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Blood cell morphology of Turkish gekkonid lizards
(Squamata: Sauria: Gekkonidae, Phyllodactylidae)

Blutzellmorphologie türkischer Geckos
(Squamata: Sauria: Gekkonidae, Phyllodactylidae)

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KURZFASSUNG

Die Autoren erhoben Daten zur Größe peripherer Blutzellen (Erythrozyten, Leucozyten, Thrombozyten) aus mit Wright-Färbung behandelten Abstrichen für sechs Arten türkische Geckos: *Asaccus barani* TORKI, AHMADZADEH, ILGAZ, AVCI & KUMLUTAS, 2011, *Mediodactylus heterocercus* (BLANFORD, 1874), *Mediodactylus kotschyi* (STEINDACHNER, 1870), *Cyrtopodion scabrum* (HEYDEN, 1827), *Hemidactylus turcicus* (LINNAEUS, 1758) und *Stenodactylus grandiceps* HAAS, 1952.

Die längsten Erythrozyten fanden sich bei *S. grandiceps*, die breitesten und größten bei *A. barani*, die kürzesten bei *C. scabrum*, die schmalsten bei *M. kotschyi* und die kleinsten bei *C. scabrum*. Die längsten und größten Erythrozytenkerne wurden bei *M. heterocercus*, die kürzesten, schmalsten und kleinsten bei *M. kotschyi* und die größten bei *A. barani* gemessen. Bezüglich des Verhältnisses von Länge zu Breite, kamen die länglichsten Erythrozyten bei *S. grandiceps*, die rundlichsten bei *M. kotschyi* vor. Die Kern-Plasma-Relation zeigte bei *C. scabrum* und *M. heterocercus* den größten, bei *S. grandiceps* den geringsten Wert. Die Kern-Plasma-Relation türkischer Geckos war ähnlich der bei türkischen Lacertiden.

Zwischen den untersuchten Geckoarten bestanden beträchtliche Unterschiede in der Gestalt der Erythrozyten und ihrer Kerne, während das für die Leukozytenmorphologie nicht zutraf. Lymphozyten waren die häufigsten Leukozyten bei allen Arten. Die Kerne der eosinophilen und basophilen Granulozyten waren durch die starke Körnung des Zytoplasmas undeutlich. Die Thrombozyten waren bei allen Arten flach ellipsoidisch.

ABSTRACT

Size parameters of peripheral blood cells (erythrocytes, leucocytes, thrombocytes) obtained from blood smears stained with Wright's stain are given for six species of Turkish gekkonid lizards: *Asaccus barani* TORKI, AHMADZADEH, ILGAZ, AVCI & KUMLUTAS, 2011, *Mediodactylus heterocercus* (BLANFORD, 1874), *Mediodactylus kotschyi* (STEINDACHNER, 1870), *Cyrtopodion scabrum* (HEYDEN, 1827), *Hemidactylus turcicus* (LINNAEUS, 1758) and *Stenodactylus grandiceps* HAAS, 1952.

The longest erythrocytes were found in *S. grandiceps*, the widest and largest in *A. barani*, the shortest in *C. scabrum,* the narrowest in *M. kotschyi* and the smallest in *C. scabrum*. The longest and biggest erythrocyte nuclei were measured in *M. heterocercus*, the shortest, narrowest and smallest in *M. kotschyi* and the largest in *A. barani.* Regarding their length-to-width ratio, the most oblong erythrocytes were found in *S. grandiceps*, the most roundish in *M. kotschyi*. The value of the nucleocytoplasmic ratio was highest in *C. scabrum* and *M. heterocercus*, and lowest in *S. grandiceps*. The nucleocytoplasmic ratio of the gekkonid erythrocytes was similar as in lacertids.

Among the species studied, erythrocyte and nucleus morphology showed considerable variation, whereas, leukocyte morphology did not. Lymphocytes outnumbered the other leucocytes in all species. The nuclei of eosinophils and basophils were not distinct because of intense granulation of the cytoplasm. The thrombocytes were the shape of a flattened ellipsoid in all species.

KEY WORDS

Reptilia: Squamata: Sauria: Phyllodactylidae, *Asaccus barani*; Gekkonidae, *Cyrtopodion scabrum*, *Hemidactylus turcicus*, *Mediodactylus heterocercus*, *Mediodactylus kotschyi*, *Stenodactylus grandiceps*, blood smears, blood cell morphology, physiology, Turkey

INTRODUCTION

Blood analyses are widely used tools in the diagnosis and monitoring of animal health and disease and the differentiation of physiological processes (CHRISTOPHER et al. 1999). These techniques are applied with several wildlife species, especially for threatened or endangered populations, and help to indicate ecosystem health (DEEM et al. 2006). The cellular metabolism, its homeostatic control mechanisms and cellular configuration are optimized for specific requirements and temperature ranges. As a result, the composition of blood varies considerably among reptile groups (DESSAURER 1970).

The studies on the comparative morphology of peripheral blood cells (erythrocytes, leucocytes, thrombocytes) in reptiles mainly concentrated on the seasonal and sexual variation of counts (e.g., Szarski 1968; Dessaurer 1970; Duguy 1970) and size (Wintrobe 1933; Hartman & Lessler 1964; Saint Girons & Saint Girons 1969; Saint Girons 1970; Sevinç et al. 2000; Sevinç & Uğurtaş 2001; Atatür et al. 2001; Arikan et al. 2009; Arikan & Çiçek 2010; Arikan & Çiçek 2014), and the diagnosis of blood parasites (Roca & Galdon 2010). Nevertheless, only a few studies described the morphology and size of circulating blood cells of one or more species (e.g., Hartman & Lessler 1964; Szarski & Czopek 1966; Knotková et al. 2002).

There are various studies on the comparative morphology of the peripheral blood cells in Turkish lacertids and scincids (Sevinç et al. 2000; Sevinç & Uğurtaş 2001; Atatür et al. 2001; Arikan et al. 2009b; Arikan & Çiçek 2010), however, knowledge on gekkonids is still limited. In Turkey, these saurians are, according to current knowledge (Baran & Atatür 1998; Uetz & Hošek 2016), represented by two families (Phyllodactylidae and Gekkonidae), five genera and six species [*Asaccus barani* Torki, Ahmadzadeh, Ilgaz, Avci & Kumlutaş, 2011, *Mediodactylus heterocercus* (Blanford, 1874), *Mediodactylus kotschyi* (Steindachner, 1870), *Cyrtopodion scabrum* (Heyden, 1827), *Hemidactylus turcicus* (Linnaeus, 1758), *Stenodactylus grandiceps* Haas, 1952]. The objective of the present study was to obtain and discuss comparative information on morphology and size of peripheral blood cell types in these six gekkonid species from Turkey.

MATERIALS AND METHODS

The study sample comprises a total of sixteen specimens collected in April and May 2000 to 2010 at various localities in Turkey (Table 1). Sexes were not distinguished. The blood samples were obtained according to MacLean et al. (1973), from postorbital sinuses using heparinized glass capillaries. Three smears per sample were measured and evaluated individually.

The blood smears prepared were stained with Wright's stain. The cells were measured under a light microscope, using a MOB-1-15x LOMO eyepiece ocular micrometer. From each blood smear, 40 erythrocytes were randomly chosen and their lengths (EL), widths (EW) nuclear lengths (NL) and nuclear widths (NW) measured. The volumes of erythrocytes (EV) and their nuclei (NV) were calculated according to the formulae $EV = (EL*EW^2)*(\pi/6)$ [μm^3] and $NV = (NL*NW^2)*(\pi/6)$ [μm^3]. The cellular and nuclear shapes were compared using the EL/EW and NL/NW ratios while the comparison of the nucleocytoplasmic ratios (NR) were calculated according to the formula NR = NV/(EV-NV). Besides, measurements of the largely spherical leukocytes (lymphocytes, monocytes, heterophils, eosinophils, basophils) and thrombocytes (length and width; TL, TW) were made.

Table 1: Collecting localities of the Turkish gekkonid specimens used in the present comparative hematological study. N – number of individuals.

Tab. 1: Fundorte der türkischen Geckos, die zur vorliegenden hämatologischen Untersuchung verwendet wurden. N – Anzahl der Individuen.

Species / Art	N	Locality / Fundort	Latitude / geogr. Breite	Longitude / geogr. Länge
Asaccus barani	2	Birecik-Urfa	37.025002	37.976955
Mediodactylus heterocercus	2	Mardin	37.301906	40.730414
Mediodactylus kotschyi	4	Halfeti-Şanlıurfa	37.247000	37.866667
Cyrtopodion scabrum	2	Şanlıurfa	37.120305	38.784801
Hemidactylus turcicus	4	Mut-Mersin	36.644337	33.435555
Stenodactylus grandiceps	2	Kilis	36.718399	37.121220

The photographs of the blood cells were taken with an Olympus CX21-Altra 20 Soft Imaging Solutions system.

Since the measured data was normally distributed (Kolmogorov-Smirnov D test, $P \geq 0.05$), parametric one-way ANOVA was used to determine the variation of peripheral blood cell morphology among species. The alpha level was set at 0.05, and the mean values were provided with their standard deviations. All statistical analyses were performed using PAST statistical package (HAMMER et al. 2001).

RESULTS

The typical shape of erythrocytes in gekkonid lizards is oval, as is the case with fish, amphibians and other reptile species. Their nuclei are also oval and almost located at the centre of the cell. In Wright-stained preparations, cytoplasm looks light yellowish pink and chromophilic nuclei are dark purplish blue (Figs. 1A, 1B, 1C).

In the blood preparations considerable variation regarding length, width and volume of the erythrocytes was detected among species and even conspecifics. Potential differences in the physiological status, age or sex may have caused the observed high degree of variation among conspecifics. For the erythrocyte measurements, see Table 2.

The averages of the individual species' erythrocyte length, width, volume, and EL/EW ratio were ranged from 14.83 - 18.62 μm, 8.34 - 9.94 μm, 541.83 - 924.37 μm^3, and 1.72 - 2.00, respectively. The longest erythrocytes were found in *S. grandiceps* (Fig. 1C, one-way ANOVA, $F_{EL} = 72.20$, $p < 0.01$); the widest and largest in *A. barani* ($F_{EW} = 28.59$, $p < 0.01$; $F_{ES} = 58.54$, $p < 0.01$), the shortest in *C. scabrum*, the narrowest in *M. kotschyi* and the smallest in *C. scabrum*. In terms of the EL/EW ratio, the most elongate erythrocytes were found in *S. grandiceps*, the most rounded ones in *M. kotschyi* (Table 2, $F_{EL/EW} = 16.35$, $p < 0.01$).

The averages of the individual species' nuclear length, width, and volume were ranged from 6.66 - 7.57 μm, 3.69 - 4.59 μm and 52.78 - 83.48 μm^3, respectively, the mean length-to-width ratios (NL/NW) from 1.52 - 2.05. The species' mean nucleocytoplasmic ratios ranged between 0.07 - 0.15. The longest and biggest nuclei were measured in *M. heterocercus* ($F_{NL} = 17.93$, $p < 0.01$; $F_{NV} = 41.33$, $p < 0.01$); the shortest, narrowest ($F_{NW} = 58.81$, $p < 0.01$) and smallest in *M. kotschyi* and the largest in *A. barani*. When the ratio NL/NW was considered, the most elongate nuclei were found in *S. grandiceps* and the most rounded ones in *A. barani* ($F_{NL/NW} = 57.48$, $p < 0.01$). The nucleocytoplasmic ratio was highest in *C. scabrum* and *M. heterocercus*, and lowest in *S. grandiceps* ($F_{NR} = 99.75$, $p < 0.01$; Table 2).

Regarding leucocytes, both small and large lymphocytes were observed as the dominant cells in the blood smears of all gekkonid species. Agranulocytes (lymphocytes and monocytes) constituted 80 % of the leucocytes of the examined species. The average diameter of small lymphocytes was biggest (10.34 μm) in *S. grandiceps* and smallest (7.11 μm) in *C. scabrum* (Table 3). In small lymphocytes, the spherical nuclei were more chromophilic and localized in a certain cell zone than in large lymphocytes in which the cytoplasm covered a larger area and was stained a pale blue, whereas, nuclei were stained a purplish blue with Wright's stain (Figs. 1D, 1E). The average diameter of large lymphocytes was biggest (15.18 μm) in *S. grandiceps*, and smallest (10.71 μm) in *C. scabrum* (Table 3).

Monocytes resembled large lymphocytes from which they were easily differentiated by their kidney-shaped nuclei. Cytoplasm was stained a light gray, and the nuclei a dark purplish blue with Wright's stain (Fig. 1F). The average monocyte diameter was biggest in *M. heterocercus* (14.58 μm), and smallest (10.50 μm) in *S. grandiceps* and *M. kotschyi* (Table 3).

Among the granulocytes, heterophils had light blue cytoplasm and numerous granules of ellipsoidal shape. Their bilobate nuclei were stained a dark purplish blue color with Wright's stain (Fig. 1G, 1H). The mean diameter of heterophil granulocytes was biggest (12.44 μm) in *S. grandiceps* and smallest (11.00 μm) in *M. kotschyi* (Table 3).

Table 2: Descriptive statistics of the size of erythrocytes and their nuclei in the peripheral blood of six gekkonid species from Turkey. EL – erythrocyte length, EW – erythrocyte width, EL/EW – erythrocyte aspect ratio, EV – erythrocyte volume, NL – nucleus length, NW – nucleus width, NV – nucleus volume; NR – nucleo-cytoplasmic ratio, *N* – sample size, mean – arithmetic mean, SE – standard error of the mean, Min – minimum, Max – maximum, SD – standard deviation.

Tab. 2: Deskriptive Statistiken der Größe von Erythrozyten und ihren Kernen im peripheren Blut von sechs Gekkoarten der Türkei. EL – Erythrozytenlänge, EW – Erythrozytenbreite, EL/EW – Erythrozytenformfaktor, EV – Erythrozytenvolumen, NL – Kernlänge, NW – Kernbreite, NV – Kernvolumen; NR – Kern-Plasma-Verhältnis, *N* – Stichprobengröße, mean – arithmetisches Mittel, SE – Standardfehler des Mittelwertes, Min – Minimum, Max – Maximum, SD – Standardabweichung.

Species / Art	*N*		EL (µm)	EW (µm)	EL/EW	EV (µm^3)	NL (µm)	NW (µm)	NL/NW	NV (µm^3)	NR
A. barani	240	Mean	17.78	9.94	1.79	924.37	6.95	4.59	1.52	77.00	0.09
		SE	0.11	0.09	0.02	19.73	0.05	0.04	0.01	1.73	0.003
		Min	16.25	9.00	1.59	727.64	6.25	4.00	1.35	52.33	0.06
		Max	19.00	11.25	2.03	1208.78	7.50	5.00	1.76	98.13	0.13
		SD	0.68	0.57	0.10	124.75	0.32	0.26	0.08	10.92	0.017
M. heterocercus	240	Mean	16.16	8.81	1.84	656.93	7.57	4.59	1.65	83.48	0.15
		SE	0.20	0.06	0.03	11.65	0.08	0.02	0.02	1.26	0.003
		Min	13.50	8.25	1.54	534.29	6.25	4.50	1.39	66.23	0.11
		Max	19.75	9.75	2.26	837.20	8.50	5.00	1.89	100.37	0.19
		SD	1.29	0.36	0.16	73.70	0.50	0.13	0.11	7.97	0.019
M. kotschyi	480	Mean	16.15	9.48	1.72	771.11	6.66	3.84	1.75	52.78	0.08
		SE	0.12	0.16	0.03	30.84	0.09	0.08	0.03	2.77	0.005
		Min	14.50	7.50	1.40	500.44	5.50	3.00	1.38	25.91	0.02
		Max	17.50	12.50	2.27	1430.99	8.00	5.00	2.23	104.67	0.17
		SD	0.78	1.01	0.18	195.06	0.60	0.50	0.2	17.51	0.034
C. scabrum	240	Mean	14.83	8.34	1.78	541.83	7.08	4.38	1.62	70.93	0.15
		SE	0.10	0.07	0.01	10.92	0.06	0.02	0.02	0.87	0.003
		Min	14.00	7.00	1.54	359.01	6.50	4.25	1.44	61.44	0.11
		Max	16.50	9.25	2.00	716.44	8.25	4.50	1.94	82.13	0.21
		SD	0.65	0.43	0.09	69.04	0.37	0.13	0.10	5.49	0.022
H. turcicus	480	Mean	16.52	8.91	1.85	689.95	7.44	4.41	1.69	75.69	0.13
		SE	0.22	0.07	0.02	15.82	0.09	0.02	0.02	1.14	0.003
		Min	14.50	8.25	1.57	525.39	6.25	4.25	1.44	59.08	0.09
		Max	20.50	9.75	2.28	945.24	8.75	4.50	2.06	90.08	0.17
		SD	1.37	0.42	0.15	100.06	0.58	0.12	0.14	7.18	0.018
S. grandiceps	240	Mean	18.62	9.37	2.00	867.74	7.50	3.69	2.05	55.13	0.07
		SE	0.15	0.15	0.03	30.20	0.12	0.08	0.04	2.88	0.003
		Min	16.25	7.25	1.71	488.26	5.25	2.50	1.67	17.17	0.03
		Max	20.50	11.00	2.72	1298.13	9.25	5.00	2.75	111.21	0.12
		SD	0.97	0.94	0.20	190.99	0.76	0.50	0.24	18.21	0.022

Table 3: Descriptive statistics of the size of leukocytes and thrombocytes in the peripheral blood of six gekkonid species from Turkey. TL – thrombocyte length, TW – thrombocyte width, N – sample size, Mean – arithmetic mean, SE – standard error of the mean, Min – minimum, Max – maximum SD – standard deviation.

Tab. 3: Deskriptive Statistiken der Größe von Leukozyten und Thrombozyten im peripheren Blut von sechs Gekkoarten der Türkei. TL – Thrombozytenlänge, TW – Thrombozytenbreite, N – Stichprobengröße, Mean – arithmetisches Mittel, SE – Standardfehler des Mittelwertes, Min – Minimum, Max – Maximum, SD – Standardabweichung.

Species / Art		Lymphocyte (large) / (groß) (µm)	Lymphocyte (small) / (klein) (µm)	Monocyte (µm)	Heterophil granulocyte (µm)	Eosinophil granulocyte (µm)	Basophil granulocyte (µm)	TL (µm)	TW (µm)
A. barani	N	8	8	5	5	4	7	10	10
	Mean	12.56	7.59	11.50	11.15	10.44	10.32	12.13	9.48
	SE	0.35	0.14	0.18	0.10	0.12	0.09	0.18	0.30
	Min	11.00	7.00	11.00	11.00	10.25	10.00	11.25	7.50
	Max	14.00	8.25	12.00	11.50	10.75	10.75	13.00	10.50
	SD	0.99	0.40	0.40	0.22	0.24	0.24	0.58	0.95
M. heterocercus	N	9	10	6	9	6	7	10	10
	Mean	11.11	7.50	14.58	12.42	10.50	10.18	7.00	5.43
	SE	0.15	0.06	0.17	0.29	0.09	0.11	0.05	0.05
	Min	10.00	7.25	14.00	11.25	10.25	9.75	6.75	5.25
	Max	11.50	7.75	15.00	13.50	10.75	10.50	7.25	5.75
	SD	0.45	0.20	0.41	0.87	0.22	0.28	0.17	0.17
M. kotschyi	N	8	7	6	6	6	6	6	6
	Mean	14.31	9.82	10.50	11.00	8.96	10.42	6.67	4.50
	SE	0.16	0.19	0.26	0.14	1.80	0.08	0.14	0.06
	Min	13.75	9.25	10.00	10.50	0.00	10.25	6.25	4.25
	Max	15.00	10.75	11.50	11.50	11.25	10.75	7.25	4.75
	SD	0.46	0.49	0.63	0.35	4.40	0.20	0.34	0.16
C. scabrum	N	7	7	8	6	6	5	10	10
	Mean	10.71	7.11	12.91	11.42	10.00	10.00	7.08	5.35
	SE	0.25	0.19	0.14	0.18	0.09	0.08	0.07	0.08
	Min	9.50	6.25	12.50	10.75	9.75	9.75	6.75	5.00
	Max	11.50	7.75	13.50	12.00	10.25	10.25	7.50	5.75
	SD	0.65	0.50	0.40	0.44	0.22	0.18	0.21	0.27
H. turcicus	N	8	8	5	5	3	7	7	7
	Mean	12.81	8.03	12.30	11.20	10.75	10.50	6.75	4.54
	SE	0.32	0.06	0.38	0.09	0.14	0.08	0.19	0.07
	Min	11.50	7.75	11.00	11.00	10.50	10.25	6.00	4.25
	Max	14.00	8.25	13.25	11.50	11.00	10.75	7.50	4.75
	SD	0.91	0.16	0.86	0.21	0.25	0.20	0.50	0.17
S. grandiceps	N	10	8	5	9	7	7	10	10
	Mean	15.18	10.34	10.50	12.44	10.43	10.21	10.65	7.90
	SE	0.20	0.09	0.18	0.19	0.12	0.16	0.20	0.24
	Min	14.50	10.00	10.00	11.50	10.25	9.75	9.75	7.25
	Max	16.25	10.75	11.00	13.25	11.00	11.00	11.50	9.75
	SD	0.64	0.27	0.40	0.56	0.31	0.42	0.63	0.76

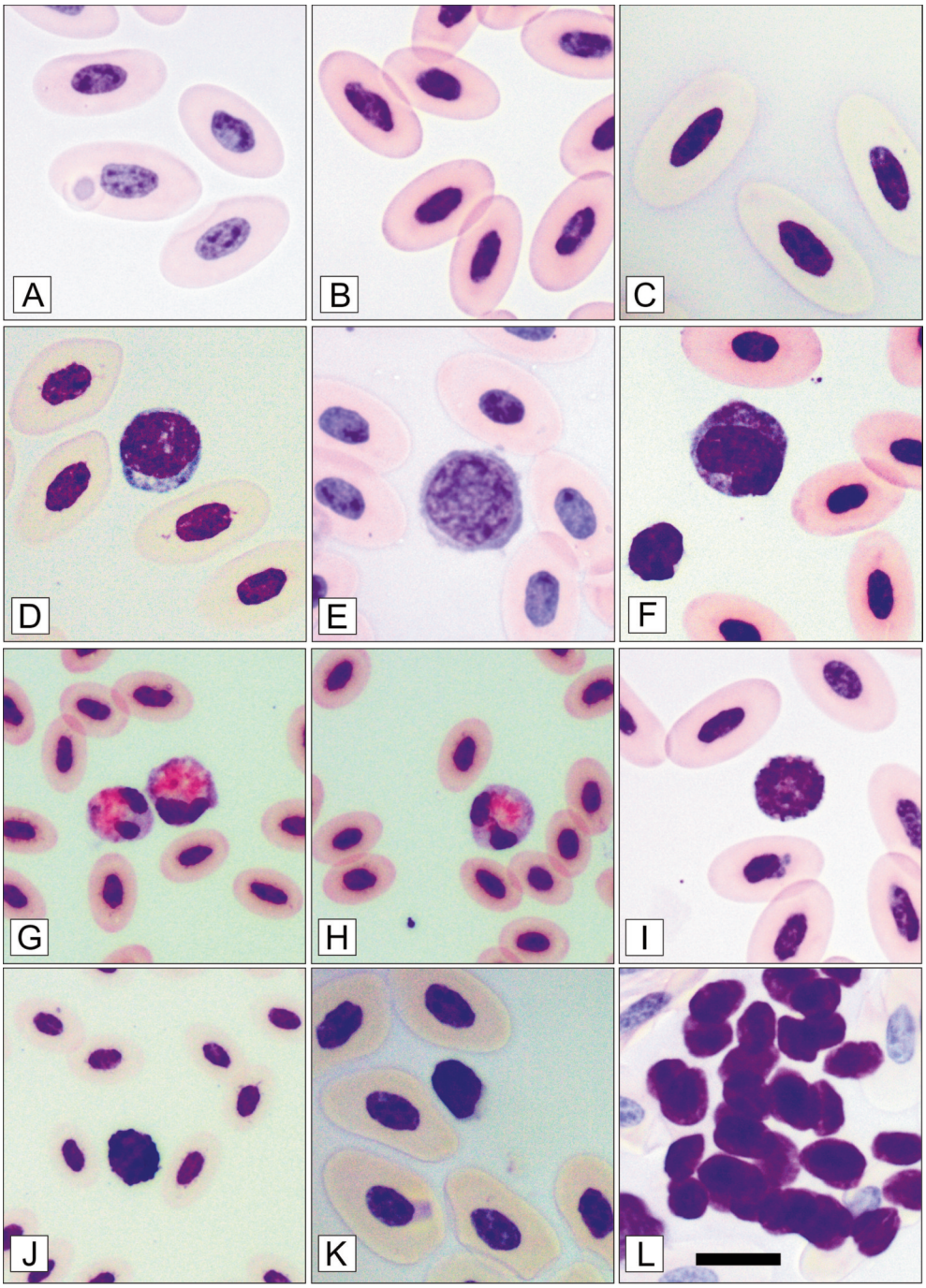

Fig. 1: For legend see opposite page. / Abb. 1: Legende siehe gegenüberliegende Seite.

The cytoplasm of eosinophil granulocytes was stained a light yellowish color with Wright's stain. Since the nucleus was masked by large and bright red granules in the cytoplasm, its shape couldn't be distinguished clearly (Fig. 1I). The mean diameter of eosinophils was biggest (10.75 µm) in *H. turcicus* and smallest (8.96 µm) in *M. kotschyi* (Table 3).

The cytoplasm of the basophil granulocytes was filled with black granules, which masked the nucleus just like in the eosinophils (Fig. 1J). The mean diameter of basophils, which was smaller than of other granulocytes, was biggest (10.50 µm) in *H. turcicus* and smallest (10.00 µm) in *C. scabrum* (Table 4).

Thrombocytes were of flattened ellipsoidal shape, their nuclei filling nearly the whole cell (Figs. 1K, 1L). The longest and largest thrombocytes were observed in *A. barani*, the shortest and narrowest in *H. turcicus*.

DISCUSSION

Reptilian erythrocytes are similar in function and appearance to the birds' red blood cells but differ in size and number. Among reptiles, the largest erythrocytes are observed in *Sphenodon punctatus* GRAY, 1831, turtles and crocodiles, the smallest in lacertid lizards (HARTMAN & LESSLER 1964; SAINT GIRONS & SAINT GIRONS 1969; SAINT GIRONS 1970; SEVINÇ et al. 2000). This heterogeneity in blood cell morphology is not only considerable between orders but even within families (e.g., HARTMAN & LESSLER 1964; SZARSKI & CZOPEK 1966; SAINT GIRONS & SAINT GIRONS 1969; SAINT GIRONS 1970; ARIKAN et al. 2009a, 2009b, 2010).

ARIKAN & ÇIÇEK (2010) studied the morphology of peripheral blood cells of various Turkish reptilian species, noted that there is considerable variation in the size of erythrocytes among or within lizard families and hypothesized that erythrocyte size might be correlated with differences in the species-specific activity levels. These authors found the largest erythrocytes in *Varanus griseus* (DAUDIN, 1803), the smallest in *Ophisops elegans* MÉNÉTRIES, 1832. In terms of the EL/EW ratio, the most elongate cells were determined in *Lacerta pamphylica* SCHMIDTLER, 1975, and the most spherical in *Anatololacerta danfordi* (GÜNTHER, 1876).

As regards reptiles from Turkey, the erythrocyte and nucleus volumes observed by ARIKAN & ÇIÇEK (2010, 2014) were 366.88 - 675.01 µm^3 and 46.15 - 68.50 µm^3 for lacertids, and 421.52 - 497.98 µm^3 and 16.15 - 26.72 µm^3 for scincids; the nucleocytoplasmic ratios ranged between 0.04-0.05 in scincids and 0.10-0.13 in lacertids.

In the present study, the largest erythrocytes were seen in *Asaccus barani*, the smallest in *Cyrtopodium scabrum*, the most elongate in *Stenodactylus grandiceps*, the most spherical in *Mediodactylus kotschyi*.

The mean values of the nucleocytoplasmic ratios were between 0.07 and 0.15 for gekkonids. Concerning the nucleocytoplasmic ratio, the gekkonids studied resembled the lacertids.

Lymhocytes were the dominant cells in the blood smears of many reptile species

Fig. 1 (opposite page) / Abb. 1 (gegenüberliegende Seite):

Photomicrographs of erythrocytes, leukocytes and thrombocytes of some Turkish geckos. Erythrocytes: A – *A. barani*, B – *C. scabrum*, C – *S. grandiceps*. Leukocytes: D – small lymphocyte (*M. heterocercus*), E – large lymphocyte (*C. scabrum*), F – monocyte (*H. turcicus*). Granulocytes: G – heterophil (*C. scabrum*), H – heterophil (*C. scabrum*), I – eosinophil (*C.scabrum*), J – basophil (*C.scabrum*). Thrombocyte: K – (*M. kotschyi*), L – an aggregate of thrombocytes (*S. grandiceps*). Horizontal bar: 20 µm.

Mikroskopische Aufnahmen von Erythrozyten, Leukozyten und Thrombozyten einiger türkischer Geckoarten. Erythrozyten: A – *A. barani*, B – *C. scabrum*, C – *S. grandiceps*. Leukozyten: D – kleiner Lymphozyt (*M. heterocercus*), E – großer Lymphozyt (*C. scabrum*), F – Monozyt (*H. turcicus*). Granulozyten: G – heterophiler (*C.scabrum*), H – heterophiler (*C. scabrum*), I – eosinophiler (*C. scabrum*), J – basophiler (*C. scabrum*). Thrombozyt: K – *M. kotschyi*, L – ein Aggregat von Thrombozyten (*S. grandiceps*). Balkenlänge entspricht 20 µm.

(e.g., Arikan et al. 2004, 2009a, 2010), and the nuclei of eosinophils and basophils were not easily distinguished as they were masked by dense granulation in the cytoplasm. Identical results were obtained for six geckonid species in the present study.

Reptilian thrombocytes appear as flattened ellipsoidal cells with pale cytoplasm and centrally localized, extremely chromophilic nucleus which largely fills the cell (Saint Girons 1970; Canfield & Shea 1988; Arikan et al. 2004, 2009a, 2010), which is in full agreement with the observations made here for six gecko species. The largest thrombocytes were observed in *A. barani*, the smallest in *H. turcicus*.

In conclusion, the present data details the considerable morphological variation of peripheral blood cells of six gekkonid species occurring in Turkey. Considering the nucleocytoplasmic ratio, the gekkonids were more similar to lacertids than scincids.

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