



Effect of Lactation on Haematological and Metabolic Profile in Zobawng Cattle

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ABSTRACT

Background: Zobawng is a local non-descript cattle of Mizoram, a hilly state of North-east India. Current study was carried out to investigate the haemato-biochemical profile of Zobawng cattle with the purpose of analyzing the physiological variations under the influence of different lactation stages in terms of determining possible biomarkers to monitor the energy balance and the metabolic adequacy during lactation.

Methods: Eighteen clinically healthy lactating Zobawng cattle were categorized into three groups based on the length of their lactation: group-I (early stage), group-II (mid stage) and group-III (late stage). Haematological analysis was carried by automated blood analyzer (Melet Schlosing4e, France); whereas, metabolic parameters were evaluated by using automated clinical chemistry analyzer (Fuji Dry Chem 4000i, Fujifilm, Tokyo, Japan)

Result: Haematological parameters varied non-significantly amongst the three groups of animals. The value of packed cell volume (PCV), RBC count and haemoglobin (Hb) concentration were found to be lowest during early stage of lactation. Other parameters viz. total leucocyte count (TLC), differential leucocyte count (DLC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and platelet count were within the normal limits. Similarly, metabolic parameters also differed apparently, but the differences were statistically non significant amongst the groups. The glucose level was recorded to be the lowest in the early stage of lactation; whereas, protein and creatinine concentrations were slightly higher in this stage. No significant alteration in the concentration of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) was noticed amongst the three groups of cattle. Data generated during the study may be useful as reference values for the scientific community as this is the first study of its kind in Zobawng cattle.

Key words: Haematology, Lactation stage, Metabolic, Zobawng cattle.

INTRODUCTION

Blood indices and metabolic parameters vary during different physiological stages of animals (Ahmad *et al.*, 2013). Pregnancy and lactation are two most important stages in the life of dairy animals, which affect metabolism resulting in the alteration of the haemato-biochemical profile (Krajnicakova *et al.* 2003; Iriadam, 2007). There are numerous reports on the effects of different phases of the reproductive cycle and pregnancy on haemato-biochemical indices in domestic animal species including cattle and buffalo (Jain *et al.*, 2009). However, no such study could be traced investigating the blood picture during different stages of lactation in Zobawng cattle, local cattle of North-eastern part of India. It is well established that milk and milk components are directly and indirectly synthesized from blood. The rate at which blood flows to the mammary gland is one of the key-factors in determining milk synthesis. Approximately, 400 to 500 liters of blood circulate through mammary gland to produce one liter of milk (Fernandez and Hoeffler, 1998). There is a 2-6 folds increase in blood flow in the mammary gland starting 2-3 days prepartum. During lactation, the mammary gland secretory cells utilize 80% of the blood metabolites for milk synthesis depending on the infiltration of precursors of milk components like amino acids,

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glucose and fatty acids (Piccione *et al.*, 2009). Hence, blood biochemical parameters including total protein, triglycerides, free fatty acids and urea are important indicators of the metabolic activity in lactating animals (Karapehlivan *et al.*, 2007). Since the milk yield and composition varies across the length of lactation stage, it is, therefore, imperative, to study haematolo-biochemical constituents during different stages *i.e.* early, mid and late stage of lactation. Accordingly, the present study was undertaken to investigate the variations in haematological and metabolic profile during different stages of lactation in Zobawng cattle.

MATERIALS AND METHODS

Experimental animals

Eighteen (18) clinically healthy lactating Zobawng cattle were selected from Champhai district of Mizoram and from the existing stock maintained in ILFC, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram. The cows were in various stages of lactation and based on the length of their lactation, the animals were identified as in early (10 to 100 days), mid (100 to 200 days) and late (200 to 300 days) lactation stage. Accordingly, they were categorized into three different groups of six animals each *viz.* group-I (early lactation), Group II (mid lactation) and Group III (late lactation).

Collection of blood samples

Blood samples were collected aseptically from each animal of all the three groups by jugular vein puncture into collection tubes containing anticoagulants *viz.* K₃EDTA and Lithium heparin for hematological and biochemical analysis, respectively.

Haematological analysis

Collected blood samples were analyzed for different hematological parameters including packed cell volume (PCV), haemeoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), total erythrocyte count (TEC), total leucocyte count (TLC), differential leucocyte count (DLC) and platelet count (PLT) using automated blood analyzer (Melet Schlosing4e, France).

Biochemical analysis

Blood samples were analyzed for different biochemical analytes *viz.* glucose, total protein, blood urea nitrogen (BUN), calcium (Ca), creatinine, total bilirubin, alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST) by using automated clinical chemistry analyzer (Fuji Dry Chem 4000i, Fujifilm, Tokyo, Japan).

Data analysis

The results were statistically analyzed using one-way ANOVA as per the method of Snedecor and Cochran (1989) and $p < 0.05$ was considered to be statistically significant.

RESULTS AND DISCUSSION

The results (mean \pm SE) of the biochemical and haematological analysis have been presented in Table 1 and Table 2, respectively.

Table 1 reveals no significant difference ($p > 0.05$) in the concentrations of various biochemical constituents amongst the three groups of lactating Zobawng cattle. This finding corroborates the report of Hagawane *et al.* (2012). Present study further indicated that the mean concentration of blood glucose was lowest (40.67 ± 2.04 mg dl⁻¹) in early stage and increased subsequently as the lactation advanced. The observed values of blood glucose for mid and late stage of lactation were 42.5 ± 4.57 mg dl⁻¹ and 46.37 ± 4.31 mgdl⁻¹, respectively. The trend of variations is consistent with earlier report in lactating ewes (Roubies *et al.*, 2006) and in lactating mares (Heidler *et al.*, 2002). In contrast, glucose levels were reported to be the same throughout the three stages of lactation by Peterson and Waldern (1981); whereas, Doornenbal *et al.* (1988) reported somewhat higher ($p < 0.05$) glucose concentration at parturition that declined during lactation period. The lower level of blood glucose recorded during early stage of lactation may be ascribed to the utilization of large amount of blood glucose by mammary gland for the synthesis of lactose (Schultz, 1968). It is reported that lactose synthesis and milk yield show a linear positive correlation with glucose uptake and thus the lactose synthesis potential is accompanied by greater glucose uptake by lactating mammary gland (Afshar and Fathi, 2012).

The total protein level (8.45 g dl⁻¹) was found to be slightly higher in group-I as compared to group-II and group-III animals. This observation is contrary to the finding of Yaylak *et al.* (2009), who recorded lower protein values during dry and early stages of lactation in case of Holstein cows. Krajnicakova *et al.* (2003) also observed an increasing trend of total protein level of serum with the progression of lactation in lactating goats and concluded that the trend was due to the catabolism of protein for milk synthesis. The variation may be attributed to the differences in species, nutrition, husbandry, environment and methods of assay (Beaunoyer, 1992; Osman and Al-Busadah, 2003). However, Hagawane *et al.* (2012) reported high protein value in the early stage of lactation, which is comparable to current

Table 1: Mean \pm S.E. values of metabolic parameters at different stages of lactation.

Parameters	Early lactation	Mid lactation	Late lactation
Glucose (mg/dl)	40.67 \pm 2.04	42.5 \pm 4.57	46.37 \pm 4.31
Total protein (g/dl)	8.45 \pm 0.13	8.12 \pm 0.22	8.01 \pm 0.29
Blood urea nitrogen (mg/dl)	22.67 \pm 1.3	20.5 \pm 1.58	18.89 \pm 2.25
Calcium (mg/dl)	7.0 \pm 0.93	8.1 \pm 0.54	8.19 \pm 0.23
Creatinine (mg/dl)	1.33 \pm 0.08	1.2 \pm 0.07	1.15 \pm 0.16
Total bilirubin (mg/dl)	0.23 \pm 0.03	0.22 \pm 0.04	0.24 \pm 0.04
Alanine aminotransferase (ALT) (U/L)	66.67 \pm 5.35	72.67 \pm 6.37	67.5 \pm 5.07
Aspartate aminotransferase (AST) (U/L)	154.0 \pm 4.46	148.5 \pm 17.97	159.5 \pm 7.87
Alkaline phosphatase (ALP) (U/L)	178.67 \pm 81.50	168.67 \pm 47.03	165.56 \pm 45.50

($p < 0.05$: statistically non significant).

Table 2: Mean±S.E. values of hematological indices at different stages of lactation.

Parameters	Early lactation	Mid lactation	Late lactation
WBC (K/ μ l)	9.63±0.65	8.24±0.79	9.55±0.98
NEU(%)	30.83±2.19	28.28±1.58	29.12±2.01
LYM (%)	50.17±2.02	48.35±1.69	50.15±2.29
MONO (%)	7.17±0.40	7.18±1.03	8.95±1.96
EOS (%)	5.83±1.49	6.44±0.97	5.36±0.57
BASO (%)	0.841±0.15	0.746±0.16	0.644±0.17
RBC (M/ μ l)	5.67±0.98	6.38±0.35	7.49±0.41
HGB (g/dl)	12.35±4.48	14.1±4.17	13.73±2.84
PCV (%)	30.87±0.97	32.72±1.87	31.33±1.35
MCV (fL)	48.07±2.021	45.22±2.54	41.93±0.87
MCH(pg)	16.22±0.69	15.48±0.80	15.17±0.58
PLT(K/ μ l)	326.5±33.63	617.17±104.86	507.17±51.62

($p < 0.05$: statistically non significant).

findings. The possible explanation for this phenomenon may be the haemoconcentration and water losses due to parturition. Further, earlier investigations have clearly shown that the expression of major milk proteins increases dramatically and in a concerted way during the onset of lactation (Bionaz and Looor, 2011).

Similarly, the mean value of blood urea nitrogen (BUN) was also recorded to be higher in initial stage of lactation and decreased as the lactation progressed. This may hold good in relation to observed apparently increased level of total protein. The BUN values observed in the present study at different stages of lactation were higher than those reported in earlier investigation (Hagwane *et al.*, 2012). Reinartz and Hofmann (1989) also found that serum urea concentration was significantly influenced by the lactation stage. It is recorded that the efficiency for utilization of metabolisable protein for milk production (0.68) is less than that of maintenance (1.00) (McDonald *et al.*, 1995). So, as the milk production increases, the overall protein utilization efficiency decreases, which consequently leads to more drainage of nitrogen in terms of urea through urine and milk (Roy *et al.*, 2003). An increase in urea value was further observed in the first 8 weeks of lactation (Ndibualonji and Godeau, 1993) and found to be peak at 12 weeks postpartum, which decreased slowly thereafter (Rajcevic *et al.*, 1993). However, other researchers found a different trend of variation in case of BUN. During the first month of lactation lower milk urea (MU) concentration was recorded by Carlsson *et al.* (1995). Likewise, Whitaker *et al.* (1995) also reported that cows in early lactation often have much lower MU level. In contrast, no relation was reported between urea concentration in milk and stage of lactation by Erbersdobler *et al.* (1990) and values were relatively constant between 200 to 300 mg/l. Similarly, Coustumier (1996) also found no correlation between lactation stage and urea levels except just after calving. Similar to our study, Schepers and Meijer (1998) also observed that stage of lactation had no significant influence on BUN and thus on MU concentration. Hence, in the light of varying observations

of different researchers, a systemic and critical investigation may be established in this aspect.

In this study, the drop in calcium (Ca) level (7.0 ± 0.93 mg dl^{-1}) was more pronounced during early stage of lactation as compared to mid and late stage. This may be due to excessive drainage of blood calcium pool through colostrum and milk during this stage. As the stage of lactation progressed, the blood calcium level is increased, which is in agreement with the findings of Rowlands *et al.* (1975) and Nale (2003). It may be hypothesized that the cattle gradually recover from the stress of parturition and excess demand of calcium for initiation of lactation. On the contrary, Ramakrishna (1991) recorded higher values (9.77 ± 0.33 mg dl^{-1}) of calcium in lactating cattle. Further, Yokus *et al.* (2004) also concluded that the levels of Ca decreased slightly in early pregnancy to late pregnancy and then increased during lactation period in sheep.

Present study also indicated that the blood creatinine level was higher in group-I as compared to group-II and group-III cows. The apparent increase in creatinine level at the early stage of lactation may be ascribed to uterine involution and myometrial protein degradation (Bell *et al.*, 2000). Nonetheless, Peterson and Waldern (1981) found no differences in creatinine concentrations amongst the various stages of lactation, but observed that creatinine levels rose in dry cows with increasing days of pregnancy. Kronfeld (1982), working with 21 Holstein herds, reported the highest serum creatinine levels during the peak of lactation. Total bilirubin concentration recorded in this study was found to be consistent throughout the lactation period indicating that its concentration remains unaffected with the stage of lactation. Similarly, no significant alteration in the concentration of aspartate aminotransferase (AST), alanine aminotransferase (ALT) and alkaline phosphatase (ALP) was recorded amongst the three groups of zobawng cows under the current study. The concentration of AST was found to be highest (72.67 ± 6.37 U/L) in the mid lactation stage. Ling *et al.* (2003) observed that the blood concentration of AST increases between day 117 and 151 of lactation (mid stage)

in Holstein mares, which is in accordance with the present findings. Conversely, Yaylak *et al.* (2009) reported that the stage of lactation affects AST and ALT activities significantly. An increase in ALT, AST and GGT (α -glutamyl transferase) activity in the blood of ewes during lactation is indicative of increase in hepatic metabolism (Antunovic *et al.*, 2004, 2011). Further, AST and ALP are considered to be effective biomarkers to detect the energy and mineral imbalance in Saanen dairy goats (Mundim *et al.*, 2007). Changes in activities of these enzymes may also be related to reduced dry matter intake around parturition, which leads to hepatic lipidosis and alter the normal function of the liver (Greenfield *et al.*, 2000). However, no indications were found in the literature to explain the relationship of the recorded trends of variations in the concentrations of these enzymes with different stages of lactation.

Table 2 indicated that although the observed values of the haematological parameters varied apparently, the differences were statistically non significant. Similar types of observations were also recorded by Hagawane *et al.* (2012). The packed cell volume (PCV), RBC count and haemoglobin (Hb) concentration was found to be lowest in Zobawng cows in early stage of lactation corroborating with those of Esiebo and Moore (1979), who concluded that the concentrations of PCV RBC, Hb along with serum iron (SI), iron binding capacity (IBC) and serum albumin decreased in early lactation and rose to pre-lactation levels by mid-lactation. Decline in the number of RBC in the blood of ewes in the early lactation was also reported by Antunovic *et al.* (2011). Other haematological indices such as the TLC, DLC, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and platelet count were found to be within the limits of normal values laid for the cattles. Similar to current investigation, non significant differences in various haematological indices were also reported by Flores *et al.* (1990) during early and late stage of lactation.

CONCLUSION

It may be concluded that stage of lactation does not play significant role in alteration of haemato-biochemical profile in lactating Zobawng cows. The limited sensitivity of these blood parameters to stage of lactation in clinically normal dairy animals is not surprising because, most of these parameters are under the homeostatic control systems (Cozzi *et al.*, 2011). Nonetheless, data generated during the current study may be useful as reference values for the scientific community as this is the first study of its kind in case of Zobawng cattle. Further, blood profile has traditionally been used to assess the metabolic health status of the animals; hence the present investigation may also be helpful in this regard. In addition, this study may also assist the nutritionists to formulate ration for optimum productivity of the Zobawng cows since blood-biochemical analytes are being widely considered to identify dietary causes of diseases leading to low productivity.

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Conflict of interest: None.

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