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Blood Plasma Chemistries from Wild Mourning Doves Held in Captivity

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ABSTRACT: Despite the extensive amount of research conducted on mourning doves (*Zenaida macroura*), no biochemical reference values exist for this species. Our objective, therefore, was to establish base line clinical chemistry reference values for mourning doves to assist with establishing clinical diagnoses. Wild mourning doves were captured 19 March 1996 to 8 August 1996, and 6 February 1998 to 12 May 1998; blood samples were collected from 382 mourning doves. Plasma biochemical values were established for glucose, sodium, potassium, chloride, enzymatic CO_2, albumin, total protein, globulin, calcium, phosphorus, cholesterol, magnesium, aspartate aminotransferase (AST), gamma glutamyl transferase (GGT), lactate dehydrogenase (LDH), and uric acid. These reference values are invaluable for determining diagnosis of diseases of the gastrointestinal, hepatic, renal, cardiovascular, musculoskeletal, and endocrine systems.

Key words: Biochemical reference values, blood plasma chemistries, mourning doves, *Zenaida macroura.*

Mourning doves (*Zenaida macroura*) are the most studied migratory upland game bird in North America (Baskett et al., 1993; Mirarchi and Baskett, 1994). Despite the extensive amount of information available from a wide range of research, few data exist concerning several critical management questions. For example, what is the effect of environmental contaminants on mourning dove populations (Conti, 1993), or what are the possible causes for long term population trend declines in the Western and Central Management Units and more recent declines in Eastern Management Unit (Dolton and Smith, 1998)?

With the development of the Webless Migratory Game Bird Research program (Dolton 1999), more research will be conducted to address many of these management questions. Before these challenging questions can be answered, however, a solid foundation of base line data must exist. Values for mourning dove blood chemistries are one important parameter that is missing. Reference values of biochemical variables would be invaluable for future projects establishing clinical diagnoses of diseases of the gastrointestinal, hepatic, renal, cardiovascular, musculoskeletal, and endocrine systems. Several current references exhaustively review the use of biochemistry values to evaluate avian organ systems (Ritchie et al., 1994; Rosskopf and Woerpel, 1996; Fudge, 2000). Examples of changes in biochemistry values that indicate organ system disease are as follows. Elevated AST, LDH, and GGT values are most commonly associated with liver disease. Elevated uric acid is typically associated with renal disease. A decrease in total protein and cholesterol is observed in birds during starvation. Abnormalities in electrolyte status (i.e., sodium, potassium, chloride) can be marked in birds that are dehydrated or have severe enteric disease. Changes in calcium and phosphorus levels can be observed with metabolic bone disease (rickets). The interpretation of plasma biochemistry values is usually more complex than evaluating a single parameter. Typically, the entire biochemistry profile is used to characterize the health status of the patient.

The data that exist on avian blood chemistry values either relate to a general dove category (Ritchie et al., 1994), or to an undefined pigeon species (Lumeij, 1996). General guidelines are available for inter-

TABLE 1. Blood plasma chemistry values for wild-trapped mourning doves held in captivity.

Year	Assay	Sex	*n*	$\bar{x}$	SE	Range
1996	Glucose (mg/dL)	M	89	477.96	8.51	351.00–663.00
		F	90	466.87	8.55	340.00–718.00
	Sodium (mmol/L)	M	90	146.26	0.37	137.00–160.00
		F	91	145.41	0.31	138.00–153.00
	Potassium (mmol/L)	M	91	7.05	0.20	3.60–12.50
		F	91	6.76	0.18	3.90–13.00
	Chloride (mmol/L)	M	90	113.21	0.45	104.00–137.00
		F	91	112.20	0.36	101.00–119.00
	Enzymatic CO_2 (mmol/L)	M	90	29.37	0.41	17.00–36.00
		F	91	29.05	0.37	21.00–37.00
	Albumin (g/dL)	M	90	1.19	0.02	1.00–2.00
		F	91	1.18	0.01	1.00–1.60
	Total Protein (g/dL)	M	91	2.75	0.05	2.10–5.10
		F	91	2.68	0.04	2.00–3.50
	Globulin (g/dL)	M	90	1.56	0.04	1.10–3.40
		F	89	1.52	0.02	1.00–2.00
	Calcium (mg/dL)	M	90	9.98	0.09	7.60–12.10
		F	91	9.74	0.10	6.40–12.00
	Phosphorus (mg/dL)	M	90	3.78	0.12	1.90–7.40
		F	91	3.70	0.10	1.50–6.60
	Cholesterol (mg/dL)	M	90	258.48	4.88	175.00–441.00
		F	91	261.68	6.40	141.00–506.00
	Magnesium (mg/dL)	M	90	2.55	0.04	1.90–3.60
		F	91	2.48	0.04	1.70–3.40
	AST[1] (U/L)	M	87	227.53	8.71	81.00–663.00
		F	90	245.44	10.68	93.00–757.00
	GGT[2] (U/L)	M	86	8.24	0.65	5.00–48.00
		F	90	8.71	0.47	5.00–29.00
	LDH[3] (U/L)	M	86	1,040.27	94.33	445.00–8,117.00
		F	89	1,091.30	104.57	425.00–9,168.00
	Uric Acid (mg/dL)	M	90	5.13	0.18	1.90–10.00
		F	91	5.17	0.23	1.50–13.30
1998	Glucose (mg/dL)	M	94	489.68	9.04	310.00–822.00
		F	87	503.06	11.78	342.00–1,116.00
	Sodium (mmol/L)	M	97	144.00	0.33	137.00–154.00
		F	87	143.43	0.41	125.00–156.00
	Potassium (mmol/L)	M	96	7.78	0.19	4.00–14.90
		F	87	7.81	0.18	4.50–12.00
	Chloride (mmol/L)	M	94	113.64	0.33	107.00–121.00
		F	88	112.60	0.42	96.00–123.00
	Enzymatic CO_2 (mmol/L)	M	97	32.48	0.35	24.00–40.00
		F	87	32.85	0.35	22.00–40.00
	Albumin (g/dL)	M	97	1.21	0.02	0.90–1.70
		F	87	1.22	0.02	1.00–1.70
	Total Protein (g/dL)	M	97	2.62	0.04	1.80–3.90
		F	87	2.66	0.05	1.70–3.90
	Globulin (g/dL)	M	97	1.42	0.03	0.90–2.60
		F	87	1.44	0.03	0.70–2.60
	Calcium (mg/dL)	M	97	9.47	0.08	7.20–11.50
		F	87	9.79	0.21	8.10–25.10
	Phosphorus (mg/dL)	M	97	3.89	0.11	2.10–8.40
		F	87	3.87	0.12	2.10–8.10
	Cholesterol (mg/dL)	M	94	231.79	5.80	122.00–550.00
		F	87	239.11	7.92	84.00–485.00
	Magnesium (mg/dL)	M	97	2.87	0.03	2.10–3.90
		F	87	2.87	0.03	2.10–3.70

TABLE 1. Continued.

Year	Assay	Sex	*n*	$\bar{x}$	SE	Range
	AST (U/L)	M	97	252.60	11.37	94.00–709.00
		F	86	270.07	11.10	143.00–659.00
	GGT (U/L)	M	94	11.16	0.40	9.00–37.00
		F	86	10.87	0.31	9.00–27.00
	LDH (U/L)	M	95	905.35	36.38	312.00–1,822.00
		F	87	1,175.26	108.11	320.00–8,528.00
	Uric Acid (mg/dL)	M	96	7.22	0.23	3.00–14.20
		F	87	7.22	0.31	2.60–17.10

[1] AST = aspartate aminotransferase.
[2] GGT = gamma glutamyl transferase.
[3] LDH = lactate dehydrogenase.

preting laboratory findings in birds with unknown reference ranges (Gascoyne et al., 1994), however, the lack of species specific ranges is problematic. Our objective, therefore, was to establish base line blood plasma chemistry values for mourning doves to assist with further mourning dove investigations.

Captive colonies of wild-trapped mourning doves were maintained during 1996 and 1998 as part of an experiment to develop and evaluate techniques for implanting subcutaneous radio transmitters with external antennas (Schulz et al., 1998, 1999). Wild mourning doves were captured in Boone County Missouri; (39°00′N, 92°20′W) with modified Kniffin traps (Reeves et al., 1968) baited with white proso millet. Doves were captured 19 March 1996 to 8 August 1996, and 6 February 1998 to 12 May 1998; 200 doves were used in 1996, and 195 in 1998. Sex of mourning doves was verified by examination of gonads at the conclusion of the experiments. Captive mourning doves had reached adult prebasic molt by the start of the experiment and were all considered adults.

Captured mourning doves were maintained at the University of Missouri Animal Sciences Research Center (University of Missouri, Columbia, Missouri, USA) in individual stainless steel cages; cage size in 1996 was 24 × 18 × 18 cm, and 24 × 40 × 18 cm in 1998. Colony rooms had average temperatures of 21 to 24 C, average relative humidity of 50 to 60%, and artificial lighting for 12 hr during each 24 hr period. All doves were given a broad spectrum anthelmintic (200 μg Ivermectin/kg body mass, or 0.25 ml/dove of 0.1 mg/ml solution) administered directly into the crop; this ensured all doves were the same physiological status. During 1996, doves were fed a complete and balanced formulated ration (prepared at Animal Science Research Center, University of Missouri, Columbia, Missouri), and a mixed wild bird seed diet during 1998 (MFA Agri Service, Columbia, Missouri). Food and water were provided ad libitum both years. Laboratory animal care and use protocols were followed throughout the study (National Academy of Sciences, 1977; Gaunt et al., 1997), which were approved through the University of Missouri Animal Care and Use Protocol Review (Reference No. 2698 and 3019).

We euthanized all birds individually in a CO_2 chamber at approximately 30 wk post-capture in 1996, and 20 wk post-capture in 1998. We bled each dove via heart puncture (Campbell, 1988), using a 3 ml draw Vacutainer® lithium heparin tube (Becton Dickinson, Franklin Lakes, New Jersey, USA) <3.0 min after death to collect blood for plasma chemistry profiles. Blood samples were immediately placed on ice and centrifuged <4 hr after collection to separate the plasma. Plasma biochemical values for glucose, sodium, potassium, chloride, enzymatic CO_2, albu-

min, total protein, globulin, calcium, phosphorus, cholesterol, magnesium, AST, GGT, LDH, and uric acid were determined with the use of an automatic chemistry analyzer (Kodak Ektachem Analyzer, Eastman Kodak Co., Rochester, New York, USA; University of Missouri Veterinary Medical Diagnostic Laboratory, Columbia, Missouri, USA).

We did not pool data among years because of differences in how the birds were housed, differences in diet, and potential differences in conducting blood chemistry analyses (Cherry, 1998; Johnson, 1999). Male and female plasma biochemical values were not pooled to provide sex specific reference ranges for mourning doves. All means are presented ± standard error.

During 1996 we collected 189 blood samples which provided 184 usable samples, and in 1998 we collected an additional 193 samples with 184 usable samples; not all samples contained enough blood to conduct all tests. During 1996, males weighed more (114.9 ± 1.1 g, n = 100) than females (106.3 ± 1.0 g, n = 100) at ≥4 wk post-capture. During 1998, males again weighed more (119.0 ± 0.84 g, n = 102) than females (111.1 ± 0.96 g, n = 92) at ≥4 wk post-capture. Reference values were obtained for the 16 biochemical parameters for males and females during 1996 and 1998 (Table 1).

Comparisons of blood plasma analysis from healthy and sick birds can provide the basis for diagnosis of various diseases. Although general guidelines exist for interpreting biochemical values in birds with unknown reference values (Gascoyne et al., 1994), species and sex specific ranges are preferred. These specific reference values are invaluable for determining diagnosis of diseases of the gastrointestinal, hepatic, renal, cardiovascular, musculoskeletal, and endocrine systems. The interpretation of plasma biochemistry values is usually more complex than evaluating a single parameter. Typically, the entire biochemistry profile is used to characterize the health status of the patient.

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