



Full Length Article

Effect of Pregnancy on Blood Biochemical Profile of Semi-Intensive Kept Marecha (*Camelus dromedarius*) Camel

Asim Faraz^{1*}, Abdul Waheed¹, Nasir Ali Tauqir², Riaz Hussain Mirza¹, Hafiz Muhammad Ishaq¹ and Muhammad Shahid Nabeel³

¹Department of Livestock and Poultry Production, Bahauddin Zakariya University Multan, Pakistan

²Department of Animal Science, University of Sargodha, Pakistan

³Camel Breeding and Research Station Rakh Mahni, Livestock & Dairy Development Department, Punjab, Pakistan

*For correspondence: drasimfaraz@bzu.edu.pk; drasimfaraz@gmail.com

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Abstract

This trial was performed at Camel Breeding and Research Station (CBRS) Rakh Mahni to study the effect of pregnancy on blood biochemicals in Marecha dromedary she-camels reared under semi-intensive system (SIS). About 30 she-camels were divided into two groups viz., 1st group (G1) of fifteen non-pregnant and 2nd group (G2) of fifteen pregnant she-camels. The animals were kept in semi-open pens throughout the trial and fed with concentrate, gram straw and available jungle grazing/browsing. Twice watering was done. The animals were dewormed and vaccinated regularly after 3 months according to farm routine management. Blood biochemical parameters were analyzed on hematology and biochemistry analyzer. The hemoglobin mean concentration ($P < 0.05$) was found to be 13.78 ± 0.52 and 12.83 ± 0.64 g/dL respectively for G1 and G2 being higher in non-pregnant animals. In energetic parameters, glucose and cholesterol mean concentrations ($P < 0.05$) were found to be 136.80 ± 8.88 , 58.60 ± 4.54 and 132.60 ± 6.68 , 54.28 ± 3.98 respectively, in G1 & G2 being higher in non-pregnant animals. Regarding protein parameters, mean concentrations ($P < 0.05$) of total protein, albumin and globulin were found to be 6.28 ± 1.12 , 2.86 ± 1.04 , 2.98 ± 1.06 and 7.16 ± 0.98 , 3.23 ± 1.68 , 3.47 ± 0.96 respectively, in G1 & G2 being higher in pregnant animals. Values of triglycerides, urea, creatinine, calcium and phosphorus were found to be non-significantly varied ($P > 0.05$) among groups. These parameters could be used as confirmation of pregnancy besides other confirmatory tests. The results are discussed with relation to previous studies and could be used as a primary database for future studies of this field. © 2021 Friends Science Publishers

Keywords: Camel; Blood; Biochemical; Physiological condition; Pastoral

Introduction

The camel seems extremely important addition to the food chain as it provides milk, meat and by-products of economic importance. It plays a key role in the social life and economy of the people of arid and semi-arid areas of the world (Faraz *et al.* 2019a). Generally, camels are of two types, i.e., one humped (*Camelus dromedarius*) or Arabian camel and two humped (*Camelus bactrianus*) or Bactrian camels. There are 35 million camels in the world while Pakistan ranks 8th in the world with 1.1 million camels (FAOSTAT 2019; GOP 2019–20). Dromedary camels are 95% of total camel population, whereas 70% of the dromedaries of Asia are present in India and Pakistan (Faraz *et al.* 2019b).

Study of blood biochemical indices act as biomarker of general health status, physiological condition and provide information about the sickness of animals (Al-Busadah

2004; Getnet *et al.* 2005). However, this biomarker is variable in different climatic, physiological and pathological conditions (Mohamed and Hussein 1999). Related measurable indices to body weight are very important for proper dosing of drugs and for assessing feed conversion performances (Abebe *et al.* 2002). The quantitative analysis of blood constituents can often assist the clinician by providing normal reference values for easy evaluation of the health and sickness of animals (Osman *et al.* 2015). The blood profile of camels in Pakistan is poorly documented and little is known about the normal ranges of the biochemistry blood references compared to the extensive studies conducted in other countries (Faraz *et al.* 2018).

More than 40% of Pakistan's camel population is present in Balochistan, 30% in Sindh, 22% in Punjab and 7% in Khyber Pakhtunkhwa province (ACO 2006). 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 in Pakistan and few attempts have been made so far to characterize its production potential and related parameters under natural conditions (Faraz *et al.* 2019c). There are twenty breeds of camel documented in Pakistan (Isani and Baloch 2000), among them Marecha is very famous breed of Punjab having good production capacity with aesthetic preference (Faraz *et al.* 2019b).

Mostly the research work on camel has been done under traditional management systems without consideration of production systems (Iqbal *et al.* 2001; Faraz *et al.* 2018). Research work done so far is mostly on moving herds, a lot of work have based on survey studies under traditional management systems. The previous studies not justify requirements of the subject so more concise studies during different basic and physiological conditions about Pakistani camel are needed. As a little is known, this study covers biochemical parameters in reference to pregnancy under semi-intensive system (SIS) in natural habitat (Thal desert). It will be a useful addition to build the country's data base for future studies in camel science.

Materials and Methods

Location of study area

The Camel Breeding and Research Station (CBRS), Rakh Mahni, Tehsil Mankera, District Bhakkar 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°C, 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 management

Thirty she-camels of Marecha breed reared under semi-intensive system (SIS) were divided into two groups; 1st group (G1) of fifteen non-pregnant and 2nd group (G2) of fifteen pregnant she-camels. All animals were carefully examined before the start of experiment. Only physically healthy camels were included in the trial. Animals were dewormed by injection 1% Ivermectin at 1mL/50 kg body weight after every 3 months. The animals were sprayed with Ecofleece solution at 1cc/liter water and shed with 2cc/liter of water. They were vaccinated for Trypanosomiasis by injection Trypanemium (Samorine) 1 g sachet for 4 adult camels after every three months as per farm routines.

All animals fed same quantity of ration and provided same experimental conditions. The animals were fed concentrate at 2–3 kg per day. The animals were sent for

jungle grazing/browsing for 3–4 h daily. They were fed gram straw (*Cicer arietinum*) *adlib* as manger feeding in rest of time. Water was provided twice a day. Salt lumps were placed in mangers while 100 g DCP powder was fed per she-camel daily. The ingredients and chemical composition of concentrate is mentioned in Table 1 and the proximate analysis of gram straw and different grazing/browsing species in study area is shown in Table 2.

Blood sampling and lab analysis

Blood samples were collected from all animals by jugular puncture in two sets with and without EDTA for serum separation. The blood samples were studied for hemoglobin and biochemical analyses. Hemoglobin (Hb) in blood sample was analyzed by using standard kits (Spin-react, Spain) in hematology analyzer (BC 2300, Mindray Germany). Cholesterol, triglyceride, urea, creatinine, total protein and albumin in serum samples were estimated by using standard kits in 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.

About 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). Calcium and phosphorus concentrations were determined by using atomic absorption spectrophotometer (Method 965. 09A; AOAC 1990) at High Tech Lab, University of Agriculture Faisalabad, Pakistan.

The forage species available for grazing/browsing were *Acacia nilotica*, *A. modesta*, *Ziziphus mauritiana*, *Albizia labbek*, *Prosopis cineraria*, *Tamarix aphylla*, *Cenchrus ciliaris*, *Suaeda fruticosa*, *Cymbopogon schoenanthus*, *Kochia indica*, *Tribulus terrestris*, *Capparis spinosa*, *C. decidua*, *Haloxylon salicornicum*, *H. recurvum* and *Calligonum polygonoides*. The *Cicer arietinum* and forage species available for grazing/browsing were analyzed for percent dry matter, crude protein, crude fiber, ether extract and ash (AOAC 1990). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) was also determined (Soest *et al.* 1991).

Statistical analysis

Microsoft Excel (Microsoft Office 2010) was used for data compilation which was presented to analysis of variance for statistical analysis by 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).

Table 1: Ingredients and chemical composition of experimental ration

Ingredients composition	Percentage
Maize grain	9
Wheat bran	24
Cotton seed cake	25
Rape seed cake	6
Corn gluten 30%	20
Molasses	14
DCP	1
Salt	1
Chemical composition	
Dry matter	90.32
Crude protein	18.06
NDF	29.09
ADF	14.41
TDN	70
ME (Mcal/kg DM)	2.41

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

Feed/Forage Species	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>A. 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
Khar Laana (<i>H. 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; (Faraz 2020)

Results

The mean values of hemoglobin ($P < 0.05$) were found to be 13.78 ± 0.52 and 12.83 ± 0.64 g/dL for G1, G2 respectively. The mean values of glucose and cholesterol were found to be significantly different ($P < 0.05$) among groups, being higher in non-pregnant she-camels while the levels of triglycerides were found to be varied ($P > 0.05$) among groups. The mean values of total protein, albumin and globulin were found to be significantly different ($P < 0.05$) among groups being higher in pregnant she-camels while the levels of urea and creatinine were found to vary ($P > 0.05$) among groups. The mean values of calcium and phosphorus were found to be non-significantly different ($P > 0.05$) among groups being higher in non-pregnant she-camels (Table 3).

Discussion

Mean values of Hb in the present study are close to that reported in literature (Mutugi *et al.* 1993; Farooq *et al.*

2011; Abdalmula *et al.* 2018 a, b; Elitok and Cirak 2018; Faye and Bengoumi 2018; Abdalmula *et al.* 2019). However, Hb was higher than observed by several authors (Iqbal *et al.* 1992; Amin *et al.* 2007; Zaher *et al.* 2017; Adah *et al.* 2017; Ghafoor *et al.* 2018; Ebissy *et al.* 2019; Islam *et al.* 2019) while lower than those reported by Abdalla *et al.* (1988), Snow *et al.* (1988), Al-Busadah and Osman (2000).

Current values are not in agreement with the findings of Rezakhani *et al.* (1997), Alhadrami (1997), Al-Busadah and Osman (2000) and Saeed and Hussein (2008) who observed non-significant differences in values of pregnant and non-pregnant she-camels. 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 (Omer *et al.* 2006).

However, Hb was found at greater level in single humped camel of India (Narnaware *et al.* 2016). In Pakistan, Farooq *et al.* (2011) studied the normal reference

Table 3: Mean biochemical profile of Marecha camel at SIS, CBRS Rakh Mahni Bhakkar, Punjab

Parameters	Non-Pregnant (15)	Pregnant (15)	Overall Mean
Hemoglobin (g/dL)	13.78 ± 0.52 ^a	12.83 ± 0.64 ^b	13.51 ± 0.48
Glucose (mg/dl)	136.80 ± 8.88 ^a	132.60 ± 6.68 ^b	134.70 ± 7.76
Cholesterol (mg/dL)	58.60 ± 4.54 ^a	54.28 ± 3.98 ^b	56.44 ± 4.18
Triglycerides (mg/dL)	36.35 ± 4.93	36.10 ± 5.0	36.22 ± 4.8
Total Protein (g/dL)	6.28 ± 1.12 ^a	7.16 ± 0.98 ^b	6.77 ± 1.03
Albumin (g/dL)	2.86 ± 1.04 ^a	3.23 ± 1.68 ^b	3.06 ± 1.35
Globulin (g/dL)	2.98 ± 1.06 ^a	3.47 ± 0.96 ^b	3.22 ± 1.05
Urea (mg/dL)	46.10 ± 4.64	47.33 ± 3.90	46.71 ± 4.28
Creatinine (mg/dL)	1.42 ± 0.07	1.44 ± 0.08	1.43 ± 0.06
Calcium (mg/dL)	9.06 ± 1.28	8.98 ± 1.17	9.01 ± 1.22
Phosphorus (mg/dL)	4.10 ± 0.7	3.95 ± 0.5	4.02 ± 0.7

"SIS: Semi-intensive system; CBRS: Camel Breeding and Research Station"

hematological concentration of one-humped camels in Cholistan desert and reported mean concentration and range for hemoglobin as 12.00 ± 0.63 , 11.34 ± 0.95 ; 7–17, 8–17 g/dL in male and females, respectively. Amin *et al.* (2007) studied seasonal variation in blood constituents of Sudanese dromedary camel and reported hemoglobin concentration as 10.67 ± 0.19 , 10.73 ± 0.18 g/dL respectively, in dry and green season.

Reported hemoglobin concentration was 14.80 ± 1.15 g/dL in male dromedary camels (Al-Harbi 2012). Hemoglobin concentration was found to be 14.06 ± 0.24 g/dL in female dromedary camels (Zaher *et al.* 2017). Adah *et al.* (2017) studied hematological profile of the one-humped camel subjected to packing in the harmattan season in the semi-arid region of Nigeria and reported hemoglobin as 7.33 ± 0.35 g% in control group. Reported hemoglobin concentration of dromedary camels in Bangladesh was 10.4 g/dL (Islam *et al.* 2019). The reported concentration of hemoglobin varied in majority of the references between 9.3 and 15.5 g/dL (Faye and Bengoumi 2018).

Ghafoor *et al.* (2018) studied prevalence of hemoparasites of camels (*Camelus dromedarius*) in Thal desert Pakistan in winter and reported average negative concentration of hemoglobin as 11.78 ± 0.57 g/dL. Elitok and Cirak (2018) reviewed blood biochemical features of camels and reported hemoglobin concentration as 12.43 ± 0.19 , 12.43 ± 0.18 g/dL respectively, in pregnant and non-pregnant she-camels. Abdalmula *et al.* (2018a) checked blood profile of normal Libyan dromedary camel and reported hemoglobin concentration and range as 12.55 ± 0.27 and 7.28–17.70 g/dL, respectively.

Abdalmula *et al.* (2018b) investigated the effect of breed variation on blood profile of Libyan dromedary camel and reported the hemoglobin concentration as 11.06 ± 0.59 , 13.44 ± 0.27 and 10.95 ± 0.59 g/dL in Sirtaweya, Fakhreya and Mahari camels respectively. Abdalmula *et al.* (2019) studied effect of sex on blood profile of normal Libyan dromedary camel and reported hemoglobin concentration as 11 ± 0.41 and 13.44 ± 0.27 g/dL respectively, in males and females. Ebissy *et al.* (2019) studied hematological profile of female dromedary camel during transition period and reported hemoglobin concentration as 10.62 ± 0.55 g/dL.

Sugar and cholesterol were also found higher but in

normal range in non-pregnant she-camels. Glucose level in camels was found to be higher than other ruminants and this could be the reason of reported higher lactic acid contents in the blood of camels (Osman and Al-Busadah 2003). 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. Amin *et al.* (2007) reported glucose (mmol/L) and triglycerides (mg/dL) mean concentration as 3.31 ± 0.13 , 34.24 ± 1.55 and 4.81 ± 0.13 , 26.71 ± 1.51 respectively, in dry and green season in blood of Sudanese dromedary camel. Kelanemer *et al.* (2015) reported glucose (g/L), cholesterol and triglycerides (mg/L) mean concentration as 0.91 ± 0.02 , 229.93 ± 1.31 and 399.09 ± 1.87 in pregnant Algerian dromedary she-camel.

Mean glucose concentration was found to be 88.68 ± 1.66 mg/dL in female dromedary camels (Zaher *et al.* 2017). Abdalmula *et al.* (2018a) reported mean concentrations and range of glucose (g/dL), cholesterol and triglycerides (mg/dL) as 111.8 ± 5.36 , 26.14–240.9; 36.39 ± 1.72 , 5.72–77.60 and 31.60 ± 1.81 , 8.14–82.22, respectively in Libyan dromedary camel. Reported normal plasma glucose concentration varied between 60–140 mg/dL (Faye and Bengoumi 2018). Abdalmula *et al.* (2018b) investigated the effect of breed variation on blood profile of Libyan dromedary camel and reported the glucose, cholesterol and triglycerides concentration as 138.1 ± 4.15 , 43.84 ± 3.64 , 36.70 ± 2.62 ; 125.5 ± 5.21 , 37.29 ± 2.15 , 32.86 ± 2.60 and 45.28 ± 3.08 , 27.16 ± 3.06 , 23.25 ± 1.55 mg/dL in Sirtaweya, Fakhreya and Mahari camels respectively.

Elitok and Cirak (2018) reviewed blood biochemical features of camels and reported glucose concentration as 100.55 ± 1.03 and 96.58 ± 1.53 mg/dL in non-pregnant and pregnant she-camels. Reported glucose mean concentration was to be 228.0 ± 5.21 mg/dL during transition period in Egyptian female dromedary camel (Ebissy *et al.* 2019).

Reported glucose concentration of dromedary camels in Bangladesh was 114.9 mg/dL (Islam *et al.* 2019). Mohamed *et al.* (2019) reported glucose mean concentration as 176 ± 10.7 mg/dL in Egyptian dromedary lactating camels.

The variation in the blood biochemical levels reported in literature data could be attributed to the availability of food and water and the remarkable adaptive mechanisms of camels to thirst and lack of food. The glucose level in camel blood increases from 20–80% after 10 days of water deprivation. This hyperglycemia is accompanied with no glucosuria to reduce moisture loss and with decreased insulin level that inhibits lipolysis and lower the basic metabolism to decrease the glucose use (Ouajd and Kamel 2009; Aichouni *et al.* 2013). The plasma concentration of glucose in camels decreased with the reduction in the available food during dry season (Aichouni *et al.* 2013) and feeding of camels after fasting was reported to increase the plasma glucose level (Amin *et al.* 2007). The lipid concentration in liver decreased by 13–25% after dehydration and the concentration of cholesterol and triglycerides increases after 14 days of water deprivation (Ouajd and Kamel 2009; Aichouni *et al.* 2013). Moreover, the poor dietary condition during the dry season was related to the observed higher concentration of serum triglycerides in camels (Amin *et al.* 2007; Aichouni *et al.* 2013). In addition, lipid profile, like human, is influenced by age where it is higher in older animals and in advanced age (Nazifi *et al.* 2000).

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).

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 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. Amin *et al.* (2007) reported mean concentrations of total protein, albumin, globulin (g/dL), urea, creatinine (mg/dL) as 8.43 ± 0.08 , 3.17 ± 0.05 , 5.83 ± 0.39 , 5.66 ± 0.30 , 74.26 ± 4.42 and 7.08 ± 0.08 , 3.09 ± 0.05 , 4.0 ± 0.38 , 9.18 ± 0.29 , 136.14 ± 3.54 respectively, in dry and green season in blood of Sudanese dromedary camel.

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. Kelanemer *et al.* (2015) reported total protein (g/L) and urea (mg/L) mean concentration as 57.84 ± 0.46 and 372.65 ± 1.83 in pregnant Algerian dromedary she-camel. Reported protein concentration as 73.00 ± 2.20 g/L

in Nigerian dromedary camel (Adah *et al.* 2017). Reported mean concentrations of total protein, albumin and creatinine were found to be 6.27 ± 0.13 , 3.82 ± 0.14 g/dL and 1.12 ± 0.05 mg/dL in female dromedary camels (Zaher *et al.* 2017). 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).

Elitok and Cirak (2018) reviewed blood biochemical features of camels and reported total protein, albumin, globulin (g/dL), blood urea nitrogen, creatinine (mg/dL) concentrations as 5.95 ± 0.08 , 2.49 ± 0.02 , 3.51 ± 0.06 , 7.85 ± 1.45 , 1.20 ± 0.06 and 6.43 ± 0.04 , 2.70 ± 0.05 , 3.74 ± 0.04 , 15.48 ± 1.45 , 1.42 ± 0.04 respectively, in non-pregnant and pregnant she-camels. Abdelmula *et al.* (2018a) reported mean concentrations and range of total protein, albumin, globulin (g/L) and urea, creatinine (mg/dL) as 50.98 ± 0.91 , 31.09–67.82; 30.58 ± 0.63 , 17.51–39.52; 20.40 ± 0.83 , 4.42–46.05 and 43.31 ± 1.39 , 17.00–69.00; 1.50 ± 0.02 , 1.00–2.10 respectively, in Libyan dromedary camel. Abdalmula *et al.* (2018b) investigated the effect of breed variation on blood profile of Libyan dromedary camel and reported the total protein, albumin, globulin (g/L), urea, creatinine (mg/dL) concentration as 55.16 ± 1.45 , 36.64 ± 0.60 , 18.52 ± 1.30 , 37.39 ± 2.72 , 1.58 ± 0.05 ; 48.87 ± 1.09 , 30.45 ± 0.61 , 18.42 ± 0.74 , 47.29 ± 1.61 , 1.48 ± 0.03 and 54.27 ± 2.24 , 25.86 ± 1.45 , 28.41 ± 2.30 , 35.47 ± 2.80 , 1.46 ± 0.06 in Sirtaweya, Fakhreya and Mahari camels respectively.

Reported concentrations of total protein, albumin (g/dL) and urea (mg/dL) in dromedary camels of Bangladesh were to be 8.2, 4.4 and 25.04 (Islam *et al.* 2019). Mohamed *et al.* (2019) reported mean concentrations of total protein, albumin, globulin (g/L) and creatinine (mg/dL) as 5.8 ± 0.08 , 2.4 ± 0.06 , 3.47 ± 0.19 and 0.88 ± 0.07 in Egyptian dromedary lactating camels. Reported total protein, albumin, globulin (g/L), blood urea nitrogen (mmol/L), creatinine (mg/dL) mean concentrations were to be 5.92 ± 0.17 , 2.65 ± 0.19 , 29.53 ± 2.10 , 17.09 ± 0.46 , 1.05 ± 0.11 during transition period in Egyptian female dromedary camel (Ebissy *et al.* 2019).

Camels are well adapted to lower nitrogen diets by limiting the urinary excretion of urea and increase the nitrogen recycling in case of low proteins in diet and/or dehydration (Gihad *et al.* 1989). Camels have higher level of blood urea nitrogen when compared to other livestock species due to the ability of camels to utilize urinary nitrogen at times of poor grazing or water deprivation (Al-Busadah 2007; Aichouni *et al.* 2010; Patodkar *et al.* 2010) and the urea is efficiently utilized for microbial protein synthesis (Abdalla *et al.* 1988; Haroun 1994). The total protein values were higher in summer season compared to the other seasons in camels (El-Hairi *et al.* 2010). This increase was attributed to the stimulation of growth releasing hormone that cause elevation in the plasma proteins which are important to maintain plasma water (Horowitz and Adler 1983). The dehydrated camels also

showed decrease in creatinine clearance and elevated level of albumin that maintain higher colloid osmotic pressure needed for storing water in blood (Al-Busadah 2007; Amin et al. 2007; Ouajd and Kamel 2009; Aichouni et al. 2013).

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. Calcium metabolism under hormonal regulation of thyroid and parathyroid is more active in non-pregnant as the physiological condition like pregnancy imparts the stress in female (El-Khasmi et al. 2000). Sarwar et al. (1992) and Al-Busadah (2007) determined blood values in Saudi camels and reported calcium as 7.6–13.1 mg/dL.

Reported mean concentrations of calcium and phosphorus (mmol/L) as 1.94 ± 0.03 , 2.03 ± 0.02 and 2.35 ± 0.03 , 2.20 ± 0.02 respectively, in dry and green season in blood of Sudanese dromedary camel. There is an $\uparrow$ in Ph and Ca values in the serum of dromedary camels in the wet season due to the availability of plants rich in minerals (Amin et al. 2007). Other authors recorded an $\uparrow$ in Na, Ca but $\downarrow$ in K and Ph in the summer season compared to the other seasons (El-Hairry et al. 2010). Kelanemer et al. (2015) reported calcium and phosphorus (mg/L) mean concentration as 73.68 ± 1.89 and 62.70 ± 0.97 in pregnant Algerian dromedary she-camel. Reported mean concentrations of calcium and phosphorus were found to be 10.65 ± 0.18 and 5.41 ± 0.17 mg/dL in female dromedary camels (Zaher et al. 2017). Abdelmula et al. (2018a) reported mean concentrations and range of calcium and phosphorus (mg/dL) as 9.87 ± 0.08 , 7.65–12.81 and 5.20 ± 0.24 , 1.75–8.89 respectively, in Libyan dromedary camel. 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).

Abdalmula et al. (2018b) investigated the effect of breed variation on blood profile of Libyan dromedary camel and reported the calcium and phosphorus concentration (mg/dL) as 10.08 ± 0.30 , 7.97 ± 0.22 ; 10.05 ± 0.08 , 4.42 ± 0.26 and 9.12 ± 0.13 , 5.36 ± 0.28 respectively, in Sirtaweya, Fakhreya and Mahari camels. Elitok and Cirak (2018) reviewed blood biochemical features of camels and reported calcium and phosphorus mean concentration as 9.0 ± 0.1 and 3.8 ± 0.5 mg/dL in dromedary she-camel. Reported calcium and phosphorus (mmol/L) mean concentration was to be 2.22 ± 0.08 , 1.70 ± 0.11 during transition period in Egyptian female dromedary camel (Ebissy et al. 2019). Mohamed et al. (2019) reported mean concentrations of calcium and phosphorus (mmol/L) as 2.23 ± 0.03 and 1.62 ± 0.075 mmol/L in Egyptian dromedary lactating camels.

Conclusion

Hemoglobin, glucose, cholesterol, calcium and phosphorus concentrations were comparatively higher in pregnant animals. Moreover, total protein, albumin and globulin concentrations were also higher in pregnant animals

nevertheless triglycerides, urea, creatinine, calcium and phosphorus were analogous among pregnant and non-pregnant groups. These measures could be used to check the state of pregnancy along with other confirmatory tests. The values observed were within the physiological range reported in previous studies besides the variations observed could be attributed to many unexplored factors. The effects of breed, age and stage of lactation on haematological and biochemical parameters should be investigated in supplementary studies.

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Author Contributions

Asim Faraz conducted research and wrote the paper, Muhammad Shahid Nabeel helped in conduct of Research, Abdul Waheed and Riaz Hussain Mirza helped in the analysis, Nazir Ali Tauqir and Hafiz Muhammad Ishaq helped in writeup.

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