

Nutrients that Affect the Growth and Quality of the Hoof

With all hoof troubles all possible steps should be taken to promote the growth of good new horn.

-M. Horace Hayes

by Henry Heymering, RMF

In hoof growth, both the rate of growth, and the quality of hoof are important and nutrition affects both.

Increasing the rate of hoof growth is always helpful. Most especially so whenever the form or quality of the horn is not good. The two most important factors in the rate of hoof growth are balanced nutrition and good circulation. Massaging the coronet (with a medium toothbrush, or fingers), especially in conjunction with a mild irritant (such as Reducine) has been a traditional recommendation. Studies have supported the idea (Lockard & Reinertson 1986), but results may not be consistent. I have personally seen hoof growth double (3/4 of an inch in 6 weeks) in several cases. Lots of mild exercise walking is beneficial: the more the better. There is a decrease in the hoof growth rate in the winter (Dinger 1976), this can be due to cold as well as decreased nutrition (Wheeler, Bennet & Hutchinson 1972)

The quality of the hoof is usually more important than the rate of growth, and may be influenced by nutritional factors. The causes of poor quality hoof growth are probably not the same for every horse. Each horse will respond differently, depending on the cause of the hoof problems. Increased hoof growth should be measurable in a month, but nutritional improvements in hoof quality may not be apparent until the new growth is at the ground surface of the wall 3 to 4 months for the heel to grow down to the ground 9 to 12 months for the toe.

Hoofs reflect the nutritional status of the horse good quality hoofs indicate good nutrition, poor quality hoofs may indicate nutritional deficiencies. A horse's hoofs may improve in response to any nutritional factor that is lacking. If you wish to improve poor quality hoofs, first look to correct any deficiencies in the diet. A computer program such as "Equi Ration" is ideal, and greatly facilitates formulating a balanced ration. Certainly the place to start is with a well-balanced nutritional program for the horse. Some of the most common deficiencies that cause hoof problems are: vitamin A, Ca:P imbalance, vitamin E, lysine, selenium, and trace minerals (particularly zinc) biotin is usually not deficient, but supplementation with biotin can make a dramatic difference in those cases where it is deficient. Ideally you want to supply what is missing that was making the hoofs less than ideal structurally. With a little common sense and some trial and error, you will do much better than simply always relying on the same product.

The following is an overview of nutritional factors thought to influence hoof growth and quality:

VITAMIN A

Indications of Need:

"Many horses diets lack vitamin A. (Cunha 1991)" "A vitamin A deficiency is the vitamin imbalance most likely to occur. (Stashak 1987)"

The horse obtains most of its vitamin A from beta carotene in grass and hay. Horses will be lacking in vitamin A if they are fed old hay, they do not have access to pasture, they cannot convert beta carotene to vitamin A because of thyroid or liver disorder, and/or they have had their vitamin A stores depleted by parasites or infections. If they are deficient, they may have dull, dry, staring coats, dull looking eyes, and a predisposition to infections.

"Horses suffering from vitamin A deficiency may have marked scaling of the periople. (Hintz 1983)" "A vitamin A deficiency often accompanies abnormal hoof growth. (Asmus 1927)" "Hooves are frequently deformed, the horny layer unevenly laid down and unusually brittle. (Merck 1986)"

"Horses on pasture had plasma B-carotene concentrations 8 to 13 times higher than horses kept in stables. (NRC 1989)" "Rations based on cereal grains and grass hays with little access to pasture may be relatively deficient in vitamins A, D, and E, and some B-complex vitamins (Rose & Hodgson 1993)." Fall and winter grass has little if any beta carotene.

Hay loses much of its beta carotene when baled, and the rest is lost after a year of storage. "About 80% of all the carotene in hay will be destroyed by the sun in 24 hours of field curing hay. ...Additional destruction of Vitamin A or carotene occurs as hay is stored.... One should not plan on obtaining Vitamin A from barn stored hay after a six-month storage period. (Tyznik 1968)"

Horses with even a mild parasite load generally have dry staring coats, and poor quality hoofs (Woolf 1991). Parasite loads, or any infection, will deplete the horse's vitamin A. Functioning thyroid and liver are necessary to convert beta carotene to vitamin A. Hypothyroid (cresty) horses are likely to be lacking in vitamin A. Pregnant mares have a much greater need for vitamin A (NRC 1989).

What it Does:

Vitamin A is needed to utilize protein, and to form keratin. It is also necessary for tendon and ligament repair. I've noticed that horses who were on pasture instead of hay often had much better quality hoofs this difference is likely to be due to vitamin A (though cleaner footing and more exercise may also be involved).

Vitamin A may be particularly helpful in treating and preventing laminitis. Vitamin A is necessary for the body's utilization of protein to make hoofs, etc. It is also necessary for proper thyroid functioning. A lack of vitamin A can cause low thyroid output (Langer & Scheer 1984) and a hypothyroid condition in turn causes a predisposition to laminitis.

Conversely, hypothyroid causes the body to be less efficient at converting beta carotene to vitamin A. Additionally, the infections of the gut and hoofs that are typical of foundered horses will further deplete stores of vitamin A. It appears that vitamin A supplementation may be of value in both the treatment and prevention of laminitis.

"Horses under stress of training and repeated racing are less able to efficiently convert carotene to Vitamin A (Retinol). ...Observations suggest that a supplement of 50,000 IU Retinol (Vitamin A) given daily to racehorses on deficient cereal based diets, may reduce the incidence of tendon weakness and breakdown. (Kohnke 1992)"

"Responses [to supplemental vitamin A] amongst Thoroughbreds in training suffering tendon strain and lameness have been noted. (Frape 1986)"

How to Supplement:

The NRC recommends between 13,500 IU (maintenance) and 30,000 IU (pregnant mare) per day for a 1000 pound horse.

"Dr. S. Donoghue, a research veterinarian at the University of Pennsylvania Veterinary

School, reports that horses need higher levels of vitamin A than recommended by NRC (National Research Council). For example, growth peaked at 1.5 times NRC levels, liver function at 5 times NRC levels, and red blood cell metabolism at 10 times NRC recommended levels. She concluded that their studies indicated that vitamin A may be needed at 2 to 5 times present NRC recommended levels. (Cunha 1987)"

Supplementing vitamin A in the range of 75,000 to 100,000 IU per day is both safe and effective (Putnam 1986). I have only been able to find vitamin A by itself in a product called A-30, which comes in 50 pound bags for use in making custom mixes of feed. One half teaspoon of A-30 supplies about 75,000 IU of vitamin A. A 4 oz baggie of A-30 costs about 25 cents, and is enough to supply one horse with 100,000 IU of vitamin A per day for 6 weeks.

Although higher levels of supplementation may help some conditions, toxicity is also a possibility. 120,000 IU per day for a 1000 pound horse (maintenance) is presumed safe for chronic dietary administration (NRC 1987).

BIOTIN (vitamin H)

Indications of Need:

Biotin is not an essential vitamin, because the horse is able to manufacture its own supply in its intestine (NRC 1987). "The adult horse is said to have no dietary requirement for biotin unless under stress conditions such as intense work, traveling, being stabled for long periods or fed low quality diets. (Kempson 1993)" Some antibiotic sulfa drugs can cause a biotin deficiency (NRC 1987).

What it Does:

Biotin has been highly touted as improving hoof quality and rate of growth some, but not all research has supported these claims. Many of my customers have tried it, and although some of them claim success, I have not seen any improvement in hoof quality.

Dr. Kempson (1987) explains that she found 2 different types of horn defects. Type 1 was found in 6% of the horses studied, and responded to biotin. Type 2 was found in 94% of the horses in her study and it did not respond to biotin, but instead responded to increased calcium and protein. I have closely followed 16 horses on biotin none of which showed noticeable improvement. Bruce Daniels had one horse out of 20 (i.e. 5% about the same as Dr. Kempson) show a dramatic improvement while on biotin (1992).

How to Supplement:

With biotin, for that small percentage of horses that need it, it seems the more, the better. At least 15 mg per day should be tried, possibly as much as 30 mg per day if no response is seen in 6 months, it will probably not be of benefit. Biotin is widely available by itself, and in products like HT 20, H.B. 15, and Farrier's Formula.

CALCIUM

Indications of Need:

If simple grains are being fed (instead of a commercial balanced grain mix) with grass or grass hay, or if bran is being fed each day (without compensating for its high P), then

calcium is probably lacking.

The addition of bran to an otherwise balanced diet can throw off the Ca:P balance. Bran is what Dr. Kempson felt was responsible for most cases of nutritionally caused hoof defects (1987).

Alfalfa has 0.6 to 2.0% Ca and 0.1 to 0.3% P. There is a lot of disagreement as to how much of that can be utilized by the horse. Therefore, alfalfa makes it very difficult to balance rations. If alfalfa is being fed to young stock there is probably too much calcium in the diet it is too high in Ca for growing horses.

What it Does:

The hoof wall is 326.5 ppm calcium (Butler 1985).

Calcium, in the correct ratio with phosphorus (1.5:1 to 2:1 Ca:P), is reported to be important for hoof quality (Kempson 1987). I have not noticed consistent problems in horses who were fed too little calcium, nor have I seen an improvement in their hoofs when the proper calcium balance was met. However, the horses I've seen on alfalfa hay, which has too much calcium, usually had bad feet, especially if kept in a stall this I attribute to excess ammonia in the urine of horses fed alfalfa.

How to Supplement:

Wheat bran contains 0.1% Ca and 1.2% P, while the diet should have 0.35% Ca and 0.2% P. You can get limestone (calcium carbonate) from your feed store. It is about 35% calcium. If the rest of the diet is balanced for Ca:P, you can balance additional bran for Ca:P by adding 4 teaspoons of limestone for every pound of bran fed.

If the diet is not thrown off by alfalfa hay, or bran, then simply providing a loose salt mineral containing 1.5:1 to 2:1 Ca:P free choice (GroStrong, or Equine Choice) will provide the necessary Ca:P in balance.

VITAMIN E

Indications of Need:

Vitamin E is lacking in most horse diets unless they have frequent access to pasture, or are being supplemented with Vitamin E and selenium grains, commercial feeds and hays are typically deficient. Selenium must be present to enable vitamin E to be absorbed from food so a lack of selenium will in turn cause a lack of vitamin E.

What it Does:

The hoof wall contains between 1 and 4 percent fat (Butler 1977). Vitamin E and selenium protect the phospholipids in the hoof wall these phospholipids are crucial to the strength and integrity of the hoof wall.

"Vitamin E and selenium function as parts of a multicomponent antioxidant defense system. This system protects the cell against the adverse effects of reactive oxygen and other free radical initiators of the oxidation of polyunsaturated membrane phospholipids, critical proteins, or both. (NRC 1987)"

"As each keratinocyte reaches maturity, it releases a lipid compound that cements it to adjacent keratinocytes. This 'mortar,' however, can take one of several forms phospholipids are used primarily in the hoof wall, while the more pliable neutral lipids and glycolipids are found more commonly in the laminae and coronary band. The proportions of lipid used

determine the hardness and resiliency of the hoof; the quality of the compound influences the horn's durability and integrity.(Kopp Du Teil 1993)"

How to Supplement:

Vitamin E is typically included in selenium supplements. If you need to supplement selenium (see below) then the combination is your best choice. If you are not in a selenium deficient area, and do not need to supplement selenium, pure vitamin E supplements in either powder or liquid are available. Vitamin E requirements for a 1000 pound horse range from 375 IU (maintenance) to 850 IU per day (intense work). As vitamin E is non-toxic and beneficial in higher doses (many researchers feel current NRC recommendations are low), supplementation in the range of 2000 IU per day is appropriate (Putnam 1986). Supplementation of 2000 to 5000 IU of vitamin E per day has been shown to improve racing performance (Cunha 1991). Vitamin E is presumed safe at levels of 30,000 IU per day for a 1000 pound horse (NRC 1987).

GELATIN

Indications of Need:

Gelatin is composed primarily of two amino acids: glycine and proline. These amino acids are generally not lacking in the diet.

What it Does:

Gelatin supplementation is recommended by Adams (Adams 1974, Stashak 1987). Gelatin at best is unreliable; it may even cause slower hoof growth as shown by the work of Butler and Hintz (1977): "Gelatin did not affect hoof growth, base area, compression strength (yield point or elasticity), moisture, Fe, Zn or N content." "We found no benefit from the addition of gelatin to commercial, complete pelleted feed. Hoof growth was .33 mm per day for those weanling ponies fed the pellets and .31 mm per day for those ponies fed the pelleted diet plus 90 grams of gelatin per 100 kg of body weight. (Hintz 1983)"

"Studies at Cornell University by Dr. H. F. Hintz and at the University of Kentucky by Dr. John P. Baker have shown no beneficial effect of hoof development from gelatin supplementation. Levels of 0.2-0.25 lb of gelatin were used. If gelatin supplementation has an effect on the hoof of the horse, other research is needed to verify it since these two well-conducted studies showed no value for gelatin use. (Cunha 1991)"

How to Supplement:

As gelatin is not usually deficient, and supplementation may do more harm than good, no supplementation with gelatin is advisable. "Don't expect the addition of amino acids to balanced rations to improve the rate of growth of the hoof. (Hintz 1983)"

IODINE

Indications of Need:

Only horses without free-choice access to iodized salt are likely to be deficient in iodine.

What it Does:

Iodine is necessary for proper thyroid function. "The thyroid hormones, which contain iodine, are known to have a role in thermoregulation, intermediary metabolism, reproduction, growth and development, hematopoiesis and circulation, and neuromuscular functioning. (NRC 1980)"

How to Supplement:

Iodine is toxic in excess. The horse is less tolerant of excess iodine than other species. A typical diet supplies about 2 mg of iodine. Horses need only 1 ppm or 0.8 mg per day about 5 ppm or 35 mg per day for a 1000 pound horse is where toxicity becomes a threat (NRC 1980). Free access to a loose salt mineral mix will supply sufficient iodine in a balanced mix with all the minerals. It is best to avoid specific iodine supplements, and/or kelp and seaweed supplements that may contain excessive amounts of iodine (Stashak 1987).

IRON

Indications of Need:

There have been reports of iron deficiency causing spoon shaped nails in humans. "Iron deficiency is not a practical problem in foals or mature horses at any performance level. (NRC 1987)" The horse requires about 40 ppm in the diet. Grains contain 30 to 60 ppm and grasses and legumes 100 to 700 ppm (NRC 1980).

What it Does:

Iron is essential to the transport of oxygen and oxygenation of the tissues. The hoof wall is 14 ppm iron (Butler 1985).

How to Supplement:

Iron is toxic in excess. While gross toxicity may not be apparent below 1000 ppm, or 7 gm per day (NRC 1980), research now indicates that excess iron well below that level can stimulate the production of toxic free radicals (Pearson & Shaw 1982). The typical diet and loose trace mineral salt will provide all the necessary iron. Supplements high in iron should be avoided.

LEGUMES

Soybeans and other legumes (such as alfalfa) may have a negative effect on hoof quality. Typically, horses on legumes have poorer quality hoofs this may be due only to the increase of ammonia in the urine (which damages hoofs), or other mechanisms may be involved in addition. Some legumes contain goitrins, which disrupt thyroid function (Frape 1986). Legumes should be fed in moderation, if at all.

LYSINE

Indications of Need:

Lysine is lacking in most horse diets that don't contain alfalfa.

What it Does:

Lysine is reported to improve hoof quality (Emery, Miller & VanHoosen 1977). The horse needs complete protein, containing a balance of all the essential amino acids. Lysine is the limiting amino acid the one essential amino acid most commonly in short supply. Thus, the horse has only as much complete protein as the amount of lysine allows. Therefore, in most cases, supplementing lysine is more effective in increasing available protein than is increasing the total amount protein in the feed. Supplementing lysine (in lysine deficient diets) improves the available protein without increasing ammonia in the urine.

How to Supplement:

Using a grass/alfalfa hay mix will provide adequate lysine. Replacing about 3 pounds of grass hay with alfalfa per day will provide the necessary lysine, though alfalfa has some undesirable qualities if fed in larger quantities. It is interesting to note that Emery, *et al.* (1977) suggest 4 ounces of powdered milk per day as a good source of lysine. Powdered milk also contains calcium (370 mg per oz), which Dr. Kempson (1987) feels is important for treating most cases of brittle hoofs. Four ounces of powdered milk contain about 3 grams of lysine (NRC 1989), while a diet without alfalfa may be 12 grams short of the lysine requirements. Another source of lysine is dried brewer's yeast, which contains about 1 gram of lysine per ounce. Many of the multiple-supplement products that contain lysine have less than 2 grams (2000 mg) of lysine. For providing lysine, a pure lysine supplement may be best, though I am not aware of any currently available, except in 50 pound bags for use by mills in mixing special feeds.

METHIONINE

Indications of Need:

It is rare for methionine to be deficient in the diet (Frape 1986).

What it Does:

Methionine has been reported to provide a disulfide bond substrate for maintenance of the hoof-pedal bone bond, and to be necessary for keratinization of the hoof wall.

"There was a clear difference between the distribution of the 2 labeled amino acids in the keratinizing epidermis of the hoof. Cysteine was located mainly in keratinocytes of the keratogenous zone in the matrix and in the nucleated keratinocytes that formed the incompletely keratinized basal part of the primary epidermal laminae and covered the lateral surface of the outer, full keratinized part of those laminae. Methionine was located mainly in the stratum basale and in the stratum spinosum of the matrix and in the secondary epidermal laminae of the laminar layer. (Ekfalck, *et al.* 1990)"

All the important sulfur containing nutrients (see list under Sulfur), except B-1 and biotin, can be synthesized in the body from dietary methionine (NRC 1980).

The hoof keratin is 18 percent cystine and 0.7 percent methionine (Butler 1985).

How to Supplement:

Methionine is reported to increase the bond between the lamina and for that reason is used to treat foundered horses. The few foundered horses I've seen it used on did not seem to recover any faster or better than those horses not on methionine. Methionine is best accompanied with supplemental B-6 to prevent the formation of kidney stones. Methionine is the most toxic amino acid in excess (NRC 1980) and may block the absorption of copper, iron and zinc (Kempson 1993). I have not seen any benefit in hoof growth or quality from additional methionine. I doubt that it is worth supplementing, and certainly should not be used in high amounts. MSM is probably a better supplement for foundered horses. MSM moderates allergic reactions, gives relief from pain, donates sulfur for the biosynthesis of methionine and other sulfur containing nutrients, and is utilized in the formation of hoof (Jones 1987).

PROTEIN

Indications of Need:

Most horses get sufficient protein, if they get sufficient lysine.

What it Does:

Nutritionally an increased amount of feed, and/or an increase in protein content (up to 14% but not beyond) have been shown to increase the rate of hoof growth (Hintz 1983), but poor quality feed, and/or poor utilization (possibly parasites) may be more common than inadequate amounts.

The hoof wall dry matter is about 95% protein (Butler 1985).

How to Supplement:

If lack of protein is found in the diet, a higher protein feed may be used, or a protein supplement such as Calf-Manna can be added. Calf-Manna also contains vitamin A, lysine, and calcium.

SALT-MINERALS

Indications of Need:

Salt is lacking from grains, hay and grass. It must be supplied.

Trace minerals are lacking particularly if no salt or a plain (containing no trace minerals) salt is fed. As most pastures and hays do not have sufficient trace minerals, nearly all horses need a trace mineral supplement.

"Many people do not self-feed minerals. They feel they are using a feed that has all the minerals needed by the horse, and, hence, there is no need to self-feed extra minerals. ...this is not the case." "It is highly recommended that a mineral mixture containing calcium and phosphorus be self-fed to horses. The calcium-to-phosphorus ratio in the mineral mixture should be between 1 to 2 parts calcium to 1 part of phosphorus. (Cunha 1980)"

"It is very difficult for horses to eat hard block or rock salt. This often results in inadequate

consumption. (Ensminger 1978)"

What it Does:

Salt (sodium chloride) helps keep body fluids in balance. Sodium is involved in the utilization of protein and energy (Cunha 1991). "Sodium is also involved in nerve impulse transmission, muscle tone and nutrient transport. (Passwater & Cranton 1983)" The hoof wall is 227.5 ppm sodium (Butler 1985). Trace minerals are essential to all growth and body functions.

How to Supplement:

Salt is toxic in excess, but horses will not willingly eat dangerous amounts of salt. Salt poisoning is only a problem if the available drinking water is more than 2500 ppm sodium (Lewis 1982).

Feeding GroStrong loose salt-mineral mix free-choice often makes a noticeable improvement in hoof quality. It contains a 2:1 Ca:P ratio, and so supplies the needed calcium. It also supplies 30,000 IU of vitamin A or so, and near NRC amounts of all the trace minerals and vitamins. Another excellent loose salt-mineral is Equine Choice, which also contains sulfur. A loose salt-mineral-vitamin mix such as one of these should always be provided free choice.

SELENIUM

Indications of Need:

Nearly every horse east of the Mississippi River (as well as most other horses) gets less than recommended amounts of selenium while higher than NRC amounts are beneficial.

A toxic excess of selenium can cause poor hoof quality, pain in the hoofs, and even cause the hoofs to completely slough off (Sutton & Butler 1980). Selenium toxicity is a potential problem in a tall, bell-shaped area of the U.S. that covers the Rocky Mountains, goes from Canada to New Mexico, spreading out at the bottom from Southern California to Alabama. If there is any question about the selenium status of a horse, blood samples can be drawn by your vet and selenium levels can be inexpensively analyzed. Selenium deficiency is every bit as damaging as toxicity, and 40 states (more than 2/3 of the country) are deficient in selenium.

Selenium deficiency causes a yellowing of body fat due to oxidation. That yellowing of fat is visible in non-pigmented frogs. Although horses can be low in selenium (or have black pigmented frogs) and not have yellow frogs, yellow frogs are a clear indication of selenium deficiency (Devitt 1984). The yellow in the frogs will disappear after 2 or 3 months of selenium supplementation.

Selenium is particularly important for muscle function and endurance, it has also been shown to improve immune response (Baalsrud & Overnes 1986), and to help alleviate allergies. I have noticed a strong correlation between lack of selenium and sore suspensory ligaments, and also between lack of selenium and poor quality hoofs. About 70% of the horses I see in selenium deficient areas have mild suspensory soreness typically after a few weeks to a few months of selenium supplementation (at 4mg per day) they are no longer sore.

The cause of white line disease, and other cheesy hoofs is thought to be a fungus and selenium is anti-fungal. White line disease is most prevalent in the NW, the NE and Florida precisely the same areas that are most deficient in selenium. Selenium may prove to be

important in treating and preventing white line disease.

What it Does:

Selenium is so important in the structure of the hoof that radioactive selenium-cystine can be used to study the keratinization of hoofs (Ekfalk, et al. 1985). The hoof wall is normally composed of up to 8 ppm selenium however, 8 ppm or above indicates toxicity (Stashak 1987).

Selenium protects fats from oxidation. "Selenium in the animal body becomes an essential part of a selenoenzyme, glutathione peroxidase, which in tissues reduces lipid peroxides to hydroxy acids, eliminating their toxic potential to cellular membranes. (Hunt & Jones 1983)"

How to Supplement:

Extended feeding of up to 2 ppm of selenium in the diet is considered safe for all species by the most conservative estimates (NRC 1980). That would be 16 mg per day for a 1000 pound horse. Most researchers now feel toxicity is not a problem unless the diet contains 5 ppm (40 mg for a 1000 pound horse) or more (Stashak 1987). Feeding 0.5 ppm (or 4 mg per day of selenium) is both safe and effective.

"Even though clinical signs of selenium deficiency do not occur unless the ration contains less than 0.1 ppm, a ration containing levels of 0.5 ppm [about 4 mg for a 1000 lb horse] may be necessary to maintain optimal plasma selenium concentrations. (Stashak 1987)" In my experience in Florida and Maryland, I too have found that selenium supplementation does not seem to be effective unless about 4 mg per day of selenium is given.

Selenium supplements are widely available. Horse Health, Spectra, and Vita-Flex each manufacture vitamin E and selenium supplements.

SULFUR

(and sulphur containing nutrients: cysteine, cystine, methionine, vitamin B-1, and biotin)

Indications of Need:

"Sulfur deficiency in horses has not been described. (NRC 1987)" However, some researchers and nutritionists believe the requirements are greater than previously thought, and we have simply overlooked sulfur deficiencies.

What it Does:

"Some evidence indicates that dietary sulfur-containing amino acids may act as a source of glutathione, which has a sparing effect upon vitamin E/selenium deficiency. (Hunt & Jones 1983)" The hoof wall contains 2 to 4.6 percent sulfur (Butler 1977).

Observations have been made of bulls hoofs supplemented with sulfur: "Improvement in the growth of claw horn, diminution in its rate of wear and an increase in the sulphur content of claw horn were claimed for six beef bulls fed a diet containing 0.25% sulphur, in comparison with six bulls fed 0.18% sulphur. (Molokanov 1985)"

How to Supplement:

Elemental sulfur is one of the least toxic elements (NRC 1980). I have seen consistent doubling of hoof growth with only one nutritional product H.G. Special. It consists mostly of sulphur and sulphur containing amino acids. Equine Choice contains additional sulphur, as does HT 20, but in lower levels than H.G. Special. MSM has many beneficial properties (Jones 1987), and is 34% sulfur.

ZINC

Indications of Need:

"Diets commonly fed to horses need zinc supplementation in order to meet NRC zinc requirements. (Cunha 1991)" At least 30 states have deficiencies of zinc in the soil (Passwater & Cranton 1983). Vitamin B-6 significantly improves absorption of zinc (Passwater & Cranton 1983).

What it Does:

"Zinc is needed for the development and maintenance of hair and skin. (Cunha 1991)" Zinc content in the hoof wall (125 ppm) is higher than other hoof parts (Butler 1985). Zinc is necessary for the transport of vitamin A. Zinc deficiency has been shown to cause hoof deformity (Nelson, *et al.* 1984). "Zinc deficiency leads to low blood levels of vitamin A due to the impaired ability to mobilize vitamin A from the liver in the form of vitamin A-retinol-binding protein complex. (Passwater & Cranton 1983)"

The enzyme which limits the rate at which the body can make protein (DNA dependent RNA polymerase) cannot function without zinc (Passwater & Cranton 1983). Zinc is used to remove excess lactic acid from working muscles, and to transport carbon dioxide back to the lungs (Passwater & Cranton 1983).

How to Supplement:

Zinc requirements are about 40 ppm, or 300 mg per day for a 1000 pound horse. Zinc is toxic in excess (over 500 ppm, or 3500 mg per day) (NRC 1980), but toxicity is not common. "Potential sources of excess zinc include pesticides, fungicides, and industrial pollution. (NRC 1980)"

In humans, zinc deficiency causes white spots in the nails. Supplementing zinc has been noted to improve human nail strength (Passwater & Cranton 1983). Zinc supplementation in cows has shown an improvement in hoof quality (Moore, *et al.* 1989). Some researchers are now recommending higher than NRC levels for horses.

A good loose salt mineral mix (GroStrong or, better yet, Equine Choice) should provide sufficient levels.

MULTIPLE SUPPLEMENTS

Many multi-supplements are available. Most of them try to provide a wide range of nutrients that may benefit hoof growth.

Russians have studied a substance called sapropel. "Sapropel, an organic silt, contained vitamins, major and trace elements, amino acids, humus, oestrogen-like compounds, carbohydrates and fats. When given to Large White sows at 1 kg/day.... ..the sulphur content of hooves was increased by 6.5%. The breaking strength of tubular bones of limbs was greater by 12.3% with sapropel, which also increased the elasticity and growth of hooves, and prevented hoof fracture (Eliseev 1983)."

H.B. 15 or United Vet Equine's Biotin II both have biotin, lysine, methionine, and vitamin B-6. Bet-r Hoof contains methionine, biotin, gelatin and zinc. HT 20 supplies biotin, methionine, lysine, sulfur, copper, zinc, B-6 and microbials.

Farrier's Formula is no doubt the most studied of the multiple supplements (Kempson 1991, Kempson 1993). Farrier's Formula contains: methionine, biotin, ascorbic acid (vitamin C), choline, inositol, glycine, proline, (the glycine and proline are supplied by gelatin) tyrosine, copper, zinc and iodine. Vitamin A, calcium, protein, and lysine are not listed, though they are in the alfalfa base, in small amounts.

SUMMARY

Before nutrition, check to see that the horse is kept in a clean and dry environment. Nutritionally, first check to see that the horse is getting a balanced ration including all essential NRC amounts of protein, vitamins and minerals. Many of the nutrients that affect hoof growth and quality (vitamin A, vitamin E, calcium, lysine, selenium, and zinc) are frequently lacking from equine diets. Just making sure that the horse gets his salt from a loose salt-mineral-vitamin mix containing Ca and P (about 1.5:1) will prevent most deficiencies.

Three nutrients are particularly noteworthy: vitamin A, vitamin E and selenium are all likely to be below NRC levels in many horse diets. It is generally helpful for the horse to get about 5 times the NRC levels for both vitamin A (Putnam 1986), and selenium (Stashak 1986). Vitamin E at more than 5 times the NRC levels is safe and beneficial. These three nutrients may well be the key for any horses you have that, after months or years on biotin or other hoof supplements, still have bad hoofs.

Conversely, if, after 6 to 8 months on a balanced ration with extra vitamin A and selenium the horse's hoofs are not good, then it may pay to experiment with extra protein, or lysine, or sulfur, or biotin or one of the multiple supplement products such as Farrier's Formula may help. Each horse is an individual.

Products:

- 1) Stallion Services, 8273 Diagonal, Streetsboro, OH 44241. phone 216/626-2854 (Equi Ration equine diet balancer IBM compatible program)
- 2) MoorMan's Mfg. Co., Quincy, IL 62301-3496. phone 217/222-7100 (GroStrong loose mineral salt)
- 3) Renaissance Nutrition, Inc., Roaring Spring, PA 16673. phone 814/793-3538 (Equine Choice loose mineral salt)
- 4) Vita-Flex Nutrition Co., Inc., 30 Futurity Place, Staten Island, NY 10312. phone 800/848-2359 (HT 20, E-SE, MSM, Vitamin E)
- 5) Farnam Companies, Inc., P.O. Box 12068, Omaha, NE 68112 (Reducine, H.B. 15)
- 6) Life Data Labs, Inc., P.O. Box 490, Cherokee, AL 35616. phone 800/624-1873 (Farrier's Formula)
- 7) Manna Pro Corporation, Los Angeles, CA 90301 (Calf-Manna)
- 8) Horse Health, P.O. Box 311, Aiken, NC 29802-03311. phone 800/845-3006 (Vitamin E & Selenium, Bet'r Hoof)
- 9) Spectra Animal Health Division, 2875 Northwind Dr., East Lansing, MI 48823. phone 800/527-0375 (Mega-Sel vitamin E and selenium liquid)
- 10) International Stock Food Corp., P.O. Box 29, Waverly, NY 14892. phone 607/565-2805 (H.G. Special)

References

- Adams OR. 1974. *Lameness in horses*. Philadelphia: Lea & Febiger
- Asmus H. 1927. *Farm horseshoeing*. Washington, DC: GPO
- Baalsrud KJ & Overnes G. 1986. Influence of vitamin E and selenium supplement on antibody production in horses. *Equine Veterinary Journal*. 18(6):472-474
- Butler KD. 1977. Hoof quality. *American Farriers Journal* 3(3):48-49
- Butler KD. 1985. *The principles of horseshoeing II*. Maryville, MO:Butler Pub.
- Butler KD & Hintz HF. 1977. Effect of level of feed intake and gelatin supplementation on growth and quality of hoofs of ponies. *Journal of Animal Science*. 44(2):257-261
- Cunha TJ. 1987. Parasites, feed & disease. *Horse Action Annual Yearbook*. San Clemente: Horse & Rider
- Cunha TJ. 1991. *Horse feeding and nutrition, 2nd ed*. New York: Academic Press
- Daniels B. 1992. Personal communication.
- Devitt M. 1984. Northwest selenium deficiency and the foot. *American Farriers Journal*. (Oct) 10(5):377
- Dinger JE. 1976. Recent findings in hoof physiology. *American Farriers Journal*. 2(4):58
- Ekfalck A, Funkquist B, Jones B & Obel N. 1985. Incorporation of L-75 Se-cystine in tissue fragments from the matrix of the hoof and the claw a tool for studying the pathogenesis of laminitis? *Equine Veterinary Journal* 17(5):377-380
- Ekfalck A, Appelgren LE, Funkquist B, Jones B, Obel N. 1990. Distribution of labelled cysteine and methionine in the matrix of the stratum medium of the wall and in the laminar layer of the equine hoof. *Journal of Veterinary Medicine*. (Series A 1990) 37(7):481-491
- Eliseev A. 1983. Effect of spropel on the strength of extremities of young pigs. *Svinovodstvo* (No. 5):32
- Emery L., Miller J. & VanHoosen N. 1977. *Horseshoeing theory and hoof care*. Philadelphia: Lea & Febiger
- Ensminger ME & Olentine, Jr. CG. 1978. *Feeds & nutrition complete*. Clovis, CA: Ensminger Publishing Co.
- Frape D. 1986. *Equine nutrition and feeding*. New York: Churchill Livingstone, Inc.
- Hintz HF. 1983. *Horse nutrition*. New York: Arco
- Hunt RD & Jones TC. 1983. *Veterinary pathology 5th ed*. Philadelphia: Lea & Febiger
- Jones, WE. 1987. MSM reviewed. *Journal of equine veterinary science*. 7(2):59-61
- Kempson S. 1987. Ultrastructure of the normal and brittle hoof. *Veterinary Record* 120:568-570
- Kempson S. 1991. Effects of Farrier's Formula. *Anvil*. 16(12):38-41
- Kempson SA. 1993. How nutrition plays a key role in hoof horn growth and structure. *American Farriers Journal*. 19(2):44-48
- Kohnke J. 1992. *Feeding and nutrition: the making of a champion*. Rouse Hill, Australia: Birubi Pacific
- Kopp Du Teil K. 1993. Hoof findings. *Equus* (No.185):59-63, 91-94
- Langer S. & Scheer J. 1984. *Solved: the riddle of illness*. New Canaan, CT: Keats Pub.
- Lewis LD. 1982. *Feeding and Care of the Horse*. Philadelphia: Lea & Febiger
- Lockard AJ & Reinertson EL. 1986. Stimulation of equine hoof growth using a counter-irritant. *Iowa State University Veterinarian*. 48(2):99-101
- Merck & Co. 1986. *Merck veterinary manual, 6th ed*. Rahway, NJ: Merck & Co.

- Molokanov VA. 1985. Effect of a sulphur supplement on properties of the claws of beef cattle. *Veterinariya Moscow, USSR* (No. 11):61-62
- Moore CL, Walker PM, Winter JR, Jones MA & Webb JW. 1989. Zinc methionine supplementation for dairy cows. *Transactions of the Illinois State Academy of Science*. 82(3-4):99-108
- National Research Council. 1980. *Mineral tolerance of domestic animals*. Washington, DC: National Academy Press
- National Research Council. 1987. *Vitamin tolerance of animals*. Washington DC: National Academy Press
- National Research Council. 1989. *Nutrient requirements of horses, 5th revised ed.* Washington DC: National Academy Press
- Nelson DR, Wolff WA, Blodgett DJ, Luecke B, Ely RW & Zachary JF. 1984. Zinc deficiency in sheep and goats: three field cases. *Journal of the American Veterinary Medical Association*. 184(12):1480-1485
- Passwater RA & Cranton EM. 1983. *Trace elements, hair analysis and nutrition*. New Canaan, CT: Keats Publishing
- Pearson D & Shaw S. 1982. *Life extension: a practical scientific approach*. New York: Warner Books
- Putnam ME. 1986. The role of vitamins in nutrition of performance horses. *Modern Veterinary Practice* (Feb.) p.121-124
- Rose RJ, & Hodgson DR. 1993. *Manual of equine practice*. Philadelphia: W. B. Saunders
- Stashak TS. 1987. *Adams' lameness in horses, 4th ed.* Philadelphia: Lea & Febiger
- Sutton B & Butler D. 1980. Selenium toxicity in horses. *American Farriers Journal*. 6(2):44-46
- Tyznik WJ. 1968. Nutrition. *Care and training of the trotter and pacer*. Columbus: USTA
- Wheeler JL, Bennett JW & Hutchinson JCD. 1972. Effect of ambient temperature and daylength on hoof growth in sheep. *Journal of Agricultural Science*. 79 (Part 1):91-97
- Woolf A. 1991. Personal communication.