Something extra for joints

Some nutritional additives, or supplements, are proven to help a horse improve its athletic potential

by Amy Gill, Ph.D.

A GROWING number of horse owners and trainers are aware that alternative therapies and dietary supplements are useful in treating many conditions and illnesses that affect horses.

Until about 15 years ago, many industry professionals viewed therapeutic options as quackery. Now, equine chiropractic, acupuncture, and physical therapy are widely accepted. Many veterinarians feel the best therapeutic programs involve a combination of traditional western medicine and alternative therapies, and injured horses often benefit from the pain relief afforded by a variety of therapeutic options.

Likewise, nutritional therapy has become popular in the horse industry for a variety of reasons. The nutraceutical and supplement industry has exploded, bombarding owners and trainers with an array of products that claim to do a multitude of things, such as improve horses' speed, improve their stamina and strength, make them calmer, and relieve their pain.

With all the choices, how do you decide which products work?

There are many anecdotal reports of a supplement improving a specific condition in a horse or enhancing its performance, but these testimonials are at times difficult to consider legitimate because they lack the controlled clinical research conditions needed to eliminate variation between horses and the environment. And while many trainers know their horses extremely well and recognize true improvement in performance, without eliminating variation and conducting a controlled trial, evaluating results is impossible because data cannot be scrutinized and analyzed any other way.

Also, even if it were possible to conduct racing research trials, measuring improvement in the performance of a racehorse can be difficult. Sometimes the difference between winning and losing a race involves only a split-second. If a horse improves at all, the performance is difficult to assess statistically as the result of a certain feed supplement because of all the variables that are involved with the individual horse and the race conditions. That tiny bit of improvement might be all a loser needs to become a winner on a certain day, but it is not as easy as measuring, say, milk or meat production, where variability is controlled and data with exact amounts and weights can be obtained.

Some changes in performance horses can be clearly measured, such as improvements in overall condition (weight gain) and the reduction of pain—though the latter is subjective. Several products or ingredients on the market today have been measured in clinical settings with horses and other species of animals, and some have proven to be effective, while others have been proven noneffective.

The following information summarizes several products and ingredients that have been scientifically studied and appear to be useful in conjunction with a sound feeding and training program for the performance horse.

Cartilage and bone

Glucosamine and chondroitin sulfate, used to treat arthritic conditions, are well-established feed supplements for horses.

Glucosamine, which plays a role in cartilage formation and repair, is an amino monosaccharide found in chitin, glycoproteins, and glycosaminoglycans such as hyaluronic acid and heparan sulfate. Glucosamine is available commercially as a nutritional supplement in three forms: glucosamine hydrochloride or glucosamine HCl, glucosamine sulfate, and N-acetyl-glucosamine.

Chondroitin sulfate is part of a large protein molecule produced by specialized cells called chondrocytes that gives cartilage elasticity and is a natural component of the equine cartilage matrix. Chondroitin sulfate belongs to a family of heteropolysaccharides called glycosaminoglycans. Glycosaminoglycans in the form of proteoglycans are part of the extracellular matrix of connective tissue (between the cells), which also contains structural proteins such as collagen and elastin.

Chondroitin sulfate is a very long molecule made up of linear repeating units containing D-galactosamine and D-glucuronic acid, and it is found in cartilage, bone, cornea, skin, and the arterial wall. The large size of the molecule has always led to the belief that feeding chondroitin sulfate orally was ineffective because the molecule was too large to be absorbed across the intestinal wall.

Both glucosamine and chondroitin sulfate have been studied extensively with positive results in humans and dogs, and several studies have shown the compounds to be effective in reducing pain in horses—but primarily when injected either intramuscularly or intra-articularly. There has been much speculation in the scientific community about the efficacy of oral dosing, particularly with lower-grade and cheaper products.

Nutramax, the manufacturer of Cosequin, a joint supplement marketed for horses, humans, and pets, claims Cosequin has been proven to be effectively absorbed through the intestinal wall intact and can be used at target sites. Nutramax conducted a study using a low-molecular weight oral chondroitin sulfate and showed the nutrient was absorbed rapidly in the horse (between 1.3 and 2.3 hours) with bioavailability at 22%. Glucosamine also was fed orally and shown to be 2.5% available. This is one example of a product manufactured by a company that invests time in research to prove its product works and provides pharmaceutical-grade ingredients, which are preferred over cheaper priced, lower concentration, or lesser quality products.

Arthritis is a degenerative joint disease that causes pain, inflammation, and limited joint movement. With osteoarthritis, the joint that is affected has degenerated cartilage. Cartilage acts as a cushion between the joints so when it deteriorates, bone rubs against bone and causes pain, inflammation, and lack of mobility. Relief from pain can be obtained by treatment with nonsteroidal anti-inflammatory drugs (phenylbutazone) or by injection with corticosteroids.

However, these therapies only mask the symptoms and relieve the pain, but do little to stop the progression of the actual disease. Glucosamine and chondroitin sulfate, when administered to horses at therapeutic doses, can cause a profound improvement in pain relief in deteriorated joints, but currently there is little scientific proof that either substance—when fed singly or in combination—will actually slow the degenerative process or restore cartilage in arthritic joints. Almost all studies done to date have been conducted using injectable forms of the combinations and were short term, or focused mainly on pain relief.

Results from a study at Michigan State University published in *Osteoarthritis Cartilage* in May 2005 titled "Glucosamine and chondroitin sulfate regulate gene expression and synthesis of nitric oxide and prostaglandin E(2) in articular cartilage explants" might provide some proof that glucosamine and chondroitin sulfate actually could slow the progression of joint disease. The study indicated that glucosamine and chondroitin sulfate might work by regulating gene expression and synthesis of nitric oxide and prostaglandin E(2) in articular cartilage.

Though the exact mechanism of action of

This article appeared in the July 30, 2005, issue of Thoroughbred Times. To subscribe, call 1-888-499-9090.

these nutraceuticals remains unresolved, the study determined that therapeutic concentrations of glucosamine and chondroitin sulfate have an effect on gene expression and decrease the synthesis of nitric oxide and prostaglandin E(2) in cartilage in vitro (performed on tissue in a laboratory). Both nitric oxide and prostaglandin are involved in the inflammatory process in the joint. It is possible that physiologically relevant concentrations of glucosamine and chondroitin sulfate can regulate gene expression so that synthesis of nitric oxide and prostaglandin are curtailed, providing a plausible explanation for their purported anti-inflammatory properties.

This study points out that these compounds are beneficial because they potentially alter the production of harmful elements in osteoarthritic cartilage through gene regulation. However, this study was conducted with bovine cartilage in vitro; producing similar results in live animals through feeding trials, if at all feasible, is needed. Proving their effectiveness will further validate these supplements as useful in combating the progressive deterioration of joints associated with arthritis.

Hyaluronic acid

Hyaluronic acid is a naturally occurring biopolymer that serves important biological functions in bacteria and higher animals, including humans and horses.

Naturally occurring hyaluronic acid is found in the tissue of higher animals and is the main source of lubrication of joints. Hyaluronic acid exerts an anti-inflammatory action in the joint and also appears to regulate normal cellular components that decrease the release of enzymes that cause deterioration of healthy joints. Hyaluronic acid improves the healing of skin, mucous membranes, and bone. Hyaluronic acid viscoelastic character (sticky and elastic) has been used in the past ten to 15 years to improve the lubrication in arthritic joints in humans and horses.

Originally, hyaluronic acid was given to horses only as an intra-articular injection. This procedure has been replaced by newer technology due to a high level of joint infection associated with puncturing the joint capsule and the discovery that intramuscular injections are effective at treating multiple sites via a single injection.

Hyaluronic acid is found in greatest concentrations in the vitreous humour of the eye (clear gel filling in the eye), rooster combs, and in the synovial fluid of articular cartilage. It can also be cultivated in the laboratory in the outer wall of gram-positive streptococci bacteria.

Hyaluronic acid comprises long, unbranched lines of linked glucuronic acid and N-acetyl glucosamine. It is a member of the glycosaminoglycan family, which includes chondroitin sulfate, dermatin sulfate, and heparan sulfate. When incorporated into an aqueous solution, hydrogen bonds form between water molecules and the carboxyl and N-acetyl groups in the hyaluronic acid. The result is a very stiff polymer, which limits its flexibility. Hyaluronic acid solutions are characteristically very viscous and stiff, the desired characteristic needed to add shock-absorbing capability to joints.

The hydrogen bond formation is reason for the water-binding and retention capacity of hyaluronic acid. Interestingly, the water-binding capacity and subsequent lubricating ability of hyaluronic acid is directly related to the molecular weight of the molecule. Remarkably, up to six liters of water may be bound per gram of hyaluronic acid.

Animal sources of hyaluronic acid have a much higher molecular weight than the hyaluronic acid produced by bacteria and, therefore, are considered more effective sources for lubricating joints.

Hyaluronic acid has been traditionally extracted from rooster combs and bovine vitreous humour. However, it is difficult to isolate pure, high-molecular-weight hyaluronic acid economically from these sources because it forms a complex with proteoglycans found in animal tissues, and the extraction and purification processes result in a significant reduction in molecular weight of the polymer. Additionally, the use of animal-derived biochemicals for human and animal therapeutics is not currently viewed as socially acceptable, not only because of ethics, but also because of the risk of infection.

Therefore, the industry has focused on bacterial fermentation processes with the hope of obtaining a commercially viable hyaluronic acid. With bacterial fermentation, extracellular polysaccharide is added to a growth medium, and control of the polymer characteristics and product yields can be manipulated. Large quantities of hyaluronic acid can be produced in this manner.

The use of bacterial fermentation comes with some disadvantages. Unfortunately, the mucoid capsule serves as a protective shield for the bacteria, which enables them to evade the host's natural immune defenses, affording it the opportunity to potentially cause infection in the horse being treated. However, purification procedures now are used to reduce the incidence of infections.

For example, Legend is an intravenous form of hyaluronic acid commonly used to treat osteoarthritis in horses that has been used in the field for many years without compromise. Hyaluronic acid in this product is extracted from bacteria and then purified to a form that is free of protein and nucleic acids. The manufacturer also claims that since Legend originates from a microbial and not animal source, there is no potential for contamination with dermatin, chondroitin sulfate, or any other glycosaminoglycan.

As previously mentioned, one drawback to using bacterial streptococcal fermentations is that they produce hyaluronic acid with a low average molecular weight, and much higher molecular weights are more desirable to achieve good results within joints. Because much higher molecular-weight hyaluronic acid can be obtained from animal tissue, there is considerable room for improvement in bacterial fermentation and production of hyaluronic acid.

Recent studies have shown there are several fermentation parameters that significantly can affect the molecular weight of hyaluronic acid produced. Low growth temperatures (at 28° centigrade or 82.4° Fahrenheit), availability of oxygen, and high initial glucose concentration (40 grams per liter) have resulted in the production of higher molecular weight hyaluronic acid in streptococcus. Altering the pH or stirring or shaking the culture did not influence the molecular weight outcome of hyaluronic acid fermentations.

Oral hyaluronic acid preparations such as Conquer HA, Hyalun, and LubriSyn are newer to the equine industry than intravenous or intramuscular products such as Legend and Adequan. Researchers in the Czech Republic have performed several studies on hyaluronic acid in horses, rats, and humans. The most comprehensive studies have been conducted with racehorses. Results include:

- In a study of 53 sport horses of various breeds that received oral hyaluronic acid syrup at a dosage rate of 100 milligrams per 500 kilograms of body weight for 30 days, good to very good results were observed in multiple orthopedic diagnoses;
- Daily 100-milligram doses of hyaluronic acid produced higher serum levels at day seven in four horses than a single intravenous infusion of hyaluronic acid in four comparable horses; and
- The effect of 100 milligrams of hyaluronic acid on lameness and other orthopedic conditions in 13 actively training Thoroughbreds was notably beneficial when compared with 12 others horses serving as controls.

Oral hyaluronic acid supplements, which are manufactured under strict quality-control measures, appear to be absorbed into the circulation, delivered to the joint capsule, and incorporated into synovial fluid and other tissues. They can safely and effectively benefit any tissue that is in need of hydration, lubrication (as in arthritic, painful joints), and function to absorb concussion in joints. In addition, their antioxidant and free-radical scavenging effects contribute to overall improved general health. No side effects of oral hyaluronic acid supplementation have ever been reported.

Silicon

Recently, products containing more biologically available forms of silicon have come on the market as a supplement for horses, humans, and companion animals. Silicon acts as a regulator for calcium and phosphorus uptake and will directly contribute to a healthy bone cortex (the outer portion of bone that is initially cartilage but is converted to bone as the horse matures) and a well-calcified bone matrix (which comprises minerals and collagen). Silicon also plays an important role in the formation of connective tissue and collagen (bones, cartilages, ligaments, tendons, hair, skin, and hooves).

The sudden interest in silicon is due to its role in the development of new bone and the calcification process. During the early stages of calcification, silicon and calcium content are low, but both increase as mineralization of bone proceeds. As bone matures, however, silicon content decreases and calcium levels remain elevated. Therefore, silicon supplementation would appear to be exceptionally critical in the young, growing animal when the skeleton is undergoing rapid development.

Studies in the past ten years have shown young horses in training benefited from supplementation of silicon. Horses fed silicon were able to train more total distance without injuries (particularly to shins) and had faster times than those not supplemented. Support for the theory that silicon is involved in an early stage of bone formation is further validated by studies in which chicks had defective bone growth after being fed a silicon-deficient diet.

Silicon is the second-most common element of the Earth's crust that is found throughout the environment. Silicon dioxide, which is the quartz crystal found in sand, is not biologically available to mammals. Plants, however, can use silicon to provide rigidity and structure to some of their cell walls; horses can obtain minimal amounts in their normal diet of forage and grain.

Unfortunately, processing of commercial horse feeds further reduces silicon's availability from plant sources. However, if silicon can become hydrated, monosilicic acid is formed, and it provides a highly available form of silicon that is not available with silicon from natural sources.

Recently, a study looked at two groups of calves that were fed a standard milk formula, but one group received supplemental monosilicic acid. At seven weeks, the calves' daily silicon intake from food was 360 milligrams and only 17.5 milligrams from monosilicic acid. However, by the end of the study, silicon concentrations in the blood of the calves consuming monosilicic acid were 70% higher than controls, indicating better absorption. Additionally, skin collagen content also was greater in calves being fed monosilicic acid, supporting the theory that silicon also is needed for collagen synthesis.

Until recently, sodium zeolite A was the only biologically available supplemental source of silicon for horses. Sodium Zeolite A is a fluffy powder and must be fed in very large amounts to achieve therapeutic doses. Often it is pelleted or mixed with other ingredients to make it more manageable to feed. A new liquid silicon product manufactured in Europe and derived from monosilicic acid called Siliforce Horses recently has been made available in North and South America.

Though more research is needed to solidify the emerging belief that higher levels of silicon in the diets of young, skeletally immature horses will help them to lay down stronger bone, early reports indicate silicon supplementation, in conjunction with specific training regimens, allows horses to train longer without injury. Though the exact mechanism remains elusive, results obtained when feeding silicon are beginning to confirm its usefulness as a supplement, especially in barns of two-year-olds in training, where stress fractures are so prevalent.

With, not instead

Dietary supplementation of certain nutraceuticals can be helpful in alleviating symptoms of exercise-related conditions and disorders, but it is important to fully understand how a product works before deciding to use it.

Supplements should be used in conjunction with, and not as an alternative to, a good veterinary diagnosis, treatment, and proper training, feeding, and management. Because not all supplements are created equal, choosing products made by manufacturers that have tested and proven their products work makes the most sense for the owner, the trainer, and, most importantly, the horse.

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