

Advancing Animal Performance and Welfare for a Sustainable Future

In any livestock production system, the management of an animals' gut health and the nutrition of the diet is fundamental in the potential performance and welfare of the animals. Minerals are essential for animal health and performance, as they are involved in numerous metabolic and endocrine processes within the body. Consequently, providing trace minerals in the correct form and concentration within the diets improves the performance and wellbeing of the animal. However, no matter how good the animals' nutrition is, if their gut health isn't optimum, they will not get the full benefit from the nutrients within the diet.

Firstly, the gut health status of the animal will determine the ability of that animal to digest and absorb nutrients from the diet, and its susceptibility to disease challenges. When gut health is compromised, the animal will not be able to fully utilise the diet provided, feed conversion will worsen and ultimately, so will farm profitability. Therefore, achieving optimal gut health is critical along with the correct nutrition of the animal.

Alltech has created a novel nutritional approach known as Advantage Pak, which has been uniquely designed to advance economic, environmental and social sustainability of pig and poultry businesses. By working together with producers to enhance animal welfare and performance, reduce carbon footprint, and minimise environmental pollution.

The Power of Chelated Trace Minerals

Conventionally standard animal diets contain inorganic sources of trace minerals (for example, copper sulphate, zinc oxide and sodium selenite), to meet the needs of the animals for maintaining normal bodily functions, skeletal development, growth performance and reproduction, whether that be eggs or piglets. However, minerals from inorganic sources are extremely reactive in the premix, the feed and in the gastrointestinal tract of the animal, due to their poor stability and reduced bioavailability (Macelline *et al.*, 2024). Due to this low bioavailability and reactive nature of inorganic minerals, inclusion levels are regularly over formulated to ensure the animals requirements are actually met, however, uptake and utilisation of these minerals are limited, resulting in poor animal performance and high levels of mineral excretion and waste. As a result, dietary mineral levels are coming under added scrutiny from an environmental perspective and 'over-fortifying' the ration will become a less acceptable practice in modern production systems. The interactions of inorganic minerals with other feed components include binding to other components of the premix such as feed additives and vitamins, reducing the efficacy of dietary enzymes such as phytase, and acting as pro-oxidants (which can cause oxidative stress in the gut) (Concarr, Sinkunaite and Murphy, 2021; Concarr, O'Rourke and Murphy, 2021). Therefore, when inorganic minerals are added to an animal's diet, the animal will not be getting the most out of that diet due to the negative interactions occurring within the feed. For this reason, there is increasing interest in alternative forms of minerals which are better absorbed, stored and utilised by the animal. Trace minerals, that are proteinated or chelated minerals, are a

more stable form of iron (Fe), zinc (Zn), copper (Cu), and manganese (Mn)), as well as minerals in yeast form such as selenium (Se). These are more stable in the premix, the diet and gastrointestinal tract meaning they are more bio-available than inorganic sources, and provide a metabolic advantage to the animal, which often results in enhanced performance and lower mineral excretion.

Alltech has proven that chelated trace minerals and organic selenium yeast can be included at significantly lower levels while improving animal performance. This optimises animal mineral requirements and reduces negative environmental impacts. We call this innovation Alltech's Total Replacement Technology™ (TRT). The Advantage Pak combines Alltech TRT and Gut Health Technologies to help pig and poultry producers achieve economic and environmental sustainability benefits, by improving animal performance through improved gut health and welfare, and effective animal nutrition.

Alltech's Advantage Pak contains chelated trace minerals, which are chelated to amino acids and small chain peptides, making them proteinates. The minerals are protected by the peptides which help the mineral get from the premix through the GI tract to the site of absorption in the animal. The specific organic material that the mineral is bound to is very important and is what determines the bond strength at varying pH levels and their stability, two important factors in trace mineral nutrition. Minerals must be bound strong enough, so that even at a very low pH along the intestinal tract, the mineral continues to be bound and reaches the site of absorption without dissociating. As the minerals within Advantage Pak are more stable and have an enhanced bioavailability, lower levels of inclusion can be used and less mineral are excreted, therefore, reducing the environmental impact. This means that with the Advantage Pak, all inorganic minerals can be removed from the diet and replaced with lower levels of chelated trace minerals, known as Total Replacement Technology (TRT). Consequently, the negative interactions from the inorganic minerals are eliminated, allowing for better animal performance and environmental sustainability; ensuring that the growth, immune function and reproductive health of the animal is supported.

Driving Animal Performance Through Optimal Gut Health

Advantage Pak not only supports the mineral nutrition of the animal, but it also ensures optimal gut health and development. The combination of these technologies offers complimentary benefits, the TRT Minerals support key physiological functions in the animal, while the gut health technologies support gut integrity and immune function, leading to better feed efficiency, growth rates, and overall health. Supporting the gut health of the animal is key, because if gut health is compromised the animal won't be able to efficiently digest and absorb the nutrients in the diet, which will then pass through the gut and be excreted. Gut health and its management are an intricate and complex area affected by numerous factors, including nutrition, stress, management and environment.

One of the most critical determinants of gut health is the diversity of the animals' gut microbiome, the community of

bacteria, fungi, protozoa and viruses within the gut. A diverse microbiome with beneficial microbes acts as a protective barrier covering the gut, thus preventing the colonisation of pathogenic bacteria such as *E. coli* and salmonella. This can be achieved via several mechanisms, firstly, by the beneficial microbes occupying the space and attachment sites on the gut cells, meaning that pathogens have reduced opportunities to colonise the gut. Secondly, the beneficial microbes are known to secrete metabolites that make the environment less favourable to the growth of pathogenic microbes. Promoting a diverse gut microbiome supports the gut health of the animal and improves the gut integrity, resulting in a large surface area with suitable tight junctions, so the animal can absorb nutrients efficiently and stop pathogens from entering and causing harm.

Alltech's Advantage Pak contains a combination of gut health technologies, one of which is a Mannan Rich Fraction (MRF). This MRF technology is a unique, second-generation, bioactive fraction derived from a specific yeast strain, *Saccharomyces cerevisiae*, which promotes gut health by supporting the immune system, improving nutrient absorption and support against unfavourable bacteria. Several research and commercial studies have shown that it boosts overall animal performance, welfare and resilience.

In monogastrics, it has been shown that feeding Advantage Pak also optimise gut health and microbial diversity. Studies indicate that in both layers and broilers, feeding Advantage Pak can influence the microbiome diversity, by changing the β -diversity which shows that Advantage Pak birds have different and more uniform bacterial compositions than control birds (Leigh *et al.*, 2024; Leigh *et al.*, 2022). The same researchers then looked at α -diversity in layers and broilers and saw that the α -diversity was higher in Advantage Pak supplemented birds, indicating a healthier gut environment with more favourable bacteria. In pigs, Advantage Pak promotes a better microbial status of the GI tract and supports the maintenance of gut integrity and function, ensuring an optimal gut environment (Taylor-Pickard, 2011). Consequently, a review of several studies has shown that when Advantage Pak is included in the diet, there are considerable and consistent advantages for both sows and piglet performance, with benefits including (Taylor-Pickard, 2011):

- An increase in the concentration of immunoglobulins in sow colostrum (contributing to better immune status of suckling piglets)
- An improvement in piglet weaning weight of 0.3kg
- A reduction in the wean-oestrus period of sows (fewer empty days and therefore more litters born)

Improving the microbiome diversity of an animal helps to protect the gut from damage caused by unfavourable bacteria, reduces inflammation and strengthens the integrity of gut, allowing for better digestion and nutrient absorption, leading to more efficient feed conversion and growth. By fostering a stable and diverse gut microbiome, this ultimately helps improve overall animal health and performance, making it an essential tool for producers looking to boost productivity and welfare in their herds or flock.

Global Research Trials

Alltech has recently conducted a number of large-scale commercial studies as part of collaborative projects to determine the effects of Advantage Pak on animal performance and welfare, carbon footprint, and mineral excretion. One such study was conducted over a number of commercial layer farms over an extended period, and during the trial, comments from the farm managers were that "birds appeared to be noticeably calmer, have better feather coverage and drier litter". Performance results from the study showed that the Advantage Pak achieved improved hen day production, reduced farm seconds by 7% and improved shell strength by 4%. This has also been shown in a recently published meta-analysis showing that feeding Alltech's chelated trace minerals resulted in 1.5% higher hen-day production, significantly reduced feed conversion (73.1g feed/kg egg), reduced egg loss (0.57%, equates to 41.3%) and improved shell strength by 3.9% (Byrne *et al.*, 2023). Additionally, in both commercial and research studies improvements in minerals excretion have been widely reported. For example, Advantage Pak reduced mineral excretion by up to 38% (P, Zn, Cu, Mn, K, Mg, Na, Se, Ca) and calcium and phosphorus utilisation was improved by 22% and 3% respectively.

In pigs up to 26% reduction in mineral excretion levels (Cu, Zn, Fe and Mn) was observed with a significant improvement

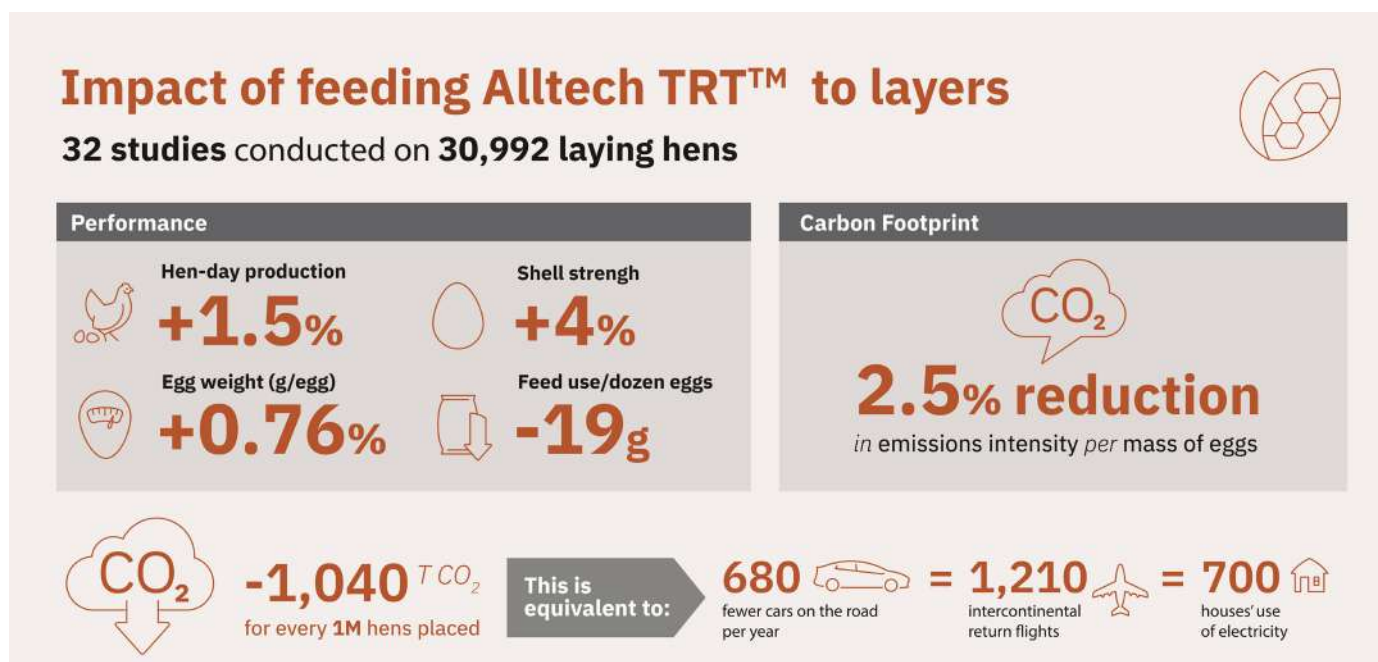


Figure 1: Peer-reviewed meta-analysis on the effect of chelated trace mineral in layer production and sustainability (Byrne *et al.*, 2023)

in pig growth performance post-weaning. This has also been shown in a recent sow study, whereby feeding Alltech's chelated trace minerals to sows reduced faecal mineral excretion by up to 77% (Mn, Fe, Zn) in gestating sows and by up to 56% (Mn, Fe, Zn) in lactating sows (Ma *et al.*, 2020). Similar effects have been observed in grow-finisher pigs, whereby faecal mineral levels were reduced by up to 85% (Cu, Fe, Zn) in pigs fed diets supplemented with 50% chelated minerals from Alltech (Burkett *et al.*, 2009).

Putting Sustainable Animal Production into Practice

In poultry, tibia bone strength was also analysed and was not negatively affected by reduced mineral levels in the diet, and keel bone deviation were significantly reduced by Advantage Pak. Furthermore, in both pigs and poultry, Advantage Pak improved the economic and environmental sustainability of the business, by reducing the overall carbon footprint, as a direct result of improved animal efficiency and reduced waste. This result is supported by a recently published meta-analysis and life cycle assessment model that show that feeding Alltech technologies can reduce the carbon footprint of egg production by 2.4% in feed and 2.5% total emission intensities per kg eggs (Byrne *et al.*, 2023). In pigs, a 9.6% reduction in overall carbon footprint from farrow to finish was reported, again, as a direct result of improved pig efficiency and less waste.

Based on these results, it shows that similar effects can be seen in both pigs and poultry, with the inclusion of Advantage Pak, resulting in benefits to production performance and improving profitability, while simultaneously contributing to a lower carbon footprint.

In summary, Alltech's Advantage Pak, which combines the powerful benefits of TRT Minerals and Gut Health Technologies, represents a comprehensive solution for advancing animal performance, welfare, and sustainability. The enhanced bioavailability of chelated trace minerals supports key physiological functions, while the MRF optimises gut health and microbial diversity, improving feed efficiency and overall health. Together, these technologies not only boost productivity but also contribute to better animal welfare and supporting immune function. With a reduced environmental footprint through more efficient nutrient utilisation, Advantage Pak is a valuable tool for producers seeking to meet their sustainability goals while enhancing the well-being and performance of their animals.

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