COMPARATIVE HEMATOLOGY OF SOME FALCONIFORMS

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Although the hematology of certain birds such as poultry species has been studied extensively, there are few data on the hematology of falconiforms. The available data have been compiled by Altman (1961) and Sturkie (1968). As part of our systematic and comparative determination of hematological values in different avian orders (Balasch et al. 1973, 1974), we present here our results from several captive falconiforms—five Common Buzzards (*Buteo buteo*), three Black Kites (*Milvus migrans*), two Golden Eagles (*Aquila chrysaetos*), one Imperial Eagle (*A. heliaca*), one Crowned Eagle (*Stephanoetus coronatus*), six Griffon Vultures (*Gyps fulvus*), two Andean Condors (*Vultur gryphus*), and six King Vultures (*Sarcorhamphus papa*). The ages of the birds were: two Golden Eagles 10 and 12 months old, two condors more than 15 years old, six King Vultures ranging between 2 and 15 years old, and the remaining species about 4–6 years old. The diet was fresh meat. The birds' sex could not be determined because they were to be used for zoological exhibition and could not be sacrificed.

Blood samples of 7 ml were taken from the basilic vein in the wing using a heparinized hypodermic syringe. The samples were collected in winter, though the temperature in the Mediterranean climate where the study was made ranged between 12–16°C at the time of extraction, which was always between 16:00 and 17:00. The birds were held in open zoological installations (wings clipped so they could not fly) with freedom of movement. The following determinations were made (the apparatus or method indicated in parentheses): hematocrit (micromethod), hemoglobin (Drabkin), erythrocyte count (Thoma), sedimentation rate (micromethod), total glucides (Anthrone), total proteins (biuret), urea (urease), and lactate (LDH/NAD). The red cell indices, i.e., mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC), were obtained by calculation. The determinations were made about 30 min after extraction, the blood being kept in cold tubes.

Table 1 shows the results of whole blood determinations and table 2 the results of plasma determinations. Glucose and total glucides (table 2) were found to be lower in these falconiforms than in other birds we have studied (Balasch et al. 1973, 1974), which were captives under similar conditions. Hematic glucose and total glucides of these meat-eating falconiforms were similar to those of fish-eating birds, but the values for both were lower than for birds eating grains or other plant matter.

The amount of hemoglobin and the erythrocyte number (table 1) also were lower in these birds than in the pelecaniform, anseriform, galliform, charadriiform, columbiform, and passeriform species studied

TABLE 1. Whole blood values.

Species	Sed. rate (mm) 1 hr	Sed. rate (mm) 2 hr	HC	Hb (g/100 ml)	Erythr. (×10)	MVC (μ^3)	MCH ($\gamma\gamma$/cell)	MCHC (%)
Buteo buteo	2.0[a] ±0.5	4.4 ±1.9	34.7 ±4.6	10.75 ±1.87	2.43 ±0.68	147.86 ±28.70	45.28 ±6.54	30.88 ±1.77
Milvus migrans	1.3 ±0.3	3.4 ±0.5	36.2 ±1.5	10.74 ±0.41	2.39 ±0.04	151.09 ± 4.78	44.87 ±1.22	29.73 ±1.57
Aquila chrysaetos	1.75 ±0.3	2.85 ±0.5	40.0 ±0.0	12.02 ±0.81	2.51 ±0.09	159.78 ± 5.86	47.98 ±1.48	30.06 ±2.03
Aquila heliaca	2.0	2.5	36.0	13.13	2.54	141.73	51.69	36.47
Stephanoetus coronatus	2.0	6.0	38.5	12.44	2.18	176.61	57.06	32.31
Gyps fulvus	1.25 ±0.6	2.9 ±1.7	45.25 ±5.0	13.99 ±1.92	2.90 ±0.36	163.17 ± 6.42	50.50 ±6.87	30.89 ±1.76
Vultur gryphus	1.5 ±1.4	2.5 ±2.1	43.7 ±6.7	13.35t ±0.94	2.31 ±0.45	190.19 ± 8.8	58.54 ±7.4	30.72 ±2.57
Sarcorhamphus papa	0.9 ±0.7	2.1 ±1.3	42.7 ±4.7	14.4 ±2.8	2.60 ±0.22	165.8 ±14.9	56.4 ±9.0	33.9 ±3.2

[a] Mean ± S.D.

TABLE 2. Plasmatic values of metabolites (mg/100 ml).

Species	Glucose	Total glucides	Protein	Urea
Buteo buteo	322.6 ± 62.0[a]	354.3 ± 110.7	2963.1 ± 798.0	7.0 ± 0
Milvus migrans	215.7 ± 47.2	182.1 ± 36.3	2684.7 ± 684.1	11.2 ± 1.8
Aquila chrysaetos	254.0 ± 12.7	262.5 ± 41.7	1825.3 ± 224.6	14.0 ± 2.5
Aquila heliaca	180.0	276.9	2407.4	11.5
Stephanoetus coronatus	360.0	323.1	3518.0	10.6
Gyps fulvus	209.3 ± 24.2	210.0 ± 50.4	2963.0 ± 608.6	14.9 ± 1.6
Vultur gryphus	219.1 ± 43.7	165.4 ± 27.8	2972.9 ± 785.7	13.8 ± 0.8
Sarcorhamphus papa	223.0 ± 51.2	175.6 ± 47.9	4279.5 ± 448.0	11.6 ± 3.1

[a] Mean ± S.D.

TABLE 3. Plasma protein fractions.

	Fraction no. and possible identification						
Species	1 pre-alb.	2 alb.	3 α_1	4 α_2	5 α_3	6 β	7 γ
Buteo buteo	10.0[a]	35.6	6.8	12.8		19.3	15.0
	±2.7	±0.4	±0.4	±3.7		±15.4	± 9.5
Milvus migrans	14.5	33.5	13.3	6.5		19.2	12.8
	±2.8	±0.4	±2.2	±1.1		± 1.6	± 1.6
Aquila chrysaetos	22.2	30.0	16.2	4.5		19.0	8.0
	±2.7	±2.0	±1.2	±0.0		± 2.5	± 1.0
Aquila heliaca	20.5	23.0	5.5	14.0	4.0	17.0	16.0
Stephanoetus coronatus	11.5	36.5	14.0	5.0		22.0	11.0
Gyps fulvus	7.2	30.6	12.2	7.1		29.5	13.8
	±0.9	±3.2	±2.8	±1.2		± 6.8	± 2.3
Vultur gryphus	2.0	38.7	5.0	15.0		19.2	19.7
	±2.0	±8.7	±3.0	±0.7		± 2.7	±10.2
Sarcorhamphus papa	11.4	30.5	24.6			19.9	13.6
	±5.5	±3.7	±3.4			± 3.8	± 3.5

[a] Mean (in %) ± S.D.

previously (Balasch et al. 1973, 1974). The hematocrits of vultures were similar to those of birds previously studied but those of the hawks, kites, and eagles had lower values. The amount of plasma protein varied widely but was generally lower than in galliforms.

Vultures had more hemoglobin than the other falconiforms. Other blood values and the plasmatic values did not differ significantly among the species in this study.

The plasma protein fractions and electrophoretic scans showed specific values for each species and can be used for identification (table 3). The three eagles studied showed the most similar electrophoretic patterns, but these were different from *Sarcorhamphus* patterns. Our electrophoretic data reflect the view that the Cathartidae (e.g., *Sarcorhamphus*) are the most primitive falconiforms, and the hawks and eagles evolved later, followed still later by the accipitrid vultures (Fisher and Peterson 1964). The accipitrid vulture *Gyps* is more closely related to other accipitrids (*Aquila*, *Milvus*, and *Buteo*) in electrophoretic pattern than to the cathartid vulture *Sarcorhamphus*.

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