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**Vasantha SKI**
Assistant Professor, Department of Veterinary Physiology, NTR college of Veterinary Science, Gannavaram, Andhra Pradesh, India

**Nikhil Kumar Tej**
Assistant Professor, Department of Veterinary Physiology, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh, India

**Saikiran BVS**
MVSc, Department of Veterinary Physiology, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh, India

**Lavanya S**
MVSc, Department of Veterinary Physiology, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh, India

**Sivaiah K**
Scientist, Livestock Research Station, Lam farm, Guntur, Andhra Pradesh, India

**Mutha Rao M**
Professor and Officer in-Charge, Livestock Research Station, Lam farm, Guntur, Andhra Pradesh, India

**Srinivasa Prasad CH**
Professor and University Head, Department of Veterinary Physiology, NTR College of Veterinary Science, Gannavaram, Andhra Pradesh, India

**Corresponding Author:**
**Vasantha SKI**
Assistant Professor, Department of Veterinary Physiology, NTR college of Veterinary Science, Gannavaram, Andhra Pradesh, India

# Hematological and biochemical changes in Ongole cows one week before and one week after parturition in relation to THI

**Vasantha SKI, Nikhil Kumar Tej, Saikiran BVS, Lavanya S, Sivaiah K, Mutha Rao M and Srinivasa Prasad CH**

**Abstract**
The objective of the present study was to assess the hematological and biochemical changes during periparturient period Ongole cattle. Eight Ongole pregnant cattle of four to six years of age during the summer season were used for the experiment. Temperature humidity index (THI) was calculated by recording the ambient temperature and relative humidity in the calving season. Whole blood was collected one week before and after calving. Haematological and biochemical parameters were estimated. The study revealed that transition period had no effect (p>0.05) on total erythrocytic count (TEC), haemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). The total leucocyte count (TLC) was significantly ($p$< 0.05) higher and lymphocyte percent was significantly ($p$< 0.05) lower during postpartum compared to prepartum. There was no significant (p>0.05) difference between prepartum and postpartum with respect to biochemical parameters such as total protein, BUN and creatinine. Cholesterol, calcium and phosphorous levels were significantly ($p$< 0.05) lower during postpartum compared to prepartum. Changes in hematological and biochemical parameters are indicative of parturition stress in Ongole cows and these parameters could be used as stress markers. The mean values obtained for hematological and biochemical parameters are within the reference range of cattle despite of high THI which is indicative of high thermo tolerance to the existing adverse ambience.

**Keywords:** Ongole cattle, hematological, biochemical, periparturient period, temperature humidity index

## 1. Introduction
Periparturient period is the most stressful condition for dairy animals as it induces several physiological changes for the onset of lactation and is also associated with oxidative stress (Konvicna *et al*., 2015; Ambily *et al*., 2019) [15, 4]. The animals are also subjected to various metabolic and endocrine changes during this phase in the life cycle of dairy animals (Tharwat *et al*., 2013). Initiation of lactation compared to the late gestation induces more stress to the animals as the nutrient requirement by the mammary gland is several times more than that of a growing fetus (Tharwat *et al*., 2012) [34]. This makes the animals highly susceptible to negative energy balance (Mohamed *et al*., 2015) [23], fat mobilization, elevation of circulating nonesterified fatty acids and ketone bodies (Ingvarsten and Andersen, 2000; Seifi *et al*., 2007) [16, 31]. Moreover, when transition period is accompanied by high environmental temperature and humidity, the health of the animals is more compromised making them prone for diseases.

The alterations in hematological and biochemical parameters are used to understand the physiological adjustments during periparturient period. Moreover in tropical country like India, thermal stress is one of the major factors which further aggravate stress in cattle and buffaloes. Hence a comprehensive understanding of the effect of the THI on the periparturient period is of utmost importance to understand the physiology of animals and to adopt nutritional and managemental strategies to optimize production.

## 2. Materials and Methods
Eight female Ongole cattle of four to six years of age were randomly selected from the LAM Farm, Guntur, and Andhra Pradesh. The animals were kept in shed with appropriate facilities for feeding and watering. The animals were fed as per ICAR feeding standards (Ranjhan, 1998) [27] with concentrates and roughage stall fed.

**2.1 Meteorological data**

The experiment was conducted at different days in the month of May (summer). The meteorological data during May was recorded. Ambient temperature (AT) and relative humidity (RH) was recorded from outdoor atmosphere using Digital Thermo Hygrometer. Temperature humidity index (THI) was calculated using the equation, THI = (0.8 X Tdb) + [(RH/100) X T db-14.4] + 46.4 (Tdb= temperature of dry bulb, RH= relative humidity) (Mader *et al*., 2006) [22] from daily recordings AT and RH.

**2.2 Blood collection and analysis**

Blood samples were collected on one week prepartum and one week postpartum for assessing the haematological parameters and biochemical parameters. Whole blood was collected between 10.00 h-11.00 h by venepuncture of the jugular vein using vacutainers containing sodium ethylene diamine tetra acetic acid salt (EDTA) as anticoagulant. Total erythrocyte count (TEC), total leucocyte count (TLC), Haemoglobin (Hb), Lymphocyte%, Monocyte%, Granulocyte%, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) were estimated using Mindray Heamoanalyzer BC 2800 Auto hematology Analyzer purchased from Shenzhen Mindray Biomedical Electronics Co Ltd. Haematological indices such as MCV, MCH and MCHC were calculated from the erythrocytic series.

The serum was separated from another aliquot of blood samples by centrifugation at 3500 rpm for 10 minutes at room temperature and stored at -20 ºC for estimation of biochemical parameters. total plasma proteins (biuret method, Doumas *et al*., 1971) [9], cholesterol (phenol amino antipyrine method, Richmond, 1973) [28], total calcium (o-cresol Phenolphthalein complex one method, Baginski, 1973) [5], phosphorous (Ammonium molybdate method, Wang, 1983) [35], urea (GLDH-urease method, Young, 1990) and ceatinine (Jaffe's method, Bowers, 1980) [7] concentration was determined photometrically.

**2.3 Statistical analysis**

The data obtained on various parameters were statistically analysed using paired t test (Snedecor and Cochran, 1994). The whole data was analysed using computerized software programme SPSS Ver.20.0.

**3. Results and Discussion**

The mean± SE values of minimum and maximum temperature, relative humidity and THI during the study period are given in Table 1. The mean THI recorded in the present study was found to be 81.22±1.69. As per Helal *et al.* (2010) [15] a THI of 74 or less is considered as normal or comort zone, A THI of 75-78 is indicative that animal is in alert state, while a THI of 79-83 is danger state and above 84 is an emergency condition. In the current study, a high THI of above 72 in the present study was indicative that the animals were under significant heat stress during the study period.

**3.1 Hematological parameters**

The changes in hematological parameters from prepartum to postpartum were presented in Fig. 1 to 10. The results of our present study with respect to hematological parameters are as follows. The TEC concentration during prepartum and postpartum was found to be 6.2±0.21 and 6.42±0.24 $10^6$/µl respectively; with no significant (p>0.05) difference. Similarly, Abdulkareem (2013) [3] also did not notice significant difference in TEC, Hb, PCV, MCV, MCH, and MCHC between calving and postpartum period in Iraqi riverine buffaloes. The findings of Abdelrazek *et al.* (2018) [2] are also similar to our findings, with non-significant alteration in TEC, Hb, PCV, MCV, MCH, MCHC of Egyptian buffaloes in transition period. In contrary to present findings, Gavan *et al.* (2010) [12] reported TEC values of 6.94 and 5.02 $10^6$/µl suggesting a decreased TEC at parturition in HF cows. Nevertheless TEC is within the reference range of 4.9-7.5 $10^6$/µl for cattle (Wood and Rocha, 2010) [36].

The TLC concentration during prepartum and postpartum was found to be 8.98±0.51 and 11.48±0.79 $10^3$/µl respectively; with significant ($p$< 0.05) increase in postpartum compared to prepartm. The results of Abdelrazek *et al*. (2018) [2] also showed an increase in TLC towards calving and few days postpartum. Contradictory to our findings Gavan *et al.* (2010) [12] reported values of 13.8 and 11.68 $10^3$/µl suggesting a decreased TLC at parturition in HF cows. In the reports of Mohamed *et al*. (2015) [23] a significant decrease in TLC in the early lactating period when compared with the late pregnant Murrah buffalo heifers in Assiut city, Egypt was observed. At parturition, there was an increase in TLC due to high levels of cortisol secreted, which in turn stimulates the bone marrow (Kim *et al.* (2005) [19]. Nevertheless TLC is within the reference range of 5.1-13.3 $10^3$/µl for cattle (Wood and Rocha, 2010) [36].

The Hb concentration during prepartum and postpartum was found to be 8.68±0.25 and 8.85±0.25 g/dl respectively with no significant (p>0.05) difference. Contrarily, Gavan *et al.* (2010) [12] reported an Hb values of 11.10 and 7.88 g/dl during prepartum and postpartum with significant difference in HF cows. Nevertheless Hb is within the reference range of 8.4-12.0 g/dl for cattle (Wood and Rocha, 2010) [36].

The PCV observed during prepartum and postpartum was found to be 28.20±1.17 and 29.03±1.11% respectively with no significant (p>0.05) difference. Gavan *et al.* (2010) [12] reported a PCV value of 30.5 and 21.31% during prepartum and postpartum respectively suggesting a decreased PCV in HF cows. The MCV observed during prepartum and postpartum was 45.23±0.69 and 45.68±0.49 fl respectively. Gavan *et al.* (2010) [12] reported MCV values of 43.8 and 41.66 fl during prepartum and postpartum in HF cows with no significant difference. In contrary to the present findings Mohamed *et al.* (2015) [23] reported a significant decrease in PCV, MCV in the early lactating period. Nevertheless PCV and MCV are within the reference range of 21-30% and 36-50 fl for cattle (Wood and Rocha, 2010) [36].

The MCH observed during prepartum and postpartum was found to be 13.73 ±0.20 and 13.78±0.19 pg respectively with no significant (p>0.05) difference. Gavan *et al.*, (2010) [12] reported no significant difference between prepartum and postpartum with MCH values of 16.02 and 15.46 pg in HF cows. The MCHC observed during prepartum and postpartum was found to be 33.68± 2.01and 31.80±1.80% respectively. Gavan *et al.* (2010) [12] also reported no significant difference between prepartum and postpartum with MCHC values of 36.42 and 37.16% in HF cows. Contradicting our results, Mohamed *et al.* (2015) [23] reported a significant decrease in MCHC in the early lactating period. Nevertheless MCH and MCHC are within the reference range of 14-19 pg and 38-43 g/dl for cattle (Wood and Rocha, 2010) [36].

The monocyte%, Lymphocyte% and granulocyte% prepartum and postpartum was found to be 9.38±0.49 and 10.03±0.26, 42.5±0.29 and 36.48±4.25 and 50.88±2.20, 53.43±4.35 respectively. There was no significant (p>0.05) between pre and postpartum with respect to monocyte and granulocyte % whereas, lymphocyte% was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similar to present findings, Gavan *et al.* (2010) [12] reported no significant difference in monocyte% between pre and postpartum in HF cows. Abdelrazek *et al.* (2018) [2] observed significant decrease in Lymphocyte% and increase in Monocyte% at calving in Egyptian buffaloes in transition period. High lymphocyte% during postpartum could be due to increased cortisol levels at calving which causes Lymphocytopenia (Jacor *et al*., 2001) [17]. Nevertheless monocyte and Lymphocyte counts are within the reference range of 1.8-8.1 $10^3$/µl and 0.1-0.7 $10^3$/µl for cattle (Wood and Rocha, 2010) [36].

### 3.2 Biochemical parameters

The changes in biochemical parameters from prepartum to postpartum were presented in Fig. 11 to 16. The changes in some of the parameters indicate the physiological changes across the parturition but do not necessarily indicate any disease (Tharwat *et al*., 2015) [33]. The mean serum total protein concentration recorded in the present study was found to be 5.94±0.13 and 5.63±0.14 g/dl in prepartum and postpartum respectively with no significant difference. The present findings were in agreement with the reports of Piccione *et al.* (2012) [25] where no significant in protein concentration between pre and postpartum dairy cows with values of 5.52±0.45 and 4.83±0.88 g/dl. Whereas, Contradictory to the present findings, Tharwat *et al.* (2015) [33] found an increased trend in total protein in goats during transition period while Seifi *et al*. (2007) [31] also reported a significant decrease in protein concentration with values of 71.8±1.1 and 61.6±1.6 g/l in prepartum and postpartum dairy cows. Nevertheless the total protein value recorded from our study falls within the reference range of 6.2-8.2 g/dl for cattle (Kahn, 2005) [21]. Serum plasma proteins indicate the maternal requirement of proteins for milk production and immunoglobulins (Mohri *et al.*, 2007; Piccione *et al.*, 2012) [24, 25].

The mean serum cholesterol concentration recorded in the present study was found to be 84.80±1.59 and 79.15±0.85 mg/dl. The serum cholesterol concentration was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similarly, Tharwat *et al.* (2015) [33] found significant decrease in cholesterol levels towards postpartum in goats. Contrary to the present findings, no significant difference in cholesterol concentration between pre and postpartum with mean values of 79.17±12.30 and 63.50±6.76 in HF cows. In the postpartum period there is an increase in circulating high density lipoproteins (HDL) as well decrease in low density lipoproteins (LDL), along with decrease in very low density lipoproteins; which contain the largest proportion of cholesterol amongst the lipoproteins (Bruss 1997) [8]. However the mean plasma cholesterol concentration recorded falls within the reference range of 62.1- 192.5 mg/dl for cattle (Kahn, 2005) [21]. This indicates that the values of our study are within the range. Although within the reference range, due to change in endocrine profile; lipid reserves are increased during the late pregnancy and utilized during lactation (Roche *et al.*, 2009; Piccione *et al*., 2012) [29, 25].

The mean BUN concentration recorded in the present study was found to be 22.33±0.88 and 21.83±0.60 mg/dl. The serum BUN concentration was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similar to our results, Tharwat *et al*. (2015) [33] found no significant change in levels of BUN between pre and postpartum in goats. Similarly, Seifi *et al.* (2007) [31] also reported no significant change of 2.63±0.12 and 2.39±0.11 mmol/l in prepartum and postpartum dairy cows respectively. In contrary to our findings, Piccione *et al.* (2012) [25] reported a significant increase ($P$< 0.01) during the postpartum in dairy cows with values of 16.00±1.92 and 20.83±4.30 mg/dl. The increase in urea levels during the lactation depends on the dietary protein intake (Roubies *et al*., 2006; Piccione *et al.*, 2012) [30, 25] and feed intake (Bauchart, 1993; Seifi *et al.*, 2007) [6, 31]. However; the mean plasma BUN concentration recorded falls within the reference range of 7.8-24.6 for cattle (Kahn, 2005) [21]. Quiroz-Rocha *et al*. (2009) [26] reported reference values of 2.1-8.0 and 1.9-7.8 mmol/lit in pre and post calving cows in Southern Ontario dairy farms. This indicates that the values of our study are within the range.

The mean serum creatinine concentration recorded in the present study was found to be 1.10±0.11 and 1.20±0.82 mg/dl. The creatinine concentration was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similar to our results, Tharwat *et al*. (2015) [33] found no significant change towards postpartum in goats. Piccione *et al*. (2012) [25] found that creatinine serum showed higher levels during the late pregnancy and early lactation of 1.21±0.22 and 1.22±0.24 mg/dl respectively. The mean plasma creatinine concentration recorded in the study animals agree with the reference value of 0.6-1.8 for cattle (Kahn, 2005) [21]. Although within the reference range the values were on the higher side which could be due to the development of the foetal musculature and the load of organic waste of the newborn (Ferrell *et al.*, 1991; Piccione *et al*., 2012) [11, 25]

The mean serum calcium concentration recorded in the present study was found to be 10.80±0.81 and 8.07±0.30 mg/dl. The serum calcium concentration was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similar to our results, Tharwat *et al.* (2015) [33] found significant decrease in calcium levels towards postpartum in goats. Piccione *et al.* (2012) [25] also reported significantly lower calcium concentration of and 5.78±1.00 during postpartum compared to prepartum with 7.75±0.48 mg/dl. Quiroz-Rocha *et al*. (2009) [26] reported reference values of 2.18-2.65 and 1.64-2.61 mmol/lit in pre and post calving cows in Southern Ontario dairy farms. The drop in calcium concentration occurs at parturition or in the 1st days after calving (Goff, 2004) [13]. This is due to the onset of lactation, where calcium is drained in colostrum and milk (Goff, 2000) [14].

The mean serum phosphorous concentration recorded in the present study was found to be 4.72±0.21 and 3.68±0.17 mg/dl respectively. The serum phosphorus concentration was significantly ($p$< 0.05) lower during postpartum compared to prepartum. Similar to our results, Tharwat *et al.* (2015) [33] found significant decrease in levels towards postpartum in goats. Piccione *et al*. (2012) [25] also reported 5.67±0.66 and 4.88±0.86 mg/dl in prepartum and postpartum dairy cows. Quiroz-Rocha *et al*. (2009) [26] reported reference values of 1.48-2.65 and 1.04-2.73 mmol/lit in pre and post calving cows in Southern Ontario dairy farms. The decrease in phosphorus concentration after parturition could be due to initiation of lactation.

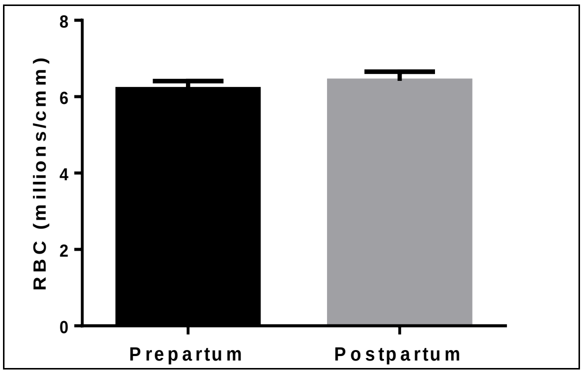


Fig 1

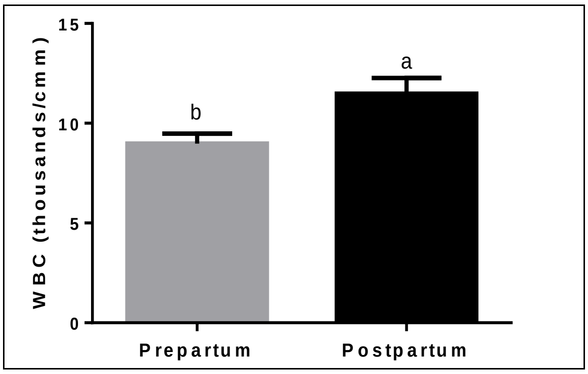


Fig 2

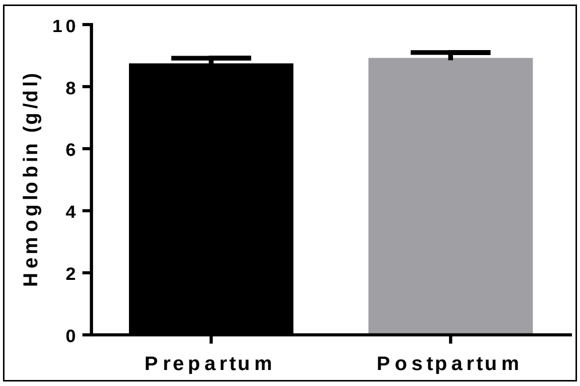


Fig 3

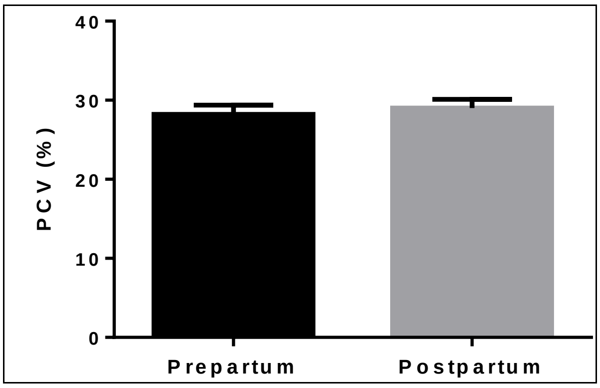


Fig 4

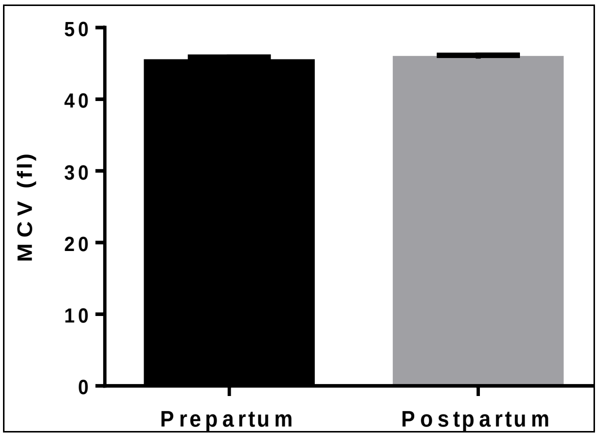


Fig 5

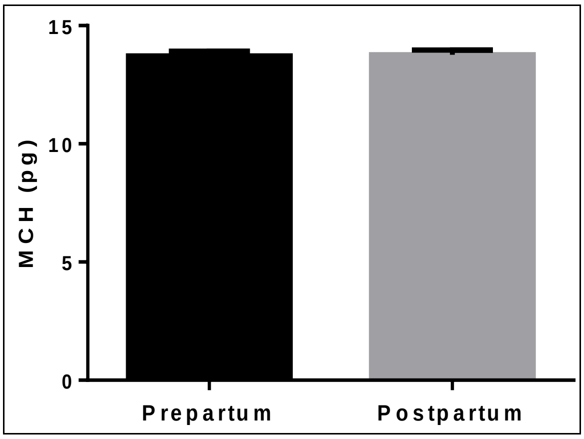


Fig 6

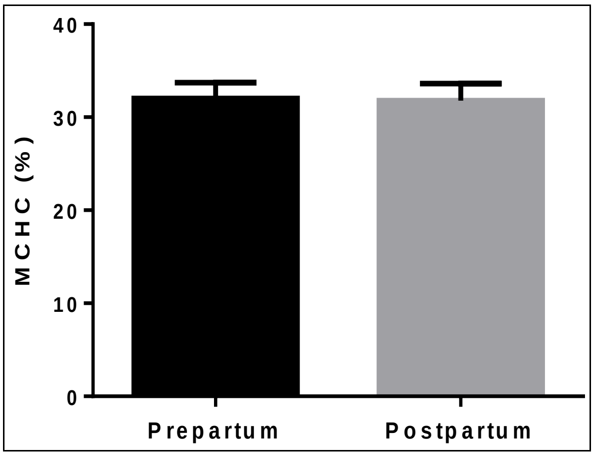


Fig 7

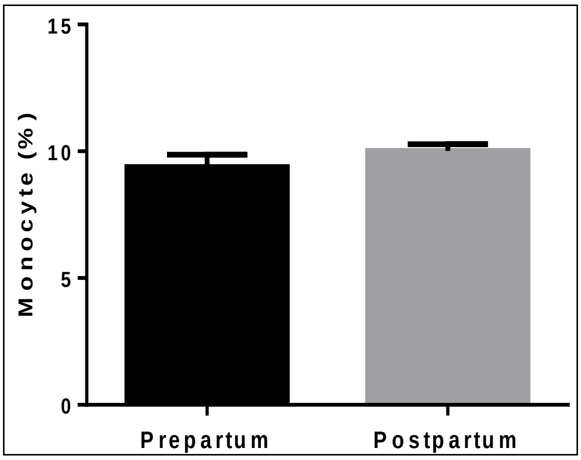


Fig 8

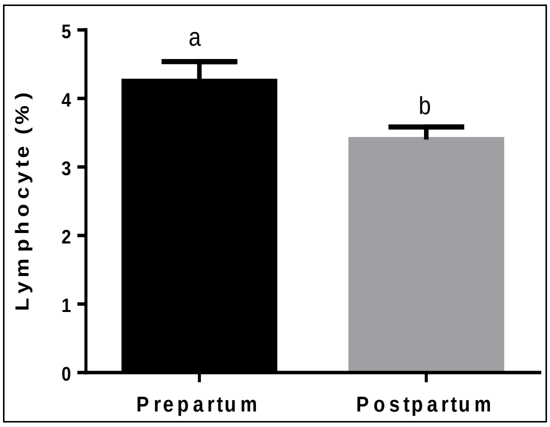


Fig 9

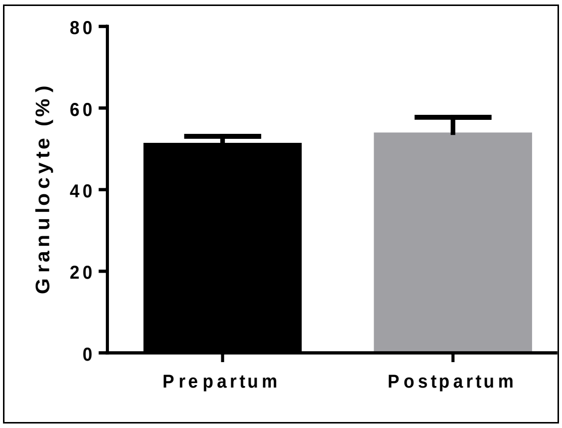


Fig 10

**Fig 1 to 10:** Shows the changes in hematological parameters from prepartum to postpartum during periparturient period in Ongole cows

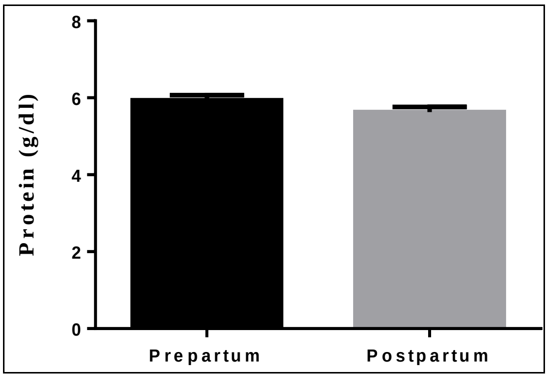


Fig 11

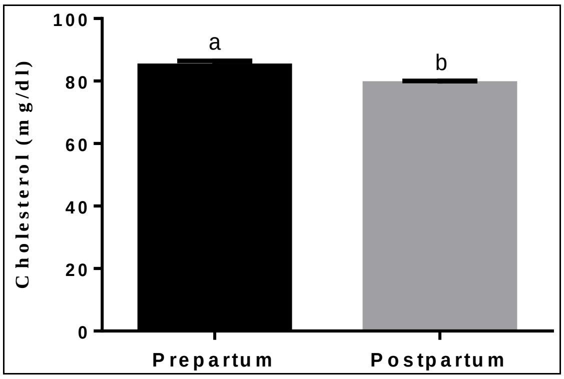


Fig 12

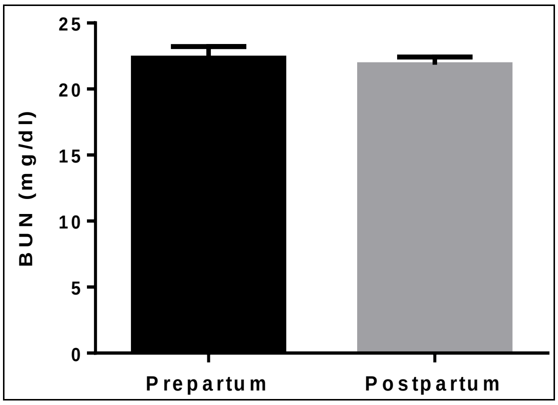


Fig 13

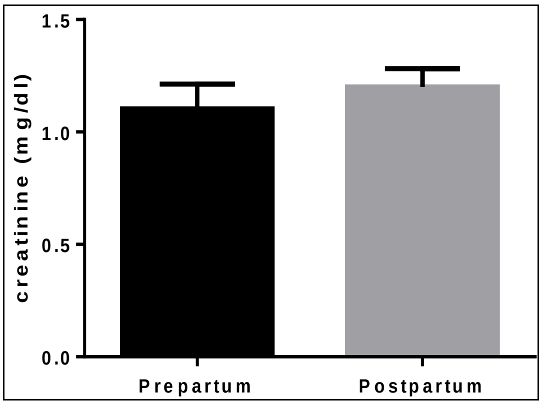


Fig 14

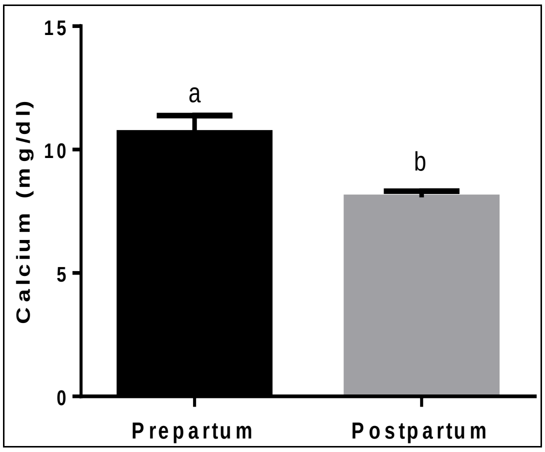


Fig 15

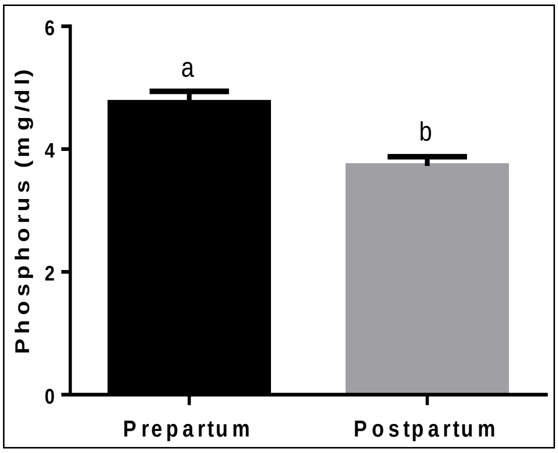


Fig 16

**Fig 11 to 16:** Shows the changes in biochemical parameters from prepartum to postpartum during periparturient period in Ongole cows

## 4. Conclusion

Periparturient period is the most stressful in the life of a dairy animal. Therefore estimation of hematological and biochemical parameters is of paramount importance to find out the physiological alterations and health status of the animals. A significant decrease in cholesterol, calcium, phosphorous, lymphocyte percent and a significant increase in TLC concentration during postpartum compared to prepartum is indicative of stressful condition during postpartum. These parameters could be used as markers to evaluate the quantum of stress during parturition in Ongole cows. However, the mean values obtained for various hematological and biochemical parameters were within the reference range despite of high THI which is further indicative of adaptability of Ongole cows to existing adverse ambience.

## 5. Acknowledgements

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## 6. Conflict of Interest

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

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