

RESULTS OF HORSE HAIR TESTING FOR HORSES ON VARIOUS FEEDS

Beyond Nutrition

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When I first began doing hair tests on horses in the Pilot Point/Aubrey area, I expected to find that horses were fairly well balanced in their minerals as this is Horse Country. The first test I did showed that the horse was very low in copper, manganese and iron and had elevated phosphorus with normal levels of zinc and selenium. The next two were very similar as were subsequent ones. The high phosphorus reminded me of the water at the ranch I owned in WA state. The mineral pattern was what one would expect from excess phosphorus. I noticed that many of the horses had "big-head" syndrome as they had in WA. The name comes from calcium in the bones of the face being replaced by fibrous tissue. I had the water tested for phosphorus by Mustang water but the content was very low.

I then started researching on the web to determine what was causing this pattern. The answer appeared to be sweat loss. Very little phosphorus, zinc and selenium are lost in sweat. A lot of iron is lost in sweat as are calcium and magnesium. All the horses were low in iron except those which had elevated levels of aluminum. Aluminum which is a toxin causes iron to be mobilized from the liver to remove it. Iron cannot be absorbed by a horse unless copper is present and iodine which is necessary for thyroid function cannot be absorbed unless available iron is present. Thus sufficient copper is crucial to maintaining a normal mineral profile and a healthy horse.

I began by testing horses on the main feeds fed in the area: Cargill (Acco and Nutrena, Evergreen, Martindale, and Purina). When I went to the ranches, I tested both body and fetlock hair. The former is tissue and shows the minerals available to the horse for current use. The latter is cuticle and shows the minerals that are being excreted by the horse. Note that the mineral levels are expressed in mg% on the hair test results. To convert mg% to parts per million (ppm) multiply by ten. Martindale and Purina turned out to be very alike as the horses tested from both had very similar profiles: low in copper, iron and manganese. The test results for Trash show why this is so. Note that in fetlock hair (cuticle) more copper and manganese are present while in body hair there is much less. Iron is low in fetlock hair but even lower in body hair. The reason is that zinc is interfering with their absorption and they are lost for use and excreted via cuticle hair (e.g. fetlock, mane and tail). Neither of these feeds contains any organically combined minerals. Cargill and Evergreen feeds have a different mineral pattern due to the use of ZIN-PRO 4 PLEX (zinc, copper, manganese and cobalt). Nasty illustrates their profile. Copper is present in both body and fetlock hair at a reasonable level. Manganese is below normal and even more is lost via fetlock hair due to interference from zinc. Cobalt is very low in both. Iron is low in both and even more is lost due to zinc.

Thus none of the feeds produce a normal mineral profile and iron is extremely low in horses on all of them. I asked one of the local veterinarians if she had noticed any horses

with iron deficiency. She replied her clinic had. I asked her what they recommended to bring the iron levels up and she replied that nothing worked. The hair test revealed that the feeds were responsible for iron deficiency due to insufficient available copper. High levels of zinc, manganese and iron interfered with copper so that the horses had a copper deficiency. The high Zn:Cu ratios pointed to copper deficiency also. I gave my horses Lixotinic by the gallon while they were in WA state. The hair test done on my mare Sophie (deceased) showed extremely low iron. I wondered why until I did the comparisons of body and fetlock hair. She had been on Purina feed. Little research has been done on iron and the assumption is that horses have adequate levels of iron. Horses lose iron in sweat and copper is needed to make more iron available. I also tested a yearling (Cowboy) that had very low iron. He was also copper deficient. He was on Nutrena Compete feed and the remainder of the profile is similar except that he has very elevated sodium and potassium. Both elevated and low levels of sodium and potassium are indicative of overactive adrenals.

In July my 20 year old mare Madonna stopped sweating. I had never heard that horses did this until I came to Texas. I gave her One AC for three months and she did not start sweating. I was told it works best to give it before the horse stops sweating completely. Wise too late. I reviewed all the hair tests and on November 3rd took her off Purina Equine Senior and put her on oats and Dia Glo (a discontinued supplement that contains iron proteinate and copper). In less than 48 hours I came home late in the afternoon to find her sweating. I was astounded. The One AC must have repaired her dopaminic system but she required copper and iron to start sweating again. This has not been reported but it appears that adequate levels of copper and iron are necessary to keep a horse sweating. The other "cure" is Pro Sweat a supplement which has no contents label. I had Pro Sweat tested for mineral content and chloride. The results showed that it contains potassium chloride which makes horses sweat. The problem is that it does not provide the horse with the other minerals lost in sweat and thus further depletes its body of essential minerals. Hair tests done at different ranches on several horses that were given Pro Sweat showed that horses eating oats had elevated levels of aluminum, iron and potassium. Testing showed the oats contained significant levels of aluminum as did Pro Sweat. The ranch feeding the oats with the highest level of aluminum had the most nonsweaters. Chloride is known to depress iodine levels and thus cause hypothyroidism in the same way that fluoride does. It may also enhance the absorption of aluminum as does fluoride. Pro Sweat is now being tested for fluoride. There is also a supplement (Equine Multi-Pak) made by Albion Advanced Nutrition that contains chelated minerals that supplies the minerals lost in sweat. This supplement is the logical choice for ranches that do not want to change the type of feed they use as it contains no selenium. Thus I recommend that oats and feeds containing significant amounts of aluminum should not be fed to horses especially in areas where anhidrosis is common.

In order to determine whether the chelated minerals produced by Albion could supply horses with the copper and iron and other minerals they needed to keep sweating, I designed a study to compare normal horses (sweaters) with horses that had stopped sweating and had been given Pro Sweat. I had already found that high aluminum in oats was correlated with nonsweating. I was interested to see whether other nonsweaters on

different feeds also had elevated levels of aluminum. I chose six "normals" and six "nonsweaters" at six different ranches for the study. Three normals were at ranches which did not have any nonsweaters. Horses were given pre-supplement hair tests. Then most horses were on the chelates for at least sixty days. One horse on oats was tested after thirty days on the supplement as he had very elevated levels of aluminum, manganese, and iron. I was curious to see if and how rapidly the chelated minerals made a difference. When I went to the ranches to do the hair tests, I learned that one of the normals had difficulty getting sufficient air and was being given ventipulmin. I researched the problem and found it too is due to iron deficiency. Later I learned that one of the nonsweaters also had difficulty getting air. Two of the horses were working cow horses; all the rest were reiners. Both of these disciplines require a lot of exercise at high speed. Thus the horses sweat a great deal and lose more minerals than pleasure horses.

To date results are back on eight horses. I decided to write these up so that results would be available before the hot weather season. The preliminary results show that for the nonsweaters and the horses having difficulty getting sufficient air, in particular, the Albion chelated minerals did help to lower levels of aluminum in body hair and increase its excretion in fetlock hair. The trainers felt that the supplement helped the horses sweat better and enabled them to get more air and want to keep them on it. Thus it corrects damage the use of Pro Sweat does and promotes sweating in horses that did not respond to One AC. I have advised trainers to use both One AC and chelated minerals to ensure that horses do not stop sweating as each one addresses a different component of making horses sweat. It is easier to keep a horse sweating than it is to start it sweating once it has stopped. Pro Sweat did make some horses sweat but at a cost to their overall health. Moreover, it further depleted the horses of minerals lost in sweat so they became dependant on it to make them sweat. That was good for the manufacturer but not the horses.

Test results for four of the horses revealed some interesting information:

Larry is a nonsweater and had been on Pro Sweat. The initial tests showed he had a pattern termed the "four lows" as all four macrominerals have levels below normal. The test following the supplement showed he was actually carrying body burdens of high levels of aluminum and heavy metals. I had seen a similar pattern for a horse that had been on fluoridated surface water in Colorado. Surface water is treated with alum (aluminum sulfate) to remove particles. Fluoride reacts with aluminum so that it is taken into the body more readily. Fluoride also interferes with the uptake of iodine by the thyroid and thus may lower its activity. Larry had been in Kentucky for several years where most of the water is fluoridated. The chelates mobilized aluminum from bone and heavy metals from storage sites in the body so that they were being removed. The trainer said Larry was sweating better than previously. This chelation effect also improves the overall health of the horse. If horses are on or have been on fluoridated water, it is very beneficial for them to be given the chelates to prevent aluminum and heavy metal accumulation or remove it.

Larry's stablemate MCD had been given an all breed (cattle) supplement along with Big V heritage feed which contains Zin-Pro 4 PLEX. He also is a nonsweater that had been given Pro Sweat. Since feeds are formulated to contain minerals at levels appropriate for horses, it can be more harmful than beneficial to also give them all breed minerals which are formulated for cattle. MCD's test results illustrate that excessive minerals were being supplied. The zinc level in body hair was too high. The extremely high level of zinc and elevated manganese in fetlock hair showed the intake of zinc and manganese were indeed excessive. The chelates lowered zinc in the body hair and much less zinc and manganese were excreted in fetlock hair as the all breed supplement was not given to MCD while he was given the chelates. Note that the chelates increased the excretion level of aluminum from storage sites (bone) in the body and excreted it via fetlock hair along with iron.

SP another horse at the same ranch as Larry and MCD had been given Stride a supplement which also contains Albion chelates for three years. Body and fetlock hair were tested to compare whether Stride or the Multi-Pak produced better results. As both SP and Larry were not getting the all breed minerals they differ only in Stride vs. the Multi-Pak. SP had never been on Pro Sweat. SP was given thyroid medication which made him sweat. His body hair test result showed very low potassium which is needed to sensitize tissues to thyroxine. It is likely that the elevated zinc in Stride depressed potassium so that thyroid medication was required by SP. SP's Ca/K ratio (thyroid ratio) is elevated which indicates low thyroxine activity at the cellular level. Larry also had low potassium on the pre-test. The Multi-Pak, in contrast, greatly increased the level of potassium in his body hair in sixty days. His Ca/K ratio was also lowered to the normal range. Overall, sixty days on the Multi-Pak produced a much more normal pattern in Larry than Stride had in SP over several years.

SSB's trainer referred to him as the "king" of the nonsweaters. He had been on Pro Sweat for more than one season. The pre-test showed aluminum, iron and manganese levels near the top of or off the chart. Sodium and potassium were very low. Note the elevated arsenic and low selenium levels. SSB is a stallion and the breeding manager said his sperm motility was low. An enzyme essential for sperm motility contains selenium. If selenium is low, sperm motility is slow. The post-test shows lower arsenic and increased selenium. The breeding manager said his sperm motility increased with the use of the chelates. In only 30 days the chelates had lowered the levels of aluminum, iron and manganese markedly. At the same time the amounts in fetlock hair increased with the exception of iron.

It is useful information that the chelates are detoxing the horses that had been on Pro Sweat and horses that had been on fluoridated water so rapidly.

I also had my own unfortunate experience with a feed. In less than a month my horses were all having health problems. Two had gas colic, one ran a temperature of 106 (depressed immune system), and my laminitic mare lost weight. Testing of this feed at Equi-analytical Laboratories in Ithaca, N.Y showed it contained 600 ppm aluminum and over 500 ppm iron (500 ppm is toxic to horses). As beet pulp was the main ingredient I

researched its iron and aluminum content. The Equi-analytical library showed beet pulp contains high iron. I also found that aluminum sulfate is used as a press agent to remove sugar from beets. Thus beet pulp is the source of elevated levels of iron and aluminum. Beet pulp is used as an ingredient in some senior and performance feeds because of its high digestibility. In my opinion, the high iron and aluminum content makes it a poor choice for horses. Other horse feeds contain soybean hulls to increase digestibility. Since soybeans are processed by acid washing in tanks that often are made of aluminum, soy products in horse feed may also contribute to the aluminum content. The other minerals were not present at the levels specified in the "Guaranteed Analysis". Moreover, the ratios were all off.

The general balancing ratios for horses are:

Major (Macro) Minerals:

Calcium 1 – 1½ to 2 times phosphorus and magnesium

Potassium 3.3 to 10 times sodium (3.3:1 is the ideal target)

Trace (Micro) Minerals:

Iron 4 to 10 times copper (4:1 is the ideal target)

Zinc and manganese 3 times copper, with manganese lower than zinc

Healthy horses can tolerate fairly large deviations from these ratios but circumstances like pregnancy, age and illness lower the tolerance for imbalance. Other factors may affect balancing a ration, including long standing excesses or deficiencies, high levels of toxic minerals (aluminum, lead cadmium, etc.), and area water mineral levels (e.g. iron).

Bottom line: Everything interfered with copper which was present at a level one-third lower than it was guaranteed to be. It is doubtful the horses were getting any copper at all from this feed. I had tried this feed in December. It is almost May and my mares have not been cycling normally. The lesson from this experience is: Test a feed before you give it to your horses.

IN MEMORIAM

COLONELS MADONNA May 11, 1987 - June 9, 2008

Summer came early this year in North Texas and the weather turned very hot the end of May. I had moved my horses to another pasture on May 1st as a tornado had blown the roof off their shelter in April. I had given Madonna One-AC all winter and as much Dia-Glo as I had left but when the weather turned hot, she started puffing and was sweating only under her mane. I had hoped she would resume sweating normally but she did not. I started giving her Lixotinic. Evidently, the three months of nonsweating had caused her sweat glands to atrophy. I decided to move her to a friend's mare motel where

she could have a fan and total shade. When the trailer arrived to pick her up, she would not get up even though I had given her a dose of banamine paste earlier. She was putting her head up and then banging it on the ground. I knew her well enough to know that she had given up trying to put up with her situation. I decided I had no option but to call my vet and have her euthanized. I was not really up to this either but I had to do it for her.

Be aware that anhydrosis is a serious condition that can be deadly to your horse if it is low in available copper and iron. Since sulfur can also interfere with copper, I examined sulfur levels in the horses. In addition, Madonna's coat was dry in areas that were losing hair and she appeared unable to thermoregulate. I suspected that her thyroid function was not normal. The Pro Sweat horses thyroid ratios showed they were hypothyroid. I decided to examine the iodine levels in the study horses. I had always wondered about the high Ca:P mean ratio (6.14:1) in the 500+ horses and what significance that had. Since all those horses had been found to have elevated aluminum (mean of 490 ppm) and aluminum interferes with phosphorus, I felt the answer might account for the "big-head" syndrome that had first caught my attention.

The NRC recommendation (2007) for sulfur for horses is 0.15% (1500 ppm). The major sources of sulfur in feeds are soybean meal, distillers' grains, corn gluten and barley malt sprouts which may contain 0.4 and 1% sulfur. Diets containing more than 0.35% (3500 ppm) sulfur are copper deficient due to interference with copper absorption by sulfur. The normal range for sulfur in the original test horses is 3200 – 4200 ppm. Thus many of the horses tested to determine normal values were actually receiving more sulfur than is required and were copper deficient. Ten of the forty horses tested in this study had sulfur levels below 3500 ppm. Four of those had been on Pro Sweat, one had been on fluoridated water, one on diet balancer made by Progressive Nutrition, one on Evergreen feed, one on oats and two unknowns in Colorado. The others all had sulfur levels exceeding 3500 ppm. Nic on Martindale had the highest sulfur level at 4636 ppm and Trash on Purina was second at 4624 ppm. In general, horses on Purina and Cargill feeds had higher sulfur levels than horses on Evergreen or oats.

Analysis of the iodine levels in the study horses revealed that over a third of them exceeded the original range of 0.68 – 1.20 ppm (Table 1). Most of them were nonsweaters. Since it turned out that the nonsweaters that had Pro Sweat were highly represented in this group, I feel it is safe to assume that Pro Sweat contains iodine. The first horse I tested was Lipstick who had been euthanized before the results of her hair test came back. She had severe anemia which can be caused by excess iodine. Later testing of her mom showed she had an extremely elevated level of iodine. The most likely source of iodine was kelp. The veterinarians had diagnosed Lipstick with navel ill. Without the hair test I doubt anyone would have suspected the true cause of her health problems. This demonstrates the usefulness of the hair test as a diagnostic tool for difficult cases. Purina Equine Senior was also a source of excess iodine. My mare Dolly was very lethargic and had a poor hair coat. Her energy and hair coat improved markedly when she was taken off this feed. All the horses had various symptoms of hypothyroidism. Either too little or too much iodine can cause hypothyroidism. The hair test is a simple test that provides the answer to deficiency vs. excess. It is very important

to determine whether the horse needs iodine supplementation or not. Table 1 gives the horses with iodine levels in the normal range. Nutrena feeds have iodine levels toward the higher end of the range of iodine levels while Evergreen feed is toward the lower end. Bluebonnet feed is at the low end of iodine in study horses as are the normal horses on oats, Buckeye, and BigV Heritage. Looking at the feed tags it appears that whey which is a waste product of milk production and concentrates iodine is the most likely source of excess iodine in Purina Equine Senior. Progressive Nutrition feed is produced with a higher iodine content on purpose. The former NRC guideline for iodine was 0.1 ppm. The new NRC guidelines for horses recommend 3.5 g. I feel this is in response to the observation that many horses appear hypothyroid. The logical reaction is to assume that horses are not getting sufficient iodine. The hair test results, however, show that in many cases the horses are getting too much iodine. As the safety margin for iodine in horses is so narrow (5 ppm is toxic), I feel that 3.5g is too high. No investigations have been done on the chronic effects of chronic iodine excess in horses. These data indicate horses do better on less iodine rather than more. They also indicate that excess iodine interferes with selenium which is excreted via fetlock, mane and tail hair and the hooves. While my horses were in WA state Madonna had a thick, bunchy mane that was inclined to form witches' knots. Her mom Sophie developed the characteristic Aladdin slipper foot of selenium toxicity on both front feet when she had laminitis. Later when she developed laminitis, Madonna's front hooves did the same thing. After Madonna was taken off Purina feed, her mane grew six inches longer and was straight, silky and did not tangle. My other mares manes are now growing longer too. All my horses had rings around all four hooves which is a sign of excess selenium while they were on Purina feeds. Now that they are on oats these rings are disappearing.

Information on the interactions of aluminum, phosphorus, and calcium and bone mineralization came from Equine Animal Nutrition: Feeding and Care by Lon Lewis. Aluminum interferes with the absorption of phosphorus and thus causes a negative phosphorus balance (phosphorus deficiency). As there is not sufficient phosphorus to produce bone, calcium is removed from bone and thus bone is demineralized. Thus a phosphorus deficiency as well as a phosphorus excess can cause "big-head". Calcium is removed from the facial bones and replaced by fibrous tissue. Thus aluminum in the feeds is the ultimate cause of "big-head" in horses in this area. If the phosphorus deficiency is sufficiently prolonged and severe the horse may develop shifting lameness and spontaneous fractures. Aluminum in fluoridated water can do the same thing. This phosphorus deficiency induced bone demineralization may not only increase urinary excretion of calcium but also of phosphorus. This increase in urinary phosphorus excretion is opposite of the nutritional imbalances that induced it so it is quite misleading. The fetlock hair tests showed increased excretion of calcium and phosphorus in horses with "big-head". In addition, a sufficient excess of calcium caused by phosphorus deficiency results in calcitonin secretion. Calcitonin inhibits conversion of cartilage to bone and causes resorption of calcium in bone which may result in osteochondrosis (OCD). Emphasis has been placed on calcium supplementation rather than the Ca: P ratio and this cause of OCD was missed. In fact, I found that cattle nutritionists are aware of the importance of a phosphorus deficiency caused by excess aluminum and/or iron while horse nutritionists appear to be unaware of it given the current extent of

phosphorus deficiency in horses from the feeds they have formulated. Thus excess iron content in horse feeds is also of major concern to avoid soundness problems. Only three horses in this study had Ca:P ratios in the healthy range: Larry (2.5), Angel (2.47) and LRP (2.89) on Nutrena Safe Choice. When Larry was given the Albion chelates, both high levels of aluminum and calcium were excreted and his Ca:P ratio zoomed up to 18. The same thing occurred in my mares when they were given Lixotinic (see Table 2). A test on Purina Equine Senior showed it contained 377 ppm aluminum. I am convinced that aluminum in fluoridated water and feeds is an important causative factor in "thoroughbred breakdown" as many of the thoroughbred farms in Kentucky are on municipal fluoridated water.

What has become clear doing the hair tests on horses locally is that the hair test "norms" developed by Dr. Raymond LeRoy using horses in Colorado and Arizona reflect mineral balances that are the result of contamination of horse feeds by aluminum which is nothing other than a toxin as well as inputs of excess iron, iodine and sulfur. Aluminum not only interferes with phosphorus but also binds with iron, manganese, chromium and iodine so that they are unavailable. Beet pulp is one of the ingredients that accounts for a great deal of the aluminum and iron. The Zn:Cu ratio should be at most 4:1 and the original horses had a Zn:Cu mean ratio of 14.47:1. This is terrible as copper is important for many critical enzymes and proper bone development. Since the level of copper is influenced by not only Zn but also sulfur, manganese, and iron all of these should be lower in feeds. Instead, the levels were all increased by the 2007 NRC recommendations. The copper level was increased also but evidently given the ratios in horses not nearly enough. All the horses tested locally had Zn:Cu ratios higher than the mean ratios. My horses on Purina Equine Senior had Zn:Cu ratios between 20 and 30. Trash on Purina Senior had the highest Zn:Cu ratio (70). His body hair level was 2 ppm and the fetlock hair level was 8 ppm. Most of the copper was excreted and unavailable for use. Horses on other feeds generally had Zn:Cu ratios between 16 and 25. Clearly, the feed companies need to adjust their formulas to provide the horses with adequate copper.

I have contacted the various feed company nutritionists about my findings and only one nutritionist has been willing to discuss them with me. I had hoped for a better response than that but it is better than none. In his article on trace minerals for the performance horse equine nutritionist Steve Jackson notes the lack of data is staggering. This study provides data and direction.

As more hair testing is done and more information is available I will update this information. Albion chelates can be ordered on the web from various veterinary and supplement suppliers. If you are interested in having hair testing done on your horse(s), please contact me at methylsue@yahoo.com for hair sampling directions, costs, and mailing addresses.