TÜBİTAK

Turkish Journal of Zoology

http://journals.tubitak.gov.tr/zoology/

Research Article

Turk J Zool
(2016) 40: 388-391
© TÜBİTAK
doi:10.3906/zoo-1509-46

Some hematological parameters in *Myotis myotis* and *Myotis blythii* (Mammalia: Chiroptera) in Turkey

İrfan ALBAYRAK*, Hava BAĞATUR ÖZCAN, Merve BAYDEMİR
Department of Biology, Faculty of Science and Arts, Kırıkkale University, Yahşihan, Kırıkkale, Turkey

Received: 22.09.2015 • **Accepted/Published Online:** 08.12.2015 • **Final Version:** 07.04.2016

Abstract: In this study the reference ranges belonging to some hematological parameters of *Myotis myotis* and *Myotis blythii*, collected from three localities in Turkey in 2012 and 2013, are given for the first time. Bats were caught using a special bat net and they were released after the required amount of blood sample was taken. In *Myotis myotis*, erythrocyte diameter was recorded as 5.04 µm and the number of erythrocytes and leukocytes in 1 mm^3 of blood was 11.35×10^6 and 4865, respectively. While the hemoglobin level was 14.9 g/dL, the hematocrit value was measured as 57.0%. The other values were as follows: mean cell volume (MCV) 52.40 fL, mean cell hemoglobin (MCH) 13.70 pg, mean cell hemoglobin concentration (MCHC) 23.30%, and amount of total protein 10.5 g/L. In *Myotis blythii* specimens, erythrocyte diameter was recorded as 5.69 µm and the number of erythrocytes and leukocytes in 1 mm^3 of blood was 14.52×10^6 and 4296, respectively. While the hemoglobin level was 13.09 g/dL, the hematocrit value was measured as 60.20%. The other values measured as follows: MCV 43.67 fL, MCH 9.70 pg, MCHC 21.70%, and amount of total protein 10.625 g/L.

Key words: Hematology, blood cells, *Myotis myotis*, *Myotis blythii*, Turkey

1. Introduction

There are 1116 species belonging to 202 genera and 18 families of bats, known as flying mammals. Of these families, Vespertilionidae, known as the vesper bats, is represented by 48 genera and 407 species (Simmons, 2005).

Myotis myotis and *Myotis blythii* are spread over the Palearctic Region. Many morphological, taxonomical, and biogeographic studies have been conducted concerning both species in Turkey (Zimmermann, 1953; Kahmann and Çağlar, 1960; Osborn, 1963; Çağlar, 1965; Deblase and Martin, 1973; Albayrak, 1985, 1990, 1993; Helversen, 1989; Harrison and Bates, 1991; Spitzenberger, 1996; Albayrak and Aşan, 2001).

Myotis myotis and *Myotis blythii* are insectivorous and sympatric species that are regarded as 'sibling species'. Many hematological studies on bat species exist in the literature (Jurgens et al., 1981; Basset and Wiederhielm, 1984; Arvelo et al., 1987; Wightman et al., 1987; Wolk and Bogdanowicz, 1987; van der Westhuyzen, 1988; Wolk and Ruprecht, 1988; Korine et al., 1999; Ratnasooriya et al., 2005; Rodriguez-Duran and Padilla-Rodriguez, 2008; Schinnerl et al., 2011). However, there has been no hematological study of the bat species in Turkey.

Plasma biochemistry parameters and hematological analyses of wild-caught animals may be used to analyze population health and can serve as indicators of poor nutritional status, diseases, trauma, and environmental changes, such as altered habitat quality. These values have been used to guide the management of captive and wild populations (Hossain et al., 2013).

The purpose of this study is to determine and compare the results of some hematological analyses in two different bat species in Turkey.

2. Materials and methods

For this study, 19 bat specimens were collected from Balıkesir (*Myotis myotis*: 2 males), Kırıkkale (*Myotis myotis*: 5 males, 2 females; *Myotis blythii*: 3 males, 5 females), and Hatay (*Myotis blythii*: 2 males) provinces of Turkey. Blood samples of specimens were obtained in the laboratory within 1 day of their capture. Samples were taken from the veins extending to the upper arm or from the veins extending to the femur and tibia in the tail membrane, via heparinized hematocrit capillaries (Wimsatt, 2005). After the procedures were performed, the bats were released back into the same localities.

The red blood cell (RBC) counts and white blood cell (WBC) counts were determined using a Neubauer

* Correspondence: iralbayrak@yahoo.com

hemocytometer where standard Hayem's solution for RBCs and Turk's solution for WBCs were used as diluting solutions. The hematocrit (HCT) value was determined by the microhematocrit method. The tubes were spun in a microhematocrit centrifuge for 5 min at 13,000 rpm and the packet cell volume was calculated with a hematocrit reader. Hemoglobin (Hb) concentration was measured with a Sahli hemometer, in which 100% corresponds to 14.5 g Hb/100 mL of blood. The mean cell volume (MCV), mean cell hemoglobin (MCH), and mean cell hemoglobin concentration (MCHC) were calculated according to Wintrobe's formula (1933) and the method of Tanyer (1985).

Blood smears stained with Wright's stain were used in describing the morphology and size of the blood cells. However, erythrocyte diameters were measured using a MOB-1-15x micrometric ocular. The blood samples were centrifuged at 3000 rpm for 10 min and it was ensured that the plasma section was isolated from the blood cells. The serum total protein quantity in the plasma was measured using a refractometer (Tanyer, 1985). Statistical analyses were performed with SPSS 10.00.

3. Results

The hematological values of males and females in both species were pooled as there were no significant sexual differences in any of the measured parameters. Our results were compared in terms of erythrocyte diameter as well as some clinical hematology parameters between the two species.

In all samples of analyzed blood smear preparations stained with Wright's stain, erythrocytes were biconcave disks. Cytoplasm of erythrocytes stained with Wright's stain was pink. *Myotis myotis* specimens' erythrocyte mean diameter was 5.04 µm, while that of *Myotis blythii* specimens was 5.69 µm.

In *Myotis myotis* specimens, the mean erythrocyte count was $11.35 \times 10^6/mm^3$, leukocyte count was 4865/mm^3, and Hb level and HCT values were 14.9 g/dL and 57%, respectively. The leukocyte count, Hb, MCV, MCH, and MCHC values of *Myotis myotis* specimens were greater than those of *Myotis blythii* specimens. The total protein values were similar in the two species (Table 1).

In *Myotis blythii* specimens, erythrocyte and leukocyte counts were $14.52 \times 10^6/mm^3$ and 4296/mm^3, respectively, while Hb level was 13.09 g/dL and HCT level was 60.20%. The erythrocyte counts and HCT values of *Myotis blythii* specimens were greater than those of *Myotis myotis* (Table 1).

4. Discussion

Erythrocyte diameters of *Myotis myotis* and *Myotis blythii* specimens were almost the same. The HCT values and erythrocyte counts in *Myotis myotis* were found to be lower than those of *Myotis blythii*. Leukocyte count, Hb, MCV, MCHm and MCHC values in *Myotis myotis* were greater than those of *Myotis blythii*. The total protein values were similar in these species (Table 2).

Data of our *Myotis blythii* specimens for erythrocyte diameter are similar to those of *Myotis daubentonii* given by Wolk and Bogdanowicz (1987), but values for erythrocyte counts and HCT values are higher. Data on *Myotis blythii* specimens for leukocyte count, Hb, MCV, MCH, and MCHC values were found to be lower than those of *Myotis daubentonii* (Wolk and Bogdanowicz, 1987). Some hematological values of *Myotis myotis* were compared to the values given for the same species by Arvelo et al. (1987); RBC count, hematocrit, and MCV were higher, while MCH and MCHC values were found to be lower. However, comparing the hematological values of both *Myotis myotis* and *Myotis blythii* to those of previous studies (Jurgens et al., 1981; Arvelo et al., 1987; Wolk and Bogdanowicz, 1987; Schinnerl et al., 2011), they are generally found to be of similar value, except for variances (Table 2).

Table 1. Blood cell measurements and clinical hematology data in *Myotis myotis* and *Myotis blythii* specimens (N: Number of specimens, Min: minimum value, Max: maximum value, M: mean, SD: standard deviation, SE: standard error).

Parameters	*Myotis myotis*					*Myotis blythii*				
	N	Min–Max	M	SD	SE	N	Min–Max	M	SD	SE
Erythrocyte diameter (µm)	7	4.50–7.00	5.04	0.53	-	9	4.50–7.00	5.69	0.46	-
RBCs (/mm^3)	8	8,760,000–16,300,000	11,350,000	2,479,216	876,535.4	9	10,360,000–19,140,000	14,526,666	3,101,628.6	1,033,876.2
WBCs (/mm^3)	8	3000–6400	4865	1137	401.9	9	1866–7133	4296	1991.22	663.74
Hb (g/dL)	8	11.9–19.2	14.9	2	0.8	10	10.20–17.20	13.09	1.95	0.62
HCT (%)	8	0.52–0.62	57	-	-	10	49.00–69.00	60.20	5.90	1.87
MCV (fL)	8	37.42–64.77	52.40	10	3.6	9	32.92–66.60	43.67	10.93	3.64
MCH (pg)	8	9.45–19.00	13.7	4	1.3	9	6.20–16.60	9.70	3.18	1.06
MCHC (%)	8	9.8–27.9	23.30	3	1.1	10	16.45–24.93	21.70	2.39	0.76
Total Pr (g/L)	8	9.2–14.7	10.5	2	0.7	9	9.40–11.90	10.62	0.81	0.27

Table 2. Some hematological parameters from previous studies for different *Myotis* species (all abbreviations are explained in Section 2).

Literature	Species	Erythrocyte diameter (μm)	RBCs ($\times 10^6$/mm^3)	WBCs (/mm^3)	Hb (g/dL)	HCT (%)	MCV (fL)	MCH (pg)	MCHC (%)
Present study	*M. blythii*	5.69	14.52	4296	13.09	60.20	43.67	9.70	21.70
Present study	*M. myotis*	5.04	11.35	4865	14.9	57	52.40	13.7	23.30
Wolk and Bogdanowicz, 1987	*M. daubentonii*	5.80	10.55	5345	15.4	48.9	47.75	15.10	31.50
Arvelo et al., 1987	*M. nattereri*	-	12.59	-	20.06	59.78	47.74	15.82	33.60
	M. myotis	-	9.31	-	15.80	43.30	46.79	17.08	36.73
Schinnerl et al., 2011	*M. elegans*	-	-	2045	-	56.50	-	-	-
	M. nigricans	-	-	5133	-	49.75	-	-	-
Jurgens et al., 1981	*M. myotis*	-	11.0	3300	18.4	51	46.4	16.7	36.0

Changes in the hematological values in circulatory systems can be related to many factors such as sex, age, physiological period, and environment. Leukocyte counts in bats show wide variations in terms of reproductive period, sex, age, and size (Valdivieso and Tamsitt, 1971; Ratnasooriya et al., 2005), because of the necessity to sustain the energy requirements of flight and the high oxygen-carrying capacity. This is shown mainly in high HB content, relatively high count of RBCs, and high HCT values (Wolk and Bogdanowicz, 1987). We cannot make any comparison of total plasma protein due to a lack of data in the relevant literature.

In conclusion, reference ranges have been given for the first time for some hematological parameters in *Myotis myotis* and *Myotis blythii*, which have a wide range of distribution in Turkey.

Acknowledgments

This study is a part of two master theses and was funded by the Coordination Unit of Scientific Research Projects of Kırıkkale University (BAP, Project No: 2012/07). We thank Ç Gül for technical assistance during the laboratory studies.

References

Albayrak İ (1985). Researches on bats of Ankara province (Mammalia: Chiroptera). Communications de la Faculté des sciences de l'Université d'Ankara 3(C): 1–20.

Albayrak İ (1990). Doğu Anadolu yarasaları ve yayılışları (Mammalia: Chiroptera). Doğa Tr Zool 14: 214–228 (in Turkish).

Albayrak İ (1993). Batı Türkiye yarasaları ve yayılışları (Mammalia: Chiroptera). Doğa Tr J Zool 17: 237–257 (in Turkish).

Albayrak İ, Aşan N (2001). The structure of baculum in *Myotis myotis* and *Myotis blythii* (Chiroptera: Vespertilionidae) from Turkey. Turk J Zool 25: 229–233.

Arvelo F, Perez-Suarez G, Lopez-Luna P (1987). Hematological data and hemoglobin component in bats (Vespertilionidae). Comp Biochem Physiol 88A: 447–450.

Bassett JE, Wiederhielm CA (1984). Postnatal changes in hematology of the bat *Antrozous pallidus*. Comp Biochem Physiol 78A: 737–742.

Çağlar M (1965). Türkiye'nin Chiroptera faunası. Fen Fakültesi Döner Sermayesi Basımevi İstanbul Seri B 30: 125–134 (in Turkish).

Deblase AF, Martin LR (1973). Distributional notes on bats (Chiroptera: Rhinolophidae, Vespertilionidae) from Turkey. Mammalia 37: 598–601.

Harrison DL, Bates PJJ (1991). The Mammals of Arabia. 2nd ed. Sevenoaks, UK: Harrison Zoological Museum.

Helversen OV (1989). New records of bats (Chiroptera) from Turkey. Zool Middle East 3: 5–18.

Hossain MB, Islam MN, Yasin MG, Hassan MM, Islam SKMA, Khan SA (2013). Hematological profile of wild-captured Indian Flying Fox (*Pteropus giganteus*) in Bangladesh. International Journal of Natural Sciences 3: 12–17.

Jurgens KD, Bartels H, Bartels H (1981). Blood oxygen transport and organ weights of small bats and small non-flying mammals. Respir Physiol 45: 243–260.

Kahmann H, Çağlar M (1960). Beiträge zur Säugetierkunde der Türkei. 1- Fledermäuse aus der landschaft Hatay (eine vorläufige Mitteilung). İstanbul Üniversitesi Fen Fakültesi Mecmuası Seri B 25: 1–21 (in German).

Korine C, Zinder O, Arad Z (1999). Diurnal and seasonal changes in blood composition of the free-living Egyptian fruit bat (*Rousettus aegyptiacus*). J Comp Physiol B 169: 280–286.

Osborn DJ (1963). New distributional records of bats from Turkey. Mammalia 27: 210–217.

Ratnasooriya WD, Udagama-Randeniya PV, Yapa WB, Digana PMCB, Dharmasiri MG (2005). Haematological parameters of three species of wild caught microchiropteran bats, *Miniopterus schreibersii*, *Taphozous Melanopogon* and *Hipposideros lankadiva* in Sri Lanka. Journal of Science of University of Kelaniya 2: 27–40.

Rodriguez-Duran A, Padilla-Rodriguez E (2008). Blood characteristics, heart mass and wing morphology of Antillean bats. Carribbean J Sci 44: 375–379.

Schinnerl M, Aydinonat D, Schwarzenberger F, Voigt CC, (2011). Hematological survey of common neotropical bat species from Costa Rica. J Zoo Wildl Med 42: 382–391.

Simmons NB (2005). Order Chiroptera. In: Wilson DE, Reeder DM, editors. Mammal Species of the World: A Taxonomic and Geographic Reference. Vol. 1. Baltimore, MD, USA: Johns Hopkins University Press, pp. 312–529.

Spitzenberger F (1996). Distribution and subspecific variation of *Myotis blythi* and *Myotis myotis* in Turkey (Mamm., Vepertilionidae). Ann Naturhist Mus Wien 98 B (Suppl.): 9–23.

Tanyer G (1985). Hematoloji ve Laboratuar. Ankara, Turkey: Ayyıldız Matbaası AŞ (in Turkish).

Valdivieso D, Tamsitt JR (1971). Hematological data from tropical American bats. Can J Zool 49: 31–36.

Van der Westhuyzen J (1988). Haematology and iron status of the Egyptian fruit bat, *Rousettus aegyptiacus*. Comp Biochem Physiol 90 A: 117–120.

Wightman J, Roberts J, Chaffey G, Agar NS (1987). Erythrocyte biochemistry of the grey-headed fruit bat (*Pteropus poliocephalus*). Comp Biochem Physiol 88 B: 305–307.

Wimsatt J, O'Shea TJ, Ellison LE, Pearce RD, Price VR (2005). Anesthesia and blood sampling of wild big brown bats (*Eptesicus fuscus*) with an assessment of impacts on survival. J Wildl Dis 41: 87–95.

Wolk E, Bogdanowicz W (1987). Hematology of the hibernating bat: *Myotis daubentoni*. Comp Biochem Physiol 88A: 637–639.

Wolk E, Ruprecht AL (1988). Haematological values in the serotine bat, *Eptesicus serotinus* (Schreber, 1774). Acta Theriol 33: 545–553.

Zimmermann K (1953). Die Wildsaugern von Kreta. Das Gesamtbild der Sauger-Fauna Kretas Zeit Sauget 17: 67–72 (in German).