IDENTIFYING COPPER DEFICIENCIES UNDER FIELD CONDITIONS

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Having spent the last five years using injectable copper, copper oxide boluses and copper sulfate as a mineral supplement, I believe there are many more copper deficient cattle in the country than recognized. **Visual appearance and performance appraisal of the animal, historical data for an area on feed, water, blood, liver, soil, etc., and analysis of forage, water, blood, liver and soil can help in identifying copper deficiency. Genetics or breed of cattle should also be considered when appraising copper status.** Simmental and Charolais cattle have been documented to have higher copper requirements than Angus cattle. Limousin and other Exotic breeds very likely do also. I suspect within breed differences possibly exist also. I find that the Exotic breeds perform much better when the NRC dietary requirement for copper of 8 - 10 PPM is increased at least 50 percent.

Symptoms of extreme copper deficiency are easy to recognize but marginal copper deficiency is less easily recognized. Adults may be unaffected unless the deficiency is severe and long. Young animals are more severely affected.

The cheapest, easiest and first step in identifying copper deficiency is to learn to evaluate hair visually. Coarse, faded, dull off-colored hair is often an early indicator of mineral problems frequently followed by growth depression and fertility problems if the deficiency is not corrected. Other nutrients such as vitamins, protein and energy will also affect the bloom on hair but a typical cattleman does a better job of supplementing these nutrients.

Bloom, luster and vitality of hair usually indicates cattle are performing well. Too many producers accept dull, faded, bleached, off-colored, coarse hair as normal, just an indication of hard times or changing seasons.

Hair is expected to lose its luster and take on a dead appearance just prior to shedding, but this shouldn't take place months ahead of shedding. Winter hair will be long and possibly shaggy but should have luster and bloom in a healthy animal. Failure to shed properly and quickly is an indication of mineral deficiencies where protein and energy are adequate and intestinal parasites are not involved.

Cattle that continue to have that dull, wormy haired look following repeated deworming should be investigated for mineral deficiencies and diseases such as Johne's disease. The chances are great that these cattle are deficient in copper and possibly other minerals.

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Signs of Copper Deficiency

Symptoms of copper deficiency based on a review of literature and my own experiences include:

* changes in hair coat color
  - loss of hair color is very sensitive to lack of copper, especially if caused by high sulfur or molybdenum interactions
  - depigmentation usually shows up first around eyes and ears, especially the peripheral hairs of the ears, but can effect all hair
  - graying of hair is typical but
    -in Herefords red turns to yellowish-dun color
    -in Angus black turns to reddish-brown, mouse-colored
  - coat appears dry and often lacks luster
  - cattle are slow to shed winter coats
  - hair becomes kinky
  - however, copper problems have been observed when hair and body condition appeared completely normal

* fertility problems
  - delayed or suppressed estrus
  - embryo death between 30-50 days of age (gives appearance of irregular cycles)
  - nitrogen fertilization of pastures, particularly above 75 lb/acre, is documented in U.S. and Europe to result in infertility due to copper responsive causes
  - reduced birth weights

* scouring or diarrhea is common
  - not always present
  - not prolonged or profuse
  - with presence of molybdenum
    -scouring becomes profuse
    -has high gas content
    -has a foul characteristic odor

* long bone fractures for no apparent reason
  - typically in young rapidly growing animals
  - can be up to 5-10 % herd

* enlargement of medial and lateral aspects of the distal metacarpal and metatarsal physeal regions in calves
  - may show lameness
  - stiff, stilted gate, upright pasterns, reluctant to move

* characteristic soreness of feet
  - lame gait
  - swelling above coronary band
  - seems painful as animals will remove weight from one foot at a time giving all four feet needed relief over time
  - corrects rapidly with supplemental copper

* hooves may crack in adults
  - hooves grow out like foundered cattle
  - toes may then break off leaving the animal lame

* cattle stay in only moderate to poor condition even though pasture conditions suggest something better
  - decreased appetite
  - cattle don't ever appear extremely full

* simple sudden death "falling disease"
  - due to rupture of major arteries due to lack of elastin
  - first reported in Australia but now occurring in Ohio in young rapidly growing cattle and sheep

* perforating abomasal ulcers in calves have been frequently observed in copper deficient areas but cause and effect has not been proven
  - abdominal discomfort
  - colic
  - abdominal distension
  - death

* decreased immune function
  - reduced antibody production
  - reduced phagocyte function
  - reduced B and T lymphocyte function
  - reduced killing capacity of circulating leukocytes and pulmonary macrophages

* increased disease
  - mastitis
  - calf scours
  - navel infections
  - retained afterbirth
  - pneumonia
  - parasitic and mycoplasmal infections

* possibly signs of copper deficiency
  - thick hides from collagen deposition
  - tongue lolling
  - excessive licking of hair coats
  - increased incidence of ketosis

* cases of ill thrift in calves and yearlings on pasture that are unresponsive to anthelmintics should cause immediate suspicion of copper deficiency - copper deficient cattle often, but not always, look wormy.

Historical Data

There are many published research reports for certain minerals indicating plant composition for many areas. In many counties, reports of analysis of irrigation water are readily available. The Diagnostic Laboratories see many individual plant, blood and liver analyses for various minerals each year. Local veterinarians often have information available. A telephone call to your County Extension Agent or Extension Beef Cattle Specialist can often (not always) provide you potential information sources.

Blood Testing

I consider blood serum copper levels below .5 PPM to be deficient, .6 to .7 to be marginal and .8 to 1.1 adequate. When the level of various minerals fall below established minimum values, a problem is definitely defined. However, blood mineral levels often appear in a normal range even when production problems are known to exist. Low blood mineral levels help to define a problem, but normal blood levels can not always be taken as assurance that all is well. Dysfunctions in other areas of the body often occur, affecting growth or reproduction, long before mineral levels in the blood appear deficient. There are also forms of copper which appear upon analysis of blood but are not forms which are useful to the animal. Thus interpretation of blood mineral levels is not easy. Relationships among the minerals are sometimes more useful than the specific level of each mineral individually. As a result, testing of individual minerals is seldom as useful as having a complete mineral profile for minerals that are known to interact with each other. Where visual appraisal of hair, forage tests, growth and/or reproductive data suggest potential problems, mineral levels in the low-normal range should not be accepted as adequate.

Bleed at least 10 head, or 10% of a group when collecting blood for mineral analysis - possibly 6 head will give reasonable results for very small herds and keep costs reasonable. Select the animals for sampling randomly since copper actually increases in the blood during stress or sickness leading to false interpretations.

Forage Analysis

Since forages are much more variable in mineral content than concentrates, it is usually the forages that need to be analyzed but analysis of complete rations is also useful.

Diagnosis of dietary mineral deficiency in a beef herd depends largely on chemical analysis of pastures which should be done in a manner that recognizes grazing selectivity. Watch cows graze and sample what they eat as best you can. This is fairly easy to do in improved pastures with a limited number of plant species. In range areas, where numerous plant species are available for grazing, you should sample plants in proportion to the amounts of each you think the cattle might be consuming. Because of the problem of accurately sampling of the cow's diet in range areas, it may be more feasible to first sample blood for potential mineral deficiencies. In single species pasture situations, we tend to prefer forage sampling first using blood only if needed to clarify the overall picture.

A knowledge of dietary mineral intake is essential before corrective supplementation can be efficiently approached. Blood mineral analysis can help in detecting a problem, but a knowledge of mineral consumption is essential before a corrective supplementation program can be established. Thus in many instances, the mineral content of water must also be determined. Further, an estimate of soil consumption, which occurs more with drought and close gazing or in certain rainy seasons, needs to be evaluated for possible alterations to mineral intake.

I recommend increasing copper levels above the normally accepted 8 to 10 PPM of diet any time dietary molybdenum is above 2 PPM, sulfur above .2% and iron above 300 PPM or some combination of the above. Total diets containing 15 to 30 PPM of copper have worked well for us where dietary antagonist (including those from water) have been present or the exotic breeds of cattle are involved.

Water Testing

The level of minerals in water often have a very definite effect on animal performance. The performance of the animal is affected by total mineral intake from both feed and water. Many of the minerals in water are more available than those in feed. Excess iron or sulfate in water decrease copper utilization. You must estimate the contribution of minerals from water to the total diet when evaluating mineral adequacy or excess.

Soil Testing

The best use of soil testing is to evaluate the forage, to help in understanding why the forage does or does not contain a specific level of mineral. Animal performance has not related well at all with specific trace mineral levels in soils, so soil tests without forage tests aren't of much help in evaluating animal performance. Soil tests are very helpful in evaluating forage performance. Maps of varying soil types can be suggestive of potential problems but should not be relied on very heavily.

Tissue Testing

Liver levels are very good indicators of the animals status for: copper, zinc, selenium and manganese. Liver copper levels above 40 PPM (dry basis) are preferred though levels from 25 to 40 PPM may exist without apparent problems. We have observed numerous problems where levels below 10 PPM are detected. Remember that newborn calves should have about 2.5 times the liver level of copper as adults.

Liver would not normally be available for analysis unless an animal is lost, though it is possible to biopsy the live animal. Where mineral problems are suspected, have the livers of any animals that die analyzed for the suspect minerals.

Blood Enzyme Analysis

Some laboratories are running Catalase, Glutathione Peroxidase, Superoxide Dismutase and possible other enzymes to help evaluate copper, zinc and selenium status of cattle. Because of the high cost of running such assays, in excess of $75/sample, such tests will be reserved for only the most difficult of problems. Most problems can likely be solved with other cheaper analyses (feed, water, and blood mineral) which are necessary even with enzyme assays before appropriate supplementation can be formulated.

Chemical Hair Analysis

Several problems keep hair from being a good indicator of mineral status. First, dirt and contamination on the hair creates problems with over estimation while washing of hair to remove outside contamination results in leaching and underestimation of some minerals. Further, damage has already occurred in other body functions because of deficiency before the deficiency shows up in hair. Because of inconsistent results, chemical hair analysis is not routinely recommended.

THE WHY QUESTIONS

As suggested above, the symptoms of copper deficiency are often very subtle and hard to detect. Many of us need to be keener in observing our cattle and asking questions about why - why aren't the cattle full when pasture is plentiful, why don't some of the cows ever pass body condition score 4 to 5 when many are 6 or more, why don't they shed their winter coats completely and quickly, why is hair color changing from season to season if we look close enough to detect it? Copper will not be the answer to all these why questions but I'm becoming more convinced copper **and other trace minerals including zinc and selenium are the answer to many of them when they appear after we've already done most other things we know to do.**

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