

METHODS TO PREVENT COPPER DEFICIENCY IN BEEF CATTLE

Copper deficiency in beef cattle is been recognized as one of the most common disease problems in California. Copper deficiency causes significant economic losses where it occurs. Copper deficiency in cattle is complicated because it can be the result of (1) very low copper in the diet—a **primary** copper deficiency, or (2) interference with copper absorption in the animal due to molybdenum and/or sulfates in the food or water—a **secondary** copper deficiency. Regardless of the reason for the copper deficiency, the problems exhibited by the animals can be the same and result in a long list.

Diarrhea
Illthrift/poor weight gains
Weight loss
Light hair coat (achromotrichia)
Spontaneous fractures (broken bones)
Swollen joints
Rear leg weakness or paralysis in calves
Infertility
Anemia
Reduced immune function

The most common copper deficiency problems seen are light hair coat (Angus are reddish, Herefords are yellow), diarrhea, and poor weight gains (illthrift). One of the most important problems caused by copper deficiency is the reduced function of the immune system. This causes increased illnesses of various types and the cattle do not respond well when vaccinated—further increasing potential problems. This is particularly evident when cattle are weaned or sent to the feedlot. In both cases there is much more illness and death loss than normal. These problems will vary greatly from herd to herd and are not easily predictable. However, when copper deficiency does occur, it invariably causes losses in production, health, animal welfare and profits.

The problem of diarrhea may be easy to see when it is constant and profuse; however, it may only be noticed as soiling of the back of the hind legs and tail. Signs of diarrhea and/or weight loss **are not specific** for copper deficiency and could be caused by parasites, selenium deficiency, BVD virus, or a number of other conditions. The other signs of copper deficiency (broken bones, infertility, anemia, etc.) that can occur in cattle may be subtle or occur only as the deficiency worsens.

The diet of cattle (pasture, range, hay, etc.) should contain about 4-10 parts per million (ppm) of copper to supply the needs of cattle. Less than this amount results in a primary copper deficiency; however, if excess molybdenum and/or sulfates are present in

the feed or water there can be marked interference with copper utilization by the cattle and copper deficiency will result. Cattle will usually perform normally when the copper to molybdenum ratio is from 5:1 to 10:1 in the diet. When the copper to molybdenum ratio falls to 2:1 or less, one can expect severe interference with copper utilization and a resulting copper deficiency to occur. While molybdenum and sulfates are the most common interfering substances in cattle's diets, other situations can drastically interfere with copper nutrition and these include (1) soil ingestion due to overgrazing, (2) excess cadmium, (3) excess zinc, and (4) excess calcium, particularly as limestone. It is easy to see that copper nutrition in cattle can be complicated by a number of factors. While it is possible to test feed, soil, and water for all the various minerals mentioned above, it is more practical to test the cattle to determine their copper status and make any necessary changes based on those findings.

The University of California's Animal Health and Food Safety and other UC laboratories are available for routine testing of animal and feed samples for copper, as well as a number of other nutrients. Your veterinarian can test animals within your herd for copper status using serum samples (serum is the straw colored fluid in blood left when the red cells are removed). If the serum copper concentration is below 0.5 ppm in your cattle, this is diagnostic of a copper deficiency. Screening the herd with serum copper analysis is quick and inexpensive; however, it is primarily of value to identify advanced deficiency situations. Copper metabolism is complicated by the fact that most of the copper in the body is stored in the liver and it is the liver copper level that gives the true reflection of the copper status of the animal. The serum copper concentration begins to drop only after the liver copper reaches very low levels. That is why serum copper is a good screening tool; however, is not a good measurement for marginal deficiencies or for monitoring the cow herd after supplementation with copper begins. On a practical level this means that liver samples from a few cows (4 to 7) for copper analysis is necessary for monitoring the effectiveness of copper supplementation. This is important for two reasons: (1) to be sure that the copper supplementation method(s) is solving the deficiency, and (2) because excess copper is extremely toxic to cattle, to be sure that excess copper supplementation is not occurring. Liver samples from cattle can be obtained by two common methods: (1) when normal animals are slaughtered a small piece (3 ounces) of liver can be saved and frozen (indefinitely) until analyzed, and (2) your veterinarian can take liver biopsy samples from live cattle (usually 4-7 animals are sufficient) and these can be analyzed. Liver biopsy can place the animals at increased risk of Redwater and your veterinarian will usually administer penicillin after the liver biopsy procedure.

Copper deficiency can be managed by supplementation of the cattle by a variety of methods. Any time there are several methods to solve a problem that usually means no method is perfect—this is the case with copper supplementation.

- Salt-mineral mixes with copper added
- Molasses-based supplements
- Injectable copper glycinate
- Copper oxide boluses

Copper can be added to salt-mineral mixes to aid in supplementing the cattle. With diagnosed copper deficiency, these mixes are usually formulated to contain 0.2% to 0.5% copper, with the higher levels reserved for severe deficiencies. The above levels of copper in the salt-mineral mixes assume intakes of about one ounce of salt-mineral mixture per cow per day to meet the cows' copper requirements. Also, copper can be added to total mixed rations via a premix or can be added to molasses-based supplements to meet the copper requirements for the cattle.

Injectable copper glycinate has been used successfully for many years to treat and prevent copper deficiency. This product is available only through your veterinarian. Your veterinarian must diagnose copper deficiency in your herd, write a prescription for copper glycinate and send it to a compounding pharmacy where the injectable product is manufactured. This copper injection product provides adequate copper supplementation for four to six months in most cases.

Another method to supplement copper is the copper oxide bolus (Copasure®) which is given orally and usually provides supplementation for 10-12 months. This product works very well; however, it has the disadvantage of having to be given via a balling gun and the capsule is water soluble, so that it will melt if rained on. Whatever the method of supplementation it is extremely important to remember that while a little copper may be good, too much copper can be extremely toxic.

Each of these methods has advantages and disadvantages. The salt mineral mixes are inexpensive; however, they are labor intensive to keep fresh and in front of the animals. Additionally, the consumption of mineral mixes can be sporadic and/or inadequate. Most are formulated to be consumed at 1 ounce per head per day for adult beef cattle. Over consumption can be costly or cause toxicity. The molasses-based supplements promote better consumption; however, they are more expensive. The copper glycinate injections work very well in many cases. They are administered subcutaneously the injection site should be as clean as possible. Consult with your veterinarian about the proper way to administer this product in your cattle. Rarely, animal may die after the copper injections are given. This is more of a risk with selenium deficient cattle.

There is another product available that contains an injectable form of copper. This is a product called Multi-Min® and it contains copper carbonate. This product (Multi-Min®) contains much less copper than the copper glycinate injectable products and there is no data I am aware of to show whether the liver copper concentration increases after injection. The Multi-Min® product does have selenium injection which should last for about 30 days, based on the scientific literature. The copper oxide boluses work well and provide supplementation for 6-12 months; however, the boluses are sometimes difficult to administer, the cattle can cough them up, and the capsules can break or melt. Again, visit with your veterinarian about the correct way to give this product.

It is important to point out that often more than one of these methods is needed to solve a severe copper deficiency problem. This is where working with your veterinarian is an essential part of this solution. You may need to monitor the copper status of the cattle with liver samples every 1-2 years to be sure the supplementation is enough but not too much to cause toxicity which can easily kill large numbers of cattle.

All of the methods mentioned above can provide excellent supplementation for cattle. However, sheep are much more sensitive to copper toxicity than are cattle and if sheep are allowed access to copper supplements formulated for cattle in most circumstances the sheep will experience significant death losses. When copper is fed in excess of requirements it tends to accumulate in the liver. With minimal stress, the stored copper can cause death in cattle or sheep within a few hours to a few days. As the excess copper being fed accumulates in the liver there are no outward signs in the animals and death can occur at any time. Treatment of copper toxicity is invariably unsuccessful. Therefore, it is extremely important for you and your veterinarian to monitor any copper supplementation program with liver samples on at least a yearly basis. Copper deficiency occurs commonly in California and new analytical methods make diagnosis and control much easier. Working with your veterinarian, prevention of both copper deficiency and the possibility of copper toxicity are relatively straightforward even though the metabolism of copper in cattle can be very complicated.

John Maas, DVM, MS
Diplomate, ACVN & ACVIM
Extension Veterinarian
School of Veterinary Medicine
University of California-Davis