Potentiated ZnO: your competitive edge in piglet production

By Animine Technical Team

AFTER THE ZNO BAN: RETHINKING ZINC SOURCES IN ANIMAL NUTRITION

The ban of medicated zinc oxide marked a turning point in the industry, reflecting growing societal expectations for responsible livestock production. Since its implementation, feed and premix manufacturers have faced increasing pressure from farmers seeking effective nutritional and health solutions within the new regulatory limits. With zinc levels limited to 150 ppm in Europe, covering only the nutritional needs of animals but insufficient for microbial control, producers are actively searching for zinc sources that are both bioavailable and microbiota-friendly. Faced with this challenge, many players have shifted away from zinc oxide, opting for sulfates or chelates to ensure bioavailability (Figure 1).

For microbial stability, numerous alternatives have entered into the market with different degrees of success. Since zinc oxide's antimicrobial effects are only expressed at pharmacological doses, its inclusion in the diet at low levels has only nutritional purpose., Consequently, the true differences in zinc source quality and efficacy have often been overlooked in the post-ZnO era. Meanwhile, pork producers in Western Europe face a variety of societal concerns about pork production. Historically, producers predominantly focused on low consumer prices, therewith addressing just one concern. However, this approach has resulted in an intensive and large-scale production system, increasing concerns about pork safety, animal welfare, environmental pollution, and more.

This is why feed manufacturers and premixers are now facing new challenges, related from both farmers' expectations and societal demands. These expectations are not only related to a product with high bioavailability and microbiota efficiency, but also to a high-quality standard and low carbon emissions.

Figure 1: Feed and premix industry under pressure

ARE ALL ZINC OXIDES THE SAME?

Recent publications highlighted the importance of considering physical and chemical characteristics of zinc oxide sources to predict their bioavailability. During a 3-year PhD thesis, more than 30 well-defined samples of grade ZnO were collected across the world and analyzed. The results showed that their physical characteristics strongly influence their dissolution kinetics and consequently, their final bioavailability. The different analyzed sources can be sorted into three main categories:

- 'Large Dense Particles' (LDP). This source can be remembered as lollipops. LDP are found in coarse ZnO powders. These are large non-porous particles which dissolve too slowly to become bio-accessible to the intestinal zinc transporters and thus have poor bioavailability.
- 'Small Aggregate Particles' (SAP). This source can be remembered as icing sugar. SAP are powders with a smaller particle size, high Specific Surface Area (SSA) and lower density than LDP. These powders dissolve too quickly, rapidly bind to antagonists and have limited final bioavailability.
- 'Small Aggregated and Agglomerated Particles'(SAAP). This source can be remembered as a candy floss. Potentiated zinc (HiZox®) is alone in this category; it is a source produced with a patented manufacturing technology with a larger particle size than SAP but with a high Specific Surface Area (10 to 15 times greater than conventional zinc oxide sources). It dissolves at an optimal, steady rate to provide a continuous diffusion of ionic zinc.

A recent study done in Denmark (Nielsen et al., 2022) calculated the apparent total tract digestibility (ATTD) of Zn for different zinc sources, supplemented during the first 14 days after weaning at 100 ppm Zn (figure 2). Potentiated zinc oxide (HiZox®) displayed a numerically improved digestibility compared to other inorganic sources and even one chelated source. This could possibly be due to its unique physical-chemical properties that make its dissolution optimal, steady rate to provide a continuous diffusion of ionic zinc without binding to antagonists.

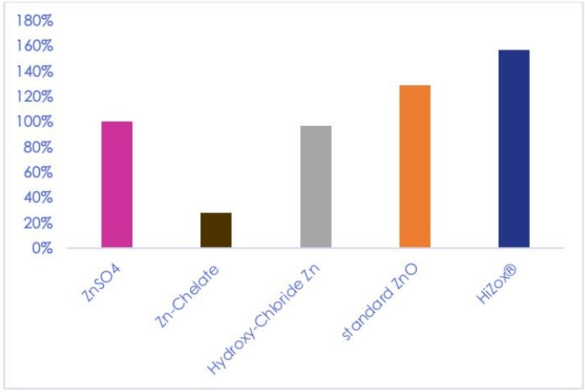

Figure 2: Relative zinc ATTD of different zinc sources determined at day 14 after weaning

Not only do the physical-chemical properties of zinc oxide affect dissolution kinetics and bioavailability, but they also impact its antibacterial effects. A study performed at Ghent University (Figure 3) involving piglet weaned at 21 days, scrutinized the effect of a standard feed grade zinc

oxide and HiZox® (Wang et al., 2018). The larger surface area of HiZox® drastically increases the contact area with gut bacteria, and the high porosity amplifies the antibacterial activity of this potentiated zinc oxide making it very interesting even at European levels (150 ppm of Zn). The antibacterial properties of HiZox® at low level (150 to 300 ppm) seem equivalent to the pharmacological ZnO (3'000 ppm), as can be seen in Figure 3.

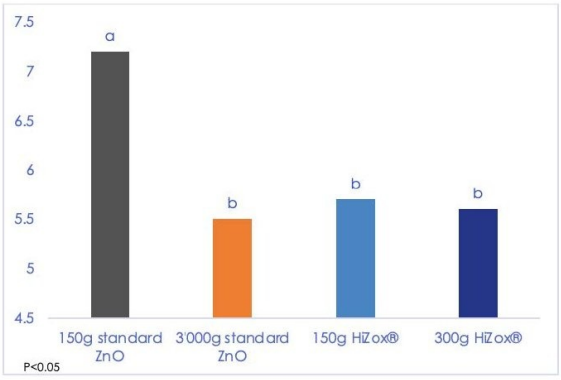

Figure 3: Intestinal coliform count (selective media plates; log10 CFU/g) after 14 days (35-days-old piglets)

With these data, we can easily see that zinc oxides are not the same. Some zinc oxide sources can offer higher performances to farmers even under European levels. HiZox® is the only zinc oxide in the feed market that offers high bioavailability and high capacity to modulate microbiota.

FROM COMMODITY TO INNOVATION: REDEFINING ZNO

Zinc oxide is widely used in piglet diets, but some sources may contain heavy metal contaminants such as cadmium, lead, and arsenic. These contaminants can enter pig feed through polluted raw materials or mineral additives and accumulate mainly in organs like the liver and kidneys. Recent analytical surveys have shown that one fourth of pig kidneys in an Asian country was above the regulatory limits for human consumption due to an excess in Cd. Recent analysis on batches of ZnO products used in animal nutrition have shown elevated levels of contaminants. Implementing a stricter quality control system in the pig production chain, along with regulatory measures, could significantly enhance food safety.

The presence of heavy metals in ZnO originates from two main sources: (1) the origin of the raw material and (2) the manufacturing process. Regardless of the origin of the ZnO, all ZnO used in Europe must be in line with European standards. However, due to its high quality and awareness of potential risks to consumers, HiZox® imposes even stricter quality standards. This is because the presence of heavy metals in feed ingredients represents a risk not only to animals, but also to humans, as accumulation in organs used for human consumption may lead to public health issues (Table 1).

Contaminants (mg/kg)	Lead	Cadmium	Arsenic
Max authorized level EU	400	30	100
Max HiZox® levels	20	2	5

Table 1: Quality standards of feed grade ZnO and HiZox®

DO YOUR SUPPLIERS OF TRACE ELEMENTS PROVIDE LIFE CYCLE ANALYSIS TO ANSWER SOCIETAL DEMANDS?

Societal demand for environmentally sustainable products is growing. Among the methods used to assess environmental impact, Life Cycle Assessment (LCA) is increasingly adopted by the feed industry. In line with this trend, Animine became a pioneer in the trace mineral market by conducting an LCA for its potentiated ZnO, HiZox®, in 2020 (Monteiro et al., 2020).

Even if trace minerals represent less than 1% of total feed ingredients in Europe, they make the highest contribution to freshwater and marine ecotoxicity due to their high toxicity when released into soils and waters, and to metal depletion, due to the fact that they are non-renewable resources. This high contribution demonstrates the importance of selecting the right source and dose of trace minerals.

The recent LCA performed by Animine for its trace mineral sources showed that the carbon footprint (e.g CO2-eq/100 ppm of mineral provided in the diet) of HiZox® is lower than the standard sulfate sources commonly used worldwide (Figure 6). This trend was also observed for water quality impact categories such as freshwater ecotoxicity, freshwater eutrophication, and marine eutrophication. The lower environmental impact of HiZox® can be attributed to the high metal concentration combined with low levels of contaminants, including heavy metals.

Feed manufacturers can include these results in their calculation of their own Product Environmental Footprint (PEF) assessments, enabling them to demonstrate the environmental impacts of their complete feed or premixes in response to societal demands.

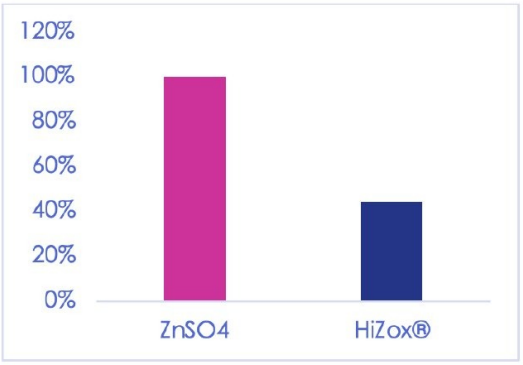

Figure 4: Relative carbon footprint (per kg of Zn provided in the diet) of HiZox® compared to zinc sulfate

ARE YOU REALLY TRAPPED BY THE EUROPEAN REGULATION AND SOCIETAL EXPECTATIONS?

Since the European ban on therapeutic levels of zinc oxide (ZnO) in June 2022, its use in pig production has significantly declined. However, what many overlook is that not all ZnO sources are the same — they differ in their physico-chemical properties, which can impact bioavailability and efficacy. While standard feed-grade ZnO, sulfates, and even newer forms like chelates often fail to deliver consistent performance, HiZox® — a potentiated zinc oxide — continues to meet the expectations of both farmers and regulators. Its unique formulation ensures ongoing benefits in post-ZnO strategies, even under low-inclusion conditions.