Mineral Panel #1 Reference Ranges for Livestock – PDS Toxicology

Source: Mineral Levels in Animal Health – 2nd Edition (R. Puls, 1994)

EQUINE

Adult Horse Trace Mineral Reference Ranges – Serum

Trace Mineral	Sample	Concentration
Cobalt	Serum	>0.25 ppb (>0.00025 ppm)
Copper	Serum	0.5-2 ppm
Iron**	Serum	0.84-2.57 ppm
Magnesium**	Serum	18-35 ppm
Manganese**	Serum	0.5-2 ppb (0.0005-0.002 ppm)
Molybdenum	Serum	0.05-0.5 ppb
Selenium**	Serum	0.14-0.25 ppm
	Blood	0.17-0.25 ppm
Zinc	Serum	0.47-1.70 ppm

** Hemolyzed samples will result in falsely high concentrations.

Adult Horse Trace Mineral Reference Ranges – Liver (wet weight basis)

Trace Mineral	Concentration
Cobalt	--
Copper	4.0-7.5 ppm
Iron	100-300 ppm
Magnesium	130-200 ppm
Manganese	1.0-6.0 ppm
Molybdenum	--
Selenium	0.3-1.0 ppm
Zinc	40-125 ppm

Adult Goat Trace Mineral Reference Ranges – Serum

Trace Mineral	Sample	Concentration
Cobalt	Serum	Based on bovine data: 0.9-15 ppb
Copper	Serum	0.8-1.20 ppm
Iron**	Serum	1.3-2.3 ppm
Magnesium**	Serum	20-35 ppm
Manganese**	Serum	Based on bovine and ovine data: Bovine: 0.006-0.70 ppm Ovine: 0.08-0.51 ppm
	Plasma	>0.03 ppm
Molybdenum	Plasma	Based on bovine and ovine data: Bovine: 0.01-0.10 ppm Ovine: 0.01-0.7 ppm
Selenium	Serum	0.08-0.2 ppm Ovine whole blood: 0.120-0.50 ppm
Zinc**	Serum	0.65-2.70 ppm
	Blood	1.4-2.82 ppm

Notes:
** Hemolyzed samples will result in falsely high concentrations.

Adult Goat Trace Mineral Reference Ranges – Liver (wet weight basis)

Trace Mineral	Concentration
Cobalt	Based on bovine and ovine data: Bovine: 20-85 ppb Ovine: 30-90 ppb
Copper	25-150 ppm
Iron	50-130 ppm
Magnesium	130-220 ppm
Manganese	2.0-6.0 ppm
Molybdenum	Based on bovine and ovine data: Bovine: 0.14-1.40 ppm Ovine: 0.4-6.0 ppm
Selenium	0.25-1.20 ppm
Zinc	25-120 ppm

Adult Sheep Trace Mineral Reference Ranges – Serum

Trace Mineral	Sample	Concentration
Cobalt	Serum	Based on bovine data: 0.9-15 ppb
	Blood	0.15 ppm
Copper	Serum	0.7-2.0 ppm
Iron**	Serum	1.66-2.22 ppm
Magnesium**	Serum	20-35 ppm
Manganese**	Serum	0.08-0.51 ppm
	Blood	0.02-0.025 ppm
Molybdenum	Serum	0.001-0.050 ppm
	Plasma	0.01-0.7 ppm
Selenium	Serum	0.08-0.4 ppm
	Blood	0.120-0.50 ppm
Zinc**	Serum	0.8-1.2 ppm

Notes:
** Hemolyzed samples will result in falsely high concentrations.

Adult Sheep Trace Mineral Reference Ranges – Liver (wet weight basis)

Trace Mineral	Concentration
Cobalt	30-90 ppb
Copper	25-100 ppm
Iron	30-300 ppm
Magnesium	118-200 ppm
Manganese	2.0-4.5 ppm
Molybdenum	0.4-6.0 ppm
Selenium	0.25-1.5 ppm
Zinc	30-75 ppm

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BOVINE

Adult Cattle Trace Mineral Reference Ranges – Serum

Trace Mineral	Sample	Concentration
Cobalt	Serum	0.9-15 ppb
	Blood	0.15 ppm
Copper*	Serum	0.6-1.5 ppm
Iron**	Serum	1.3-2.5 ppm
Magnesium**	Serum	18-35 ppm
Manganese**	Serum	0.006-0.07 ppm
	Blood	0.07-0.09 ppm
Molybdenum	Serum	0.01-0.10 ppm
	Plasma	0.08-10 ppm
Selenium**	Serum	0.07-0.3 ppm
	Blood	0.2-1.2 ppm
Zinc**	Serum	0.8-1.4 ppm

Notes:
* Copper in blood will decrease when liver stores become depleted (approx. ≤10 ppm ww). Therefore, normal blood copper does not rule out copper deficiency.
** Hemolyzed samples will result in falsely high concentrations.

Adult Cattle Trace Mineral Reference Ranges – Liver (wet weight basis)

Trace Mineral	Concentration
Cobalt	20-85 ppb
Copper	25-100 ppm
Iron	45-300 ppm
Magnesium	100-250 ppm
Manganese	2-6 ppm
Molybdenum	0.14-1.40 pm
Selenium	0.25-0.50 ppm
Zinc	25-100 ppm

Adult Bison Trace Mineral Reference Ranges – Liver (wet weight basis)

Trace Mineral	Concentration
Cobalt	Based on bovine data: 20-85 ppb
Copper	25-100 ppm
Iron	45-300 ppm
Magnesium	100-250 ppm
Manganese	2-6 ppm
Molybdenum	Based on bovine data: 0.14-1.40 ppm
Selenium	0.25-0.50 ppm
Zinc	25-100 ppm