Pakistan J. Zool., pp 1-7, 2020. **DOI**: https://dx.doi.org/10.17582/journal.pjz/20190430140425

Blood Biochemical and Hair Mineral Profile of Camel Calves Reared under Different Management Systems

Asim Faraz*

Department of Livestock and Poultry Production, Faculty of Veterinary Science, Bahauddin Zakariya University, Multan

ABSTRACT

This study was conducted at Camel Breeding and Research Station (CBRS) Rakh Mahni to check the effect of management system on the blood biochemical and hair mineral profile of male and female camel calves. Eighteen Marecha camel calves of almost same weight and age were divided randomly into three groups each having 3 ♂ and 3 ♀ reared under intensive (IMS), semi-intensive (SIMS) and extensive (EMS) management systems. The calves in first group reared in IMS were fed @ 1 kg concentrate having 18% CP and 2.41 Mcal/kg energy along with gram crop residues *ad libitum*, the second group calves reared in SIMS were allowed grazing/browsing for 8-10 hours and fed gram crop residues *ad libitum* while the calves of third group reared in EMS were allowed grazing/browsing 10-12 hours along with feeding of household supplementation. The calves of first two groups were maintained at CBRS in semi-open housing system while the third group owned by the camel herders in the close vicinity. All the calves had access to water twice daily. In blood biochemicals analyses the levels of hemoglobin, cholesterol, triglycerides, total protein, albumin, calcium and phosphorus were found to be significantly different higher in IMS compared to SIMS and EMS. The levels of urea, creatinine and glucose were found to be varied (P>0.05) among groups. Regarding hair mineral status Ca, Mg, Cu, Zn, Fe and Mn concentrations were found to be significantly different (P<0.05) among calf groups in IMS, SIMS and EMS.

Article Information
Received 30 April 2019
Revised 11 June 2019
Accepted 14 September 2019
Available online 02 June 2020

Key words
Camel, Blood chemistry, Wool minerals, Management systems, Calves

INTRODUCTION

Camel husbandry system is in a state of flux as pastoralists are deviating from their traditional management system to semi-intensive and intensive management systems. This rapidly changing scenario needs overall evaluation and there is an urgent need to undertake multi-disciplinary studies (Khan *et al*., 2003; Faraz *et al*., 2019a). Camel plays an indispensible role in the social life and economy of the people of arid and semi-arid areas in various regions of the world. Despite of its significant contribution to the livelihood of pastoral society who does not have any alternate mode of production system, the camel is one of the most neglected species and very few attempts have been made so far to characterize its production potential and related parameters under natural conditions. Under traditional management system the camel productive traits are low (Bakheit *et al*., 2012).

In Pakistan, mostly the research work on production potentials of camel has been done under traditional management systems without consideration of production systems (Iqbal *et al*., 2001). Most of the research work on camel is either based on one time surveys, short observations, interviews or estimates due to the reason that camel production is usually a migratory system as it is practiced mainly in remote areas with harsh living conditions, poor infrastructure and lower economic potential, thus making such studies difficult, expensive and time consuming. Therefore, not a single long-term methodological study covering any aspect of camel productivity under such conditions has been published in Pakistan.

Related measureable indices to body weight are very important for proper dozing of drugs and for assessing feed conversion performances (Abebe *et al*., 2002). The study of blood constituents provides valuable information about the general health status of the animal (Faye and Bengoumi, 2018). Mineral estimation in camel hair is relatively a newer concept in Pakistan. It could be an interesting tool for monitoring the general health status of camel calves (Faraz *et al*., 2019b). However, in Pakistan, camel hairs are not taken up for mineral estimation so far. So, the current study was planned to explore the blood constituents and hair mineral status of Marecha calves reared under intensive, semi-intensive and extensive management systems in desert conditions.

* Corresponding author: drasimfaraz@bzu.edu.pk
0030-9923/2020/0001-0001 $ 9.00/0

MATERIALS AND METHODS

Study area and metrological conditions

This study was conducted at Camel Breeding and Research Station (CBRS), Rakh Mahni, Tehsil Mankera, District Bhakkar. The CBRS is located in Thal area between 31° 10' and 32° 22' North Latitude and 70° 47' and 72° East Longitude. Most of the area lies in the desert plain of the Thal. This area is included in the Agro Ecological Zone-III A and B (sandy desert area) having narrow strips of sand ridges and sand dunes. The climate is arid to semi-arid subtropical continental and means monthly highest temperature goes up to 45.6 ºC, while in winter it goes from 5.5 to 1.3 °C. Mean annual rainfall in the region ranges from 150-350 mm, increasing from South to North (Rahim *et al*., 2011).

Experimental animals and feeding plan

Eighteen Marecha calves (*Camelus dromedarius*) around 330±30 days of age were allotted randomly to three comparable groups of 6, each containing 3 males and 3 females, so the group was composed on homobreed and heterosex calves. Before the start of experiment, all calves were marked for identification and were dewormed to reduce the parasitic load. Calves were housed in semi-open pens throughout the trial at farm and under available housing in the field. The trial was of 120 days with 15 days additional as adaptation period. Water was provided twice a day in all the systems. The animals in the first group were fed concentrate @ 1 kg/h/d along with crop residues of gram (*Cicer arientinum*) round the clock, considered as intensive management system (IMS). In second group all animals were sent for grazing/browsing daily for about 8 hours (8-16 h) while rest of the time were stall-fed with the gram crop residues *ad lib* and considered as semi-intensive management system (SIMS). The third group which belonged to the field in close vicinity, the animals were allowed grazing/browsing daily for 10 h (8-18 h) and were stall fed with household supplementations in rest of the time according to the field prevailing practices. Proximate analysis of concentrate, crop residues and herbage samples were performed by using standard procedures as described in AOAC (1990), while NDF and ADF values were determined by Van Soest (1991) methods. The chemical composition of concentrate and herbage samples is shown in Tables III and IV, respectively.

Blood collection and lab analysis

Towards the end of experiment, blood samples were collected from all calves for hematological analysis by jugular puncture in two sets. One contained EDTA as anticoagulant and the other without EDTA for serum separation. The blood samples were studied for hematological and biochemical analyses. Hemoglobin (Hb) in blood sample while cholesterol, triglyceride, urea, total protein and albumin in serum samples were estimated by using standard kits (Spin-react, Spain) in hematology analyzer (BC 2300, Mindray Germany) and biochemistry analyzer (DL 9000, Italy), respectively. The digestion of blood samples for mineral analyses was done 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 90º C up to half. After that 5 ml of double acid mixture containing 3 parts of nitric acid and 1 part of 70% per-chloric 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 (Bhakat *et al*., 2008). Calcium and phosphorus concentrations were determined by using atomic absorption spectrophotometer (Method 965. 09A; AOAC, 1990) at High Tech Lab, University of Agriculture Faisalabad.

Hair collection, digestion and analyses

Hair samples were collected from shoulder, neck, hump and mid region of body of camel calves. The hair was cut with the stainless-steel scissors into pieces of about 1 cm length from each region and mixed well to ensure homogeneity. The skirting of sample was done properly. Samples were washed with acetone and filtered, rinsed with plenty of water. These were dried in hot air oven and 0.5 g of dried mass was taken for further processing. Digestion of hair samples was done in Animal Nutrition Lab, Faculty of Animal Husbandry, University of Agriculture Faisalabad. Concentrated nitric acid (2 ml) was added to each hair sample and was kept at 100° C until half of the total volume evaporated. The samples were taken out and cooled. Concentrated per-chloric acid (2 ml) was added and again the sample was kept until half of the total volume evaporated. After this procedure, distilled water was added to give a total volume of 10 ml (Bhakat *et al*., 2009). The solution was used for determination of important macro-minerals and micro-minerals. The concentration of macro (Ca, Mg) and micro (Cu, Fe, Mn, Zn) minerals was determined by atomic absorption spectrophotometer (Method 965. 09A; AOAC, 1990) at High Tech Lab, University of Agriculture Faisalabad.

Statistical analysis

Data collected on different parameters were analyzed statistically by one-way ANOVA using GLM of Statistix software. LSD test at 0.05 levels of significance was used to compare the differences among the treatment means (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Chemical components of blood

Table I shows the level of various biochemical components such as hemoglobin, cholesterol, triglycerides, total protein, albumin, urea, creatinine, glucose, calcium and phosphorus in blood of camel calves. The mean values for hemoglobin were found to be significantly different between systems (P<0.05) as 16.6±0.3, 16.0±0.3; 14.7±0.3, 14.1±0.2 and 16.1±0.3, 16.0±0.3 g/dl for male and female camel calves in IMS, SIMS and EMS, respectively. Hemoglobin was found to be higher in males compared to females probably due to testosterone effects on the kidneys to produce more erythropoietin that accelerates the erythropoiesis (Murphy, 2014).

Al-Busadah and Osman (2000) determined hematological values in camels of Saudi Arabia and reported mean value for hemoglobin as 13.3±0.6, 12±0.2 and 10.1±0.8 g/dl in dry-adult, lactating and calves, respectively. Reported range values for hemoglobin was 8.9-15 g/dl (Hassan *et al*., 1968), 7.8-15.9 g/dl (McGrane and Kenyon, 1984), 11.4-14.2 (Higgins and Cock, 1984) and 11.5 g/dl on average (Omer *et al*., 2006). Omer *et al*. (2008) studied hematological profile of Sudanese camel calves and reported significantly higher hemoglobin concentration in suckling calves as 11.42±1.20 compared to their lactating dams as 10.69±0.62 g/dl. In Pakistan, Farooq *et al*. (2011) studied the normal reference hematological concentration of one-humped camels in Cholistan desert and reported a range for hemoglobin as 7-17 and 8-17 g/dl in male and females, respectively. The reported concentration of hemoglobin is found to be varied in majority of the references between 9.3 and15.5 g/dl (Faye and Bengoumi, 2018).

The mean values of cholesterol and triglycerides were found to be significantly different (P<0.05) among calf groups, being higher in IMS than SIMS and EMS while the levels of glucose were found to be varied (P>0.05) among groups between the systems. All values were found to be higher in males compared to females. Cholesterol and triglycerides were also found higher but in normal range in calves of IMS and EMS as the calves were in active metabolic state. Glucose level in camels was found to be higher than other ruminants and that could be the reason of reported higher lactic acid contents in the blood of camels (Osman and Al-Busadah, 2003). Contrary to our findings, Indian scientist Bhakat *et al*. (2008) determined blood biochemicals in camel calves under different management systems and reported significant differences for triglycerides as 34.8±3.7, 19.1±2.9 mg/dl in camel calves in intensive and semi-intensive system of management, respectively. While in another study, Saini *et al*. (2014) found significantly lower glucose values in grazing pre-pubescent camels than stall fed group under pastoral management in arid western Rajasthan.

In a different study, Osman and Al-Busadah (2003) investigating normal concentrations of serum biochemicals of she-camels in Saudi Arabia, determined glucose (134.4±11), cholesterol (58.4±8.6) and triglycerides (31.4±3) mg/dl. In Sarwar *et al*. (1992) and Al-Busadah (2007) reports on blood values in Saudi camels cholesterol range was 1.9-4.2 mmol/L. Nagpal *et al*. (2012) determined serum profile of weaned Indian camel calves and reported glucose as 110.5±3.7, 105.5±0.8 mg/dl; cholesterol as 35.8±3.4, 28.0±1.4 mg/dl and triglycerides as 28.3±1.3, 48.4±2.8 mg/dl in weaned calves at 6 and 9 months age, respectively. Reported normal plasma glucose concentration varied between 60-140 mg/dl (Faye and Bengoumi, 2018).

The mean values of total protein and albumin were found to be significantly different (P<0.05) among calf groups being higher in IMS than SIMS and EMS while the levels of urea and creatinine were found to vary (P>0.05) among groups between the systems. All values were found to be higher in males compared to females, males being healthier and heavier than females in the three systems. Urea and creatinine are the indirect tests for the proper kidney functioning and excretion. Creatinine which is an anhydride of creatine phosphate results by the muscle synthesis, a routine product formed due to muscle metabolism and excreted on regular basis (Brar *et al*., 2000). Being in active fattening condition, the levels of total protein and albumins were also higher as the animals showed increased growth rate. Moreover, the serum electrolytes were also found to be higher as their ratio relates with the age factor being higher in early and growing age. Both energetic and protein parameters testify the highest protéo-energetic value of camel diet in intensive system.

Bhakat *et al*. (2008) determined blood biochemicals in Indian camel calves under different management systems and reported significant differences for total protein as 6.3±0.3, 4.7±0.4 g/dl in camel calves in intensive and semi-intensive system of management, respectively while non-significant differences were found regarding urea and albumin. In another study, Saini *et al*. (2014) found significantly higher urea values in grazing pre-pubescent camels than stall fed group under pastoral management in arid western Rajasthan.

In their study, Osman and Al-Busadah (2003) investigating normal concentrations of serum biochemicals of she-camels in Saudi Arabia, determined urea (49.8±5.5), creatinine (1.5±0.1) mg/dl, total protein (7.1±0.3) and albumin (3.7±0.3) g/dl. Reported value for albumin was

Table I. Blood biochemicals analyses of male and female camel calves in IMS, SIMS and EMS.

Parameter	IMS		SIMS		EMS	
	Male (n=3)	Female (n=3)	Male (n=3)	Female (n=3)	Male (n=3)	Female (n=3)
Hemoglobin (g/dl)	16.6±0.3 ^{ax}	16.0±0.3 ^{ay}	14.7±0.3 ^{bx}	14.1±0.2 ^{by}	16.1±0.3 ^{ax}	16.0±0.3 ^{ay}
Cholesterol (mg/dl)	46.7±1.2 ^{ax}	44.0±0.9 ^{ay}	38.3±1.9 ^{bx}	37.9±2.1 ^{by}	45.6±0.6 ^{ax}	44.7±1.1 ^{ay}
Triglycerides (mg/dl)	38.7±0.9 ^{ax}	36.0±0.6 ^{ay}	18.5±3.2 ^{bx}	17.7±2.9 ^{by}	33.3±2.0 ^{ax}	28.7±6.9 ^{ay}
Total Protein (g/dl)	6.5±0.2 ^{ax}	6.3±0.1 ^{ay}	5.3±0.1 ^{bx}	5.0±0.3 ^{by}	6.0±0.5 ^{ax}	5.9±0.2 ^{ay}
Albumin (g/dl)	1.5±0.1 ^{ax}	1.5±0.1 ^{ay}	1.4±0.1 ^{bx}	1.2±0.1 ^{by}	1.4±0.1 ^{bx}	1.3±0.1 ^{by}
Urea (mg/dl)	35.4±3.7 ^{ax}	32.0±1.0 ^{ay}	36.3±4.6 ^{ax}	31.3±5.0 ^{ay}	34.0±1.3 ^{ax}	32.7±3.2 ^{ay}
Creatinin (mg/dl)	1.4±0.2 ^{ax}	1.5±0.2 ^{ay}	1.4±0.1 ^{ax}	1.5±0.0 ^{ay}	1.5±0.0 ^{ax}	1.5±0.1 ^{ay}
Glucose (mg/dl)	126.3±0.9 ^{ax}	130.7±2.2 ^{ay}	130.0±1.8 ^{ax}	136.3±0.7 ^{ay}	125.3±3.3 ^{ax}	128.7±2.9 ^{ay}
Calcium (mg/dl)	9.1±0.6 ^{ax}	7.3±0.5 ^{ay}	7.0±0.2 ^{bx}	6.4±0.4 ^{by}	7.1±0.3 ^{bx}	6.5±0.4 ^{by}
Phosphorus (mg/dl)	4.6±0.3 ^{ax}	3.5±0.3 ^{ay}	3.5±0.1 ^{bx}	3.2±0.1 ^{by}	3.6±0.1 ^{bx}	3.4±0.1 ^{by}

Means having different superscript in columns are significantly different (P<0.05). IMS, intensive management system; SIMS, semi-intensive management system; EMS, extensive management system.

Table II. Wool minerals analyses of male and female camel calves in IMS, SIMS and EMS.

Parameter	IMS		SIMS		EMS	
	Male (n=3)	Female (n=3)	Male (n=3)	Female (n=3)	Male (n=3)	Female (n=3)
Calcium (g/dl)	685.0±25.3 ^{ax}	595.7±38.0 ^{ay}	523.2±39.2 ^{bx}	486.0±8.7 ^{by}	529.8±15.9 ^{bx}	498.7±23.2 ^{by}
Magnesium (g/dl)	104.3±2.0 ^{ax}	101.2±0.9 ^{ay}	80.6±0.6 ^{bx}	78.2±1.6 ^{by}	87.8±3.4 ^{bx}	83.5±4.0 ^{by}
Copper (g/dl)	7.0±0.4 ^{ax}	6.7±0.4 ^{ay}	5.6±0.3 ^{bx}	4.3±0.4 ^{by}	5.7±0.4 ^{bx}	4.5±0.1 ^{by}
Zinc (g/dl)	65.3±2.9 ^{ax}	59.3±3.0 ^{ay}	55.5±1.0 ^{bx}	43.8±1.5 ^{by}	59.3±2.4 ^{bx}	46.9±1.8 ^{by}
Iron (g/dl)	322.2±6.3 ^{ax}	311.1±6.3 ^{ay}	294.2±5.1 ^{bx}	239.9±7.8 ^{by}	300.6±3.1 ^{bx}	242.3±4.7 ^{by}
Manganese (g/dl)	46.5±1.7 ^{ax}	40.7±0.3 ^{ay}	31.2±1.1 ^{bx}	25.4±2.4 ^{by}	32.5±2.4 ^{bx}	27.0±1.6 ^{by}

For details and abbreviations, see Table I.

Table III. (a) Ingredients of experimental ration (b) chemical composition of experimental ration.

(a) Ingredients (%)	Exp-ration	(b) Parameters (%)	Exp-ration
Maize grain	9	DM	90.32
Wheat bran	24	CP	18.06
Cotton seed cake	25	NDF	29.09
Rape seed cake	6	ADF	14.41
Corn gluten 30%	20	TDN	70
Molasses	14	ME (Mcal/kg DM)	2.41
DCP	1		
Salt	1		

2.5-5.2 g/dl (McGrane and Kenyon, 1984); 3-4.4 g/dl (Higgins and Cock, 1984); 3.3 g/dl (Omer *et al*., 2006); 4.5 g/dl (Osman and Al-Busadah, 2000). In addition to this, Sarwar *et al*. (1992) and Al-Busadah (2007) determined blood values in Saudi camels and reported creatinine as 0.16-0.5 mmol/L. In another study, Nagpal *et al*. (2012) determined serum profile of weaned Indian camel calves and reported total protein as 5.7±0.2, 5.1±0.2 gm/dl; albumin as 3.7±0.1, 3.7±0.1 gm/dl and urea as 20.0±1.1, 25.4±1.7 mg/dl in weaned calves at 6 and 9 months age, respectively. 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).

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

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

The mean values of calcium and phosphorus were found to be significantly different (P<0.05) among calf groups being higher in IMS than SIMS and EMS (Table I). All values were found to be higher in males as compared to females. 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 calves, 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) determined blood minerals in camel calves under different management systems and reported non-significant differences regarding calcium and phosphorus. Sarwar *et al*. (1992) and Al-Busadah (2007) determined blood values in Saudi camels and reported calcium as 7.6-13.1 mg/dl. Nagpal *et al*. (2012) determined serum profile of weaned Indian camel calves and reported calcium as 10.9±0.3, 11.1±0.5 mg/dl and phosphorus as 8.7±0.4, 7.0±0.6 mg/dl in weaned calves at 6 and 9 months age, respectively. 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).

The mean values of macro (Ca, Mg), and trace elements (Cu, Fe, Mn, Zn) of male and female camel calves in the different farming systems (Table II) were found to be significantly different (P<0.05) for calcium, magnesium, copper, iron and manganese between male and female calves, the values being be higher in males than females in all the systems. A significant difference is also observed between the 3 systems with globally higher values in intensive systems compared to the others.

Determination of mineral hair composition could be an indirect tool for assessing the general health status of the animal as it is an accumulative mineral nutrition witness. The observed differences reflect the better mineral nutrition in intensive systems compared to the others. No work has been reported on wool mineral analysis of camel calves in Pakistan yet. Faraz *et al*. (2019c) studied the growth performance and hair mineral status of Marecha camel calves in different management systems and reported higher weight gain and mineral concentrations in calves of intensive management system than semi-intensive management system. Bhakat *et al*. (2009) in India determined hair mineral status of camel calves reared under different management systems and reported higher concentrations of macro and micro minerals in calves of semi-intensive management system. They reported 549.6±74.5, 434.4±60.2 and 719.7±78.6, 476.0±128.0 mg/dL calcium, 88.9±2.4, 67.6±6.3 and 77.5±3.7, 69.8±3.2 mg/dL magnesium, 6.7±0.7, 4.3±0.4 and 7.4±0.7, 5.7±1.0 mg/dL copper, 66.0±4.4, 57.6±2.3 and 64.3±2.0, 54.8±1.5 mg/dL zinc, 285.7±26.6, 216.0±30.9 and 319.4±27.9, 261.9±33.4 mg/dL iron and 21.6±3.7, 20.6±1.0 and 45.8±1.8, 32.9±4.4 mg/dl manganese in calves reared

under semi-intensive and intensive management system with guar phalgati (*Cyamopsis tetragonoloba*) and moth chara (*Phaseolus aconitifolius*) feeding, respectively. Moreover, relationship between physical, chemical and industrial characteristics of different dromedary camel's hair types was studied by Helal (2015) who reported higher concentrations of B, Cd, Co, Cr, Fe, Mn, Ni and S in fine hairs of Magrabi camels while Mo, Pb and Zn were higher in coarse fibers. Furthermore, the similar studies done on horses (Or *et al*., 2004) and yaks (Chatterjee *et al*., 2005) revealed that level of some mineral elements were affected by nutritional differences in horses and yaks, respectively.

CONCLUSION

The study of blood constituents can provide valuable information about the general health status of the animal and could be used as an indirect measure. Observation of a deviation of certain blood parameters from their normal limits could be a guide for diagnosis of a disease condition. Constituents entering into body are accumulated in hairs also reflect the nutritional status of the animal. These levels could be used in the diagnosis of various diseases and metabolic disorders of the animal. In addition to the nutritional status of animal the mineral accumulation in the soil can be judged by these means very easily. This paper describes the hemoglobin, biochemical blood serum constituents and hair mineral status of young calves reared under different management systems in desert conditions and could be used as primary data base for future studies of this field.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the cooperation and kind support of the management of Camel Breeding and Research Station (CBRS) Rakh Mahni district Bhakkar, Punjab Pakistan. The financial support of Higher Education Commission (HEC) Islamabad, Pakistan, made this study possible.

Statement of conflict of interest

The author declares there is no conflict of interest.

REFERENCES

Abebe, W., Getinet, A.M. and Mekonnen, H.M., 2002. Study on live weight, carcass weight and dressing percentage of Issa camels in Ethiopia. *Rev. Med. Vet*., **153**: 713-716.

Al-Busadah, K.A. and Osman, T.E.A., 2000. Haematological parameters of adult dry, lactating and camel calves in Saudi Arabia. *Pak. J. biol. Sci*., **3**: 1749-1751. https://doi.org/10.3923/pjbs.2000.1749.1751

Al-Busadah, K.A., 2007. Some biochemical and haematological indices in different breeds of camels in Saudi Arabia. *Sci. J. King Faisal Univ., (Basic appl. Sci.)* **8**: 131-142.

AOAC, 1990. *Official methods of analysis of the association of official analytical chemists*, Washington, D.C. U.S.A.

Bakheit, S.A., Idris, A., Faye, B. and Abdelhadi, O., 2012. *The effect of management system on camel's milk yield and calve growth rate in North Kordofan, Sudan*. Conf. Int. Res. on Food Security, Natural Resource Management and Rural Development, Sept, 19-21, Tropentag, Gottingen, Germany.

Bhakat, C., Saini, N. and Pathak, K.M.L., 2008. Effect of management systems on the performance of dromedary camel calves reared under organized farm condition. *Indian J. Anim. Sci*., **78**: 1023-1027.

Bhakat, C., Saini, N. and Pathak, K.M.L., 2009. Growth characteristics, economics and hair mineral status of camel calves reared in different systems of management. *Indian J. Anim. Sci*., **79**: 932-935.

Brar, R.S., Sandhu, H.S. and Singh, A., 2000. *Veterinary clinical diagnosis by laboratory methods*. Kalyani Publishers. India.

Chatterjee, A., Raquib, M., Sheikh, I.U. and Bhattacharya, M., 2005. Elemental status in Yak hair. *Indian Vet. J*., **82**: 526-528. https://doi.org/10.1111/j.1751-0813.2004.tb11183.x

El-Khasmi, M., Riad, F., Safwate, A., Bengoumi, M., Hidane, K., Davicco, M.J., Coxam, V., Faye, B. and Barlet, J.P., 2000. Evolution compare de quelques paramètres minéraux, de l'ostéocalcine, du 25(OH) D et du 1,25(OH)2D chez la chamelle du Sud marocain et son chamelon nouveau-né. *Rev. Elev. Méd. Vét. Pays. Trop.,* **53**: 115–119. https://doi.org/10.19182/remvt.9732

Faraz A. and Waheed A., 2019c. *Growth performance and hair mineral status of Marecha camel*. A book published by Lambert Academic Publishing.

Faraz A., Younas, M., Waheed, A., Yaqoob, M. and Ishaq, K., 2019b. Growth performance and hair mineral status of Marecha (*Camelus dromedarius*) calves reared under different management systems. *Pakistan J. Zool*., **51**: 503-509. https://doi.org/10.17582/journal.pjz/2019.51.2.503.509

Faraz, A., Waheed, A., Mirza, R.H. and Ishaq, H.M., 2019a. Role of camel in food security: a perspective aspect. *J. Fisher. Livest. Prod*., **7**: 290.

Faye, B. and Bengoumi, M., 2018. *Camel clinical*

biochemistry and hematology. Cham: Springer, ISBN: https://doi.org/10.1007/978-3-319-95562-9

Farooq, U., Samad, H.A., Khurshid, A. and Sajjad, S., 2011. Normal reference hematological values of one-humped camels (*Camelus dromedarius*) kept in Cholistan desert. *J. Anim. Pl. Sci*., **21**: 157-160.

Hassan, Y.M., Hoeller, H. and Hassan, I.M., 1968. Observations on the blood constituents of camels in the Sudan. *Sudanese J. Vet. Sci. Anim. Husb*., **9**: 464-474.

Helal, A., 2015. Relationships among physical, chemical and industrial characteristics of different dromedary camel's hair types. *J. Am. Sci*., **11**: 67-75. https://doi.org/10.12816/0016622

Higgins, A.J. and Kock, R.A., 1984. A guide to the clinical examination, chemical restraint and medication of the camel. *Br. Vet. J*., **140**: 485-504. https://doi.org/10.1016/0007-1935(84)90045-9

Iqbal, A., Khan, B.B., Younas, M., Gill, R.A. and Jasra, I.A.W., 2001. Comparative growth performance of camel calves kept under farm/farmer's conditions. *Pak. J. agric. Sci*., **38**: 16-18.

Khan, B.B., Iqbal, A. and Riaz, M., 2003. *Production and management of camels*. Dept. Livestock Management, Univ. Agric. Faisalabad, Pakistan.

McGrane, J.J. and Kenyon, S.J., 1984. *Laboratory diagnosis manual for field veterinarians in Sudan*. Overseas Development Administration, London. UK.

Murphy, W.G., 2014. The sex difference in haemoglobin levels in adults – Mechanisms, causes, and consequences. *Blood Rev*., **28**: 41-47. https://doi.org/10.1016/j.blre.2013.12.003

Nagpal, A.K., Singh, G.P., Bissa, U.L. and Sharma, N., 2012. Voluntary feed intake, serum profile, growth performance and economics of weaned camel calves. *J. Camel Prac. Res*., **19**: 283-285.

Omer, S.A., Agab, H., Samad, G.H.A. and Turki, I.Y., 2008. Effect of feed type on some blood constituents of Sudanese growing camel (Camelus dromedarius) calves. *Sud. J. Vet. Sci. Anim. Husb*., **47**: 107-115.

Omer, S.A., Khougali, S.M.E., Agab, H. and Samad, G.H.A., 2006. Studies on some biochemical and haematological indices of Sudanese camels (Camelus dromedarius). *Sudanese J. Vet. Sci. Anim. Husb*., **45**: 8-14.

Or, M.E.K., Maden, A., Gulyasar, D., Tosun, R. and Dourka, C., 2004. Determination of trace elements (Fe, Cu and Zn) in serum and tail hair of healthy horses as a function of nutritional differences in certain months. *Nigerian Vet. J*., **25**: 9-13. https://doi.org/10.4314/nvj.v25i1.3459

Osman, T.E.A. and Al-Busadah, K.A., 2000. Effects of age and lactation on some biochemical constituents of camel blood in Saudi Arabia. *J. Camel Prac. Res*., **7**: 149-152.

Osman, T.E.A. and Al-Busadah, K.A., 2003. Normal concentrations of twenty serum biochemical parameters of she-camels, cows and ewes in Saudi Arabia. *Pak. J. biol. Sci*., **6**: 1253-1256. https://doi.org/10.3923/pjbs.2003.1253.1256

Rahim, S.M.A., Hasnain, S. and Farkhanda, J., 2011. Effect of calcium, magnesium, sodium and potassium on farm plantations of various agroecological zones of Punjab, Pakistan. *Afr. J. Pl. Sci*., **5**: 450-459. https://doi.org/10.5897/AJPS11.070

Saini, N., Kiradoo, B.D. and Bohra, D.L., 2014. Impact of feeding on growth performance, blood biochemical and mineral profiles of pre-pubescent camels under pastoral management in arid western Rajasthan. *Trop. Anim. Hlth. Prod*., **46**: 987-994. https://doi.org/10.1007/s11250-014-0589-2

Sarwar, A., Majeed, M.A., Hur, G. and Khan, I.R., 1992. Studies on the serum transferases and electrolytes of normal one-humped camel. *Pak. Vet. J*., **12**: 178-182.

Steel, R.G.D., Torrie, J.H. and Dicky, D.A., 1997. *Principles and procedures of statistics*. A biometric approach 3rd Ed. McGraw Hill Book Co., New York, USA.

Van Soest, P.J., Robertson, J.B. and Lewis, B.A., 1991. Method for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *J. Dairy Sci*., **74**: 3583-3597. https://doi.org/10.3168/jds.S0022-0302(91)78551-2