

HYPP: Diet Makes a Difference

In Greek mythology, the gods are often depicted as strong and virile. Known for their awe-inspiring physiques, including voluminous muscle stretched over perfectly proportioned skeletons, the gods were looked upon as epitomes of masculinity. Think Adonis, think Zeus. If indeed equivalents exist within the equine kingdom, it may be those horses that compete in conformation classes at stock breed shows. For indeed, these specimens epitomize the aesthetics so often sought in horseflesh.

From their powerful, expansive chests to the bulging muscles of their stifles and gaskins, these models of muscu-

larity have resulted from decades of careful matchmaking. Breeders strive to produce balanced horses with sculptured heads, tight throatlatches, well-shaped necks, prominent withers, strong backs, wide loins, long hips, and structurally correct limbs. But these things alone rarely earn a horse a top ribbon in conformation classes. While all of the aforementioned attributes and many others must be intact, so does abundant, yet smooth muscling.

A stallion named Impressive invigorated the halter-horse industry in the 1980s and early 1990s. His progeny possessed remarkable refinement coupled with deep, ample muscling. This single sire redefined the standard by which

halter horses were judged, and his influence was sweeping and irrefutable. As his foals achieved success in the show ring, Impressive's popularity as a sire exploded, and he serviced thousands of mares during his lifetime. The stallion's influence extended beyond the Quarter Horse breed and into other breeds that allowed outcrossing such as the Appaloosa and Paint Horse.

But time and time again, Impressive passed on to his sons and daughters more than his standout conformation and massive musculature. Hidden in the double helixes of the DNA passed from sire to offspring, Impressive oftentimes transmitted a genetic mutation, one that would forever stain the stallion's once-formidable legacy. The defect causes a devastating syndrome known as hyperkalemic periodic paralysis, or HYPP.

For some breeders of halter horses, this mare possessed all the qualities for inclusion into a broodmare band. A great-great granddaughter of Impressive, her femininity blends beautifully with structural correctness and muscle. Lurking in her DNA, however, is the gene for HYPP. While this mare has been asymptomatic her entire life, her foals were not. Retired from her career as a broodmare, she spends her days as a model for equine anatomy and management classes at a university.



Mark Lewellyn

The Mechanics of the Syndrome

On a physiological level, sodium channels are gateways in the muscle cell membrane that strictly regulate muscle contraction. The genetic mutation interrupts the flow of sodium in and out of muscle cells. As potassium levels increase in the blood, the channel that normally regulates the influx becomes stuck, allowing sodium to flood into the cells. When this occurs, uncontrolled muscle twitching and trembling result. As potassium levels rise further in the bloodstream, the muscles become unable to contract, and the horse becomes paralyzed. This cycle continues until excessive potassium is excreted through the urine or resorption of potassium into cells occurs.

The physical effects of HYPP vary considerably. Some affected horses show no outward signs, while others exhibit prolapse of the third eyelid (seen as a membrane flickering over the eyeball), yawning, heavy sweating, intermittent muscle tremors, whole-body shaking, and profound weakness. Affected horses might have weakness in the hindquarters, and position themselves in a peculiar dog-sitting posture. In other cases, horses may make unusual respiratory sounds, which result from paralysis of muscles that serve the larynx and pharynx and aid in breathing. In severe cases, horses might collapse. Sudden death can occur and is usually the result of cardiac arrest due to extremely elevated potassium levels. Once signs begin, episodes may last a few minutes or a few hours.

Stress frequently precipitates clinical signs of the disease. Many HYPP-positive horses show few or no signs of the disease in their lifetime. Others show signs only when they become stressed. It's not unusual, therefore, for horses to show signs during transport or upon arrival at a horse show, rodeo, parade, or other event as well as during other stressful times such as clipping, veterinary procedures, or farrier visits. In foals, the anxiety associated with weaning has brought about attacks. General anesthesia may also cause an attack of HYPP, so consult with your veterinarian about the HYPP status of a horse before veterinary procedures are performed.

For many HYPP-positive horses, however, the attacks come about without provocation.

Diagnosis of HYPP

A DNA test, using hair or blood, is available to identify horses carrying the defective gene that causes HYPP. According to Sharon Spier, D.V.M., Ph.D., writing on the University of California-Davis Veterinary Genetics Laboratory Web site, "The test is extremely specific, and is accurate for the gene sequence substitution which has been shown to cause HYPP in descendants of Impressive."

Potassium Levels in Common Feedstuffs

Low-potassium feedstuffs

(should constitute the majority of an HYPP-positive horse's diet)

Oats
Corn
Barley
Wheat
Wheat midds (middlings)
Wheat bran
Soybean hulls
Beet pulp (without molasses)
Pure fats and oils (corn and other vegetable oils)

Medium-potassium feedstuffs

(should be fed with low-potassium feedstuffs)

Brome hay
Fescue hay
Clover hay
Timothy hay
Coastal bermudagrass hay
Oat hay
Kentucky bluegrass
Stabilized rice bran

High-potassium feedstuffs

(should be avoided)

Molasses (from sugar beets or sugarcane)
Soybean meal
Alfalfa hay or cubes
Reed canarygrass
Orchardgrass
Rich spring pasture
Canola oil
Electrolyte supplements

Understanding HYPP

Here's a short list of terms that may be helpful as you learn more about HYPP by reading this article and others.

- **asymptomatic** – presenting no symptoms or signs of disease
- **genetic mutation** – a relatively permanent change in hereditary material involving either a physical change in chromosome relations or a biochemical change in the codons that make up genes
- **heterozygous** – having the two alleles at corresponding loci on homologous chromosomes different for one or more loci (in the case of HYPP, N/H)
- **homozygous** – having the two genes at corresponding loci on homologous chromosomes identical for one or more loci (in the case of HYPP, H/H)
- **hyperkalemic** – having elevated potassium levels
- **paralysis** – inability to move
- **periodic** – occurring or recurring at regular intervals
- **potassium** – an electrolyte vital for normal function of nerves and muscles, among other functions
- **sodium** – the most plentiful electrolyte in the body, essential for normal body processes
- **symptomatic** – showing a symptom or a sign of a disease

After testing, horses are given one of three designations: normal (N/N), heterozygous positive (N/H), or homozygous positive (H/H). Because HYPP is a dominant trait, it is readily passed from generation to generation. Only four genetic scenarios exist: (1) when a N/N horse is bred to a N/H horse, 50% of resulting foals will be H/N and 50% will be N/N; (2) when a N/N horse is bred to a H/H horse, 100% of resulting foals will be N/H; (3) when a N/H horse is bred to a N/H horse, 50% of resulting foals will be N/H, 25% will be H/H, and 25% will be N/N; and (4) when a N/H horse is bred to a H/H horse, 50% of resulting foals will either be H/H or N/H.

Most horses considered “positive” are N/H, as those identified as H/H are the most fragile, requiring meticulous care and management for long-term survival.

Preventing Attacks in HYPP-Positive Horses

Dietary management is key to preventing attacks. Potassium abounds in the normal diets of horses. Therefore, limiting potassium intake is the most crucial element. Total potassium in the diet should not exceed 1%. Requirements differ depending on the lifestyle of the horse. Sedentary horses may require less potassium, and intense exercise may increase that requirement twofold. An equine nutritionist should be consulted if questions arise while formulating a diet for a horse with HYPP.

Forages. Whether it's pasture, hay, or hay cubes, forage constitutes the basis for all equine diets. For horses afflicted with HYPP, forage choices narrow considerably. According to Nutrient Requirements of Horses, produced by the National Research Council, grass forages generally contain 1-2% potassium and would be classified as middle-potassium feedstuffs. When paired with a low-potassium cereal grain, a suitable diet can be formulated. The addition of an all-purpose vitamin and mineral supplement may be necessary. Even though this supplement will likely contain potassium, when fed with other low-potassium feeds, the total diet will not contain excessive potassium. Legumes, particularly alfalfa, tend to be higher in potassium and should be used sparingly or not at all in the diets of HYPP-positive horses.

If the horse is an easy keeper (maintains his weight well on little feed), he may derive sufficient calories from pasture alone. Be astute as to the plants within the pasture, however. Fields should not contain significant legumes such as varieties of clover. Low-potassium plants should comprise the majority of plant life in paddocks and pastures intended for HYPP-positive horses.

A reminder: Hay and pasture can be tested for potassium content. Contact an equine nutritionist or a local or state extension specialist to learn more about forage test-



Because of Impressive's incredible prepotency, he was often crossed with Appaloosa mares. Before purchasing a Quarter Horse, Appaloosa or Paint with Impressive in its pedigree, be sure to ask about the horse's HYPP status.

ing. Your local feed store may also be able to help you with this service.

Concentrates. Most commercially prepared sweet and pelleted feeds are a no-no for HYPP-positive horses because they contain molasses. According to Nutrient Requirements of Horses, molasses often possesses as much as 6% potassium. Soybean meal, far and away the primary source of protein in sweet and pelleted feeds, is also rich in potassium.

If textured or pelleted feeds are stricken from the menu, what's left? Plain oats are the most popular grain fed to horses and represent a low-potassium option. Oats are

AQHA's Position on HYPP

The American Quarter Horse Association (AQHA) classifies HYPP as a genetic defect. Beginning in 1998, the association included this statement on the registration certificates of horses that traced to Impressive: "This horse has an ancestor known to carry HYPP, designated under AQHA rules as a genetic defect. AQHA recommends testing to confirm presence or absence of this gene." If the owner chooses to test the horse and the test reveals a negative finding, the above statement is replaced by "HYPP N/N" on the registration certificate. Mandatory testing for HYPP is required with parentage verification.

appropriate for horses that are not sensitive to starch. If calories must be added and starch-laden feeds are not an option, calorie-dense vegetable oils are safe.

Salt and water. Salt and water are critical for affected horses. A lack of either reduces urination, which is how the horse rids superfluous potassium from the body. A white salt block is best.

Supplements. Read carefully the ingredient lists of any supplements intended for an HYPP horse. Most commercial electrolytes are unsuitable for these horses as they contain high levels of potassium. If the label does not reveal ingredients or a guaranteed analysis, contact the manufacturer to get the information.

Medication

In addition to strict control of diet, the administration of acetazolamide has been recommended for HYPP-positive horse. Acetazolamide is a diuretic often recommended by veterinarians, especially for young HYPP-positive horses being fed high-protein (and often high-potassium) diets to promote growth. The medication stabilizes blood glucose and potassium by stimulating insulin excretion.

It's not unusual for horses to be maintained on the medication for long periods of time. Many halter horses continue to be fed pure alfalfa hay while simultaneously receiving this medication daily. Breed registries differ in their restrictions on the use of acetazolamide during competitions.

Exercise

In nutrition and exercise physiology circles, it's well known that exercise increases potassium levels in the blood. Logic would dictate, therefore, that exercise would increase the likelihood of an HYPP attack. The opposite has proven true. A regular exercise schedule is advised. When the horse is not exercised under saddle or in harness, he should have access to turnout that provides low-potassium forage, salt, water, and adequate shelter. Stall confinement is often contraindicated for horses with HYPP.

The Future of HYPP-Positive Horses

Responsible breeding is the key to reducing the incidence of HYPP in the stock-horse population. Some horsemen are reluctant to eradicate HYPP-positive horses from their breeding programs because they often possess the very qualities that garner not only championship ribbons but glory. But too often that glory comes at a steep price. ☹



Reprint Courtesy of Kentucky Equine Research, Inc.

3910 Delaney Ferry Road
Versailles, KY 40383
Phone: 859-873-1988
Fax: 859-873-3781
Order Department: 888-873-1988
www.ker.com
info@ker.com