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Effect of sex and age on some Morphometric, Hematological and Biochemical Parameters in Egyptian Fruit Bat (*Rousettus aegyptiacus*)

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Abstract
Present study on Egyptian Fruit Bat (*Rousettus aegyptiacus*) conduct on 60 apparently healthy bats (19 young, 36 adults and 5 neonate) and designed to investigate data base in this species, bat's morphometric measurements needed to determine all bat's external characters which help in identification of different species and different age or sex. morphometric parameters measured by ruler, show significant difference between different age and no effect of sex, overall mean of body weight 111.1±34.29 g, Forearm 8.74±0.85 cm, body length 14.26±1.58 cm and Wingspan 61.18±6.41 cm. Evaluation of hematological and biochemical parameters of animals are very important to diagnosis diseases and to determine a requirements of nutrition to them. hematological parameters measured by Hemocytometer show significant difference between different age in RBC, MCV, Eosinophil and no effect of sex, overall mean of RBC 7.19±2.56 10^{12}/l, WBC 6.87±3.96 10^{9}/l, HB 13.99±1.96 g/dl and Platelets 199.3±118.9 10^{9}/l. biochemical parameters measured by Spectrophotometer show significant difference between different age in triglyceride and between different sex in total calcium and cholesterol, overall mean of AST 219.5±191.2 IU/l, ALT 115.6±77.68 IU/l, Total calcium 1.85±0.40 mmol/l, Urea 3.98±3.48 mmol/l, Cholesterol 0.26±0.15 mmol/l, Glucose 5.37±1.70 mmol/l.

Keywords: Chiroptera, Flying foxes, Frugivorous, Body weight, Nocturnal

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Introduction

Chiroptera divided into the two suborders Megachiroptera (old world fruit bats) and Microchiroptera (echolocating bats) (Jones et al., 2002). All bats are included in the order Chiroptera (meaning hand-wing) (Teeling et al., 2005). Bats is about more than one fifth of all mammalian life on the planet. Currently know about 1300 species of bats and are constantly discovering new ones (Johan and Jens, 2018). They are the second largest group of mammals after rodents, represent about 20 percent of all classified mammal species worldwide (Brock and Nancy, 2014). Megachiroptera has only one family (Pteropodidae) and it has nearly 166 species. All Megachiroptera feed on plant, fruit, nectar or pollen (Hill and Smith, 1984; Nowak, 1991;Vaughan, et al., 2000)

Egyptian Fruit Bat (*Rousettus aegyptiacus*) (Geoffroy, 1810) Order Chiroptera, Family Pteropodidae). Existent in Africa south of the Sahara, in Egypt, and in the coastlines of the Arabian Peninsula (Grzimek, 2003). South of the Sahara found in most habitats where caves and fruiting trees. In Egypt, R. a. aegyptiacus inhabits cultivated areas in the Nile Valley and Nile Delta and some oases, and it roosts in man-made cave-like day-roosts where caves are absent (Happold and Happold, 2013). The Egyptian fruit bat live in large colonies which consist of thousands of individuals in their established roosts (Kwiecinski and Griffiths, 1999; Del Vaglio et al., 2011).

This is the largest Egyptian bat (Dietz, 2005). Characterized by large eyes, simple ears, and simple muzzles. Tail and tail membranes are typically small or non-existent (John, 2011). The ear is simple without tragus or antitragus. The second finger is clawed (Dietz, 2005). Egyptian Fruit Bat has a similar fox-like head with a profound muzzle. The eyes are large and adapted for twilight and night vision (Kwiecinski and Griffiths, 1999). The ears are medium sized, dark color and rounded at the apex, cylindrical body and the wingspan is about 605 ± 6.4 mm (Karatas et al., 2003).

The head covered with short fur to the end of the muzzle, except of the forehead, the fur is slightly longer (Kwiecinski and Griffiths, 1999). Ears are with blunt tips and dark color compared to dorsal pelage (Kwiecinski and Griffiths, 1999). The fur on its body is short and consists of soft and sleek strands (Kwiecinski and Griffiths.1999; Jonathan Kingdon et al, 2013)

The Egyptian fruit bat is frugivorous, consuming mostly fruit, (Albayrak et al, 2008). It is a nocturnal animal; it is more active in the evening. The type of fruit consumed is influenced by overall availability depending on the season and habitat type (Del Vaglio et al, 2011)

For the last three-decade bats have been in the focus of many research projects and the knowledge in the field of taxonomy, ecology and distribution of species has increased extraordinarily. bat's morphometric measurements needed to determine all bat's external characters which help in identification of different species and different age or sex. The main measurements used is the length of forearm (FA), wingspan, head-body-length and body mass is a good indicator for the identification. A caliper will be needed to obtain reliable values. And this method considers not expensive as identifying bats by molecular genetic methods (Dietz, 2005)

The bones of juveniles at are not fully ossified and the epiphyses are best visible in the joints of the digits on a light background by using illumination source. Joints of small juveniles are long stretched, and the fingers are still cartilaginous. Then most parts of the fingers are fully ossified, but the growth plates near the joints are apparent as a light (translucent) cartilaginous gap. After that the cartilage is replaced by bone and the joint becomes more rounded, knuckle-like (Dietz, 2005)

Blood is a tissue consisting of red blood corpuscles (erythrocytes), white corpuscles (leukocytes), and platelets. It transports oxygen, carbon dioxide, metabolites, products of digestion, hormones, enzymes and clotting factors (Anosike et al, 2020).

Evaluation of hematological and biochemical parameters of animals are very important to indicate infection, organ function diagnosis diseases and to determine a requirement of nutrition to them (Vogelnest and Woods, 2008). The blood profile is affected by many factors as age, sex and reproductive state, health, geographic location and by endogenic rhythms of various metabolites, and by external factors as season, time of the day, food availability and quality (Hellgren et al., 1988; Van et al., 1993; Minematsu et al., 1995).

Most hematological studies are focused on domestic animals, with little information on free-living wild animals (Raskin and Wardrop, 2011). Blood profile studies on the of Megachiroptera are rare and the available data are based on captive bats (Westhuyzen, 1978; Widmaier and Kunz, 1993; Widmaier et al., 1996; Heard and Whittier, 1997).

WBCs count decreased significantly with increase in age. (Aikin et al., 2012) In flying birds, increase in RBCS count may be to supply more oxygen for the body cells because these animals consume more energy for flight which in turn will increase the RBCS count (Smith et al., 2011). (Koopman et al., 1995; Farzad et al., 2007) reported that, differences in RBCS mass between species also may be a reflection of nutritional factors or exposure to chronic stressors, such as being kept in captivity. RBCS parameters can be affected by a variety of homeostatic mechanisms in the body.

The higher osmotic concentrations and the higher hematocrit and hemoglobin levels may be explained by changes in vascular permeability that helps control plasma volume (Arad et al., 1989).

Glucose and steroid hormones changed daily; it is reported by study on three species of Megachiroptera in captivity. But glucose levels were within the normal range for mammals, the steroid levels in these species were the highest ever recorded in mammals (Widmaier and Kunz., 1993). This increase may reflect a state of dehydration as reported by Arad and Korine, (1993), or may reflect a physiological state associated with low temperatures, similar to other mammals (Jakubow et al., 1984; Lochmiller et al., 1985).

Changes in muscle membrane permeability (Haralambie, 1973), possible as a result of muscle glycogen depletion (Bricknell et al., 1981), cellular damage induced by mechanical processes. (Friden et al, 1983). During moderate exercise, glucose uptake by the working muscle increase up to 20 times over the basal levels. This exercise induced glucose utilization without appropriate increase in endogenous glucose production with delayed hepatic glucose production may explain significantly decreased levels of glucose. (Zdrenghea et al., 2008). However, intense exercise provokes the release of insulincounter regulatory hormones such as glucagon and catecholamine which ultimately cause a reduction in insulin action. Thus, explaining the observed increase in plasma glucose after hard exercise compared with moderate exercising. (Zdrenghea et al., 2008).

Nagel et al., (1990) reported that, increase of plasma aspartate and alanine amino transfers (ASAT and ALAT) activities after extra-long distance running. The beginning of the activity period is characterized by low glucose level but high triglyceride levels, while an opposite was found at the end of the nightly activity period (Westhuyzen, 1978).

Serum ASAT and ALAT activities increased significantly, in flying animals (birds and mammals) in comparison with nonflying (Van et al., 1973). This increase may be several factors responsible for the changes in serum enzyme activities during training such as, hem dilution or hem concentration, (Van et al., 1973). Increases in ALT are nonspecific and can be due to damage of almost any tissue, whereas increases in ASAT are indicative of liver or muscle damage.

Until now, there is no complete biological dataset including CBC, serum biochemistry for the Egyptian fruit bat R. aegyptiacus. Interest in this species has increased given that it is the natural reservoir for some severe emerging viral infections. (Amman et al., 2012; Paweska et al., 2016), and none of the previous studies have focused on the establishment of reference intervals.

Materials and Methods

Animals: The present study carried on 60 Egyptian Fruit Bat (*Rousettus aegyptiacus*), They were two genders and different ages, free ranging from Sohag, Assiut and Giza governorates in the period from 31 March to 30 October 2022, Bats were caught between two and four mist nets placed around the fruiting trees, Bats captured from fruit farms (Sohag and Assiut) and abandoned villa (Giza), Manual restrained using either protective thick gloves to hold the head and the limbs.

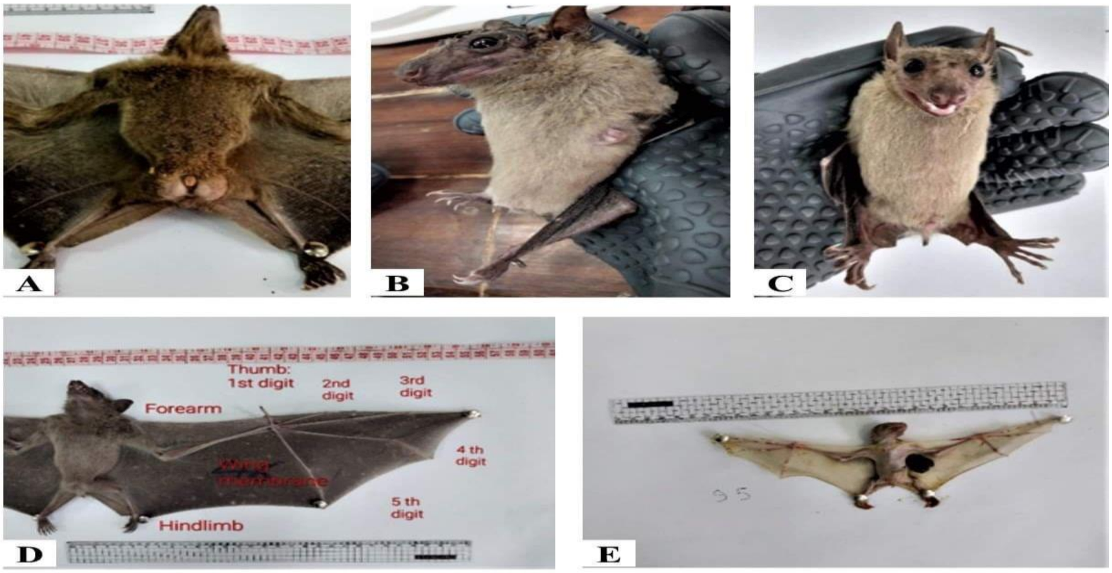
Physical examination for the animals carried out by inspection the animals from distance away from the animal and flock from all side and around of them from all directions and detect any lesions or changes in eternal parts animals, from mouth to claws.

Sex determined by identification of sexual organs, to detect the age of animal, it is used measurement long of for arm, if its long is less than 88 mm it is considering young, but if its long equal 88 mm or more consider adult. According to Andersen, (1912)

Sample: Blood sample was collected from the heart on EDTA and plain tube.

Morphometric parameters measured by using ruler, meter and electronic balance for weighting, and the haematological data were obtained by manual method by Hemoyctometer and blood smears and automatic method by (MINDRAY BC 5000) Automated Hematology Analyzer to estimate RBC, HB, HCT, MCV, MCH, MCHC, total and differential leucocyte count, Biochemical analysis evaluated by using an analyzer (T70+UV/VIS Spectrometer& BIOLAB ES-90) as some Liver, Kidney function parameters, some Minerals, lipogram and glucose.

The data analysis was performed using of Excel spreadsheet (Microsoft Excel 2016) The obtained data were statistically analysed to calculate Mean±SD and P values using statistical software (GraphPad Prism version 8) program.



Figures 1: A. Adult male Egyptian Fruit Bat. B. Adult female Egyptian Fruit Bat. C. Young Egyptian Fruit Bat. D. morphometrics of Egyptian Fruit Bat E. Neonate Egyptian Fruit Bat.

Results

The study was conducted on apparently healthy Egyptian Fruit Bat as they free from any signs of diseases and free from internal and external parasites, for the determination of morphometric, hematological and biochemical measurements for different age and sex of bats from three localities of Egypt.

Based on this study results; body weight, forearm, body length, wingspan, arm, leg and thumb in young Egyptian Fruit Bat were (75.29±28.69 g, 7.84±0.766 cm, 12.69±1.58 cm, 54.84±6.64 cm, 3.54±0.391 cm, 3.46±0.44 cm, 1.7±0.15 cm respectively) and these results were illustrated in (Table 1).

Results of the same parameters in adult, male, female, overall combined bats also were illustrated in (Table 1).

Mean morphometric measures in table (1) show statistical significance between young and adult bats in all morphometric measurements, but Statistical no significance between male and female bats in all morphometric measurements, adult higher than young in all measures and male higher than female.

Neonates (1 female and 4 male) Body weight 22.3±3.9 g, forearm 4.42±1.11 cm, body length 8.12±1.06 cm, wingspan 29.6±6.6 cm, arm 2.26±0.6 cm, leg 2±0.5 cm, thumb 0.94±0.17cm. with closed eye and furless.

Table (1) mean morphometric measurements for different age and sex of bats.

M. measurements	Young (n=19)	Adult (n=36)	Male (n=25)	Female (n= 30)	Combined mean(n=55)
Body weight (g)	75.29±28.69	130±18.14**	113.7±40.17	108.9±29.03	111.1±34.29
Forearm (cm)	7.84±0.766	9.23±0.36**	8.74±0.99	8.75±0.73	8.74±0.85
body length (cm)	12.69±1.58	15.08±0.74**	14.28±1.69	14.24±1.5	14.26±1.58
Wingspan(cm)	54.84±6.64	64.53±2.73**	60.92±7.19	61.4±5.79	61.18±6.41
Arm (cm)	3.54±0.391	4.07±0.23**	3.92±0.45	3.85±0.33	3.88±0.38
Leg (cm)	3.46±0.44	4.06±0.27**	3.81±0.52	3.8±0.37	3.85±0.44
Thumb (cm)	1.7±0.15	2.20±0.38**	2.08±0.48	1.98±0.32	2.03±0.39

M. measurements= Morphometric parameters (Mean ± SD)
** high significant differences (P < 0.001)

This study results showed; RBC, HCT, HB, MCV, MCHC, MCH, PLT, WBC, Neutrophil, Lymphocyte, Monocyte, Esinophile and Basophil in young Egyptian Fruit Bat were (8.97±2.64, 41±8.057, 13.81±2.41, 49.19±11.67, 33.65±4.84, 16.35±3.58, 272±123.4, 7.233±3.55, 48.63±12.32, 48.36±10.29, 2.25±0.886, 4±5.806, 0±0 respectively) and these results were illustrated in (Table 2).

Results of the same parameters in adult, male, female, overall combined bats also were illustrated in (Table 2).

Mean hematological values in table (2) showed statistical significance between young and adult bats in RBC, MCV, Eosinophil and no Statistical significance between male and female, adult higher than young in HCT, HB, MCV, MCH, Monocyte, Basophile and male higher than female in all values except in Platelets and Basophil.

Statistical significance between manual and automated hematology in all parameters except WBC and Basophil, automatic method higher than manual method in RBC, HB, MCHC, Platelets, Lymphocyte and Monocyte and equal in WBC.

Table (2) mean hematological values for different age and sex of bats, manual and automatic hematology mechanisms.

H. measure	Young (n=8)	Adult (n=31)	Male (n=17)	Female (n=22)	All manual mean(n=39)	All automatic mean (n=37)
RBC (10^{12}/l)	8.97±2.64*	6.741±2.38	7.43±2.68	7.02±2.52	7.19±2.56	8.82±0.78**
HCT (%)	41±8.057	43.26±6.77	43.35±7.52	42.6±6.67	42.93±6.97*	39.6±4.74
HB (g/dl)	13.81±2.41	14.04±1.87	14.17±1.66	13.85±2.18	13.99±1.96	14.25±1.71**
MCV (fl)	49.19±11.67	69.4±24.86	65.52±22.76	65.05±25.63	65.25±24.11**	39.83±3.54
MCHC(g/dl)	33.65±4.84	31.63±6.33	33.1±3.28	31.24±7.51	32.05±6.05	35.88±2.26**
MCH (pg)	16.35±3.58	22.76±9.122*	21.68±8.06	21.27±9.28	21.45±8.66**	13.99±1.00
PLT(10^9/l)	272±123.4	180.5±112.1	193.1±110.8	204±127.1	199.3±118.9	396±280**
WBC (10^9/l)	7.233±3.55	6.775±4.103	7.86±4.19	6.10±3.67	6.87±3.96	6.86±3.15
Neutro(%)	48.63±12.32	47.81±12.21	48.18±12.51	47.82±12.01	47.97±12.07**	9.73±8.51
Lympho(%)	48.36±10.29	47±13.28	47.59±11.92	47.14±13.41	47.33±12.62	81.19±14.44**
Mono (%)	2.25±0.886	3.355±2.36	3.18±1.74	3.09±2.51	3.13±2.18	8.97±6.66**
Eosino (%)	4±5.806	1.355±1.55	2.77±4.16	1.23±1.54	1.89±3.03**	0.14±0.35
Baso(%)	0±0	0.032±0.18	0±0	0.05±0.21	0.026±0.16	0±0

H. measur = Hematological measurements (Mean ± SD)
* significant difference ($P < 0.05$) ** high significant difference ($P < 0.001$)

This study results showed; AST, ALT, Total protein, Albumin, Globulin, A/G ratio, Total calcium, Phosphorus, Creatinine, Urea, BUN, Triglycerides, Cholesterol and Glucose in young Egyptian Fruit Bat were (149.2±58.47, 136.9±97.48, 68.23±13.73, 36.96±10.3, 31.27±5.874, 1.201±0.341, 1.816±0.313, 2.752±1.901, 88.53±33.9, 4.075±2.299, 1.901±1.075, 0.69±0.316, 0.267±0.141, 3.177±1.513 respectively) and these results were illustrated in (Table 3).

Results of the same parameters in adult, male, female, overall combined bats also were illustrated in (Table 3).

Mean biochemical values in table (3) showed statistical significance between young and adult bats in triglyceride and Statistical significance between male and female in total calcium and cholesterol, adult higher than young in AST, globulin, total calcium, creatinine, glucose and male higher than female in AST, albumin, A/G ratio, creatinine, urea and BUN.

Table (3) mean biochemical values for different age and sex of bats.

B. measurements	Young (n=8)	Adult (n=31)	Male (n=17)	Female (n=22)	Combined mean(n=(39)
AST (IU/l)	149.2±58.47	237.7±209.4	239.9±261.1	203.78±116.78	219.5±191.2
ALT (IU/l)	136.9±97.48	110.1±72.62	96.98±72.82	130.03±79.88	115.6±77.68
Total protein(g/l)	68.23±13.73	65.93±9.966	66.21±10.19	66.55±11.28	66.4±10.68
Albumin (g/l)	36.96±10.3	34.04±5.703	35.34±7.02	34.09±6.79	34.63±6.83
Globulin (g/l)	31.27±5.874	31.64±7.056	30.88±6.99	32.09±6.68	31.56±6.76
A/G ratio	1.201±0.341	1.118±0.339	1.19±0.29	1.09±0.36	1.14±0.33
T.ca (mmol/l)	1.816±0.313	1.853±0.425	1.65±0.32	1.99±0.39*	1.85±0.40
Phosphorus (mmol/l)	2.752±1.901	2.135±1.412	1.87±1.17	2.57±1.70	2.26±1.52
Creatinine (mmol/l)	88.53±33.9	114.4±41.43	110.2±40.62	108.25±42.17	109.1±40.97
Urea (mmol/l)	4.075±2.299	3.955±3.75	4.51±5.003	3.57±1.54	3.98±3.48
BUN (mmol/l)	1.901±1.075	1.845±1.752	2.11±2.34	1.67±0.72	1.86±1.62
TG(mmol/l)	0.69±0.316*	0.527±0.113	0.52±0.07	0.59±0.23	0.56±0.18
CHO (mmol/l)	0.267±0.141	0.254±0.125	0.19±0.06	0.31±0.18*	0.26±0.15
Glucose(mmol/l)	3.177±1.513	5.931±3.903	5.31±3.75	5.41±3.76	5.37±1.70

B. measurements = Biochemical measurements (Mean ± SD)
* significant difference ($P < 0.05$) T. ca = total calcium
TG = triglycerides CHO = cholesterol
BUN = blood urea nitrogen A/G ratio = albumin / globulin ratio

Discussion

The mean Body weight of adult Egyptian fruit bat (*Rousettus aegyptiacus*) is (130±18.14) cm, this is lower than mean of same species which reported by (Arad and Korine, 1993), Who estimate its Body weight equal (147.99±8.80, range 140-160 g). and (Amari, 2022) estimate its Body weight equal (100-150 g), and (Lik et al., 2018) reported that adult Egyptian fruit bat (Rousettus aegyptiacus) body weight mean 169,47g with range (115-210).

The mean Body weight of overall Egyptian fruit bat (*Rousettus aegyptiacus*) is (111.1±34.29) which lower than (Eshar et al., 2017) who estimate overall Body weight equal (140±23g), and (Meropi et al., 2003) estimate overall Body weight (135.6 ± 8.1) g.

The mean wingspan of male and female Egyptian fruit bat (*Rousettus aegyptiacus*) is (60.92±7.19 and 61.4±5.79 respectively) disagree with (Lik et al., 2018) who reported that Egyptian fruit bat (Rousettus aegyptiacus) male and female wingspan mean (58,85 and 54,69 respectively) cm.

The mean forearm of adult Egyptian fruit bat (*Rousettus aegyptiacus*) is (9.23±0.36) cm, this is higher than result of same species which reported by (Selim and El Nahas, 2015), Who estimate its forearm equal (80 (79.4–82.5)) mm.

The mean body length of adult Egyptian fruit bat (*Rousettus aegyptiacus*) is (15.08±0.739) cm, this is higher than result of same species which reported by (Selim and El Nahas, 2015), Who estimate its body length equal (93 (88.5–95)) mm. and Lik et al., (2018) who reported that adult Egyptian fruit bat (Rousettus aegyptiacus) body length mean 13,38 cm with range (11,00- 15,02).

The mean hind foot (leg) of adult Egyptian fruit bat (*Rousettus aegyptiacus*) is (4.058±0.273) cm, this is higher than result of same species which reported by (Selim and El Nahas, 2015), Who estimate its hind foot (leg) equal (35.5 (34.2–36)) mm.

The present study agrees with (Bamidele et al., 2020) who reported that Straw-coloured fruit Bat (Eidolon helvum) male higher than female in morphometric parameters (body weight, forearm, body length and leg)

Body weight of neonate 22.3±3.9 g agrees with (Jacobsen and DuPlessis, 1976; Mutere, 1968; Noll, 1979) who reported that Weights of neonates are 18–24 g.

Weight is a good indicator of bat condition as maturity, reproduction state and amount of body fat (Kamins et al., 2011).

External morphology is usually used to identify bats, to investigate flight and foraging behaviour. While Forearm, Body length and Body weight be used to determine the age and maturity of the fruit bats, Forearm is the most vital measurement reflecting overall size of bat (Kruskop, 2013)

Haematocrit (HCT) and Haemaglobin (HB) in adult Egyptian fruit bat (*Rousettus aegyptiacus*) (43.26±6.765, 14.04±1.868 respectively) are lower than HCT and HB in the same species which reported by (Arad and Korine, 1993) who estimate (50.22±1.97, 17.65± 1.23 respectively). MCV and MCH values in adult bats (69.4±24.86, 22.76±9.122 respectively) higher than it is values in young bats (49.19±11.67, 16.35±3.582 respectively), this agree with (Edson, D, et al 2018). And reported that RBC, WBC, lymphocyte and neutrophil count in young bats (8.97±2.64, 7.233±3.546, 48.36±10.29, 48.63±12.32 respectively) higher than their values in adult bats (6.741±2.375, 6.775±4.103, 47±13.28, 47.81±12.21 respectively), but disagree with him in monocyte count as young bats (2.25±0.886) lower than the adult bats (3.355±2.36).

Heard and Whittier, (1997); Edson et al., (2018) report that the higher leukocyte counts in young bats reflects a maturation of the immune system.

In the present study, there is positive correlation in HB, HCT between young and adult Egyptian fruit bat (*Rousettus aegyptiacus*) which agree with (McMichael et al., 2015) who reported that It is a positive correlation some between black flying-foxes, (Pteropus alecto) age and heamogram as Hb, HCT, and disagree with him in RBCs, MCHC and neutrophil.

The high HCT values, RBC counts, and HB concentrations in bats are probably necessary to meet the oxygen requirements of active flight (Maina, 2000).

In the present study, there is negative correlation in total leukocyte counts and lymphocyte between young and adult Egyptian fruit bat (*Rousettus aegyptiacus*) which agree with (McMichael et al., 2015) who reported that It is a negative correlation some between black flying-foxes, (Pteropus alecto) age and heamogram as total leukocyte counts and lymphocyte, and disagree with him in monocyte.

Edson et al., (2018) reported that with respect to age, the reference values largely change between age classes with a few exceptions.

Female higher than male in platelet counts (PLT) (204±127.1, 193.1±110.8 respectively), which agree with (McMichael et al., 2015), and disagree with him in MCH, MCHC and neutrophil counts in black flying-foxes (Pteropus alecto).

WBC, Lymphocyte and monocyte counts in female (6.10±3.67, 47.14±13.41, 3.09±2.51 respectively) lower than their value in male (7.86±4.19, 47.59±11.92, 3.18±1.74 respectively) which disagree with (Edson et al., 2018) who reported that Female bats higher WBC, lymphocyte, and monocyte counts than male bats.

Present study agrees with (Kuzel, 2020) who reported that male great fruit-eating bat (Artibeus lituratus) higher than female in WBC, RBC, HB, Neutrophil, Lymphocyte and monocytes but male Artibeus lituratus less female in Platelet count. And agree with (Olayemi et al., 2006) who reported that male African Fruit Bat (Eidolon Helvum) higher than female in RBC, HCT, HB, MCV, WBC, Neutrophil, Esinophil and monocyte. And agree with (Anosike et al., 2020) who reported that adult Straw-Coloured Fruit Bats (Eidolon helvum) higher than young in HCT, HB, MCV and lower than young in MCHC and Lymphocyte, male African Fruit Bat (Eidolon Helvum) higher than female in RBC, HCT, HB, MCV and lower than female in Basophil.

The higher values in erythrocytes and hematocrit in males are due to the presence of androgenic hormone, which stimulates the kidney to produce erythropoietin, which controls red blood cell production. Testosterone may be activating erythropoiesis by stimulating erythropoietin production (He et al., 2017; Mirand et al., 1965). Rocha et al., (2014) reported that androgen products stimulate erythropoiesis and increase iron availability, erythrocyte and hematocrit values. And in the other side, cases of anemia (decrease in erythrocytes) may occur in the presence of renal failure (López and Macaya, 2009). In addition, the increase in erythrocytes and hematocrit may also be due to the feeding behavior of the species.

High monocytes count indicates chronic inflammation; it is may be a normal phenomenon. The mean percentage of monocytes is high in all bat’s species (Riedesel, 1977).

Edson et al., (2018) reported that the differences between males and females are unlikely to represent clinical differences and more likely reflect lifecycle physiologic changes.

Exposure to cold lead to increased hematocrit and hemoglobin levels (Horton, 1981; Lochmiller et al., 1985) and in increased triglyceride level (Alfaro et al., 1994; Korine et al., 1999)

The blood profile affects by stress when capturing, handling and sampling the bats (Widmaier and Kunz, 1993; Koopman et al., 1995; Korine et al., 1999)

Blood parameters in the Chiroptera have mainly focused on hematological composition. Bats are characterized by high hematocrit and hemoglobin levels than terrestrial mammals (Lewis, 1977; Jürgens et al., 1981; Arevalo et al., 1987, 1992; Wightman et al., 1987; Viljoen et al., 1997; Korine et al., 1999)

Comparison between manual and automated hematology resulted in RBC, HB, MCHC, Platelets, Lymphocyte and Monocyte higher in automatic than manual method. Agree with (Shamila et al., 2019) who reported that RBC, HB, Platelets, Lymphocyte, Monocyte higher in automatic than manual methods and Neutrophil lower in automatic than manual method but disagree with (Shamila et al., 2019) who reported that HCT, MCV, MCH, Eosinophil and Basophil higher in automatic than manual method, and MCHC lower in automatic than manual method.

Blood hematology give a rapid estimation of quantitative and qualitative alteration in different blood cells (RBC, WBC and platelets) (Mehain et al., 2019; Rejec et al., 2017). Leukocytes (WBC) (total and differential) are widely used in the clinical process to determine the inflammatory response (Willard and Tvedten, 2012). This relationship between WBC and inflammatory response makes the number of WBCs an important measurement for etiology, diagnosing, prognosis, treatment, prevention of various diseases. (Chung et al., 2015).

Automated methods can count large numbers of cells. The most important feature of these devices is that they give results quickly compared to manual methods and minimize the number of smears to be examined. various devices are used in human and veterinary medicine. It is expensive as it requires special equipment (Stirn et al., 2014). These devices measure based on the number of cells, size, surface area, and properties as inside granules. Because of these features, they may sometimes not be able to distinguish normal cells from abnormal ones and may cause incorrect counts in case of abnormal cells (Platelet aggregation, giant platelets, any erythrocytes abnormalities) are present (Putzu and Di Ruberto, 2013). The cells should be examined by doing a peripheral smear to confirm the results of the device and identify morphological abnormalities (Jones and Alison, 2007).

RBC count was statistically significant when measured with the automated method compared to the traditional manual method suggesting the passage of two or more RBC through the “flow cell”, which is called “coincidence” causing a higher number than in the sample (Lee et al., 2012). Upon noticing the rates of haemoglobin concentration, it is observed that they are increased in the samples when measured with the automatic method as compared to the traditional manual method (Shamila et al., 2019). When impedance technology is used for platelet and erythrocyte count, Microcytes or fragmented Erythrocyte may be counted as platelets (Shamila et al., 2019)

Manual microscopic blood examination should always be used to confirm the automated methods. Delayed analysis of blood samples produces art factual changes, in MCV, PCV, platelet count, MPV and red blood cell morphology. It is preferred to measure hematologic parameters shortly after collection. In the case of delayed analysis, specimens should be stored in the refrigerator and care must be taken to prevent misinterpret art factual changes as pathologic findings (Shamila et al., 2019)

In the present study, overall BUN (1.86±1.62) mmol/l slightly higher than result reported by (Eshar et al., 2017) who estimate BUN as (1.79±3) mmol/l in Egyptian fruit bat (*Rousettus aegyptiacus*).

In the present study, urea (3.955±3.75) higher than result reported by (Arad and Korine, 1993) who estimate urea as (2.67±1.37), and Total protein (65.93±9.966) lower than his result (80.19± 1.21) g/l in adult (male and female) Egyptian fruit bat (*Rousettus aegyptiacus*).

ALT level in young bats (136.9±97.48) higher than its level in adult bats (110.1±72.62), which agree with (McMichael et al., 2015) who report that

ALT levels were also increased in young black flying-foxes (Pteropus alecto). While ALT activity tends to be relatively specific to hepatic parenchymal cells, the higher ALT values in the juvenile were representative of physiologic status and altered enzyme activity related to growth (McMichael et al., 2015)

AST level in adult bats (237.7±209.4) higher than its level in young bats (149.2±58.47), AST is found in a wide range of tissues, including the liver, heart, brain, skeletal muscle and erythrocytes, elevated AST can be an indicator of capture myopathy (Clarke et al., 2013)

In the present study, globulin and creatinine levels in adult bats (31.64±7.056, 114.4±41.43 respectively) higher than their levels in young bats (31.27±5.874, 88.53±33.9 respectively), this agree with (McMichael et al., 2015) who reported that globulin and creatinine values increased with maturity, it is a positive correlation in globulin and creatinine between young and adult Egyptian fruit bat (*Rousettus aegyptiacus*), and disagree with him in Total protein as young higher than adult (68.23±13.73, 65.93±9.966 respectively), which a negative correlation between young and adult Egyptian fruit bat (*Rousettus aegyptiacus*).

Albumin to globulin ratio (A/G ratio) and triglycerides levels in young (1.201±0.341, 0.69±0.316 respectively) higher than their levels in adult (1.118±0.339, 0.527±0.113 respectively), this agree with (McMichael et al., 2015) who reported that Albumin to globulin ratio (A/G ratio) and triglycerides values decreased with maturity, it is a negative correlation in globulin and creatinine between young and adult Egyptian fruit bat (*Rousettus aegyptiacus*)

Globulin, creatinine values in adult bats (31.64±7.056, 114.4±41.43 respectively) higher than their values in young bats (31.27±5.874, 88.53±33.9 respectively), this agree with (Edson et al., 2018), but disagree with him in total protein and alanine transferase (ALT) values in adult bats (65.93±9.966, 110.1±72.62 respectively) lower than young bats (68.23±13.73, 136.9±97.48 respectively) and urea consider equal in young and adults (4.075±2.299, 3.955±3.75 respectively).

Roulston et al., (2000); Churchill, (2008.) reported that the higher mean urea and creatinine values reflect suboptimal nutrition and muscle catabolism.

Edson et al., (2018) reported that the higher urea in adults reflect changing food resources and increased physiologic demand of foraging as animals mature. Edson et al., (2018) reported that with respect to age, the reference values largely change between age classes with a few exceptions.

Glucose, triglyceride and cholesterol levels in female bats (5.41±3.76, 0.59±0.23, 0.31±0.18 respectively) higher than its level in male bats (5.31±3.75, 0.52±0.07, 0.19±0.06 respectively), which agree with (McMichael et al., 2015) who report that glucose, triglyceride and cholesterol levels were higher in females than males black flying-foxes (Pteropus alecto).

Albumin, albumin to globulin ratio (A/G ratio) and creatinine in male bats (35.34±7.02, 1.19±0.29, 110.2±40.62 respectively) higher than its level in female bats (34.09±6.79, 1.09±0.36, 108.25±42.17 respectively), which agree with (McMichael et al., 2015) who report that Males black flying-foxes (Pteropus alecto) higher in Albumin, albumin to globulin ratio (A/G ratio) and creatinine levels compared to females, but disagree with him in ALT, calcium, phosphorous levels as male (96.98±72.82, 1.65±0.32, 1.87±1.17 respectively) lower than its level in female bats (130.03±79.88, 1.99±0.39, 2.57±1.70 respectively), May because (McMichael et al., 2015) report his values in wild Black flying-foxes (*Pteropus alecto*).

ALT and glucose in male bats (96.98±72.82, 5.31±3.75 respectively) lower than their values in female bats (130.03±79.88, 5.41±3.76 respectively), this disagree with (Edson et al., 2018) who reported that male bats had higher ALT and glucose than female bats, may because (Edson et al., 2018) report his values in grey-headed flying fox (*Pteropus poliocephalus*).

Edson et al., (2018) reported that the differences between males and females are unlikely to represent clinical differences and more likely reflect lifecycle physiologic changes.

Specific blood parameters may affect when animals are exposed to cold and to low-quality food. For example, in response to energy and nitrogen shortage, blood urea nitrogen (BUN) and creatinine levels increase, while total nitrogen and albumin decrease (Nieminen, 1980; Hellgren et al., 1988; Alfaro et al., 1994; Del Giudice et al., 1994; Wolkers et al., 1994; Korine et al., 1999)

Blood parameters of *Rousettus aegyptiacus* in captivity result in glucose and triglyceride levels changed daily and in the opposite side, high glucose levels in the morning and high triglyceride levels in the evening (Westhuyzen, 1978). (Korine et al., 1999) reported that cholesterol may change, as a function of the diet (Lenz et al., 1976; Carroll and Kurowska, 1995; Widmaier et al., 1996; Heard and Whittier, 1997), glucose level changes after a meal (Westhuyzen, 1978), calcium (Van et al., 1993; Korine et al. 1999)

Widmaier and Kunz, (1993); Korine, et al. (1999) reported that glucose and steroid hormones daily changes, glucose levels were within the normal range for mammals, the steroid levels in these species were the highest ever recorded in mammals.

Conclusion

For the last three-decade bats have been in the focus of many research projects and the knowledge in the field of taxonomy, ecology and distribution of species has increased extraordinarily. Egyptian Fruit Bat (Rousettus aegyptiacus) is a small animal widely distributed in Egypt across Nile Delta and Valley, Rousettus aegyptiacus has great benefits as it plays an important role in pollination and seed disperser also their guano used as biological fertilizers, on the other hand it is sometimes become harmful as it consumes large quantity of fruit and it act as source of various infectious agents which transported to human and other wild or domestic animals. Studies on Egyptian Fruit Bat (Rousettus aegyptiacus) are lack and insufficient, so that the present study aimed to evaluation different parameters of this bat species and effect of sex and age of these parameters. Egyptian Fruit Bat (*Rousettus aegyptiacus*), it is a nocturnal, frugivorous and only flying mammals. 60 bats of different age and sex conducted to evaluation these parameters. Ruler, meter and electronic balance used in morphometric parameters which show significant difference between different age and no effect of sex with overall (male, female, young and adult) range of body weight (33-170), forearm (6.5-10.1), body length (10-16.5), wingspan (42-72) neonate rang of body weight (16-36.5), forearm (3-5.6), body length (6.7-9.6), wingspan (21-

35), Hemocytometer used in hematological parameters which show significant difference between different age in RBC, MCV, Eosinophil and no effect of sex with overall range of RBC (3.08-13), WBC (1.7-17.5), Platelets (25-478), HB (8.8-16.8), compared between manual hemocytometer method and automatic hematology analyzer method which show Statistical significance in all parameters except WBC and Basophil. Spectrophotometer used in biochemical parameters which show significant difference between different age in triglyceride and significant difference between different sex in total calcium and cholesterol with overall range of AST (6.4-376.6), total calcium (1.08-2.52), urea (1.91-23.66), cholesterol (0.07-0.71) and glucose (0.53-16.01).

This thesis concludes that, age effect on all morphometric, some hematological and some biochemical parameters. Sex does not affect on morphometric and hematological parameters but effect on some biochemical parameters.

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