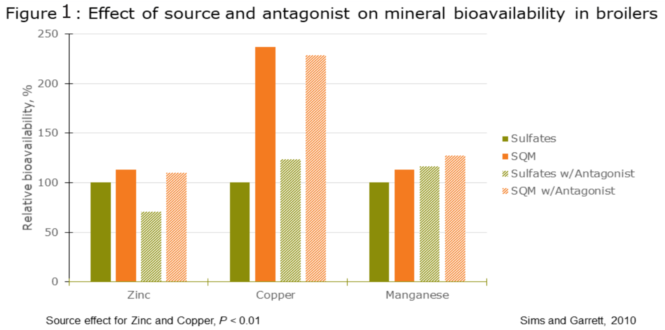
Organic Trace Minerals (OTMs) for Optimized Bioavailability

The use of organic trace minerals (OTMs) has become standard practice in animal production. The decision to include OTMs has been based on their ability to improve animal performance.

Organic trace minerals are defined as trace minerals (zinc, copper, manganese, iron, cobalt and chromium) that are bound or chelated to a matrix consisting of an organic ligand (protein, amino acids, polysaccharides, volatile fatty acid). The products take advantage of positive charges of the minerals attracted and binding to a negative charge of the ligand. This ligand protects the trace mineral from the negative interactions that can, and will, occur when they come into contact with compounds carrying an opposite charge. These compounds may occur naturally in the animal diet, or they may be the result of partially digested feed components, such as free amino acids.

Figure 1 : Effect of source and antagonist on mineral bioavailability in broilers



Hempe and Cousins (1992) proposed a model for mineral absorption that uses intestinal proteins (Zip) to transport minerals across the membrane and into the intercellular space. There, the mineral is sequestered until called for by the body to be transported to a target tissue (Figure 3). This model has been subsequently further developed by Lichten and Cousins (2009), Wang and Zhou (2010) and Nichito and Kambre (2018). Any compound that would react with these minerals would make them unavailable to the intestinal protein, since their conformation would now not fit the active site of these proteins (Zip). Therefore, limiting mineral bioavailability could and would affect the level of animal performance. It can be inferred that minerals with greater bioavailability will improve an animal's performance whereas minerals from sources that get bound to antagonists result in lower animal performance.

Identifying the antagonists within a diet and quantifying their level is not something that has been explored within ration formulation programs. These programs can use a given level of bioavailability and then balance it to deliver the necessary level of digestible or metabolizable nutrients. Within trace mineral research, studies have been conducted to determine bioavailability comparing a unique source (such as OTMs) with a sulfate standard. The difference within a given diet gives a unique value, but that value is restricted to that specific diet. Change the composition and the level of antagonists present in the diet, and the resulting bioavailability will change.

Figure 2: Comparison of bioavailability of iron sulfate vs. *SQM Iron* under normal or pathogen exposure conditions with weaned pigs.

For individual minerals, the ligand will influence them differently. In a study with broilers that QualiTech conducted a few years back (Figure 1), zinc bioavailability from *SQM Zinc* was 13% greater than that of zinc sulfate in a low antagonist diet. However, addition of zinc antagonists reduced the availability of zinc from zinc sulfate resulting in 56% greater zinc bioavailability for *SQM Zinc*. Within that same study, copper bioavailability from *SQM Copper* was as much as 136% greater than that of copper sulfate.

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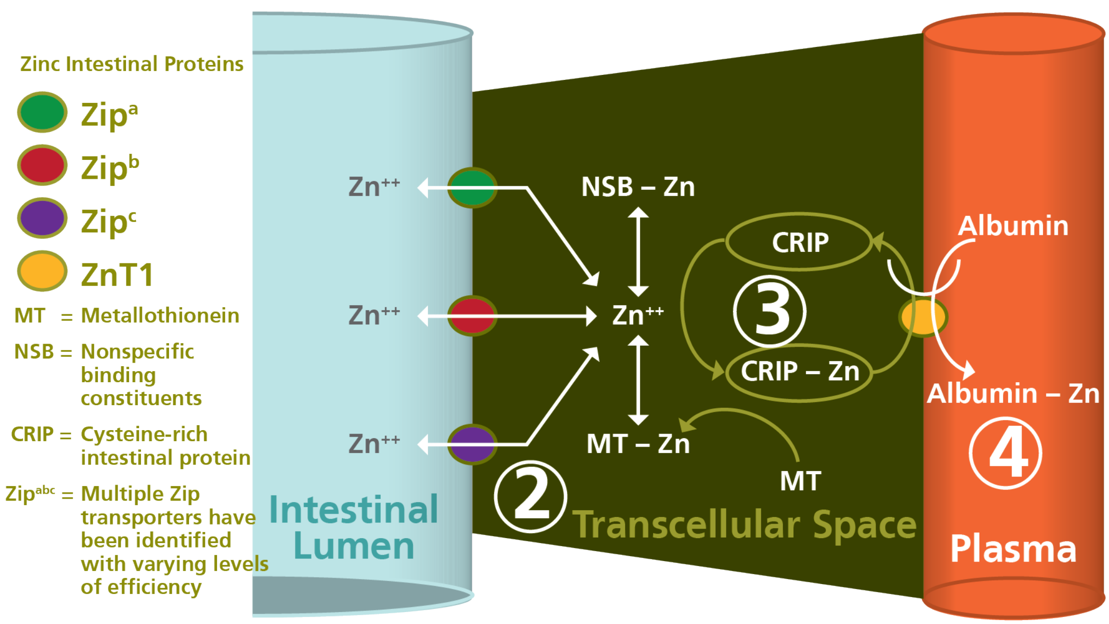
In a recent study with baby pigs, the bioavailability of iron was compared between *SQM Iron* and iron sulfate. When the baby pigs were not stressed by an environmental challenge, iron bioavailability from *SQM Iron* was 50% greater than that of iron sulfate (Figure 2). When there was an environmental challenge imposed on the baby pigs, iron bioavailability from *SQM Iron* was 158% greater than that of the iron sulfate standard.

The conclusion that can be made from these studies is that dietary and environmental factors influence the bioavailability of trace minerals. Bioavailability for trace minerals is not as easy as assigning a number, as is done with feed compounds like proteins, carbohydrates and fats. The mineral concentration itself remains the same, but its ability to be absorbed can be influenced by multiple factors. Until it is possible to determine and quantify the antagonists present in a specific diet formulation, the simple guideline should be that OTMs like *SQM protected minerals* will provide the optimum availability to the animal, compared to inorganic sources such as sulfates. These inorganic sources can easily disassociate and react with antagonists, thus reducing their bioavailability. Consider *SQM protected minerals* as an insurance policy to improve trace mineral delivery, thereby helping optimize animal performance.

Figure 3:

Theoretical model for transcellular zinc absorption



Sources: Hempe & Cousins 1992, Lichten & Cousins 2009; Wang & Zhou 2010; Nishito & Kambre 2018.

To learn more about the benefits of SQM protected minerals®, contact QualiTech at 800-328-5870 or qualitechco.com.