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UCD VET VIEWS  
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## COPPER NUTRITION OF BEEF CATTLE

Since the 1995 CCA column on copper deficiency in beef cattle, a number of important developments have occurred. Copper deficiency situations and copper toxicities have both been recognized more commonly in California. 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 feed or water—a secondary copper deficiency. Whether the copper deficiency is primary or secondary the common symptoms in cattle can include (1) diarrhea, (2) unthrifty appearance, (3) poor weight gains, (4) light hair coats (Angus are gray, Herefords are yellow), (5) swollen, painful joints, (6) broken bones, (7) rear leg weakness or paralysis in calves, (8) infertility, (9) anemia, and (10) decreased resistance to disease. The main symptoms vary from herd to herd and are not easily predictable. However, when copper deficiency does occur, it invariably causes losses in production, health, and profits.

The most commonly observed results of copper deficiency in cattle are diarrhea and poor weight gains, particularly in calves. The 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 can 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. Copper deficiency lowers the immune response and can make the cattle more susceptible to disease and as well as less responsive to vaccines.

The diet of cattle (pasture, range, hay, etc.) should contain about 4 to 10 parts per million (ppm) of copper. Less than this amount results in a primary copper deficiency. However, excess molybdenum and/or sulfates in the feed or water can cause a 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. While molybdenum and sulfates are the most common interfering substances, other situations can drastically interfere with copper nutrition and 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.

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). Serum copper concentrations below 0.5 ppm are 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 for copper analysis are necessary for monitoring the effectiveness of copper supplementation. This is important for two reasons: (1) to be sure that the copper supplementation 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. Many California veterinarians have been trained over the last year on advanced liver biopsy techniques and are able to help producers obtain this information about their cattle. Liver biopsy can place the animals at increased risk of Redwater and your veterinarian will usually administer a small amount of penicillin, or other appropriate antibiotic, after the liver biopsy procedure.

Copper can be supplemented to cattle by a variety of methods. Injectable copper glycinate has been used for many years to treat and prevent copper deficiency. The longtime injectable product (Moly-Cu® Schering-Plough) was removed from the market for manufacturing reasons and while it is still legal to use, it is not anticipated that it will be available as an over-the-counter (OTC) product again. There are now pharmacies that will compound copper glycinate injectable products for your veterinarian. Your veterinarian must write a prescription for your herd and the pharmacy will compound (or manufacture) the copper glycinate specifically for your herd. This process requires a prescription and is an extra-label drug use as discussed in last month's column. The pharmacies compounding these copper glycinate products have more variable methods

than previous manufacturers of copper glycinate. Therefore, I recommend each new batch of copper glycinate be given to a few cattle to observe for possible adverse reactions. Remember to always shake these copper glycinate products well before using, as the suspension tends to settle out in the bottom of the vial. Also, consult with your veterinarian regarding the best methods to use when injecting these products. Severe adverse reactions can occur after administration of copper glycinate. Copper glycinate injection products provide adequate copper supplementation for six months in most cases.

Copper can also be added to salt-mineral mixes to aid in supplementing 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 amounts of copper in the salt-mineral mixes assumes 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. A relatively new method of copper supplement is the copper oxide bolus (Copasure®-Schering-Plough) which is given orally and provides supplementation for up to 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 copper supplementation, it is important to remember that while a little copper may be good, too much copper can be extremely toxic.

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. Working with your veterinarian and UC livestock advisors, prevention of both copper deficiency and copper toxicity is relatively straightforward even though the metabolism of copper in cattle is very complicated.

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