

Vet 406: Essential AA, Fat Soluble Vitamins, Trace Minerals

Nutrient	Dietary Sources	Function	Deficiency	Toxicity	Testing
Essential AA					
Arginine	Most protein sources		Hyperammonemia		
Isoleucine, Leucine, Lysine, Methionine			Skin/Coat effects	Methionine Vomiting, Diarrhea, CNS signs Death	
Phenylalanine and Tyrosine			Reddening of coat		
Threonine			Neurological dysfunction and lameness		
Taurine			DCM		
Fat Soluble Vit					
Vit. A	Fish oils and liver Milk fat and egg yolk Green Leaves Carrots, sweet potatoes, pumpkin, squash, yellow corn	Vision Growth, Cell Differentiation and Metabolism Reproduction Bone Formation	Hyperkeratization Infectious disease Dry eye/ poor vision Infertility/abortion Anorexia/diarrhea Congenital Malformed ocular structures Haired corneal dermoid Microphthalmia	Carotenoids considered non-toxic Retinoids can cause toxicity if overconsumed with supplementation Rashes, hair loss, skeletal malformation,	Measure plasma Vit A levels Measure vitamin A in liver biopsy

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				<p>premature growth plate closure Birth defects Sympathetic nerve damage due to otitis media</p> <p>*Hyena disease in cattle</p>	
Vit. E	<p>Vegetable oils Eggs and liver Green forages *alfalfa</p>	<p>Antioxidant!!! Cell signaling and gene regulation</p>	<p>Oxidation of cellular membranes Damage to tissues Oxidized fatty acids may react with divalent cations *Nutritional Muscular dystrophy (white muscle disease) *steatitis in cats!</p>	<p>Relatively non-toxic but may antagonize other fat soluble vitamins at high levels</p> <p>May compete for absorption</p>	<p>Plasma alpha tocopherol levels</p> <p>Erythrocyte hemolysis test</p>
Selenium	<p>Forage, Water, cereal content depends on soil selenium content and plant species</p>	<p>Antioxidant! Reduces lipid peroxides to hydroxy fatty acids -> metabolized Prohormone T4 which activates T3</p>	<p>Hepatic necrosis Pancreatic dystrophy Infertility / embryonic death</p>	<p>Narrow margin of safety</p> <p>Sloughed hooves, loss of mane or tail, rough coat</p> <p>Sudden death with dyspnea, sweating, pyrexia,</p>	<p>Blood selenium levels</p> <p>Erythrocyte glutathione peroxidase activity</p> <p>Elevation of LDH</p> <p>Elevated ratio of T4 to T3</p>

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				tachycardia, ataxia, and excitability *potential anemia and liver necrosis in dogs and cats	
Vit. K	Gut and rumen microbes Green leaves or dark green vegetables Vegetable oils, liver, and fish meal	Co-factors for carboxylases Activates clotting factors 2, 7, 9, 10 Key in formation of carboxyglutamic acid (calcium binding site) Calcium binding function Carboxylates proteins including matrix proteins and osteocalcin in bone	Ingestion of antagonists Antibiotic treatment Infants (lack gut microflora) Lipid malabsorption Bleeding disorders and hemorrhage	Oral toxicity is not seen clinically	Measure clotting time P.I.V.K.A testing
Trace Minerals					
Copper	Liver > shellfish > nuts > grains > fish > poultry > vegetables > muscle meat	Essential for redox chemistry	Can be caused by Zinc excess due to the induction of metallothionein in enterocytes because of calcium	Hemolytic anemia Liver failure	Diet history and analysis Liver Biopsy *gold standard*

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	Drinking water with copper pipes		<p>binding which limits absorption</p> <p>Anemia Microcytic or normocytic, hypochromic type</p> <p>Neonatal ataxia Discoloration of hair and wool Twisting or kinking of hair and wool Defective collagen and elastin formation Oxidative damage</p>		Plasma or whole blood copper is not reliably sensitive
Zinc	Red meat and shellfish > whole grains, legumes, nuts	<p>Catalytic roles</p> <p>Structural roles</p> <p>Regulatory roles</p>	<p>Growth impairment</p> <p>Impaired appetite and taste</p> <p>Parakeratosis</p> <p>Male repro. Failure</p> <p>Developmental skeletal disease</p>	<p>Low naturally occurring risk</p> <p>Dietary over supplementation may occur</p> <p>Zn-containing foreign bodies most common in dogs</p>	<p>Plasma zinc concentration</p> <p>*Some anticoagulants (citrate and EDTA) can chelate zinc and transfer it from RBC to plasma artificially increasing it</p>

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			<p>Depressed immune function</p> <p>Fetal resorption and congenital malformations</p> <p>Dermatoses in northern dog breeds</p>		
Iron	<p>High: Organs, yeast, wheat germ, egg yolk, shellfish, dried beans/fruits</p> <p>Mod: Cereals, meat, fish, poultry, green veggies</p> <p>Low: Dairy and non-green veggies</p>	<p>Oxygen transport and storage</p> <p>Electron donor and acceptor</p> <p>Immune function</p> <p>Energy metabolism</p>	<p>Iron deficiency anemia in piglets</p> <p>Low growth rates Lethargy and pallor</p> <p>Edematous head and forequarters</p> <p>Dyspnea and predominant heart beats</p>	<p>Iron overload</p> <p>May be genetic or iatrogenic due to transfusions</p> <p>Hemosiderosis-increase iron deposits in tissues including liver</p>	<p>Evaluate RBC concentration and appearance, hemoglobin concentration to assess and classify anemia</p> <p>Total iron binding capacity</p> <p>Serum ferritin</p> <p>Serum iron measured directly</p>
Manganese	<p>Coffee, tea > nuts, cereals > vegetables > meat, dairy, poultry and fish</p>	<p>Enzyme activator and component of metalloenzymes</p>	<p>Neonatal ataxia</p> <p>Impaired growth and reproduction</p> <p>Skeletal abnormalities</p>	<p>Rare in occurrence</p> <p>*Joint supplement overdose in dogs</p>	<p>Liver Mn content Useful for deficiency but not toxicity</p> <p>Whole blood concentrations</p>

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			<ul style="list-style-type: none">*shortening and bowing of forelimbs*perosis or slipped tendon in birdsAltered lipid synthesisClotting abnormalities		<ul style="list-style-type: none">Can be elevated with dietHair concentrations are not helpful
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