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Haematological and biochemical profiling of Ladakhi cow: A native cattle of high altitude Leh-Ladakh, India

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ABSTRACT

Ladakhi cattle is a native breed of cattle which is well adapted to hypobaric-hypoxia and cold-stress conditions prevalent at high altitude. These cattle are the main source of A2 quality milk. However, their utility, health and dairy production managements were not standardised for optimum dairy farm economics. Moreover, the haematological and biochemical parameters have not been investigated in details in adult Ladakhi cows, which is the primary requirement of farm health managements. Thus, the objective of this study was to examine the haematology and biochemical parameters in adult Ladakhi cow to establish baseline reference values. Clinically healthy female Ladakhi cattle (10) were selected from the Ladakhi cattle research section, DIHAR, Leh. The resulted haematological and biochemical parameters were compared with already reported reference values for low lander cattle and high lander native and crossbred cattle. Haematological findings revealed that RBC, Hb, heamatocrit, MCV and WBC were within the reference range, rather MCH and MCHC values were more than the reference range. Biochemical findings revealed that albumin, glucose, creatinine, uric acid, alkaline phosphatase, and aspartate aminotransferase were within the reference range limits of low lander. However, urea, triglycerides, total protein values were higher than the reference range and calcium was less than the reference range. These findings indicated that the native Ladakhi cattle are in healthy condition and metabolically adapted to high altitude stress. Hence, these hemato-biochemical profile could be the good biomarkers to evaluate their health status in high altitude stress condition.

Keywords: Biochemical, Body-measurements, Haematology, High altitude, Ladakhi cow

The climate of Leh-Ladakh is extremely harsh and hypobaric-hypoxic. These adverse environmental factors affect animal health and production. However, all the native livestock population are adapted to the high altitude stress as evolved through natural selection. Therefore, our earlier efforts were focused on the characterization of native cattle and their breed registration, if it is a unique germplasm (Verma *et al*. 2018a, 2018b; Sodhi *et al*. 2018). The government of India (ICAR) accepted our new breed application and registered Ladakhi cattle as a 42nd native breed of India.

Haematological parameters help in determining the adaptation of animals to the environment and also used to assess the stress and well-being of animals (Kumar *et al*. 2000, Giri *et al.* 2017). Besides, biochemical parameters are responsible for various body functions and its deficiency result in impairment of functions and induces structural and physiological abnormalities (Mamun *et al.* 2013). Further, changes in the biochemical and haematological constituents are important indicators for the physiological or pathological state of the animal (Kumar *et al*. 2000, Ahmed *et al.* 2009). Therefore, the Ladakhi cattle health at high-altitude region requires a clinical examination, and range of biochemical assays and haematology, which help in the diagnosis or may give an indication of the disease type and severity.

However, Bharti *et al.* (2017) and Giri *et al.* (2017) in their study reported that significant variation of haematology parameters between Ladakhi and Jersey crossbred cattle reared at high altitude. They reported that these parameters vary within the normal reference range for cattle published, however no reference or normal range of these parameters of cattle of high altitude was available to compare. So, the present study was designed for monitoring of Ladakhi cattle health by using phenotypical, haematological and biochemical parameters and provide the reference values of haemato-biochemical parameters of Ladakhi cattle that are important for the clinical interpretation of laboratory data and a valuable diagnostic tool in animal health care at high-altitude.

MATERIALS AND METHODS

Experimental animal and their husbandry: All the animal experimental procedures were followed in accordance with the animal ethics committee of Defence Institute of High-Altitude Research (DIHAR). The

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experimental animals consisted of 10 adult apparently healthy Ladakhi cows from Cattle Research Section, DIHAR, Leh, age ranging from 5 to 10 years. This is a high altitude located at 3,500 m msl in cold-desert Himalayan region of India. Furthermore, all cows were kept under standard cattle housing condition and outside paddocks. These animals were given dry alfalfa grass and concentrate mixture as per the institute ration scale developed for high altitude and *ad lib.* drinking water.

Sample collection: The blood was collected aseptically during the month of September 2017, temperature varied 5°C to 18°C and humidity 57% to 60%. Then, serum samples obtained after centrifugation at 3,600 rpm for 10 min and stored at –20°C until the further experiments.

Analysis of haematological parameters: In order to analyze the blood parameters, blood with anticoagulants was used in Hematology analyser (Sysmex XP-100) and parameters, viz. Red blood cell count (RBC), White blood cell count (WBC), haemoglobin (Hb), hematocrit (HCT), mean corpuscular volume (MCV), mean corpuscular haemoglobin concentration (MCHC), mean platelet volume (MPV) and platelets count (PLT) were carried out.

Analysis of biochemicals parameters: Serum biochemicals estimation were studied such as total protein (TP), albumin (ALB), glucose (GLU), high-density lipoprotein (HDL), low-density lipoprotein (LDL), aspartate aminotransferase (AST), alkaline phosphatase (ALP), creatinine (CREA), triglyceride (TGL), uric acid (UA), urea and calcium (Ca) with Automated Chemistry Analyzer (Mindray BS-120). All biochemical estimation was carried out using commercial kits as per manufacturer instruction (RANDOX Laboratory Limited).

Body measurements: The animals body weight (kg) was taken by using electronic digital balance (Avery L 105 A, max. 500 kg and min. 4 kg) in the morning on fasting. Further, height, chest girth, body length and udder girth were measured by using the routinely used measuring tape.

Statistical analysis: All the data recorded were subjected to statistical analysis using Microsoft office Excel 2013 software and values are presented as mean±standard deviation.

RESULTS AND DISCUSSION

The results of the haematological, biochemical and body-measurements obtained from this study are presented in Tables 1, 2 and 3. The results obtained from this study, i.e. haematology and biochemical analysis were compared with the already existed reference range of cattle from plain area and reference value of high altitude crossbreed cattle studied by our group. No other literature are available to compare these haematological and biochemical parameters of cattle of high altitude.

WBC, RBC, Hb, HCT, MCV and PLT values were within the normal reference range of healthy cow (Table 1). However, slightly higher MCH and MCHC level than the normal range, this may be due to the hypoxic condition which might have increased the erythrocyte-stimulating factor (ESF) under the increase of tissues oxygen demand (El–Nouty FD *et al.* 1990). Further, significantly higher MCH values were reported, it may be due to more immature red cells in circulation and simultaneous incorporation of an increased amount of Hb at the time of their release (Doxey *et al.* 1983). In comparison with the high-altitude reference range of crossbreed cattle, it shows that haematological profile of Ladakhi cattle is within the range and cattle is well adapted to the prevalent high altitude stress condition (Bharti *et al.* 2017, Giri *et al.* 2017). Furthermore, different biochemical parameters have analyzed and the results are presented in Table 2.

The biochemical estimation results clearly suggested that the ALP, AST, ALB, GLU, CREA and UA are within the reference range limits. Though the ALP and AST give the information about the state of liver health, so on the basis of present findings ALP and AST are within the normal range and liver metabolic functions are well adapted (Payne *et al.* 1970). Similarly, the LDL and HDL showed within the normal range. Whereas, TGL and TP were higher than the reference range value. The higher TP indicates that hypoxia results in alkalosis which stimulate protein synthesis (Imoberdorf *et al.* 2001). Additionally, at high altitude, hematocrits values are higher in response to increase of TGL value (Temte 1996). High urea can be

Table 1. Haematological profile of Ladakhi cattle

Haematological parameters	Mean±SD	Reference range of plain area crossbreed*	Mean reference value of altitude native cattle§	Mean reference value of high-altitude crossbreed#
WBC ($\times 10^3/\mu L$)	9.38±1.47	4.0–12.0	8.56±1.75	8.63±0.81
RBC ($\times 10^6/\mu L$)	5.29±0.87	5.0–10.0	6.96±1.01	3.56±0.05
Hb (g/dL)	12.41±0.70	8–15	11.44±1.65	9.39±0.15
HCT (%)	25.44±4.75	23–33	35.64±4.83	21.79±0.32
MCV (fL)	47.86±1.83	40–60	58.38±1.75	60.01±0.45
MCH (pg)	23.93±3.69	11–17	16.18±0.76	25.14±0.13
MCHC (g/dL)	50.2±8.84	30–36	31.89±0.97	42.11±0.19
PLT ($\times 10^3/\mu L$)	206.71±89.3	100–800	406.28±16.05	298.26±15.56

*Low lander/plain areas cattle: Radostits *et. al*. 2000 and Jain *et. al*. 1993. §#High altitude areas cattle: Bharti *et. al.,* 2017 (Ladakhi Cattle); Giri *et. al.,* 2017 (Crossbred cattle of Leh-Ladakh).

Table 2. Biochemical profile of Ladakhi cattle

Biochemical parameters	Mean±SD	Reference range*	Mean reference value of high-altitude crossbreed#
Ca (mg/dL)	6.86±1.5	10.2–13.4	–
CREA (mg/dL)	1.08±0.18	0.5–2.0	–
GLU (mg/dL)	54.30±9.86	40–100	72.23±9.86
TP (g/dL)	8.68±1.19	6.7–7.5	5.91±0.10
TGL (mg/dL)	24.30±9.98	0–14.0	–
ALB (g/L)	3.48±0.33	2.5–3.8	3.66–0.06
ALP (U/L)	89.84±52.41	0–500	97.06±7.08
AST (U/L)	78.77±17.75	60–125	93.39±3.01
LDL (mg/dL)	12.88±4.40	<100	–
HDL (mg/dL)	97.71±29.74	60 >	–
UREA (mg/dL)	37.86±9.43	10–25	–
UA (mg/dL)	0.88±0.23	0.52–8.52	1.21±0.10

*Low lander/plain areas cattle: Radostits *et. al*. 2000, Sevnic *et. al*. 2003, Kaneko *et. al*. 2008, Latimer *et. al*. 2011. #High altitude areas cattle: Giri *et. al*. 2017.

caused by increased urea production, decreased urea elimination, or a combination of the two (Higgins 2016). Hypoxia is also one of the reasons for elevated urea concentration in serum (Samanta *et al.* 2018). Due to hypoxia, the alkalinity of plasma increases which causes the calcium-binding with protein and decreases free Ca ions in plasma (Ash *et al.* 2004). In comparison to the reference range of high-altitude crossbreed cattle which shows the normal range of biochemical profile which is well accomplished for adaptation at high altitude (Giri *et al.* 2017). Furthermore, the phenotypic results of Ladakhi cattle are listed in Table 3.

Table 3. Phenotypic characteristics of Ladakhi cattle

Phenotypic traits measurement	Mean±SD
Body weight (kg)	149.6±27.93
Height (cm)	96.6±3.23
Chest girth (cm)	136.4±10.30
Body length (cm)	150.4±10.44
Udder girth (cm)	47.2±5.24

The present study on phenotypic characterization of Ladakhi cows revealed that the cattle are of small size with less body weight and well adapted to the high-altitude region. This study has shown their metabolic adaptability to prevalent hypobaric hypoxia and cold stress is excellent as compared to findings on low lander cattle reared for high milk yield. Now being a distinct breed of the region, Ladakhi cattle have unique germplasm suitable for grading-up with high yielder low lander cattle to improve milk yield in Leh-Ladakh without affecting native gene-pool of adaptability (Verma *et al.* 2018a, 2018b; Sodhi *et al.* 2018).

The present study documented the baseline values for various important haemogram and blood biochemical parameters of healthy adult Ladakhi cows, which can serve indices for health and dairy production management and clinical diagnosis of various productive and reproductive ailments. Moreover, the phenotypic characteristics of Ladakhi cattle were analysed and further validated in the present study. Overall, our study revealed that Ladakhi cattle confers higher resistance to stresses, thus more valuable for sustainable dairy production in high-altitude Leh-Ladakh. However, more studies should be undertaken to establish their nutritional requirement, reproductive profile, and farm practices for rearing under commercial intensive farm system.

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