Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

J E Z S Journal of Entomology and Zoology Studies

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(2): 242-244

Received: 02-01-2017
Accepted: 03-02-2017

Mayuri Chetia
Department of Veterinary Biochemistry, College of Veterinary Science Khanapara, Assam Agricultural University, Guwahati-22, Assam, India

Satya Sarma
Department of Veterinary Biochemistry, College of Veterinary Science Khanapara, Assam Agricultural University, Guwahati-22, Assam, India

Correspondence
Mayuri Chetia
Department of Veterinary Biochemistry, College of Veterinary Science Khanapara, Assam Agricultural University, Guwahati-22, Assam, India

Investigation of minerals in the dairy cattle (*Bos taurus)* in the different seasons in Assam, India

Mayuri Chetia and Satya Sarma

Abstract
Calcium, phosphorus and magnesium are main mineral elements in dairy cattle, especially high milk producing ones. The research was conducted on 12 clinically healthy dairy cattle (*Bos taurus*). Blood samples were taken during the summer and winter seasons. Concentrations of calcium, phosphorus and magnesium in serum were determined by using commercially available kits. The average Mean±SE of calcium, phosphorus and magnesium concentrations in dairy cattle estimated as 10.06±0.07 and 9.68±0.06 mg%, 6.12±0.05 and 5.78 ±0.05 mg/dl and 3.17±0.04 and 2.77±0.04 mg/dl in winter and summer season respectively. Significant difference (P<0.01) were observed in the concentrations of the examined minerals between the two seasons.

Keywords: Dairy cattle, seasons, minerals, summer, winter

1. Introduction
Minerals play a vital role to modulate various biological functions in animal species. Minerals are involved in all living processes, either in the capacity of structural elements or as regulators of almost all metabolic processes [1]. Apart from the above indicated roles, minerals are important for milk production of high-yielding cows. Consequently, their role assumes an increasing importance. Homeostasis of calcium, phosphorus and magnesium is primarily affected by the very same homeostatic mechanisms, and as a result, the changes in their concentrations are in most cases mutually linked. Calcium is the most pervasive mineral in an organism. The maintenance need of calcium is approximately 15.4 mg Ca/kg of body mass [2]. The need in lactation is approximately 1.23 g Ca/kg of the produced milk. Considering the fact that phosphorus and calcium jointly participate in the bone building, these two minerals are often considered together. The effect of calcium and phosphorus ratios on the performances of ruminants is considered to be overstated. The calcium and phosphorus ratios in feed in the range of 1:1 up to 7:1 resulted in the same performances [3]. Phosphorus is indispensable for rumen's microorganisms for their growth and cellular metabolism. The focal place of magnesium absorption in ruminants is in the rumen [4]. In many respects magnesium metabolism is specific in relation to other microelements. The regulatory mechanisms of magnesium flow have not been discovered up to now. Inside the cell, magnesium acts as a catalyst to all reactions that use ATP. In this manner magnesium affects all endergonic and exergonic processes in the organism [5]. A dietary deficiency or disturbance in metabolism of calcium, phosphorus or vitamin D including imbalance of calcium- phosphorus ratio is the principle cause of osteodystrophies and periparturient hypocalcemia [6]. Each kilogram of milk with 4 % fat approximately has 1.22 g calcium [7]. Then pregnancy and lactation were the most important causes of hypocalcemia in dairy cattle. Amount of phosphorous in dairy cow's feed must be very high because of following reasons: losing high amount of endogenous phosphorous in feces, absorption of phosphorous from alimentary tract is approximately low and high concentration of phosphorous in milk. In contrast to calcium there was not any mechanism for transfer of bone phosphorous to blood stream [8]. According to NRC, daily requirement of a 450 kg dairy cow with 18 kg milk production is 4 grams [9].

2. Materials and Methods
2.1 Experimental animals
The study was conducted in the two seasons namely, summer (June to August) and winter (December to February) season. A total of twelve numbers of dairy cattle (*Bos tauraus*) free from any kind of anatomical or reproductive diseases, were selected and maintained in the

Instructional Livestock Farm (Cattle), College of Veterinary Science Khanapara, Assam Agricultural University, Guwahati-22 with latitude and longitude position being 26° 10' N and 91° 44' E respectively. The animals were supplied with both green fodder and concentrate as per the standard feeding practices of the farm. The designed experimental work for the present study was approved by the Institutional Animal Ethics Committee, College of Veterinary Science, Assam Agricultural University, Khanapara, Guwahati-22, Assam, India.

2.2 Sample collection and serum analysis

The venous blood was collected aseptically from each of the experimental animals fortnightly for the two seasons. The collected blood samples were allowed to clot and then serum was separated by centrifugation at 2000 g for 15 minutes and stored at -20 ^{0}C in different sterile screw capped plastic vials for estimation of minerals. The different minerals like calcium (Ca^{2+}), phosphorous (P) and magnesium (Mg^{2+}) were estimated by using commercially available kits. The serum calcium, phosphorous and magnesium content was estimated by OCPC (O-Cresolphthalein Complexone) method, Gomorri's method and Titan yellow method.

2.3 Statistical analysis

The analysis of variance was performed to determine the presence or absence of significant differences in the analytical variables using GraphPad PRISM version 5.0 statistical software packages. The p values less than 0.05 were considered significant.

3. Results and Discussion

The calcium, phosphorous and magnesium concentration in *Bos tauraus* in the different seasons are presented in the Table 1. The concentration of the estimated minerals in the dairy cattle were decreased the summer season than that of the winter season. The difference in mineral concentration was observed to be significant between the summer and winter season respectively.

Table 1: Mean±SE in *Bos tauraus* during summer and winter seasons.

Parameters (Unit)	Winter Season (Mean±SE)	Summer Season (Mean±SE)
Calcium (mg%)	10.06^{a}±0.07	9.68^{b}±0.06
Phosphorous (mg/dl)	6.12^{a}±0.05	5.78^{b} ±0.05
Magnessium (mg/dl)	3.17^{a}±0.04	2.77^{b}±0.04

Note: Means bearing same superscripts in a row didn't differ significantly (P<0.01).

From the results of biochemical analysis of serum samples in the present study, it has been found that the mean serum calcium concentration of *Bos tauraus* in Assam was within the reported range for dairy cattle (9- 12 mg/dl) [6, 8]. Similarly, the mean serum phosphorus and magnesium concentrations were in defined normal range for dairy cattle (4- 7 mg/dl and 1.9- 3.2 mg/dl respectively) [6, 9]. Furthermore, this study defined that the calcium, phosphorus and magnesium concentrations of dairy cattle was higher in winter than summer season. Most of the herbivorous animals under natural grazing conditions obtain their minerals from forage plants. However, these pasture forages can rarely, completely satisfy all minerals requirements [10]. Their concentrations in the body fluids will, therefore, depend on the mineral contents of feed and forage, the level of dietary sources intake, and the availability of minerals [11]. The concentrations of minerals in the body fluids will, then, depend on absorption from the gut, metabolic usage, hormones and excretion [12]. In addition, many environmental and plant factors affect the mineral concentration of forage plants, which include, species or strain or variety, soil type, climatic and seasonal conditions during plant growth, stage of maturity of forage plants and other management practices. Variations in serum macro mineral status in dairy cattle in the different seasons may be attributed to many factors affecting mineral requirements which include nature and level of production of milk, age levels and chemical forms of elements, inter-relationships with other nutrients, mineral intake and animal adaptation to the existing environment [13]. Mineral requirements and status are highly dependent on the level of productivity and physiological state of the animal [14]. Dietary requirements may decline with age, because the major requirement for growth, usually, remains constant while appetite increases in proportion to body size [15]. Specific mineral requirements are difficult to pinpoint since exact needs depend on chemical form and numerous mineral inter-relationships. Age and class of animals can affect requirements of minerals through changes in efficiency of absorption. Overall, young animals absorb minerals more efficiently than older animals [16]. Moreover, other possible causes for the apparent variation in mineral requirements in the different seasons could be genetic difference in the efficiency of absorption [17].

4. Conclusion

The present study concluded that the mineral concentration in dairy cattle of Assam, India was decreased in summer compared to the winter season. There was a significant difference (P<0.01) in the mineral concentration between the different seasons. Therefore, supplementation of the dairy animals with a bio-available mineral mixture in summer season will probably increase the serum mineral concentration. However, more studies should be carried out in order to determine the requirements and economic benefits of different mineral supplementations. In view of the seasonal changes in serum mineral concentration, we suggest to carry out our future research in different age groups, breeds and physiological status.

5. Acknowlegement

The authors are thankful to Instructional Livestock Farm (Cattle), C.V.Sc Khanapara, A.A.U., Guwahati-22 for proving the experimental animals to carry out the study.

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