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HEMATOLOGICAL PROFILE OF MARECHA CAMEL (*CAMELUS DROMEDARIUS*) REARED UNDER SEMI-INTENSIVE MANAGEMENT SYSTEM

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ABSTRACT

The present study was conducted to study the hematological indices of Marecha dromedary camel at Camel Breeding and Research Station (CBRS) Rakh Mahni in semi-intensive management system (SIMS). About 40 animals were used in two groups viz: 1st group (G1) of twenty calves (10 ♂ and 10 ♀) and 2nd group (G2) of twenty adult animals (5 ♂ and 15 ♀). The animals were kept in semi-open pens throughout the trial and fed with concentrate, gram straw and available jungle grazing/browsing. Twice a day watering was provided. The animals were dewormed and vaccinated regularly after 3 months according to farm routine practices. Hemoglobin (Hb), red blood cells (RBC) counts, white blood cells (WBC) counts, granulocyte, lymphocytes, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were determined. The Hb concentrations were found to be 14.15±0.12, 13.94±0.12 and 14.84±0.18, 14.07±0.10 g/dl for males and females of G1 and G2 respectively. The values of all parameters differed significantly among groups. There was sexual dimorphism for hematological values in all the parameters being higher in males. It was concluded that the achieved results could be used as a primary data baseline for future studies of this field.

Keywords: camel, blood, desert, pastoral, sex, physiological condition

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INTRODUCTION

The dromedaries are capable of thriving, producing and reproducing under hostile environment compared to other domestic species living in same environment (Mohammed, 2000, Faraz *et al*., 2022*a*). They are very cheaper source of transportation comparative to motorized sources for nomads (Faraz *et al*., 2019*a*) and could survive in harsh environments lethal to other animals (Faraz *et al*., 2019*b*; Faraz *et al*., 2022). Camels can travel 5-9 days with little / no feed by losing quarters of bodyweights without impairing the normal routine functioning of body (Ouajd and Kamel, 2009; Faraz *et al*., 2019*c*).

Knowing about physiological condition is very imperative for effective management of animals (AL-Haidary, 2006) and camel has unique physiological mechanisms which enable him accomplishing great feats of endurance in extreme environments (Faraz, 2020*a*). This adaptation is due to the principal role of its blood having increased number of leucocytes (neutrophils 50%) than other animals where lymphocytes present dominantly (Ouajd and Kamel, 2009).

There are small, ovoid and thin erythrocytes which present high transferring surface and continue circulation even in the situation of increased blood-viscosity. On animal hydration, they have capacity to change enough volume (Mohammed and Hussein, 1999). Hemoglobin (Hb) values vary in the range of 12.5 to 16 g/dl, which is higher compared to other domestic species and has greater affinity for binding of oxygen (Bogin, 2000). According to Ayo *et al*. (2008) there are many factors playing important role in defining the blood homeostasis of animals including electrolyte concentration, pH, ambient temperature and relative humidity (Peshin *et al*., 2010).

Hematological parameters are indicator of general health status which provides ample information about the health of animals (Faye and Bengoumi, 2018). Camel hematology as influenced by age, season, health status, stage of lactation is investigated by different researchers in Saudi-Arabia (Al-Busadah and Osman,

2000i), Sudan (Babeker *et al*., 2013i) and Iran (Jalali *et al*., 2018i). However to best of our knowledge, information on hematology of Pakistani camel is available still scarce in literature. In Pakistan, mostly the research work on camel was survey reports under traditional management systems (Faraz *et al*., 2018). Hence, this present study was undertaken to investigate some hematological indices of Pakistani Marecha dromedary camel reared under SIMS in Thal Desert. This could be useful to build the country database for further studies of this field.

MATERIALS AND METHODS

Location and Meteorological Conditions: The CBRS is located in the deserted plain of Thal Desert. There is subtropical, continental, arid and semi-arid climate having summer mean temperature as 45.6 º C and in winter as 5.5-1.3 º C. Annual mean rainfall is 150-350 mm increase from South to North (Rahim *et al*., 2011).

Experimental Animals: Forty animals of Marecha breed reared in SIMS were used in two groups; 1st group (G1) of twenty calves (10 ♂ and 10 ♀) and 2nd group (G2) of twenty adult animals (5 ♂ and 15 ♀). The study was conducted in summer season and the duration was four months. The calves were of age about 10-12 months and were weaned. The adult camels were of age between 5-7 years and males were in non-breeding season while females were non-pregnant. Camels were examined carefully in beginning of experiment and only healthy camels were included in the trial. Animals were dewormed by subcutaneous injection 1% Ivermectin @ 1ml/50 kg body weight after every 3 months. The animals were sprayed with insecticide Ecofleece solution @ 1cc/liter water for external deworming and shed with 2cc/liter of water for disinfection. They were treated for trypanosomosis by intramuscular injection Trypamedium (Samorine) 1 g sachet for 4 camels after every three months as per farm routines.

All animals were fed same quantity of ration and provided same experimental conditions. The animals were fed concentrate @ 2-3 kg per day for adult and 1 kg for calves. The camels were sent for range browsing for 3-4 hri daily. They were fed gram straw (*Cicer arientinum*) *adlib* as manger feeding the rest of time. Water was provided twice a day. Salt lumps were placed in mangers while 100 g Dicalcium Phosphate (DCP) powder was fed per she-camel daily. The ingredients and chemical composition of concentrate feed is mentioned in Table 1 and the proximate-analysis of gram straw and differenti browsing species in study area is shown in Table 3.

Table 1. (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		

Adapted from (Faraz *et al*., 2022*b*)

Table 3. 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
Khar Laana (*Haloxylon recurvum*)	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 Adapted from (Faraz, 2020*b*)

Sampling and Lab Analysis: Blood films from all animals were studied. Camels were properly restrained before collection of blood sample. Blood samples were attained from jugular puncture in test tubes; EDTA was used as anti-coagulant and immediately analyzed. Hematological parameters were analyzed on hematology analyzer (BC 2300, Mindray Germany). Samplings were done weekly for the period of one month and all tests were performed in duplicate. Hb, RBC, WBC, Granulocytes, Lymphocytes, Mid, PCV, MCV, MCH and MCHC were determined. The gram straw and forage speciesi were analyzedi for % DM (dry-matter), CP (crude-protein), CF (crude-fiber), EE (ether-extract) and total-ash (AOAC, 1997). NDF (neutral-detergent-fiber) and ADF (acid-detergent-fiber) was determined by method of Van Soest *et al*. (1991).

Data collected was statistically analyzed by unbalanced 2x2 Factorial design two-way ANOVA, with two factors i.e. gender and age using GLM of Statistix software. Differences among the treatment means were compared by using LSD test at 0.05 level of significance (Gecer *et al*., 2016).

RESULTS AND DISCUSSION

Hemoglobin: The averages of Hb were found to be 14.15±0.12, 13.94±0.12 and 14.84±0.18, 14.07±0.10 g/dl for male and females in G1, G2 respectively under SIMS (Table 2). Hb was found greater in males as compared to females probably due to increased level of erythropoiesis which is accelerated by erythropoietin in response to the testosterone effects on kidneys (Murphy, 2014). Hb concentrations varied between 13 to 15 g/dl, a bit higher compared to other domestic species.

Table 2. Mean hematological profile of Marecha camel at CBRS Rakh Mahni Bhakkar, Punjab.

Parameters	Calves		Adult	
	Male (10)	Female (10)	Male (05)	Female (15)
Hemoglobin (g/dl)	14.15±0.12 ^{bx}	13.94±0.12 ^{by}	14.84±0.18 ^{ax}	14.07±0.10 ^{by}
RBC (10^6/µl)	9.10±0.09 ^{ax}	9.03±0.09 ^{by}	9.54±0.14 ^{cx}	10.41±0.08 ^{cy}
WBC (10^3/µl)	22.74±0.15 ^{ax}	23.94±0.15 ^{ay}	29.28±0.21 ^{bx}	29.34±0.12 ^{cy}
Granulocytes (%)	54.36±0.14 ^{bx}	52.84±0.14 ^{dy}	56.30±0.19 ^{ax}	53.77±0.11 ^{cy}
Lymphocytes (%)	36.83±0.08 ^{ax}	34.82±0.08 ^{by}	32.22±0.11 ^{cx}	31.54±0.06 ^{dy}
PCV (%)	28.85±0.06 ^{ax}	26.84±0.06 ^{by}	38.34±0.08 ^{cx}	35.20±0.05 ^{dy}
MCV (fl)	36.91±0.12 ^{ax}	36.86±0.12 ^{ay}	38.46±0.17 ^{bx}	38.12±0.09 ^{by}
MCH (pg)	16.82±0.07 ^{ax}	15.92±0.07 ^{ay}	20.54±0.09 ^{bx}	20.48±0.58 ^{cy}
MCHC (g/dl)	45.57±0.08 ^{ax}	43.93±0.08 ^{by}	54.36±0.11 ^{cx}	53.83±0.06 ^{dy}

Means having different superscript in columns are significantly different (P<0.05); CBRS: Camel Breeding and Research Station; *Number of Animals in Parentheses; RBC: Erythrocyte Count; WBC: White Blood Cell Count; PCV: Packed Cell Volume; MCV: Mean Corpuscular Volume; MCH: Mean Corpuscular Hemoglobin; MCHC: Mean Corpuscular Hemoglobin Concentration.

Mean average values of Hb in the present study were close to those reported by Sarwar and Majeed (1997), Singh *et al*. (1997), Farooq *et al*. (2011), Elitok and Cirak (2018), Abdalmula *et al*. (2018 *a,b*), Faye and Bengoumi, 2018 and Abdalmula *et al*. (2019). However, the present values are lower than those determined by Abdalla *et al*. (1988) and Snow *et al*. (1988). However Hb was found higher than observed by Nyang'aoi *et al*. (1997), Amin *et al*. (2007), Zaher *et al*. (2017), Adah *et al*. (2017), Ghafoor *et al*. (2018), Ebissy *et al*. (2019) and Islam *et al*. (2019).

The averages of bulls were similar to that reported by Mutugi *et al*. (1993); however, Gupta *et al*. (1979) and Iqbal *et al*. (1992) investigated lower values than the present study. Al-Busadah and Osman (2000) reported Hb values in Saudi camels and described mean values for Hb as 13.33±0.62, 124±0.22 and 10.13±0.82 g/dl in the dry-adult, lactating and calves, respectively. Reported range values for Hb (g/dl) was 8.9-15 by Hassan *et al*. (1968), 7.8-15.9 by McGrane and Kenyon (1984), 11.4-14.2 by Higgins and Cock (1984) and 11.5 by Omer *et al*. (2006). Omer *et al*. (2008) found higher (P<0.05) Hb values in Sudanese dromedary suckling calves as 11.43±1.22 compared to lactating dams as 10.70±0.63 g/dl. However, Hb was found higher in dromedary camels of India as reported by Narnaware *et al*. (2016). Likewise, Hb was also found at greater level in suckling camel calves (Omer *et al*., 2006). Amin *et al*. (2007) investigated seasonal variations in the blood constituents of Sudanese dromedary camel and reported Hb concentration as 10.67±0.19, 10.73±0.18 g/dl respectively, in dry and green season.

Significantly higher Hb concentrations in suckling calves as 11.43±1.21 compared to lactating dams as 10.70±0.63 g/dl reported by Omer *et al*. (2008). In Pakistan, Farooq *et al*. (2011) determined mean

concentration and range for Hb as 12.00±0.63, 11.34±0.95; 7-17, 8-17 g/dl in dromedary males and females in Desert Cholistan, respectively.

In earlier study, average Hb concentration was determined to be 14.80±1.15 g/dl in male dromedary camels (Al-Harbi, 2012). Hb concentration was found to be 14.06±0.24 in female dromedary camels (Zaher *et al*., 2017). Adah *et al*. (2017) studied hematological indices of Nigerian dromedary camel and reported Hb as 7.33±0.35 g% in control group. Reported Hb concentration of dromedary camels in Bangladesh was 10.4 g/dl (Islam *et al*., 2019). The reported concentration of Hb was found to be varied in many references ranged between 9.3-15.5 g/dl (Faye and Bengoumi, 2018). Ghafoor *et al*. (2018) investigated hemoparasites prevalence in dromedary camel in Desert Thal and reported average negative concentration of Hb as 11.78±0.57 g/dl.

Elitok and Cirak (2018) evaluated hematological and biochemical features of camel and reported Hb concentration as 12.43±0.19, 12.43±0.18 g/dl in pregnant and non-pregnant she-camels while 14.20±1.55 and 14.80±1.15 g/dl in males of rut and non-rut season, respectively. Abdalmula *et al*. (2018*a*) determined blood profile of normal Libyan dromedary camel and reported average Hb concentration and range as 12.55±0.27 and 7.28-17.70 g/dl, respectively.

Earlier Hb concentration was found to be 11.06±0.59, 13.44±0.27 and 10.96±0.58 g/dl respectively, in Sirtaweya, Fakhreya and Mahari Libyan dromedary camels (Abdalmula *et al*., 2018*b*). Abdalmula *et al*. (2019) studied effect of sex on blood profile of normal Libyan dromedary camel and reported average Hb concentration as 11±0.41 and 13.44±0.27 g/dl respectively, in males and females. Average hemoglobin concentration was reported as 10.62±0.55 g/dl in female dromedary camel (Ebissy *et al*., 2019).

RBC & WBC: The averages of RBC, WBC, granulocytes and lymphocytes were found to be as (9.10±0.09, 9.03±0.09, 9.54±0.14, 10.41±0.08 10^6/µl); (22.74±0.15, 23.94±0.15, 29.28±0.21, 29.34±0.12 10^3/µl); (54.36±0.14, 52.84±0.14, 56.30±0.19, 53.77±0.11 %); (36.83±0.08, 34.82±0.08, 32.22±0.11, 31.54±0.06 %), respectively in males and females among groups G1, G2 being slightly higher in males than females and adults than calves under SIMS (Table 2).

The averages of RBC count for males and females are in agreement with those reported concentrations by Al Ani *et al*. (1992), Iqbal *et al*. (1992), Mutugi *et al*. (1993), Al-Busadah and Osman (2000), Al-Harbi (2012), Adah *et al*. (2017), Zaher *et al*. (2017), Abdalmula *et al*. (2018 *a,b*), Elitok and Cirak (2018), Abdalmula *et al*. (2019), Ebissy *et al*. (2019) and Islam *et al*. (2019). While values observed for RBC in the present study were found higher than the values found by Gupta *et al*. (1979), Abdelgadir *et al*. (1984), Iqbal *et al*. (1992), Amin *et al*. (2007), Farooq *et al*. (2011) and Ghafoor *et al*. (2018). The fluctuations in values may be attributable to different geographical, climatic and genetic variations (Saeed and Hussein, 2008).

Non-significant differences observed in both sexes were in agreement with those reported by Saeed and Hussein, (2008). Ghodsian *et al*. (1978) postulated that RBC values are not affected by age. The average RBC concentrations for Sudanese dromedary camel were recorded as 6.41±0.15 and 5.79±0.14 10^6/µl respectively, in dry and green season (Amin *et al*., 2007). In Pakistan, Farooq *et al*. (2011) reported average concentrations and ranges for total erythrocytic and leucocytic count as 6.83±0.38, 7.31±0.58; 4.3-12.4, 4.25-12.9 10^6/µl and 12.38±0.97, 12.97±0.99; 4-22.3, 4.2-20.9 10^3/µl in dromedary male and females, respectively in Desert Cholistan. Reported concentration averages and ranges of lymphocytes were obtained as 47.50±1.40, 48.60±1.50 and 40-55, 43-63 % respectively in males and females.

Adah *et al*. (2017) determined hematological indices of Nigerian dromedary camel and reported erythrocytes and leukocytes concentrations as 15.05±2.10 10^{12}/l and 16.20±0.32 10^9/l in control group. Erythrocytic and leukocytic counts of dromedary camels in Bangladesh were reported as to 5.3 million/cumm and 8.9 thousand/cumm respectively (Islam *et al*., 2019). However, total erythrocytic count was found higher in Indian dromedary camel as reported by Narnaware *et al*. (2016). Likewise, PCV values were also found higher in suckling camel calves while total erythrocytic count was greater in the weaned calves (Omer *et al*., 2006).

Ghafoor *et al*. (2018) determined hemoparasites prevalence in dromedary camels in Desert Thal and reported average negative concentration of total erythrocyte count as 7.25±0.08 10^6/µl. The average RBC concentration was reported as 10.99±1.04 10^6/µl in male dromedary camels (Al-Harbi, 2012). Reported RBC concentration was 9.48±0.16 10^6/µl in female dromedary camels (Zaher *et al*., 2017). Elitok and Cirak (2018) determined hematological and biochemical features of camels and reported RBC concentration as 8.90±1.45, 10.90±1.04 10^6/µl in males of rut and non-rut season, respectively.

White blood cells were found higher in number compared to those reported by Gupta *et al*. (1979), Snow *et al*. (1988), Mutugi *et al*. (1993), Sarwar *et al*. (1993), Alhadrami (1997), Nyang'ao *et al*. (1997), Rezakhani *et al*. (1997), Singh *et al*. (1997) and Mohamed and Hussein (1999). Non-significant differences were observed in male and female camels and also in pregnanti and non-pregnant she-camels. The average lymphocyte % of male, pregnant and non-pregnant she-camels was higher than reported by Al-Busadah and Osman (2000), while lower than of Al-Busadah (2007). The granulocytes percentage averages of male, pregnant and non-pregnant she-camels

were lower than those reported by Al-Busadah and Osman (2000), but higher than those reported by Al-Busadah (2007).

Amin *et al*. (2007) evaluated reported lymphocytes concentration as 56.24±1.57, 34.93±1.54 % respectively, in dry and green season in Sudanese dromedary camel. Earlier WBC (10^3/µl) and lymphocytes percentage averages were reported to be 10.10±1.20 and 45±1.05 in male dromedary camels (Al-Harbi, 2012), but determined to be 10.95±0.81 and 34.86±1.99 in female dromedary camels, respectively (Zaher *et al*., 2017). The reported average for lymphocytes in Nigerian dromedary camel was 6.05±0.3 10^9/l (Adah *et al*., 2017). Elitok and Cirak (2018) studied hematological and biochemical features of camels and reported WBC concentration as 10.54±0.25, 11.28±0.24 in pregnant and non-pregnant she-camels while 10.5±1.89 and 10.10±1.20 10^3/µl in males of rut and non-rut season, respectively. The reported range was 7.5-22 in adult camels, while lymphocytes concentration was 30.50±1.95, 40.43±2.48; 54±1.48, 45±1.05 % in pregnant, non-pregnant; males of rut and non-rut season, respectively. Lymphocytes concentration for normal camels was reported as 41%.

Abdalmula *et al*. (2018*b*) investigated the effect of breed on blood parameters of Libyan dromedary camel and reported the RBC (10^6/µl) and WBC (10^3/µl) concentration as 12.53±0.43, 9.45±0.61; 11.52±0.25, 11.28±0.61 and 12.06±1.64, 11.29±1.50 in Sirtaweya, Fakhreya and Mahari camels respectively. Lymphocytes concentration averages were reported as 6.41±0.39, 6.27±0.40 and 8.45±1.35 10^3/µl in Sirtaweya, Fakhreya and Mahari camels respectively. The previous concentration averages of RBC and WBC were found to be 10.74±0.42 10^6/µl and 9.96±1.22 10^3/µl in female dromedary camels during transition period (Ebissy *et al*., 2019).

Islam *et al*. (2019) reported the lymphocytes as 48.6% in dromedary camels of Bangladesh. Abdalmula *et al*. (2019) studied the effect of sex on blood profile of normal Libyan dromedary camel and reported RBC and WBC concentration as 12.27±0.89, 11.52±0.25 10^6/µl and 10.45±0.86, 11.28±0.61 10^3/µl respectively, in males and she-camels. Abdalmula *et al*. (2018*a*) determined blood profile of normal Libyan dromedary camel and reported RBC (10^6/µl) and WBC (10^3/µl) concentration and range as 11.79±0.36, 10.98±0.50 and 7.53-30.88, 4.75-21.20, respectively. Lymphocytes concentration average and range were reported as 6.73±0.38 and 2.60-18.05 10^3/µl, respectively.

PCV, MCV, MCH & MCHC: The averages of PCV, MCV, MCH and MCHC were found to be as (28.85±0.06, 26.84±0.06, 38.34±0.08, 35.20±0.05 %); (36.91±0.12, 36.86±0.12, 38.46±0.17, 38.12±0.09 fl); (16.82±0.07, 15.92±0.07, 20.54±0.09, 20.48±0.58 pg); (45.57±0.08, 43.93±0.08, 54.36±0.11, 53.83±0.06 g/dl), respectively in males and females among groups G1, G2 being slightly higher in males than females and adults than calves under SIMS (Table 2).

In the present study, the obtained values were close to those observed by Abdelgadir *et al*. (1984), Al-Harbi (2012), Adah *et al*. (2017), Zaher *et al*. (2017), Abdalmula *et al*. (2018 *a,b*), Elitok and Cirak (2018), Abdalmula *et al*. (2019), Ebissy *et al*. (2019) and Islam *et al*. (2019). Horse, cattle and camel showed higher number of RBC so MCV values are low as compared to other species likely determined by Schalm *et al*. (1975), Sarwar and Majeed (1997). While Abdelgadir *et al*. (1984) observed lower values of RBC in Saudi and Indian camels. The MCH averages were higher than those reported by Al Busadah and Osman (2000), Amin *et al*. (2007), Al Busadah (2007) and Saeed and Hussein (2008). Higher MCHC averages were obtained in the present study in comparison with those reported by Al-Busadah (2004) and Saeed and Hussein, (2008). Higher average values also reflected that oxygen carrying capacity of camel blood was more, irrespective of sex as also reported by Rezakhani *et al*. (1997) and Al-Busadah and Osman (2000).

Amin *et al*. (2007) assessed average concentrations of (PCV %), (MCV fl), (MCH pg), (MCHC g/dl) as 25.14±0.33, 25.95±0.32; 40.09±0.81, 46.43±0.79; 16.99±0.43, 19.44±0.42; 42.49±0.63, 41.62±0.61 respectively, in dry and green season in Sudanese dromedary camel. In Pakistan, Farooq and coworkers (2011) reported mean concentration and range for (PCV %), (MCV fl), (MCH pg), (MCHC g/dl) as 37.21±2.48, 32.83±3.76 and 22-67, 24-50; 57.13±5.09, 50.24±7.72 and 27-140, 26-103; 18.69±1.45, 17.80±2.21 and 11-35, 7-35; 33.61±1.42, 34.81±2.16 and 22-46, 27-42 in dromedary male and females, respectively in Desert Cholistan. PCV (%), MCV (fl), MCH (pg) and MCHC (g/dl) concentrations were reported to be 39.80±1.99, 40.10±2.86, 16.70±1.97 and 49.30±3.12, respectively in male dromedary camels (Al-Harbi, 2012).

The average concentrations of (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) were reported to be 28.62±0.31, 36.45±0.51, 14.02±0.17 and 42.23±0.19 in female dromedary camels, respectively (Zaher *et al*., 2017). Average PCV % was reported as 25.71±0.13 in Nigerian dromedary camel (Adah *et al*., 2017). Islam *et al*. (2019) reported PCV concentration as 36.5 % in dromedary camels of Bangladesh. Similarly, PCV values were found to be higher in suckling dromedary calves while total erythrocytic count was greater in weaning calves as determined by Omer *et al*. (2006). Ibrahim *et al*. (2015) found PCV % as 23.44 in Sudanese camel. Ghafoor *et al*. (2018) studied hemoparasites prevalence in dromedary camels in Desert Thal and reported average negative concentration of PCV as 29.25±0.13 %.

Elitok and Cirak (2018) studied hemato-chemical features of camel and reported PCV (%), MCV

(fl), MCH (pg) and MCHC (g/dl) averages and ranges were to be 30±5, 40±3, 18±3, 45±5 and 24-35, 36-55, 16-22, 26-50 in normal camels. Earlier ranges of PCV, MCV and MCHC were recorded as 27-45 %, 21-31 fl and 39-48 g/dl respectively in adult camels. PCV concentration averages were reported to be 26.88±0.39 and 27±0.37 % in pregnanti and non-pregnant she-camels. Reported concentration of (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) was 39.50±2.65, 39.80±1.99; 36.40±3.39, 40.10±2.86; 16±2.37, 16.70±1.97 and 46.20±3.77, 49.30±1.39 in males of rut and non-rut season, respectively.

Abdalmula *et al*. (2018*a*) checked blood profile of normal Libyan dromedary camel and reported concentration and range of (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) as 33.47±1.01, 16.00-50.00; 29.24±0.93, 7.10-48.70; 11.06±0.32, 3.30-18.60 and 39.38±1.30, 21.60-87.30 respectively. Abdalmula *et al*. (2018*b*) investigated the effect of breed variations on blood indices of Libyan dromedary camel and reported concentration of (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) as 36.74±1.38, 29.62±1.36, 8.95±0.54 and 30.72±2.29; 35.62±1.15, 31.41±1.11, 11.84±0.30 and 39.16±1.32; 23.77±1.46, 21.92±1.76, 10.31±1.03 and 47.41±3.57 in Sirtaweya, Fakhreya and Mahari camels respectively.

Abdalmula *et al*. (2019) investigated the effect of sex on blood parameters of normal Libyan dromedary camel and reported (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) concentration averages as 29.71±1.67, 35.62±1.15; 25.45±1.37, 31.41±1.11; 9.68±0.61, 11.84±0.30 and 39.76±2.76, 39.16±1.32 respectively, in males and females. Average concentrations of (PCV %), (MCV fl), (MCH pg) and (MCHC g/dl) were reported to be 32.10±1.44, 30.06±1.53, 8.98±0.54 and 26.65±0.95 in female dromedary camels during transition period (Ebissy *et al*., 2019).

Conclusion: The study of blood constituents is of great interest and keen importance as mirror of general health status and body functioning of animals. These could be used as an indirect measure for disease diagnosis and general well-being. Observation of deviation from normal limits serve as guide for disease condition and differential diagnosis. This manuscript describes the hematological profile of Marecha camel in relation to age and sex and the results will be a useful addition in country primary database for further studies in camel science.

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