Iron is absolutely essential for life. The high affinity of iron for oxygen is what makes it so useful in trapping oxygen in hemoglobin for delivery to the body tissues. Iron is also incorporated in some very reactive enzyme systems. However, iron’s high affinity for oxygen and high reactivity also makes it dangerous.

Free, ionized iron will react with peroxide or water in the body, ending in the creation of OH*, hydroxy radicals. OH* damages lipids/fats in cell structures and membranes, in the process generating more radicals to produce a chain reaction of destruction.

Iron is absorbed by binding to specific metal transporters in the small intestine, and also passively via the junctions between cells. Work in other species has shown that the volatile fatty acids produced from fiber fermentation enhance iron absorption in the colon. Because the horse is a hind gut fermenter, this likely is a significant source of iron. Iron bound to metal transporters is taken inside the intestinal cells. From there, it may be bound to blood proteins and released, or continue to accumulate and eventually be lost into the manure when the cell dies. By regulating how much iron gets released into the blood, the body has some control. However, the other pathways for absorption cannot be regulated.

If you ask any veterinary pathologist they will tell you that finding black, iron loaded livers at necropsy is common in horses. The color comes from iron deposits called hemosiderin.
This is so common it is considered “normal”. There are reports of iron causing liver disease, even death in foals, but chronic conditions related to iron overload were not recognized in horses.

Iron overload in humans is usually caused genetic disorders resulting in overabsorption, or diseases that require frequent transfusions. However, overload related to diet is also possible. Liver damage or liver failure does occur, but is a late stage. Earlier symptoms include fatigue, joint pain/arthritis and often metabolic syndrome/insulin resistance.

The same syndrome and consequences has been recognized in a variety of animal species, including several birds, black rhinoceros, tapir, lemur, and dolphin. It may also be linked to IR in other old world primates but iron overload has not been studied in them.

A paper on iron storage disease in lemurs can be found here

An extensive paper can be seen here assessing iron storage disease in black rhinoceros and other animals
Iron overload symptoms in horses are likely a combination of direct iron effects and induced secondary deficiencies of other minerals. These include coat changes of bleaching and red ends on dark manes and tails, often hoof issues such as laminitis and abscessing.

Iron overload symptoms in horses include coat changes of bleaching and red ends on dark manes and tails, often hoof issues such as laminitis and abscessing.
A recently released study, shown below, linked iron status to IR in horses:

![Image of study](Image)

A potential link between insulin resistance and iron overload disorder in browsing rhinoceroses investigated through the use of an equine model.

Author information

Abstract
Iron overload disorder affects captive rhinoceroses but has not been documented in the wild. The specific cause for the disorder has not been identified but is likely associated with diet and management. Compared with wild counterparts, captive rhinoceroses eat diets containing more iron, have greater fat stores, and exercise less. It has been suggested that the problem may be linked to development of insulin resistance in the captive population. Given that controlled experiments with sufficient numbers of rhinoceroses are logistically not possible, an equine model was used to look for a relationship between iron status and insulin resistance; the nutritional requirements of horses are used as a guide for rhinoceroses, because they have similar gastrointestinal tracts. Sixteen horses were tested to determine blood insulin responses to an oral drench of dextrose (0.25 g/kg bodyweight) and a meal of pelleted corn (1.5 g/kg bodyweight). Feeding blood samples were taken 30 and 60 min before administration. Further blood samples were taken every 30 min for 4 hr after administration to determine peak insulin and total area under the insulin curve (AUC). Feeding samples were tested for serum ferritin concentrations. Correlations were determined between ferritin and peak insulin concentrations and insulin AUC after administration of oral dextrose and pelleted corn. The strongest correlation was between ferritin and insulin AUC after dextrose administration (r = 0.60; P = 0.01), followed by AUC after feeding a meal of pelleted corn (r = 0.60; P = 0.01), with the correlation for peak insulin being 0.53 (P = 0.03) after dextrose administration and 0.56 (P = 0.02) after pelleted corn. When evaluating responses by gender, a significant correlation existed only for females, influenced by one insulin resistant individual. Those data support a potential link between insulin resistance and body stores of iron and also suggest that approaches to reduce the susceptibility to insulin resistance should be incorporated into management of captive browsing rhinoceroses.

Other areas for exploration to determine if there is a link with iron status include arthritis, raised liver enzymes and other issues, even Cushing’s disease because the changes seen in the brains of horses with Cushing’s are virtually identical to those seen in human brains with iron overload. There is a discussion of this and suggestions for further research in my [Equine Congress paper here](link).

**Diagnosis and Treatment of Iron Overload in Horses**

The only way to accurately diagnose iron overload is with the correct blood work. Serum iron alone is not accurate. It reflects iron in the diet but not how much is stored.

Transferrin is the protein that carries iron in the blood. When transferrin and iron are both measured, the percent transferrin saturation can be calculated by dividing serum iron by transferrin and multiplying by 100. That % is useful in interpreting the third test that is needed, ferritin.

**Ferritin is a measure of the body's total iron content. High ferritin can mean iron overload but chronic disease involving inflammation or infection may also elevate ferritin.**

Click To Tweet With true iron overload, transferrin saturation is high normal or elevated. There is currently only one laboratory in the world that can measure equine ferritin, the comparative hematology laboratory at [Kansas State Veterinary Diagnostic Laboratory](link).
Iron overload in humans is treated by phlebotomy – blood draws. Blood letting sounds positively medieval but is a very effective way to reduce the body’s iron level because of how much iron is in red blood cells. Stored iron is then used to replace the lost red cells. It works in horses too and can have dramatic effects on IR.

A case in point was a gelding with PPID and IR that needed to have surgery to break up and remove a very large bladder stone. Despite diet and pergolide control, his insulins were always running around 120 and he was iron overloaded. The surgery took several hours and blood loss was substantial. His insulin dropped to 20 after surgery, despite a postop diet of senior feed.

Very tight mineral balancing to forage: hay, haylage, grass fed, will help iron overload in horses.Click To Tweet

An alternative to blood letting is very tight mineral balancing to the forage, grass, hay or haylage fed. The forage must be tested through forage analysis. This also works but can take a year or longer. The ratio of iron:copper:zinc must be no higher than 4:1:3. In some cases even higher copper and zinc intakes are needed.

I truly hope interest in researching possible health effects of iron in horses increases. It is a very fertile area for study and the best part about it is that iron overload is preventable.

Forageplus Talk is a free access website sponsored by

Forageplus Ltd

Intelligent Nutrition for your Horse

Dr Kellon writes a monthly e-zine called the Horse’s Mouth where you can subscribe and read more excellent articles on horse health and the way forage focused, balanced mineral approach can help your horse maintain optimal health.