Transition to ZnO-free production in a safe and profitable way

Zinc oxide (ZnO) is traditionally used at high dose to prevent post-weaning diarrhoea in piglets. In June 2022, a zinc oxide ban prohibiting the use of therapeutic doses of ZnO in piglet diets to control post-weaning diarrhoea in young piglets came into effect in the European Union (EU).

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This ban echoes a further growing global trend of Zinc oxide-usage restrictions.

At weaning, piglets are subject to multiple stress factors over a very short period while the gastro-intestinal tract, immune system and microbiota are not fully developed or established yet.

Therefore, the early post-weaning period is at risk for poor growth performance and increased susceptibility to diarrhoea.

To prevent such challenges in the absence of ZnO and antibiotics, supporting feed digestibility, the immune system, gut integrity but also the establishment of a diverse and stable piglet gut microbiome are key objectives.

Different alternatives are being evaluated by nutritionists and experts; based on various formulations but also specific manufacturing technologies to guarantee consistent performance and sufficient profitability when removing ZnO from the ration, also in adverse conditions.

Replacing ZnO while controlling post-weaning diarrhoea occurrence is challenging and requires not only the right combination of active molecules but also a specific release of each molecule in the gut.

Smart technology for challenges

Lately, one innovative feed additives company developed a technology (NUQO SAFE) to help animals in such adverse conditions, based on unique active molecules and exclusive double micro-encapsulation technology.

This solution, the first of its kind, enables a double controlled-release in the gut.

The first layer of each particle will release its ingredients at the beginning of the digestive tract, in the duodenum and jejunum of animals.

The second layer will release its ingredients later in the digestive tract, around the ileum and caecum.

The first layer of particles contains phytogenics and phycogenics (plant extracts and seaweed extracts) that will improve digestibility, enhance gut integrity and immune modulation and initiate pathogen control.

The second layer of particles contains a core with six organic acids with a broad spectrum of action (Gram positive/Gram negative) and synergistic effect against pathogens (E. coli, Salmonella spp., C. perfringens, S. suis).

This technology is the outcome of a long process to develop the right manufacturing process for a double encapsulation and double release in the gut and to select the right active molecules and ingredients.

Several in-vitro and in-vivo tests have been performed to validate the optimal release and efficacy of this technology and also to determine the right dose and its efficacy in adverse conditions, with high incidence of pathogens (E. coli, Salmonella spp., C. perfringens, S. suis) and in the case of post-weaning diarrhoea.

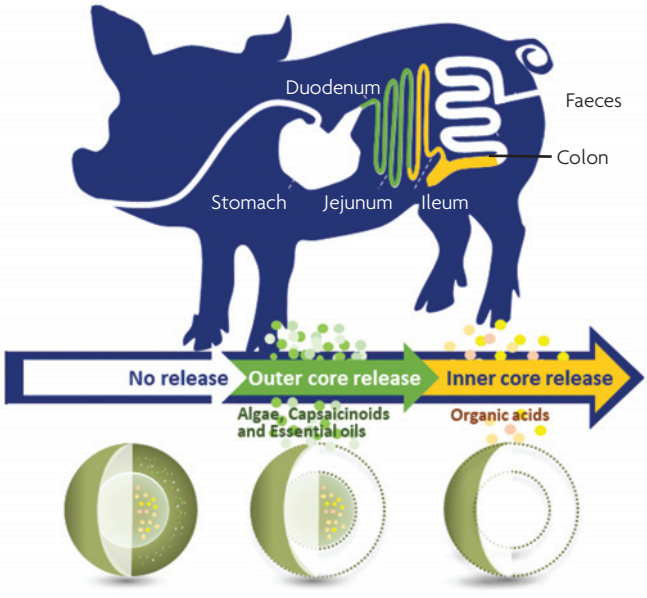
Fig. 1 illustrates the mode of action of this new technology (NUQO SAFE) in relation to the targeted release of its active ingredients.

An alternative to ZnO?

Recently, a trial was set up with the University of Berlin (FUB) and the team of Professor K. Männer to evaluate the effect of such technology compared to a high dose of ZnO, in a group of piglets with history of E.coli associated diarrhoea.

In this trial, the effects of a double encapsulated solution, containing organic acids at the core and plant

Fig. 1. Mode of action.



	Stomach	Small intestine	Caecum/ colon
pH	3-5	6-7	6-8
Bacteria density (CFU/g)	10^{2}-10^{3}	10^{4}-10^{6}	10^{11}-10^{12}

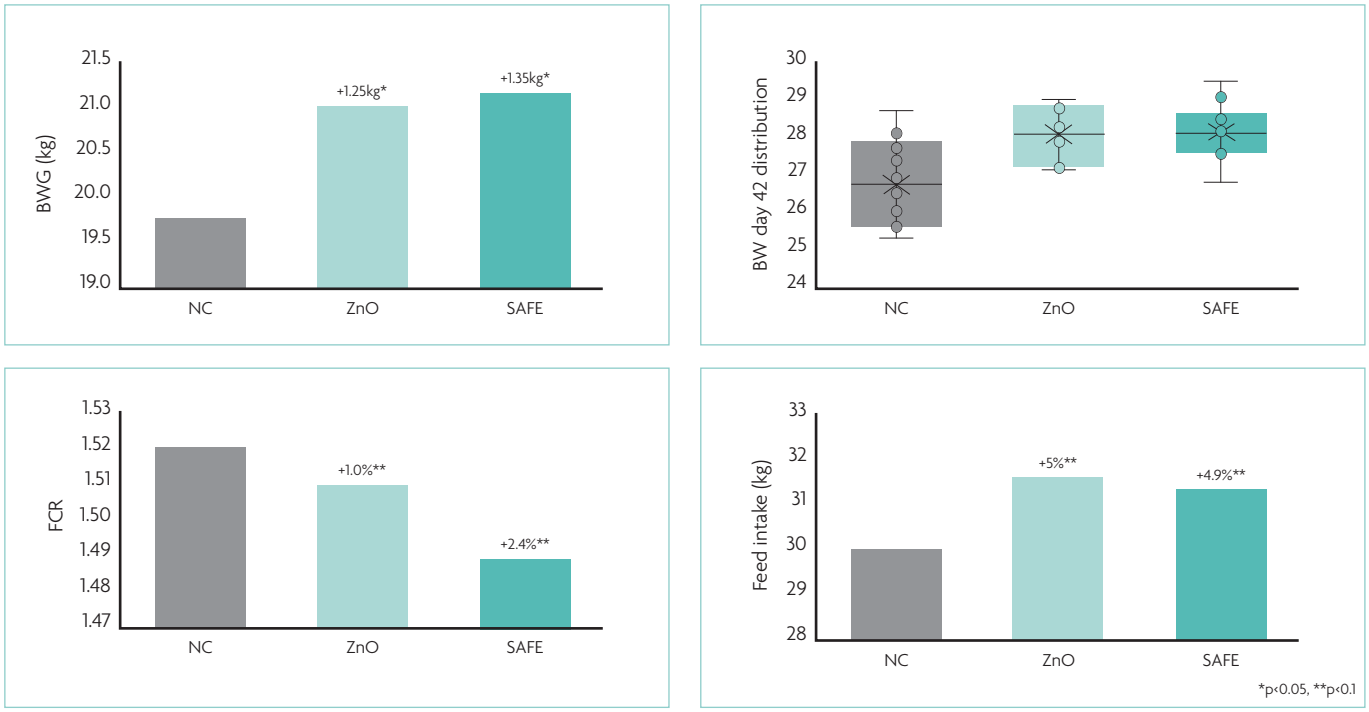


Fig. 2. Performance (day 1-42 pw).

extracts and seaweeds on the outer layer, on piglet performance and health status were studied in a random complete block design during 42 days post-weaning.

The treatments were:

- Basal diet with 80g/t ZnO (NC).
- Basal diet with 2,500g/t ZnO (ZnO).
- NC with 800g/t of the double encapsulated solution (SAFE). Each treatment had 10 replicates of 10 piglets.

Regarding performance, in the starter phase, SAFE and ZnO tended to improve body weight gain compared to NC by 12% and 14% respectively.

At day 42 post-weaning, this trend became significant and SAFE and ZnO had 1.35kg and 1.25kg, respectively, extra final weight compared to NC.

SAFE also improved FCR compared to NC (-2.5%) and compared to ZnO (-1.3%).

Regarding health parameters, SAFE and ZnO significantly improved faecal consistency compared to NC in starter phase and overall.

Fig. 2 presents some of the results of the study on performance.

Additional analyses were performed to measure the impact of the different treatments on the microbiome composition.

At day five post-weaning, the treatment SAFE did not influence the level of total E. coli but already reduced level of pathogenic E. coli (Enterotoxigenic Escherichia coli – ETEC), to a similar level as ZnO. At day 42 post-weaning, the treatment SF significantly reduced level of E. coli by 2log vs NC and even better than ZnO.

Moreover, the treatment SF improved levels of Bifidobacteria at day five post-weaning, which is associated with good gut health (preventing pathogen colonisation and enhancing host immune response).

In addition, the treatment SF improved levels of Lachnospiraceae at day 42 post-weaning, which is associated with good gut health because of their ability to produce butyrate.

Finally, the treatment SF maintained levels of Lactobacillus, a beneficial bacteria in the caecum, at day five post-weaning and day 42 post-weaning, while ZnO reduced their levels.

Fig. 3 presents some of the results concerning the effect on microflora.

The study showed promising results of the double encapsulation of plant extracts, algae and organic acids to replace high-level ZnO in the diet.

This new technology is a successful tool to improve piglet performance and flock homogeneity post-weaning, it is efficient to reduce incidence of post-weaning diarrhoea; finally it improves gut health by reducing the level of E. coli, and (unlike ZnO) by improving levels of beneficial bacteria.

In this trial, the new technology showed a return on investment of 1:3.5.

Exclusive technology as a reliable and profitable alternative to ZnO

The progress of research during the last decade has highlighted the direct relationship between animal performance and 'gut health', but also the complexity of this topic, that encompasses a number of physiological and functional disciplines, including nutrient digestion and absorption, host metabolism, energy generation, gut integrity, immunology, among others.

With the ban of ZnO this year, nutritionists look even more for new solutions to maintain performance and reduce the incidence of post-weaning diarrhoea of young piglets.

One emerging solution, combining exclusive formulation, with an innovative double-encapsulation, has shown consistent efficacy, in-vitro and in-vivo and represents a reliable solution to build an holistic strategy for ZnO-free production. ■

Fig. 3. Pathogen level.