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EXTENSION

Vitamin and Mineral Nutrition of the Horse

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Horse Program

Providing research-based information to Minnesota Horse Owners

Minerals are inorganic nutrients that are needed in relatively small quantities by the horse. The essential major minerals are calcium, phosphorus, magnesium, sodium, chloride, potassium and sulfur. The essential trace minerals needed are iron, zinc, copper, selenium, manganese, iodine, and cobalt.

A horse's mineral requirements will vary based on its body weight, age, physiological condition (e.g., pregnant, lactating …) and activity level. For example, late gestation and lactating mares as well as young, rapidly growing horses have a proportionally greater requirement for some specific minerals e.g., calcium, phosphorus, copper, and zinc, than do other horses. The National Research Council (NRC) 2007 publication entitled, *Nutrient Requirement of Horses* (http://www.nap.edu/catalog.php?record_id=11653) lists daily mineral requirement as well as the mineral content of common feedstuffs. The mineral content of most grains and supplements are consistent enough that you can use values in the NRC tables; however, the quantity of minerals in forages can vary significantly with soil mineral content, plant species, stage of maturity at harvest, harvest conditions etc. Consequently, forages should be sent to a laboratory for mineral analysis.

Providing minerals at less than the recommended quantities can result in a dietary deficiency whereas providing minerals in excessive quantities can result in toxicity. In addition to the amount of mineral required daily, the ratios of minerals with each other and with other components of the ration are important due to effects on absorption, metabolism and/or excretion. In particular, a critical consideration in mineral nutrition of the horse is the calcium to phosphorus (Ca:P) ratio. The Ca:P ratio should be about 2:1 with twice as much Ca as P; with acceptable ratios ranging from 1.5 to 3:1 in the young growing horse and 1:1 to 6:1 in the mature horse, assuming that adequate levels of P are provided. A ratio less than 1:1 where the P content actually exceeds that of the Ca content, even if the absolute amounts of Ca and P are adequate, will result in interference of the bioavailability of Ca which can cause orthopedic or bone disorders, especially in young, rapidly growing horses. The Ca and P content in forages can be quite variable, with legumes typically having higher Ca concentrations than grasses whereas grains are usually high in P and low in Ca. Consequently, it is important to know the Ca and P content of all feedstuffs to ensure that the appropriate Ca:P ratio is achieved. High quality forages are typically adequate in Mg, K and S. The Na and Cl requirements are met by providing salt. However, a performance horse that sweats a great deal may require K, Na and Cl supplementation to replace excess mineral loss via the sweat.

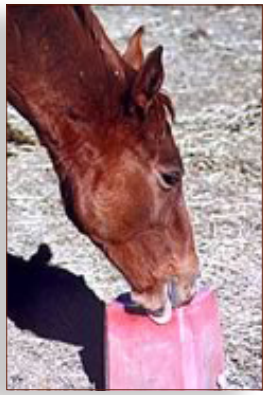

Figure 1. Mineral block

Although the quantity of trace minerals required for normal growth, development and metabolism is very small, they are all absolutely essential. Trace mineral content of feedstuffs is quite variable and needs to be determined via laboratory analysis for an accurate assessment if you intend to formulate a ration from common feedstuffs alone. Moreover, there are interactions between many of the trace minerals which can affect their absorption and post-absorption utilization. For example, very high levels of zinc can interfere with copper utilization, even though copper requirements have been met. Another trace mineral, selenium (Se) has a fairly narrow range of daily intake which satisfies the horse's Se requirement before being so high as to be toxic. Consequently it is advisable to be aware of the horse's trace mineral requirements and meet them without excessive over or under feeding in order to minimize potential adverse interactions.

Because it can be complicated and/or difficult to formulate a ration using only common feedstuffs to meet all of a horse's mineral requirements, supplementation of minerals may be the most practical solution. The safety margin for most trace minerals is fairly wide which allows you to use a mineral supplement in addition to traditional feedstuffs without risk of exceeding the maximum tolerance levels. Providing mineral supplementation can be accomplished in a number of different ways. You can use:

1. Trace mineral salt, either in block or loose form containing Na, Cl and trace minerals but no Ca or P. This approach assumes that the Ca and P levels as well as the Ca:P ratio provided in the rest of the ration are appropriate. Care should be exercised when selecting trace mineral salt in either the block or loose form since the compositions of different trace minerals mixes can vary significantly, especially for different species. If providing free choice trace mineral salt, no other source of salt should be available to the horse. The goal is to encourage free choice consumption of trace minerals to ensure requirements are met. The use of a loose form of trace mineral mix results in an approximately 15%

greater consumption. Placing the mineral supplement holder in areas where horses congregate, as well the addition of flavorings, such as dried molasses to the mineral mix can also increase voluntary mineral intake. The mineral mix should be kept fresh, since high humidity in the summers can cause clumping which reduces consumption. The expectation is that horses will consume about 1.5 - 2 oz/horse/day. If the horse is not eating the supplement at expected rates, do not assume it doesn't need the minerals, rather attempt to relocate the mineral mix holder and try different additives to encourage consumption. This approach to supplementation of minerals is the least dependable since different horses will consume different amounts and it is very difficult to be sure that each horse is getting the minerals it needs.

2. Commercial complete mineral supplements containing major minerals such as Ca, P, Na, Cl, trace minerals etc. The mineral supplement should be chosen to compliment the mineral content of the remainder of the ration e.g., type of forage and concentrate if any. The complete mineral supplement is fed daily at the recommended rate to each individual horse. This method ensures that each horse consumes the appropriate amount of mineral. When using a complete mineral supplement horses should also have access to a white salt block that does not contain trace minerals.
3. Commercial grain mix which contains major and trace minerals. If fed at the manufacturer's recommended rate, this method ensures that each horse consumes the appropriate amount of mineral. If however, the grain mix was formulated to be fed at 6 pounds / day, but was fed at a lot more or a lot less, the result would be either over or under feeding minerals, respectively. It is also important that you not top dress a commercially prepared grain mix, which has already been balanced for mineral content with another feedstuff (oats, wheat bran etc.) without carefully factoring in the impact of the mineral contribution it makes. When using a commercial grain mix, horses should also have access to a white salt block that does not contain trace minerals.

The minerals used in supplements will differ in chemical form, concentration and bioavailability. They are usually available either as salts or in a complex with an organic compound e.g., protein. Studies in horses, comparing the use of trace mineral salts to trace minerals complexed to proteins have not shown overall, that either form is better than the other.

Vitamins are organic compounds that are needed in even smaller quantities than minerals by the horse, although no less critical. Vitamins can be divided into two groups, the fat soluble vitamins A, D, E and K and the water soluble C and B – complex vitamins. The National Research Council (NRC) 2007 publication entitled, *Nutrient Requirement of Horses* (http://www.nap.edu/catalog.php?record_id=11653) lists estimates of the daily requirements for vitamins A, D, E, and the B-vitamins thiamin and riboflavin. Requirement estimates in the NRC for different vitamins are based on a variety of criteria with the intent of preventing dietary deficiencies, maximizing tissue stores and optimizing specific biological functions. Since vitamins play a number of very diverse and interactive roles in normal metabolism, supplementation of vitamins at levels greater than those estimated in the NRC may prove to be advantageous in certain circumstances.

Vitamin A (or its precursor beta-carotene) and vitamin E are present in high concentrations in fresh green forages or newly harvested hay. Consequently, a horse grazing pasture will meet its vitamin A and E requirements. However, during the winter, when hay is stored, the levels of vitamins A and E in hay drop significantly, necessitating supplementation to meet requirements. Vitamin supplements differ in chemical form as well as activity and stability. Commercial vitamin/mineral supplement combinations are readily available, as well as commercial grain mixes which contain the necessary vitamins. Feeding such sources, even when the horse is on pasture when vitamin A and E requirements have been met, does not present a problem. Sun-cured forages contain vitamin D. The vitamin D requirement is also met if the horse is exposed to sunlight for four to six hours a day because the ultraviolet rays of the sun will convert a precursor present in the skin to vitamin D. Specific daily requirements for vitamins K, C and B-complex are not delineated in the NRC, because they are usually available in sufficient quantities from a combination of common feedstuffs, microbial synthesis in the horse's gastrointestinal tract and production by the horse's liver. Consequently they do not generally need to be supplemented.

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