

## Morphological Observations on the Erythrocyte and Erythrocyte Size of Some Gecko Species, Turkey

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**Abstract.** - In this study, erythrocyte size and morphology of the four gecko species [*Asaccus elisae*, *Hemidactylus turcicus*, *Cyrtopodion scaber* and *C. heterocercus mardinensis* (Gekkonidae)] from Turkey were examined. Forty-two specimens were used in this study, of which twelve were *A. elisae*, eight were *H. turcicus*, twelve were *C. scaber*, and ten were *C. h. mardinensis*. Erythrocyte morphology of these examined species was described using Wright's technique. The sizes of erythrocytes and their nuclei were measured using an ocular micrometer at a magnification of 1600x. The results of this study were compared with previous works on the other reptile species. The longest erythrocytes were found in *H. turcicus* and the shortest in *A. elisae*. In terms of the studied species, the nucleus and erythrocyte sizes were found to be correlated (Gekkonidae:  $r = 0.39$ ;  $P < 0.001$ ).

**Key words.** - Gekkota, Turkey, erythrocyte.

### Introduction

Initial studies on the blood of reptiles described the structures, often comparing them with those of the other vertebrates. Literature on the haematology of reptilian blood are based on a few studies where most were concerned with especially European species (Saint Girons, 1970).

Various authors have focused on the different circulating blood cell types of different reptiles (Taylor and Kaplan, 1961; Heady and Rogers, 1963; Hartman and Lessler, 1964; Szarski and Czopek, 1966; Duguy, 1970; Saint Girons, 1970; Mateo et al., 1984; Canfield and Shea, 1988; Cannon et al., 1996; Alleman et al., 1999; Sevinç et al., 2000; Atatür et al., 2001; Sevinç and Uğurtaş, 2001; Uğurtaş et al., 2003). Some authors have studied seasonal (Hutton, 1960; Cline and Waldman, 1962; Haggag et al., 1966) or sexual (Altland and Thompson, 1958) variations in the number of blood cells of different reptile species. In addition, researchers have studied the number of blood cells of different reptiles (Baker and Kline, 1932; Charipper and Davis, 1932; Altland and Thompson, 1958; Hutton, 1961; Hutchinson and Szarski, 1965; Engbretson and Hutchinson, 1976; Mateo et al., 1984). Furthermore, authors have also studied haemoglobin and hematocrit content of blood and hematopoiesis of different reptiles (Altland and Thompson, 1958; Hutton, 1961; Goin and Jackson, 1965; Engbretson and Hutchinson, 1976; Newlin and Ballinger, 1976; Mateo et al., 1984; Alleman et al., 1999).

In Turkey, hematological studies have generally been conducted on humans and some economically important animals. However, there are few hematologi-

cal studies of the reptiles living in this country (Sevinç et al., 2000; Atatür et al., 2001; Sevinç and Uğurtaş, 2001; Uğurtaş et al., 2003).

In the current study, our aim was to describe and measure erythrocytes of *Asaccus elisae* (Werner, 1895), *Hemidactylus turcicus* (Linnaeus, 1758), *Cyrtopodion scaber* (Heyden, 1827) and *C. heterocercus mardinensis* (Mertens, 1924) which live in Turkey. This study is the first of its kind on Turkish species.

### Materials and Methods

In this study, twelve (6 males, 6 females) individuals of *Asaccus elisae*, eight (4 males, 4 females) of *Hemidactylus turcicus*, twelve (8 males, 4 females) of *Cyrtopodion scaber* and ten (4 males, 6 females) of *C. heterocercus mardinensis* (Gekkonidae) were examined. Twenty-two specimens examined were male and twenty were female.

The study was performed on 01-05 June 2000. *H. turcicus* species were collected from Hatay (36° 34' N, 36° 09' E) and the other specimens were from Şanlıurfa (36° 53' N, 39° 02' E) (Fig. 1; Table 1). Blood was obtained by cutting the tail (Duguy, 1974). Immediately after blood was obtained in heparinized capillary tubes, blood smears were prepared. Three or five blood smears were prepared per individual. The smears were air-dried and stained with Wright's stain (Hartman and Lessler, 1964). Twelve drops of Wright's stain were dropped on the slides and allowed to remain on the slide one and half minutes before rinsing with phosphate buffer (pH 6.5). The slides were allowed to stand for ten minutes at room temperature, were washed with distilled water, and allowed to dry.



Figure 1. Collection localities.

On each slide, fifty mature erythrocytes and their nuclei were measured by means of an ocular micrometer at a magnification of 1600x. In this way fifty erythrocyte sizes were calculated. Erythrocyte and nucleus measurements of examined species are given in tables 2-5. Erythrocyte and nucleus sizes were, respectively, calculated according to the formulas  $[(EL \times EW \times \pi) / 4]$  and  $[(NL \times NW \times \pi) / 4]$ ; where EL is the erythrocyte length, EW is the erythrocyte width, NL is the nucleus length and NW is the nucleus width.

## Results

Erythrocytes, or red blood cells, of geckos are nucleated, oval cells. Their nuclei are also oval and centrally located, like those of the other reptiles. The cytoplasm of mature erythrocytes appeared both light, dark pink, and homogeneous under Wright's stain. Nuclei of mature erythrocytes are chromophilic (Figs. 2-5).

Because there were no significant differences between the erythrocyte sizes of female and male geckos, data from the females and males of individual species were combined.

The longest erythrocytes were found in *Hemidactylus turcicus*. The mean length of mature erythro-

cyte of *H. turcicus* was 16.98 mm ( $\pm 1.26$  standard deviations, with a range of 14.64-19.52 mm) (Table 2; Fig. 6) and also erythrocyte size and length/width ratios of *H. turcicus* are given in table 2.

The shortest erythrocytes were found in *Asaccus elisae*. The mean length of mature erythrocytes of *A. elisae* was 14.96 mm ( $\pm 0.79$  standard deviations, with a range of 13.42-17.08 mm) (Table 3; Fig. 6). Erythrocyte size and length/width ratios of *A. elisae* are given in table 3.

The widest erythrocytes were found in *Cyrtopodion scaber*. The mean width of mature erythrocytes of *C. scaber* was 10.26 mm ( $\pm 0.78$  standard deviations, with a range of 8.54-12.20 mm) (Table 4; Fig. 7). Erythrocyte size and length/width ratios of *C. scaber* are given in table 4.

The narrowest erythrocytes were found in *Cyrtopodion heterocercus mardinensis*. The mean width of mature erythrocyte of *C. h. mardinensis* was 9.18 mm ( $\pm 0.70$  standard deviations, with a range of 6.71-10.98 mm) (Table 5; Fig. 7) and also erythrocyte size and length/width ratios of *C. h. mardinensis* are given in table 5.

The longest nuclei were found in *Cyrtopodion scaber*. The mean length of mature nuclei of *C. scaber*

Table 1. Materials list. NM: number of males; NF: number of females; CD: collection date; CL: collection locality. All specimens are from the Zoology Museum in Uludag University Science and Art Faculty, Department of Biology.

Species	NM	NF	CD	CL
<i>Asaccus elisae</i>	6	6	1-3 June	Sanliurfa
<i>Hemidactylus turcicus</i>	4	4	4-5 June	Hatay
<i>Cyrtopodion scaber</i>	8	4	1-3 June	Sanliurfa
<i>C. heterocercus mardinensis</i>	4	6	1-3 June	Sanliurfa

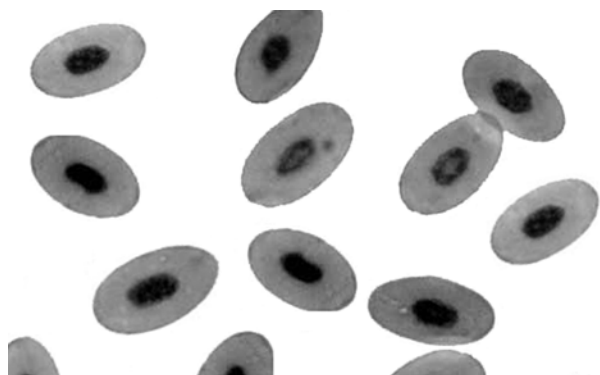


Figure 2. Erythrocyte and nucleus sizes of *Hemidactylus turcicus*.

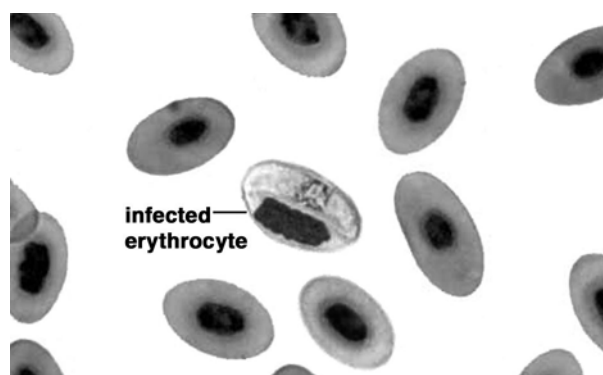


Figure 3. Erythrocyte and nucleus sizes of *Asaccus elisae*.

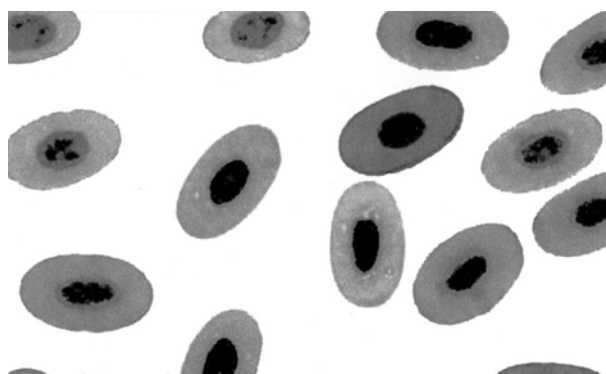


Figure 4. Erythrocyte and nucleus sizes of *Cyrtopodion scaber*.



Figure 5. Erythrocyte and nucleus of *Cyrtopodion heterocercus mardinensis*.

was 6.81 mm ( $\pm 0.60$  standard deviations, with a range of 5.49-8.54 mm) (Table 4; Fig. 6). Nucleus size and length/width ratios of *C. scaber* are given in table 4.

The shortest nuclei were found in *Asaccus elisae*. The mean length of mature nuclei of *A. elisae* was 6.06 mm ( $\pm 0.58$  standard deviations, with a range of 4.88-7.32 mm) (Table 3; Fig. 6). Nucleus size and length/width ratios of *A. elisae* are given in table 3.

The widest nuclei were found in *Cyrtopodion heterocercus mardinensis*. The mean width of mature nuclei of *C. h. mardinensis* was 3.78 mm ( $\pm 0.44$  standard deviations, with a range of 3.05-4.88 mm) (Table 5; Fig. 7). Nucleus size and length/width ratios of *C. h. mardinensis* are given in table 5.

The narrowest nuclei were found in *Hemidactylus turcicus*. The mean width of mature nuclei of *H. turcicus* was 3.53 mm ( $\pm 0.42$  standard deviations, with a range of 3.05-4.27 mm) (Table 2; Fig. 7). Nucleus size and length/width ratios of *H. turcicus* are given in table 2.

## Discussion

Investigations carried out by various authors (Hartman

and Lessler, 1964; Szarski and Czopek, 1966; Saint Girons, 1970; Sevinç et al., 2000; Sevinç and Uğurtaş, 2001; Atatür et al., 2001; Uğurtaş et al., 2003) reported that the sizes of erythrocytes vary in members of the four orders of reptiles.

Within the class Reptilia, the largest erythrocytes are seen in *Sphenodon punctatus*, turtles, and crocodilians (Hartman and Lessler, 1964; Saint Girons, 1970; Alleman et al., 1984).

Cryptodiran turtles have the largest erythrocytes from all previously studied reptiles (Saint Girons, 1970). The shortest erythrocytes are found in the Lacertidae family (Hartman and Lessler, 1964; Saint Girons, 1970; Sevinç et al., 2000; Sevinç and Uğurtaş, 2001).

Saint Girons (1970) reported erythrocytes and nuclei measurements of some gecko species. In *Coleonyx variegatus*, erythrocyte length is 18.9  $\mu$ m and width is 9.6  $\mu$ m; nucleus length is 7.3  $\mu$ m and width is 3.7  $\mu$ m. In *Gehyra variegata*, erythrocyte length is 17.2  $\mu$ m and width is 11.5  $\mu$ m; nucleus length is 6.3  $\mu$ m and width is 3.8  $\mu$ m. In *Heteronota binoei*, erythrocyte length is 21.4  $\mu$ m and width is 10.7  $\mu$ m; nucleus length is 8.1  $\mu$ m and width is 3.4  $\mu$ m.

Table 2. Erythrocyte dimensions of *Hemidactylus turcicus* with standard deviations. EL: erythrocyte length; EW: erythrocyte width; ES: erythrocyte size; NL: nucleus length; NW: nucleus width; NS: nucleus size.

	EL (μm)	EW (μm)	EL/EW (μm)	ES (μm)	NS/ES (μm)
Maximum	19.52 ± 1.26	11.59 ± 0.67	2.07 ± 0.14	166.50 ± 15.45	0.20 ± 0.02
Minimum	14.64 ± 1.26	7.93 ± 0.67	1.42 ± 0.14	94.93 ± 15.45	0.09 ± 0.02
Mean	16.98 ± 1.26	9.69 ± 0.67	1.76 ± 0.14	129.50 ± 15.45	0.14 ± 0.02
	NL (μm)	NW (μm)	NL/NW (μm)	NS (μm)	
Maximum	7.93 ± 0.59	4.27 ± 0.42	2.40 ± 0.22	26.58 ± 3.17	
Minimum	4.88 ± 0.59	3.05 ± 0.42	1.43 ± 0.22	11.68 ± 3.17	
Mean	6.41 ± 0.59	3.53 ± 0.42	1.83 ± 0.22	17.84 ± 3.17	

Table 3. Erythrocyte dimensions of *Asaccus elisae* with standard deviations. EL: erythrocyte length; EW: erythrocyte width; ES: erythrocyte size; NL: nucleus length; NW: nucleus width; NS: nucleus size.

	EL (μm)	EW (μm)	EL/EW (μm)	ES (μm)	NS/ES (μm)
Maximum	17.08 ± 0.79	10.98 ± 0.66	2.08 ± 0.14	142.00 ± 10.38	0.27 ± 0.03
Minimum	13.42 ± 0.79	7.32 ± 0.66	1.29 ± 0.14	83.54 ± 10.38	0.11 ± 0.03
Mean	14.96 ± 0.79	9.26 ± 0.66	1.62 ± 0.14	108.80 ± 10.38	0.16 ± 0.03
	NL (μm)	NW (μm)	NL/NW (μm)	NS (μm)	
Maximum	7.32 ± 0.58	4.88 ± 0.41	2.40 ± 0.25	23.37 ± 2.47	
Minimum	4.88 ± 0.58	3.05 ± 0.41	1.14 ± 0.25	11.68 ± 2.47	
Mean	6.06 ± 0.58	3.62 ± 0.41	1.69 ± 0.25	17.24 ± 2.47	

Table 4. Erythrocyte dimensions of *Cyrtopodion scaber* with standard deviations. EL: erythrocyte length; EW: erythrocyte width; ES: erythrocyte size; NL: nucleus length; NW: nucleus width; NS: nucleus size.

	EL (μm)	EW (μm)	EL/EW (μm)	ES (μm)	NS/ES (μm)
Maximum	18.30 ± 0.88	12.20 ± 0.78	1.93 ± 0.13	175.30 ± 13.93	0.23 ± 0.02
Minimum	14.64 ± 0.88	8.54 ± 0.78	1.33 ± 0.78	102.20 ± 13.93	0.10 ± 0.02
Mean	16.20 ± 0.88	10.26 ± 0.78	1.59 ± 0.78	130.60 ± 13.93	0.15 ± 0.02
	NL (μm)	NW (μm)	NL/NW (μm)	NS (μm)	
Maximum	8.54 ± 0.60	4.88 ± 0.47	2.75 ± 0.26	30.38 ± 3.42	
Minimum	5.49 ± 0.60	2.44 ± 0.47	1.38 ± 0.26	12.85 ± 3.42	
Mean	6.81 ± 0.60	3.65 ± 0.47	1.89 ± 0.26	19.53 ± 3.42	

Table 5. Erythrocyte dimensions of *Cyrtopodion heterocercus mardinensis* with standard deviations. EL: erythrocyte length; EW: erythrocyte width; ES: erythrocyte size; NL: nucleus length; NW: nucleus width; NS: nucleus size.

	EL (μm)	EW (μm)	EL/EW (μm)	ES (μm)	NS/ES (μm)
Maximum	17.69 ± 0.85	10.98 ± 0.70	2.27 ± 0.16	147.20 ± 11.00	0.28 ± 0.03
Minimum	14.03 ± 0.85	6.71 ± 0.70	1.39 ± 0.16	80.33 ± 11.00	0.12 ± 0.03
Mean	15.65 ± 0.85	9.18 ± 0.70	1.71 ± 0.16	112.80 ± 11.00	0.17 ± 0.03
	NL (μm)	NW (μm)	NL/NW (μm)	NS (μm)	
Maximum	7.93 ± 0.62	4.88 ± 0.44	2.40 ± 0.25	30.38 ± 3.10	
Minimum	5.49 ± 0.62	3.05 ± 0.44	1.13 ± 0.25	13.14 ± 3.10	
Mean	6.56 ± 0.62	3.78 ± 0.44	1.76 ± 0.25	19.49 ± 3.10	



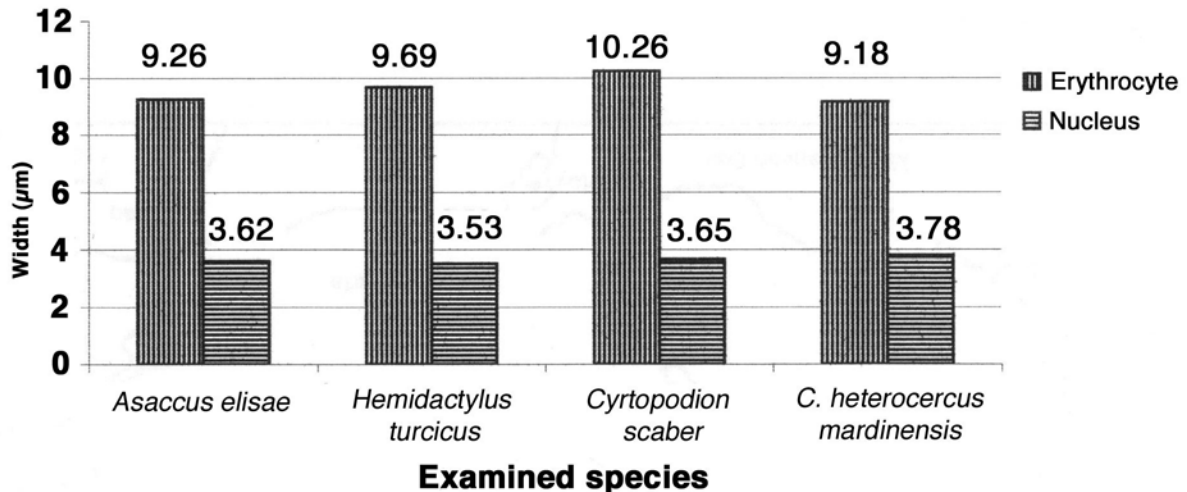


Figure 6. Erythrocyte and nucleus lengths of examined specimens.

Cannon et al. (1996) reported the leukocyte morphology and size of the rougtail gecko *Cyrtopodion scabrum*. However, they did not report any information on the erythrocyte of this species.

In reptiles, the numbers of erythrocytes are smaller than in mammals or birds. Lizards have more erythrocytes than snakes, and turtles have the fewest. Since lizards have the smallest erythrocytes of all reptiles, and turtles the largest, there may be an inverse correlation between the number of erythrocytes and their size; this hypothesis was advanced by Ryerson (1949) (Duguy, 1970).

In this study, the longest erythrocytes were found in *H. turcicus*, the shortest in *A. elisae*, the largest in *C. scaber* and the narrowest in *C. heterocercus mardinensis*. The longest nuclei were found in *C. scaber*, the shortest *A. elisae*, the largest in *C. heterocercus mardinensis* and the narrowest in *H. turcicus* (Tables 2-5; Figs. 6,7).

In the present study, erythrocyte morphology and the results of erythrocytes and nuclei sizes (Tables 2-5; Figs. 6,7) are agreement with the other results carried out by (Saint Girons, 1970).

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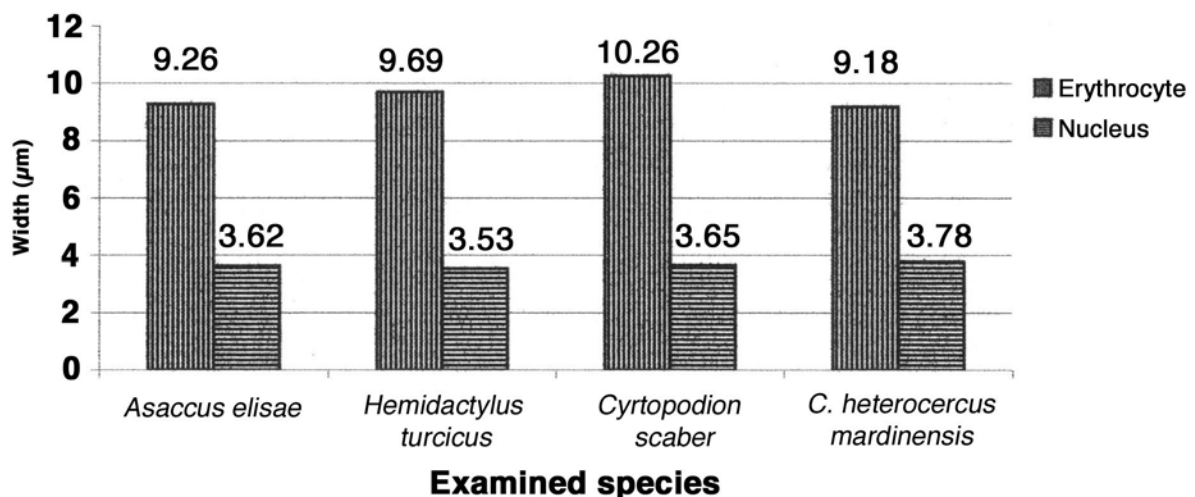


Figure 7. Erythrocyte and nucleus widths of examined species.

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