

*Article*

## **Comparison of some serum biochemical parameters between lactating and non-lactating dairy cows in selected dairy farms of Chittagong district of Bangladesh**

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Received: 23 July 2015/Accepted: 30 August 2015/Published: 30 September 2015

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**Abstract:** Physiological status-related changes in serum biochemical values are known to occur in many species. The aim of the current study was to evaluate total serum protein, albumin, glucose, calcium and phosphorus concentration and these parameters were measured by the serum analyzer for lactating (n=50) and non-lactating (n=50) dairy cattle in selected dairy farms of Chittagong district. The results (mean  $\pm$  standard deviation) of the study showed that among serum biochemical parameters total protein ( $82.3 \pm 2.15$  gm/l), albumin ( $27.45 \pm 5.06$  gm/l), calcium ( $12.97 \pm 6.67$  mg/dl) and phosphorus ( $7.26 \pm 0.41$  mg/dl) level in non-lactating cows were higher than the value of lactating cows as ( $81.28 \pm 2.41$  gm/l), ( $14.09 \pm 2.05$  gm/l), ( $10.05 \pm 2.51$  mg/dl) and ( $6.52 \pm 0.30$  mg/dl) respectively. Only glucose level in lactating cows ( $63.01 \pm 6.67$  mg/dl) was found higher than the non lactating cows ( $58.47 \pm 3.84$  mg/dl). In case of parity-wise parameters insignificant variation was noticed. It may be concluded that biochemical variation present between lactating cow and non lactating cow is important for interpretation of laboratory data and also for physiological diagnosis.

**Keywords:** dairy cow; lactating cow; non lactating cow; serum biochemistry; parity

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### **1. Introduction**

Blood is the fluid connective tissue peruses an immediate indication of an animal's nutritional status at that point in time. Nutritional concentrations in blood represent an integrated index of the adequate supply of nutrient in relation to nutrient utilization of dairy cows. Metabolite levels in blood serum also indicate the extent of body metabolism, such as energy, proteins and minerals (Ndlovuet *et al.*, 2007). In like manner these parameters are influenced by both intrinsic and extrinsic factors like breed, age, sex, lactation, pregnancy, health and nutrition status of the cows (Aengwanich, 2002; Al-Shami, 2007; Mohammed *et al.*, 2007). Henceforth the changes in biochemical and hematological constituents are important prerequisites to assess the physiological or pathological state of the animal (Ahmed *et al.*, 2009; Hassan *et al.*, 2012). Blood tests from farm animals are routinely used to extract pertinent information relative to herd nutrition and help to diagnose metabolic disease problems in dairy cows (Van Saun and Wustenberg, 1997). On the other hand, in advanced animal husbandry practice the importance of

hematoma-biochemical parameter indices are well documented, acknowledged and improving day by day (Opara *et al.*, 2006). In dairy herd, it is important to realize that lactation and the dry period are two important physiological statuses considered to modify the hematoma-biochemical variables in cows because of pattern of demand and supply of nutritional plan (Iriadam, 2007; Tanritanir *et al.*, 2009). Indeed, animals require minerals such as calcium (Ca), magnesium (Mg), and phosphorus (P) for contemporary maintenance or further growth, reproduction and lactation (Tanritanir *et al.*, 2009; Samardzija *et al.*, 2011). Feeding of non-lactating or milking cow low in essential energy and minerals leads to clogging down the homeostatic mechanisms, rendering the cow ready for the massive draw on further production. This is relevant since blood constituent's has been changed in relation to the physiological conditions of animals (Etim *et al.*, 2014). According to Daramola *et al.*, (2005), hematological values could serve as baseline information for comparisons of nutrient trends in different lactation and parity. Although some variation has also been observed in the hematological parameters between breeds of farm animals (Tambuwal *et al.*, 2002), in this regard, it may be difficult to formulate a universal blood metabolic profile test for animals. These differences have underlined the need to establish appropriate physiological baseline values for various breeds, farming and environmental condition of livestock. Therefore, the present study was undertaken to estimate the selected hematological nutritional status of crossbred dairy cows in Bangladesh in relation to age, parity and lactation.

## 2. Materials and Methods

### 2.1. Study area and duration

This study was conducted for a period of 4 months (10<sup>th</sup> January to 10<sup>th</sup> April, 2014) in three selected dairy farms in Chittagong city. The farms were selected based on population size greater than 50 crossbred (*Holstein Friesian* × Local) cows, house in tie-stall barn, standard ration feeding based on productive performance, milk yield more than or equal to ten litres per day, record keeping history, immunization against infectious disease and acceptance of farm to contribute in research work.

### 2.2. Study population

The study population was 100 cross bred (HF × Local) healthy cows. In the farms, cows were in different age and production status, from which 50 lactating and 50 non lactating (dry) cows were selected based on parturition record for the first time, but not exceed for more than three times. Cows were further grouped into three categories on the basis of calving history (parity) of which parity 1 (n=29), parity 2 (n=52) and parity 3 (n=19). Some of the dry cows were pregnant, but they were not grouped further. All animals were fed both roughage and concentrates. Normal feeding habits of animals were observed during the research activities. All animals involved in this study were clinically healthy and to ensure this clinical history was reviewed with the farm manager through the examination of physical condition.

### 2.3. Sample collection and processing

All blood samples were collected between 10 am to 12 pm in order to standardize time. Blood samples were taken from jugular vein puncture with proper aseptic measures. About 5 ml of blood was collected and kept in the vacutainer tube (without anticoagulant). The samples were transported to the Department of Physiology, Biochemistry and Pharmacology at Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh for analysis. After coagulation, coagulated blood was centrifuged in 3000rpm for 15 minutes. Serum was transferred to the Eppendorf tube by using micropipette. The obtained serum samples were stored in -20°C for biochemical test and total protein, albumin, glucose, calcium and phosphorus of blood serum were determined according to the biochemical analyzer manual (Humalyzer 3000, Germany<sup>R</sup>).

### 2.4. Statistical analysis

Obtained laboratory data was stored in Microsoft Excell-2007 and imported to the software STAT/IC-13.0 for analysis. Descriptive statistical analysis was done to measure the mean, SEM, 95% confidence interval (CI) and p-value of different parameters. The arithmetic means ( $\pm$ SE) serum biochemical parameters in different groups were calculated. PAIRED T-TEST was done to assess the biochemical parameters in crossbred lactating and non lactating cows. Further Kruskal-Wallis has been done for unequal variance analysis, among the different parity. In all cases the level of significance was determined at  $p < 0.05$ .

## 3. Results and Discussion

Total protein levels in both lactating and dry cow were higher than the reference value, but the variation was insignificant between the lactating and dry group of cows. Serum albumin level was found lower in both groups

than the standard value and variation between the groups was highly significant. Findings for serum glucose, calcium and phosphorus level were within the reference range and their variations were insignificant (Table 1). According to parity, total protein level were found elevated than the reference value and the insignificant variation were shown among the different parity where lowest value was found in the third parity followed by first and second parity. On the other hand alike serum protein the serum albumin level was found lower in all three parities in which lowest value was found in parity two followed by parity three and parity one even though there variations were insignificant. However the serum glucose level was found in decreasing trend with insignificant variation in relation to parity proceed. Serum calcium and phosphorus level were followed almost similar trends and found higher at second parity (Table 2). Within parity 1 serum total protein, albumin and phosphorus level were higher in the non lactating cows than the lactating whereas in parity 2 albumin and glucose level was higher in non lactating cows. Conversely, in the case of third parity total protein, glucose, calcium and phosphorus level were found higher in lactating cows in comparison to the non lactating cows. Overall variation within the parity were insignificant ( $p>0.05$ ) (Table 3).

Total protein in serum in lactating and non lactating cows were  $81.28 \pm 2.41$ (gm/l) and  $82.32 \pm 2.15$  (gm/l) respectively. The results of the current study were similar with Peterson *et al.*, (1981) where total protein levels were reported to be higher in non lactating cows ( $90.23 \pm 0.23$  gm/l) than lactating cows ( $70.73 \pm 0.09$  gm/l). Conversely, the total serum protein in lactation period ( $60.32 \pm 0.60$  gm/l) was slightly higher than the dry period ( $60.17 \pm 0.89$  gm/l) reported by Giuseppe *et al.*, (2012). Serum total protein value in mixed race of Austrian Bălțat with Red Holstein and Red Holstein metis was found  $80.50 \pm 0.70$  g/l (Matei *et al.*, 2010). Again,  $49.08 \pm 8.16$  g/l value was found from twenty pregnant Freizian cows in Saudi Arabia (Al-Mujalli, 2008). In another study, the value of total protein in Holstein dairy cows was mentioned  $82 \pm 6.10$  g/l by Cozzi *et al.*, (2011). Manzooret *al.*, (2008) stated that, biochemical parameter of blood serum was higher in non lactating cow than in lactating cows. There is a general modification in animals in serum proteins with advancing age and in the very old cows (Kaneko *et al.*, 1997).

Albumin in non lactating cows ( $27.45 \pm 5.06$  gm/l) was higher than the lactating cows ( $14.09 \pm 2.05$  gm/l) with significant variation. Similarly Peterson *et al.*, (1981) reported that, albumin was higher in dry cows ( $30.97 \pm 0.14$  gm/l) than lactating ( $30.87 \pm 0.06$  gm/l). In contrast albumin value was found higher in lactating than non lactating cows (Giuseppe *et al.*, 2012). Serum albumin parameter in mixed race with Austrian Bălțat with Red Holstein and Red Holstein metis was found  $30.50 \pm 0.20$  g/l (Matei *et al.*, 2010). In another study the overall mean value of albumin was found  $15.13 \pm 6.33$  gm/l from twenty pregnant Friesian cows in Saudi Arabia (Al-Mujalli, 2008). In addition albumin reference value  $37 \pm 2.50$  gm/l was reported by Cozzi *et al.*, (2011) in the Holstein dairy cows. Higher protein rich feed intake is responsible for higher albumin concentration in blood serum. Lower serum albumin level in lactating cow is related to higher milk production of animal and depletion of albumin for maintaining milk production. The concentration of albumin was influenced not only by the physiological condition of the animal, but also by nutrition (Kaneko *et al.*, 1997).

The glucose level in lactating cows ( $63.02 \pm 6.67$  mg/dl) was higher than the non lactating cows ( $58.47 \pm 3.84$  mg/dl) that differ insignificantly. Peterson *et al.*, (1981) reported that glucose was higher in dry cows ( $69.8 \pm 3.7$  mg/l) than lactating cows ( $65.2 \pm 1.7$  mg/l). The blood glucose level is regarded as one of the indicators of energy status in the cow. The blood glucose level was higher in lactating cows this may be due to high energy diet feeding during lactation period and also for taking the extra amount of feed than the requirement of animal for milk production and maintenances. Other research by Cozzi *et al.*, (2011) in Holstein dairy cows reviled  $58 \pm 0.40$  mg/l. In a yearlong study of five upazila namely KhagrachariSadar, Laxmichari, Matiranga, Mahalchari and Dighinala in Khagrachari Hill District of Bangladesh serum glucose level was found  $69.21 \pm 2.31$  mg/l in indigenous cattle (Mamun *et al.*, 2013).

Calcium level was found slight lower ( $10.05 \pm 2.51$  mg/dl) in lactating cows than the non lactating ( $12.97 \pm 6.67$  mg/dl). This result was supported by Peterson *et al.*, (1981) where serum calcium in dry cows ( $10.83 \pm 0.35$  mg/dl) was significantly higher than lactating cows ( $9.02 \pm 0.14$  mg/dl). But this result was not in line with Giuseppe *et al.*, (2012), where a level was found higher in lactation period ( $8.03 \pm 0.80$  mg/dl) from the dry period ( $7.83 \pm 0.76$  mg/dl). In a previous report serum calcium level was reported as  $8.01 \pm 0.32$  mg/dl in indigenous cow of Bangladesh (Mamun *et al.*, 2013). Serum Ca decline at or soon after parturition might be an unavoidable mechanism in dairy cows, especially in aged cows (Horst *et al.*, 1990; Goff *et al.*, 1991) due to the expeditious loss of a by milk synthesis, and less efficiency of Ca absorption by the intestinal transcellular pathway (Horst *et al.*, 1990) and inactivation of the bone Caresorption pathway (Ramberg *et al.*, 1970; Kamiya *et al.*, 2005).

**Table 1. Biochemical parameters in crossbred lactating cows and non lactating cows.**

Parameters	Total protein (gm/l)		Albumin (gm/l)		Glucose (mg/dl)		Calcium (mg/dl)		Phosphorus (mg/dl)	
	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI
Reference value	67.4-74.6		30.03-30.55		45-75		9.7-12.4		5.1-9.3	
Lactating cow	81.28±2.41	76.43-86.13	14.09± 2.05	9.96-18.21	63.02± 6.67	49.6 -76.42	10.05±2.51	5-15.12	6.52±0.30	5.89-7.14
Non- Lactating cow	82.3±2.15	78 - 86.63	27.45± 5.06	17.28-37.61	58.47 ±3.84	50.76-66.18	12.97±6.67	9.51-16.43	7.26 ±0.41	6.43-8.09
P value	0.77		0.00**		0.53		0.27		0.07	

\*\*= P<.05 (significant in 95% confidence interval). (PAIRED T- TEST)

**Table 2. Parity-wise changes of serum biochemical parameters in selected cows.**

Parameters	Total protein (gm/l)		Albumin (gm/l)		Glucose (mg/dl)		Calcium (mg/dl)		Phosphorus (mg/dl)	
	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI
Reference value	67.4-74.6		30.03-30.55		45-75		9.7-12.4		5.1-9.3	
Parity 1	84.62±2.47	79.55-89.69	28.53±7.83	12.49-44.56	67.92±10.76	45.88-89.96	10.23±0.63	8.94-11.52	6.62±0.45	5.70-7.55
Parity 2	80.74±1.98	76.76-84.72	16.1±2.25	11.59-20.61	60.46±3.62	53.20-67.73	10.58±0.43	9.73-11.44	7.13±0.39	6.34-7.91
Parity 3	82.12±3.73	74.27-89.96	18.63±5.76	6.53-30.72	53.61±6.50	39.96-67.25	10.76±0.81	9.07-12.46	6.11±0.38	5.30-6.91
P value (Kruskal Wallis)	0.5303		0.1588		0.5614		0.4493		0.4303	

**Table 3. Comparison of the serum biochemical parameters between lactating (L) and non lactating (NL) crossbred dairy cows according to parity.**

Parameters	Total protein (gm/l)		Albumin (gm/l)		Glucose (mg/dl)		Calcium (mg/dl)		Phosphorus (mg/dl)	
	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI	Mean± SEM	95% CI
Reference value	67.4-74.6		30.03-30.55		45-75		9.7-12.4		5.1-9.3	
Parity 1 (L)	81.11±3.32	73.99-88.24	18.35±4.01	9.75-26.96	68.05±19.90	25.37-110.72	10.75±0.97	8.66-12.84	6.07±0.69	4.59-7.54
(NL)	88.38±3.53	80.75-96.01	39.43±15.40	6.16-72.70	67.79±7.72	51.11-84.48	9.67±0.78	7.98-11.37	7.22±0.56	6.02-8.43
P value (ttest)	0.1453		0.1832		0.9908		0.3985		0.2065	
Parity 2 (L)	81.8±2.81	76.03-87.57	14.84±2.91	8.87- 20.82	57.21±5.39	46.12-68.27	11.01±0.66	9.66-12.37	7.19±0.45	6.27-8.10
(NL)	79.5±2.82	73.67-85.33	17.57± 3.53	10.27-24.86	64.26±4.68	54.57-73.95	10.08±0.51	9.03-11.14	7.05±0.68	5.65-8.45
P value (ttest)	0.5681		0.5506		0.3360		0.2817		0.8608	
Parity 3 (L)	92.47±5.02	80.20-104.74	7.41±3.49	-1.13-15.96	67.09±8.31	46.74-87.43	11.44±1.38	8.06-14.82	6.3±0.34	5.47-7.13
(NL)	76.08±4.37	66.45-85.70	25.17±8.45	6.57-43.77	45.74±8.49	27.05-64.43	10.37±1.02	8.12-12.61	5.99±0.58	4.71-7.27
P value (ttest)	0.0296		0.1410		0.1152		0.5357		0.7084	

Phosphorus level in lactating and non lactating cows were  $6.52 \pm 0.308$  and  $7.26 \pm 0.41$  mg/dl respectively. According to Rowlands *et al.*, (1974), phosphorus level was higher in dry cows than lactating. Peterson *et al.*, (1981) also agreed the result of the present study where phosphorus low ( $5.01 \pm 0.11$  mg/dl) in lactating than the dry period ( $6.02 \pm 0.28$  mg/dl). Conversely Giuseppe *et al.*, (2012) stated that, phosphorus level was higher in lactation than dry period. According to Patel *et al.*, (1966) serum phosphorus level depends on climatic variation and the nature of the feed. Supplements of phosphorus in the diet have a very important role in blood phosphorus level of cow. The low level of dietary supplement of phosphorus is responsible for lower phosphorus level in serum (Kincaid *et al.*, 2010). In a previous report serum phosphorus level was reported as  $5.84 \pm 0.30$  mg/dl in indigenous cow of Bangladesh (Mamun *et al.*, 2013).

#### 4. Conclusions

The result found that there is some biochemical difference between lactating and non lactating cow. Total protein and albumin is higher in non lactating cow than lactating cow, whereas glucose and calcium is higher in lactating cows. The phosphorus serum level is lower in lactating cow and higher in non- lactating cow. This may be due to seasonal, geographic, dietary, breed or other residual effect that needs further study. Subtropical conditions of the present study might have played a role in the differences with other studies. Finally biochemical values are an efficient tool for evaluation of physiological status, metabolic disorders, and management problems of the farm which have a great relation to health status of the animal and diagnosis of some pathos-physiological disorder in animals.

#### Acknowledgements

The authors are grateful to the respected farm members for their welcoming attitude during the study.

#### Conflict of interest

None to declare.

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