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Peracetic acid to replace zinc oxide, modulating microbiota to control pig post-weaning diarrhoea

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Optimising liquid feeding system hygiene to improve the microbiological quality of liquid feed for grow-finisher pigs

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Application
No standard guidelines exist for optimising liquid feeding system hygiene, and current practices vary considerably between farms. This study examines the possibility of providing pig farmers with a protocol for improving liquid feeding system hygiene.

Introduction
Uncontrolled fermentation in liquid feed leads to the proliferation of undesirable microbes, with a subsequent loss of energy and amino acids from the diet (O'Meara et al., 2020). Our objectives were to perform an intensive physical and chemical cleaning protocol on the feeding system to disrupt microbial biofilms, suppress *Enterobacteriaceae* and fungal growth, and maintain system hygiene.

Materials and methods
Baseline samples were collected before the start of the trial. An intensive physical and alkaline detergent cleaning, followed by an acid wash, was performed on the feeding system. Thereafter, an acid rinse of the system was conducted nightly during the 76-day feeding study. This rinse residue was used to prepare the first feed of each day. On day (d)1 post-cleaning, 180 pigs (35.0 kg ± 4.90 SD) were sorted by weight into pen groups of 5 pigs each (36 pens in total) and liquid-fed from the system. At each of 13 sampling occasions during the study, swabs from the mixing tank and inside the feed pipe were collected, along with feed samples from the mixing tank and troughs, for microbiological and physicochemical analysis. Scanning electron microscopy (SEM) was also performed on internal pipe surfaces.

Results
Enterobacteriaceae, yeasts and moulds were undetectable during the d1-week (wk)1 post-cleaning period on the mixing tank and pipe surfaces, compared to baseline. However, yeasts and moulds were still detected in the pipes at d1 post-cleaning, but were undetectable by d3. This finding was confirmed by SEM images showing damaged fungal hyphae in the pipes on d1 post-cleaning, which were absent thereafter. Yeasts and moulds remained undetectable on the mixing tank surface up to wk4 post-cleaning, while *Enterobacteriaceae* and moulds were undetectable in the pipes until wk10 post-cleaning. By wk5 post-cleaning, *Enterobacteriaceae*, lactic acid bacteria and yeasts had returned to baseline levels on the mixing tank surface. Microbial counts and pH of the feed were not impacted by the cleaning protocol.

Conclusions
An intensive cleaning protocol improved liquid feeding system hygiene, while feed microbiology was not impacted. Direct acidification of feed or microbial inoculants may be required to improve the microbial quality of liquid feed.

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Peracetic acid to replace zinc oxide, modulating microbiota to control pig post-weaning diarrhoea

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Application

In-water peracetic acid (PAA, CH_3CO_3H), derived by the hydrolysis of sodium percarbonate (SP) and tetraacetylenediamine (TAED) could replace zinc oxide (ZnO), controlling pig post-weaning diarrhoea via microbiota modulations.

Introduction

ZnO has been widely used to alleviate weaning-diarrhoea symptoms (Ou et al., 2007), however it has recently faced a ban due to environmental pollution. SP/TAED-derived in-water PAA is a broad-spectrum antimicrobial-alternative with proven efficacy in poultry (Galgano et al., 2021). In this study, we tested the PAA potential towards post-weaning diarrhoea compared to ZnO.

Materials and methods

Four treatments, control, in-feed ZnO (3100 ppm), 50 ppm and 150 ppm of PAA, were administered to 6 pens/treatment (14-day trial) with 2 pigs per pen and 6 rooms (4 pens/room). In-water PAA treatments were prepared daily, mixing different ratios of SP and TAED. We measured faecal scores/performance, and microbial composition via 16S rRNA sequencing (515Fb-816Rb) of DNA from stomach, ileum and caecum. Linear mixed model was carried out in R with lme4 for performance and MaAsLin2 for taxonomical data, including fixed (treatment) and random effects (rooms/pens/pigs), β-diversity was analysed via PERMANOVA.

Results

Lower faecal score, linked to improved diarrhoea was found in the ZnO group at day-7 (1.26 ± 0.2) compared to control (1.52 ± 0.1, $P < 0.05$), whilst day-14 diarrhoea improved in 150 ppm (1.57 ± 0.44, $P = 0.05$), ZnO and 50 ppm (1.36 ± 0.26 1.57 ± 0.31, $P < 0.05$) compared to control (1.8 ± 0.37).

Bray-Curtis dissimilarity analysis showed different caecal microbial composition in the control group, compared to 50 ppm, 150 ppm and ZnO ($P < 0.05$, $Q < 0.05$). The same analysis showed that 50 ppm and 150 ppm had similar caecal composition, which was however different from ZnO ($P < 0.05$, $Q < 0.05$). Stomach *Campylobacter* was reduced in 150 ppm, ZnO ($P < 0.05$, $Q < 0.05$), and 50 ppm ($P < 0.05$, $Q = 0.161$) compared to control. ∼20 caecal genera were differentially abundant, e.g., *Ruminococcus*, *Oribacterium* reduced were in ZnO compared to control ($P < 0.05$, $Q < 0.05$).

Conclusions

We found that both PAA and ZnO improved the faecal scores. PAA and ZnO reduced stomach *Campylobacter*, linked to post-weaning diarrhoea (Adhikari et al., 2019). *Ruminococcus* and *Oribacterium*, linked with better performance (Uryu et al., 2020) were only reduced in ZnO.

Acknowledgments

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Comparing a seaweed blend to zinc oxide in weaner pig diets: The effect on performance and gut health

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Application

Seaweed blend has potential to improve performance in ZnO-free diets.

Introduction

After the ban of pharmacological zinc oxide (ZnO) in EU pig diets, alternatives to improve performance and health of pigs post-weaning are being sought. Seaweed blends are of interest, with potential prebiotic effects. This work compared two levels of OceanFeed Swine, to low and high ZnO diets, on feed intake, growth, feed efficiency and gut health.

Materials and methods

240 pigs ((Large white × landrace) × Danish duroc)) were weaned (8.5 ± 0.31 kg) into pens of five pigs, balanced for weight and gender. Pigs were fed either: 1) positive control(PC)- standard diet with 3100 mg/kg Zn; 2) negative control(NC)- standard diet with 150 mg/kg