Mighty Minerals

While copper supplements serve an important function in cattle productivity, new research suggests that, for some producers, it may be just a drain on their pocketbooks.

Story by
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Chris Vinton of Whitman, Neb., brought his mineral cost down $300/ton by asking one question — "What'd you do with *your* cattle?" Vinton says he was paying $550/ton before he met University of Nebraska-Lincoln (UNL) Extension beef reproduction specialist Gene Deutscher, now retired.

"We went to a program UNL was running near here, and the subject of supplementation was brought up. We just asked him (Deutscher) what he used on his cattle at the university. We knew they had done forage and water testing there and our range was really similar," says Vinton, who manages a 1,000-head cow-calf operation just 25 miles from the university's Gudmundsen Sandhills Laboratory.

Vinton was one of the first producers to test the results of a recently completed UNL study concluding supplementation of copper, both organic and inorganic, did not improve the total pregnancy rate or growth and health of calves. While Vinton didn't completely eliminate copper supplements from his management practices, he did lower the amounts and switch to an inorganic form.

Some producers could save $8-$12/head annually by getting rid of their copper (Cu) supplements, Deutscher says.

He and other researchers at UNL collected data for two years on 197 first-calf heifers. The heifers were divided into three groups by body condition and expected calving date. Then each group of heifers received a different level of copper supplement. The first group was a control group receiving no supplement. The second group was fed 200 milligrams (mg)/head/day of copper sulfate, an inorganic supplement. The third group was fed an organic copper supplement at 100 mg/head/day.

The study also looked at which form of copper supplement, either inorganic or organic, was most beneficial. The cattle were fed twice as much inorganic copper as they were fed organic copper because the organic form is believed to be more bioavailable, or easier to be used by the animal.

Some trace minerals are needed for vitamin synthesis, hormone production, enzyme activity, collagen formation, tissue synthesis, oxygen transport, energy production and other physiological processes related to growth, reproduction and health. [PHOTOS BY SHAUNA ROSE HERMEL]

According to UNL's report, cattle fed organic copper supplements showed even less improvement than cattle fed inorganic sources.

Deutscher says the research may differ from other studies due to the number of cattle and their copper levels before the study began. It compared reproductive performance, growth and health of the calves, and concentration of copper in the liver, colostrum and milk.

"We have more cattle in our study than many other studies," Deutscher explains. "You need to have large numbers to get accurate results. You also need to look at where our animals were at the beginning. If they had been deficient before we started, then the results would have been different."

Basic minerals

There are two categories of minerals: macrominerals and trace minerals.

Macrominerals are those required in large quantities that usually go into the synthesis of structural tissues. Calcium, phosphorus, potassium, sodium, chlorine, sulfur and magnesium are macrominerals.

Trace minerals are components or activators of various enzyme systems. Iron, zinc, copper, manganese, iodine, cobalt, molybdenum, selenium and chromium are trace minerals.

Minerals affect bone growth, help maintain water balance, help synthesize protein and may play a role in carcass characteristics, says John Paterson, a Montana State University (MSU) Extension beef cattle specialist.

Some trace minerals (cobalt, copper, iodine, iron, manganese, selenium and zinc) are needed for vitamin synthesis, hormone production, enzyme activity, collagen formation, tissue synthesis, oxygen transport, energy production and other physiological processes related to growth, reproduction and health, he explains.

Paterson says the complex balance among these minerals is not fully understood. An animal simply could be deficient in one or more minerals, causing poor productivity. Or an animal may not have

There are two types of mineral deficiencies. Primary deficiencies result from low levels of a mineral in forages or water. Secondary deficiencies occur when another element prevents the absorption of a mineral.

perfect health due to a negative interaction between minerals.

There are two types of deficiencies, he says. Primary deficiencies are a result of low levels of minerals in forages or water, and secondary deficiencies occur when another element prevents the absorption of a mineral. Sulfates in water, or molybdenum in forages, can prevent the absorption of copper — even if there is plenty of it available for the cattle, Paterson says.

Animals that are deficient in trace minerals reproduce or grow at a decreased rate and with decreased feed efficiency and depressed immune functions, according to a study conducted by Paterson and his colleagues Connie Swenson, Bruce Johnson and Ray Ansotegui.

In their study, they tested the forages and water consumed by cattle in Montana, Texas and Arkansas. Then they conducted a liver biopsy on the cattle to determine mineral amounts received and used.

Paterson notes the largest deficiencies were for copper and zinc.

Deficiencies in copper can cause anemia, diarrhea, depressed growth, change of hair color, neonatal ataxia, temporary infertility and fragile bones.

Timing

There are specific times when mineral absorption is critical and supplements would be beneficial, Paterson says. "If a rancher calls and says he doesn't have enough money to provide supplements year-round, then I can recommend some important times when mineral absorption is critical."

Paterson recommends providing supplements at least 60 days prior to calving and 45 days prior to weaning, as these are the times of greatest stress in a cow's or a calf's life.

"You want to have the calf healthy and give that vaccine every chance to work correctly. Calves are building immunity 10 to 14 days after vaccination. They need to be healthy to keep every bit of productivity," he says.

Copper supplementation during the last trimester and postpartum shortened the time from beginning of the breeding season to conception. Supplementation also improved the chance of fertility due to reduced bacterial infections, embryonic mortality and fewer incidences of endometrial scarring, according to MSU's report.

Paterson says the suggested copper and zinc requirements are 10 mg/kilogram (kg) and 30 mg/kg of daily intake, respectively.

Location

The mineral content and bioavailability of different forages vary due to factors like soil-mineral level, soil pH, climate, plant species and the stage of plant maturity. Legumes also tend to be higher in calcium, copper, zinc and cobalt than grasses.

Paterson's research found, on average, copper and zinc content was insufficient in grass, grass-legume and legume-hay samples collected in Montana, Texas and Arkansas. Data collected in Texas indicate that phosphorus, magnesium, cop-

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Table 1: Comparisons of mineral requirements and maximum tolerable concentrations

Mineral	Growing and finishing cattle	Gestating cow	Early lactation	Maximum tolerable concentration
chromium, mg/kg intake	–	–	–	1,000
cobalt, mg/kg intake	0.10	0.10	0.10	10
copper, mg/kg intake	10	10	10	100
iodine, mg/kg intake	0.50	0.50	0.50	50
iron, mg/kg intake	50	50	50	1,000
manganese, mg/kg intake	20	40	40	1,000
molybdenum, mg/kg intake	–	–	–	5
nickel, mg/kg intake	–	–	–	50
selenium, mg/kg intake	0.10	0.10	0.10	2
sulfur, %	0.15	0.15	0.15	0.40
zinc, mg/kg intake	30	30	30	500

(Marston, Compendium, January 1999)

Table 2: Mineral requirements and maximum tolerable levels for beef cattle

Mineral	Suggested value	Range*	Maximum tolerable level
cobalt, ppm	0.10	0.07-0.11	5
copper, ppm	8	4-10	115
iodine, ppm	0.5	0.20-2.0	50
manganese, ppm	40	20-50	1,000
selenium, ppm	0.20	0.05-0.30	2
sulfur, %	0.10	0.08-0.15	0.40
zinc, ppm	30	20-40	500
molybdenum, ppm	–	–	6

*The listing of a range in which requirements are likely to be met recognizes that requirements for most minerals are affected by various dietary and animal (body weight, sex, rate of gain) factors. Thus, it may be better to evaluate rations based on a range of mineral requirements and for content of interfering substances than to meet a specific dietary value.

(Marston, Compendium, January 1999)

per, manganese and zinc would be deficient for a lactating cow. Data collected in Arkansas for mixed grass and hays showed phosphorus, copper and zinc levels would be insufficient on certain ranches.

"Texas and Montana were low in copper levels. It wasn't as widespread in Arkansas. It's almost on a ranch-to-ranch basis," Paterson says. "We have to remember the way our resources looked millions of years ago. Look at Montana 65 billion years ago — it was under a sea. That left us with high levels of sulfates. What happened then is definitely affecting us now."

Too much

While too little copper can reduce cattle productivity, too much copper can be lethal. There needs to be a balance with trace-mineral supplementation, explains Twig Marston, assistant professor of animal sciences and industry at Kansas State University (K-State).

"Some producers say, 'a little bit did good so a lot has got to be better,'" Marston says. "At high levels some minerals become toxic. Some producers hurt their cattle's performance by overcompensating and not paying attention to trace minerals' dietary recommendations and interactions."

Marston cautions that most forages in Kansas provide adequate trace minerals for cattle. However, producers should pay close attention to the presence of other minerals that may tie up their availability. He recommends starting with 10 parts per million (ppm) of copper and 30 ppm of zinc in the total diet. Cattle should receive as little molybdenum as possible because it reduces copper availability.

Marston says nature does a good job of providing the trace minerals cattle need, but supplementation is sometimes an excellent insurance policy. He says he supports the UNL study that concluded supplements don't provide any benefits to total pregnancy rate, growth or health of calves.

"The Nebraska study is right on, and I support their work," Marston says. "Their cows were not deficient in the first place so supplementation caused no response. If you don't have a deficiency, then supplementation won't do you any good. In some incidences, feeding too much trace minerals can actually be toxic. Producers without trace mineral concerns are the lucky ones, and trace mineral nutritional concerns should be constantly monitored."

What's the difference?

Dennis Brink, a professor of animal sciences at UNL, was part of the team that published evidence suggesting copper supplements are unnecessary in some situations.

"If you have average grass and know the copper status and management is good, don't expect a big, magic bullet from feeding organic trace element supplement," Brink says.

"In our current research, the objective is to determine the interactions that may influence mineral status for cow reproduction," Brink says. "We have to look at the adequate supply of all nutrients, not just copper. From calving to rebreeding is when they're most susceptible nutrient- and energywise. Protein and energy-nutrient demands are greater then than any other time in their reproductive life."

INSIGHT:

Do you need to supplement?

History, cattle productivity examination, and forage and water analysis are key to pointing out mineral deficiencies in cattle herds. Being observant of a few simple characteristics of your herd — or the neighbor's herd — could alert you to a problem, increase the herd's productivity or help save money on unneeded copper supplements, cattle experts say.

1. Body condition. *Cattle with low body condition scores (BCS) might mean the herd isn't receiving enough energy — a feeding problem, not a mineral problem, says Twig Marston, assistant professor of animal sciences and industry at Kansas State University (K-State).*

2. Geology. *Copper deficiencies sometimes occur in pastures with creeks or streams, Marston says.*

3. Water source. *Well water often contains higher levels of sulfates and iron, which can tie up the copper supply, Marston says. John Paterson, Montana State University (MSU) Extension beef cattle specialist, says a water analysis can help point out antagonists to the absorption of copper. Look for high levels of sulfates. Water can be analyzed for around $25/sample.*

4. Health. *An increase in scours could signal a copper deficiency, Paterson says.*

5. Productivity. *A decrease in cow productivity also could signal a deficiency, Paterson says.*

6. Hair color. *A red tinge to the hair of Angus cattle could signal a deficiency, Paterson says.*

7. Neighboring herds. *Dennis Brink, professor of animal science at the University of Nebraska-Lincoln (UNL), suggests looking at the situation in surrounding cattle herds because the soil, which controls the amount of nutrients in forages, is usually similar.*

8. Reproductive rates. *What are the reproduction and conception rates for the past 10-15 years? Brink says the parent material the forage is drawing upon doesn't change drastically. A deficiency of copper would be present in the long-term history of a herd beyond different management practices.*

9. Forages. *Paterson says forage analysis will help make sure cattle are receiving enough major nutrients. Also, look for high levels of molybdenum, which can decrease the absorption of copper. Forage usually can be analyzed for less than $25/sample.*