



Mineral Antagonisms

of the Rocky Mountain Region

Minerals	Antagonists	Signs of Deficiency	Management Strategies
Calcium	Phosphorous Sulfur Magnesium Vitamin D ₃ Deficiency	Waterbelly (urolithiasis /urinary calculi / urinary struvite calculi), Rickets (weak/soft bones in young animals), Osteodystrophies (i.e. osteopenia, osteoporosis, osteomalacia; demineralization of structural bone in mature animals), and Hypocalcaemia (aka "milk fever" or "downers").	Evaluate total dietary calcium and insure total diet Calcium:Phosphorus ratio is 2:1 - 6:1, Ammonium Chloride (0.5% of total diet) to acidify the urine and break down urinary calculi stones, increased Vitamin D ₃ in the diet / increased exposure to sunlight, and access to salt.
Phosphorous	Calcium Imbalance Vitamin D ₃ Deficiency Phytate (organic sources of P)	Osteodystrophies (i.e. osteopenia, osteoporosis, osteomalacia; demineralization of structural bone in mature animals), impaired reproduction, reduced milk production and fragile bones, lameness, enlargement of upper and lower jaws (aka "big head disease"), and pica.	Evaluate total dietary Phosphorus, but insure total diet Calcium:Phosphorus ratio is 2:1 - 6:1, provide microbial phytase (enzyme) activity in the diet, provide additional inorganic phosphorus in the diet (more available than organic sources), increased Vitamin D ₃ in the diet / increased exposure to sunlight.
Magnesium	Potassium Excess Protein-nitrogen	Grass Tetany (anorexia, hyperexcitability, convulsions, respiratory distress, frothing at the mouth and excessive salivation), and calcification of soft tissue.	Provide elevated levels of Mg and Ca during high-risk times of the year when tetany is most likely to occur. Avoid heavily fertilized fields (where potash and nitrogen levels are high).
Salt (Sodium Chloride)	Potassium <i>Not provided!</i>	Pica (chewing or licking of wood, fencing, rocks, soil, urine, and bones), dehydration, reduced feed intake, impaired growth and milk production.	As a rule of thumb, the total diet of most animals should contain 0.4-1.0% Salt. Always provide free-choice access to plain white salt year-round.
Potassium	Sodium Stress	Reduced feed intake and weight gain, rough hair coat, muscular weakness, and cardiac arrhythmia.	Insure that animals under stress (i.e. heat, environmental, productive, etc.) receive adequate K ⁺ in their diet.
Sulfur	PROBLEMATIC ANTAGONIST!	Sulfur is in excess in most water and forages in the High Plains and Rocky Mountain Region and causes severe Cu, Zn, and Thiamin (B ₁) deficiencies.	Test water and forage sources for S concentration and manage it by limiting/eliminating "toxic" sources from the diet.
Copper & Zinc	Iron Sulfur Molybdenum Thiomolybdates (S + Mo) <i>Each other (Cu & Zn)!</i>	Infertility, impaired immune response, poor response to vaccination protocol, reduced growth and feed efficiency, swollen feet with scaly lesions, dermatitis (parakeratotic lesions) and discolored hair coat.	Test forages for Cu and Zn levels, plus antagonists. Liver biopsies may be necessary to access severity of Cu and Zn deficiency. Consider implementation of chelated/organic sources of Cu and Zn for improved absorption. Avoid supplements using Cu and Zn oxides, which is essentially unavailable. Avoid ferrous (iron) oxide supplementation in feed as it exacerbates Cu and Zn deficiency. Keep Zn and Cu in balance with each other (~3:1 ratio)!
Manganese	Iron Phytate (organic sources of P)	<i>Rarely a problem!</i> Mn is in excess in the forages in the High Plains and Rocky Mountain Region, therefore Mn deficiencies are extremely rare.	Test forage sources for Mn, typically Mn only requires modest supplementation or not supplemented at all in most diets in our region unless iron and phytate-phosphorus is extremely high.
Iron	PROBLEMATIC ANTAGONIST!	Iron is in excess in the forages in the High Plains and Rocky Mountain Region and causes severe Cu and Zn deficiencies.	Test water and forage sources for iron concentrations and provide aggressive supplementation of Cu and Zn.
Molybdenum	PROBLEMATIC ANTAGONIST!	Mo is in excess in the forages in the High Plains and Rocky Mountain Region and causes severe Cu and Zn deficiencies.	Test forage sources for Mo concentrations and provide aggressive supplementation of Cu and Zn.
Selenium	Sulfur Vitamin E Deficiency Alfalfa Hay	White Muscle Disease: paralysis and recumbency, weak pasterns, stiffness, and acute death (due to pneumonia or heart failure). Additionally, retained placentas, reproductive failure, and depressed immune response.	Often Selenium deficiency is exacerbated with Vitamin E deficiency, insure that both are adequately supplemented in diet. Provide organic sources of selenium for improved absorption. Be aware that Selenium can also be at TOXIC levels in our region, therefore testing forages is prudent.
Iodine	Cobalt (deficiency or excess) White Clover Kale, Turnips & Rapeseed	Hypothyroidism: goiter, hairless or stillborn calves, impaired reproduction in males and females (reduced egg production in hens), and retained placentas.	Increasing the iodine (from EDDI) is very affordable to supplement in the diet and should be done, it is also known to be effective against foot rot at aggressive levels.
Vitamin A	High Nitrates and Urea Oxidative stress: humidity, moisture/rain, heat, sunlight, rancid fat and trace minerals.	Corneal lesions (blindness), retained placentas, and unthriftiness.	Supplement additional Vitamin A in the diet, avoid weather-stressed forages that are deficient in Vitamin A, identify and reduce the intake of excess nitrate and/or urea in the diet. Provide access to green pasture or leafy green forages.
Vitamin E	Oxidative stress: humidity, moisture/rain, heat, sunlight, rancid fat and trace minerals.	White Muscle Disease: paralysis and recumbency, weak pasterns, stiffness, and acute death (due to pneumonia or heart failure). Additionally, depressed immune response.	Supplement additional Vitamin E (and selenium) and protect supplements by storing them in cool, dry, dark locations (keep out of direct sunlight and other elements). Provide access to green pasture or leafy green forages. Insure that supplements are not aged and expired (due to depletion of Vitamin E).
Thiamin B₁	Sulfur Selenium	Polio / Polioencephalomalacia / "brainards" (cerebrocortical necrosis): blindness, muscle tremors, recumbancy, and death.	Test water and forage sources for S content and limit sulfur-rich components in total diet. Aggressive thiamin (injectable or dietarily) may be necessary, copper and urea supplementation may also help with excess S.