

Bioavailability: where mineral nutrition becomes performance

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How smarter trace mineral choices support resilient, efficient and sustainable animal production

On paper, trace minerals look small, few milligrams in a kilogram of feed. But inside the animal, those milligrams carry a much larger responsibility. Trace minerals may be small in inclusion rate, but they are deeply connected to the biological systems that keep animals productive, healthy and resilient.

For many years, mineral nutrition was mainly approached as a matter of coverage: add enough to meet the requirement, include a safety margin, and prevent deficiency. But modern animal production has changed. Animals are more productive. Diets are more complex. The use of plant-based raw materials, by-products and alternative ingredients is increasing. Feed costs remain under pressure. At the same time, the industry is expected to reduce waste, improve efficiency and demonstrate more sustainable production.

In this context, the question is no longer only: *How much mineral do we add?* But the more relevant question is: *How much mineral can the animal actually use?*

That is where bioavailability becomes a key driver of mineral efficiency.

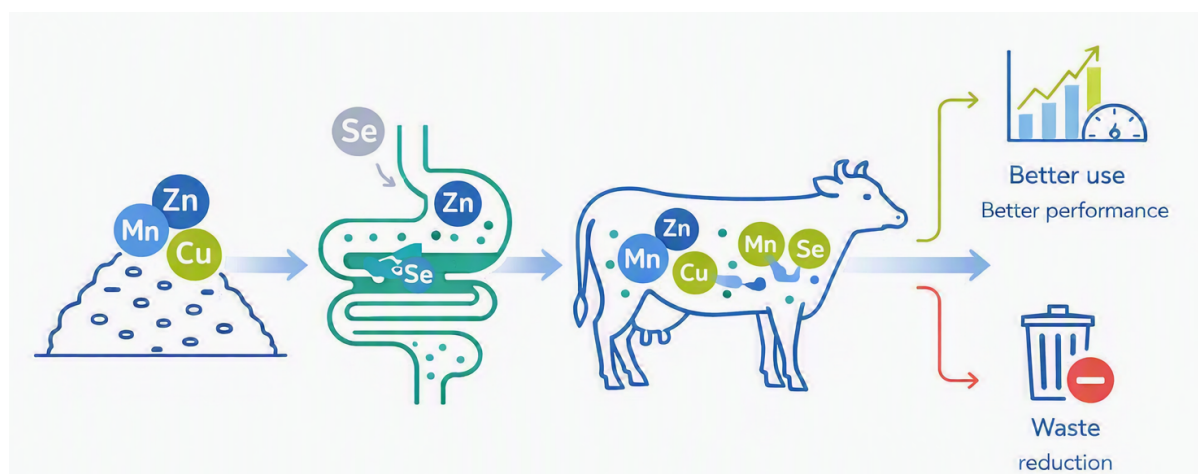
The journey from feed bin to biological function

A mineral does not create value by simply being present in the feed. Its real value starts only when it survives the journey through the digestive tract, is absorbed, transported and used in the right biological process. That journey is not always easy.

In the gut, and even before in the feed, minerals can interact with other feed components. They may bind to phytate, vitamins, fiber or antagonistic minerals. They can become unavailable before the animal has the opportunity to absorb them. Processing conditions, gut health, intestinal pH and species-specific physiology can further influence the outcome. This means that two diets may contain the same declared mineral level, but deliver very different biological results.

For the nutritionist this creates uncertainty. If mineral availability is inconsistent, higher safety margins are often used to reduce the risk of deficiency. But this approach has a downside. Minerals that are not absorbed are excreted. What was intended as nutritional insurance can become inefficiency, both economically and environmentally.

A more bioavailable mineral source changes that equation. It allows the animal to make better use of the mineral supplied, helping nutritionists formulate with more confidence and less unnecessary excess.



Why form matters more than the label

In practice, the form of the mineral strongly influences what happens after ingestion. Inorganic minerals such as sulphates are commonly used, but they can easily dissociate in the digestive tract (Spears, J.W. 2023). Once present as free ions, they are more exposed to interactions with other dietary components. This can reduce absorption and may also affect the stability of sensitive nutrients in the feed or gut environment.

Exential SMART takes a different approach. It is based on hydroxy trace minerals with a strong covalent bond and crystalline structure, designed to reduce unwanted interactions in the feed and upper digestive tract. Such bioavailable trace mineral sources are designed to improve delivery. Their value is not simply that they contain the mineral, but that they help protect it and support more efficient uptake. The goal is not ‘more mineral on paper’, but more mineral reaching the tissues where it can contribute to performance.

Trace minerals rarely show their value at the moment problems become visible, they start working earlier. In the field, the link between mineral source and performance becomes visible. A dairy farm in Germany reported 20.4% fewer non-pregnant cows at 110 days in lactation (field data). A sow farm in Scandinavia observed 60% fewer cracked wall horns (field data).

These are not just mineral effects. They are changes in fertility, herd flow, animal longevity, and welfare.

The same pattern appears in controlled studies. In a broiler trial, different levels of manganese from hydroxy trace minerals were compared with manganese sulphate over 42 days. Higher inclusion levels improved tibia development, increased antioxidant enzyme activity, and reduced indicators of oxidative stress in the liver.

The outcome is straightforward: better mineral availability supported stronger bones, improved antioxidant capacity, and better physiological development in early growth.

Selenium: small inclusion, strategic impact

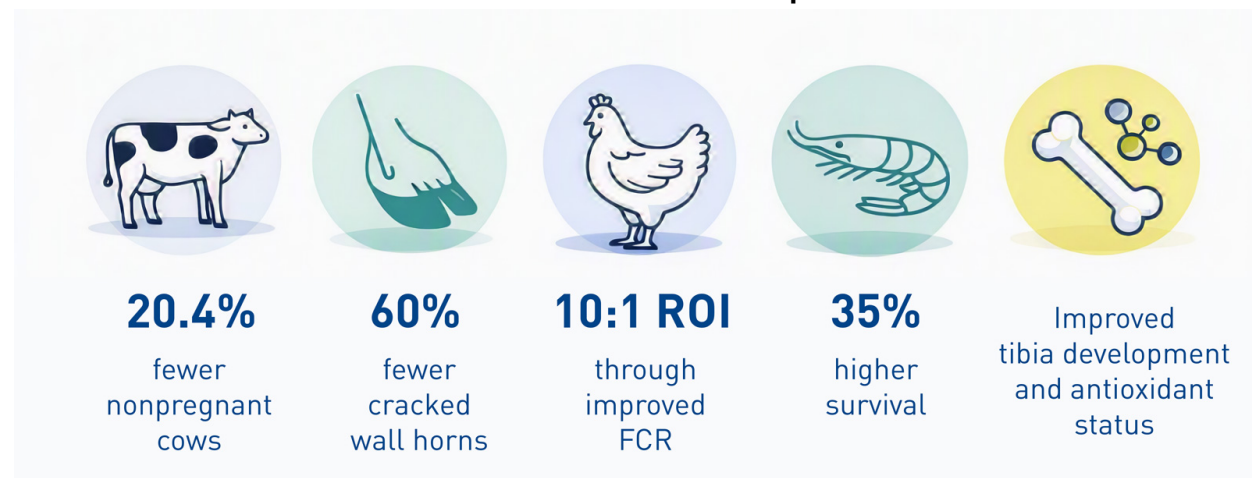
Selenium is one of the clearest examples of why bioavailability matters. It is required in very small amounts, yet it plays a central role in antioxidant defense and cellular protection. Not all selenium sources behave the same way. Inorganic selenium can

contribute to selenium-dependent enzyme activity, but it is not efficiently stored in body proteins. L-selenomethionine follows a different route. Because it is metabolized via the methionine pathway (Schrauzer, G.N. 2000), it can be incorporated into body proteins in place of methionine. This creates a selenium reserve in tissues, which can be used when the animal faces increased oxidative pressure or reduced intake. This is the difference between supplying selenium for the moment and building selenium status for the future. For producers, that difference can be highly practical. Better selenium status can support animals during critical phases such as fertility, early life, transition, immune challenge or heat stress. It can also improve selenium transfer into animal products such as eggs, milk and meat, supporting both animal nutrition and the nutritional value of the final product. The impact of L-selenomethionine (Excential Selenium 4000) becomes clear when you look at what changes on the farm. In France, a dairy farmer noticed fewer cows returning for a second insemination, about one third less, improving profitability in a very practical way (field data).

Further along the chain, the effects show up differently. In broilers, replacing sodium selenite with Excential Selenium 4000 generated an ROI of 10:1 through improved FCR (from 1.350 to 1.327; presented at PSA 2022). In sows, piglets were 12% heavier at weaning (Zhan et al. 2012). In shrimp, university trial data showed that L-selenomethionine in shrimp can increase survival by 35% after a challenge with *Vibrio parahaemolyticus* (presented at Asian-Pacific Aquaculture 2024).

Across species and systems, the pattern is consistent. Selenium source is not just a formulation choice, it quietly shapes fertility, growth, product quality and resilience long before problems become visible. Even beyond effects in animal, with differentiation in odour and dust, also workers' safety should be considered when choosing a selenium source.

Excential SMART and Excential Selenium 4000 can help to reach:



Sustainability starts with what the animal can use

Solutions such as Excential SMART and Excential Selenium show how mineral nutrition is evolving from basic supplementation to targeted support for animal health and performance. Because minerals that are not absorbed are excreted, improving bioavailability helps animals utilize more of every milligram supplied, supporting both productivity and sustainability.

In the future, mineral nutrition will be defined not by adding more, but by adding better. More bioavailable mineral sources allow nutritionists to formulate closer to the animal's true requirements, reducing waste while supporting health, resilience and feed efficiency. When delivered in the right form, trace minerals become powerful contributors to more sustainable animal production.

References are available upon request