Assessment of Trace Mineral Nutritional Status - An Important Part of Animal Health

Trace mineral nutritional analyses are an important—and often overlooked—part of total health-care management. The Diagnostic Center for Population and Animal Health has extensive capacity for mineral analysis in a wide variety of sample types such as feed, blood and blood serum, and animal tissues such as liver and bone. The instruments we have available for mineral analysis are among the most sensitive in the world, allowing us to analyze samples for nearly any mineral in existence, even when the concentrations of individual minerals in a sample are extremely small. Moreover, our instruments are automated and suitable for high-volume, rapid analysis. This means we provide the results for mineral analyses of most sample types within three days, and often within the same day the sample is received at the laboratory.

DCPAH offers a number of mineral profiles to help you assess the nutritional status of animals under your care. Attention should be given to ensure that samples for mineral analysis—especially blood mineral analysis—are collected and handled appropriately. The nutritional interpretation of sample results can be complex and varies with specific minerals. The remainder of this article provides information about the applications of the selenium, selenium/copper, and primary trace nutrient panels. DCPAH also offers an electrolyte panel (as a stand-alone test or in combination with the primary trace nutrient panel) and a toxic-element screen to identify lead, arsenic, and other heavy metals. Please see the test catalog on our website at www.animalhealth.msu.edu for more information about available nutritional testing.

Selenium and Selenium/Copper Panel
Selenium and copper are the trace elements most likely to be deficient in livestock diets, particularly the diets of grazing livestock and those subsisting primarily on forages.

Selenium may be measured in either serum or whole blood; each is a relatively sensitive indicator of dietary selenium status. Whole-blood selenium concentrations, however, are more stable over time and are thus a better long-term indicator of selenium status than is serum selenium. To run the selenium tests alone, submit EDTA-preserved (purple top tube) whole blood.

Copper is currently measured in serum. There is some confusion about the value of serum-copper concentrations for assessment of nutritional status. The test is relatively insensitive, but is reasonably specific as an indicator of dietary copper deficiency. This means that animals with marginal or deficient copper intake may have serum-copper concentrations in an adequate range, resulting in a false-negative result for copper deficiency. However, animals with serum concentrations in the deficient range are likely to be truly copper deficient. There are few false positives with respect to copper deficiency. A serum sample in a red-top tube is the minimum sample required for the selenium and copper panel. When only a serum sample is received, both elements are measured in serum. The recommended submission, however, is two tubes: serum from a red-top tube for copper plus a purple-top tube of whole blood for selenium. The price of the panel is the same whether the selenium is measured in serum or whole blood. (Continued on page 3.....)
Specimen Shipping Tip #2 - Need to Chill? Use a Gel Pack!

Many of the specialty and routine tests offered at DCPAH require the samples to be received at less than 60 degrees Fahrenheit. To make sure these samples arrive at the proper temperature, it is important to use dry ice, frozen gel packs, or another type of commercially-available frozen brick. Makeshift ice packs or ice cubes can melt and leak in transit, jeopardizing the sample. Further, the postal service may refuse to handle a leaking diagnostic specimen container. If shipping a frozen sample, it is extremely important to use an insulated container within a sturdy box. The box should be able to withstand any abuse that may be encountered in the shipping process. The smaller DCPAH shipping boxes are not intended for use with cold packs, but we offer insulated boxes that will accommodate both the commercial cold packs and several diagnostic samples. These boxes are available for $10 each. For ordering instructions or for more information about proper shipping methods for diagnostic specimens, please visit our Website at www.animalhealth.msu.edu or call 517-353-1683.

Autumn Brings Risk of Red Maple Leaf Toxicity in Horses

Dr. Jennifer Thomas, Acting Department Chair, Pathobiology and Diagnostic Investigation

Ingestion of red maple leaves is associated with acute hemolytic anemia in horses. Fresh leaves are not toxic. Only ingestion of wilted or dried leaves will cause anemia so the syndrome tends to occur in summer and fall. Leaves are toxic at levels of 1.5g/kg body weight or more. There is no age, sex or breed predilection. Most horses will show signs within 24 to 48 hours of ingestion of leaves. Clinical presentation varies from subclinical to death. Commonly reported clinical signs include acute onset of weakness, lethargy, inappetance, icterus, colic, and discolored urine due to hemoglobinuria. Physical examination may reveal brown discoloration of the mucous membranes due to the presence of methemoglobinemia. Renal failure and laminitis are frequent sequela. Complications are associated with tissue hypoxia resulting from decreased erythrocyte mass and decreased oxygen carrying ability of hemoglobin due to methemoglobin formation. Anemia results from oxidative damage to erythrocytes, leading to intravascular and extravascular destruction of damaged cells. Gallic acid is a strong oxidant that has been identified in maple leaves and likely, in combination with other as yet unidentified compounds, plays a role in the pathogenesis.

Differential diagnoses for acute hemolytic anemia in horses include primary or secondary immune-mediated hemolytic anemia, equine infectious anemia, babesiosis, fragmentation due to angiopathy, or oxidative damage. Microscopic examination of a blood smear often provides vital diagnostic clues in patients with a hemolytic anemia. A diagnosis of red maple leave toxicity is based upon historical exposure to red maple leaves and laboratory evidence of oxidative damage. In horses, finding Heinz bodies or eccentricocytes on a blood smear are suggestive of red maple leaf toxicity. Heinz bodies are precipitates of denatured hemoglobin that form following oxidative damage. Eccentricocytes are erythrocytes that have the hemoglobin displaced to the side of a collapsed, crescent shape region. They form when oxidative damage causes abnormal membrane adhesions. Less common causes of oxidant damage in horses include onions, phenothiazine, or congenital deficiencies of erythrocyte enzymes. If red maple leave toxicity is suspected, air dried blood smears and EDTA anticoagulated blood should be submitted for a CBC.
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Primary Trace Nutrient Panel
This panel includes iron, cobalt, zinc, manganese, and molybdenum, in addition to copper and selenium. Use this panel when a more detailed investigation of trace-nutritional-element status is desired.

Iron deficiency in livestock species is most likely to occur in very young animals. Because hemolysis can result in false elevations in serum-iron concentrations, a test specific for non-heme iron is used in the primary trace nutrient panel. The anticoagulant EDTA interferes with the non-heme iron assay, making it very important to submit serum samples, rather than plasma, for this assay.

Cobalt as an element is a dietary requirement only for ruminants, in which cyanocobalamin, or vitamin B12, is synthesized from cobalt by rumen microbes. Monogastric species require dietary cobalt only as a component of preformed vitamin B12. Serum cobalt concentrations appear to be a relatively sensitive indicator of dietary cobalt consumption, and cobalt deficiency is a major livestock production problem in some areas of the world. At DCPAH we have only recently had the capability of measuring cobalt concentrations in serum and we are still in the process of establishing reference ranges.

Zinc nutritional deficiencies can occur under practical livestock management conditions. However, serum zinc concentrations are generally insensitive determinants of zinc deficiency. Similar to copper, however, a low serum zinc concentration is a reasonably specific indicator of zinc deficiency. For accurate serum zinc determination it is critical that samples be collected and shipped in appropriate containers. Regular rubber collection tube stoppers contain zinc, which can leach into the sample, giving artificially-elevated zinc results. Special royal-blue-stopper tubes, suitable for zinc samples, are available from DCPAH. Hemolysis and/or prolonged exposure of serum to the clot can also artificially elevate serum zinc concentrations, because zinc is present in red cells in higher concentrations than are normally present in serum.

Manganese deficiencies are known to occur in domestic animals, although they are generally believed to be less frequent than deficiencies of other nutritional trace elements. As with zinc and iron, there is a substantial difference in the concentration of manganese in normal blood serum versus within red cells. There is some controversy over the relative value of whole blood versus serum for the assessment of manganese nutritional status. Currently at DCPAH we are assessing manganese status from serum values. As with iron, zinc, and selenium testing, it is important to avoid hemolysis. Separate serum from the clot within a few hours after sample collection.

Molybdenum is also included in the primary trace nutrient panel. Molybdenum in very small concentrations is a dietary requirement, but in most cases we are more worried about excessive, rather than insufficient, molybdenum intake. High serum molybdenum concentrations indicate high dietary intakes, and may also signify the presence of copper thiomolybdate complexes in serum. Copper in such chemical complexes is not available for physiological functions, but does contribute to the total copper measured in serum. Thus, animals with high serum molybdenum concentrations may be copper deficient, even when total serum copper concentrations appear adequate.

The minimum sample for the primary trace nutrient panel is blood serum collected in a royal-blue stopper tube. An additional EDTA tube may be submitted, in which case selenium will be determined on whole blood. The price of the test is the same in either case. If you would like more information about mineral, nutritional, or toxin analysis capabilities at DCPAH, please visit our Website at www.animalhealth.msu.edu or call 517-353-1683.

~ Thomas H. Herdt DVM MS
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The DCPAH Website Redesign is Online!

www.animalhealth.msu.edu

- Easier Login and Report Access
- New Test Database—including Sample and Shipping Requirements
- Downloadable and Fillable Submittal Forms
- New Search Feature—Find What You’re Looking for FAST!
- The Most Up-to-Date Fee Schedules, Frequently-Asked Questions, Hot Topics, and Client Shipping Options and Procedures!