

Avian Metal & Mineral Data (where known)

Metals and minerals measured by ICP/MS. This mineral data is based on Puls, [Mineral Levels in Animal Health](#), 1994 and data gathered by Dr. Tom Herdt, Nutritionist at the Michigan State University Veterinary Diagnostic Laboratory. Please note that data for non-poultry birds are available from this source only as noted. We are in the process of gathering population data for multiple species to adjust the adequate ranges.

Blood and Serum/Plasma

Analyte	Sample	Avian Normal Range	Units	Deficient	High	Toxic
Cobalt	Serum	0.13 – 0.18	ng/mL	-	-	-
Copper – Chicken (grower)	Serum	0.08 – 0.50	µg/mL	< 0.04	-	-
Copper – Chicken (layer)	Serum	0.20 – 0.45	µg/mL	< 0.04	-	-
Copper – Turkey	Serum	0.18 – 0.28	µg/mL	-	-	-
Copper – Ostrich	Serum	0.20 – 0.39	µg/mL	-	-	-
Iron	Serum	160 - 300	µg/dl	-	-	-
Manganese	Blood	85 - 91	ng/mL	-	-	-
Molybdenum	Serum	-	ng/mL	-	-	-
Selenium	Blood	130 - 200	ng/mL	< 85	-	-
Zinc - Poultry	Serum	1.45 - 3.40	µg/mL	< 0.60	-	> 4.00
Zinc - Psittacine, exotic	Serum	1.45 - 2.80	µg/mL	< 0.40	-	> 3.00
Arsenic	Blood	-	µg/mL	-	-	-
Cadmium	Blood	-	µg/mL	-	-	-
Lead – Chickens	Blood	< 0.20	µg/mL	-	-	> 4.00
Lead – Geese	Blood	< 0.50	µg/mL	-	-	> 1.00
Lead – Ducks & Swans	Blood	< 0.50	µg/mL	-	-	> 3.30
Lead – Falconiformes	Blood	< 1.00	µg/mL	-	-	> 5.00
Thallium	Blood	-	ng/mL	-	-	-

Liver (Dry weight basis) – Determined gravimetrically

Analyte	Avian Normal Range	Units	Deficient	High	Toxic
Cobalt	0.28 – 0.84	ug/g dwt	< 0.03	10 – 25	> 50
Copper ¹ – Growers	16 – 60	ug/g dwt	< 8	-	> 80*
Copper ¹ – Layers	16 – 24	ug/g dwt	< 8	-	> 80*
Copper ¹ – Turkeys	20 – 40	ug/g dwt	-	-	-
Copper ¹ – Ducks	40 - 240	ug/g dwt	-	100 - 1200	> 2160
Copper ¹ – Geese	20 - 104	ug/g dwt	-	-	> 200
Copper ¹ – Ostrich	16 - 36	ug/g dwt	-	-	-
Iron	240 - 1200	ug/g dwt	< 160	1200 - 8000	> 32,000
Manganese	8 - 16	ug/g dwt	-	> 16	> 36
Molybdenum	-	ug/g dwt	-	-	-
Selenium	1.40 – 4.00	ug/g dwt	< 1.00	8 – 16	> 16
Zinc - Poultry	100 - 160	ug/g dwt	< 100	360 - 800	> 800
Zinc - Psittacine, exotics	100 - 180	ug/g dwt	-	-	> 280
Arsenic	-	ug/g dwt	-	-	-
Cadmium	-	ug/g dwt	-	-	-
Lead	-	ug/g dwt	-	-	-
Thallium	-	ug/g dwt	-	-	-
Dry wt. fraction	25 - 34	%			

¹Liver copper levels of 80 – 600 ug/g dry weight indicate chronic toxicity, while those above 1100 ug/g dry weight reflect acute poisoning

Liver (As received basis) – wet weight

Analyte	Avian Normal Range	Units	Deficient	High	Toxic
Cobalt	0.07 – 0.021	ug/g wwt	< 0.008	2.5 – 6.25	> 12.5
Copper ¹ – Growers	4 – 15	ug/g wwt	< 2	-	> 20
Copper ¹ – Layers	4 – 6	ug/g wwt	< 2	-	> 20
Copper ¹ – Turkeys	5 – 10	ug/g wwt	-	-	-
Copper ¹ – Ducks	10 – 60	ug/g wwt	-	25 - 300	> 540
Copper ¹ – Geese	5 – 26	ug/g wwt	-	-	> 50
Copper ¹ – Ostrich	4 – 9	ug/g wwt	-	-	-
Iron	60 – 300	ug/g wwt	< 40	300 – 2000	> 8000
Manganese	2 – 4	ug/g wwt	< 2	> 4	> 9
Molybdenum	-	ug/g wwt	-	-	-
Selenium	0.35 – 1.00	ug/g wwt	< 0.25	2 – 4	> 4
Zinc	25 - 40	ug/g wwt	< 25	90 - 200	> 200
Arsenic	-	ug/g wwt	-	-	-
Cadmium	-	ug/g wwt	-	-	-
Lead	-	ug/g wwt	-	-	-
Thallium	-	ug/g wwt	-	-	-

¹Liver copper levels of 20 – 150 ug/g indicate chronic toxicity, while those above 275 ug/g reflect acute poisoning. Psittacine birds are far more zinc sensitive than poultry.