

## **I HEMATOLOGY AND BIOCHEMISTRY**

Conversions

Psittaciformes

Various Species

Columbiformes

Galliformes

Anseriformes

Ratites

## **II CLASS AVES:**

A LIST OF ORDERS, COMMON  
AND SCIENTIFIC NAMES

## **III DETERMINATION OF METABOLIC SCALING**



# **APPENDIX**

# Hematology and Biochemistry

## CONVERSIONS

### Conversion Factors: SI Units/ Gravimetric Units

Analyte	To convert		Multiply by	To convert		Multiply by
	From	To		From	To	
Albumin	g/dl	g/l	10.0	g/l	g/dl	0.1
Ammonia	μg/dl	μmol/l	0.5871	μmol/l	μg/dl	1.7
Bilirubin	mg/dl	μmol/l	17.1	μmol/l	mg/dl	0.059
Calcium	mg/dl	mmol/l	0.25	mmol/l	mg/dl	4.0
Chloride	mEq/l	mmol/l	1.0	mmol/l	mEq/l	1.0
Chloride	mg/dl	mmol/l	0.272	mmol/l	mg/dl	3.5
Cholesterol	mg/dl	mmol/l	0.02586	mmol/l	mg/dl	38.7
Corticosterone	μg/dl	nmol/l	28.9	nmol/l	mg/dl	0.0346
Cortisol	μg/dl	nmol/l	27.59	nmol/l	mg/dl	0.0362
Creatinine	mg/dl	μmol/l	88.4	μmol/l	mg/dl	0.0113
Globulin	mg/dl	g/l	10.0	g/l	mg/dl	0.1
Glucose	mg/dl	mmol/l	0.05551	mmol/l	mg/dl	18.0
Insulin	μU/ml	pmol/l	7.175	pmol/l	μU/ml	0.1296
Iron	μg/dl	μmol/l	0.1791	μmol/l	μg/dl	5.58
Lead	μg/dl	μmol/l	0.04826	μmol/l	μg/dl	20.72
Magnesium	mEq/l	mmol/l	0.5	mmol/l	mEq/l	2.0
Magnesium	mg/dl	mmol/l	0.4114	mmol/l	mg/dl	2.43
Phosphate (inorganic)	mg/dl	mmol/l	0.3229	mmol/l	mg/dl	3.097
Potassium	mEq/l	mmol/l	1.0	mmol/l	mEq/l	1.0
Pressure	mmHg	Pa (pascal)	0.1333	Pa (pascal)	mmHg	7.5
Progesterone	ng/dl	nmol/l	0.032	nmol/l	ng/dl	31.25
Protein	g/dl	g/l	10.0	g/l	g/dl	1.0
Sodium	mEq/l	mmol/l	1.0	mmol/l	mEq/l	1.0
Thyroxine	μg/dl	nmol/l	12.87	nmol/l	μg/dl	0.0777
Triglycerides	mg/dl	mmol/l	0.01129	mmol/l	mg/dl	88.5
Urea	mg/dl	mmol/l	0.167	mmol/l	mg/dl	6.0
Urea nitrogen (BUN)	mg/dl	mmol/l	0.7140	mmol/l	mg/dl	1.4
Urea nitrogen (BUN)	mg/dl	mmol urea/l	0.3670	mmol urea/l	mg/dl	2.72
Uric acid	mg/dl	mmol/l	59.48	mmol/l	mg/dl	0.0168

With the increasing exchange of knowledge between the United States, Europe and other parts of the world with regard to avian clinical chemistry, it is imperative that a uniform system of units be used to avoid confusion. The World Health Assembly recommended the International System of Units (SI, Systeme International d'Unites) for the health professions in 1977. The SI is the result of many decades of international efforts to develop a universally acceptable system. In many countries and many scientific journals, the use of the SI system is mandatory. It seems that the SI has gained more acceptance in European countries than in the USA. Many American veterinary journals still use conventional units (Journal of the Association of Avian Veterinarians) or a mixture of conventional and SI units (Avian Dis-

eases) while European journals use the SI system (Avian Pathology). Until the SI system is used in all scientific papers and handbooks conversion factors are indispensable.

This table is not complete and further information may be obtained from: Units, Symbols and Abbreviations. London, Royal Society of Medicine Services, 1988, ISBN 0905958780.

In the American veterinary literature the units of weight, temperature and pressure used are often different from SI (derived) units and therefore conversion factors for these quantities will also be given.

## PSITTACIFORMES

### Reference Values for Selected Psittacine Species

Parameter	Budgerigar	African Grey Parrot	Amazon Parrot	Cockatoo	Macaw
TP g/100ml	2.0-3.0	2.6-4.9	3.3-5.3	2.8-4.3	2.5-4.4
Ca mg/100ml	6.4-11.2	7.0-9.5	7.5-9.7	7.6-8.9	6.8-9.9
P mmol/l	0.9-1.9	1.0-5.2	0.8-3.4	1.0-3.6	1.3-4.8
Uric acid mg/100ml	3.0-8.6	3.1-7.0	1.3-5.6	3.5-9.3	2.9-8.5
Crea mg/100ml	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4	0.1-0.4
AST U/l	55-154	28-200	35-200	32-180	45-125
ALT U/l	5-20	2-21	4-13	5-12	5-15
LDH U/l	154-271	105-420	65-420	130-353	65-400
CK U/l	54-252	71-408	64-322	27-253	39-384
AP U/l	54-326	24-94	93-311	32-171	25-152
Amyl U/l	187-582	211-519	106-524		276-594
Glu mg/100ml	254-399	224-308	221-300	209-318	230-326
Chol mg/100ml	172-286	217-330	181-310		108-200
Trig mg/100ml	109-271	51-140	59-200		67-125
K mmol/l	2.2-3.7	2.2-3.5	2.1-3.3		2.1-4.5
Na mmol/l	139-159	146-167	127-158		133-160
Cl mmol/l	95-144	110-128	97-127		97-126

Kodak Ektachem®-25°C

Hochleithner M: Reference values for selected psittacine species using a dry chemistry system. J Assoc Avian Vet 3(4):207-209, 1989.

### Reference Values in Psittaciformes

Parameter	African Grey Parrot	Amazon Parrot	Cockatoo	Macaw
Urea mmol/l	0.7-2.4	0.9-4.6	0.8-2.1	0.3-3.3
Creatinine µmol/l	23-40	19-33	21-36	20-59
Uric acid µmol/l	93-414	72-312	190-327	109-231
Urea:Uric acid ratio	2.4:15.6	4.4:33	2.7:8.9	5:28
Osmolality mOsm/kg	320-347	316-373	317-347	319-378
Sodium mmol/l	154-164	149-164	152-164	150-175
Potassium mmol/l	2.5-3.9	2.3-4.2	3.2-4.9	1.9-4.1
Ca mmol/l	2.1-2.6	2.0-2.8	2.2-2.7	2.2-2.8
Glucose mmol/l	11.4-16.1	12.6-16.9	12.8-17.6	12.0-17.9
AST U/l	54-155	57-194	52-203	58-206
ALT U/l	12-59	19-98	12-37	22-105
GGT U/l	1-3.8	1-10	2-5	<1-5
LDH U/l	147-348	46-208	203-442	66-166
CPK U/l	123-875	45-265	34-204	61-531
Bile acids µmol/l	18-71	19-144	23-70	25-71
TP g/l	32-44	33-50	35-44	33-53
Albumin:Globulin ratio	1.4:4.7	2.6:7.0	1.5:4.3	1.4:3.9

Recommendations of the German Society for Clinical Chemistry Enzymes 30°C

Lumeij JT, Overduin LM: Plasma chemistry reference values in psittaciformes. Avian Pathol 19:235-244, 1990.

### Serum Biochemical Methods (37°C) Used in Determining Reference Values in Psittaciformes

Parameter	Method
Albumin	Modified Doumas Method (Bovine Standard)
ALP	Mod. Bowers and McComb
ALT	Mod. IFCC
AST	Mod. IFCC
T. Bili	Mod. Walters and Gerarde
BUN	Mod. Talke and Schubert
Calcium	Mod. Connerty and Briggs
Chloride	Mod. Schoenfeld and Lewellen
Cholesterol	Enzymatic Method
CK	Mod. Oliver and Rosalki
Creatinine	Kinetic Jaffe
GGT	Mod. Szasz
Glucose	Trinder Glucose (Gilford Reagent)
LDH	Mod. Wacker
Phosphorus	Mod. Daly and Ertingshausen
Total CO <sub>2</sub>	Enzymatic PEPC
Total Protein	Mod. Biuret
Triglyceride	Mod. Fossati and Prencipe
Uric Acid	Mod. Fossati
Sodium	Ion Selective Electrode
Potassium	Ion Selective Electrode

From Clubb SL, et al: J Assoc Avian Vet 4(4):222, 1990.

### Serum Biochemical Values for Juvenile Eclectus Parrots

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
NA (mEq/L)	141 (2)	154 (3)	148 (6)
K (mEq/L)	2.9 (1.0)	2.7 (0.6)	2.8 (0.7)
CL (mEq/L)	105 (3)	115 (3)	111 (5)
CA (mg/dl)	9.5 (0.5)	9.1 (0.4)	9.3 (0.4)
PHOS (mg/dl)	7.9 (0.8)	5.7 (0.9)	6.8 (1.2)
UREA (mg/dl)	1.5 (2.3)	2.0 (3.1)	1.7 (2.4)
CREAT (mg/dl)	0.3 (0.1)	0.4 (0.1)	0.4 (0.1)
UA (mg/dl)	0.8 (0.9)	3.9 (1.5)	2.0 (1.6)
CHOL (mg/dl)	181 (43)	300 (69)	268 (80)
GLUCOSE (mg/dl)	249 (16)	265 (19)	258 (18)
LDH (IU/L)	235 (145)	268 (70)	228 (101)
AST (IU/L)	85 (21)	216 (47)	140 (58)
ALT (IU/L)	4 (3)	7 (3)	4 (3)
ALP (IU/L)	421 (85)	565 (217)	489 (159)
GGT (IU/L)	5 (2)	2 (1)	4 (2)
CK (IU/L)	555 (164)	643 (262)	616 (472)
TP (g/dl)	2.6 (0.4)	2.9 (0.4)	2.9 (0.5)
ALB (g/dl)	1.2 (0.2)	1.3 (0.2)	1.3 (0.3)
GLOB (g/dl)	1.3 (0.3)	1.6 (0.3)	1.5 (0.3)
A:G (ratio)	0.9 (0.1)	0.8 (0.1)	0.9 (0.2)
ALB (Elect) (g/dl)	1.8 (0.5)	2.1 (0.4)	2.2 (0.4)
GLOB (Elect) (g/dl)	0.7 (0.2)	0.7 (0.2)	0.8 (0.2)

From Clubb SL, et al: J Assoc Avian Vet, 4(4):224, 1990.

### Hematology Values for Juvenile Eclectus Parrots

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean(SD)
RBC (x 10 <sup>6</sup> /μl)	1.95 (0.28)	3.22 (0.51)	2.69 (0.67)
HB (g/dl)	8.83 (1.15)	15.42 (2.38)	12.46 (3.01)
HCT (%)	33.7 (4.4)	53.8 (3.0)	43.8 (8.4)
MCV (fl)	174 (25)	169 (27)	166 (26)
MCH (pg)	43.9	49.1 (9.9)	45.5 (10.7)
MCHC (g/dl)	261.(2.5)	28.7 (4.1)	27.7 (5.0)
WBC (cells/μl)	18500 (6900)	10900 (3700)	13700 (6300)
WBC Est (cells/μl)	17000 (6000)	10500 (4000)	13500 (6000)
BANDS (%)	0.2 (1.1)	0.4 (0.9)	0.5 (1.5)
HET (%)	62.8 (7.7)	52.1 (10.2)	53.9 (11.4)
LYMPH (%)	30.4 (6.3)	40.8 (10.4)	39.5 (11.5)
MONO (%)	5.5 (3.0)	5.2 (2.7)	5.0 (2.7)
EOS (%)	0.0 (0.0)	0.1 (0.4)	0.1 (0.3)
BASO (%)	1.2 (1.0)	1.5 (1.0)	1.1 (1.0)
BAND # (cells/μl)	34 (188)	48 (111)	70 (221)
HET # (cells/μl)	11800 (5400)	5900 (2800)	7700 (4800)
LYMPH # (cells/μl)	5500 (2100)	4200 (1200)	5100 (2000)
MONO # (cells/μl)	930 (520)	532 (331)	639 (428)
EOS # (cells/μl)	0	9 (43)	8 (44)
BASO # (cells/μl)	209 (199)	175 (158)	152 (169)
HET: LYMPH (ratio)	2.2 (0.8)	1.4 (0.6)	1.6 (0.8)
PP (Refrac) (g/dl)	2.8 (0.6)	3.9 (0.6)	3.5 (0.8)

From Clubb SL, et al: J Assoc Avian Vet 4(4):223, 1990.

**Hematology Values for Juvenile Cockatoos**

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
RBC # (x 10 <sup>6</sup> /μl)	196.0(0.22) <sup>a</sup>	2.84 (0.49) <sup>b</sup>	2.53 (0.63)
HB (g/dl)	8.12 (0.83) <sup>a</sup>	14.04 (1.23) <sup>c</sup>	11.43 (2.90)
HCT (%)	30.1 (2.8) <sup>a</sup>	47.6 (4.1) <sup>c</sup>	39.7 (9.0)
MCV (fl)	155 (17) <sup>a</sup>	172 (28) <sup>b</sup>	160 (23)
MCH (pg)	38.9 (11.7) <sup>a</sup>	49.0 (12.9) <sup>b</sup>	43.8 (10.8)
MCHC (g/dl)	24.6 (7.9) <sup>a</sup>	28.5 (6.2) <sup>bc</sup>	27.2 (6.1)
WBC# (cells/μl)	13700 (7400) <sup>a</sup>	10000(2800) <sup>b</sup>	12900(6300)
WBC Est (cells/μl)	13200 (6700) <sup>a</sup>	10400 (2800) <sup>b</sup>	13100 (5900)
BAND (%)	1.3 (2.3) <sup>ab</sup>	1.3 (2.3) <sup>ab</sup>	1.3 (2.3)
HET (%)	54.8 (9.7) <sup>a</sup>	49.0 (8.1) <sup>b</sup>	50.8 (11.7)
LYMPH (%)	36.4 (8.1) <sup>a</sup>	43.6 (8.4) <sup>b</sup>	41.2 (11.9)
MONO (%)	6.9 (3.4) <sup>a</sup>	4.9 (3.4) <sup>bc</sup>	5.8 (3.4)
EOS (%)	0 (0)	0 (0.2)	0 (0)
BASO (%)	0.6 (0.9) <sup>ac</sup>	1.2 (1.1) <sup>b</sup>	0.9 (1.1)
BAND # (cells/μl)	150 (275) <sup>a</sup>	130 (290) <sup>a</sup>	160 (325)
HET # (cells/μl)	7800 (5000) <sup>a</sup>	4400 (2200) <sup>b</sup>	6500 (4500)
LYMPH # (cells/μl)	4900 (2600) <sup>a</sup>	3900 (2000) <sup>a</sup>	4900 (2500)
MONO # (cells/μl)	880 (530) <sup>a</sup>	440 (450) <sup>a</sup>	690 (525)
EOS # (cells/μl)	0 (0)	0 (0)	0 (0)
BASO # (cells/μl)	67 (130) <sup>a</sup>	115 (130) <sup>a</sup>	100 (140)
HET: LYMPH (ratio)	1.6 (0.6) <sup>a</sup>	1.2 (0.4) <sup>b</sup>	1.4 (0.8)
PP Est (Refrac) (g/dl)	2.3 (0.5) <sup>a</sup>	4.0 (0.8) <sup>b</sup>	3.2 (0.9)

a,b,c = Values for parameters are statistically different (P<0.05) when letters are different.

From Clubb SL, et al: J Assoc Avian Vet 5(1):20, 1991.

**Hematology Values for Juvenile Umbrella Cockatoos**

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean
RBC #(x 10 <sup>6</sup> /μl)	1.98 (0.51) <sup>n</sup>	2.75 (0.49) <sup>n</sup>	2.54
HB (g/dl)	7.9 (1.64) <sup>n</sup>	14 (0.92) <sup>n</sup>	11.6
HCT (%)	29.5 (5.65) <sup>n</sup>	46.9 (2.92) <sup>n</sup>	39.3
MCV (fl)	151 (25.6) <sup>n</sup>	175 (28.5) <sup>n</sup>	158.0
MCH (pg)	35.3 (10.03) <sup>n</sup>	51.9 (8.57) <sup>n</sup>	43.6
MCHC (g/dl)	21.8 (10.5) <sup>n</sup>	29.9 (1.1) <sup>n</sup>	27.0
WBC # (cells/μl)	20311 (5717) <sup>s</sup>	10238 (3368) <sup>n</sup>	16567.0
WBC Est (cells/μl)	19190 (5127) <sup>s</sup>	10500 (3184) <sup>n</sup>	16412.0
BAND (%)	1 (2.57) <sup>n</sup>	1.93 (2.76) <sup>n</sup>	1.31
HET (%)	58.4 (11.4) <sup>s</sup>	50 (9.7) <sup>n</sup>	54.1
LYMPH (%)	34.4 (11.5) <sup>n</sup>	41.2 (9.9) <sup>n</sup>	38.1
MONO (%)	5.77 (3.1) <sup>n</sup>	5.29 (3.27) <sup>n</sup>	5.35
EOS (%)	0(0.14) <sup>n</sup>	0.07 (0.27) <sup>n</sup>	0.02
BASO (%)	0.45 (1.05) <sup>n</sup>	1.43 (0.94) <sup>n</sup>	1.03
BAND # (cells/μl)	185 (331) <sup>n</sup>	192 (368) <sup>n</sup>	202.0
HET # (cells/μl)	12041 (4993) <sup>s</sup>	4465 (2595) <sup>n</sup>	8917.0
LYMPH # (cells/μl)	6893 (2581) <sup>s</sup>	3663 (2076) <sup>n</sup>	5695.0
MONO # (cells/μl)	1118 (624) <sup>s</sup>	492 (529) <sup>n</sup>	843.0
EOS # (cells/μl)	0 (0) <sup>n</sup>	0 (0) <sup>n</sup>	0.00011
BASO # (cells/μl)	83 (181) <sup>n</sup>	137 (135) <sup>n</sup>	143.0
HET: LYMPH (ratio)	1.83 (1.05) <sup>n</sup>	1.33 (0.54) <sup>n</sup>	1.64
PP Est (Refrac) (g/dl)	2.69 (0.71) <sup>s</sup>	4.26 (0.55) <sup>n</sup>	3.56

s = Mean is statistically different (P<0.05) from the same parameter in all juvenile cockatoos.

n = Mean is not statistically different (P<0.05) from the same parameter in all juvenile cockatoos.

From: Clubb SL, et al: J Assoc Avian Vet 5(1):20, 1991.

## Serum Biochemical Values for Juvenile Cockatoos

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
NA (mEq/l)	139 (3) <sup>a</sup>	150 (3) <sup>c</sup>	145 (6)
K (mEq/l)	4.0 (0.8) <sup>a</sup>	3.1 (0.4) <sup>b</sup>	3.6 (0.7)
CL (mEq/l)	105 (4) <sup>a</sup>	115 (4) <sup>c</sup>	110 (6)
CA (mg/dl)	9.2 (0.6) <sup>a</sup>	9.5 (1.0) <sup>ab</sup>	9.6 (0.7)
PHOS (mg/dl)	7.0 (0.6) <sup>a</sup>	5.1 (1.0) <sup>c</sup>	6.1 (1.1)
UREA (mg/dl)	1.6 (1.9) <sup>a</sup>	2.6 (2.5) <sup>b</sup>	2.0 (2.2)
CREAT (mg/dl)	0.31 (0.06) <sup>a</sup>	0.42 (0.07) <sup>ab</sup>	0.4 (0.1)
UA (mg/dl)	1.2 (0.9) <sup>a</sup>	5.1 (1.8) <sup>c</sup>	2.9 (2.3)
CHOL (mg/dl)	165 (32) <sup>a</sup>	350 (122) <sup>b</sup>	251 (105)
GLU (mg/dl)	247 (20) <sup>a</sup>	249 (29) <sup>a, b</sup>	253 (24)
LDH (U/l)	393 (348) <sup>a</sup>	367 (218) <sup>a</sup>	371 (285)
AST (U/l)	98 (54) <sup>a</sup>	195 (73) <sup>c</sup>	143 (79)
ALT (U/l)	2 (2) <sup>a</sup>	3 (3) <sup>ab</sup>	2 (3)
ALP (U/l)	593 (202) <sup>a</sup>	478 (167) <sup>c</sup>	579 (239)
GGT (U/l)	2.35 (1.75) <sup>a</sup>	2.79 (1.54) <sup>ac</sup>	2.55 (1.67)
CK (U/l)	595 (205) <sup>a</sup>	368 (156) <sup>b</sup>	510 (235)
TP (g/dl)	2.2 (0.4) <sup>a</sup>	3.1 (0.6) <sup>b</sup>	2.8 (0.7)
ALB (g/dl)	0.8 (0.2) <sup>a</sup>	1.2 (0.3) <sup>b</sup>	1.1 (0.3)
GLOB (g/dl)	1.3 (0.4) <sup>a</sup>	1.9 (0.4) <sup>b</sup>	1.7 (0.5)
A:G (ratio)	0.6 (0.2) <sup>ab</sup>	0.6 (0.1) <sup>b</sup>	0.6 (0.2)
PRE ALB (g/dl)	0.4 (0.1) <sup>a</sup>	0.5 (0.2) <sup>b</sup>	0.5 (0.2)
ALB (Elect) (g/dl)	1.1 (0.3) <sup>a</sup>	1.7 (0.5) <sup>bc</sup>	1.5 (0.5)
ALPHA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.2) <sup>c</sup>	0.2 (0.1)
BETA GLOB (g/dl)	0.3 (0.2) <sup>a</sup>	0.3 (0.1) <sup>a</sup>	0.3 (0.1)
GAMMA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.1) <sup>b</sup>	0.3 (0.1)

a,b,c = Values for parameters are statistically different (P) when letters are different.

From Clubb SL, et al: J Assoc Avian Vet 5(1):23, 1991.

## Serum Biochemical Values for Juvenile Umbrella Cockatoos

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean
NA (mEq/l)	139 (1.78) <sup>s</sup>	149 (2.33) <sup>n</sup>	145
K (mEq/l)	4.23 (0.57) <sup>n</sup>	3.13 (0.44) <sup>n</sup>	3.54
CL (mEq/l)	107 (2.8) <sup>s</sup>	115 (3.2) <sup>n</sup>	111
CA (mEq/l)	9.64 (0.39) <sup>s</sup>	9.43 (1.28) <sup>n</sup>	9.77
PHOS (mg/dl)	6.5 (0.44) <sup>s</sup>	4.7 (0.87) <sup>n</sup>	5.55
UREA (mg/dl)	1 (1.78) <sup>n</sup>	1.94 (2.41) <sup>s</sup>	1.61
CREAT (mg/dl)	0.34 (0.07) <sup>n</sup>	0.33 (0.04) <sup>s</sup>	0.37
UA (mg/dl)	0.83 (0.36) <sup>s</sup>	4.95 (1.68) <sup>n</sup>	2.73
CHOL (mg/dl)	180 (37.1) <sup>s</sup>	427 (70.3) <sup>s</sup>	291
GLU (mg/dl)	244 (18.03) <sup>n</sup>	236 (28.24) <sup>s</sup>	244
LDH (U/l)	326 (394) <sup>n</sup>	341 (174) <sup>n</sup>	325
AST (U/l)	84 (17.7) <sup>n</sup>	187 (39.2) <sup>n</sup>	136
ALT (U/l)	1.8 (1.7) <sup>n</sup>	2.69 (1.58) <sup>n</sup>	2.11
ALP (U/l)	426 (100) <sup>s</sup>	404 (104) <sup>s</sup>	440
GGT (U/l)	1.95 (1.73) <sup>n</sup>	2.81 (1.33) <sup>n</sup>	2.66
CK (U/l)	629 (193) <sup>n</sup>	395 (115) <sup>n</sup>	517
TP (g/dl)	2.47 (0.41) <sup>s</sup>	3.25 (0.59) <sup>n</sup>	3.03
A:G (ratio)	0.6 (0.1)	0.62 (0.08)	0.64
PRE ALB (g/dl)	0.43 (0.12) <sup>n</sup>	0.49 (0.13) <sup>n</sup>	0.45
ALB (Elect)(g/dl)	1.27 (0.27) <sup>s</sup>	1.86 (0.35) <sup>n</sup>	1.69
ALPHA GLOB (g/dl)	0.17 (0.05) <sup>n</sup>	0.29 (0.19) <sup>n</sup>	0.26
BETA GLOB (g/dl)	0.39 (0.16) <sup>n</sup>	0.34 (0.14) <sup>n</sup>	0.38
GAMMA GLOB (g/dl)	0.23 (0.06) <sup>n</sup>	0.31 (0.11) <sup>n</sup>	0.29

s = Mean is statistically different ( $\geq$ ) from the same parameter in all juvenile cockatoos.

n = Mean is not statistically different ( $\leq$ ) from the same parameter in all juvenile cockatoos.

From Clubb SL, et al: J Assoc Avian Vet 5(1):22, 1991.

## HEMATOLOGY AND BIOCHEMISTRY PSITTACIFORMES

## Hematology Values for Juvenile Macaws

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
RBC# (x 10 <sup>6</sup> /μl)	1.9 (0.3) <sup>a</sup>	3.7 (0.5) <sup>c</sup>	2.9 (0.8)
HB (g/dl)	7.7 (0.9) <sup>a</sup>	15.4(1.0) <sup>c</sup>	12.3(3.3)
HCT (%)	30.9(3.3) <sup>a</sup>	49.5(2.5) <sup>c</sup>	41.7(8.4)
MCV (fl)	165.5(25.4) <sup>a</sup>	137(19.2) <sup>c</sup>	149 (24.7)
MCH (pg)	41.7 (6.1) <sup>a</sup>	42.8(5.8) <sup>a</sup>	42.3 (6.2)
MCHC (g/dl)	25.1 (1.9) <sup>a</sup>	31.1(1.3) <sup>b</sup>	28.7 (2.9)
WBC (cells/μl)	19300 (8300) <sup>ab</sup>	17700 (4900) <sup>b</sup>	19200 (6900)
WBC Est (cells/μl)	17700 (5100) <sup>ab</sup>	18300 (4500) <sup>ab</sup>	18600 (5880)
BANDS (%)	0.8 (1.6) <sup>a</sup>	0.3(1.2) <sup>a</sup>	0.6 (1.7)
HET (%)	58.9 (11.1) <sup>a</sup>	53.9 (9.4) <sup>ab</sup>	55.3 (10)
LYMPH (%)	33.8(9.7) <sup>a</sup>	41.6 (9.6) <sup>bc</sup>	39.0 (10)
MONO (%)	5.9 (3.3) <sup>a</sup>	3.6 (2.0) <sup>b</sup>	4.4 (2.9)
EOS (%)	0 (0) <sup>a</sup>	0.1 (0.2) <sup>a</sup>	0 (0.2)
BASO (%)	0.7 (0.9) <sup>a</sup>	0.6 (1.2) <sup>ab</sup>	0.5 (1.0)
BANDS # (cells/μl)	134 (344) <sup>a</sup>	59(230) <sup>a</sup>	110 (313)
HET # (cells/μl)	10200 (7600) <sup>ab</sup>	9400 (4000) <sup>bc</sup>	10100 (5800)
LYMPH # (cells/μl)	5500 (3100) <sup>a</sup>	7000 (2500) <sup>b</sup>	6800 (3200)
MONO # (cells/μl)	910 (643) <sup>a</sup>	627 (418) <sup>b</sup>	750 (545)
EOS # (cells/μl)	0 (0) <sup>a</sup>	9.3 (51) <sup>a</sup>	4.6 (35)
BASO # (cells/μl)	115 (190) <sup>a</sup>	75 (165) <sup>ab</sup>	91 (175)
HET: LYMPH (ratio)	2.0 (1.0) <sup>ab</sup>	1.4 (0.6) <sup>bc</sup>	1.6 (0.8)
PP (refrac) (g/dl)	1.8 (0.40) <sup>a</sup>	3.5 (0.4) <sup>c</sup>	2.9 (0.8)

a,b,c = Values for parameters are statistically different (P<0.05) when letters are different.

From Clubb SL, et al: J Assoc Avian Vet 5(3):159, 1991.

## Hematology Values for Juvenile Blue and Gold Macaws

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
RBC #(x 10 <sup>6</sup> /μl)	1.9 (0.3) <sup>an</sup>	3.5 (0.4) <sup>cn</sup>	2.7 (0.7)
HB (g/dl)	7.9 (0.9) <sup>an</sup>	15 (0.9) <sup>cs</sup>	11 (2.9)
HCT (%)	30 (2.7) <sup>an</sup>	48 (2.0) <sup>cs</sup>	40 (7.7)
MCV (fl)	163 (27) <sup>an</sup>	137 (14) <sup>bn</sup>	149 (22)
MCH (pg)	43 (7.1) <sup>an</sup>	41 (3.7) <sup>an</sup>	38 (13)
MCHC (g/dl)	26 (1.6) <sup>an</sup>	31 (1.4) <sup>cn</sup>	25 (9.5)
WBC # (cells/μl)	19200 (5600) <sup>an</sup>	16600 (4300) <sup>bn</sup>	18928 (5561)
WBC Est (cells/μl)	18300 (5600)	16800 (4300)	18300 (5600)
BAND (%)	0.36 (1.3) <sup>an</sup>	0 (0) <sup>an</sup>	0.12 (0.7)
HET (%)	57 (11.6) <sup>an</sup>	48 (11) <sup>an</sup>	52 (10)
LYMPH (%)	37 (10) <sup>an</sup>	47 (11) <sup>cn</sup>	42 (10)
MONO (%)	5.3 (2.9) <sup>an</sup>	3.8 (2.2) <sup>an</sup>	4.3 (2.7)
EOS (%)	0 (0) <sup>an</sup>	0 (0) <sup>an</sup>	0 (0)
BASO (%)	0.9 (1.1) <sup>an</sup>	1.1 (1.7) <sup>an</sup>	0.9 (1.3)
BANDS # (cells/μl)	0.36 (1.3) <sup>an</sup>	0 (0) <sup>an</sup>	0.12 (0.7)
HET # (cells/μl)	11000 (4600) <sup>an</sup>	8100 (3000) <sup>an</sup>	10000 (3800)
LYMPH # (cells/μl)	7000 (2600) <sup>an</sup>	7700 (2600) <sup>bn</sup>	8000 (3100)
MONO # (cells/μl)	949 (498) <sup>an</sup>	639 (421) <sup>an</sup>	756 (446)
EOS # (cells/μl)	0 (0) <sup>an</sup>	0 (0) <sup>an</sup>	0 (0)
BASO # (cells/μl)	194 (245) <sup>an</sup>	156 (256) <sup>an</sup>	154 (229)
HET: LYMPH (ratio)	1.75 (0.85) <sup>an</sup>	1.19 (0.77) <sup>an</sup>	1.38 (0.69)
PP Est (refrac) (g/dl)	1.87 (0.2) <sup>an</sup>	3.62 (0.5) <sup>cn</sup>	2.86 (0.8)

a,b,c = Values for parameters are statistically different (P<0.05) when letters are different.

s = Mean is statistically different (P<0.05) from the same parameter in all juvenile macaws.

n = Mean is not statistically different (P<0.05) from the same parameter in all juvenile macaws.

From: Clubb SL, et al: J Assoc Avian Vet 5(3):159, 1991.

**Serum Biochemistry Values for Juvenile Macaws**

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
NA (mEq/L)	137 (1.4) <sup>a</sup>	151.1 (2.5) <sup>c</sup>	145 (6.2)
K (mEq/L)	3.3 (0.5) <sup>a</sup>	2.7 (1.0) <sup>b</sup>	2.9 (0.8)
CL (mEq/L)	101 (4) <sup>a</sup>	112 (3) <sup>c</sup>	106 (5.5)
CA (mg/dl)	9.5 (0.5) <sup>a</sup>	10 (0.5) <sup>b</sup>	9.9 (0.5)
PHOS (mg/dl)	7.3 (0.6) <sup>a</sup>	5.6 (0.6) <sup>c</sup>	6.5 (1.0)
UREA (mg/dl)	1.0 (1.7) <sup>a</sup>	3.4 (2.2) <sup>c</sup>	2.4 (2.3)
CREAT (mg/dl)	0.4 (0.1) <sup>a</sup>	0.4 (0.1) <sup>a</sup>	0.4 (0.1)
UA (mg/dl)	0.6 (0.4) <sup>a</sup>	3.9 (1.2) <sup>c</sup>	2.3 (2.1)
CHOL (mg/dl)	119 (37.2) <sup>a</sup>	231 (48.9) <sup>c</sup>	165 (62.0)
GLU (mg/dl)	264 (32) <sup>a</sup>	290 (27) <sup>b</sup>	281 (30)
LDH (U/l)	131 (75) <sup>a</sup>	114 (55) <sup>a</sup>	138 (84)
AST (U/l)	84 (17) <sup>a</sup>	127 (36) <sup>b</sup>	104 (31)
ALT (U/l)	3 (2) <sup>a</sup>	4 (2) <sup>a</sup>	3 (2)
ALP (U/l)	1072 (346) <sup>a</sup>	786 (276) <sup>b</sup>	970 (397)
GGT (U/l)	2.0 (1.0) <sup>a</sup>	1.2 (1.2) <sup>b</sup>	1.8 (1.2)
CK (U/l)	596 (330) <sup>ab</sup>	442 (280) <sup>b</sup>	550 (312)
TP (g/dl)	1.7 (0.3) <sup>a</sup>	3.0 (0.3) <sup>c</sup>	2.6 (0.6)
ALB (g/dl)	0.7 (0.2) <sup>a</sup>	1.4 (0.2) <sup>c</sup>	1.2 (0.3)
GLOB (g/dl)	0.8 (0.4) <sup>a</sup>	1.5 (0.4) <sup>c</sup>	1.3 (0.6)
A:G (ratio)	0.7 (0.4) <sup>a</sup>	0.9 (0.1) <sup>b</sup>	0.8 (0.3)
PRE ALB (g/dl)	0.2 (0.1) <sup>a</sup>	0.5 (0.1) <sup>c</sup>	0.3 (0.1)
ALB (Elect) (g/dl)	1.0 (0.3) <sup>a</sup>	1.8 (0.3) <sup>c</sup>	1.5 (0.4)
ALPHA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.1) <sup>a</sup>	0.3 (0.1)
BETA GLOB (g/dl)	0.3 (0.1) <sup>a</sup>	0.4 (0.1) <sup>a</sup>	0.3 (0.2)
GAMMA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.2) <sup>a</sup>	0.3 (0.1)

a,b,c = Values for parameters are statistically different (P<0.05) when letters are different.

Clubb SL, et al: J Assoc Avian Vet 5(3):159-160, 1991.

**Serum Biochemical Values for Juvenile Blue and Gold Macaws**

Parameter	30-day Mean (SD)	90-day Mean (SD)	All Mean (SD)
NA (mEq/l)	136 (1.25) <sup>an</sup>	150 (2.44) <sup>cn</sup>	142 (6.07)
K (mEq/l)	3.20 (0.49) <sup>an</sup>	2.20 (0.15) <sup>bn</sup>	2.71 (0.64)
CL (mEq/l)	98.8 (2.31) <sup>as</sup>	111 (1.90) <sup>cn</sup>	104 (5.37)
CA (mg/dl)	9.7 (0.24) <sup>an</sup>	10.2 (0.25) <sup>bn</sup>	10 (0.47)
PHOS (mg/dl)	7.2 (0.64) <sup>an</sup>	5.6 (0.50) <sup>cn</sup>	6.6 (0.85)
UREA (mg/dl)	1.2 (1.78) <sup>an</sup>	2.5 (2.07) <sup>an</sup>	1.9 (2.18)
CREAT (mg/dl)	0.3 (0.06) <sup>an</sup>	0.4 (0.07) <sup>bn</sup>	0.4 (0.07)
UA (mg/dl)	0.6 (0.4) <sup>an</sup>	3.4 (0.9) <sup>bn</sup>	1.9 (2.5)
CHOL (mg/dl)	114 (30) <sup>an</sup>	251 (64) <sup>cn</sup>	164 (66.6)
GLUCOSE (mg/dl)	266 (33) <sup>an</sup>	299 (22) <sup>bn</sup>	288 (31)
LDH (U/l)	136 (69) <sup>an</sup>	97 (21) <sup>an</sup>	144 (98)
AST (U/l)	88 (19) <sup>an</sup>	127 (18) <sup>bn</sup>	101 (24)
ALT (U/l)	3 (2) <sup>an</sup>	4 (2) <sup>abn</sup>	4 (3)
ALP (U/l)	1225 (300) <sup>as</sup>	950 (315) <sup>cs</sup>	1200 (390)
GGT (U/l)	2.0 (0.9) <sup>an</sup>	0.9 (0.9) <sup>bn</sup>	1.7 (1.2)
CK (U/l)	498 (162) <sup>an</sup>	330 (85) <sup>an</sup>	540 (267)
TP (g/dl)	1.7 (0.2) <sup>an</sup>	2.9 (0.4) <sup>bn</sup>	2.5 (0.7)
ALB (g/dl)	0.7 (0.1) <sup>an</sup>	1.4 (0.2) <sup>bn</sup>	1.2 (0.3)
GLOB (g/dl)	0.8 (0.3) <sup>an</sup>	1.4 (0.5) <sup>bn</sup>	1.3 (0.6)
A:G (ratio)	0.8 (0.1) <sup>an</sup>	0.9 (0.1) <sup>an</sup>	0.8 (0.2)
PRE ALB (g/dl)	0.2 (0.1) <sup>an</sup>	0.5 (0.1) <sup>cn</sup>	0.3 (0.1)
ALB (Elect) (g/dl)	1.0 (0.3) <sup>an</sup>	1.8 (0.3) <sup>bn</sup>	1.5 (0.4)
ALPHA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.1) <sup>a</sup>	0.3 (0.1)
BETA GLOB (g/dl)	0.3 (0.1) <sup>a</sup>	0.4 (0.1) <sup>a</sup>	0.3 (0.2)
GAMMA GLOB (g/dl)	0.2 (0.1) <sup>a</sup>	0.3 (0.2) <sup>a</sup>	0.3 (0.1)

a,b,c = Values for parameters are statistically different (P<0.05) when letters are different.

s = Mean is statistically different (P<0.05) from the same parameter in all juvenile macaws.

n = Mean is not statistically different (P<0.05) from the same parameter in all juvenile macaws.

From Clubb SL: J Assoc Avian Vet 5(3):161, 1991.



## VARIOUS SPECIES

### The Determination of Several Enzymes of Blood Plasma in Different Bird Species

Species	AST	ALT	LDH	AP
Green-cheeked Amazon Parrot	107.96 ± 22.66	9.15 ± 2.34	266.54 ± 75.03	122.3 ± 51.68
Blue-fronted Amazon Parrot	130.48 ± 19.75	15.9 ± 4.3	244.42 ± 76.32	129.48 ± 24.48
African Grey Parrot	63.23 ± 14.46	9.77 ± 3.33	209.19 ± 33.66	47.6 ± 14.12
Budgerigar	101.89 ± 15.2	14.96 ± 4.48	104.7 ± 28.43	194.12 ± 62.92
Homing Pigeon (Male)	46.01 ± 10.94	18.12 ± 3.51	65.51 ± 27.92	196.48 ± 56.35
Homing Pigeon (Female)	33.29 ± 11.44	16.95 ± 2.37	105.3 ± 60.32	225.07 ± 98.96

Monotest Boeringer Mannheim, Temperature not specified. From Baron HW: Vet Diss, München, 1980.

### Uric Acid Concentrations in Blood Plasma

Species	Uric Acid in mmol/l
Budgerigar	0.284 ± 0.056
Blue-fronted Amazon Parrot	0.54 ± 0.057
Green-cheeked Amazon Parrot	0.280 ± 0.052
African Grey Parrot	0.315 ± 0.088
Pigeon	0.239 ± 0.029
Eagle	0.514 ± 0.044
Goshawk	0.498 ± 0.050
Common Buzzard	0.526 ± 0.049

Urica-quant®, Boeringer Mannheim. From Baumann CR: Vet Diss, München, 1980.

### Protein Electrophoresis in Raptors

Parameter	Red Kite	American Kestrel	Montagu's Harrier	Barn Owl
Albumin	1.6 ± 0.5	1.6 ± 0.3	1.8 ± 0.31	1.6 ± 0.6
Alpha 1	0.26 ± 0.14	0.06 ± 0.06	0.50 ± 0.13	0.43 ± 0.24
Alpha 2	0.22 ± 0.12	0.06 ± 0.06		
Beta	0.21 ± 0.16	0.33 ± 0.01	0.24 ± 0.06	0.18 ± 0.07
Gamma	0.43 ± 0.24	0.58 ± 0.12	0.29 ± 0.04	0.42 ± 0.06
A:G Ratio	1.50 ± 0.73	1.34 ± 0.29	1.95 ± 0.37	1.95 ± 0.38

Hernandez, M. Blood chemistry in raptors. Proc European Assoc Avian Vet 1991, 411-419.

### Normal Hematologic and Biochemical Values in Toucans

Cornelissen H.

Parameter	Value
RBC (10 <sup>3</sup> /mm <sup>3</sup> )	2.5-4.5
WBC 10 <sup>3</sup> /mm <sup>3</sup> )	4.0-10.0
PCV (%)	45-60
Buffy Coat (%)	0-1
Hets (%)	35-65
Lymphs (%)	25-50
Basos (%)	0-5
Eosins (%)	0-4
Thromb	present
Calcium (mg/dl)	10-15
Glucose (mg/dl)	220-350
LDH (U/l)	200-400
AST (U/l)	130-330
TP (g/l)	30-50
UA (mg/dl)	4-14
Iron (µg/dl)	<350
TIBC (µg/dl)	<550

## Reference Values from Various Species

Parameter	Captive Bald Eagle	Cuban Amazon Parrot	Quaker Parrots	Blue & Gold Macaw	Hyacinth Macaw
AST (U/l)	101 ± 4.7	201 ± 79		197-297	87-160
ALT (U/l)	10.1 ± 1.5		0-21	99-263	
AP (U/l)		41 ± 21	219-823	162-580	
CK (U/l)	32.9 ± 1.9	217 ± 130			260-563
LDH (U/l)	120 ± 7.2	237 ± 155		183-664	62-89
Cholinesterase	663 ± 32				
Creatinine (mg/dl)				0.3-0.5	0.3-0.5
Uric acid (mg/dl)		2.8 ± 1.5		4-10.1	3.4-10.4
Cholesterol (mg/dl)				139-202	88-109
Glucose (mg/dl)		251 ± 43		286-332	255-324
TP (g/dl)		3.9 ± 0.7	3.8-5.0	3.3-5.6	2.7-3.6
Sodium (mEq/l)		149 ± 7		138-153	144-152
Potassium (mEq/l)		2.7 ± 0.7		5.0-10.4	2.3-6.2
Calcium (mg/dl)		9 ± 0.7		8.8-12.3	
Ionized Calcium (mg/dl)				4.6-6.2	
Phosphor (mg/dl)		2.0 ± 0.9		1.9-2.6	
Iron (µg/dl)				79-135	
BUN (mg/dl)		1.7 ± 2.0		1-5	
Bilirubin (mg/dl)				0.1-0.2	

See references 12, 18, 23, 60, 67 from Chapter 11.

## Blood Chemistry in Canary Finches

Parameter	Mean Value	SD	P <sub>2.5</sub> -P <sub>97.5</sub>
Ca (mg/dl)	7.99	1.84	5.1-13.4
P (mg/dl)	3.28	1.21	1.6-5.6
Na (mmol/l)	139.2	8.18	125-154
Cl (mmol/l)	108.88	8.85	93-123
K (mmol/l)	3.58	0.69	2.7-4.8
Gluc (mg/dl)	345.88	30.27	291-391
Trig (mg/dl)	184.78	55.46	120-312
Crea (mg/dl)	0.48	0.25	0.1-1
NH <sub>3</sub> (mmol/l)	221.18	110.42	87-467
ALT (U/l)	11.58	7.92	2-30
AST (U/l)	98.93	34.73	45-170
LDH (U/l)	1582.63	325.72	1580-1816 <sup>male</sup> 1300-1632 <sup>female</sup>
AP (U/l)	265.05	79.62	146-397
Chol (mg/dl)	165.45	44.52	110-286
Amyl (U/l)	481.78	141.84	277-787
CK (U/l)	302.1	106.94	177-556
TP (g/dl)	2.84	0.75	2.0-4.4
Uric (mg/dl)	8.93	3.31	4.3-14.8

Kodak Ektachem@-25°C. From Schöpf A, Vasicek L: Proc Europ Assoc Avian Vet, Vienna, 1991, pp 437-439.

## COLUMBIFORMES

### Plasma Chemistry Reference Values for Racing Pigeons

Parameter	P2.5-P97.5
Sodium (mmol/l)	141-149
Potassium (mmol/l)	3.9-4.7
Calcium (mmol/l)	1.9-2.6
Magnesium (mmol/l)	1.1-1.8
Inorganic phosphorus (mmol/l)	0.57-1.33
Chloride (mmol/l)	101-113
Plasma iron (μmol/l)	11-33
Iron binding capacity (μmol/l)	30-45
Osmolality (mOsm/kg)	297-317
Glucose (mmol/l)	12.9-20.5
Creatinine (μmol/l)	23-36
Urea (mmol/l)	0.4-0.7
Uric acid (μmol/l)	150-765
Urea:Uric acid (ratio)	1.8 ± 1.8 (mean ± sd)
CPK (U/l)	110-480
AP (U/l)	160-780
AST (U/l)	45-123
ALT (U/l)	19-48
GLDH (U/l)	0-1
LDH (U/l)	30-205
Bile acids (μmol/l)	22-60
GGT (U/l)	0-2.9
Total protein (g/l)	21-33
Albumin:Globulin (ratio)	1.5-3.6
Prealbumin (g/l)	1-4
Alpha globulin (g/l)	2-3
Beta globulin (g/l)	3-6
Gamma globulin (g/l)	1-3

Thyroxine before and 16 h after stimulation with 2 U/kg TSH, 6-35/100-300 nmol/l  
 Corticosterone before and 90 min after stimulation with 250 μg/kg ACTH,  
 0.2-1.24/2.22-11.2 μg/dl  
 Recommendations of the German Society for Clinical Chemistry, Enzymes 30°C.  
 From: Lumeij JT: PhD Thesis, Utrecht University, 1987.

### Blood Cells of Domestic Pigeons

Type Cell	Number
Erythrocytes (x 10 <sup>12</sup> /l)	3.1-4.5
Leukocytes (x 10 <sup>9</sup> /l)	13.0-22.3 morning<evening
Heterophils (x 10 <sup>9</sup> /l)	4.3-6.2
Eosinophils (x 10 <sup>9</sup> /l)	0.1-0.3
Basophils (x 10 <sup>9</sup> /l)	0.1-0.5
Lymphocytes (x 10 <sup>9</sup> /l)	10.9-12.2
Monocytes (x 10 <sup>9</sup> /l)	0.4-1.1
Thrombocytes (x 10 <sup>9</sup> /l)	7.0-27.0
Hemoglobin (mmol/l)	8.1-9.9
Hematocrit (vol %)	42.5

**Plasma Enzyme Activities from Clinically Normal Domestic Pigeons***Vogel C.*

Breed	LDH	MDH	AST	ALT	AP	CPK
Racing Pigeon (Male)*	161.4 ± 6.6	85.7 ± 21.9	29.3 ± 9.4	5.8 ± 1.9	47.0 ± 36.3	27.8 ± 13.8
Racing Pigeon (Female)*	121.2 ± 36.2	67.4 ± 14.6	26.7 ± 8.3	5.7 ± 1.7	41.0 ± 13.8	19.1 ± 3.3
Cologne Tumbler (Male)*	142.9 ± 20.1	103.0 ± 0.1	26.4 ± 11.6	6.2 ± 1.5	43.0 ± 1.4	40.5 ± 7.1
Cologne Tumbler (Female)*	119.2 ± 12.2	100.2 ± 19.0	24.8 ± 4.3	5.9 ± 1.4	36.1 ± 0.1	30.9 ± 15.6
Modenas (Male)*	155.6 ± 29.4	83.6 ± 26.3	64.1 ± 15.4	36.1 ± 4.3	6.1 ± 1.4	41.9 ± 9.0
Modenas (Female)*	147.2 ± 49.0			35.6 ± 0.6	6.0 ± 2.8	40.0 ± 12.7
Lynx (Male)**	105.3 ± 60.3	105.6 ± 19.7	33.3 ± 11.4	16.9 ± 2.4	225.1 ± 99.0	24.4 ± 3.9
Lynx (Female)**	65.3 ± 32.5	78.7 ± 9.6	46.1 ± 10.9	18.1 ± 3.5	196.5 ± 56.4	32.4 ± 11.9

\* mU/ml

\*\* U/l

**Blood Parameters for Non-domestic Pigeons***Vogel C.*

Parameter	Rock Pigeon	Eastern Turtle Dove
Erythrocytes (10 <sup>6</sup> /mm <sup>3</sup> )	3.7	3.0-4.1
PCV (%)	50.0	
Hb (g %)	16.5	13.9
Leukocytes (mm <sup>3</sup> )		11.1
Heterophils (%)	39.0	17.9
Lymphocytes (%)	53.0	70.8
Monocytes (%)	5.0	4.9
Eosinophils (%)	1.0	2.6
Basophils (%)	2.0	3.8
Thrombocytes (mm <sup>3</sup> )		19.1

## GALLIFORMES

**Hematology of Selected Gallinaceous Birds, Differential***Schales C., Schaes K.*

Species	Heterophils (%)	Lymphocytes (%)	Monocytes (%)	Basophils (%)	Eosinophils (%)
Domestic Fowl	19.8-32.6	45.0-75.0	8.1-16.5	1.7-4.3	1.5-2.7
Domestic Turkey	43.4	50.6	1.9	3.2	0.9
Pheasant	48.0	34.0	8.0	10.0	1.0
Guineafowl	43.5	36.2	8.4	4.5	7.4
Common Quail	33.8-50.0	40.0-46.0	1.0-2.0	0.8-3.0	1.0-4.0
Japanese Quail	20.8-52.0	40.0-73.6	1.0-2.7	0.2-3.0	1.0-4.3

Note: In both, Curassows and Guans, hemolysis occurs in EDTA tubes. It is not known whether or not this in vitro hemolysis exists in other gallinaceous birds. From: Gylstorff I: Handbuch der Geflügelphysiologie, 1983, pp 280-393; Wallach JD, Boever WJ: Diseases of Exotic Animals, 1983, pp 830-889.

**Hematology of Selected Gallinaceous Birds, Blood Parameters** *Schales C., Schaless K.*

Species	RBC ( $10^6$ /ml)	PCV (%)	Hb (g %)	MCV ( $\mu\text{m}^3$ )	WBC ( $10^3$ /ml)
Domestic Fowl	2.2-3.3	24-43	8.9-13.5	120-137	19.8-32.6
Domestic Turkey	2.3-2.8	36-41	10.3-15.2	129	23.5-26.8
Pheasant	2.2-3.6	28-42	8.0-18.9	104-150	
Guineafowl	1.7-2.8	39-48	11.4-14.9		15.5
Peafowl	2.1	33-41	12.0		
Common Partridge	1.8-3.3	28-34	7.4-11.8	117-155	
Rock Partridge	2.6	37	11.1		
Bobwhite Quail	3.4-5.4	38	11.6-15.8		
Common Quail	3.8-5.4	40-53	12.9-15.8		16.2-24.0
Japanese Quail	3.3-4.1	37-46	10.7-15.8		19.7-25.0
Chachalaca	2.7	35-45			

RBC = Red blood cells, PCV = Packed cell volume, hematocrit, Hb = Hemoglobin, MCV = Mean cell volume (erythrocytes), WBC = White blood cells  
 From Gylstorff I: Handbuch der Geflügelphysiologie, 1983, pp 280-393; Gylstorff I, Grimm F: Vogelkrankheiten, 1987; Vollmehaus B, Sinowatz F: Anatomie der Vögel, 1992, pp 159-175.

**Blood Chemistry of Selected Gallinaceous Birds**

Species	Total Protein (g %)	Albumin (g %)	Globulin (g %)	Creatine (mg %)	Uric Acid (mg %)	Glucose (mg %)	Cholesterin (mg %)	Ca (mg %)	P (mg %)	Na (mEq/l)	K (mEq/l)
Domestic Fowl	3.3-5.5	1.3-2.8	1.5-4.1	0.9-1.8	2.5-8.1	227-300	86-211	13.2-23.7	6.2-7.9	131-171	3.0-7.3
Domestic Turkey	4.9-7.6	3.0-5.9	1.7-1.9	0.8-0.9	3.4-5.2	275-425	81-129	11.7-38.7	5.4-7.1	149-155	6.0-6.4
Pheasant	6.9	5.2	1.7		2.3-3.7	335-397			164-172		
Guineafowl	3.5-4.4				2.9-5.1					149-157	
Common Quail	3.4-3.6									180	1.4
Bobwhite Quail								14.1-15.4			
Japanese Quail		1.2-1.9									
Peafowl					1.8-3.7	273-357				154-162	
Rock Partridge					2.5-4.2	270-312				145-163	
Chachalaca					3.7-7.9	235-345				158-164	

From Gylstorff I: Handbuch der Geflügelphysiologie, 1983, pp 280-393; Gylstorff I, Grimm F: Vogelkrankheiten, 1987; Vollmehaus B, Sinowatz F: Anatomie der Vögel, 1992, pp 159-175.

**Dimension of Erythrocytes in Galliformes**

Species	Long Diameter ( $\mu\text{m}$ )	Short Diameter ( $\mu\text{m}$ )	Thickness ( $\mu\text{m}$ )
Domestic Fowl	10.7-13.0	6.5-7.9	2.4-3.8
Domestic Turkey	15.0-15.5	7.0-7.5	
Pheasant	10.6-11.0	4.0-6.8	
Guineafowl	12.0	6.0	
Peafowl	12.5	7.0	
Common Quail	11.2	6.2	
Rock Partridge	11.3	6.4	

From: Gylstorff I: Handbuch der Geflügelphysiologie, 1983, pp 280-393; Sturkie P: Avian Physiology, 1986, pp 102-121.

**Sedimentation Rate of Erythrocytes of Selected Gallinaceous Birds (mm) Tubes Slanted**

Species	10 min	30 min	60 min	120 min
Domestic Fowl	0.80-1.35	2.06-5.30	3.86-10.5	7.0-18.05
Pheasant			17.2	32.6

Sturkie P: Avian Physiology, 1986, pp 102-121.

# ANSERIFORMES

All tables in this section compiled by Olsen J.

**Leukocyte Percentages in Adult Mallards during Different Reproductive States (Mean  $\pm$  SD)\***

Reproductive State	Lymphocytes	Heterophils	Basophils	Monocytes	Eosinophils
<b>Females</b>					
PE	60 $\pm$ 1.4	35 $\pm$ 1.5	2.2 $\pm$ 0.2	2.2 $\pm$ 0.3	0.7 $\pm$ 0.15
EL	58 $\pm$ 3.0	37 $\pm$ 3.0	3.2 $\pm$ 0.5	1.8 $\pm$ 0.2	0.8 $\pm$ 0.30
INC	62 $\pm$ 1.5	33 $\pm$ 1.7	3.0 $\pm$ 0.4	1.9 $\pm$ 0.2	0.2 $\pm$ 0.07
MOLT	68 $\pm$ 2.1	28 $\pm$ 2.4	2.1 $\pm$ 0.5	1.8 $\pm$ 0.5	0.1 $\pm$ 0.08
PR	57 $\pm$ 1.6	37 $\pm$ 1.4	3.2 $\pm$ 0.3	3.2 $\pm$ 0.3	0.2 $\pm$ 0.06
<b>Males</b>					
PE	58 $\pm$ 1.8	36 $\pm$ 1.9	3.4 $\pm$ 0.4	1.9 $\pm$ 0.2	0.9 $\pm$ 0.18
EL	59 $\pm$ 3.0	36 $\pm$ 3.1	2.6 $\pm$ 0.4	1.9 $\pm$ 0.2	0.6 $\pm$ 0.18
INC	66 $\pm$ 1.4	29 $\pm$ 1.4	2.2 $\pm$ 0.3	2.5 $\pm$ 0.3	0.2 $\pm$ 0.17
MOLT	67 $\pm$ 1.9	27 $\pm$ 2.0	2.9 $\pm$ 0.4	2.9 $\pm$ 0.4	0.3 $\pm$ 0.10
PR	54 $\pm$ 1.6	38 $\pm$ 1.5	3.6 $\pm$ 0.3	3.6 $\pm$ 0.3	0.4 $\pm$ 0.10

\* PE (Pre-egg laying); EL (Laying); INC (Incubating); MOLT (Molting); PR (Postreproductive). Males were classified in the same reproductive state as the female with whom they were paired until they began the post-reproductive molt.

Modified from: Fairbrother A, O'Loughlin D: J Wildl Dis 26(1):78-82, 1990.

## HEMATOLOGY AND BIOCHEMISTRY ANSERIFORMES

## Hematology of Selected Anseriformes (Mean±SD)

Species	RBC (10 <sup>6</sup> /mm <sup>3</sup> )	PCV (%)	Hg (g/dl)	MCV (μ <sup>3</sup> )	MCH (μg)	MCHC (%)	RBC size (μ)	WBC (10 <sup>3</sup> /mm <sup>3</sup> )	Heterophil x10 <sup>3</sup> /mm <sup>3</sup>	Lymph x10 <sup>3</sup> /mm <sup>3</sup>	Monocytes x10 <sup>3</sup> /mm <sup>3</sup>	Basophil x10 <sup>3</sup> /mm <sup>3</sup>	Eosinophil x10 <sup>3</sup> /mm <sup>3</sup>
American Black Duck	2.78 ± 0.22	40.24 ± 4.21	12.96 ± 1.36	144.68 ± 9.96	46.60 ± 3.00	32.23 ± 1.16		19.70 ± 6.60	4.86 ± 1.37	13.03 ± 1.53	1.46 ± 0.99	0.16 ± 0.15	0.22 ± 0.16
Wood Duck	2.79 ± 0.28	45.54 ± 3.41	14.95 ± 1.22	164.24 ± 14.43	54.08 ± 6.74	32.99 ± 3.7		23.58 ± 5.72	8.45 ± 2.59	13.28 ± 1.77	1.05 ± 0.68	0.41 ± 0.23	0.51 ± 0.06
Canvas-back*	2.5-2.6 2.61-3.51 2.61 ± 0.4	51.4-53.0 46.3-60.4 47.0 ± 6.2	13.8-18.1 15.2 ± 2.0	165-209	47-63	28-31	6.6x12.7						
Red Head	2.78 ± 0.3	44.0 ± 7.1	13.5 ± 1.8										
Lesser Scaup*	2.4-2.5 2.45 ± 0.13 2.84	56.5-58.0 57.1 ± 3.1 47.0	16.0				7.5x13.0						
Greater Scaup	2.27 ± 0.7	43.0 ± 1.4	15.9 ± 2.0										
Ring-necked Duck*	2.50 2.54	49.1 47.0	14.3										
Bufflehead*	2.6-2.7 2.64	53.9-54.7 54.3											
Ruddy Duck	2.30 ± 0.3	43.0 ± 3.4	14.6 ± 1.7										
Canada Goose*	1.6-2.6 2.15-2.82	38-58 41.7-56	12.7-19.1	145-174 168.1-229.5	53.7-70	28-29 27.6-34.7	6.9x13.2	13.0-18.5	23.0-42.8	47.8	5.1	2.4	1.9
Aleutian Canada Goose**	2.6±0.4	42±3	(M)13.48±2.01 (F)12.8±1.81		(M)32.5±5.4 (F)30.6±3.9	(M)5.2±0.8 (F)4.6±0.7							
Snow Goose white phase blue phase	2.24 2.25	45.7 46	14.5 14.0					20.1±4.71	7	12.3	0.2	0.1	0.5
Nene Goose**	2.6±0.2	46±2	(M)15.25±0.74 (F)15.72±0.60		(M)32.5±2.7 (F)34.7±1.7	(M)5.6±0.3 (F)6.3±0.5							
Embden Goose**	2.6±0.3	38±3	(M)12.30±2.23 (F)10.49±1.22		(M)32.2±6.4 (F)29.0±2.9	(M)5.0±0.9 (F)4.2±0.7							
Tule White-fronted Goose**	2.9±0.2	43±2	(M)14.76±1.54 (F)15.43±0.76		(M)34.6±1.2 (F)35.6±0.6	(M)4.9±0.4 (F)5.6±0.4							
Trumpeter Swan		41.6±2.6				32.6-36.4							

\* Variations in reference values have resulted from different studies. See Chapter 46, Anseriformes.<sup>61,62,78,79,100,113</sup>

\*\* (M) male, (F) female.

Serum Chemistry Values of Selected Anseriformes (Mean  $\pm$  SD)

	American Black Duck	Canada Goose*	Aleutian Canada Goose**	Tule White-fronted Goose**	Nene Goose**	Embden Goose**	Canvas-back	Lesser Scaup	Ringneck Duck	Bufflehead	Trumpeter Swan
Total Protein (g/dl)	4.32 $\pm$ 0.42	5.36 $\pm$ 0.27 4.26 $\pm$ 0.13	4.80 $\pm$ 0.7	4.4 $\pm$ 0.4	4.4 $\pm$ 0.7	4.4 $\pm$ 1.0	3.6-6.8 4.2-4.6	4.2-4.5	3.2-4.0	3.6-4.1	4.5 $\pm$ 0.49
Albumin (g/dl)	3.10 $\pm$ 0.36 3.04 $\pm$ 0.30	2.18 $\pm$ 0.13 1.53 $\pm$ 0.05	2.1 $\pm$ 0.2 2.0 $\pm$ 0.2	1.7 $\pm$ 0.2 1.8 $\pm$ 0.2	1.7 $\pm$ 0.2 1.9 $\pm$ 0.2	1.5 $\pm$ 0.2 1.9 $\pm$ 0.7	2.08	1.89	1.68	1.72	
Globulin (g/dl)	1.21 $\pm$ 0.52		2.8 $\pm$ 0.6	2.7 $\pm$ 0.3	2.6 $\pm$ 0.5						
A/G ratio	2.71 $\pm$ 0.77		0.76 $\pm$ 0.13	0.64 $\pm$ 0.08	0.71 $\pm$ 0.09						
Glucose (mg/dl)	175.83 $\pm$ 26.5	219.5 $\pm$ 12.39 320.33 $\pm$ 28.4	210 $\pm$ 31 236 $\pm$ 41	221 $\pm$ 28 249 $\pm$ 30	185 $\pm$ 10 192 $\pm$ 12	230 $\pm$ 31 215 $\pm$ 43	180-549				
Calcium (mg/dl)		9.22 $\pm$ 0.27 10.57 $\pm$ 0.69	10.2 $\pm$ 0.7 10.4 $\pm$ 0.5	10.1 $\pm$ 0.6 10.3 $\pm$ 0.4	10.0 $\pm$ 0.6 10.5 $\pm$ 0.5	10.1 $\pm$ 0.6 10.8 $\pm$ 1.8					
Phosphorus (mg/dl)	3.23 $\pm$ 1.15		2.8 $\pm$ 0.9 2.9 $\pm$ 0.6	3.6 $\pm$ 0.6 3.4 $\pm$ 0.8	2.4 $\pm$ 0.7 2.4 $\pm$ 0.7	3.3 $\pm$ 1.3 3.5 $\pm$ 0.7					
Sodium (mEq/l)			142 $\pm$ 4	146 $\pm$ 5	146 $\pm$ 3	140					
Chloride (mEq/l)			105 $\pm$ 4	112 $\pm$ 23	99 $\pm$ 4	101					
Potassium (mEq/l)			3.4 $\pm$ 0.6	3.3 $\pm$ 0.6	2.5 $\pm$ 0.4	3.1					
Uric acid (mg/dl)		6.05 $\pm$ 0.59 5.75 $\pm$ 0.39	8.3 $\pm$ 2.3	10.8 $\pm$ 1.0	8.0 $\pm$ 1.6	7.5 $\pm$ 1.9					
Creatinine (mg/dl)			0.8 $\pm$ 0.3	0.9 $\pm$ 0.2	0.8 $\pm$ 0.2	0.8					
Blood urea nitrogen (mg/dl)	1.49 $\pm$ 0.36		3 $\pm$ 2	3 $\pm$ 1	2 $\pm$ 1	4 $\pm$ 1					
AAT (U/l)	55.9 $\pm$ 29.7 18.6 $\pm$ 8.2		75 $\pm$ 19	98 $\pm$ 18	45 $\pm$ 17	106 $\pm$ 62					
ALP (U/l)	20.9 $\pm$ 11.7 131.8 $\pm$ 36.7		72 $\pm$ 43	78 $\pm$ 44	33 $\pm$ 8	33 $\pm$ 14					
LDH (U/l)	312.8 $\pm$ 83.5 244.7 $\pm$ 81.8		301 $\pm$ 80	361 $\pm$ 196	256 $\pm$ 68	659 $\pm$ 319					
GGT (U/l)			2 $\pm$ 3	1 $\pm$ 1	2 $\pm$ 2	1					
SGPT (U/l)			43 $\pm$ 11	50 $\pm$ 9	37 $\pm$ 7						
SGOT (U/l)			75 $\pm$ 17 76 $\pm$ 21	104 $\pm$ 15 89 $\pm$ 19	40 $\pm$ 13 49 $\pm$ 18	125 $\pm$ 82 91 $\pm$ 39					
Amylase (U/l)			570 $\pm$ 184	454 $\pm$ 201	824 $\pm$ 32	653					
Total Bilirubin (mg/dl)			0.20 $\pm$ 0.07	0.51 $\pm$ 0.30	0.12 $\pm$ 0.04	0.19 $\pm$ 0.14					
Iron $\mu$ g/dl			234 $\pm$ 72	276 $\pm$ 90		261					
Total lipids (g/dl)	1.43 $\pm$ 0.18		1.38 $\pm$ 0.67	1.69 $\pm$ 0.64	1.45 $\pm$ 0.48						
Triglyceride (mg/dl)		258 $\pm$ 60.83 145.2 $\pm$ 25.37	151 $\pm$ 28	215 $\pm$ 51	163 $\pm$ 42						
Total cholesterol		239.25 $\pm$ 9.91 307 $\pm$ 30.9	172 $\pm$ 28 172 $\pm$ 29	134 $\pm$ 14 130 $\pm$ 10	230 $\pm$ 33 233 $\pm$ 23	123 $\pm$ 24 162 $\pm$ 94	260 - 366				

\* Line 1 = spring; Line 2 = fall

\*\*Line 1 = male; Line 2 = female

Modified from references: 15,27,32,61,75,79,111



**Serum Chemistry and Enzyme Values, Non-reproductive Adult Mallards**

Assay	Male		Female	
	Mean	SD	Mean	SD
TPR (g/dl)	3.8	0.7	4.2	0.5
ALB (g/dl)	1.5	0.4	1.7	0.2
GLU (mg/dl)	185.0	47.0	215.0	34.0
AMY (U/l)	2631.0	630.0	2766.0	684.0
CHE (U/l)	794.0	249.0	812.0	197.0
ALT (U/l)	26.3	8.0	29.9	9.9
AST (U/l)	16.2	4.3	15.8	4.7
GGT (U/l)	7.7	4.2	8.0	4.8
ALP (U/l)	26.3	8.0	44.2	22.7
LDH (U/l)	199.0	83.0	147.0	80.0
CA (mg/dl)	9.4	1.9	9.8	1.1
MG (mEq/l)	1.8	0.4	1.8	0.3
PHOS (mg/dl)	2.9	1.0	3.0	1.0
UA (mg/dl)	4.0	1.3	4.5	1.8
CRN (mg/dl)	0.25	0.08	0.28	0.07
BITO (mg/dl)	0.16	0.05	0.16	0.04
BIDI (mg/dl)	0.07	0.01	0.07	0.01

Modified from: Fairbrother A: J Wildl Dis 26(1):67-77, 1990.

**Abbreviations for Anseriforme Appendix Table**

TPR (total protein), ALB (albumin), GLU (glucose), AMY (amylase), CHE (cholinesterase), ALT (alanine aminotransferase), AST (aspartate aminotransferase), ALP (alkaline phosphatase), LDH (lactic dehydrogenase), CA (calcium), MG (magnesium), PHOS (phosphorus), UA (uric acid), CRN (creatinine), BITO (total bilirubin), BIDI (direct bilirubin).

**Serum Chemistry and Enzyme Values for Adult Female Mallards of Differing Reproductive States**

Assay	Pre-egg laying		Egg laying		Incubating		Molt	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TPR (g/dl)	5.6	2.9	6.3	1.2	4.4	0.6	4.5	1.2
ALB (g/dl)	2.0	0.3	2.3	0.2	1.6	0.2	1.7	0.2
GLU (mg/dl)	238.0	21.0	258.0	51.0	211.0	53.0	199.0	30.0
AMY (U/l)	3058.0	527.0	3821.0	741.0	2700.0	626.0	2346.0	1012.0
CHE (U/l)	1337.0	280.0	1563.0	592.0	1002.0	266.0	894.0	219.0
ALT (U/l)	31.0	10.3	34.2	19.4	30.6	13.1	41.1	17.1
AST (U/l)	18.0	3.4	23.7	6.7	22.1	7.4	22.6	12.6
GGT (U/l)	19.8	19.8	199.6	283.0	7.5	4.7	20.8	36.9
ALP (U/l)	63.6	56.8	124.9	56.7	34.3	15.8	36.0	18.1
LDH (U/l)	165.0	50.0	177.0	57.0	215.0	107.0	268.0	2.2
CA (mg/dl)	14.0	4.1	21.9	5.6	10.3	2.0	10.6	4.2
MG (mEq/l)	2.3	0.5	3.6	0.8	1.6	0.3	1.6	0.5
PHOS (mg/dl)	4.6	1.7	8.1	2.4	3.7	1.0	4.1	2.2
UA (mg/dl)	5.2	1.1	9.1	5.1	5.5	1.7	4.9	1.7
CRN (mg/dl)	0.34	0.06	0.33	0.15	0.42	0.15	0.33	0.08
BITO (mg/dl)	0.23	0.08	0.43	0.28	0.20	0.11	0.21	0.05
BIDI (mg/dl)	0.07	0.04	0.15	0.22	0.06	0.04	0.06	0.01

Modified from: Fairbrother A, O'Loughlin D: J Wildl Dis 26(1):78-82, 1990.

**Serum Chemistry and Enzyme Values for Adult Male Mallards of Differing Reproductive States**

Assay	Pre-egg laying		Egg laying		Incubating		Molt	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TPR (g/dl)	4.6	0.6	4.5	0.8	4.2	0.5	3.9	0.8
ALB (g/dl)	1.8	0.2	1.6	0.2	1.7	0.3	1.5	0.3
GLU (mg/dl)	234.0	33.0	233.0	32.0	199.0	26.0	185.0	29.0
AMY (U/l)	3123.0	583.0	2869.0	614.0	3203.0	785.0	2991.0	748.0
CHE (U/l)	1326.0	344.0	1380.0	399.0	984.0	470.0	983.0	452.0
ALT (U/l)	34.6	9.4	35.8	13.1	27.6	12.1	28.4	19.2
AST (U/l)	17.3	4.0	20.5	8.0	20.8	15.7	18.1	8.1
GGT (U/l)	8.5	7.6	10.6	12.6	9.3	6.0	16.5	36.0
ALP (U/l)	40.2	25.3	44.1	44.8	38.4	48.0	35.3	44.2
LDH (U/l)	168.0	66.0	219.0	107.0	263.0	203.0	202.0	152.0
CA (mg/dl)	10.9	1.0	11.0	1.9	9.9	1.0	9.3	2.2
MG (mEq/l)	2.0	0.2	2.0	0.4	1.8	0.4	1.8	0.9
PHOS (mg/dl)	3.7	0.9	3.6	0.9	2.8	0.5	3.1	1.4
UA (mg/dl)	5.2	1.2	5.2	1.5	5.7	1.9	4.7	2.3
CRN (mg/dl)	0.35	0.08	0.36	0.10	0.34	0.12	0.30	0.12
BITO (mg/dl)	0.22	0.09	0.20	0.09	0.18	0.04	0.20	0.08
BIDI (mg/dl)	0.07	0.02	0.06	0.01	0.07	0.02	0.08	0.05

Modified from: Fairbrother A: J Wildl Dis 26(1):67-77, 1990.

**Serum Chemistry and Enzyme Values for Juvenile Mallards**

Assay	Age 5 days		Age 18 days		Age 42 days		Age 58 days	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
TPR (g/dl)	3.4	0.6	4.3	1.3	4.0	0.8	3.2	1.0
ALB (g/dl)	1.4	0.2	1.5	0.3	1.6	0.4	1.4	0.4
GLU (mg/dl)	239.0	54.0	215.0	93.0	189.0	27.0	186.0	45.0
AMY (U/L)	3230.0	760.0	3984.0	1297.0	3005.0	302.0	2395.0	699.0
CHE (U/L)	1423.0	696.0	984.0	559.0	827.0	253.0	818.0	248.0
ALT (U/L)	21.3	9.1	30.5	10.5	26.1	7.0	23.9	7.1
AST (U/L)	22.3	7.4	88.5	54.1	9.4	5.1	17.4	5.7
GGT (U/L)	1.2	2.8	4.6	3.6	5.3	5.7	6.1	3.6
ALP (U/L)	411.0	89.0	386.0	194.0	217.0	32.0	185.0	47.0
LD-L (U/L)	425.0	153.0	629.0	251.0	169.0	70.0	233.0	83.0
CA (mg/dl)	13.0	10.3	9.6	1.7	10.9	1.6	8.4	1.8
MG (mEq/L)	2.8	0.8	1.8	0.7	2.0	0.2	1.6	0.5
PHOS (mg/dl)	7.9	2.8	7.6	1.3	6.2	1.3	5.0	1.7
UA (mg/dl)	12.2	5.4	10.9	3.8	4.0	0.7	4.0	1.8
CRN (mg/dl)	0.47	0.42	0.55	0.65	0.28	0.10	0.21	0.11
BITO (mg/dl)	0.40	0.11	0.43	0.31	0.20	0.0	0.17	0.05
BIDI (mg/dl)	0.08	0.02	0.10	0.04	0.06	0.0	0.06	0.02

Modified from: Fairbrother A: J Wildl Dis 26(1):67-77, 1990.

# RATITES

**Hematological and Biochemical Values for Ratites**
*Stewart J.*

Parameter	Ostrich		Emu		Cassowary	
	Mean	SD	Mean	SD	Mean	SD
WBC ( $\times 10^3/\mu\text{l}$ )	5.5	1.9			18.0	4.5
Heterophils (%)	62.6	7.6			77.7	25.8
Lymphocytes (%)	34.1	7.0			19.7	10.4
Monocytes (%)	2.8	1.3			2.4	2.4
Eosinophils (%)	0.3	0.5				
Basophils (%)	0.2	0.5				
PCV (%)	32.0	3.0			50.8	3.7
RBC ( $\times 10^6/\mu\text{l}$ )	1.7	0.4			2.1	0.3
Hb (g/dl)	12.2	2.0			14.5	0.5
MCV (fl)	174.0	42.0			245.0	41.0
MCHC (g/dl)	33.0	5.0			28.5	1.6
MCH (pg)	61.0	16.0			70.0	11.5
Total protein (g/dl)	3.7	0.7	4.2	0.5	6.1	0.5
Osmolality (mOsm/kg)	286.0	49.0				
Glucose (mg/dl)	250.0	70.0	158.0	22.0	208.0	47.4
Triglycerides (mg/dl)	90.0	45.0	325.0	591.0	180.0	72.0
Cholesterol (mg/dl)	97.0	45.0	104.0	31.0	80.0	16.0
BUN (mg/dl)	2.4	0.6	2.5	0.9	9.3	0.6
Uric acid (mg/dl)	8.2	2.7	4.7	2.0	6.0	0.6
Calcium (mg/dl)	9.2	2.4	10.5	1.3	11.4	0.2
Phosphorus (mg/dl)	4.8	1.2	5.4	1.0	5.0	0.1
Sodium (mEq/l)	147.0	34.0			149.0	2.1
Potassium (mEq/l)	3.0	0.8			4.1	1.0
Chloride (mEq/l)	100.0	16.0			108.0	0.0
Magnesium (mEq/l)	2.2	0.8			2.3	0.3
ALP (U/l)	575.0	248.0	84.0	44.0		
ALT (U/l)	2.0	1.7	15.4	4.3	80.0	21.0
AST (U/l)	131.0	31.0	104.0	24.0	698.0	532.0
GGT (U/l)	1.5	2.9	4.4	3.4		
LDH (U/l)	1565.0	660.0	240.0	91.0	1060.0	516.0
CK (U/l)	688.0	208.0	264.0	170.0		



# Class Aves:

## A List of Orders, Common and Scientific Names

### APTERYGIFORMES

Kiwi *Apteryx* sp.

### STRUTHIONIFORMES

Cassowary *Casuarus* spp.  
Emu *Dromiceius novaehollandiae*  
Greater Rhea *Rhea americana*  
Lesser Rhea *Pterocnemia pennata*  
Ostrich *Struthio camelus*

### TINAMINIFORMES

Tinamou *Eudromia* spp.  
Bustard (Houbara) *Chlamydotis undulata*

### GRUIFORMES

Blue Crane *Tetrapteryx paradisea*  
Brolga *Grus rubicunda*  
Crowned Crane *Balearica pavonina*  
Demoiselle Crane *Anthropoides virgo*  
Hooded Crane *Grus monacha*  
Manchurian Crane *Grus japonensis*  
Sandhill Crane *Grus canadensis*  
Sarus Crane *Grus antigone*  
White-naped Crane *Grus vipio*

### RALLIFORMES

Coot (European) *Fulica atra*

### CHARADRIIFORMES

Sanderling (eroliinae) *Crocetha ulba*  
Turnstone *Arenaria interpres*

### LARIFORMES

Black-headed Gull *Chroicocephalus ridibundus*  
Herring Gull *Larus argentatus*  
Kittiwake (Black -legged) *Rissa tridactyla*

### ALCIFORMES

Black Guillemot *Cephus grylle*

### SPHENISCIFORMES

Fairy Blue (Little) Penguins *Eudyptula minor*  
Humboldt penguin *Spheniscus humboldti*  
Jackass Penguin *Spheniscus demersus*

### PELECANIFORMES

Brandt's Cormorant *Phalacrocorax penicillatus*  
White Pelican *Pelecanus onocrotalus*

### COLUMBIFORMES

#### Pigeons

Crowned (Blue) Pigeon *Goura cristata*  
Nicobar Pigeon *Caloenas nicobarica*  
Pheasant Pigeon *Otidiphaps nobilis*  
Rock-Pigeon (Racing, King) *Columba livia*  
Tooth-billed Pigeon *Didunculus strigirostris*  
Wood-Pigeon *Palumbus palumbus*

#### Doves

African Collared Dove *Streptopelia roseogrisea*  
Collard (African) Dove *Streptopelia roseogrisea*  
Emerald Dove *Chalcophaps indica*  
Galapagos Dove *Nesopelia galapagoensis*  
Luzon Bleeding-heart *Gallicolumba luzonica*  
Mourning Dove *Zenaidura macroura*  
*Zenaidura*  
Namaqua Dove *Oena capensis*  
Plain-breasted Ground Dove  
*Columbigallina minuta*  
Turtle-Dove *Streptopelia turtur*

### PSITTACIFORMES

#### Lovebirds

Black-cheeked Lovebird *Agapornis nigrigenis*  
Black-collared Lovebird *Agapornis swindermanus*

Black-winged Lovebird *Agapornis taranta*  
Fischer's Lovebird *Agapornis fischeri*  
Grey-headed Lovebird *Agapornis canus*  
Lilian's (Nyassa) Lovebird *Agapornis lilianae*  
Masked Lovebird *Agapornis personatus*  
Red-faced Lovebird *Agapornis pullarius*  
Rosy-faced Lovebird *Agapornis roseicollis*

#### Macaws

Blue and Yellow (Gold) Macaw *Ara ararauna*  
Buffon's Macaw *Ara ambigua*  
Green-winged Macaw *Ara chloroptera*  
Hyacinth Macaw *Anodrohynchus hyacinthinus*  
Illiger's Macaw *Ara maracana*  
Military Macaw *Ara militaris*  
Red-shouldered Macaw *Diopsittaca nobilis*  
Scarlet Macaw *Ara macao*  
Yellow-collared Macaw *Ara auricollis*

#### Conures

Australian Conure *Enicognathus ferrugineus*  
Blue-crowned Conure *Thectocercus acuticaudatus*  
Brown-throated Conure *Eupsittula pertinax*  
Cactus Conure *Eupsittula cactorum*  
Dusky-headed Conure *Eupsittula weddellii*  
Finsch's Conure *Psittacara finschi*  
Golden Conure *Guaruba guarouba*  
Green-cheeked Conure *Pyrhura molinae*  
Green Conure *Psittacara holochlora*  
Maroon-bellied Conure *Pyrhura frontalis*  
Mitted Conure *Psittacara mitrata*  
Nanday Conure *Nandayus nenday*  
Painted Conure *Pyrhura picta*  
Patagonian Conure *Cyanoliseus patagonus*  
Peach-fronted Conure *Eupsittula aurea*  
Pearly Conure *Pyrhura perlata*  
Slender-billed Conure *Enicognathus leptorhynchus*  
Sun Conure *Aratinga solstitialis*  
White-eyed Conure *Psittacara leucophthalma*

#### Parakeets

Alexandrine Parakeet *Psittacula eupatria*  
Blossom-headed Parakeet *Psittacula roseata*  
*Biswas*  
Blyth's Parakeet *Psittacula caniceps*  
Derbyan Parakeet *Psittacula derbiana*  
Grey-cheeked Parakeet *Brotogeris pyrrhoptera*  
Monk (Quaker) Parakeet *Miopsittia monachus*  
Moustached Parakeet *Psittacula alexandria*  
Orange-chinned Parakeet *Brotogeris jugularis*  
Red-fronted (Kakariki) Parakeet *Cyanoramphus novaezelandiae*  
Rose-ringed Parakeet *Psittacula krameri*  
Yellow-fronted (Kakariki) Parakeet *Cyanoramphus auriceps*  
Black-headed Caique *Pionites melanocephalus*  
White-bellied Caique *Pionites leucogaster*

#### Parrots

African Grey Parrot *Psittacus erithacus*  
Amboina King Parrot *Alisterus amboinensis*

Australian King Parrot *Alisterus scapularis*  
Barraband's Parrot *Gypopsitta barrabandi*  
Black Parrot *Coracopsis nigra*  
Blue-bonnet *Psephotus haematogaster*  
Blue-winged Parrot *Neophema chrysostoma*  
Bourke's Parrot *Neopsephotus bourkii*  
Budgerigar *Melopsittacus undulatus*  
Eastern Rosella *Platyercus eximius*  
Eclectus Parrot *Eclectus roratus*  
Elegant Parrot *Neophema elegans*  
Golden-shouldered Parrot *Psephotus chrysopterygius*  
Great-billed Parrot *Tanygnathus megalorhynchus*  
Green Rosella *Platyercus caledonicus*  
Green-winged King Parrot *Alisterus chloropterus*  
Ground Parrot *Pezoporus wallicus*  
Hawk-headed Parrot *Deropteryx accipitrinus*  
Kakapo *Strigops habroptilus*  
Mulga Parrot *Psephotus varius*  
Night Parrot *Geopsittacus occidentalis*  
Northern Rosella *Platyercus venustus*  
Orange-bellied Parrot *Neophema chrysogaster*  
Paradise Parrot *Psephotus pulcherrimus*  
Pennant's Rosella *Platyercus elegans*  
Pileated Parrot *Pionopsitta pileata*  
Princess Parrot *Spathopterus alexandrae*  
Red-capped Parrot *Purpurecephalus spurius*  
Red-rumped Parrot *Psephotus haematotonotus*  
Red-winged Parrot *Aprosmictus erythropterus*  
Regent Parrot *Spathopterus anthoepus*  
Ringneck Parrot *Barnardius zonarius*  
Scarlet-chested Parrot *Neophema splendida*  
Short-tailed Parrot *Graydidascalus brachyurus*  
Superb Parrot *Polytelis swainsonii*  
Thick-billed Parrot *Rhynchopsitta pachyrhyncha*  
Timor Red-winged Parrot *Aprosmictus jonquillaceus*  
Turquoise-Parrot *Neophema pulchella*  
Vasa Parrot *Coracopsis vasa greater*  
Western Rosella *Platyercus icterotis*

#### Amazon parrots

Blue-fronted Amazon *Amazona aestiva*  
Cuban Amazon *Amazona leucocephala*  
Festive Amazon *Amazona festiva*  
Green-cheeked Amazon *Amazona viridigenalis*  
Hispaniolan Amazon *Amazona ventralis*  
Lilac-crowned Amazon *Amazona finschi*  
Mealy Amazon *Amazona farinosa*  
Orange-winged Amazon *Amazona amazonica*  
Puerto Rican Amazon *Amazona vittata*  
Red-spectacled Amazon *Amazona pretrei*  
Red-lore Amazon *Amazona autumnalis*  
Tucuman Amazon *Amazona tucumana*  
Vinaceous Amazon *Amazona vinacea*  
White-fronted Amazon *Amazona albifrons*  
Yellow-lore Amazon *Amazona xanholora*  
Yellow-crowned Amazon *Amazona ochrocephala*  
Yellow-billed (Jamacian) Amazon *Amazona collaria*  
Yellow-shouldered Amazon *Amazona barbadensis*  
Yellow-faced Amazon *Amazona xanthops*

#### Fig parrots

Desmarest's Fig Parrot *Psittaculirostris desmarestii*  
Double-eyed Fig Parrot *Opopsitta diophthalma*  
Edward's Fig Parrot *Psittaculirostris edwardsii*  
Salvadori's Fig Parrot *Psittaculirostris salvadori*

#### Pionus parrots

Blue-headed Parrot *Pionus menstus*  
Bronze-winged Parrot *Pionus chalcopterus*  
Dusky Parrot *Pionus fuscus*  
Plum-crowned Parrot *Pionus tumultuosus*  
Red-billed Parrot *Pionus sordidus*  
Scaly-headed Parrot *Pionus maximiliani*  
White-capped Parrot *Pionus senilis*  
White-headed Parrot *Pionus seniloides*

#### Poicephalus parrots

Brown-headed Parrot *Poicephalus cryptoxanthus*  
Cape Parrot *Poicephalus robustus*  
Jardine's Parrot *Poicephalus guilielmi*  
Meyer's Parrot *Poicephalus meyeri*  
Niamnian Parrot *Poicephalus crassus*  
Red-bellied Parrot *Poicephalus rufiventris*  
Ruppell's Parrot *Poicephalus rueppellii*  
Senegal Parrot *Poicephalus senegalus*  
Yellow-faced Parrot *Poicephalus flavifrons*

#### Lories

Black-capped Lory *Lorius lory*  
Black Lory *Chalcopsitta atra*  
Blue-streaked Lory *Eos reticulata*  
Cardinal-Lory *Chalcopsitta cardinalis*  
Chattering Lory *Lorius garrulus*  
Dusky Lory *Pseudeos fuscata*  
Duivenbode's Lory *Chalcopsitta duivenbodei*  
Ornate Lory *Trichoglossus ornatus*  
Purple-bellied Lory *Lorius hypoinochrous*  
Purple-naped Lory *Lorius domicella*  
Rainbow-Lory *Trichoglossus haematodus*  
Red Lory *Eos bornea*  
Violet-necked Lory *Eos squamata*  
Yellow-streaked Lory *Chalcopsitta sintillata*

#### Lorikeets

Goldie's Lorikeet *Psitteuteles goldiei*  
Little Lorikeet *Glossopsitta pusilla*  
Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*  
Varied Lorikeet *Psitteuteles versicolor*

#### Cockatoos

Black Cockatoo *Calyptorhynchus funereus*  
Blue-eyed Cockatoo *Cacatua ophthalmica*  
Ducorps's Cockatoo *Cacatua ducorps*  
Galah *Eolophus roseicapillus*  
Gang-gang Cockatoo *Callocephalon fimbriatum*  
Glossy Cockatoo *Calyptorhynchus lathami*  
Goffin's Cockatoo *Cacatua goffini*  
Lesser Sulfur-crested Cockatoo *Cacatua sulphurea*  
Little (Slender-bill) Corella *Cacatua sanguinea*  
Long-billed Corella *Cacatua tenuirostris*  
Mitchell's Cockatoo *Cacatua leadbeateri*  
Palm Cockatoo *Probosciger aterrimus*  
Red-vented Cockatoo *Cacatua haematuropygia*  
Red-tailed Cockatoo *Calyptorhynchus magnificus*

## CLASS AVES: A LIST OF ORDERS, COMMON AND SCIENTIFIC NAMES

Salmon-crested Moluccan Cockatoo  
*Cacatua moluccensis*  
Sulfur-crested Cockatoo *Cacatua galerita*  
White Umbrella Cockatoo *Cacatua alba*  
Cockatiel *Nymphicus hollandicus*  
Kaka *Nestor meridionalis*  
Kea *Nestor notabilis*

## ANSERIFORMES

## Subfamily Anseranatinae

## Tribe Anseranatini

Cuban (Black-billed) Whistling (tree)  
Duck *Dendrocygna arborea*  
Eyton's (Plumed) (Grass) Whistling Duck  
*Dendrocygna eytoni*  
Fulvous Whistling Duck *Dendrocygna bicolor*  
Javan (Lesser) Whistling Duck  
*Dendrocygna javanica*  
Magpie Goose *Anseranas semipalmata*  
Northern Black-bellied (Red-billed)  
Whistling Duck *Dendrocygna autumnalis*  
Spotted Whistling Duck *Dendrocygna guttata*  
Wandering (East Indian) Whistling Duck  
*Dendrocygna arcuata*  
White-Backed (African) Whistling Duck  
*Thalassornis*  
White-faced Whistling Duck  
*Dendrocygna viduata*

## Leuconotus

## Tribe Anserini

## (Swans and True Geese)

Bar-headed Goose *Eulabeia indica*  
Barnacle Goose *Branta leucopsis*  
Bewick's Swan *Olor bewickii*  
Black-necked Swan *Sthenelides melancoryphus*  
Black Swan *Chenopsis atrata*  
Brent (Russian) (Dark-Bellied) *Brant bernicla*  
Canada (Atlantic) Goose *Branta canadensis*  
Coscoroba Swan *Coscoroba coscoroba*  
Emperor Goose *Phalacrocorax canagica*  
Freckled (Monkey) Duck *Stictonetta naevosa*  
Graylag (Domestic) Goose (Western)  
*Anser anser*  
Lesser White-fronted Goose *Anser erythropus*  
Mute Swan *Cygnus olor*  
Nene (Hawaiian) Goose *Branta sandvicensis*  
Pink-footed Goose *Anser brachyrhynchus*  
Red-breasted Goose *Ruffibrenta ruficollis*  
Ross's Goose *Chen rossii*  
Snow (Lesser) (Blue) Goose *Chen caerulescens*  
Swan Goose *Anser cynoides*  
Trumpeter Swan *Olor buccinator*  
Western (Yellow-billed) Bean Goose *Anser fabalis*  
Whistling Swan *Olor columbianus*  
White-fronted (European) Goose *Anser albifrons*  
Whooper Swan *Olor cygnus*

## Sub-Family Antinae

## Tribe Tadornini

## (Shelducks and Sheldgeese)

Abyssinian Blue-winged Goose  
*Cyanochen cyanopterus*  
Andean Goose *Chloephaga melanoptera*  
Ashy-headed Goose *Chloephaga poliocephala*  
Australian Shelduck *Casarca tadornoides*  
Cape Barren (Cereopsis) Goose *Cereopsis novaehollandiae*  
Common (European) Shelduck *Tadorna tadorna*  
Crested Shelduck *Pseudotadorna cristata*  
Egyptian Goose *Alopochen aegyptiacus*

Kelp (Patagonian) (Lesser) Goose  
*Chloephaga hybrida*  
Magellan (Lesser) (Upland) Goose  
*Chloephaga picta*  
Orinoco Goose *Neochen jubatus*  
Paradise (New Zealand) Shelduck  
*Casarca variegata*  
Radjah Shelduck (Moluccan)  
(Black-Backed) *Radjah radjah*  
Ruddy-headed Goose *Chloephaga rubidiceps*  
Ruddy Shelduck *Casarca ferrugina*  
South African (Cape) Shelduck *Casarca cana*  
Spur-winged (Gambian) Goose  
*Plectropterus gambensis*

## Tribe Cairinini (Perching Ducks)

African (South) Black Duck *Melananas sparsa*  
African Pygmy Goose *Nettapus auritus*  
American (Baldpate) Wigeon *Mareca americana*  
Australian Shoveler *Spatula rhynchotis*  
Australian Wood Duck (Maned Goose)  
*Chenonetta jubata*  
Bahama (Lesser) (Northern  
White-Cheeked) Pintail *Paecilonetta bahamensis*  
Baikal Teal *Nettion formosum*  
Blue-winged (Prairie) Teal *Spatula discors*  
Brazilian (Lesser) Teal *Amazonetta brasiliensis*  
Brown (Chillian) Pintail *Dafila georgica*  
Brown (New Zealand) Teal *Nettion aucklandicum*  
Cape (South African) Shoveler *Spatula capensis*  
Cape Teal *Nettion capense*  
Chestnut Teal *Nettion castaneum*  
Chiloe Wigeon *Mareca sibilatrix*  
Cinnamon (Northern) Teal *Spatula cyanoptera*  
Common (European Green-Winged) Teal  
*Nettion crecca*  
Common (Northern) Shoveler *Spatula clypeata*  
Common (Northern) Pintail *Dafila acuta*  
Cotton (Indian) Pygmy Goose (Cotton  
Teal) *Nettapus coromandelianus (albipennis)*  
European (Eurasian) Wigeon *Mareca penelope*  
Falcated Duck *Eunetta falcata*  
Gadwall (Gray Duck) *Chaulelasmus streperus*  
Garganey *Querquedula querquedula*  
Green Pygmy Goose *Nettapus pulchellus*  
Grey Teal (East Indian) *Nettion gibberifrons*  
Hartlaub's Duck *Pteronetta hartlaubii*  
Hottentot Teal *Punanetta hottentota*  
Knob-billed (Old World Comb) Duck  
*Sarkidiornis melanotos*  
Madagascan (Bernier's) Teal *Nettion bernieri*  
Mandarin Duck *Dendrocygna galericulata*  
Muscovy Duck *Cairina moschata*  
Red (Argentine) Shoveler *Spatula platalea*  
Red-billed Pintail *Paecilonetta erythrorhyncha*  
Ringed Teal *Callonetta leucophrys*  
Silver (Northern) (Versicolor) Teal  
*Punanetta versicolor*  
South American (Chilean Speckled) Teal  
*Nettion flavirostre*  
White-winged Wood Duck *Asarcornis scutulata*  
Wood Duck (North American) (Carolina  
Duck) *Aix sponsa*

## Tribe Anatini (Dabbling Ducks)

American (North) Black Duck *Anas fulvigula*  
Blue (Mountain) Duck *Hymenolaimus malacorhynchus*  
Bronze-winged (Spectacled) Duck  
*Specularias specularis*

Crested (Patagonian) Duck *Lophonetta specularioides*  
Falkland Flightless Steamer-Duck  
*Tachyeres brachypterus*  
Flying Steamer Duck *Tachyeres patachonicus*  
Grey Duck (New Zealand) *Anas superciliosa*  
Hawaiian Duck (Koloa) *Anas wyvilliana*  
Laysan Teal *Anas laysanensis*  
Magellanic Flightless Steamer-Duck  
*Tachyeres pterenes*  
Mallard (Northern) (Domestic) Duck  
(*Anas platyrhynchos*)  
Marbled Teal *Marmaronetta angustirostris*  
Meller's Duck *Anas melleri*  
Philippine Duck *Anas luzonica*  
Pink-eared (Zebra) Duck  
*Malacorhynchus membranaceus*  
Salvadori's Duck *Salvadorina waigiensis*  
Spot-billed (Indian) Duck *Anas poecilorhyncha*  
Australian Wood Duck (Maned Goose)  
Torrent (Chilean) Duck *Merganetta armata*  
Yellow-billed (South African) Duck *Anas undulata*

## Tribe Aythya (Pochards)

Australasian (White-Eye) (Hardhead)  
Pochard *Aythya australis*  
Baer's Pochard (Siberian White-Eye)  
*Aythya baeri*  
Canvasback *Aythya valisineria*  
Common (Ferruginous) (White-Eyed)  
Pochard *Aythya nyroca*  
European (Eurasian) Pochard *Aythya ferina*  
Greater (European) Scaup *Aythya marila*  
Lesser Scaup *Aythya affinis*  
Madagascan (White-Eye) Pochard *Aythya innotata*  
New Zealand Scaup (Black Teal) *Aythya novaeseelandiae*  
Pink-headed Duck *Rhodonessa caryophyllace*  
Red-Crested Pochard *Netta rufina*  
Redhead Duck *Aythya americana*  
Ring-necked Duck *Aythya collaris*  
Rosy-bill (Rosy-billed) Pochard *Metopiana peposaca*  
Southern (South American) Pochard  
*Phaeoaythya erythrorhynchos*  
Tufted Duck *Aythya fuligula*

## Tribe Somateria (Eiders)

Common (European) Eider *Somateria mollissima*  
King Eider *Somateria spectabilis*  
Spectacled (Fischer's) Eider *Somateria fischeri*  
Steller's Eider *Polysticta stelleri*

## Tribe Mergina (Sea Ducks)

Auckland Island Merganser *Mergus australis*  
Barrow's Goldeneye *Glaucionetta islandica*  
Black (European) Scoter *Melanitta nigra*  
Brazilian Merganser *Mergus octosetaceus*  
Bufflehead *Bucephala albeola*  
Common (European) Goldeneye  
*Glaucionetta clangula*  
Goosander (Curasian) *Mergus merganser*  
Harlequin (Atlantic) Duck *Histrionicus histrionicus*  
Hooded Merganser *Lophodytes cucullatus*  
Labrador Duck *Camptorhynchus labradorius*  
Long-tailed (Oldsquaw) Duck *Clangula hyemalis*  
Red-breasted (Common) Merganser  
*Mergus serrator*  
Scaley-sided (Chinese) Merganser *Mergus squamatus*  
Smew *Mergellus albellus*  
Surf Scoter *Melanitta perspicillata*  
White-winged (European) (Velvet) Scoter  
*Melanitta fusca*

## Tribe Oxyurini (Stiff-Tailed Ducks)

Black-headed Duck *Heteronetta atricapilla*  
Blue-billed (Australian) Duck *Oxyura australis*  
Lake (Argentine) (Ruddy) (Blue-billed)  
Duck *Oxyura vittata*  
Maccoa Duck *Oxyura maccoa*  
Masked Duck *Oxyura dominica*  
Musk Duck *Biziura lobata*  
Ruddy Duck (North American) *Oxyura jamaicensis*  
White-headed Duck *Oxyura leucocephala*

## RAPTORS

American Kestrel (Sparrow Hawk)  
*Tinnunculus sparverius*  
Bald Eagle *Haliaeetus leucocephalus*  
Barn Owl *Tyto alba*  
Common (European) (Rock) Kestrel  
*Tinnunculus tinnunculus*  
Common Buzzard *Buteo buteo*  
Eagle Owl *Bubo bubo*  
Eastern Turkey Vulture *Cathartes aura*  
European Sparrow Hawk *Accipiter nisus*  
Forest Eagle Owl *Bubo nipalensis*  
Golden Eagle *Aquila chrysaetos*  
Goshawk *Accipiter gentilis*  
Great Horned Owl *Bubo virginianus*  
Grey Eagle Buzzard *Geranoaetus melanoleucus*  
Griffon Vulture *Gyps fulvus*  
Little Owl *Athene noctua*  
Long-eared Owl *Asio otus*  
Merlin (Pigeon) Hawk *Aesalon columbarius*  
Peregrine Falcon *Hierofalco peregrinus*  
Prairie Falcon *Hierofalco mexicanus*  
Red Kite *Milvus milvus*  
Red-necked Falcon *Chiquera chiquera*  
Rough-legged Buzzard *Buteo lagopus*  
Saker Falcon *Hierofalco cherrug*  
Screech Owl *Megascops asio*  
Striped Owl *Asio flammeus*  
Snowy Owl *Nyctea scandiaca*  
South American Black-collared Hawk  
(Fishing Buzzard) *Busarellus nigricollis*  
Striped Owl *Asio clamator*  
Tengmalm's Owl *Aegolius funereus*  
Ural Owl *Strix uralensis*

## CICONIIFORMES

Black Stork *Ciconia nigra*  
Cattle Egret *Bubulcus ibis*  
Greater Adjutant Stork *Leptoptilos dubius*  
Grey Heron *Ardea cinerea*  
Hermit Ibis *Geronticus eremita*  
Marabout Stork *Leptoptilos crumeniferus*  
Night Heron (Black-Crowned) *Nycticorax nycticorax*  
Striated Heron *Butorides striatus*  
White Stork *Ciconia ciconia*  
Yellow-crowned Night Heron *Nyctanassa violacea*

## GALLIFORMES

Brush-Turkey *Alectura lathami*

## Numidinae

Crested Guineafowl *Guttera pucherani*  
Domestic Guineafowl *Numida meleagris forma domestica*  
Helmeted Guineafowl *Numida meleagris*  
Plumed Guineafowl *Guttera plumifera*  
Vulturine Guineafowl *Acryllium vulturinum*

## Pavoninae

Congo Peafowl *Afropavo congensis*  
Green Peafowl *Pavo muticus*  
Indian Peafowl *Pavo cristatus*

## Meleagridinae

Common Turkey *Meleagris gallopavo*  
Domestic Turkey *Meleagris gallopavo forma domestica*  
Oscillated Turkey *Meleagris ocellata*

**Argusianinae**

Bronze-tailed Peacock-Pheasant  
*Polyplectron chalcurum*  
Crested Argus *Rheinardia ocellata*  
Great Argus *Argusianus argus*  
Grey Peacock-Pheasant *Polyplectron bicalcaratum*  
Palawan Peacock-Pheasant *Polyplectron ephanum*

**Phasianinae**

Bar-tailed Pheasant *Calophasis humiae*  
Blue-eared Pheasant *Crossoptilon aurtum*  
Brown-eared Pheasant *Crossoptilon mantchuricum*  
Bulwer's Wattled Pheasant *Lophura bulweri*  
Cheer Pheasant *Catreus wallichii*  
Common (Ring-necked) Pheasant *Phasianus colchicus*  
Copper Pheasant *Graphephasianus soemmeringii*  
Elliot's Pheasant *Calophasis ellioti*  
Golden Pheasant *Chrysolophus pictus*  
Lady Amherst's Pheasant *Chrysolophus amherstiae*  
Mikado Pheasant *Calophasis mikado*  
Reeve's Pheasant *Syrmaticus reevesii*  
Salvadori's Pheasant *Lophura inornata*  
Siamese Fireback *Lophura diardi*  
Silver Pheasant *Lophura nythemera*  
Swinhoe's Pheasant *Lophura swinhoii*

**Lophophorinae**

Himalayan Monal *Lophophorus impejanus*

**Pucrasinae**

Koklass *Pucrasia macrolopha*

**Ithagininae**

Blood Pheasant *Ithaginis cruentus*

**Gallinae**

Domestic Fowl *Gallus gallus formadomestica*  
Red Junglefowl *Gallus gallus*

**Tragopaninae**

Satyr Tragopan *Tragopan satyra*

**Ptilopachinae**

Stone Partridge *Ptilopachus petrosus*

**Percidinae**

Black Francolin *Francolinus francolinus*  
Chinese Bamboo Partridge *Bambusicola thoracica*  
Chukar Partridge *Alectoris chukar*  
Common Partridge *Perdix perdix*  
Common Quail *Coturnix coturnix*  
Himalayan Snowcock *Tetraogallus himalayensis*  
Japanese Quail *Coturnix japonica*  
Jungle Bush Quail *Perdica asiatica*  
Painted Quail *Coturnix chinensis*  
Redlegged Partridge *Alectoris rufa*  
Rock Partridge *Alectoris graeca*  
Roulroul (Crested Wood Partridge) *Rollulus roulroul*

**Odontophorinae**

Bobwhite Quail *Colinus virginianus*  
California Quail *Callipepla californica*  
Gambel's Quail *Callipepla gambelii*  
Scaled Quail *Callipepla squamata*

**Tetraoninae**

Black Grouse *Lyrurus tetrix*  
Blue Grouse *Dendragapus obscurus*  
Common Capercaillie *Tetrao urogallus*  
Hazelhen (Common) *Tetrastes bonasia*  
Prairie Chicken *Tympanuchus cupido*  
Red Grouse *Lagopus lagopus scoticus*  
Ruffed Grouse *Bonasa umbellus*  
Sage Grouse *Centrocercus urophasianus*  
Sharp-tailed Grouse *Tympanuchus phasianellus*  
Spruce Grouse *Falcapennis canadensis*  
Willow Ptarmigan (-Grouse) *Lagopus lagopus*

**Cracidae**

Black-billed Turaco *Tauraco schuetti*  
Common Piping Guan *Aburria pipile*  
Great Curassow *Crax rubra*  
Guinea Turaco *Tauraco persa*  
Helmeted (Northern) Curassow *Pauxi pauxi*  
Lady Ross's Turaco *Musophaga rossae*  
Purple-crested Turaco *Tauraco porphyreolophus*  
Razor-billed Curassow *Mitu mitu*  
Wattled Curassow *Crax globulosa*  
White-crested Turaco *Tauraco leucolophus*

**UPUPIFORMES**

Hoopoe *Upupa epops*

**CAPRIMULGIFORMES**

Indian Edible-nest Swiftlet *Collocalia unicolor*  
Quetzal *Pharomachrus mocinno*  
Tawny Frogmouth *Podargus strigoides*

**PASSERIFORMES**

African Silverbill *Euodice cantans*  
American Bare-eyed Thrush *Planesticus nudigenis*  
American Goldfinch *Spinus tristis*  
American Tree-Sparrow *Spizella arborea*  
Antbirds and gnateaters *Formicariidae*  
Apostle-bird *Struthidea cinerea*  
Ashy (Brown-eared) Bulbul *Hemixos flavala*  
Australian Magpie *Gymnorhina tibicen*  
Avadavat (Strawberry-Finch, Red Munia) *Amandava amandava*  
Barn-Swallow *Hirundo rustica*  
Bearded Manakin *Manacus manacus*  
Bengalese (Society) Finch *Lonchura domestica*  
Birds of Paradise *Paradisaeidae*  
Black (Pied) (Pied Bell-Magpie) Currawong *Strepera graculina*  
Black-eared Wheatear *Oenanthe hispanica*  
Black-faced Cuckoo-Shrike *Coracina novaehollandiae*  
Black-faced Babbler *Turdoides melanops*

Black-throated Grass-(Parson-)Finch *Poephila cincta*  
Blackbird (Common) *Merula merula*  
Blue Jay *Cyanocitta cristata*  
Blue Tit *Cyanistes caeruleus*  
Blue Waxbill (Angola Cordon-bleu) *Uraeginthus angolensis*  
Broad-tailed (Long-tailed) Paradise Whydah *Steganura interjecta*  
Brown-headed Cowbird *Molothrus ater*  
Brown Tree-Creeper *Climacteris picumnus*  
Bushlark (Horsfield's, Cinnamon) *Miraflora javanica*  
Canary *Serinus canaria*  
Cape May Warbler *Dendroica tigrina*  
Cardinal (Crested) *Paroaria coronata*  
Catbird *Dumetella carolinensis*  
Cedar Waxwing *Bombycilla cedrorum*  
Chaffinch *Fringilla coelebs*  
Chatham Islands Robin (-Flycatcher) *Miro traversi*  
Common Bullfinch *Pyrrhula pyrrhula*  
Common Cardinal *Cardinalis cardinalis*  
Common Raven *Corvus corax*  
Cowbird *Molothrus aeneus*  
Crested Lark *Galerida cristata*  
Crested Oropendola *Psarocolius decumanus*  
Crimson Finch *Neochmia phaeton*  
Cuban (Grassquit) Finch *Tiaris canora*  
Cutthroat Finch *Amadina fasciata*  
Diamond Firetail (Diamond Sparrow) *Stagonopleura guttata*  
Double-barred Finch *Stizoptera bichenovii*  
Eastern Bluebird *Sialia sialis*  
European Goldfinch *Carduelis carduelis*  
European Robin *Erithacus rubecula*  
Fox Sparrow *Passerella iliaca*  
Glossy (Superb) Starling *Lamprospereos superbus*  
Golden-collared Manakin *Manacus vitellinus*  
Golden-headed Manakin *Pipra erythrocephala*  
Goldfinch *Carduelis carduelis*  
Gouldian Finch *Chloebia gouldiae*  
Great Tit *Parus major*  
Green Avadavat *Stictospiza formosa*  
Green Catbird *Ailuroedus crassirostris*  
Greenfinch *Carduelis chloris*  
Greenfinch *Chloris chloris*  
Grey-headed Wheatear *Oenanthe moesta*  
Hawaiian Crow *Corvus tropicalis*  
Hawfinch *Coccothraustes coccothraustes*  
Hooded Siskin *Spinus magellanicus*  
House Sparrow *Passer domesticus*  
Jackdaw *Coleus monedula*  
Java Sparrow (Rice Bird) *Padda oryzivora*  
Large-billed Seed Finch (Suriname Finch, Twa twa's) *Oryzoborus crassirostris*  
Long-tailed (Shaft-tailed) Grass-Finch *Poephila acuticauda*  
Magpie *Pica pica*  
Melba Finch (Grey-naped Pytilia) *Pytilia melba*  
Mockingbird *Mimus polyglottos*

Mynah (Hill) birds *Gracula religiosa*  
Nutmeg Mannikin (Spice-Finch) (Spotted Munia) (Rice-bird) *Lonchura punctulata*  
Orange-cheeked Waxbill *Estrilda melpoda*  
Painted Firetail *Emblema picta*  
Pekin Robin *Leiothrix lutea*  
Pied wagtail *Motacilla alba*  
Pin-tailed Parrot-Finch *Erythrura prasina*  
Purple Grackle *Quiscalus quiscula*  
Red (hooded) Siskin *Spinus cucullatus*  
Red-breasted Flycatcher *Erythrosterina parva*  
Red-capped Manakin *Pipra mentalis*  
Red-cheeked (Cordon-blue) Blue Waxbill *Uraeginthus bengalus*  
Red-headed Barbet *Eubucco bourcierii*  
Red Wattlebird *Anthochaera carunculata*  
Red-winged Pytilia (American Aurora finch, Crimson-winged Waxbill) *Pytilia phoenicoteria*  
Rock Robin *Petroica archboldi*  
Rook (European) *Corvus frugilegus*  
Rothschild's (Bali) Myna *Leucospars rothschildi*  
Rufous-sided Towhee *Pipilo erythrophthalmus*  
Rufous-tailed Weaver *Histurgops ruficauda*  
Siberian Rubythroat *Calliope calliope*  
Silvereye *Zosterops lateralis*  
Siskin (Euroasian) *Spinus spinus*  
Sky-lark *Alauda arvensis*  
Spotted Pardalote *Pardalotus punctatus*  
Starling (Common) *Sturnus vulgaris*  
Superb Lyrebird *Menura novaehollandiae*  
Swainson's (Olive-backed) Thrush *Catharus ustulatus*  
Tree Sparrow (Eurasian) *Passer montanus*  
Ultramarine Grosbeak *Cyanoloxia cyanea*  
Vesper Sparrow *Poocetes gramineus*  
Violaceous Euphonia *Euphonia violacea*  
Waxwing (Bohemian) *Bombycilla garrulus*  
Weebill *Smicrornis brevirostris*  
Welcome Swallow *Hirundo neoxena*  
White-rumped Canary *Ochrospiza leucopygia*  
White-throated Sparrow *Zonotrichia albicollis*  
Wood Thrush *Hylocichla mustelina*  
Yellow-backed (Orange-winged) Pytilia (Red-faced Waxbill) *Pytilia afra*  
Yellow-tufted (Helmeted) honeyeater *Lichenostomus melanops raxce cassidex*  
Zebra Finch *Taeniopygia guttata*

## II

# Determination of Metabolic Scaling

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### Step-by-step Technique for Determining Metabolic Scaling

*Harrison G.*

One may determine the quantity of an enteral nutritional product for a bird from information supplied in Chapter 15. This mathematical calculation requires a scientific calculator. The following is offered to assist one not familiar with such calculations.

#### Required Data and Formulas

$BMR = K(W_{kg}^{0.75})$  = Basic Metabolic Rate.

K = a theoretical constant for kcal required per 24 hours and varies with the species of bird. K is 129 for passerines and 78 for non-passerines.

$MER = 1.5 \times BMR$  = Metabolizable Energy Requirement.

$W_{kg}$  is the weight of the bird in kg.

#### To determine the BMR:

1. Divide the bird's weight in grams by 1000 to determine the  $W_{kg}$ .
2. With this number entered in the calculator, press the  $y^x$  function key.
3. Input 0.75. Then push =.
4. Multiply the number determined in step 3 by the K value for the bird (78 if it is a psittacine bird).
5. This number is the BMR for the patient in kcal/day.

#### To determine the quantity of enteral nutrient required:

1. Multiply the calculated BMR by 1.5.
2. This number is the MER in kcal per day.
3. Determine the total kcal/day of nutrients required, by multiplying the MER by the stress factor (see Table 15.4).
4. Determine the mls/day of enteral nutrient to use (see Table 15.5) by dividing the value determined in line 3 by the Calories (kcal)/ml in the enteral formula selected.
  - a. Example: ISO cal contains 1 kcal/ml. The value determined in line 3 would be divided by 1 and the resulting number would be the ml/day of this product that the patient should receive.
  - b. Example: ISO cal HCN contains 2 kcal/ml. The value determined in line 3 would be divided by 2 and the resulting number would be the ml/day of this product that the patient should receive.
5. The volume of enteral formula/feeding is determined by dividing the total number of mls required (answer from line 4) by the number of feedings per day (generally four to six).





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c=color figure, t=table, f=figure.

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