin level was found to be within the normal physiological limits. However, contrary to the present investigation there wasa decrease in the levels of total protein, albumin and globulin (Mehta *et al*., 1989; Jacob *et al*., 2002; Burke *et al*., 2010).

Serum urea concentration was significantly (P<0.01) increased in prepartum transition cows (group I) when compared to control group. The increased urea concentration in prepartum transition cows was indicative of inefficient utilisation of dietary crude proteins by the dam (Mumbach *et al.,* 2017).

In present study, the values of blood glucose were found significantly lower in pre-partum transition cows (group I) when compared to non- pregnant cows (Table 2). These observations were found to be co-linear with the investigations of Sateesh *et al.* (2018). Hypoglycaemia in pre-partum transition phase occurs primarily due to several hormonal changes at the time of parturition, initiation of lactation (Ingvartsen, 2006). These changes could be responsible for hypoglycemic state after parturition in dairy cows (Butler, 2005). However, glucose is primarily used as metabolic fuel for the vital organ functions, foetal growth and milk production (LeBlanc *et al*., 2006).

No statistically significant differences were detected in haematological indices viz. white blood cells (WBC), lymphocytes, monocytes, neutrophils, eosinophil's, basophils, red blood cells (RBC), haemoglobin, haematocrit (PCV), MCV, MCH, MCHC and platelets.

Conclusion

The baseline parameters will be used for identification of sub-clinical metabolic disorder in in pre-partum stage of transition Deoni cows. Concentration of serum calcium was significantly decreased in pre-partum group as compared to control. The level of inorganic phosphorous and glucose was significantly reduced in pre-partum group in contrast to control whereas, urea concentration was significantly increased in pre-partum group in comparison with non-pregnant control group. The negative energy balance could be overcome by manipulating ration especially in terms of supply of concentrates and mineral mixture to prepartum transition Deoni cows inorder to maintain physiological status of blood glucose for preparatory phase of lactation.

Conflict of interest

Authors declare that they have no competing interests.

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