

## **MY HORSE NEEDS MINERALS BUT WHICH ONES?**

**Dr. Bob Coleman, Ph.D. PAS**

University of Kentucky

Meeting the mineral requirements of your horses is challenging. Which minerals does your horse require and how much of each is necessary? The Nutrient Requirements of Horses 5<sup>th</sup> edition, published in 1989, is used as a guideline. This publication provides information on mineral requirements that meet the minimum needs of horses at different physiological stages. While optimum levels in feeding programs may exist, these levels are not well defined for the horse. The goal in developing feeding programs for your horses is to provide mineral intakes that meet or slightly exceed the NRC 1989 guidelines. Feeding excessive amounts of supplemental minerals will not enhance the health or performance your of horses and quite possibly could have detrimental effects on their health.

Lewis (1995) discusses 14 minerals that horse owners need to consider when feeding their horses. These minerals are grouped by major or macro minerals which include calcium (Ca), phosphorus (P), sodium (Na), chloride (CL), potassium (K), magnesium (Mg), and sulfur (S). These minerals are needed for maintenance of skeletal structure, acid base and fluid balance, nerve conduction and muscle contraction. In the diet, these minerals are required in larger amounts expressed in grams per day or parts per hundred (percent).

The second group is the trace or micro mineral group. This group is made up of copper (Cu), zinc (Zn), manganese (Mn), iron (Fe), iodine (I), cobalt (Co), and selenium (Se). These minerals are required in small amounts each day and are measured in parts per million (ppm) or milligrams per kilogram (mg/kg). (Note: a ppm = mg/kg) These minerals are involved in enzyme activities, vitamin synthesis, and many other biological reactions in the body.

In addition to these 14 minerals, there are others that have been reported to be needed in diets of various animals under laboratory conditions, but no requirement for the horse has been determined so the discussion will focus on the 14 minerals previously mentioned. While providing supplemental minerals to meet the horse requirements, it is important to remember that the forages and grains you feed can provide a significant percentage of your horse's requirements. Making good use of the base feeds in your area, and knowing the mineral levels in your feeds will help in providing diets that meet requirements with minimal supplementation.

When thinking about minerals, Ca and P are two that come to mind first. Both minerals are involved in the skeletal structure of the horse. Optimum intakes of both Ca and P are required to maintain bone density and other roles in maintaining the health of your horses. Because the ratio of Ca:P in bone is approximately 2:1, horse owners are concerned about providing this ratio in all feeds and feeding programs. NRC 1989 indicates that a Ca:P ratio of 1:1 is the minimum required, while in the diets of young horse's a Ca:P ratio up to 3:1 is fine, and a ratio of up to 6:1 for mature horses can be tolerated. In any case, it is important that the P intakes must meet the horses requirements when these higher calcium intakes are fed. Adding P to change the ratio to 2:1 may require a great deal of P and the excess P may interfere with other minerals in the diet. In addition, many P supplements are not palatable and you may find your horses refusing to eat any of the mineral supplement. Ca & P requirements for the different classes of horse are found in Table 1.

Sodium and chloride are important in acid base and fluid balance. In the case of Na, horses do have some degree of nutritional wisdom in they will seek out a source of Na. Lack of Na in their diet will result in a decrease intake of both feed and water. The performance horse not receiving enough salt will decrease sweat production and subsequently performance will suffer. While horses need salt and will readily consume it, knowing how much may be a problem for some horses. Horses that consume excessive amounts of salt may show signs of colic and suffer from diarrhea especially if adequate water is not available. The horse's chlorine needs are met when salt is consumed so this mineral requirement is easily met. When providing free choice salt, you can expect a wide range of intakes. Cornell researchers reported an average intake of 53 grams per day by mature horses with a range of 9 to 143 grams from a salt block.

The other mineral concerned with acid base balance is potassium (K). It works in combination with Na to maintain cellular balance. A deficiency of K may be caused by a low forage intake or excessive sweating. The low K can result in fatigue, And reduced feed and water intakes. Providing a reasonable daily intake of forage should meet your horses K requirements. If you have a performance horse, you could use a mixture of lite salt (KCL) plus table salt to ensure adequate intakes of Na, K, and Cl to replace what has been lost in sweat.

Magnesium is involved in enzymatic processes in the horse. In addition, it is found in the skeleton, but its role there is not well defined. Horses maintained on reasonable amounts of forage do not seem to need added Mg in their diets. Mg requirements are listed in Table 1.

Trace minerals have received a great deal of attention recently. In the early 1970's, routine feed analysis conducted by feed testing labs in Manitoba, Saskatchewan, and Alberta indicated that locally grown forages were deficient in Cu, Zn, Mn, and Se. This information provided a basis for changes in routine supplementation practices to ensure adequate intakes of these minerals. Table 2 has levels of trace minerals commonly found in Alberta forages. Copper has received a great deal of attention from horse breeders. In the late 1980's, researchers in Ohio reported that farms which fed higher levels of Cu had a lower incidence of developmental orthopedic disease (DOD) in young horses. Since then, Cu has been added at levels ranging from 15 mg/kg to 60 mg/kg in commercial feeds for horses. Because DOD is a multi factorial problem, this broad based copper supplementation program has not cured DOD but in some cases may have reduced the incidence. More recently, researchers in New Zealand looked at supplementation of the pregnant mare. In that study, mares received 28 mg/kg of Cu 13-25 weeks prior to foaling. Foals from the supplemented and unsupplemented mares were also treated with added copper for 150 days post foaling. This research reported that providing mares Cu at 28 mg/kg during gestation reduced the incidence of articular lesions. Supplementing the mares was effective whereas supplementing foals was not. Due to the low Cu levels in Western Canadian feeds, horse owners should consider supplementing Cu at the 25-28 mg/kg level throughout gestation.

Zinc is also low in Western feeds. Levels of Zn in local forages are 50% below requirements. As with Cu, reduced Zn intakes have been associated with DOD in young growing horses (Table 1 gives trace mineral levels for horse diets).

Manganese has also been reported in other species (not the horse) to affect normal limb development. Reports with calves have suggested that Mn deficient diets may cause limb abnormalities. Because of this, most trace mineral supplements for all classes of livestock contain additional Mn. It is noteworthy that grass forages will generally have higher levels of Mn than legume forages.

Selenium is the last trace mineral of concern. When first identified, Se was noted as a toxic compound and not a required mineral. Excessive intakes of Se caused horses to lose mane and tail hair, become unthrifty, lame and slough hooves. While horse owners need to be concerned over its toxic affects, Se requirements for good health must be met. The mineral is involved in the enzyme Glutathione Peroxidase (GSH-Px). This enzyme is involved in membrane integrity and the protection of cells from freed radicals that are produced during exercise. The antioxidant capability has been reported in performance horses. While NRC 1989 suggests a requirement of 0.1 ppm, equine nutritionists using current research information will use levels up to 0.3 ppm for

the performance horse. In addition, Se have been shown to have a positive effect on the immune function in the horse. Research in Kentucky reported that foals from mares fed diets with 0.3 ppm Se had higher IgG levels than foals from mares fed 0.1 ppm. When supplementing diets with Se, to meet requirements is also important to ensure you are not over supplementing. This can happen if you are using a number of fortified feeds that all contain Se. Use of multiple supplements can easily lead to over supplementation.

Other trace minerals that are provided in typical diets are cobalt and iodine. Co is important for the synthesis of vitamin B<sub>12</sub> by the horse. However, no known deficiency has ever been reported in the horse even when grazing Co deficient pastures. In addition, there have been no reports of excess Co intakes. Iodine, which is involved in the synthesis of thyroid hormones, must be supplemented because all Western Canadian feeds are deficient. Using iodized salt will generally meet requirements assuming a reasonable daily intake of salt. There is a potential for excess I intake to occur when supplements based on kelp meal are fed. If a high I product is used, feed according to label directions and as with Se, make sure you are not over supplementing by adding to many supplements to your feeding program.

Fourteen minerals of concern, but providing them does not need to be difficult. For the macro and trace minerals, a certain percentage of the horses needs will be provided in the basic feeds offered each day. Using a quality forage will supply Ca, some P, K, Mg, S plus some of the trace minerals. Where the forage was grown will have an impact on the levels of some minerals in the forage. For example, if your hay was grown on grey wooded soils, you can expect a low P level. It is not uncommon for P levels in these forages to be 0.10% or lower, while in general, you would expect a level of 0.2% or slightly higher. Calcium in legumes such as alfalfa can be 1.5 - to over 2.0%, while in grass forages 0.4-0.65 is reasonable. Having your forages tested is the only way to know. It is common knowledge that the levels of Ca and Zn will be below requirements in Western Canadian forages. The level of Se can also be affected by where the feed was grown. Se levels need to be checked to be sure, as this mineral can be highly variable in forages depending on the location the feed is grown and growing conditions for that year.

Grains such as oats, barley will provide some P in the diet but little or no Ca. Adding oats to balance the Ca:P in your horses diet is not practical. While oats are an excellent source of digestible energy, there are other better sources of minerals, especially P.

Commercial horse feeds are good sources of minerals because you know what you are getting. The Ca, P and Se will be on the feed tag and you can ask your supplier for information on the other minerals if they are not reported on the tag.

For many horses, meeting their Na, Cl and I needs is as simple as providing a source of salt free choice. In fact, all horses should have salt available, free choice. This practice should be done regardless of what other feeds you are providing. Horses generally do not over eat salt, so unless you have a horse that needs a Na controlled diet, you will be okay. You can select a salt with Co, I, Cu, Zn, Mn, and Se. Read the label to see what levels are there to make sure you are getting what your horse's need. If the salt has trace minerals included, it will be called trace mineralized salt but will not contain any Ca or P.

Other methods of supplying minerals are through mineral supplements. These come with differing Ca, P levels and contain trace minerals and salt (see Table 3 for ranges of minerals in these products). Selecting the most appropriate product will be based on the forage you are using. However, for most feeding programs, P will be a limiting mineral in your program, so select a product that has a reasonably high P content. Remember the Ca:P ratio is for the total diet, so selecting a mineral with equal parts Ca and P is ok especially if you have alfalfa in your forage and to ensure you are meeting the horse's P requirements.

Free choice minerals, how much will your horse eat? Supplying free choice minerals for voluntary consumption has been a practice with livestock feeders for years. Horse owners, have provided salt on a free choice basis as a common practice, but the other minerals have not been routinely fed in such a fashion. This free choice consumption is designed to supply that little extra towards optimum intakes and cover off any possible deficiencies individual horses may have.

The actual free choice intake of the mineral supplement will depend on a number of factors. Some factors that affect voluntary consumption are: the forms of the product, loose or block, where you place it and certainly the taste. Research with cattle indicates that free choice consumption of a mineral block product is about 15% lower than the same mineral in the loose form. In horses, salt consumption was higher for horses fed a loose salt vs. block salt. It is reasonable to expect a slightly reduced intake of a mineral block vs. a loose mineral product. One possible exception is a soft mineral block which may be consumed in much larger amounts. If consumption of the salt or mineral is a concern, consider using a loose mineral or salt product.

Where you place the mineral is also important. You need to have the mineral in a location where the horses spend time. With cattle, putting the salt and mineral near the water may ensure adequate intakes. With horses, this does not always work. In a trial conducted by the Horse Industry Branch, it was noted that placing the mineral supplement in areas where horses congregated for much of the day (to avoid heat or flies) resulted in greater intakes of the mineral.

Placing the mineral close to the water source resulted in intakes that were almost zero.

In addition to where you placed the mineral, adding something to enhance the flavor may stimulate intake. The addition of 20% salt caused an increase in daily intake as did adding 20% dried molasses. These additions, plus location of the mineral, resulted in an average daily intake of 50 grams of mineral per horse. When plain mineral was fed, intakes were below the level required to meet the horse's mineral needs.

Placing the mineral loose or block in a suitable feeder is also necessary. While some horses are reluctant to put their heads into a closed feeder the mineral and salt needs to be kept off the ground. Placing mineral or salt blocks directly on the ground results in a great deal of waste. In a trial at the University of Kentucky, mineral blocks were used for mature horses on pasture. Disappearance of the mineral ranged from 12 grams per horse per day to over 300 grams per day. This disappearance was not actual mineral consumption, as the horses were constantly dumping the block out of the holder. Even if they had consumed the 300 grams per day, it was not due to need, but because they liked the taste.

While there are many minerals to provide, making wise use of feeds available, careful supplementation selection and good management to prevent over or under consumption meeting the mineral needs of your horses can be easily accomplished. You need to read the feed tag so see what the product contains, and monitor intakes to see how much is being consumed. Remember, if the horses are not eating it, don't assume they don't need the supplementation. Horses are horses, not nutritionists, and expecting them to select and consume the correct amount of mineral is expecting to much.

### **Strategies for Feeding Minerals Free Choice**

- 1) Use a loose mineral to help increase consumption and to give you flexibility in your feeding program.
- 2) Place the mineral in a suitable feeder where horses congregate.
- 3) Consider adding salt or another product to enhance taste (if salt is added mix should be used as the only source of salt for the horses).
- 4) Keep mineral fresh.
- 5) Plan for intakes of 45-60 grams per horse per day.
- 6) Put out enough mineral for 4 days.
- 7) Be observant to see where you need to place the mineral.
- 8) Be flexible and try different additives to see what your horses will eat.
- 9) Keep track of how much mineral is being consumed.

**Table 1. Mineral Concentrations in Total Diets for Horses (dry matter basis)**

<b>Class of Horse</b>	<b>Ca %</b>	<b>P %</b>	<b>K %</b>	<b>Mg %</b>
Maintenance	0.24	.17	.30	.09
Pregnant Mares				
9 <sup>th</sup> Month Gestation	.43	.32	.35	.10
11 <sup>th</sup> Month Gestation	.45	.34	.38	.11
Lactating Mares				
First 3 months	.52	.34	.42	.10
Growing Horses				
6 month Weanling Moderate Growth	.56	.31	.30	.08
12 month Yearling Moderate Growth	.43	.24	.30	.08
Working Horses				
Light Work	.30	.22	.37	.11
Moderate Work	.31	.23	.39	.12
Intense Work	.35	.25	.43	.13

**Other Minerals**

	<b>Maintenance</b>	<b>Pregnant &amp; Lactating Mares</b>	<b>Growing Horses</b>	<b>Performance</b>	<b>Max. Tolerance Limits</b>
Sodium %	.1	.1	.1	.3	3
Sulfur %	.15	.15	.15	.15	1.25
Iron mg/kg	40	50	50	40	1000
Copper mg/kg	10	10	10	10	800
Zinc mg/kg	40	40	40	40	500
Manganese mg/kg	40	40	40	40	1000
Selenium mg/kg	.1	.1	.1	.1	2
Iodine mg/kg	.1 - .6	.1 - .6	.1 - .6	.1 - .6	5
Cobalt mg/kg	.1	.1	.1	.1	10

Adapted from NRC 1989

**Table 2. Mineral Analysis of Forages in Alberta\***

Hay Type	Ca %	P %	K %	Mg %	Ca ppm	Zn ppm	Mn ppm	Se ppm
Alfalfa	1.76	0.22	1.82	0.31	6	25	40	0.28
Alfalfa Grass	1.58	0.18	1.35	0.24	6	23	48	0.35
Timothy	0.50	0.14	1.20	0.12	4	21	48	0.11
Native Hay	0.46	0.13	0.98	0.13	5	20	55	0.13
Oat Hay	0.37	0.21	1.74	0.20	5	23	54	0.15
Oats	0.09	0.35	0.45	0.14	4	33	45	0.10

\* Values reported on a 100% dry basis.

Values reported are averages of feeds analyzed by AAFRD Soil and Feed Testing Laboratory, Edmonton Alberta. 1967-1994.

**Table 3. Trace Mineral Levels in Common Mineral and Trace Mineral Salt Products**

Product	Ca %	P %	Cu ppm	Zn ppm	Mn ppm	Se ppm
1:1 Mineral	10-18	10-18	2000-3500	7500-10,000	2000-4000	0-90
2:1 Mineral	12-24	6-12	2000-3500	7500-10,000	2000-4000	0-90
Trace Mineral Salt*	–	–	2000-3500	7500-10,000	2000-4000	0-90

\*Trace Mineral Salt does not contain Ca or P, but does have I and may also have Co

*But does contain I ...*



## **Additional Reading**

Nutrient Requirements of Horses. 1985. National Academy Press, Washington D. C.

Lon D. Lewis - Feeding and Care of the Horse. 1995. William & Wilkins.

E. A. OH - Minerals in Basic Equine Nutrition and it Psychological Functions. 1997. Purina Mills, Inc. and American Association of Equine Practitioners.

Pearse, S. G., E. C. Firth, N. D. Grace, & P. F. Fennessey. 1998. Effect of Copper supplementation on the evidence of developmental of orthopedic disease in pasture-fed New Zealand Thoroughbreds. Equine Veterinary Journal 30(3) 211-218.

