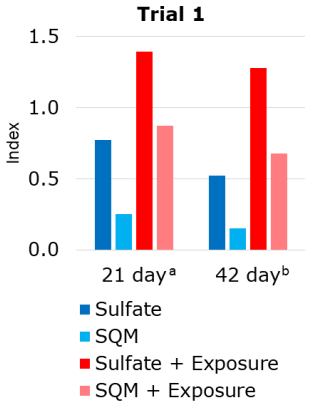
SQM® PolyTransport Technology Reduces Iron Availability to *Salmonella* and *E. Coli*

By Joshua A. Jendza, PhD – Sr Research and Technical Services Manager, QualiTech, Inc.

All microbes require trace minerals, but pathogenic microbes often use the available iron concentration as an environmental signal to coordinate level of virulence. As Iron levels increase, so do measures of virulence in pathogenic bacteria such as growth rate, adhesion, invasion, membrane translocation, and cell damage (Kortman et al., 2012).

Therefore, reducing availability of iron to enteric microorganism has the potential to improve animal performance, so long as it does not create a deficiency for the host. In fact, replacing iron sulfate with SQM Fe has already been shown to reduce intestinal abundance of *Salmonella*, *E. coli*, and *C. perfringens* in broilers raised on re-used and contaminated litter (Garrett and McNaughton, 2019; Figures 1-5).

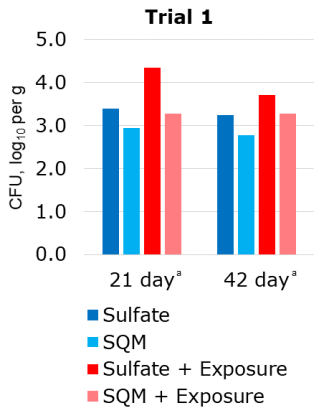
Figure 1. Intestinal lesion score in broilers by iron source and pathogen exposure



[a] Iron source and Exposure effect $P < 0.01$
[b] Iron source x Exposure Interaction $P < 0.01$

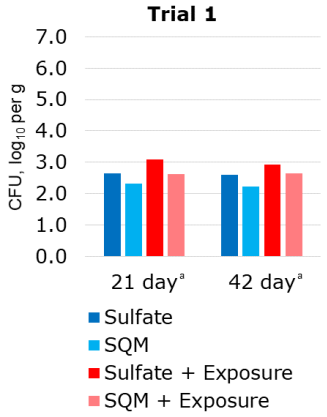
0 = No lesions found
1 = Slight redness but no cell sluffing (mucus)
2 = Moderate redness and/or slight cell sluffing
3 = Severe redness and/or severe cell sluffing
4 = Actual bleeding observed

Figure 2. *Clostridium perfringens* counts in broilers by iron source and pathogen exposure



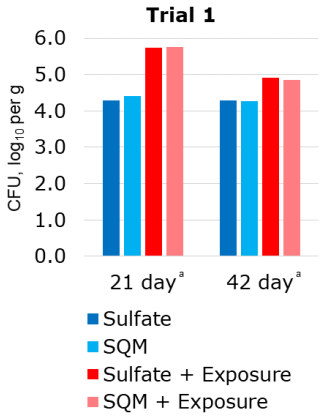
[a] Iron source and Exposure effect $P < 0.01$
[b] Exposure effect $P < 0.01$
[c] Iron source x Exposure Interaction $P < 0.01$

Figure 3. *Eimeria acervulina* (Coccidia) counts in broilers by iron source and exposure



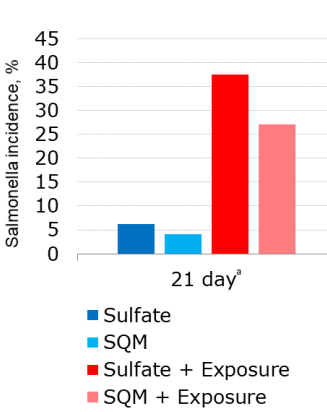
[a] Iron source and Exposure effect $P < 0.01$
[b] Iron source x Exposure Interaction $P < 0.01$

Figure 4. *E. coli* counts in broilers by iron source and exposure



[a] Exposure effect $P < 0.01$
[b] Iron source x Exposure Interaction $P < 0.01$

Figure 5. *Salmonella* incidence in broilers by iron source and pathogen exposure



[a] Exposure effect $P < 0.01$

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To further understand the effect of iron on pathogen growth, a series of in vitro trials were conducted. The main objective was to quantify the difference in availability of iron source across a range of known pathogenic strains of *E. coli* and *Salmonella*. Pathogens were grown in a low iron media supplemented with 2, 5, or 10 ppm of supplemental iron from iron sulfate and SQM Fe, as well as an equivalent dose of the SQM matrix without iron. Growth rate was analyzed by common-intercept slope ratio assay to determine the relative potency of each supplement, with results of the pooled data presented in Figure 6 and discrete analysis of each strain presented in Figure 7.

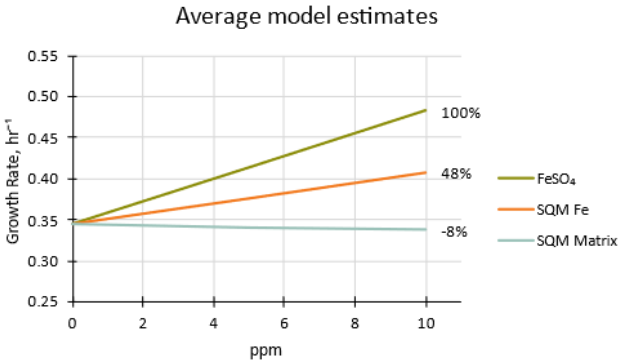

Figure 6. Common intercept slope ratio results from pooled growth data (7 *Salmonella*, 2 *E. coli*).

On average, iron in SQM Fe is 52% less available to the pathogens tested than the control iron sulfate it replaces in mineral mixes. Depending on the strain, this reduction ranged between 27% (*E. coli* isolated from swine lung infection) and 81% (*S. enterica* serovar Reading isolated from turkey GIT).

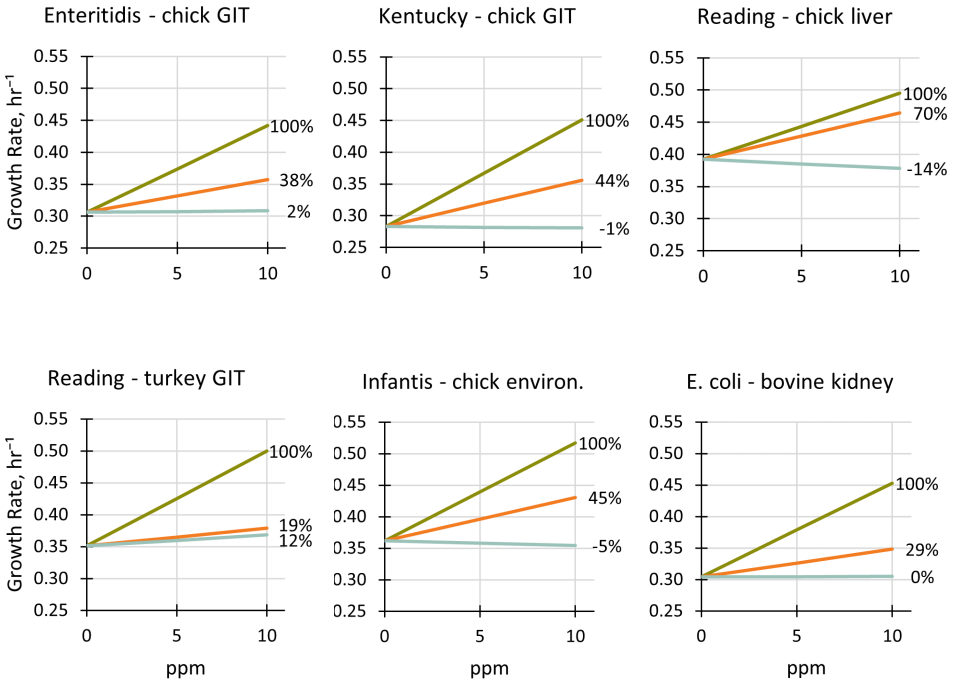

Figure 7. Common intercept slope-ratio results of selected strains from growth data.

As expected, the SQM matrix (which did not supply any supplemental iron) had no apparent effect on growth rate. This would rule out a potential antimicrobial effect of the SQM matrix as an explanation for the lower growth rate observed in response to the SQM Fe supplementation as compared with iron sulfate.

SQM PolyTransport technology has long been known to shield trace minerals from antagonist interactions with phytic acid, other minerals, and antinutritional factors. Specifically for SQM Iron, we now know that PolyTransport also protects the gut from pathogens by denying them access to a crucial pro-virulence factor – free iron. This helps to optimize gut health as it promotes better nutrient uptake by the animal.

If you'd like to learn more about SQM PolyTransport protected trace minerals, please contact your local QualiTech sales representative.

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