Three reasons to rethink sulphate trace minerals in the dairy ration

Findings from studies conducted by leading research universities and pioneers in trace mineral nutrition suggest it may be time to rethink the use of inorganic trace minerals in the dairy ration.

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The evolution of trace minerals in the dairy ration

Before addressing these concerns, it may be helpful to understand how sulphate-based trace minerals became so widely used in the dairy industry. Nutritionists have long known that supplementing cows' diets with small amounts of copper, zinc and manganese is a vital part of supporting functions such as immunity, fertility, production and metabolism.

Beginning in the 1930s, oxide trace minerals became available as a more concentrated source of trace mineral supplementation for use in cattle feeds.

Sulphate trace minerals followed in the late 1940s offering producers a source of trace minerals with higher bioavailability than oxides at a moderate price. Based on this difference, sulphate-based trace minerals have grown to become the dairy industry's primary source of trace mineral nutrition.

To further improve trace mineral bioavailability and effectiveness, organic trace minerals were introduced in the 1970s. While many organic trace mineral sources delivered improved results, their high cost meant producers only replaced a small fraction of the animal's total trace mineral requirement (for example 20% organics and 80% sulphate trace minerals).

Early in the 2000s a new source of trace mineral supplementation became available with the introduction of hydroxy trace minerals (IntelliBond).

Hydroxy trace minerals offer better mixing and handling qualities along with equal or better performance compared to higher-quality organic trace minerals, at significantly less cost.

Multiple research evaluations were conducted to evaluate and compare how different sources of trace minerals work inside the cow's gastrointestinal tract. The

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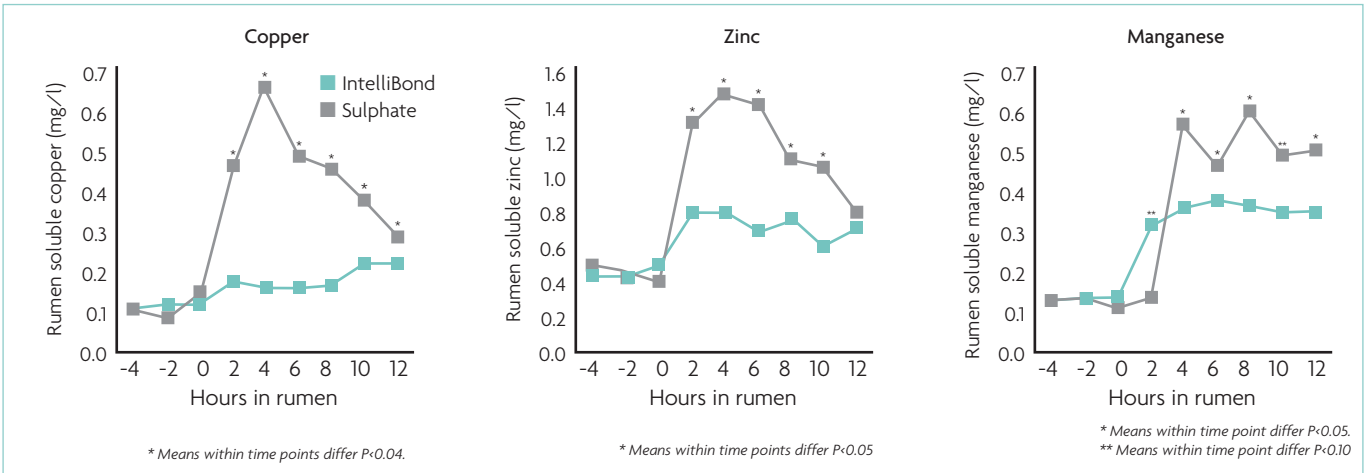
Fig. 1. Sulphate sources of trace minerals were shown to be significantly more soluble in the rumen of cattle than IntelliBond hydroxy trace minerals (Weigel et al, 2017).



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findings pointed to three reasons dairymen and their advisors may want to rethink the use of sulphate-based trace minerals in their rations.

Reason 1:
Sulphate trace minerals have high reactivity in the rumen

As scientists studied sulphate-based trace mineral sources and compared them to IntelliBond trace minerals, the structure of the trace minerals became an important area of focus.

Sulphate trace minerals have weak ionic bonds that are significantly more soluble in water (rumen fluid) than hydroxy trace minerals.

The weak ionic bonds between the metal ion and the sulphate molecule break down quickly when they encounter moisture releasing the metal ion.

This highly reactive metal ion is now in a form where it can negatively react with diet antagonists and beneficial microbes present within the upper gastrointestinal tract.

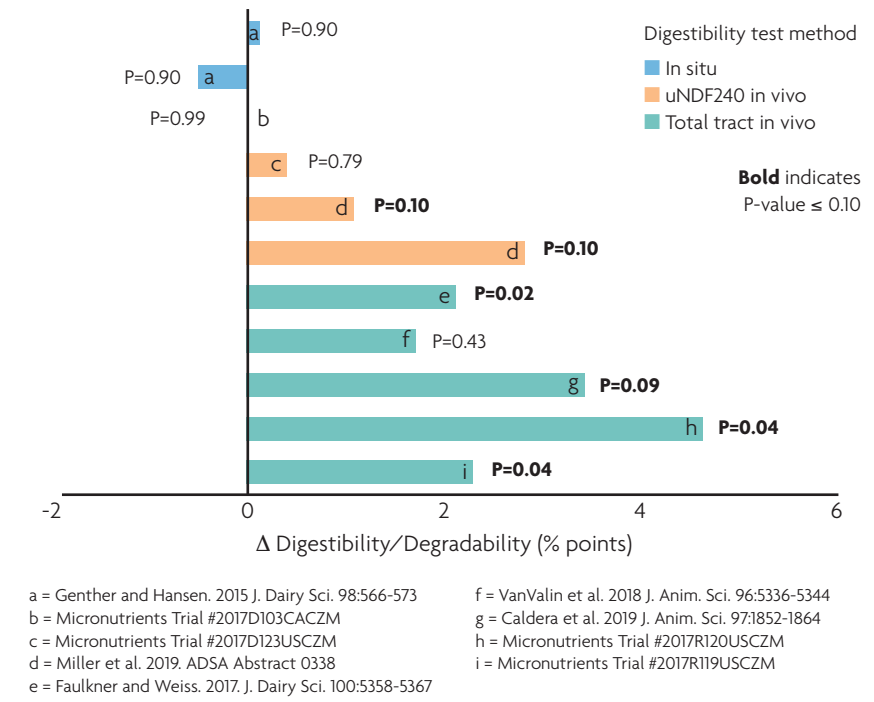

Fig. 2. Neutral detergent fibre digestibility.

Reason 2:
Sulphate trace minerals may harm beneficial rumen microbes

Once broken down in the rumen, the metal ion (zinc and copper) originally linked within the sulphate trace mineral now possesses antimicrobial properties.

Consequently, these free metal ions can potentially harm the beneficial bacteria that digest fibre.

In contrast, hydroxy trace minerals are comprised of a crystalline structure and covalent bonds that make them significantly less soluble and less susceptible to disassociation in the rumen, thus making it all but impossible for free metal ions to be released in the rumen environment.

'Good' microbes in the rumen play an essential role in promoting fibre digestibility and supporting the production of important volatile fatty acids used by the cow for optimised productivity and well-being.

As these microbes multiply and travel down the digestive tract, they become a high-quality source of by-pass protein for the cow, providing about half the total dietary protein needed.

Thus, a trace mineral source that interferes with microbial activity in the rumen – where 90% of digestion takes place – can interfere with the productivity and health of the animal.

A practical observation is the knowledge that sulphate trace minerals have for many decades been used in footbaths for their efficacy in killing microbes.

Unfortunately, the same properties that make sulphate trace minerals effective in footbaths (antimicrobial properties of the metal ions) can potentially harm rumen microbial populations. Negatively impacting rumen microbes should not be the objective when selecting the trace mineral source that is best for your cows.

As a side note, supplemental copper, zinc and manganese are not required by the rumen microbes when practical diets are fed, given that the basal diet ingredients provide adequate levels of zinc, copper and manganese to support the microbial requirement. This allows all trace mineral supplementation to be focused on the needs of the animal.

Reason 3:
Sulphate trace minerals have been shown to reduce NDF digestibility

It is well understood that microbial activity in the rumen is essential to promote optimised neutral detergent fibre digestibility (NDFd), which further supports the production of important volatile fatty acids.

To further evaluate the impact of trace mineral source on this process, animal scientists from multiple research universities compared how sulphate trace minerals and hydroxy trace minerals (IntelliBond) affected NDFd in the rumen.

The research found a decrease in NDFd of 1.1 to 4.6 points when sulphate trace minerals were fed compared to hydroxy trace minerals (Fig. 2).

As literature and data suggest, a one-point change in NDFd can translate to a half-pound change in the production of 4.0% fat-corrected milk.

Study results suggest that when sulphate trace minerals are replaced with hydroxy trace minerals, cows may see an increase in milk production, translating into improved profitability for dairymen.

Planning a path forward

There are three paths forward when removing sulphate trace minerals from the dairy ration. One option is to feed all organic trace minerals; however, the benefits may not be offset by the large additional cost. A second option is to completely replace sulphate trace minerals with hydroxy trace minerals. A final option is to completely replace sulphate trace minerals with a combination of organic (20%) and hydroxy trace minerals (80%).

A conversation with your nutrition advisor can help dairymen assess how replacing sulphate trace minerals may be of benefit to their herds.

Here are some questions to ask:

- Does my ration include sulphate sources of trace minerals?
- Based on new information backed up by multiple research evaluations, should I continue feeding sulphate trace minerals?
- What are the benefits of improved NDFd if we remove sulphate trace minerals from our ration?

As dairymen consider changes to enhance their herds' nutrition without sacrificing economics, a conversation with a dairy nutritionist is a good place to start. ■

References are available from the author on request