

## HOOF HEALTH©

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Hoof quality is a fairly sensitive indicator of overall nutritional state. Although it can be modified by genetic factors or extremes of environmental conditions, if one or more key “ingredients” needed for growing healthy hooves is inadequate, hoof quality will suffer.

The effect of deficiencies in the diet on the structure and function of the equine hoof has been recognised in recent years. Biotin, one of the B-group vitamins is synthesized in the intestinal tract of the horse but ability to absorb it is questionable, so the base diet should include good biotin sources. Intake from feed sources is fairly low - fresh grasses contain the spectrum of B vitamins but this source is not available for many racehorses. B-vitamins are fragile and rapidly lost in hays - seeds have the greatest level (about 0.6 to 0.8 mg/kg), followed by grains. Brewer’s yeast is better but only has about 1 mg/kg.

Biotin cannot drive hoof growth though. Like all vitamins, once you reach the optimal level there will be no further effect (except high biotin in the urine). Optimal level for hoof health, at least in horses that have problem feet, seems to be somewhere in the 10 to 30mg/day range.

There has been a plethora of investigations into the effect of biotin on the growth rate and quality of hooves. Controlled studies have had varying results on whether or not biotin supplementation has an effect on the growth of hoof horn. The amount of time required for supplementation in order to see results in the hoof also varies from five to nine months.

Biotin is not the complete answer though. There are many other nutrients needed to manufacture hoof horn. If you take out the water, the hoof is nearly 100% protein, predominantly keratin, which is an insoluble protein. Protein deficiency can have the same effect as energy deficiency. The hoof growth of weanlings fed 10% protein was only two thirds that of weanlings fed 14.5% protein.

The amino acid concentration has been shown to be different within the horn of good quality hooves as compared to that of poor quality hooves. Deficiency of the sulfur containing amino acids, such as methionine, is particularly likely to effect hoof growth, as are deficiencies in amino acids involved in connective tissue and skin, hoof formation. There is a linear correlation between the amino acid cystine and hoof hardness.

Mineral deficiencies also play a role. Zinc deficiency is one of the most common mineral problems in horses on unsupplemented hay and grain diets. It is important in the keratinization process and inadequate levels can lead to compromised hoof health and quality. One study found that horses with insufficient hoof horn strength had less zinc in the hoof horn and plasma than did horses with no hoof horn damage.

Calcium and phosphorus and their ratio to each other are related to normal hoof development. Calcium is needed for cell-to-cell attachment in the hoof horn. Calcium is also important in the metabolism of the intercellular lipids. Excess phosphorus can block the absorption of calcium from the small intestine. This can result in a calcium deficiency and a disease called Bran Disease. Bran Disease causes weak and abnormal bones. Calcium deficiency can affect cell-to-cell attachment and metabolism of intercellular lipids. Commercially

manufactured feeds are balanced so that when fed with good quality hay the proper calcium:phosphorus ratio will be achieved.

Vitamin A is a fat-soluble vitamin that plays an important role in cell differentiation and integrity. Inadequate levels may result in hoof dryness.

It is now 20 years since the effect of feeding supplementary biotin to horses was first reported and 17 years since the need for adequate calcium in the diet to support the growth of good quality horn, was described. More recently the effect of feeding excess quantities of certain nutrients has become more of a problem. There is always a belief that 'if a little is good, then more is better'.

A small amount of some vitamins and trace minerals is essential for life, in excess they can be fatal. Actual poisoning from high mineral intakes is relatively rare, but the horse doesn't have to have his hair fall out or drop dead to be negatively effected. Feeding too much phosphorus, selenium and methionine can have a detrimental effect on the quality and growth of the hoof horn. Whilst these substances are essential in the diet, in excess they can lead to poor performance and lameness.

Just meeting mineral requirements isn't going to get the job done when you have high levels of competing minerals. The essential amino acid methionine is thought to cause depletion of iron, copper and zinc if fed in excess. Copper often takes a hit from many different directions - hays are borderline for copper and also have excessively high levels of iron or other inhibitors of absorption.

Crumbling of the horn in the inner layers of the wall and white line disease has been reported in thoroughbreds fed a fashionable supplement containing high levels of methionine. The effect of excess methionine is progressive degeneration of the horn, starting at the white line. Affected horses were intermittently lame with 'sore feet' and had difficulty holding the shoe for more than a few days. Microscopic examination found a change in cell shape and incomplete maturation of hoof cells in the white line and surrounding horn. The changes were reversed when the methionine was removed and the diet balanced for copper and zinc.

Excess selenium in the diet can lead to substitution of sulfur in the keratin fibers with selenium, resulting in little to no structural integrity. Microscopic study of hoof trimmings showed that the hoof cells were filled with crystals and the selenium had replaced the normal sulphur component. The removal of the supplement and a diet designed to promote hoof growth produced a dramatic improvement in the feet in 3 to 6 months.

Calcium is essential for cell-to-cell attachment in the hoof horn and plays a significant role in cellular fat metabolism. The cell fats are essential for creating a permeability barrier in the hoof horn and if this permeability barrier is compromised, bacteria and fungi can penetrate the horn. Diets containing adequate levels of fat can therefore be beneficial to the hoof.

Weak crumbling horn, collapsed heels and flaking, especially at the nail holes has been described in horses on grain/bran diets which have a high level of phosphorus as phytate. Microscopic evaluation showed a loss of cell-to-cell adhesion and absence of normal horn structure. Secondary bacterial and fungal infections were common. An imbalanced calcium:phosphorus ratio results in a relative calcium deficiency. Excess phosphorus blocks the absorption of calcium from the small intestine. The correct ratio of calcium:phosphorus is 1.6:1. Very high levels of calcium or phosphorus may interfere with the absorption and metabolism of the other. Balancing the diet produced a dramatic improvement within 12 weeks but the use of multiple supplements instead of providing

balanced diet can create imbalances that could lead to other problems over the long haul.

To understand factors that help or hinder the hoof, it is essential to understand environmental factors that affect hoof function. The frog has sebaceous glands - a modified sweat gland - from which a slightly acidic excretion is released, protecting against desiccation and infections such as thrush. Alkaline products may toughen the hoof, sole and frog but are detrimental in the long term. Ammonia is also damaging as it destroys hoof horn. A clean stable gives off 10 times the levels of ammonia gas recommended (for people) – poorly maintained stables have much higher ammonia levels and are many times more dangerous to the hoof.

Soundness and performance are optimised when the foot is balanced. The hoof is frequently at the limit of its mechanical tolerance and hoof balance affects the distribution of forces and patterns of movement of the lower limbs. Balance is most easily assessed by measurement of the toe angle. Modifying the shape and amount of hoof horn affects the centre of rotation and breakover point of the foot. Alterations in these components of locomotion contribute to racehorse injuries. Lower toe angles are found in race horses with musculoskeletal problems and have been associated with an increased risk of catastrophic injury. An increased toe-heel angle is a risk factor for suspensory apparatus failure and is more important than toe or heel angle alone.

Increasing the toe length also influences the metabolic response to exercise – increasing the workload and reducing the efficiency of locomotion.

There is no single, magical ingredient for growing healthy feet and little evidence to suggest that the addition of extra nutrients to an already balanced diet will promote hoof growth. Slight imbalances in hoof nutrition and structure can cause a breakdown of integrity and function and care must be taken not to create toxic effects by overfeeding supplements - in the foot, a small imbalance creates a big problem. It is important to remember that the absence of lameness does not mean the horse is sound or preclude the existence of hoof problems and professional advice should be sought whenever in doubt.

Nutritional inadequacies are often at the root of hoof problems. However, the problem is more complicated than just one or two nutrients. No single vitamin or mineral accounts for all the abnormalities seen and it is very rare to find a horse with hoof problems that is on a high quality balanced feed. Mitavite racing feeds are formulated to provide the correct balance of key elements of equine nutrition that are critical to the development of the hoof.