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Haematological, Hemostatic and Blood Chemical Values of Captive Erlanger's Gazelles (*Gazella erlangeri*) in Saudi Arabia

[1,2]Riyadh S. Aljumaah and [1]Mansour F. Hussein
[1]Department of Animal Production, College of Food and Agriculture Sciences,
King Saud University, P.O. Box 2460, 11451 Riyadh, Saudi Arabia
[2]Center of Excellence in Biotechnology Research, P.O. Box 2455,
11451 Riyadh, Saudi Arabia

Abstract: Normal reference ranges for hematology, blood chemistry, platelet indices and coagulation parameters were determined in male and female Erlanger's gazelles (*Gazella erlangeri*). Data investigated included complete blood count, Platelet count (PLT), plateletcrit, mean platelet volume, platelet distribution width and a wide range of biochemical and chemical parameters including serum proteins, enzymes and other clinically important metabolites and inorganic constituents. Normal ranges of coagulation parameters were also investigated, namely; Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), fibrinogen, procovertin, antihemophilic factor A coagulation activity, plasma thromboplastin component, Stuart factor and plasma thromboplastin antecedent concentration. Statistical analysis showed significantly higher ($p<0.05$) total leucocyte and lymphocyte counts in female as compared to male gazelles. All other haematological parameters were similar in males and females. No significant intersex differences were found in mean platelet counts, platelet indices and coagulation parameters. As in other desert gazelles, decreased PT and APTT and increased PLT, fibrinogen and antihemophilic factor coagulation activity were recorded in Erlanger's gazelle as compared to humans. Serum chemical analysis revealed significantly higher ($p<0.05$) concentrations of glucose, urea, BUN and total bilirubin and significantly lower total protein and CL concentration ($p<0.05$) in female versus male gazelles. Other chemical parameters were similar in the two sexes. All the data recorded in this study are reported for the 1st time in Erlanger's gazelles.

Key words: Erlanger's gazelles, Neumann's gazelles, *Gazella erlangeri*, hematology, blood chemistry, coagulation parameters, platelet indices, Saudi Arabia

INTRODUCTION

Reference intervals for hematological and blood chemical constituents were reported for different species of gazelles including Dorcas gazelle, *Gazella dorcas*, Grant gazelle, *Gazella granti*, Cuvieri gazelle, *Gazella cuvieri*, Thomson's gazelle, *Gazella thomsoni*, Speke's gazelle, *Gazella spekei* and Dama gazelle, *Gazella dama* (ElNabi *et al*., 2009).

Reference ranges for hematology and blood chemistry were also investigated in captive mountain (*Gazella gazella*) and sand (*Gazella subgutturosa marica*) gazelles in Saudi Arabia (Mohammed *et al*., 2010) along with data on their blood coagulation and platelet parameters (ElNabi *et al*., 2009; Hussein *et al*., 2010a, b). Knowledge of these variables is important as an aid for the diagnosis and prognosis of diseases and for assessing the health status of these animals and their ability to sustain the stressful conditions of desert life (ElNabi *et al*., 2009; Mohammed *et al*., 2010). To the knowledge such information is completely lacking for the Erlanger's (Neumann's) gazelle (*Gazella erlangeri*, Neumann 1906), a rare species of Arabian gazelle known locally as Khudri. This animal previously inhabited the mountainous range of Southwestern Arabia but is currently extinct in the wild. Though, previously considered to be a subspecies of the *Gazella gazella* group (Anonymous, 1988), the Erlanger's gazelle is presently treated as a distinct species (Grubb, 2005). Captive specimens of *G. erlangeri* are reared at King Khalid Wildlife Research Center (KKWRC) in Thumama, Saudi Arabia and Al-Wabra Wildlife Preservation (AWWP) Park in As-Sahhaniyah in Qatar for the purpose of conserving and breeding this species for possible re-introduction into the wild. Owing to the scarcity of these animals and therefore, difficulty in obtaining

Corresponding Author: Riyadh S. Aljumaah, Department of Animal Production, College of Food and Agriculture Sciences, King Saud University, P.O. Box 2460, 11451 Riyadh, Saudi Arabia

samples for research, extremely little is known about them, other than fragmentary information regarding their taxonomy. The objective of this study was to establish reference ranges for hematology, blood chemistry and coagulation variables in healthy male and female Erlanger's gazelles. These data are needed for future reference to evaluate the physiological status, pathophysiology and clinical aspects of this species.

MATERIALS AND METHODS

Animals: Eleven male and eleven female Erlanger's gazelles, aged 0.5-12 years (mean 5.1+0.8 years) were investigated between April and July, 2009. The animals were part of a herd of 44 gazelles currently kept at KKWRC in Thumama (25°07'N, 46°49'E) North of Riyadh, Saudi Arabia. Their founder population comprised six male and eight female gazelles originally obtained from private collections in the Kingdom. They were housed in an animal enclosure and some were kept in breeding pens. They were vaccinated against enzootic infectious diseases and given coccidiostats and anthelminthics as necessary. Feeding consisted of a balanced diet of dried alfalfa (*Medicago sativa*) and commercial concentrate (16% protein) with free access to water and mineral salt licks. All of the studied animals were checked by a wildlife veterinarian and found to be clinically normal and none of the adult females was pregnant at the time of sampling.

Sampling: Three blood samples were collected from the jugular vein of each gazelle while the animal was manually restrained using a drive-in boma (Pienaar, 1973). No tranquilizers or chemical immobilization drugs were used. The animals' heads were covered and the blood samples were taken immediately upon capture. One sample was collected into Ethylenediamine-Tetra-acetic Acid-dipotassium (EDTA-K_2) vacuotainer tube (Becton, Dickinson and Company, Franklin Lakes, New Jersey, USA) for determination of hematology and platelet indices in whole blood. The 2nd sample was collected into a vacutainer tube containing 3.2% trisodium citrate (0.11 M) at a final citrate to blood ratio of 1:9 for determination of coagulation parameters in plasma. The 3rd sample was collected into a plain vacutainer tube for serum separation. Whole blood samples in EDTA-K_2 were analyzed within 1 h of collection. Plasma was separated from citrated blood by centrifugation at 3,500 g for 15 min in a refrigerated centrifuge (4°C) while serum was separated by centrifugation from clotted blood samples in plain vacutainers 4 h after collection.

Plasma and serum samples were transferred into plastic tubes and stored at 40°C for laboratory analysis.

Hematology and platelet indices: Total erythrocyte count (RBC), Hemoglobin (HB), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), Red cell Distribution Width (RDW), Total Leucocyte Count (TLC), lymphocytes, monocytes, granulocytes, Platelet Count (PLT), Mean Platelet Volume (MPV), Plateletcrit (PCT) and Platelet Distribution Width (PDW) were determined in whole blood (EDTA-K_2) samples using automated VetScan HM2 hematology analyzer (Abaxis Veterinary Diagnostics, Union City, CA, USA).

Serum biochemical and inorganic constituents: Reference values for the following serum constituents were determined spectrophotometrically (Thermo Fisher Scientific Inc., Madison, Wisconsin, USA) using commercial reagent kits (United Diagnostic Industry, Dammam, Saudi Arabia): total protein, albumin, glucose, urea, triglycerides, total cholesterol, total lipids, creatinine, total bilirubin, Aspartate aminotransferase (AST), Alanine aminotransferase (ALT), alkaline phosphatase, creatine kinase, α-amylase and inorganic constituents (Na, K, Cl, Mg, Ca and P). Total globulin was taken as the difference between total protein and albumin and the albumin:globulin ratio was calculated. The value of Blood Urea Nitrogen (BUN) was calculated from blood urea concentration.

Coagulation tests: Prothrombin Time (PT), Activated Partial Thromboplastin Time (APTT), fibrinogen concentration, procovertin (factor VII), antihemophilic factor A coagulation activity (factor VIII:C), plasma thromboplastin component (factor IX), Stuart factor (factor X) and plasma thromboplastin antecedent (factor XI) were determined as previously described (ElNabi *et al*., 2009) in citrated plasma samples, using automated STA compact coagulation analyzer (Diagnostic Stago, Roche, Basilea, Switzerland) and commercial reagents.

Rabbit thromboplastin reagent (Simplastin, Organon Tekina Corp., USA) was used for determining PT while actin-activated cephaloplastin reagent (Organon Teknika Corp., Dublin, Ireland) was used for determining APTT. Control values for both parameters were based on citrated human reference plasma (Baxter Diagnostics Inc., Deerfield, Ill, USA). Fibrinogen concentration was assayed using commercial STA kit (Diagnostic Stago, Roche, Basilea, Switzerland). The biological activities of coagulation factors VII, VIII:C, IX and X were assayed as previously described (ElNabi *et al*., 2009) using sub-strates of human plasma deficient in the

corresponding factor (Organon Teknika Corp., Dublin, Ireland). Factor XI activity was determined using canine factor XI-deficient plasma (Dade Actin, Baxter Diagnostics, New Jersey, USA). Due to the lack of laboratory assays of clotting factors in the plasma of gazelles, standard curves were prepared using human reference plasma and the clotting times were converted into units per liter of biological activity and compared with human plasma having an assigned value of 1 UL^{-1} coagulation factor. The results are therefore, relative to the reference human plasma.

Statistical analysis: Results were statistically analyzed using SAS 8.1 program for windows. Shapiro-Wilk testing for normality showed that all parameters were normally distributed. Pearson correlations were used to analyze correlations among platelet indices and between the latter and corresponding red cell indices (Schork and Remington, 2000). Significance was set at $p \leq 0.05$.

RESULTS AND DISCUSSION

Means and ranges of hematological parameters and platelet indices are shown in Table 1 and 2, respectively. Mean RBC, HB, HCT, MCV, MCH, MCHC and RDW values were similar in male and female gazelles. Lymphocytes constituted the most predominant type of leucocytes (~40-60%) in these gazelles and had significantly ($p \leq 0.05$) higher value in female as compared to male gazelles and consequently, TLC was also significantly ($p \leq 0.05$) higher in female as compared to male gazelles (Table 1). Means and ranges of Platelet Count (PCT) and platelet indices (PCT, MPV and PDW) showed no significant differences between male and female gazelles (Table 2). Biochemical analysis (Table 3) revealed significantly higher ($p \leq 0.05$) concentrations of glucose, urea, BUN and total bilirubin and significantly lower total protein concentration ($p \leq 0.05$) in female versus male gazelles. No significant intersex differences were recorded in albumin, globulin, A:G ratio, creatinine, total lipids, cholesterol and triglycerides. Similarly, no significant intersex differences were recorded in creatinine kinase, alkaline phosphatase, α-amylase, AST and ALT values.

The mean values of serum inorganic constituents (Table 4) were similar in both sexes, with the exception of Cl which was significantly higher ($p \leq 0.05$) in male than it was in female gazelles. The same was true for PT, APTT, fibrinogen and coagulation factors VII-XI, all of which were comparable in male and female gazelles (Table 5).

G. erlangeri is one of the rarest and least known mammals in the world. An active program is currently underway at KKWRC to breed this species and protect it from disease. However due to the small size of the founder population, significant inbreeding has taken place which is apparently responsible for increased mortality among the neonates of this species (Mohammed, pers. Comm.). The usefulness of the haemogram and blood chemistry in clinical practice cannot be over-emphasized. In many instances, these tests are required to assess the

Table 1: Haematological parameters of Erlanger's gazelle (*Gazella erlangeri*)

	Males (11)		Females (11)		Total (22)	
Parameters	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
RBC ($\times 10^{12}$ L^{-1})	13.05±0.32	(11.33-14.62)	12.72±0.48	(12.08-13.53)	12.98±0.82	(11.33-14.62)
HB (g dL^{-1})	19.34±1.17	(16.90-20.4)	18.53±0.81	(17.40-19.6)	18.97±1.07	(16.90-20.4)
HCT (%)	51.29±4.05	(42.89-56.3)	50.22±2.94	(45.96-55.1)	50.79±3.14	(42.89-56.3)
MCV (fL)	39.13±0.99	(38.00-40.0)	39.57±1.40	(37.00-41.0)	39.33±1.18	(38.69-40.1)
MCH (pg)	15.05±0.47	(14.40-15.7)	14.74±0.53	(14.10-15.8)	14.91±0.50	(14.10-15.8)
MCHC (g L^{-1})	38.30±0.77	(37.00-39.4)	37.34±0.90	(35.60-38.5)	37.85±0.94	(35.60-39.4)
RDW (%)	19.11±0.94	(18.30-20.6)	19.63±0.84	(18.30-20.17)	19.35±0.90	(18.30-20.6)
TLC ($\times 10^{9}$ L^{-1})	5.53±1.44^{a}	(4.10-7.56)	7.41±1.75^{b}	(5.00-9.31)	6.14±1.82	(4.10-9.31)
LYMPH ($\times 10^{9}$ L^{-1})	2.43±0.85^{a}	(1.74-4.42)	4.60±1.50^{b}	(2.97-6.41)	3.32±1.51	(1.74-6.41)
MONO ($\times 10^{9}$ L^{-1})	0.50±0.11	(0.36-0.65)	0.61±0.37	(0.07-0.87)	0.54±0.22	(0.07-0.87)
GRAN ($\times 10^{9}$ L^{-1})	2.30±1.00	(1.52-4.42)	3.19±1.54	(0.99-4.33)	2.78±1.17	(0.99-4.33)

Values are mean±SEM (range). Data in the same raw bearing different lowercase letters are statistically different ($p \leq 0.05$). RBC = Total erythrocyte count, HB = Hemoglobin, HCT = Hematocrit, MCV = Mean Corpuscular Volume, MCH = Mean Corpuscular Hemoglobin, MCHC Mean Corpuscular Hemoglobin Concentration, RDW = Red cell Distribution Width, TLC = Total Leucocyte Count, total WBC count, LYMPH = Lymphocyte count, MONO = Monocyte count, GRAN = Granulocyte count

Table 2: Platelet parameters in Erlanger's gazelles (*Gazella erlangeri*)

	Males (11)		Females (11)		Total (22)	
Parameters	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
PLT ($\times 10^{9}$ L^{-1})	363.83±123.7	(203-568)	503.2±235.95	(258.0-841)	427.8±192.62	(203.0-814)
PCT (%)	0.36±0.130	(0.23-0.51)	0.41±0.220	(0.20-0.72)	0.38±0.170	(0.20-0.72)
MPV (fL)	8.10±0.560	(3.46-3.90)	8.23±0.570	(7.50-9.00)	8.16±0.550	(6.40-9.00)
PDW (%)	36.26±2.240	(33.1-39.8)	37.67±1.740	(35.5-39.2)	36.92±2.080	(33.1-39.8)

PLT = Platelet count, PCT = Plateletcrit, MPV = Mean Platelet Volume, PDW = Platelet Distribution Width

Table 3: Serum Biochemical parameters in Erlanger's gazelles (*Gazella erlangeri*)

	Males (11)		Females (11)		Total (22)	
Parameters	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
TP (g L^{-1})	71.70±1.600[a]	(67.95-77.30)	66.20±1.690[b]	(60.25-77.30)	68.67±1.220	(60.25-77.30)
ALB (g L^{-1})	34.33±0.970	(29.64-41.95)	32.43±0.830	(28.38-37.71)	33.23±0.780	(28.38-41.95)
GLO (g L^{-1})	36.67±1.620	(30.14-44.25)	33.76±1.570	(25.80-42.59)	33.70±1.160	(25.80-44.25)
A:G (%)	0.96±0.050	(0.70-1.27)	0.93±0.190	(0.71-1.34)	0.97±0.050	(0.70-1.34)
TL (g L^{-1})	3.68±0.220	(2.25-4.85)	3.59±0.260	(2.56-4.82)	3.63±0.180	(2.25-4.85)
CHL (mmol L^{-1})	0.61±0.050	(0.39-0.90)	0.65±0.040	(0.37-0.91)	0.63±0.030	(0.37-0.91)
TGL (mmol L^{-1})	0.16±0.020	(0.09-0.28)	0.20±0.030	(0.09-0.31)	0.18±0.020	(0.09-0.31)
GLU (mmol L^{-1})	7.82±0.520[a]	(5.55-10.71)	11.49±0.970[b]	(6.72-16.70)	9.65±0.670	(5.55-16.70)
CRE (μmol L^{-1})	85.24±3.900	(68.24-104.43)	84.12±3.830	(70.81-113.15)	84.68±2.670	(68.24-113.15)
UR (mmol L^{-1})	10.80±0.540[a]	(8.01-14.15)	12.52±0.360[b]	(10.42-13.89)	11.62±0.380	(8.01-14.15)
BUN (mmol L^{-1})	5.95±0.250[a]	(3.74-6.61)	5.84±0.170[b]	(4.87-6.49)	5.43±0.180	(3.74-6.61)
TBIL (μmol L^{-1})	3.38±0.170[a]	(2.00-5.00)	4.69±0.500[b]	(3.00-8.00)	3.84±0.230	(2.00-8.00)
ALP (U L^{-1})	81.32±8.360	(44.60-128.0)	82.76±7.930	(66.40-113.0)	81.84±5.880	(44.60-128.00)
CK (U L^{-1})	193.95±63.29	(56.10-563.0)	342.00±62.60	(67.80-634.0)	268.13±11.36	(56.10-634.00)
AST (U L^{-1})	159.70±14.40	(84.00-264.0)	183.45±16.31	(111.0-290.0)	172.45±11.36	(84.00-290.00)
ALT (U L^{-1})	39.79±7.380	(18.90-103.0)	65.11±6.990	(30.40-181.0)	53.05±5.700	(18.90-108.00)
α-AMY (U L^{-1})	93.46±5.250	(57.00-158.0)	109.18±10.14	(59.00-181.0)	98.40±4.880	(57.00-181.00)

Data in the same row bearing different lowercase letters are statistically different ($p \leq 0.05$). TP = Total Proteins, ALB = Albumin. GLO = Total globulins, A:G ratio, TL = Total Lipids, CHL = Cholesterol, TGL = Triglycerides, GLU = Glucose, CRE = Creatinine, UR = Urea, BUN = Blood Urea Nitrogen, TBIL = Total Bilirubin, ALP Alkaline Phosphatase, CK = Creatine Kinase, AST = Aspartate aminotransferase, ALT Alanine aminotransferase, α-amylase

Table 4: Serum inorganic constituents in Erlanger's gazelles (*Gazella erlangeri*)

	Males (11)		Females (11)		Total (22)	
Parameters						
(m mol L^{-1})	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
Ca	2.40±0.14	(2.08-2.67)	2.49±0.07	(2.07-2.94)	2.43±0.03	(2.07-2.94)
K	4.92±0.13	(3.70-6.50)	5.13±0.19	(4.30-6.60)	4.99±0.11	(3.70-6.60)
Mg	0.81±0.15	(0.34-1.96)	0.99±0.14	(0.40-1.70)	0.90±0.10	(0.34-1.96)
P	2.01±0.09	(1.08-2.78)	2.00±0.17	(0.97-3.18)	2.00±0.08	(0.97-3.18)
Cl	80.25±2.37[a]	(68.20-92.5)	74.89±2.67[b]	(64.10-96.4)	77.57±1.84	(64.10-96.4)
Na	144.23±3.12	(131-170.33)	141.63±5.51	(129.00-256)	142.54±1.31	(129.00-170)

Data in the same row bearing different lowercase letters are statistically different ($p \leq 0.05$)

Table 5: Coagulation parameters in Erlanger's gazelles (*Gazella erlangeri*)

	Males (11)		Females (11)		Total (22)	
Parameters	Mean±SEM	Range	Mean±SEM	Range	Mean±SEM	Range
PT (sec)	13.96±0.36	(12.20-16.3)	13.19±0.24	(11.60-14.2)	13.58±0.23	(11.60-16.3)
APTT (sec)	23.05±0.30	(21.10-24.4)	23.16±0.19	(22.40-24.3)	23.11±0.17	(21.10-24.4)
Fib (g L^{-1})	3.63±0.02	(3.46-3.90)	3.71±0.05	(3.41-3.92)	3.67±0.03	(3.41-3.92)
F:VII (U L^{-1})	1.23±0.03	(1.10-1.40)	1.20±0.03	(1.10-1.40)	1.21±0.02	(1.10-1.40)
F:VIII:C (U L^{-1})	4.94±0.15	(4.40-6.10)	5.03±0.14	(4.60-6.00)	4.98±0.10	(4.40-6.10)
F:IX (U L^{-1})	1.18±0.02	(1.10-1.30)	1.25±0.02	(1.10-1.40)	1.21±0.02	(1.10-1.40)
F:X (U L^{-1})	1.22±0.02	(1.10-1.30)	1.18±0.03	(1.10-1.40)	1.20±0.02	(1.10-1.40)
F:XI (U L^{-1})	1.55±0.02	(1.46-1.71)	1.62±0.02	(1.47-2.73)	1.58±0.02	(1.46-1.73)

PT = Prothrombin Time, APTT = Activated Partial Thromboplastin Time, Fib = Fibrinogen, F:VII = Proconvertin, F:VIII: C = Antihemophilia factor a coagulation activity, F:IX = Plasma thromboplastin component, F:X = Stuart factor, F:XI = Plasma thromboplastin antecedent

overall health condition of the animals and assist in the diagnosis and prognosis of diseases (Ferreira *et al*., 2009). Likewise, hemostatic and platelet parameters are useful measurements for the diagnosis of hereditary coagulation diseases and many of them are known to be altered during acute inflammations and liver diseases, viral infections, septicemias and immune-related disorders (Kristensen and Lundorff-Jensen, 2004). In the present study, reference hematological, hemostatic, thrombotic and serum chemical ranges are reported for the 1st time in Erlanger's gazelles. The hematological results indicated that RBC counts in these gazelles were comparable to those reported in sand and mountain gazelles reared under similar conditions of captivity (ElNabi *et al*., 2009; Hussein *et al*., 2010a). On the other hand, HB, HCT, MCV, MCH and HCHC values were higher than mountain gazelles (Rietkerk *et al*., 1994; ElNabi *et al*., 2009) while HCT and MCV values were lower than sand gazelles (Hussein *et al*., 2010a). Total and differential leucocyte values also varied among these species. In contrast to mountain gazelles, lymphocytes rather than neutrophils constituted the most predominant leucocyte type in Erlanger's gazelles and there was no evidence of the so-called stress neutrophilia like that recorded in

mountain gazelles (Rietkerk *et al*., 1994). Most of the hemato logical data in Erlanger's gazelles with the exception of MCV were also consistent with those reported in other species of wild ruminants such as the fallow deer, *Dama dama* (English and Lepherd, 1981), Chital deer, *Axis axis* (Chapple *et al*., 1991) and Arabian oryx, *Oryx leucoryx* (Hussein *et al*., 2010b). Until recently, the RDW has been unknown for any species of the genus Gazella. This parameter which measures heterogeneity in RBC size is proving to be a useful diagnostic parameter since its value changes during clinical conditions associated with abnormalities in red cell production such as iron deficiency anemia, thrombocytopenia, sepsis and endotoxemia (Viswanath *et al*., 2001; Carrillo *et al*., 2008; Yilmaz *et al*., 2008; Yaman *et al*., 2010).

The reference range for RDW in Erlanger's gazelle (18-20%) is similar to that recently reported in mountain (ElNabi *et al*., 2009) and sand gazelles (Hussein *et al*., 2010a). It is also similar to that recorded in the red deer, *Cervus elaphus* but exceeds that recorded in humans (Wiwanitkit, 2004), bovines (Yilmaz and Yesilbag, 2008), equines (Thrall *et al*., 2004) and sheep (Abdelhamid *et al*., 2007) and is lower than that recorded in camels (Hussein *et al*., 2010b) and Arabian oryx (ElNabi *et al*., 2009).

Also in contrast to camels where, the RDW was reported to be significantly higher in males versus females, no significant intersex differences were recorded in RDW in Erlanger's gazelles. The present study provides reference data for 23 serum biochemical and inorganic constituents in Erlanger's gazelles. Compared to the published values for other species of Arabian gazelles, the data indicate higher concentrations of serum total protein, albumin, glucose, creatinine, creatine kinase, ALT and α-amylase and lower concentrations of alkaline phosphatase, AST, BUN and chloride in Erlanger's gazelles versus sand gazelles while total globulin, urea and total bilirubin concentrations were similar in the two species (Vassart *et al*., 1994; Mohammed *et al*., 2010).

On the other hand, Erlanger's gazelles had higher total protein and albumin values and lower total globulin, BUN, alkaline phosphatase, ALT and α-amylase values than mountain gazelles while glucose, total bilirubin and creatinine concentrations were similar in the two species. Compared to the Persian goitered gazelle, *G. subgutturosa subgutturosa* (Askar *et al*., 2007), Erlanger's gazelles also had higher glucose, creatinine, ALT and α-amylase, lower total bilirubin, cholesterol, triglycerides, AST and alkaline phosphatase and similar total protein, albumin, BUN and creatine kinase concentrations. Erlanger's gazelles also had lower Cl, Ca and P concentrations than sand and mountain gazelles while Na and Mg concentrations were similar in these three species. On the other hand, Na, K, Cl and Mg levels were lower while Ca and P levels were similar in Erlanger's versus Persian gointered gazelles.

In common with other species of desert ruminants (Hussein *et al*., 1992, 2010a, b; ElNabi *et al*., 2009), Erlanger's gazelles exhibited shorter PT and APTT and higher fibrinogen, PLT and factor VIII:C activity than humans. These findings indicate a state of relative hypercoagulability in these animals which could be a physiological adaptation to protects them against excessive blood and fluid loss during desert life (Hussein *et al*., 1992, 2010a, b).

Other coagulation parameters in Erlanger's gazelle were broadly similar to those reported in sand gazelles, mountain gazelles, Arabian oryx and Nubian ibex (Hussein *et al*., 2010a, b; ElNabi *et al*., 2009). The mean PT and APTT values of the Erlanger's gazelle were also comparable to while their mean PLT count was higher than the Speke's gazelle (Travis and Eby, 2006).

Similar to other species of domestic and wild ruminants, a wide range of individual variation in PLT count was observed Erlanger's gazelles. Reference PCT, MPV and PDW values in Erlanger's gazelles were similar to those reported in sand and mountain gazelles but lower than those reported in humans (Wiwanitkit, 2004) while their MPV was higher and PCT markedly lower than those reported in domestic ruminants and equines (Watson and Authi, 1996; Boudreaux and Ebbe, 1998; Hussein *et al*., 2010b).

The normal PDW range for these gazelles was higher than that recorded in camels (Hussein *et al*., 2010b) and more than double that recorded in cattle (Yilmaz and Yesilbag, 2008). Pearson's correlation analysis showed significant correlation ($p<0.05$) between PLT and all other platelet indices (MPV, PCT and PDW) and between PDW and both PCT ($p<0.005$) and MPV ($p<0.05$). By contrast, no significant correlation was found between PLT and RBC, PCT and HCT, MPV and MCV and PDW and RDW.

CONCLUSION

The present reference ranges for the hematology, blood chemistry and coagulation profile of Erlanger's gazelles provide valuable baseline information for evaluating the heath status and pathophysiology of the Erlanger's gazelle, a highly endangered species in the Arabian peninsula. Further studies should be undertaken to determine the effect of different factors such as age, season, reproductive status and health condition on these parameters.

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