

Balancing Minerals

Understanding how mineral balance affects animal health is a key to successfully feeding ethanol byproducts.

by Ed Haag

To Gavin Meerdink, veterinarian, diagnostic consultant, and corn and beef producer, feeding ethanol byproducts is neither a panacea nor a curse.

“We have to start looking at dried distillers’ grains (DDGs) as another feed option in a total mixed ration (TMR),” he says, adding that before deciding how much of the product the beef producer wants to feed, he must understand both the financial and the animal health implications of his actions.

“DDGs are one part of a bigger picture.”

While others have predicted that ethanol byproducts represent a potentially huge supply of low-cost cattle feed, Meerdink believes the jury is still out on where prices will move as more ethanol plants come on line.

“We are finding that the price of the DDGs varies quite a bit from location to location and from part of the country to part of the country,” he says. “For instance, there is going to be a substantial difference between a Chicago price and an L.A. price.”

Meerdink notes that the final local price will be determined by the demand, availability and the price of competitive feeds being offered in a particular area.

Before committing to feeding a particular source of DDGs, Meerdink suggests beef producers factor in hauling costs, moisture levels (the higher the moisture level, the more water you have to haul and the less actual feed you receive) and the actual nutritional value of the byproduct.

“This will vary from plant to plant and process to process,” he says. “For example, some plants will extract the oil from the corn, while others will leave it in the DDGs.”

While the real cost of the DDGs will play a major part in what percentage of the product is eventually fed, another equally important consideration is the role the DDGs will play in relation to the overall nutritional balance of the TMR. “Again, the big picture must be considered,” Meerdink says. “Depending on local availability of other ingredients, everyone’s TMR is different.”

This is where a knowledgeable beef nutritionist, who is familiar with local feeding scenarios, can prove invaluable, Meerdink says.

Watch concentrations, ratios

For those who have done the preliminary cost analysis on DDGs and who have decided that it is a good fit for their feeding program, Meerdink suggests paying particularly close attention to the role DDGs can play in changing the mineral balance in the TMR. Too much or too little of a certain mineral can lead to animal health issues.

The minerals that need to be tracked are phosphorous (P), calcium (Ca) and sulfur (S). Magnesium (Mg) and copper (Cu) also require some monitoring.

Meerdink points out that the removal of each component in the ethanol process will have an effect on the final composition of the DDGs. For example, in utilizing the starch for

the fermentation process, 66% of the corn kernel’s original mass has been extracted.

“The starch is gone, which represents two-thirds of the kernel,” he says. “Anything that is left of the kernel will have three times the concentration that we would expect in corn.”

This applies to all minerals resident in the original corn kernel, Meerdink says, adding that in feeding up to 15% DDGs, the likelihood of any negative repercussions from exposing cattle to the higher mineral concentrations in today’s ethanol byproducts is slight. But, as the percentage of DDGs in relation to the TMR increases, so does the risk. This is particularly true for phosphorous and sulfur.

“There are limits to what cattle can handle,” Meerdink says. “If you are feeding 40% to 50% DDGs, then you’d better do some analysis.”

Inverted ratios spell problems

He notes that the key to dealing with elevated levels of phosphorous is maintaining its balance with calcium.

“For ruminants, you always want your calcium percentage to be higher than your phosphorous,” Meerdink says. “We’d expect to see 0.8% to 1% calcium to 0.5% phosphorous.”

The problem lies in the fact that, like corn, its byproducts are low in calcium and high in phosphorous, Meerdink says. The issue is exacerbated by the concentrating of the minerals left in the DDGs after the removal of the starch.

Where a common cattle diet has a balance of 0.7% calcium to 0.35% phosphorous, dried distillers’ grains with solubles (DDGS) has a ratio of 0.71% phosphorous to 0.15% calcium (see Fig. 1).

Meerdink warns that when these inverted ratios begin to manifest themselves in a TMR, the condition known as waterbelly (urolithiasis or urinary calculi) is likely to follow.

“These are stones that form in the kidneys that plug the urinary system,” he explains. “Depending on how far off the ratios are, waterbelly can reach an acute stage in as short a time as two weeks.”

Meerdink notes that because of the reduced size of the opening in the urethra in



Table 1: Composition, percent dry matter

	Protein	Crude fiber	Phosphorus	Sulfur
Corn	10.9	2.9	0.3	0.12
Distillers’ dried grains with solubles	25 (28-33)	9.9 (5.4-10.4)	0.7 (0.42-0.99)	0.33 (var)
Corn gluten feed	26	9.7	0.8	0.23
Corn gluten meal	67	2.2	0.5	0.39

Source: National Research Council, 1982.

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castrated animals, steers are more likely to suffer from waterbelly than heifers or bulls. If not treated by a veterinarian in a timely manner, most animals that are in the advanced stages of waterbelly succumb to the disorder.

More calcium the answer

The good news is that waterbelly is easily preventable, Meerdink says. "This involves getting an analysis on your TMR to make sure that you have enough calcium," he says. "Then you find a mineral supplement that has a calcium-phosphorous ratio that is appropriate."

A bulletin released by the South Dakota State University College of Agriculture & Biological Sciences and the U.S. Department of Agriculture (USDA) reports additional calcium can also be introduced into a TMR by increasing the percentage of feedstuffs high in the mineral, such as alfalfa. Supplementation of calcium in South Dakota more often involves adding ground limestone to the ration.

The bulletin also notes that in confinement operations where feeding DDGs will increase the levels of phosphorous in the manure, waste management plans must be reformulated to reflect the new reality.

Meerdink points out that it is prudent to monitor for changes in the composition of the TMR even after balancing calcium-phosphorous ratios. If levels are creeping toward the danger zone because of outside changes to feedstuffs, it is important to catch it before serious damage is done.

He notes that in addition to paying attention to calcium and phosphorous levels, magnesium levels should be monitored. "If magnesium levels rise, it has an effect on calcium uptake," he says. "For instance, when you have higher phosphorus levels that invert with calcium, magnesium has a tendency to accelerate the process."

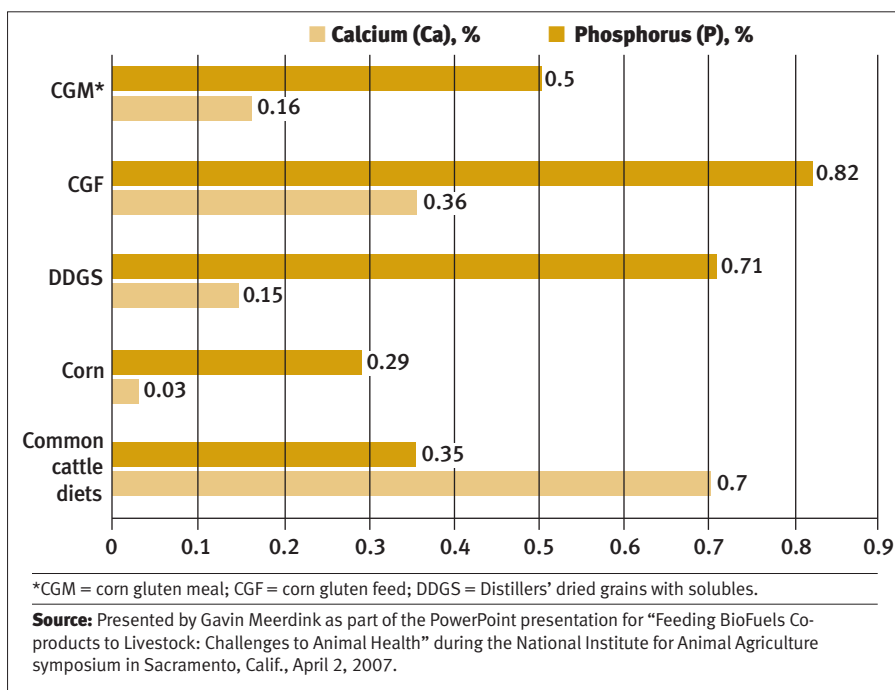
Don't forget conversions

External changes to the TMR ingredients aren't the only actions that require vigilance, Meerdink says. On-site changes can also prove devastating if they are not handled correctly.

He cites, as an example, an incident that occurred in a feedlot last fall. "It was 6:30 in the morning and there were 12 to 15 steers lying there," Meerdink says. "It was a typical case of waterbelly."

While the evidence clearly revealed the animals were victims of waterbelly, the cause wasn't as obvious. The operators, who had been feeding the cattle a high percentage of DDGs, were well-aware of the risks associated with inverted calcium-

Fig. 1: Calcium, phosphorus concentrations and ratio perspectives



phosphorous ratios and provided Meerdink with the records that confirmed they were feeding the appropriate balance of calcium and phosphorous in the TMR.

"After looking at their analysis sheets I noticed a large pile of dried distillers' grains in a bunker," he says. "The results on those sheets were for the wet distillers' grains."

Further examination revealed that after diesel fuel passed \$3 a gallon, the person hauling the distillers' grains decided to purchase dry product rather than wet grains to save money hauling the product. Unfortunately, no one thought to reconfigure the TMR to compensate for the higher concentrations of phosphorous.

"They saved on the fuel, but it cost them \$75,000 in cattle losses because of that switch," Meerdink says, noting that even the simplest change can't be ignored when high levels of DDGs are being fed.

Sulfur: hidden variables

Meerdink notes that unlike working with high levels of phosphorous, contending with too much sulfur in the TMR involves more than just rebalancing mineral ratios. "One factor to consider when feeding high-sulfur products is the maturity of the calf," he says. It's a much different issue when you are dealing with a four- or five-weight calf compared to an 800-pound (lb.) animal.

Another consideration is the accumulative effect of the sulfur in the TMR when combined with high levels of sulfur in a local supply of water.

"In certain regions of the country there are high levels of sulfur in the water,"

Meerdink says. "You have to add that into the amount consumed."

The 1996 National Research Council (NRC) *Nutrient Requirements of Beef Cattle* recommends a sulfur concentration of 0.15%, which is needed for formation of certain amino acids and the B vitamins thiamine and biotin, as well as used in some detoxification reactions to maintain normal functioning of body cells.

A total dry-matter intake (DMI) from all sources (including water) above 0.4% is considered above the tolerable level by NRC standards and can lead to polioencephalomalacia (PEM). Cattle with clinical PEM (brainers) will suffer from respiratory distress, reduced feed intake and reduced ruminal motility. Advanced signs of PEM include blindness, thrashing, kicking at the stomach and moaning, followed by death within two days.

Meerdink has had some success in preventing further cases of PEM in livestock by increasing copper levels — when that option is available — in the TMR, thus decreasing the availability of sulfur to the animal. He adds that this gives the digestive system an opportunity to adjust.

"Cattle do adjust to higher levels of sulfur over time," he says. "You don't want to introduce it to them the first day in the feedlot."

Because of the number of variables — some of them local — involved in dealing with high levels of sulfur in distillers' grains, Meerdink recommends working closely with veterinarians and/or nutritionists who are familiar with local feeding conditions. **AJ**