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Glucosamine is the building block of chondroitin sulfate, a specific type of polysulfated glycosaminoglycan (GAG). Current research suggests glucosamine has two beneficial actions in joints. Not only does it increase the production of new GAGs and therefore new cartilage, glucosamine has also been shown to inhibit the free radicals and enzymes that break down cartilage. This small but complex molecule has an important role in both the production and protection of joints.

MSM (Methylsulfonylmethane) is a naturally occurring sulfur compound which contains antioxidant properties and is commonly used in the horse industry to combat inflammation. It is a great source of dietary sulfur, which plays an important role in maintaining the health of collagen, cartilage, hooves, hair, and joint fluid. MSM is an inexpensive compound with a proven track record of safety.

Chondroitin Sulfate supports production and slows breakdown of cartilage, inhibits inflammatory mediators and improves joint comfort. Research has shown that chondroitin sulfate is bioavailable in the horse and that it appears to work synergistically with glucosamine to stimulate new cartilage production and inhibit cartilage breakdown.

Hyaluronic Acid (HA) is an integral component of joint cartilage and joint fluid, providing both lubrication and shock absorption. Hyaluronic acid is what makes joint fluid "sticky." Because it is known to protect cells in the joint, HA is especially useful in acute situations as well as flare ups of chronic joint conditions.

Yucca is a medicinal plant native to North and Central America which may have beneficial effects in the prevention and treatment of arthritis and musculoskeletal discomfort. Active components of yucca include steroidal saponins and polyphenolics such as resveratrol and yuccaols. Saponins may have antiarthritic effects associated with their antiprotozoal activity. Yucca polyphenolics may have several roles in antiarthritic activity.

Collagen is the main structural protein found in the connective tissues of the body (skin, bones, cartilage, tendons, and ligaments). Hydrolyzed collagen protein (gelatin) is a modified form that has been broken down into smaller pieces making it easier to digest and absorb. Collagen and gelatin are ingredients used to support joint health, nourish bones and the tendons and ligaments surrounding them, and aid in recovery from exercise and injury.

Mannanoligosaccharides (MOS) - (see Prebiotics): MOS is part of the yeast cell wall and helps clear the horse's hind gut of pathogens and aids in immune system health. MOS binds to harmful pathogens like E.coli and salmonella, preventing these from binding to the horse's intestine and causing infection. When the MOS is flushed from the horse's body in manure, it takes the infective agents with it. MOS also stimulates the horse's immune system by evoking an antibody response against the invading pathogen, building the horse's natural defenses.

Magnesium (Mg) is a vital macromineral, and it is becoming increasingly recommended by veterinarians for various treatments in the horse. Because one of the clinical signs of Magnesium deficiency is nervousness, it is added to many calming supplements. Magnesium helps protect against inflammation and free radical damage. Magnesium may play a role in insulin resistance and equine metabolic syndrome. Within the muscle calcium and magnesium work antagonistically - calcium causing muscle contraction and magnesium inducing relaxation. If there is not enough magnesium, muscles tend to spasm. Although the presence of low magnesium in the muscle tissue may stem from a genetic disorder rather than dietary quantities, there are reports of horses that have responded to magnesium supplementation for treatment of chronic tying-up.

Lysine is an amino acid and the only one for which a requirement in the horse has been established by the NRC. It is an essential amino acid, meaning it must be provided in the diet since the body cannot create enough of its own. Lysine is also a limiting amino acid. This means if it is not present in adequate amounts it limits the body's ability to make protein. Lysine is important in the formation of collagen (the protein that forms

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the matrix of bone, cartilage and connective tissue). Lysine supplements enhance the intestinal absorption of calcium and reduce the excretion of calcium in the urine. Lysine deficiency may result in immunodeficiency. Lysine can help inhibit the multiplication of virus and may prevent or decrease the severity of any viral flare up.

DMG (Dimethylglycine) is a naturally occurring substance in the body and in many foods, but in low levels. Supplementing with this ingredient makes additional DMG available to cells throughout the body, where it is involved in energy production processes that use oxygen. DMG is used to support muscle metabolism (especially in horses prone to tying-up), boost the immune system, and serve as an antioxidant.

Vitamin C (Ascorbic Acid) is an antioxidant that plays a pivotal role in neutralizing harmful free radicals. Because of its water-soluble nature, vitamin C can work both inside and outside the cell to combat free-radical damage. Vitamin C also helps by regenerating vitamin E. Besides its antioxidant functions, vitamin C is needed for collagen synthesis, hormone synthesis, conversion of vitamin D3 to calcitriol, bone calcification, and antihistamine control. Under normal circumstances, horses make their own vitamin C in the liver from glucose. However, transport, "heaves," old age and endurance exercise have all been shown to decrease blood levels of vitamin C, indicating horses undergoing these particular stresses may benefit from dietary supplementation.

Methionine is an essential amino acid, meaning it must be provided in the diet since the body cannot create enough of its own. This means if it is not present in adequate amounts it limits the body's ability to make protein. Methionine can be converted by the body into another sulfur-containing amino acid, cysteine. Because the concentration of both these amino acids is highest in hoof and hair, methionine especially is often included in hoof supplements.

L-Glutamine is the most abundant amino acid in the body, especially in muscle tissue. Although it is not an essential amino acid, there is such great demand for its use in the body that production may not be able to keep up with consumption, so supplementing may be necessary. Glutamine is involved in more metabolic processes than any other amino acid, including building muscle, repairing intestinal tissue and enhancing the immune system. Many studies have documented that supplementation with L-glutathione has an anti-inflammatory effect in the intestinal tract.

Licorice is one of the most widely used herbs for people and animals in both Western and Chinese medicine. Sweet and soothing, licorice is used for its action on inflammation, healing, gastric upset, and others, plus functions as an expectorant. The deglycyrrhized form is preferred because it does not have the side effects of the plant as a whole.

Slippery Elm is obtained from the bark of a tree native to North America. Slippery Elm is rich in mucilage, a soluble fiber that becomes gel-like when wet. This 'natural bandage' helps reduce irritation of mucous membranes, aiding in the relief of a sore throat or cough as well as stomach upset and loose stool.

Linolenic Acid (Omega-3) are essential fatty acids and must be obtained from the diet in order for the body to function well. Omega 3s are typically seen as the good guys because they are known to be anti-inflammatory. They are critical for brain function, and they also aid in healing the body. There must be a balance between the omega-3s and the omega-6s for a proper but not excessive inflammatory response.

Linolenic Acid (Omega-6) are essential fatty acids and must be obtained from the diet in order for the body to function well. Omega 6s are in charge of causing inflammation and immune system reactions, which is necessary to stabilize injuries and fight off infections. There must be a balance between the omega-3s and the omega-6s for a proper but not excessive inflammatory response.

Thiamine, or Vitamin B1, plays a vital role in carbohydrate metabolism and nerve transmission. The NRC has set a daily dietary requirement for thiamine because, unlike most of the other B vitamins, microorganisms in the intestine do not make enough thiamine to meet the horse's needs. Fortunately fresh forage and cereal grains are good sources of this vitamin. However, hard-working horses or those on high grain diets may have reduced production of thiamine by intestinal bacteria because of stress or hind gut acidosis. Thiamine supplementation has been shown to have a calming effect in individuals displaying undesirable behavior due to a thiamine deficiency or increased requirements.

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The **Vitamin B** family is made up of several compounds that serve many important roles in the body: protein, fat and carbohydrate metabolism; energy production; proper nerve cell transmission; and cell reproduction and division (especially rapidly dividing ones such as red blood cells). B vitamins include **thiamine (B1), riboflavin (B2), niacin (B3), pantothenic acid (B5), pyridoxine (B6), folic acid (B9), and cyanocobalamin (B12)**. For most of the B vitamins, microorganisms in the large intestine make all the horse needs. Only thiamine and riboflavin have NRC dietary requirements. However, research suggests B vitamin supplementation may be beneficial to stabled horses with little access to fresh pasture, heavily exercising horses, pregnant and lactating mares, horses with GI conditions that may interfere with normal gut flora, and any periods of stress (injury, illness, shipping, old age, etc.).

Zinc is a micro mineral involved in over 100 enzyme systems ranging from connective tissue formation and antioxidant protection to carbohydrate metabolism and immune system function. It is most recognized for its role in healthy skin and hooves. Supplementation should be considered because amounts in normal feedstuffs may not meet requirements and toxicity has not been reported.

Copper (Cu) is a micromineral required for production of normal connective tissues including tendons, ligaments, cartilage and bone. As a component of many enzyme systems, it is also involved in making iron available to the body for blood, in producing skin and coat pigments, in proper nerve signaling and in repairing antioxidants. Low copper levels in mares and foals have been implicated in developmental orthopedic disease (DOD) including osteochondrosis (OCD).

Biotin is a member of the B vitamins family and, like some other vitamins, is a co-enzyme for several metabolic pathways. It is involved in glucose metabolism, growth and utilization of niacin. Biotin is essential to the growth of strong, healthy hooves due to its role in collagen formation. A number of research studies show that long-term, daily supplementation of 10-30 mg of biotin daily improves the growth rate and hardness of hooves, especially in horses with less than optimum quality hoof horn (soft, brittle, chipped).

Selenium is a trace mineral that along with vitamin E function in a partnership that helps to protect body tissues from free radical damage that occurs during oxidation (the conversion of feedstuffs into energy). In particular, they act as a defense mechanism against damage to cell membranes and enzymes. While some parts of the country have high levels of selenium in their soil and therefore the plants that grow there, selenium deficiency has been reported in 46 states. Therefore, most horses will need supplementation to meet the NRC requirement of 1 mg/day for maintenance. For optimum immune function and exercise recovery, 2 to 3 mg/day is recommended, which is still well below 50 mg/day which may be the upper safe limit. **Selenium Yeast**, the organic form of the mineral, is better absorbed than inorganic selenium selenate or selenite.

Manganese is a micromineral essential for bone formation, growth and reproduction. It is also essential in carbohydrate and fat metabolism. Supplementation should be considered because not all diets provide the same levels of manganese. It is among the least toxic of the trace minerals, and it plays an important role in young growing horses as well as active performance horses.

Vitamin A is well-known for its role in maintaining healthy vision, especially night vision. However, it is also needed for reproduction, immunity, and normal skeletal development in young growing horses and exercising horses that are remodeling bone. Horses must satisfy their vitamin A requirement from their diet, but only horses on fresh green pasture or high-quality alfalfa are likely to meet that requirement. Horses on grass hay, horses with no access to pasture, or horses that are exercising or breeding probably need supplementation.

Vitamin D plays an indirect role in bone growth and maintenance by managing the levels of calcium (Ca) in the body. It controls the absorption of Ca from the intestine, the movement of Ca into and out of bone, and the amount of Ca excreted by the kidneys. While a minimum requirement has been set by the NRC, it is assumed that horses make all the vitamin D they need simply by exposure to sunlight, which converts precursors of vitamin D in the skin to the active form of the vitamin. However, horses kept indoors for prolonged periods, horses fed poor quality hay, very young foals or exercising horses that are remodeling bone may need supplementation. Deficiency causes reduced appetite, slowed growth, physitis in growing horses, bone demineralization (leading to stress fractures and bone deformities), and poor muscle contraction.

Vitamin E is considered the most important antioxidant and works closely with selenium to protect the body from the oxidative stress of exercise, illness and certain medical conditions. Found in high amounts in fresh pasture, levels begin to decay the moment pasture is cut for hay. That is why any horse that does not have access to grass, regardless of its activity level or health, should receive vitamin E supplementation. Horses are not very efficient in storing vitamin E and deficiency may be accelerated if the diet is deficient in selenium.

Yeast (see Prebiotics and Probiotics): Supports enzyme activity for fiber digestion/colon function associated with colic, colon pH and helps support growth of beneficial lactic acid bacteria.

Prebiotics are sources of non-digestible, soluble fiber that serve as food for the probiotics or "good" bugs in the large intestine, keeping them healthy. Prebiotics promote good bacteria and builds natural defenses thereby maximizing performance.

Probiotics are live microorganisms fed to promote healthy digestive and immune function. When these "good" bugs break down food ingredients that the body normally cannot, they produce energy and vitamins for the body, food for cells in the cecum and colon, and byproducts that keep the "bad" bugs from growing. Research suggests probiotics are useful in repopulating the intestine with "good" bugs after antibiotic use and may benefit certain horses with diarrhea. A common term used for probiotics is direct-fed microbials (DFM).