Trace minerals' role in gilt structural development

Adequate development of a replacement gilt is paramount to ensure its longevity and lifetime productivity. It is accepted that, with the aim to recover the replacement gilt investment, a sow should remain in the breeding herd to at least parity three once feed consumption, housing and management costs are considered.

by Roberto Barea, Technical Service Manager, Swine, South Europe, Novus International Inc. www.novusint.com

Through nutrition and management strategies to prevent premature culling, it is possible to influence body condition, locomotor health, mammary gland development, and proper reproductive tract function.

Genotypes of hyperprolific maternal lines are more sensitive to nutritional management because they have higher lean growth potential, but their appetite is lower.

The key to gilt development, in this case, is to reduce the speed of protein deposition and store minerals and fat (among other nutrients) in the gilt body, to be used when feed intake during lactation will not be enough to cover the requirements of the young sow.

Gilts' requirements are higher for some nutrients such as vitamins (for example, A, E) and macrominerals (calcium and phosphorus) compared to grower/finisher pigs. Thus, dietary levels of calcium (Ca) and phosphorus (P) must be high enough to maximise bone mineralisation in the gilt.

The recommended dietary requirements of Ca and P for 60-110kg replacement gilts from different genetics are a minimum of 0.7% of total Ca and 0.25-0.35% of standardised ileal digestible (STTD) P.

In contrast, trace minerals (for example, zinc, copper, and manganese) supplementation in current gilt development programs (at body weight from 60-110kg) are similar to market gilts or barrows: 110, 15 and 45mg/kg in complete feed of Zn, Cu and Mn, respectively.

However, feeding high levels of both macrominerals and trace elements can result in nutrient imbalances or mineral antagonisms. In addition, elevated levels of dietary minerals can lead to increasing their own excretion into the environment.

Chelated trace minerals such Mintrex bis-chelated trace minerals are shown to be more bioavailable, avoiding antagonisms and offering advantages over other trace mineral sources.

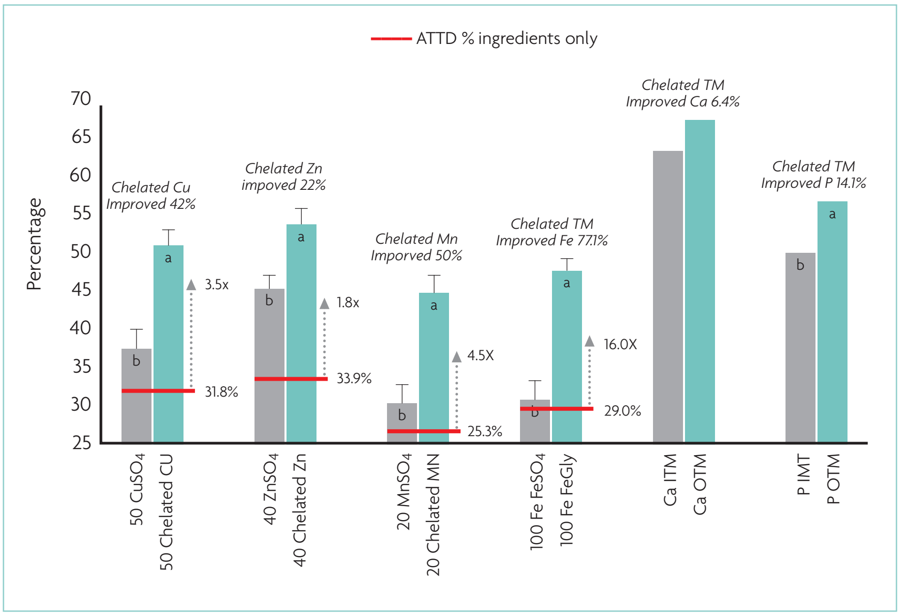
The positive effects of chelated trace minerals are attributed to: (a) the absence of free active cations (for example, $Zn^{2}+$, $Cu^{2}+$) responsible for feed degradation by the formation of free radicals; (b) the protection of minerals from phytate and oxalate sequestration as well as from competition with other minerals in the feed; and (c) less excretion of minerals into the environment.

Feeding minerals today to support growth tomorrow

Mintrex Zn, Cu and Mn are chelated in coordinate covalent bonds with two molecules of HMTBa, which provide higher stability to the molecule in the upper part

Continued on page 12

Fig. 1. Apparent total tract digestibility (ATTD, %) of minerals in pigs fed diets with Inorganic Trace minerals (ITM) or Mintrex bis-chelated trace minerals (from Liu et al., 2014).



Measured parameter	Trace mineral levels	Magnitude of response
Improved trace mineral digestibility (Zn, Cu, Mn, Fe)	Equiv[1]	20-57%
Improved Ca and P digestibility		6-14%
Reduced mineral excretion		9-20%
Improved bone mineralisation	Partial replacement[3]	5% ↑ bone ash
Plasma osteocalcin (ng/ml)[2]		13%
Improved bone mineralisation; additive effects with phytase (at 500 FTU/kg)[4]	R&R[5]	32% ↑ bone Ca
		31% ↑ bone P
		11% ↑ bone ash
Improved Ca and P digestibility[6]	R&R[5]	6-12%
Reduced Ca and P excretion[6]	R&R[5]	15-18%
Improved bone mineralisation; additive effects with phytase (at 500 FTU/kg)[7]	Equiv[1]	5% ↑ bone Ca
		6% ↑ bone P
		4% ↑ bone ash
Improved Ca and P digestibility[8]	Equiv[1]	2-5%
Reduced Ca and P excretion[8]		8-12%
Improved bone mineralisation; additive effects with phytase (at 1,500 FTU/kg)[8]		2% ↑ bone Ca
		2% ↑ bone P
		2% ↑ bone ash

1 = Equiv: same dietary levels of Mintrex bis-chelated trace minerals and ITM; 2 = Osteoaclcin is a biomarker of bone synthesis; 3 = Partial replacement: Mintrex replaced 50% of the inorganic Zn, Cu and Mn sources; 4 = Mintrex Cu (80ppm Cu) vs. $CuSO_4$ (250ppm); 5 = R&R: reduce and replace strategy of Mintrex supplementation (decreasing the supplementation of trace minerals as Mintrex, replacing all other inorganic or organic sources); 6 = Mintrex Zn (100ppm Zn) vs. ZnO (2,000ppm Zn); 7 = Mintrex Cu (150 and 80ppm Cu) vs. $CuSO_4$ (150 and 80ppm Cu); 8 = Mintrex Cu vs. $CuSO_4$ (both at 125ppm Cu)

Table 1. Mintrex bis-chelated trace minerals studies demonstrating improved Ca and P utilisation in swine vs. inorganic trace minerals (ITM).

Continued from page 11
of the gastrointestinal tract and is shown to reduce the formation of complexes among trace minerals and phytates. This characteristic allows more trace minerals to be absorbed by the enterocytes at the jejunum and ileum.

The reduction of trace mineral-phytate complexes is shown to improve Ca and P digestibility without phytase supplementation (Fig. 1). These authors studied the effect of Mintrex vs. inorganic trace minerals (ITM) at the same supplementation levels on mineral apparent total tract digestibility (ATTD). Besides the direct improvement seen with Mintrex trace minerals on the ATTD of Zn, Cu and Mn; higher P and Ca absorption rates were observed, although dietary supplementation of Ca and P were identical in all the experimental treatments.

Similarly, Ren et al (2020) demonstrated that 100ppm of zinc supplied as Mintrex Zn enhanced ATTD of Ca and P in the absence or presence of phytase (at 500 FTU/kg) compared with 2,000ppm of Zn as inorganic zinc oxide (ZnO). Finally, 125ppm of copper as Mintrex Cu improved the ATTD of P compared to 125ppm of Cu as copper sulfate ($CuSO_4$) with or without phytase supplementation at 1,500 FTU/kg.

Table 1 shows different studies in which Ca and P utilisation was improved by the supplementation of Mintrex trace minerals in swine. These findings suggest that supplementing Mintrex in replacement gilts may increase mineral reserves to maximise bone and cartilage synthesis. This is a primary goal for gilt development.

Supporting structural integrity

Lameness is a growing concern in swine breeding herds. Although replacement gilts are generally fed ad libitum, rapid growth rates can lead to leg problems and lameness in current sow genetic lines.
Multiple trials have demonstrated the benefits of Mintrex bis-chelated trace minerals on the structural integrity of turkeys, dairy cows and/or pigs compared to ITMs.

A reduction of 34% in relative removal rate was observed due to locomotion issues in gilts fed Mintrex vs. control.

Also, gilts fed Mintrex showed better gait score, higher plasma osteocalcin concentrations (a biomarker of bone synthesis), and lower mortality and overall removal rates. These findings may be associated with a better body mineral status and better immune function.

Improved mineral absorption for the environment

Finally, it is important to note that reducing mineral excretion from livestock production is increasingly in the spotlight due to environmental concerns in several areas of the world.

From a nutritional perspective, many efforts have already been made to improve the efficiency of P utilisation by the animal, such as phase-feeding approaches and dietary phytase supplementation. The indirect effects of Mintrex trace minerals on higher Ca and P digestibility and the confirmed additive effects with phytase may help to increase sustainability related to pig production.

By improving the efficiency of P absorption associated with Mintrex supplementation as described above, the total P excretion can be decreased up to 12% as shown in Table 1.

Why mineral source matters

In conclusion, there is a greater demand for gilts that can reach optimal reproductive performance and longevity during their production lives.

For this reason, optimal mineral supplementation during gilt development plays a fundamental role, since highly bioavailable and absorbable minerals can affect growth rate, body condition, and reproductive potential, reducing the occurrence of locomotor disorders.

Studies indicate that trace mineral source greatly influences the performance of gilts and sows.

Mintrex trace minerals has several advantages over other trace minerals, as shown by the enhanced growth development and bone mineralisation due to a better body mineral status.

Through improved mineral availability to the animal, Mintrex trace minerals can result in reduced excretion into the environment, which supports environmental sustainability goals in modern animal production. ■

References are available from the author on request

This research first appeared in Pig Progress, Vol. 35, No. 5 2023