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**Bilquees Fatima**

Division of Veterinary  
Biochemistry, F.V.Sc. & A.H.,  
SKUAST-Kashmir, Jammu &  
Kashmir, India

**Sheikh Bilal Ahmad**

Associate Professor, Division of  
Veterinary Biochemistry,  
F.V.Sc. & A.H., SKUAST-  
Kashmir, Jammu & Kashmir,  
India

**Ishraq Hussain**

Division of Veterinary  
Biochemistry, F.V.Sc. & A.H.,  
SKUAST-Kashmir, Jammu &  
Kashmir, India

**Shazada Mudasir Rashid**

Division of Veterinary  
Biochemistry, F.V.Sc. & A.H.,  
SKUAST-Kashmir, Jammu &  
Kashmir, India

**Manzoor R Mir**

Division of Veterinary  
Biochemistry, F.V.Sc. & A.H.,  
SKUAST-Kashmir, Jammu &  
Kashmir, India

**AM Ganai**

Division of Animal Nutrition,  
F.V.Sc. & A.H., SKUAST-  
Kashmir, Jammu & Kashmir,  
India

**Hilal Musadiq Khan**

Division of LPM, F.V.Sc. &  
A.H., SKUAST-Kashmir,  
Jammu & Kashmir, India

**Rafiq Ahmad Shahardar**

Division of Parasitology, F.V.Sc.  
& A.H., SKUAST-Kashmir,  
Jammu & Kashmir, India

**Corresponding Author**

**Sheikh Bilal Ahmad**

Associate Professor, Division of  
Veterinary Biochemistry,  
F.V.Sc. & A.H., SKUAST-  
Kashmir, Jammu & Kashmir,  
India

## To investigate the impact of gender and season on calcium and phosphorus in yak (*Bos grunniens*) and possible establishment of reference value in relation to calcium and phosphorus

**Bilquees Fatima, Sheikh Bilal Ahmad, Ishraq Hussain, Shazada Mudasir Rashid, Manzoor R Mir, AM Ganai, Hilal Musadiq Khan and Rafiq Ahmad Shahardar**

### Abstract

Yak (*Bos grunniens*) belongs to bovine species with economic importance found in the higher altitudes of snow laid Himalayan region of India. The yak in contrast to other bovine species is a multipurpose animal as it is a source of milk, meat, fiber, dung and the source of transportation of goods to highlanders. The present study was conducted to estimate the levels of calcium and phosphorus in both the genders of yak during summer and winter to possibly establish the base line data with reference to calcium and phosphorus. A total of 680 samples were evaluated comprising 340 samples in each summer and winter seasons consisting equal number of male and female yak. The calcium levels in females were  $8.69 \pm 0.74$  in summer while it was  $8.78 \pm 0.27$  in winter. The phosphorus levels were  $2.40 \pm 0.29$  in summer while it was  $2.10 \pm 0.20$  in winter. In males the calcium levels were  $8.03 \pm 0.31$  in summer and  $8.93 \pm 1.43$  in winter. The phosphorus levels were  $3.34 \pm 0.62$  and  $2.58 \pm 0.26$  in summer and winter respectively.

**Keywords:** Yak (*Bos grunniens*), calcium, phosphorus, gender, summer, winter

### Introduction

Yak (*Bos grunniens*) belongs to bovine species with economic importance found in the higher altitudes of snow laid Himalayan region of India. The yak in contrast to other bovine species is a multipurpose animal as it is a source of milk, meat, fiber, dung and the source of transportation of goods to highlanders. It had originated from the cold regions of Tibet, Yak is the only large hairy multipurpose bovid and a unique genetic resource with an amazing ability to survive, reproduce and provide marketable products to the highlanders. Traditionally, the yaks are reared under free-ranged system in the high hills where the air, water, and pasture are free from any pollution, and their products are organic and just natural [1]. The yak (*Bos grunniens*) has a long documented history and is inextricably linked to the culture, religion, and social life of the pastoral peoples of the cold and high mountainous regions. It is entirely possible, assume Chinese historians have suggested, that human civilisation would not have reached and established itself in these remote areas marked by an extreme climate at high altitudes and limited grazing resources due to short growing seasons if the yak and its adaptations had not existed [2].

Yaks can be found in alpine and sub-alpine locations with a cold and semi-humid climate, mainly between 3000 and 4500 metres above mean sea level (MSL). They even thrive at 6000 meter above mean sea level (MSL). The world population of domestic yaks is about 14.2 million, of which about 94percent (13.3 million) are in China. Indian hills accommodates around 84,000 yaks. Kargil and Leh districts in Ladakh territory and Doda districts of Jammu and Kashmir have around 62,000 yaks; West Kameng and Tawang districts of Arunachal Pradesh have around 14,000 yaks; North, East and West districts of Sikkim have around 5000 yaks; Chamba, Lahul-Spiti and Kinnaur districts of Himachal is the home of around 1900 yaks [3]. Although the yak population is small in comparisons to India's total livestock population, it is nonetheless very important in the lives of the people who live in the hilly regions adjacent to the Himalayas. The findings of scientific institutions focusing on yak research are still out of reach for yak farmers. As a result, adequate extension equipment must be established to connect researchers/development institutions with yak rearers, which is

especially missing in the high altitude regions.

The Himalayan northern region has a wide range of climatic and geographical characteristics. This region experiences harsh cold and dry weather for the most of the year, hampering biomass growth and output. In a year, the summer stays for approximately 4 months and winter prevails for the rest 8 months. There are various factors that reduce cattle productivity in high altitude cold desert, the important one is severe environmental condition. The vegetative cover in places like Ladakh, Kargil, and Dras is quite limited. During the winter, the temperature drops to  $-35^{\circ}\text{C}$ , and the altitude varies between 10,000 and 20,000 feet above mean sea level (MSL). The density of ambient oxygen falls short of MSL by 30% [4]. Kargil is located between  $32.57'$  and  $34.45'$  north latitude and  $75.35'$  east longitude in the union territory of Ladakh, in the north of Kashmir valley, at a height varying from 8000 feet to 18000 feet above sea level. The district covers a total area of 14086 km<sup>2</sup> (5439 sqm), with Rocky Mountains devoid of natural flora. The majority of the people in this area rely on small-scale agricultural and animal production. Farmers, on the other hand, are completely reliant on livestock for nutrition in the winter, and yak play a significant role among them [5].

Clinical laboratory tests are used not only for health screening, diagnosis, and illness management, but also to track therapy progress [6]. The significance of these examinations emphasizes the need of accurate and dependable outcomes. Reference intervals (RIs) are values within which a certain percentage of measurements from a healthy population would fall [7, 8]. They serve as the foundation for interpreting laboratory results [9, 10] and are thus an important part of laboratory test reporting [11]. Hematological and biochemical parameters for a specific breed may vary depending on the environmental conditions where the animal resides [12]. Knowledge of breed-specific blood values is a necessary requirement for the assessment of animal welfare in health and sickness [13, 14]. Gender, age, season, and animal feeding are some of the factors that can affect hematological and serum biochemical markers [15].

As calcium and phosphorus play such important roles in so many physiologic systems, problems with calcium and phosphorus metabolism always have serious implications, such as skeletal and cardiovascular morbidity, or even death. Physiologically, calcium and phosphorus homeostasis is achieved through a series of coordinated activities of hormones such as parathyroid hormone (PTH), vitamin D, and fibroblast growth factor (FGF23), all of which are primarily regulated in the intestine, kidney, and bone. Calcium and phosphorus metabolism may be disrupted if any organ or component is disrupted. Calcium (Ca) and phosphorus (P) shortage has a deleterious impact on several aspects of mammalian reproduction, from gamete maturation to foetal development [16, 17]. As previously stated, if the intake of Ca and P is insufficient because of the shortage of forages in the cold season, the body reserves of Ca and P become depleted and the reproductive potential is inhibited.

Since no or very few works with lesser sample size has been undertaken to in relation with levels of Ca and P in yak. The difference has further under lined the need to establish an appropriate physiological base line values for yaks with reference to Ca and P which will help in realistic evaluation of the management practices, nutritional and diagnosis of health conditions.

## Materials and Methods

### Animals and sample collection

The present study was undertaken in Kargil district of Ladakh region. A total of 680 samples comprising 340 samples of each sex were collected in both winter and summer seasons (Table 1) and the protocol for experimentation were approved by Institutional Animal Ethics Committee. 5 ml of blood was collected from jugular vein from each yak into sample collection tubes without the addition of anticoagulant. The tubes were centrifuged at 3000 rpm for 10 minutes at  $4^{\circ}\text{C}$  to get serum samples. All samples were stored at  $-80^{\circ}\text{C}$  until analyzed.

**Table 1:** Sample collection

| S. No | No. of Samples | Season | Male | Female |
|-------|----------------|--------|------|--------|
| 1     | 340            | Summer | 170  | 170    |
| 2     | 340            | Winter | 170  | 170    |

### Analysis of serum samples

The concentration of Ca and P were analyzed with commercial kits from Med source as per the instructions of manufacturer using a Shimadzu CL 7200 Automatic Analyser (Shimadzu, Kyoto, Japan)

### Statistical Analysis

The results obtained were analysed by using Minitab statistical software and results are presented as means  $\pm$  standard error (SE).

### Results and Discussion

The serum concentrations of Ca in females in summer and winter were  $8.69 \pm 0.74$  and  $8.78 \pm 0.27$  respectively while  $2.40 \pm 0.29$  and  $2.10 \pm 0.20$  levels of P were obtained in summer and winter respectively (Table 2). The serum concentration of calcium levels (6.82-11.35 mg/dl) in all yaks were below the recommended range of (40.5-49.5 mg/dl) [18]. The serum concentrations of phosphorus levels (1.19-5.71 mg/dl).

**Table 2:** Serum concentration levels of Ca and P in female yaks during summer and winter

| Sample size | Gender | Season | Calcium (Ca)    | Phosphorus (P)  |
|-------------|--------|--------|-----------------|-----------------|
| 170         | Female | summer | $8.69 \pm 0.74$ | $2.40 \pm 0.29$ |
| 170         | Female | winter | $8.78 \pm 0.27$ | $2.10 \pm 0.20$ |

The serum concentration levels of Ca in males in summer and winter were  $8.03 \pm 0.31$  and  $8.93 \pm 1.43$  respectively while  $3.34 \pm 0.62$  and  $2.58 \pm 0.26$  P levels were obtained in summer and winter respectively (Table 3).

**Table 3:** Serum concentration levels of Ca and P in male yaks during summer and winter

| Sample size | Gender | Season | Calcium (C)     | Phosphorus (P)  |
|-------------|--------|--------|-----------------|-----------------|
| 170         | Male   | Summer | $8.03 \pm 0.31$ | $3.34 \pm 0.62$ |
| 170         | Male   | Winter | $8.93 \pm 1.43$ | $2.58 \pm 0.26$ |

Calcium and phosphorus metabolism are closely associated with each other as these two minerals plays a critical role in bone mineralization [18]. In addition they are also involved in a cascade of physiological processes. As calcium has a role in hormone secretion, blood clotting and nerve excitement, while phosphorus plays its role in energy metabolism, cell signaling and stabilizing of phospholipids content on the cell membrane [19]. Hence the study was designed to establish the possible reference value in respect to Ca and P for monitoring

the normal physiological activity of the yak (*Bos grunniens*). The serum concentration of calcium levels were in the range of 6.82-11.35 mg/dl while as the serum concentrations of phosphorus levels were in the 1.19-5.71 mg/dl range. These results are not in agreement with the previous study [20] who obtained higher levels for calcium it may be because of the variation of magnitude in their geographical position and availability of Ca in the grazing pastures, the low levels of P obtained in the present study are in concurrence with the findings of earlier studies [20].

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