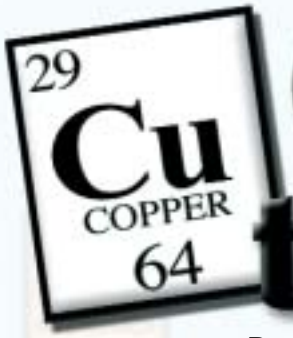


Copper is the Culprit

Beef industry sleuths partner to investigate mystery of poor performance.

Story & photos by ***Becky Mills***

If the sleuthing abilities of the investigators on CBS's *CSI: Crime Scene Investigation* impress you, take a look at members of Tennessee's beef cattle industry. The challenge was an unknown condition making well-managed cattle look poor. They had rough, discolored hair coats; weren't breeding on schedule; and were experiencing more cases of pinkeye. Immune problems were also showing up in vaccinated calves.

With an ongoing display of teamwork, producers, University of Tennessee (UT) Extension workers, veterinarians, researchers and agribusiness representatives worked together to track down the culprit. Copper (Cu), or rather the lack of it, was the guilty party.

Case in point

Mitch Powell's problems started in 1992 with 25 first-calf heifers sired by some high-profile artificial insemination (AI) sires. The young cows were grazing a pasture made up of 80% ladino clover, and Powell was also supplementing them with 6 pounds (lb.) per head per day of a 12% protein feed. Still, they had the rough, dull hair coats characteristic of cattle on endophyte-infected fescue. He also had trouble getting them to settle by AI.

"In the years that followed, the condition developed into the main herd," says the Jamestown, Tenn., producer. "They would breed in February or March, and the first of May, they'd be back in heat. Their hair coats were dull, and they were slow to shed."

Powell did his own AI work, breeding 50-60 cows a year. "My conception rates dropped from 80% to 60% or below," he recalls. "My local vet had been in charge of my herd health program for years and couldn't come up with any solutions. It really troubled me."

In 1998, UT veterinarian Larry Kerr came to Powell's farm and suggested taking blood samples. The lab work showed the Angus cattle were deficient in copper and selenium (Se), and Kerr recommended increasing the copper levels in the cows' mineral supplement.

Powell says, "I also had all species of my forages tested by an independent lab. Dallisgrass, my summer pasture, was much higher in copper than the other forages. I had noticed my cows looked much better after a few weeks of grazing Dallisgrass. That turned the light on for me."

Powell already had his cows on a high-quality mineral, but his supplier responded by raising the copper levels to 3,000 parts per million (ppm). With one group of cows, they raised the level to 4,000 ppm.

His supplier was also careful about adjusting the zinc (Zn)-to-copper ratio to keep it in the 3:1 range. "Both copper and zinc are critical for the immune system to perform," Powell notes.

"We did that for four years, from '98 to '02," he says. In 2002 blood samples on 30 cows indicated some improvement, but copper levels were still in the marginal or deficient range.

The veteran cattle producer was also working with UT Extension animal scientist Warren Gill to try to figure out what was wrong.

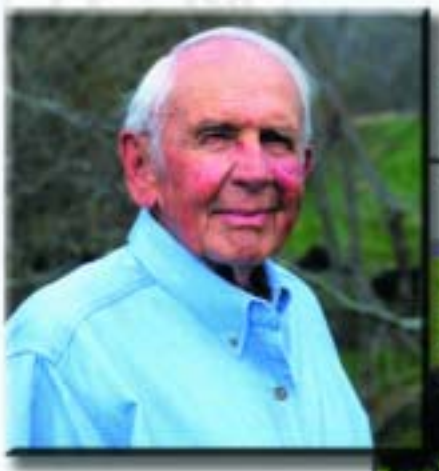
Gill recalls, "At one meeting I gave my usual mineral talk, and Mitch came up to me after and said, 'Warren, I'm already doing all that.'"

"I was about to give up on it," Powell says. "I would have been happy to sell out and start over."

Not the only one

In the meantime, Adams, Tenn., cattleman Joe Elliott noticed pinkeye was surfacing in his herd. When his local veterinarian did a culture on the pinkeye, he discovered that it wasn't *M. bovis*, the common form found in cattle, but rather, *B. ovis*, a strain usually found in sheep.

"Sheep are extremely susceptible to copper toxicity," Elliott says, "so copper levels are always low in minerals mixed for sheep. It



► Mitch Powell wrestled with copper deficiencies in his cattle for more than 10 years before finding the right mineral formulation. He says better genetics mean his cattle need a higher-quality mineral to perform at their potential.

PHOTO COURTESY OF MITCH POWELL

was cowboy logic — I started to suspect a deficiency."

Elliott urged Gill to attack the problem. At the time, Elliott was president of the Tennessee Beef Cattle Improvement Association (BCIA) and got a grant from BCIA to help Gill do a three-year forage survey to look at mineral levels.

This is where the teamwork really kicked in. More funding came from the U.S. Department of Agriculture (USDA), the Tennessee Forage and Grasslands Council, the Lower Middle Tennessee Cattlemen's Association, Tennessee Farmers Cooperative and Southern States Cooperative, as well as individual producers, agribusiness companies, and county livestock associations.

County agents across Tennessee collected 834 samples during May and again in August and September. The UT Soil Test Laboratory and the Tennessee Farmer's Cooperative testing facility did the analyses.

Copper was at least marginally deficient, or less than 10 ppm, in more than 92% of the samples. Blood work done on 20 herds and a portion of the bulls consigned to Tennessee's central bull test station also showed marginal deficiencies across the state.

The next question was, "Why?" And why were the copper levels even lower in the fall? Fescue toxicity, so often blamed for the rough, discolored hair coats, was partially to blame. "This goes along with work from Virginia Tech," Gill says. "The endophyte fungus found in fescue depresses copper availability."

The big culprit, though, was sulfur. The mineral, along with molybdenum (Mo) and iron (Fe), has a reputation for tying up copper and making it unavailable to plants and animals. The forages showed sulfur levels at least marginally antagonistic in almost 90% of the samples.

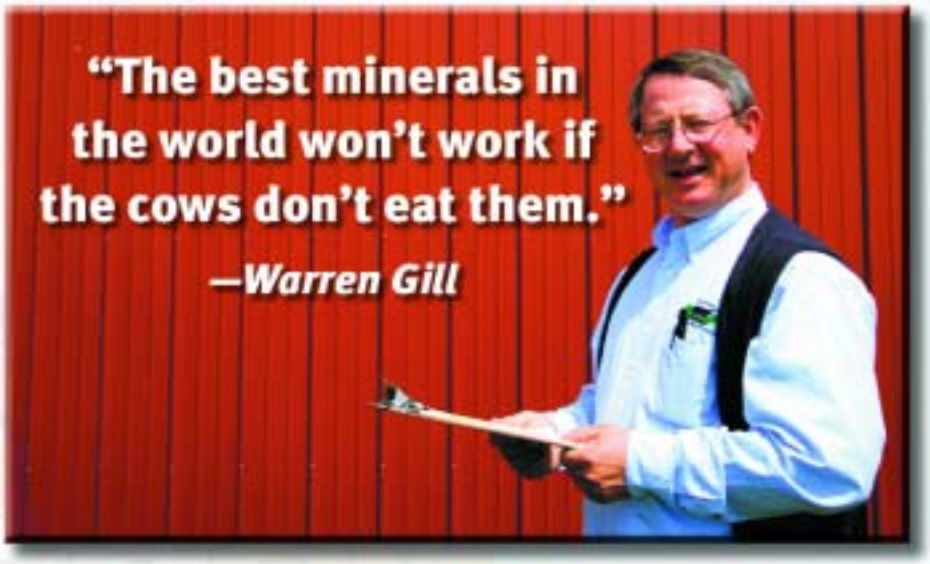
Once again, "Why?" The sky holds the answer. Tennessee is covered with sulfur-emitting smokestacks.

"We have the largest fossil-fuel-burning plant in the world just across the line in Stewart County," says John Bartee, Montgomery County Extension agent. "Ten years ago, the state of Kentucky told the Tennessee Valley Authority, owner of the plant, that if they'd burn Kentucky coal, which is high in sulfur, they would build new stacks and scrubbers to take the sulfur out. It doesn't take it all out."

Bartee says the yellow haze is visible in the air and on cars for miles. Other industries add to the problem throughout the state.

"Sulfur antagonizes copper and selenium and does it strongly," says University of Florida (UF) researcher John Arthington. "Sulfur is the key to copper nutrition."

Arthington says sulfur can sneak into bovine diets in other ways, too. Molasses and corn gluten feed are high in sulfur. Ammonium sulfate fertilizer can also increase sulfur levels in forages.



►UT animal scientist Warren Gill said teamwork helped track down and solve the problems with copper deficiencies in his state.

What to do?

Tennessee producers are switching to a mineral mix containing both organic, and inorganic sources. Arthington says, "Organic, or chelated, minerals have a higher availability to animals."

He points out, however, "Almost all the data suggests healthy, mature cows do as well on inorganic minerals. However, if antagonists are present they can make a difference."

He also says that a three-year Florida study showed that young cows consuming organic minerals had a higher pregnancy rate and shorter calving interval compared to young cows consuming inorganic minerals.

Elliott is sticking with the newer formulation. "It costs me $2.43 more per cow per year for the more expensive minerals. I haven't had a pinkeye problem since I started on a different mineral. Our fertility was already good, we are strict on culling when it comes to fertility, but our cows are cycling quicker after calving."

He also says his embryo transfer (ET) work is going much better. "Our technician is Jim Spears. He got 43 No. 1 embryos out of three cows and said this is as good a set of embryos as he has gotten." Another flush resulted in 41 No. 1 embryos out of three cows. Elliott says, "The average is 6.8 embryos per cow."

He adds, "I now require the producer with the recipient cows to feed the same minerals. At three weeks, we had 20 out of 24 pregnancies. Jim has now put his herd on the same minerals."

Elliott also talked to Powell in fall 2002, and he switched to the same formulation. "By the spring of 2003, there was a noticeable difference in my cattle," Powell reports. "This spring, my cows came through the winter

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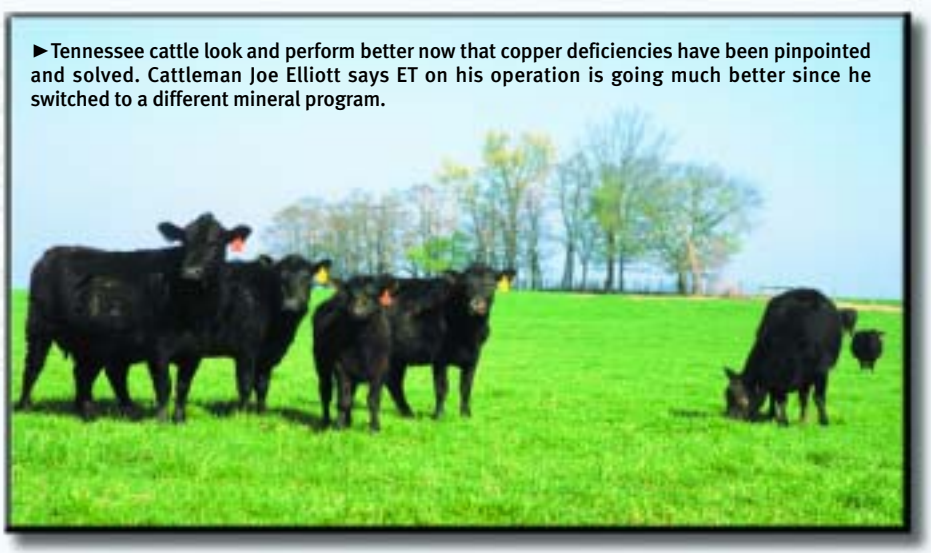

►Tennessee cattle look and perform better now that copper deficiencies have been pinpointed and solved. Cattleman Joe Elliott says ET on his operation is going much better since he switched to a different mineral program.

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with a good hair coat, a body condition score (BCS) improvement of one to two points and an excellent conception rate. This was done without any protein supplement, just hay and a mineral with organic, or chelated, copper."

Powell comments, "Dr. Kerr told me as you improve your herd, the demands on the cattle get greater. At some point in time it comes at you. Those 25 heifers this thing started with were the third generation of AI. As the EPDs build up in a cow for milk, weaning weight and yearling weight, she has to have better minerals.

"The University of Tennessee has really been on this copper thing and should be commended for it," he adds. "I am really thankful to them and the other people who helped me."

Gill emphasizes that it is a team effort. His co-workers Clyde Lane, Debbie Jones, Aaron Fisher, Chris Richards, Fred Hopkins, David Kirkpatrick and Jim Neel all played a vital role.

"The mineral companies have responded beautifully," he adds. "We've made real progress in turning it around."

He also says, "If you are going to make changes you have to partner. If we didn't have partnerships with agri-industry and several parts of the University of Tennessee, both in research and Extension, as well as the producers and producer organizations, we wouldn't have solved this problem." AJ

►The Tennessee Valley Authority plant in Stewart County burns coal and discharges sulfur, which is an antagonist to copper.

The where, how and how much of copper

Copper (Cu) deficiencies aren't just a Tennessee challenge. At least marginal deficiencies have been reported stretching to Florida and out to the western mountain states. So, how can you tell if your herd is affected?

First, back off and look at your total program. The problem could be as simple as a lack of protein and energy. "Copper gets blamed on more problems than it causes," says John Arthington, University of Florida (UF) researcher. "Producers want to think of it as a magic bullet, but there are only a few incidences where copper deficiencies cause production problems."

If you are convinced it is a trace mineral problem and copper is the prime suspect, the easiest way is to start with the hair coat. Black cows that aren't black and slick but have a reddish tinge to their coat and that don't shed out like they should are a sign of copper problems. University of Tennessee (UT) Extension animal scientist Warren Gill uses a hair-coat scoring system (see Chart I).

However, Arthington says, "In experimental conditions we have not been able to affect coat color."

Also, look for reproduction rates that aren't up to par. If your cattle aren't settling or are aborting early, it could be a problem with low copper levels or with disease brought on by lowered immunity, another indicator. If there is an immunity problem, also look at selenium (Se) levels — sulfur antagonizes that mineral, too.

Pinkeye can also be a symptom.

In Tennessee, blood samples showed copper deficiencies statewide, but Arthington notes, "It has to be an extreme case to detect a copper deficiency in the blood. Liver biopsies are the only reliable way. Fortunately, there are skilled people who can do that."

If the blood tests do indicate a lack of copper [a deficiency is usually considered under 0.55 parts per million (ppm)] then take a look at your minerals. Check the level of copper and also the form it is in. Gill says copper oxide usually isn't considered a very available source, while copper sulfate and copper carbonate are more effective. However, if copper deficiencies are caused by a sulfur excess, copper sulfate may not be the best choice.

As for rates, Gill uses the guide presented in Chart II.

"Monitor consumption, and keep records," Gill emphasizes. "The best minerals in the world won't work if the cows don't eat them." He says consumption varies through the year, but producers should generally expect them to eat 2-6 ounces (oz.) per head per day.

He also warns, "The levels of copper we are recommending for beef cattle are toxic for sheep and Jersey cattle."

Adams, Tenn., cattleman Joe Elliott learned the value of monitoring mineral intake three years ago. He had a group of yearling heifers on soy hulls and noticed after two weeks their mineral consumption dropped off. After 60 days, the hair that was growing back where they had been clipped for their ultrasounds had a reddish tinge.

"They quit eating the minerals since the soy hulls were high in minerals, and they weren't getting the copper they needed," Elliott says. "Now I get a mineral that has no salt and use it as a premix." If cattle are eating too much mineral, Arthington suggests mixing stock salt with the mineral to limit consumption. But, he warns, "Do not offer the salt and minerals separately. They'll eat the salt and not the minerals."

Chart I: Coat scoring system

Score	Condition
1	No detectable problem, healthy coat appearance appropriate to season
2	Slight indications of off-color in limited amount, possibly over shoulders or around flank
3	Definite off-color, dull hair covering less than one-third of body, slightly slow to shed
4	Enough dead hair to cover significant percent (more than 50%), slow shedding
5	Hair clearly dead in appearance, brittle, cattle not slicking off normally

Chart II : Suggested copper levels in mineral supplements based on various conditions, assuming consumption of 3 to 4 ounces of mineral supplement per cow per day

Scenario	Forage copper, ppm	Forage sulfur, %	Suggested level of copper in mineral, ppm
No known problems	10	0.2	700-1,000
Some rough hair coat	8	0.25	1,000-1,200
Rough hair, slow breeders and some open cows	6	0.3	1,500-2,000
Rough hair coat and more difficult and significant breeding problems*	<6	>0.31	2,000-3,000

*This scenario is included to emphasize extreme situations in some areas, which may require higher-than-usual levels of copper supplementation. Work with Extension agents and mineral suppliers to develop solutions to difficult problems. This may include developing a custom mineral mixture, an option which is typically available but may require ordering in bulk quantities. Monitor consumption carefully if higher copper levels are chosen. If copper levels exceed label recommendations, there could be a risk of toxicity.