



Normal Blood Biochemical Parameters of Dromedary Camel in Pakistan

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Abstract | The camel is a unique biological model and promising livestock in the climate-change context. Pakistan is one of the hotspot regions severely hit by the calamities of climate-change. The camel is the option hope and future food security livestock for the drought-stricken regions of the country, especially Thal, Cholistan and Thar Deserts. This study was conducted at Camel Breeding and Research Station (CBRS) Rakh-Mahni (Desert Thal) to report the ten normal blood biochemical concentrations of camels in Pakistan. Twelve (6 males and 6 females) camels of Marecha breed were selected for this study. The camels were reared in its natural habitat in Thal desert. The animals were kept in semi-open pens, provided with gram crop residues *ad libitum* after 8–10 hours grazing. Water was provided twice a day. In blood profile the concentrations of haemoglobin, cholesterol, triglycerides, albumin, total protein, urea, creatinine, glucose, Ca and P were determined. Data on different parameters was subjected to descriptive statistical analysis and *t* test was applied to test significant differences between means at 5% level of significance. The results were compared with those reported by other investigators in camels.

Keywords | Camel, Blood Chemistry, Desert, Pastoral, Pakistan

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INTRODUCTION

The studies of blood biochemicals provide ample clue about health status and well-being of an animal so these can be used for evaluating the health condition of animal generally. It could be an interesting tool for monitoring the bill of health in camels (Faraz et al., 2019). Observation of a deviation of certain blood parameters from their normal limits could be a guide for differential diagnosis of diseases. Despite of this fact, a few reports have been published on its blood parameters as affected by some physiological and pathological conditions or on the normal levels of blood constituents of camel calves and adults with regard of their age and physiological status (Osman and Al-Busadah, 2000).

The quantitative analysis of blood biochemicals may assist the clinician by providing normal reference values for easy evaluation of the health status and disease condition of animals (Osman et al., 2015). However, these constituents are variable in different climatic, physiological and pathological conditions (Mohamed and Hussein, 1999). The related parameters to weight are of use in feed conversion performances and proper dosing of drugs for animals (Abebe et al., 2002).

However, a few published data on camels under natural conditions are available (Eldirdiri et al., 1987; Faraz et al., 2018; Faraz, 2020). Similar data in other camel rearing areas with some published reports are also available for Indian, Saudi and Egyptian camels. In Pakistan, still data about

different blood constituents of camels are scanty. Hence this study was planned to attain the normal blood biochemical parameters of Pakistani camel in its natural habitat.

MATERIALS AND METHODS

AREA OF STUDY

The study was attained at CBRS which is located in Thal Desert between 31°-10' and 32°-22' North-Latitude and 70°-47' and 72° East-Longitude. The area is about sandy deserts having arid-semi-arid, subtropical-continental climate. Temperature upper limit is up to 45.8 °C while lower is 1.2 °C. The annual mean rainfall ranges between 150 to 350 mm with South-North increase (Rahim et al., 2011).

HUSBANDRY AND FEEDING PLAN

Twelve (6 males and 6 females) Marecha camels (*Camelus dromedarius*) around 3 years of age were selected and marked for identification. The animals were dewormed by using injection 1% Ivermectin @ 1ml/50 kg body weight to keep the animals healthy and in well-being state. The animals kept in semi-open pens at the CBRS. Animals were sprayed with Ecofleece solution @ 1cc/liter water for animals and 2cc/liter of water for shed. They were vaccinated for Trypanosomiasis by injection Trypanidium (Samorin) 1 g sachet for 4 camels after every three months as per farm routine practices. The animals were sent to grazing/browsing for 8-10 hours. They were fed gram crop residues (*Cicer arietinum*) *ad libitum* as manger feeding. The animals were allowed access to ample drinking water twice a day. Chemical composition of gram straw / herbage samples was performed by using standard procedures as described in AOAC (1990), while NDF and ADF values were determined by standard methods (Van Soest et al., 1991) (Table 2).

BLOOD COLLECTION AND LABORATORY ANALYSIS

Blood was collected from jugular vein in two sets; with and without EDTA for separation of serum. The samples were checked for haematological and biochemical parameters. Standard kits made by Spin-react-Spain were used to determine haemoglobin (Hb) in BC-2300-Mindray-Germany haematology analyzer while DL-9000-Italy biochemistry analyzer were used to check cholesterol, triglyceride glucose, total protein, albumin, urea and creatinine. Blood samples were digested for mineral analysis in Animal Nutrition Lab, Faculty of Animal Husbandry, University of Agriculture Faisalabad. The 2 ml of plasma was mixed with equal volume of nitric acid in Kjeldhal digestion tube. The samples were kept overnight and then heated over digestion bench at below 90° C up to half. After that 5 ml of double acid mixture containing 3 parts of nitric acid and 1 part of 70% perchloric acid were added to it and again digested, till white

fumes emanated and the volume was reduced to 0.5 ml. The digested sample was cooled and diluted to 50 ml with distilled water (Faraz et al., 2018). Ca and P were measured by using atomic-absorption-spectrophotometer (Method 965. 09A; AOAC, 1990) at High Tech Lab, University of Agriculture Faisalabad.

STATISTICAL ANALYSIS

Data on parameters were subjected to descriptive statistical analysis (Steel et al., 1997) by using Statistix software version 8.1 and *t* test was applied to test significant differences between means at 5% level of significance.

RESULTS

The normal concentrations of blood biochemicals like haemoglobin, glucose, cholesterol, triglycerides, urea, creatinine, total protein, albumin, Ca and P were determined in study are mentioned in Table 1. All the variables of male and female showed non-significant differences but negating the sexual dimorphism for these variables.

Table 1: Blood biochemicals analyses of male and female Marecha camels at CBRS.

| Category | Parameters | Male (n=6) | Female (n=6) |
|----------------------|-----------------------|-------------|--------------|
| Haemoglobin | Haemoglobin (g/dl) | 15.4±0.33 | 15.2±0.39 |
| Energetic Parameters | Cholesterol (mg/dl) | 40.8±2.23 | 39.5±2.49 |
| | Triglycerides (mg/dl) | 26.83±3.23 | 23.83±2.33 |
| | Glucose (mg/dl) | 127.33±1.76 | 131.50±2.20 |
| Protein Parameters | Total Protein (g/dl) | 5.57±0.23 | 5.45±0.28 |
| | Albumin (g/dl) | 1.37±0.06 | 1.27±0.06 |
| | Urea (mg/dl) | 33.5±2.55 | 30.5±1.63 |
| | Creatinine (mg/dl) | 1.47±0.04 | 1.40±0.10 |
| Minerals | Calcium (mg/dl) | 7.05±0.02 | 6.25±0.02 |
| | Phosphorus (mg/dl) | 3.5±0.12 | 3.2±0.12 |

HAEMOGLOBIN

The mean values for haemoglobin were found to be 15.4±0.33 and 15.2±0.39 respectively for male and female camels.

ENERGETIC PARAMETERS

The mean values of cholesterol, triglycerides and glucose were determined as 40.8±2.23, 39.5±2.49; 26.83±3.23, 23.83±2.33 and 127.33±1.76, 131.50±2.20 respectively for male and female camels.

PROTEIN PARAMETERS

The mean values of total protein, albumin, urea and creatinine were found to be 5.57±0.23, 5.45±0.28; 1.37±0.06, 1.27±0.06; 33.5±2.55, 30.5±1.63 and 1.4±0.04, 1.47±0.10

Table 2: Proximate analysis (%) of crop residue and different grazing/browsing species.

| Feed/ForageSpecies | DM | CP | EE | CF | NDF | ADF | Crude ash |
|--|-------|-------|------|-------|-------|-------|-----------|
| Gram Straw (<i>Cicer arietinum</i>) | 93.53 | 9.72 | 2.60 | 44.4 | 68.7 | 47.6 | 7.83 |
| Kikar (<i>Acacia nilotica</i>) | 28.5 | 16.71 | 1.79 | 25.08 | 55.4 | 25.4 | 5.94 |
| Phulai (<i>Acacia modesta</i>) | 53.4 | 13.23 | 2.21 | 35.40 | 46.6 | 28.78 | 6.94 |
| Beri leaves (<i>Ziziphus mauritiana</i>) | 40.2 | 15.52 | 5.77 | 28.02 | 48.3 | 26.9 | 8.48 |
| Siras (<i>Albizia labbek</i>) | 37.3 | 16.17 | 6.58 | 27.25 | 43 | 29 | 16.33 |
| Jand (<i>Prosopis cineraria</i>) | 46.15 | 16.86 | 6.52 | 19.14 | 47.5 | 29 | 4.95 |
| Khagal (<i>Tamarix aphylla</i>) | 31.9 | 12.81 | 3.25 | 17.32 | 42.4 | 31.6 | 13.03 |
| Dhaman (<i>Cenchrus ciliaris</i>) | 31.9 | 14.69 | 3.94 | 26.51 | 38.53 | 18.15 | 15.71 |
| Persain (<i>Suaeda fruticosa</i>) | 30.3 | 10.57 | 5.52 | 33.14 | 48.7 | 27.6 | 7.54 |
| Khawi(<i>Cymbopogon schoenanthus</i>) | 34.6 | 9.53 | 2.01 | 35.67 | 62.1 | 43.5 | 7.14 |
| Kali Bui (<i>Kochia indica</i>) | 33.78 | 10.80 | 4.91 | 27.61 | 58.6 | 39.76 | 13.32 |
| Bhakra (<i>Tribulus terrestris</i>) | 32.1 | 8.76 | 4.58 | 32.63 | 46.7 | 35.4 | 9.64 |
| Kari (<i>Capparis spinosa</i>) | 36.7 | 17.84 | 1.18 | 30.75 | 51.8 | 33.5 | 6.97 |
| Laana (<i>Haloxylon salicornicum</i>) | 34.2 | 15.85 | 3.09 | 32.33 | 51.34 | 37.5 | 11.93 |
| Phog (<i>Calligonum polygonoides</i>) | 34.7 | 8.95 | 4.82 | 23.42 | 49.6 | 31.9 | 8.76 |
| Karir (<i>Capparis decidua</i>) | 49.4 | 16.75 | 1.52 | 24.64 | 53.6 | 37.8 | 14.76 |
| KharLaana (<i>Haloxylon recurvum</i>) | 47.9 | 12.36 | 3.32 | 24.95 | 49.2 | 31.3 | 12.15 |

DM: Dry Matter; CP: Crude Protein; EE: Ether Extract; CF: Crude Fiber; NDF: Neutral Detergent Fiber; ADF: Acid Detergent Fiber.

respectively for male and female camels. All values were greater in males than females, males being heavier than females.

MINERALS

The mean values of calcium and phosphorus were found to be 7.05±0.02, 6.25±0.02 and 3.5±0.12, 3.2±0.12 respectively for male and female camels. All values were greater in males than females.

DISCUSSION

Haemoglobin was determined slightly higher in males than females probably due to testosterone effects on kidneys to form more erythropoietin which increases the erythropoiesis as reported by (Murphy, 2014). Al-Busadah and Osman (2000) studied haematological values in Saudi camels and stated mean values for haemoglobin as 13.3±0.6, 12±0.2 and 10.1±0.8 g/dl respectively in dry-adult, lactating and calves. Hassan et al. (1968) reported average range values for haemoglobin as 8.9-15 g/dl, McGrane and Kenyon (1984) as 7.8-15.9 g/dl, Higgins and Cock (1984) as 11.4-14.2 and Omer et al. (2006) as 11.5 g/dl in camels. Omer et al. (2008) determined haematological status of camel calves of Sudan and stated higher (P<0.05) haemoglobin concentration in suckling-calves as 11.42±1.20 compared to lactating-dams as 10.69±0.62 g/dl.

In Pakistan, Farooq et al. (2011) investigated the normal

haematological parameters of dromedary camel and found range for haemoglobin as 7-17 and 8-17 g/dl in males and females, respectively in Desert Cholistan. The reported concentration of haemoglobin is found to be varied in majority of the references between 9.3 and 15.5 g/dl as reported by Faye and Bengoumi (2018). In our previous study, investigating the impact of management systems on growth parameters of Marecha calves found the mean values for haemoglobin as 16.60±0.23, 15.93±0.23 and 14.73±0.23, 14.13±0.23 g/dL for males and females dromedary calves in intensive and semi-intensive management system, respectively (Faraz et al., 2018). Reported mean values (P<0.05) of haemoglobin concentration were found to be 16.6±0.3, 16.0±0.3; 14.7±0.3, 14.1±0.2; 16.1±0.3, 16.0±0.3 g/dl for males and females dromedary calves in intensive, semi-intensive and extensive management system, respectively (Faraz, 2020).

Glucose concentration in camels was reported to be greater than ruminants and which could be the reason of elevated lactic-acid contents in camel blood (Osman and Al-Busadah, 2003). Bhakat et al. (2008) studied blood profile of Indian dromedary calves affected by various systems of management and found triglyceride concentrations as 34.8±3.7 and 19.1±2.9 mg/dl respectively in intensive and semi-intensive management system. In another study of arid western Rajasthan, Saini et al. (2014) determined low values of glucose (P<0.05) in grazing pre-pubertal camels than stall-fed group in pastoral conditions. In a different

study, [Osman and Al-Busadah \(2003\)](#) determined normal values of serum profile of dromedary Saudi she-camels and reported concentrations of glucose as 134.4 ± 11 , cholesterol as 58.4 ± 8.6 and triglycerides as 31.4 ± 3 mg/dl. In a recent study, reported mean values of glucose were found to be 126.3 ± 0.9 , 130.7 ± 2.2 ; 130.0 ± 1.8 , 136.3 ± 0.7 ; 125.3 ± 3.3 , 128.7 ± 2.9 mg/dl respectively for males and females dromedary calves in intensive, semi-intensive and extensive management system ([Faraz, 2020](#)).

In [Sarwar et al. \(1992\)](#) and [Al-Busadah \(2007\)](#) reports on blood profile in Saudi dromedary camels; cholesterol range was found to be 1.9-4.2 mmol/L. Reported glucose concentration was 110.5 ± 3.7 , 105.5 ± 0.8 mg/dl; cholesterol was 35.8 ± 3.4 , 28.0 ± 1.4 mg/dl and triglycerides was 28.3 ± 1.3 , 48.4 ± 2.8 mg/dl in Indian weaned dromedary calves at 6 and 9 months age, respectively ([Nagpal et al., 2012](#)). Reported normal plasma glucose concentration varied between 60-140 mg/dl ([Faye and Bengoumi, 2018](#)). [Faraz et al. \(2018\)](#) reported the mean values of cholesterol, triglycerides and sugar in Marecha camel calves as 46.67 ± 2.48 , 43.97 ± 2.48 and 38.30 ± 2.48 , 37.87 ± 2.48 ; 38.67 ± 1.92 , 36.00 ± 1.92 and 20.67 ± 1.92 , 17.67 ± 1.92 ; 126.33 ± 3.70 , 130.67 ± 3.70 and 130.00 ± 3.70 , 136.33 ± 3.70 mg/dL for males and females, respectively in intensive and semi-intensive management system. In very recent study, reported mean values ($P < 0.05$) of cholesterol and triglycerides were found to be 46.7 ± 1.2 , 44.0 ± 0.9 ; 38.3 ± 1.9 , 37.9 ± 2.1 ; 45.6 ± 0.6 , 44.7 ± 1.1 and 38.7 ± 0.9 , 36.0 ± 0.6 ; 18.5 ± 3.2 , 17.7 ± 2.9 ; 33.3 ± 2.0 , 28.7 ± 6.9 mg/dl respectively for males and females dromedary calves in intensive, semi-intensive and extensive management system, respectively ([Faraz, 2020](#)).

The normal functioning and excretory system of kidneys depend on urea and creatinine levels; and the creatinine is an anhydride of creatine-phosphate resulting the muscle biosynthesis. This is routine product secreted regularly and synthesized in result to muscle metabolism ([Brar et al., 2000](#)). [Bhakat et al. \(2008\)](#) studied blood biochemical profile of Indian dromedary calves in different systems of management and stated total protein as 6.3 ± 0.3 , 4.7 ± 0.4 g/dl respectively in intensive and semi-intensive management system. In another study higher urea concentration ($P < 0.05$) was reported in grazing pre-pubertal Indian dromedary camel than stall-fed group in pastoral conditions ([Saini et al., 2014](#)). Recently the reported mean values of urea and creatinine concentration were found to be 35.4 ± 3.7 , 32.0 ± 1.0 ; 36.3 ± 4.6 , 31.3 ± 5.0 ; 34.0 ± 1.3 , 32.7 ± 3.2 and 1.4 ± 0.2 , 1.5 ± 0.2 ; 1.4 ± 0.1 , 1.5 ± 0.0 ; 1.5 ± 0.0 , 1.5 ± 0.1 mg/dl respectively for males and females dromedary calves in intensive, semi-intensive and extensive management system ([Faraz, 2020](#)).

[Osman and Al-Busadah \(2003\)](#) investigating normal values of serum biochemical profile of Saudi dromedary she-

camels and reported urea as 49.8 ± 5.5 , creatinine as 1.5 ± 0.1 mg/dl, total protein as 7.1 ± 0.3 and albumin as 3.7 ± 0.3 g/dl. [McGrane and Kenyon \(1984\)](#) reported value for albumin as 2.5-5.2 g/dl; [Higgins and Cock \(1984\)](#) as 3-4.4 g/dl; [Omer et al. \(2006\)](#) as 3.3 g/dl and [Osman and Al-Busadah \(2000\)](#) as 4.5 g/dl in camels. In addition to this, [Sarwar et al. \(1992\)](#) and [Al-Busadah \(2007\)](#) investigated normal blood parameters in Saudi-Arabian dromedary camels and found creatinine as 0.16-0.5 mmol/L. In another study, reported total protein concentration was 5.7 ± 0.2 , 5.1 ± 0.2 gm/dl; albumin was 3.7 ± 0.1 , 3.7 ± 0.1 gm/dl and urea was 20.0 ± 1.1 , 25.4 ± 1.7 mg/dl respectively at 6 and 9 months of age in Indian dromedary weaned calves ([Nagpal et al., 2012](#)). Reported range of normal urea concentration in blood varied between 5-40 mg/dl, creatinine 0.8-2 mg/dl, serum albumin concentration 25-45 g/l in camels ([Faye and Bengoumi, 2018](#)).

[Faraz et al. \(2018\)](#) reported the mean values of total protein, albumin, urea and creatinine in Marecha camel calves as 6.53 ± 0.17 , 6.36 ± 0.17 and 5.30 ± 0.17 , 5.03 ± 0.17 g/dL; 1.53 ± 0.07 , 1.47 ± 0.07 and 1.37 ± 0.07 , 1.23 ± 0.07 g/dL; 35.40 ± 4.48 , 32.00 ± 4.48 and 36.33 ± 4.48 , 31.33 ± 4.48 mg/dL; 1.40 ± 0.13 , 1.47 ± 0.13 and 1.37 ± 0.13 , 1.50 ± 0.13 mg/dL for males and females, respectively in intensive and semi-intensive management system. In a very recent study, reported mean values ($P < 0.05$) of total protein and albumin were found to be 6.5 ± 0.2 , 6.3 ± 0.1 ; 5.3 ± 0.1 , 5.0 ± 0.3 ; 6.0 ± 0.5 , 5.9 ± 0.2 and 1.5 ± 0.1 , 1.5 ± 0.1 ; 1.4 ± 0.1 , 1.2 ± 0.1 ; 1.4 ± 0.1 , 1.3 ± 0.1 g/dl for males and females camel calves in intensive, semi-intensive and extensive management system, respectively ([Faraz, 2020](#)).

The importance of calcium and phosphorus losses in lactating or pregnant adult camels to milk or fetus explains obviously the sex difference in those minerals' status. Regarding the young camel, the growth of males being globally higher than for females, calcium metabolism under hormonal regulation of thyroid and parathyroid is more active in male than in female ([El-Khasmi et al., 2000](#)). [Bhakat et al. \(2008\)](#) studied blood minerals in Indian dromedary calves under different systems of management and reported calcium and phosphorus values as 8.56 ± 0.48 , 7.55 ± 0.58 and 4.93 ± 0.64 , 3.49 ± 0.95 in intensive and semi-intensive management system. [Sarwar et al. \(1992\)](#) and [Al-Busadah \(2007\)](#) determined blood biochemical values in Saudi-Arabian dromedary camels and exclaimed calcium as 7.6-13.1 mg/dl. Reported Ca concentration was 10.9 ± 0.3 , 11.1 ± 0.5 mg/dl and P was 8.7 ± 0.4 , 7.0 ± 0.6 mg/dl respectively in Indian weaned dromedary calves at 6 and 9 months of age ([Nagpal et al., 2012](#)). Reported reference values of calcium and phosphorus varied between 8.4-12.4 and 4.8-8.4 mg/dl, respectively in camels ([Faye and Bengoumi, 2018](#)).

In a former study, Faraz et al. (2018) reported the mean values of calcium and phosphorus in Marecha camel calves as 9.13 ± 0.43 , 7.30 ± 0.43 and 7.00 ± 0.43 , 6.4 ± 0.43 ; 4.55 ± 0.22 , 3.52 ± 0.22 and 3.45 ± 0.22 , 3.23 ± 0.22 mg/dL respectively for males and females in intensive and semi-intensive management system. Recently the reported mean values of calcium and phosphorus concentration were found to be 9.1 ± 0.6 , 7.3 ± 0.5 ; 7.0 ± 0.2 , 6.4 ± 0.4 ; 7.1 ± 0.3 , 6.5 ± 0.4 and 4.6 ± 0.3 , 3.5 ± 0.3 ; 3.5 ± 0.1 , 3.2 ± 0.1 ; 3.6 ± 0.1 , 3.4 ± 0.1 mg/dl respectively for males and females dromedary calves in intensive, semi-intensive and extensive management system (Faraz, 2020).

CONCLUSION

The present study has provided a comprehensive biochemical analysis of the major constituents of camels. All the values were found to be in normal range and the difference with other reported values may be attributed to breed, age, nutrition, husbandry conditions, environment and methods of the assay. These levels could be used in the diagnosis of various diseases and metabolic disorders of the animal. This paper describes the haemoglobin, biochemical blood serum constituents and minerals of male and female Marecha dromedary camels in desert conditions in Pakistan and could be used as primary data base for future studies of this field.

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AUTHORS CONTRIBUTIONS

All authors contributed to make the completion of this manuscript possible. AF conducted research and wrote the paper. MSN helped in conduct of research. AW and RHM helped in analysis. NAT helped in write up. HMI reviewed the paper.

CONFLICT OF INTEREST

The authors have declared no conflict of interest.

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