Sequestered Iron is Better for Nursery Pigs

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

Background

Kochan (1997) coined the phrase "Nutritional Immunity" when describing how host metabolism will act to sequester free iron during infection. Previous pathogen exposure work[1] in poultry has shown that SQM Iron can improve broiler performance and reduce pathogen levels (*Salmonella, E. coli,* and *Clostridia*) in the intestine. Subsequent *in vitro* work has demonstrated that SQM iron is less bioavailable to pathogens than $FeSO_4$, providing an explanation for the observed effects on broiler performance and pathogen load.

The present study was designed to evaluate this nutritional immunity approach in nursery piglets under mild hygiene challenge.

Design

A 28-day nursery trial was conducted with 10 mixed-sex piglets per pen and 8 replicate pens per treatment. Treatments consisted of a 2 × 2 factorial with 2 sources of iron delivering 100 ppm of supplemental iron (SQM Iron or $FeSO_4$) and 2 levels of environmental hygiene (Clean or Dirty).

- Clean pens were cleaned before animal placement and weekly during the trial.
- Dirty pens were deliberately contaminated with feces from a wean-to-finish barn before animals were placed, and pens were not cleaned during the trial period.

Performance

Overall, access to more **hygienic conditions** resulted in improved performance.

- Pigs grew 11 to 14% faster over the 28-day period (Figure 1)
- Pigs were 10% more efficient in their utilization of feed.

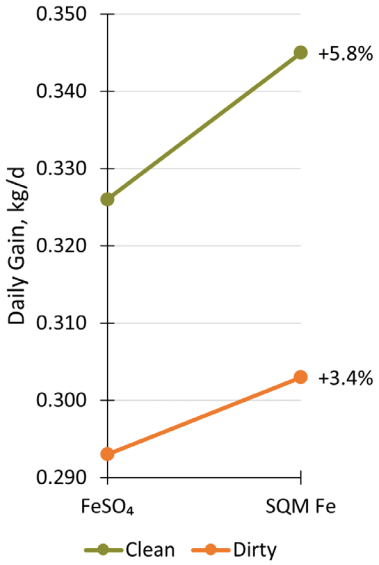

Figure 1. Average daily gain of nursery pigs consuming 100 ppm of supplemental iron from $FeSO_4$ or SQM Iron and housed in Clean or Dirty pens.

Substitution of 100 ppm of iron from $FeSO_4$ with equimolar levels of iron from **SQM Iron** also improved performance and gut health indicators.

- + 3.4 to 5.8% greater ADG in SQM Iron diets (Figure 2)
- + 4.8 to 5.1% higher ADFI in SQM Iron diets (Figure 2)

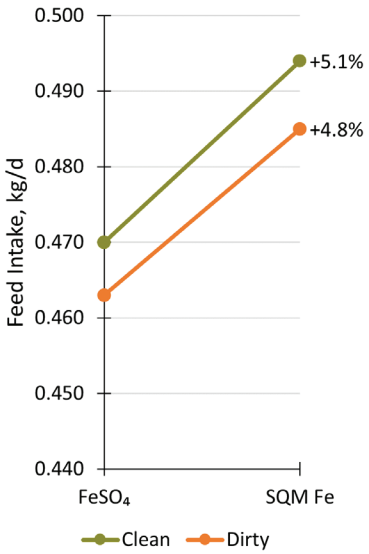

Figure 2. Feed intake of nursery pigs consuming 100 ppm of supplemental iron from $FeSO_4$ or SQM Iron and housed in Clean or Dirty pens

Pathogen Load

Relative mRNA gene expression was measured as an indicator of pathogen activity. SQM Iron resulted in smaller increases in expression of genes associated with the following bacteria from 0 to 14 days (Figure 3)

- *Campylobacter jejuni*
- *Clostridium perfringens*
- *E. coli* O157

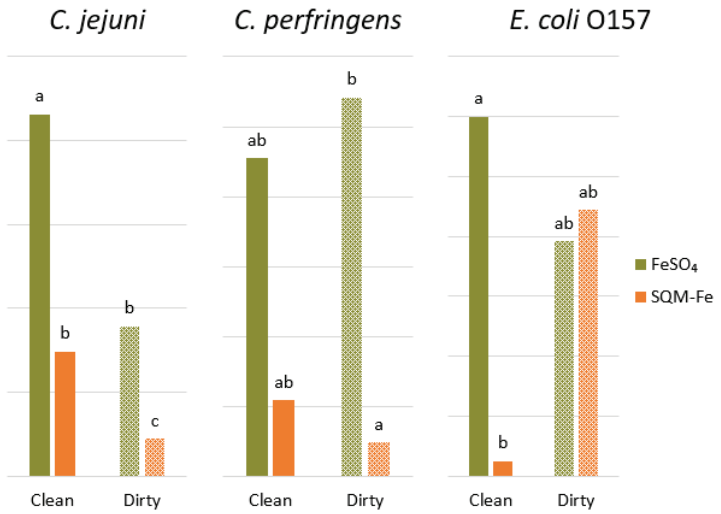

Figure 3. Relative change in pathogen mRNA gene expression from day 0 to 14 in nursery pigs consuming 100 ppm of supplemental iron from $FeSO_4$ or SQM Iron and housed in Clean or Dirty pens. Bars within sub-charts with different superscripts differ, $P < 0.05$.

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Microbiome

At the phylum level, replacement of $FeSO_4$ with an equimolar dose of SQM Iron increased the ratio of Firmicutes to Bacteroidota (Figure 4a), regardless of environmental hygiene. On the Genus level, SQM Iron fed pigs had increased relative abundance of Lactobacillus and Streptococcus, whereas the dirty environment favored microbiota in the Prevotella genus (Figure 4b).

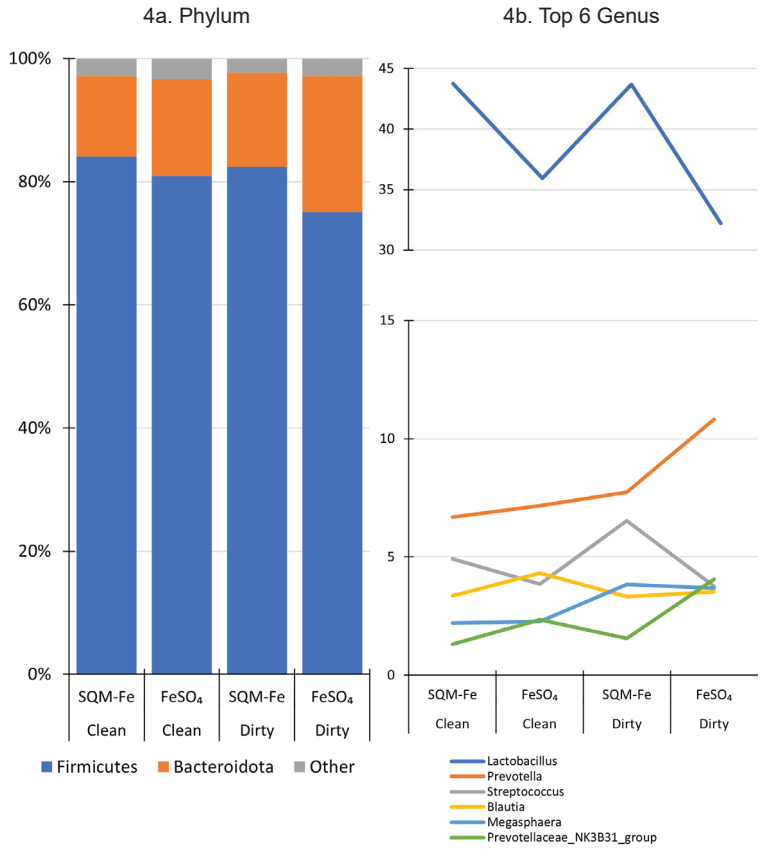

Figure 4. Microbial composition of feces from nursery pigs consuming 100 ppm of supplemental iron from $FeSO_4$ (Inorganic) or SQM Iron (Organic) while housed in Clean or Dirty pens.

Conclusions

In the final analysis, replacing standard $FeSO_4$ with SQM Iron resulted in healthier, faster growing piglets with evidence of improved gut health and reduced pathogen activity. This is in part because SQM PolyTransport technology sequesters iron in a polysaccharide matrix, which limits the extent to which pathogens can metabolize the sequestered minerals (Figure 5).

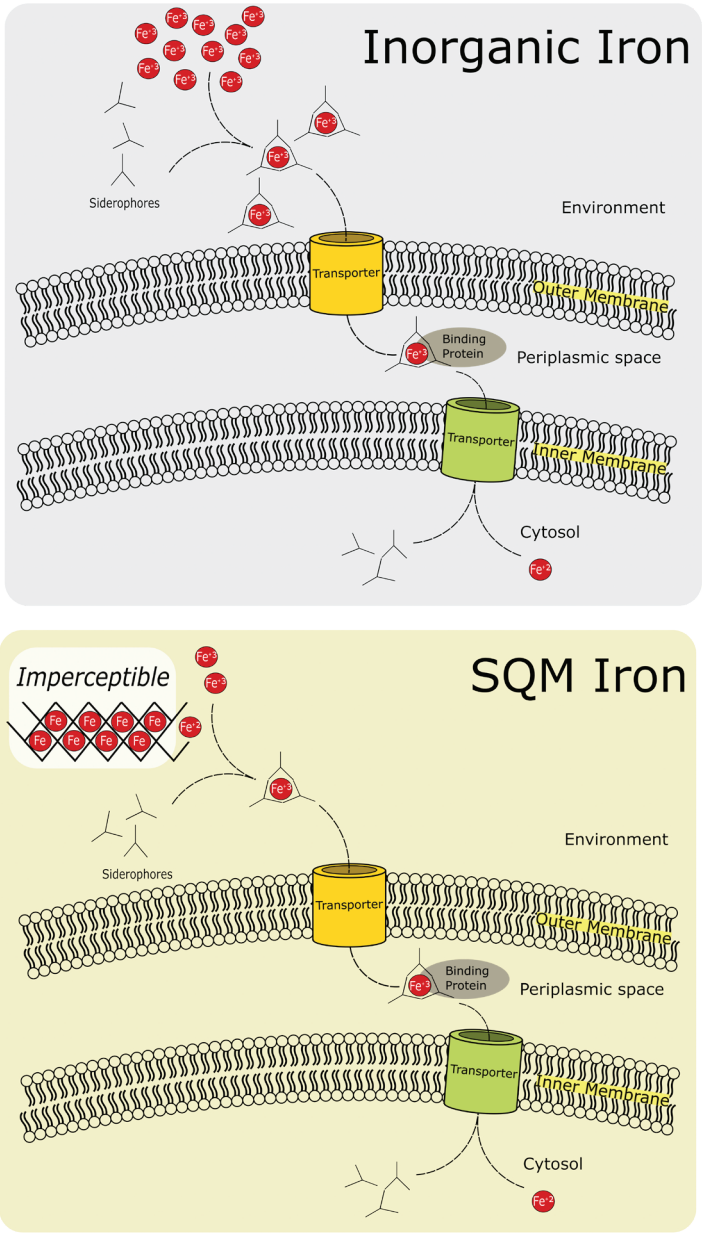

Figure 5. All iron fed as inorganic iron (top) is available and therefore perceivable by microbiota. Our SQM PolyTransport Technology sequesters iron, reducing the iron available to and perceivable by microbiota.

[1]Garret & McNaughton. 2019. Poult. Sci. 98(E-Suppl. 1):212

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