

The Importance of Selenium in the Equine Diet

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Selenium is an essential trace mineral and antioxidant that is incorporated into many important enzymes, including glutathione peroxidase. While some areas of the United States have soil that is rich in selenium, many other areas have selenium deficient soil. Consequently, forages harvested from selenium deficient areas will result in selenium deficiency in horses that consume them. Maintaining equine health and optimal antioxidant function requires adequate dietary intake of selenium.

Selenium and Its Functions

As an essential trace mineral for mammals, selenium is required for the synthesis of a variety of selenoenzymes. The most well known selenoenzyme is glutathione peroxidase, which is present in cells where it destroys the hydroperoxides that cause oxidative damage to the cell. At least 6 different glutathione peroxidases have been identified. Although glutathione peroxidase activity decreases in animals that are selenium deficient, this activity can be restored to normal levels when selenium is supplemented in the diet. Selenium also functions in a deiodinating enzyme that produces most of the T3 in the body.

Because selenium and vitamin E work together to provide antioxidant support at the cellular level, selenium requirements can be reduced when the intake of vitamin E is adequate. Similarly, adequate dietary intake of selenium can reduce the severity of clinical signs of vitamin E deficiency. Glutathione peroxidase is required for the conversion of lipid hydroperoxides to hydroxyl acids to prevent the production of free radicals that could cause additional oxidative damage. Vitamin C, another antioxidant, is also involved in the regeneration of reduced vitamin E that then scavenges cellular free radicals.¹

Selenium in the Equine Ration

Selenium Deficiency

Acidic and volcanic soils, especially those in the northeastern and northwestern regions of the United

States, often yield selenium deficient forages.

Consequently, horses that graze selenium deficient pasture grass or consume forages grown in these areas can become deficient in selenium if adequate selenium is not supplemented in the ration. Horses that are deficient in selenium often have muscle weakness and altered movement, and selenium deficient foals may have a weak suckle response, and dysphagia due to impaired swallowing.² Respiratory and cardiac function can also be compromised in animals with selenium deficiency.²

Selenium Toxicity

Plants that accumulate high concentrations of selenium exist in regions of the central United States that have alkaline soil, and in areas with low rainfall.³ Selenium toxicity can occur when these plants are consumed, when palatable weeds and forages are grown on soils that contain a high concentration of selenium, or when there is an excessive intake of selenium from commercial feeds and supplements. Acute selenium toxicity damages many organs, and may result in respiratory failure before other clinical signs (abdominal pain, diarrhea, weakness, increased heart rate) are observed.³⁻⁴ Chronic selenium toxicity occurs more commonly than acute toxicity. Affected horses have an unthrifty appearance with broken mane and tail hairs, may be stiff and lame, and may have cracked hooves that slough in severe cases. To prevent excess selenium supplementation, the selenium content of all feeds and supplements in a horse's ration should be evaluated by a veterinarian.

Selenium Status

The best way to determine the selenium status of a horse is to measure the concentration of selenium in whole blood and/or glutathione peroxidase activity, and then compare the observed values against normal reference ranges for the laboratory. Blood selenium concentrations should be monitored when a horse is placed on a selenium supplementation program to ensure that the program is both adequate and safe. When the selenium status of a horse is compared to the dietary intake of selenium, deficiencies and toxicities can be easily identified. If either a selenium deficiency or toxicity is identified on a blood test, all dietary sources of selenium should be evaluated, including the selenium concentration of the horse's pasture grass or hay.

Guidelines for Dietary Selenium Intake

The maximum tolerable concentration of selenium in an equine ration is 2 mg selenium/kg of dietary dry matter.² If this guideline is followed, a 1000 pound horse consuming 2% of its body weight (20 pounds or 9.1 kg) in feed should not consume more than 18.2 mg of selenium daily. The daily selenium requirement of a 1000 pound adult horse at a physiologic state of maintenance is much lower at only 0.91 mg of selenium. The results of one study suggest that a slight increase in selenium intake may be beneficial as evidenced by a more robust immune response to influenza vaccination by the foals of mares consuming 3 mg selenium/day when compared to mares consuming 1 mg selenium/day.⁵ The daily selenium requirement changes slightly with the physiologic state of the horse; reference values for selenium intake at different life stages and different levels of exercise intensity are available from the Nutrient Requirements of Horses publication (<http://nrc88.nas.edu/nrh/>).

Both inorganic selenium and organic selenium (as selenium yeast) can be used to supplement selenium in the equine diet. In horses the bioavailability of

selenium yeast appears to be higher than inorganic forms of selenium.⁵⁻⁶ Inorganic selenium is usually provided as sodium selenite and sodium selenate. Organic selenium is supplemented using selenium yeast that has been cultured in a selenium-rich medium and provides selenium as selenomethionine and selenocysteine. Horses supplemented with selenium yeast had higher concentrations of both plasma and red blood cell selenium and a higher expression of IL-5 from lymphocytes compared with horses that were supplemented with sodium selenite.⁷

A commercial vitamin, trace mineral, omega-3 and antioxidant supplement* provides 0.8 mg selenium as selenium yeast when fed at a dose of 132 grams (2 scoops) daily. Horses that require additional supplementation can be fed a highly bioavailable commercial selenium yeast** that provides 2 mg selenium per scoop, or a commercial antioxidant supplement*** that provides 1.5 mg selenium (as selenium yeast), 1,500 IU of vitamin E and 3,700 mg of vitamin C per 8.5 gram scoop.

Literature Cited

1. Sunde R. Selenium. In, Stipanuk MH: Biochemical and Physiological Aspects of Human Nutrition. Philadelphia, W.B. Saunders Company 2000, pp. 782-809.
2. Minerals. In, National Research Council Nutrient Requirements of Horses, 6th ed. Washington (DC), National Academies Press 2007, pp. 69-108.
3. Knight A. Plant Poisoning of Horses, In, Lewis LD: Equine Clinical Nutrition: Feeding and Care. Media, Williams & Wilkins 1995, pp. 447-502.
4. Valberg S. Diseases of Muscle. In, Smith BP: Large Animal Internal Medicine, 5th ed. St. Louis, Mosby Elsevier 2015, pp. 1276-1308.
5. Janicki K, Lawrence L, Barnes T, et al. The effect of dietary selenium source and level on selenium concentration, glutathione peroxidase activity, and influenza titers in broodmares and their foals. Proc. 17th Eq Nutr Physiol Soc Symp, Lexington, KY, 2001, pp. 43-44.
6. Pagan J, Karnezos P, Kennedy M, et al. Effect of selenium source on selenium digestibility and retention in exercised Thoroughbreds. Proc. 16th Eq Nutr Physiol Soc Symp, Raleigh, NC, 1999, pp. 135-140.
7. Montgomery JB, Wichtel JJ, Wichtel MG et al. Effects of selenium source on measures of selenium status and immune function in horses. Can J Vet Res, 2012;76(4):281-91.

* Platinum Performance® Equine Wellness and Performance Formula

** Platinum Selenium Yeast

*** Platinum Antioxidant



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