



Proper Calcium Levels Are Essential



How Important Is Calcium For Hoof Health?

By Bryan Waldridge, DVM

Calcium is required in the diets of all horses for optimal health and well-being. Considered a macromineral, it is needed in a relatively large amount, especially when compared to trace minerals.

Though calcium is aligned most often with musculoskeletal strength and soundness, as well as nerve conductivity, its importance in hoof health is unquestionable. However, a severe calcium deficiency in the diet is likely to have deleterious effects on other body systems before a significant collapse in hoof health occurs.

The provision of a well-balanced diet will ensure that calcium levels are appropriate for the type of horse being fed. A qualified equine nutritionist can determine if a horse is being offered a suitable diet for its age and use. Most

horses given a balanced diet will not have hoof problems due to poor nutrition. This is particularly true of young horses and those not engaged in demanding work.

Many Related Factors

In the hoof, calcium is present in minuscule amounts, approximately 300 to 350 mg/kg of hoof wall. One of calcium's primary roles is assisting in the creation of sulfur cross-links between hoof proteins that allow for cohesion among cells. The stronger the cohesion, the more healthy and impenetrable is the hoof.

The amount of calcium in the hoof is dependent on numerous factors, according to a study conducted in Virginia (Ley et al., 1998). In one trial, 30 mature Thoroughbred mares were fed one of three diets, with 10 mares relegated to each diet. The three diets were significantly different:

- ➔ An all-forage diet, in which the mares had access to pasture.
- ➔ A drylot diet, in which the mares had free-choice access to barn-stored, 1-year-old cured hay.
- ➔ Forage and concentrate, in which pasture feeding was supplemented with vitamins and minerals to meet National Research Council recommendations for mature horses.

The 30 mares were allowed access to a mineralized salt block at all times and were fed their respective diets for at least one year before the study began.

After hoof tissue collection and testing, the researchers concluded that hoof wall characteristics, including calcium content, were influenced by season and

nutritional management. The average amount of calcium found in hooves ranged from 906 ppm (October, 1993) for mares on the drylot diet to 1,404 ppm (October, 1993) for mares on the all-forage diet.

This study confirmed the notion that different nutritional and management regimes influence hoof composition, and changes in composition are commonplace between seasons and years.

Brittle Hooves Vs. Calcium

Other observations, recorded in the mid-1980s by Kempson (1987), illustrate the importance of adequate calcium

Incomplete keratinization leaves hooves susceptible to damage...

in the diet for hoof health. Researchers gathered 33 hoof samples from horses with brittle hooves. To qualify for review, horses had to be diagnosed with loss of tubular structure in the stratum medium and the stratum internum, as determined by scanning electron microscopy.

The hoof wall is composed of three layers: the outermost stratum externum, the intermediate stratum medium and the innermost stratum internum.

Of the 33 hoof samples, 31 showed the requisite compromise between the stratum medium and stratum internum layers. Extreme cases also showed a loss of integrity to the stratum externum.

Twenty of the horses from which hoof clippings were taken failed to show any improvement when biotin was added to the basal diet of oats or bran plus chaff or grass hay. However, when diets were upgraded through the addition of

Three Layers Of Hoof Wall

- 1 The stratum externum is the outermost layer. The primary functions involve moisture equilibrium and structural support.
- 2 The intermediate layer is the stratum medium. It is involved in shock dispersion and circulation.
- 3 The innermost layer is the stratum internum. It provides the anatomical features, specifically the laminae, by which the coffin bone is anchored to the hoof capsule.

alfalfa and protein along with increased calcium levels, the majority of horses responded with enhanced hoof health. Certain horses were also diagnosed with a bacterial infection of their hooves, which was cleared through the use of topical metronidazole.

Was the hoof improvement caused by a boost in protein and amino acid intake or because of an increase in calcium consumption? Or through eradication of the bacterial infection?

The exact reason for improvement cannot be determined from this study. If calcium levels in the diet are too low for optimal health, supplying extra calcium may positively impact overall well-being, specifically hoof and bone quality.

This study reinforces the notion that properly nourished horses rarely have hoof problems. Yes, there are exceptions, but most horses can maintain reasonably healthy hooves with appropriate diet and regular hoof care.

Varying Results

A similar study with two horses showed parallel results (Kempson, 1987). A Thoroughbred mare and a Thoroughbred-Connemara gelding had myriad hoof problems, culminating in a propensity to lose shoes. The mare's hooves improved with biotin supplementation, but the gelding's hooves did not, even after 6 months of biotin supplementation at 20 mg/day. Hoof clippings from the gelding were examined microscopically at that time, and there was a complete loss of cohesion between the stratum medium and stratum internum.

Calcium supplementation was then commenced in the form of 7.5 g/day of limestone. After 9 months of biotin and calcium supplementation, the stratum medium had regained its structural rigidity. The horse showed a reduction in the tenderness of his hooves and had fewer lost shoes. Upon evaluation of the entire diet, hoof health was hastened further with an increase in protein levels.

Cattle Vs. Horses?

Looking at research performed in other animal species often provides insight about horses. A German study


(Mülling et al., 1999) set out to investigate the relationship of single structures during keratinization of bovine hoof epidermis to specific nutritional factors such as lipids, minerals and vitamins.

Keratinization is the conversion of squamous epithelial cells into keratin, the predominant protein in hooves. According to the researchers, calcium was essential for the activation of certain enzymes that are required for normal keratinization. Under normal circumstances, keratinization creates resilient connections between the three layers of the hoof wall. Abnormal or incomplete keratinization leaves hooves susceptible to damage.

Changes in the plasma level of calcium can influence the differentiation of epidermal cells in hooves, which in turn impacts keratinization. The researchers noted that peripartum heifers and cows experience a decrease in plasma calcium level, especially at the onset of lactation, which impacts differentiating epidermal cells. This may account for the distinctive horn rings that are often associated with pregnancy in cattle. Although this work was done on cattle hooves, the importance of calcium could be extrapolated for equine hooves.

Without calcium, horses are incapable of achieving optimal growth, performance or health. A sustained lack of calcium would almost assuredly affect hoof health. Therefore, providing a well-balanced diet to horses, with a keen eye on macromineral and micromineral balance is the first step in the maintenance of healthy hooves.

References

1. Kempson, S.A. 1987. Scanning electron microscope observations of hoof horn from horses with brittle feet. *Veterinary Record* 120:568-570.
2. Ley, W.B., R.S. Pleasant, and E.A. Dunnington. 1998. Effects of season and diet on tensile strength and mineral content of the equine hoof wall. *Equine Veterinary Journal, Suppl.* 26:46-50.
3. Mülling, K.W., H.H. Bragulla, S. Reese, K.D. Budras, and W. Steinberg. 1999. How structures in bovine hoof epidermis are influenced by nutritional factors. *Anatomia, Histologia, Embryologia* 28:103-108. 



Bryan Waldridge received his veterinary degree from Auburn University. Before joining Kentucky Equine Research (ker.com), he served as an associate veterinarian at Rood & Riddle Equine Hospital. Prior to his move to Kentucky, Waldridge was a tenured professor at Auburn University, where he taught graduate and undergraduate courses, and oversaw numerous interns and residents. He has published many peer-reviewed articles, five book chapters and dozens of professional and lay articles.



SAFE ★ CERTIFIED ★ NATURAL

New!

- Chronic sore feet?
- Rotation on X-ray?
- Can't be on pasture?
- Cresty neck?
- On Cushing's meds but still foot sore?
- Stays large on little food?
- Painful on hard or frozen ground?
- Founder history?

get HEIRO
Healthy Equine Insulin Rescue Organical
Developed by Dr. Frank Reilly, DVM

Helps fight lamellar injury & foot pain to help your horse get back to pasture faster!

Contains USDA certified 100% organic herbs, magnesium, & vitamin E in a great tasting powder blend

MONEY BACK GUARANTEE!

Available wherever you buy horse health supplies or call 800-578-9234 for a dealer near you!
equinemedsur.com

Select No. 869 on Reader Service Card or www.americanfarriers.com/ff/products