Asian J. Med. Biol. Res. 2021, 7 (1), 1-5; doi: 10.3329/ajmbr.v7i1.53302

Asian Journal of Medical and Biological Research
ISSN 2411-4472 (Print) 2412-5571 (Online)
www.ebupress.com/journal/ajmbr

Article

Haemato-biochemical profile during different stages of lactation in local Sahiwal crossbred dairy cows at Savar area of Dhaka district of Bangladesh

Sajibul Hasan[1*], Mohammad Alam Miah[2] and Md. Kamrul Islam[2]

[1]Department of Preclinical Courses, Faculty of Veterinary and Animal Sciences, Gono University, Savar, Dhaka, Bangladesh
[2]Department of Physiology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensing-2202, Bangladesh

*Corresponding author: Sajibul Hasan, Lecturer in Physiology, Department of Preclinical Courses, Faculty of Veterinary and Animal Sciences, Gono University, Savar, Dhaka. Phone: +8801728908473; E-mail: sajib34dvm@gmail.com

Received: 21 January 2021/Accepted: 27 February 2020/ Published: 31 March 2021

Abstract: The present study was carried out to investigate the haemato-biochemical profile during different stages of lactation in local Sahiwal crossbreed dairy cows at Savar area of Dhaka district of Bangladesh. Twenty four local Sahiwal crossbreed cows were selected randomly from different small farms and divided into three groups: early stage lactation (1-3 months), mid stage lactation (4-6 months) and late stage lactation (7-9 months). Blood samples were collected during three stages of lactation. There were no statistical significant ($p<0.05$) variations observed in hematological parameters amongst the three stage of lactation. Although the packed cell volume (PCV), hemoglobin (Hb) concentration and RBC count were found lowest in early stage of lactation than the other groups. Total leucocyte count (TLC), platelet count (PLT), mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) were recorded within normal limits. Similarly, biochemical parameters were observed statistically non-significant amongst the groups studied. The glucose level was recorded lowest in early stage of lactation; whereas, the protein and creatinine concentrations were slightly higher in this stage. Aspartate aminotransferase (AST), Alanine aminotransferase (ALT) and Alkaline phosphatase (ALP) were not varied amongst the three groups of cows. Data generated during the current study may be useful as reference values for the scientific community.

Keywords: haemato-biochemical profile; lactation stage; Sahiwal dairy cows

1. Introduction

Hematological and biochemical profile testing is a pre-symptomatic diagnostic tool to assess the dairy herd's nutritional status and other productive and reproductive disorders (Pathan *et al*., 2011). The peri-parturient period of three weeks in dairy cattle is associated with multiple changes including hormonal changes, moving from non-lactating to lactating state as well as a major drop in feed intake and switching of the diet from a roughage-based diet (i.e. hay and grass) into a diet rich in rapidly fermentable carbohydrates (i.e. high-grain diets). One in two dairy cows in a herd is affected by one or multiple metabolic disorders. The profile may vary according to factors such as origin, climate, management practices, geographical distribution, season and stage of animals (Cozzi *et al*., 2011; Pal & Acharya, 2013; Mahima *et al*., 2013). So, it is important to determine the hematological and blood biochemical profile for the clinical interpretation of laboratory findings especially in the post parturient stage in which the cattle are more likely to suffer from metabolic disorders due to the draining of minerals like calcium and phosphorus in the milk which may lead to hypocalcaemia, hypomagnesaemia and milk fever (Pal & Acharya, 2013). The metabolic diseases are highly associated with each other like cows affected by milk fever are more prone to mastitis, retained placenta, metritis, left abomasal

displacement (LDA), dystocia, udder edema and ketosis. There are numerous reports on the effects of different phases of the reproductive cycle and pregnancy on hemato-biochemical indices in domestic animal species including dairy cow (Jain *et al*., 2009). However, no such study could be traced investigating the blood picture during different stages of lactation in local Sahiwal crossbreed dairy cows of Bangladesh. 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 to 6 folds increase in blood flow in the mammary gland starting 2 to 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, 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, necessary to study haemato-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 haemato-biochemical profile during different stages of lactation in local Sahiwal crossbreed dairy cows of Bangladesh.

2. Materials and Methods

2.1. Experimental design

The experiment on hemato-biochemical profile during different stages of lactation in local Sahiwal crossbreed dairy cows were carried out in different small dairy farms at Nolam area of Savar, Dhaka. Twenty four local Sahiwal crossbreed cows were selected randomly from different small farms and divided into three groups, depending on the day postpartum of sampling, each group consists of eight dairy cows: group I: 1-3 months after calving (early stage of lactation), group II: 4-6 months after calving (mid stage of lactation), group III: 7-9 months after calving (late stage of lactation). They were reared in same environmental management and also provide normal lactating ration.

2.2. 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 or without anticoagulants for hematological and biochemical analysis, respectively.

2.3. Hematological analysis

Collected blood samples were analyzed for different hematological parameters including total erythrocyte count (TEC), total leucocyte count (TLC), platelet count (PLT), hemoglobin concentration (Hb), packed cell volume (PCV), mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH) using automated hematology analyzer (Cell-Dyn 3700, Abbott Diagnostics, USA).

2.4. Biochemical analysis

The blood samples were allowed to clot and after clotting, the samples were centrifuged properly, then clear blood serum were separated into clean test tube. Then the serum samples were analyzed for different biochemical parameters including glucose, total protein, creatinine, blood urea nitrogen (BUN), alanine aminotransferase (ALT), asparate aminotransferase (AST) and alkaline phosphatase (ALP) by employing dry chemistry discs/cartridges in Piccolo Xpress Chemistry Analyzer (Abaxis, USA).

2.5. Data analysis

The results were statistically analyzed using one-way ANOVA as per the method of Snedecor and Cochran (1994). $P < 0.05$ was considered to be statistically significant.

3. Results and Discussion

3.1. Hematological profile during different stages of lactation

Table -1 showed the hematological parameters of local Sahiwal crossbred dairy cows during different lactation stages. Although the observed values of the hematological parameters were varied apparently, the differences were statistically non-significant. PCV, Hb and RBC count were found lowest at an early stage of lactation in local Sahiwal crossbred cow. Esievo and Moore (1979), also stated that the concentrations of PCV, Hb, RBC along with serum iron (SI), iron-binding capacity (IBC), and serum albumin decreased in an early stage of

lactation and non-significantly increase the concentration levels through the mid and late stage of lactation. A decline in the number of RBC in the blood of ewes in the early stage of lactation was also reported by Antunovic *et al*. (2011).

The total leukocyte count (TLC), platelet count (PLT), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) were found within the normal limits. Similar to current investigation, non-significant differences in various hematological indices were also reported by Flores *et al*. (1990) during early and late stage of lactation. Similar types of observations were also recorded by Hagawane *et al*. (2012).

Table 1. Hematological values (Mean ± SE) in local crossbred Sahiwal dairy cows during different stages of lactation.

Parameters	Early stage lactation (1-3 months)	Mid stage lactation (4-6 months)	Late stage lactation (7-9 months)
RBC (M/µl)	6.38±0.12	7.56±0.33	8.50±0.21
WBC (K/µl)	8.90±0.75	8.60±0.88	9.40± 0.83
PLT (K/µl)	450.2±22.18	505.38±13.45	490.16±23.87
Hb (g/dl)	10.25±1.74	12.10±2.14	11.53±1.74
PCV (%)	30.32±1.24	31.60±1.86	32.24±1.90
MCV (fL)	50.03±1.20	48.18±1.48	46.05±1.34
MCH (pg)	15.45±0.15	16.26±0.50	15.19±0.78

($P< 0.05$; statistically non-significant)

3.2. Biochemical profile during different stages of lactation

The different biochemical values (Mean ± SE) during different stages of lactation of local Sahiwal dairy cows are presented in Table 2. Data indicated that the mean concentration of blood glucose was lowest (42.75 ± 1.56 mg/dl) in the early stage and increased subsequently as the lactation advances. The observed values of blood glucose for the mid and late stage of lactation were 44.8 ± 2.36 mg/dl and 48.80 ± 2.51 mg/dl, respectively. The current trend of variations is consistent with an earlier report in lactating ewes (Roubies *et al*., 2006) and 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). Doornenbal *et al*. (1988) reported higher ($p<0.05$) glucose concentration at parturition that declined during the lactation period. The lower level of blood glucose recorded during an early stage of lactation may be due to the utilization of a large amount of blood glucose by the 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 the lactating mammary gland (Afshar and Fathi, 2012). The total protein level (8.90±0.23 g/dl) was found to be slightly higher in group I as compared to group II and group III animals. This observation is on the contrary to the finding of Yaylak *et al*. (2009), who recorded lower protein values in 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 progress of lactation in lactating goats and concluded that this is 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 AlBusadah, 2003). However, Hagawane *et al*. (2012) reported highest protein value in the early stage of lactation, which is comparable to current findings. The possible explanation for this phenomenon may be the hemoconcntration 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 Loor, 2011).

It is noted that the blood creatinine level was higher in group I (1.46±0.08 mg/dl) as compared to group II (1.34±0.09 mg/dl) and group III (1.23±0.16 mg/dl) local Sahiwal crossbred cow. The apparent increase in creatinine level at the early stage of lactation may be ascribed to uterine involution and myometrium 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) reported the highest serum creatinine levels during the peak of lactation in Holstein cows.

Similarly, the mean value of blood urea nitrogen (BUN) was also recorded to be higher in initial stage of lactation (23.40±1.6 mg/dl) and decreased the values as the lactation progresses like mid lactation (21.8±1.36 mg/dl) and late lactation (20.70±2.15 mg/dl) stages. This may hold well 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).

AST and ALP are considered to be effective biomarkers to detect the energetic and mineral imbalance (Mundim *et al*., 2007). Changes in activities of these enzymes may also be related to reduce dry matter intake around parturition which lead 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. The concentration of AST was found highest in the mid lactation stage (52.90±2.15 U/L) compare to initial lactation stage (50.12 ±2.24 U/L) and late lactation stage (49.7±2.05 U/L). However, there is no statistically significant variation observed in the concentration of AST, ALT and ALP amongst the three groups. Ling *et al*. (2003) observed that the blood concentration of AST increases between day 117 and 151 of lactation (mid stage) in Holstein cow which is in accordance with the present findings. An increase in ALT and AST activity in the blood of ewes during lactation is indicative of increase in hepatic metabolism (Antunovic *et al*., 2004, 2011).

Table 2. Biochemical values (Mean ± SE) in local crossbred Sahiwal dairy cows during different stages of lactation.

Parameters	**Early stage lactation (1-3 months)**	**Mid stage lactation (4-6 months)**	**Late stage lactation (7-9 months)**
Glucose (mg/dl)	42.75±1.56	44.8±2.36	48.80±2.51
Total protein (g/dl)	8.90±0.23	8.45±0.16	8.70±0.24
Creatinine (mg/dl)	1.34±0.08	1.46±0.09	1.23±0.16
BUN (mg/dl)	23.40±1.6	21.8±1.36	20.70±2.15
AST (U/L)	50.12 ±2.24	52.90±2.15	49.7±2.05
ALT (U/L)	26.0±2.34	24.5±1.87	22.4±1.48
ALP (U/L)	48.18±1.50	46.31±2.03	47.20±1.37

($P < 0.05$; statistically non-significant)

4. Conclusions

The present study investigated the hemato-biochemical profile during different stages of lactation in local Sahiwal crossbreed dairy cows at Savar area of Dhaka district of Bangladesh. There is no significant variation found among the hemato-biochemical profile during different stages of lactation. Nonetheless, data generated during the current study may be useful tools for the scientific community as this is the first study of its kind in case of Sahiwal cow in Bangladesh. 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 dairy cow since blood-biochemical analyses are being widely considered to identify dietary causes of diseases leading to low productivity.

Acknowledgements

This work was supported by a grand in aid from the Center for Multidisciplinary Research (CMR, GB) Gono University, Savar, Dhaka. The authors also thanks to Physiology and Biochemistry Laboratory of Gono University for the technical support of the research work.

Conflict of interest

None to declare.

References

Antunovic ZJ, H Novoselect, M Sauerwein, M Speranda1 and V Pavic, 2011. Blood metabolic profile and some of hormone concentration in ewes during different physiological status. Bulg. J. Agric. Sci., 17: 687-695.

Bell AW, WS Burhans and TR Overton, 2000. Protein nutrition in late pregnancy, maternal protein reserves and lactation performance in dairy cows. The Proceedings of the Nutrition Society, 59: 119-126.

Bionaz M and JJ Loor, 2011. Gene networks driving bovine mammary protein synthesis during the lactation cycle. Bioinform. Biol. Insights, 5: 83-98.

Carlsson JJ, Bergstrom and B Pehrson, 1995. Variations and breed, age, season, yield, stage of lactation and herd in the concentration of urea in bulk milk and individual cow's milk. Acta Vet. Scand., 36: 245-254.

Cozzi G, L Ravarotto, F Gottardo, AL Stefani, B Contiero, L Moro, M Brscic and P Dalvit, 2011. Reference values for blood parameters in Holstein dairy cows: Effects of parity, stage of lactation, and season of production. J. Dairy Sci. 94: 3895-3901.

Doornenbal H, AKW Tong and NL Murray, 1988. Reference values of blood parameters in beef cattle of different ages and stages of lactation. Can. J. Vet. Res., 52: 99-105.

Esievo KA and WE Moore, 1979. Effects of dietary protein and stage of lactation on the hematology and erythrocyte enzymes activities of high-producing dairy cattle. Res. Vet. Sci., 26: 53-58.

Flores A, R Althaus, JC Toibero, OJ Garnero and L Perren, 1990. Metabolic profile of dairy cow before and after parturition. Revista Argentia de Production Animal, 10: 289-293.

Fernandez JM and JP Hoeffler, 1998. Transgenic Expression, p.410. In Gene Expression Systems: Using Nature for the Art of Expression, Academic Press, U.S.A.

Greenfield RB, MJ Cecava, TR Johnson and SS Donkin, 2000. Impact of dietary protein amount and rumen degradability on intake, peripartum liver triglyceride, plasma metabolites and milk production in transition dairy cattle. J. Dairy Sci., 83: 703-710.

Hagawane SD, SB Shinde and DN Rajguru, 2012. Haematological and blood biochemical profile in lactating Buffaloes in and around Parbhani city. Veterinary World, 2: 467-469.

Heidler B, H Sauerwein, U Heintges, J Aurich, W Pohl and C Aurich, 2002. Metabolic profiles and plasma leptin concentrations in lactating and non-lactating mares. Theriogenology, 58: 557-561.

Kronfeld DS, S Donoghue, RL Copp, FM Stearns and RH Engle, 1982. Nutritional status of dairy cows indicated by analysis of blood. J. Dairy Sci., 65: 1925-1933.

Karapehlivan M, E Atakisi, M Citil, O Kankavi and O Atakisi, 2007. Serum sialic acid levels in calves with pneumonia. Vet. Res. Commun., 31: 37-41.

Krajnicakova ME, E Bekeova, G Kovac, M kostecky, I valocky, I Maracek, I Sutiakova and L Lenhardt, 2003. Selected clinical-biochemical parameters in the puerperal period of goats. B. Vet. I. Pulawy, 47: 177-182

Ling K, H Jaakson, J Samarutel and A Leesmae, 2003. Metabolic status and body condition score of Estonian Holstein cows and their relation to some fertility parameters. Veterinariaja Ir. Zootechnika. T., 24: 94- 100.

McDonald P, R.A Edwards, JFD Greenhalgh and CA Morgan, 1995. Animal Nutrition, 5th ed. Addison Wesley Lonman, Efinburgh Gate, Harlow, Essex CM202JE, United Kingdom.

Osman TEA and KA Al-Busadah, 2003. Normal Concentration of Twenty Serum Biochemical Parameters of She-Camels, Cows and Ewes in Saudi Arabia. Pakistan Journal of Biological Sciences, 6: 1253-1256.

Pathan MM, H Das, JZ Md, GM Siddiquee, A Latif, HR Parsani and GA Sastry, 2011. Comparative studies on haemato-biochemical profile of cyclic and non-cyclic Holstein Friesian cross-bred cows. Wayamba Journal of Animal Science. pp.69-70

Peterson RG and DE Waldern, 1981. Repeatabilities of serum constituents in Holstein-Friesians affected by feeding, age, lactation and pregnancy. J. Dairy Sci., 64: 822-831.

Piccione G, G Caola, C Giannetto, F Grasso, SC Runzo, A Zumbo and P Pennisi, 2009 Selected biochemical serum parameters in ewes during pregnancy, post-parturition, lactation and dry period. Anim. Sci. Pap. Rep., 27: 321-330.

Roy BR, K Mehla and SK Sirohi, 2003. Influence of Milk Yield, Parity, Stage of Lactation and Body Weight on Urea and Protein Concentration in Milk of Murrah Buffaloes. Asian Austral. J. Anim., 16: 1285-1290.

Roubies N, N Panousis, A Fytianou, PD Katsoulos, N Giadinis and H Karatzias, 2006. Effects of age and reproductive stage on certain serum biochemical parameters of chios sheep under greek rearing conditions. J. Vet. Med. A., 53: 277-281.

Schepers AJ and RGM Meijer, 1998. Evaluation of the utilization of dietary nitrogen by dairy cows based on urea concentration in milk. J. Dairy Sci., 81: 579-584.

Yaylak EC, Yenisey and K Seyrek, 2009. Effects of Lameness, Stage of lactation and body conditions score on some blood parameters in Holstein cows. Asian J. Anim. Vet. Adv., 4: 245-251.