Table 2. Antibiotic-resistant genes found during gut microbial profile screening of 5 to 29-day old pigs, with their targeted antibiotic classes (AM), cross-marking the possible resistance to antibiotic classes for each pig.

Gene sequences found (CARD short name)	Class of AM targeted	N1	N2	W1	PW-H	PW-D	PW-SL
ANT(6)-Ia, APH(3')-IIIa, ANT(9)-Ia, APH(6)-Id, APH(3'')-Ib, ANT(6)-Ib	Aminoglycoside	x	x	x	x	x	x
tet(40), tet(W), tet(Q),tet(M), tet(L), tet(44), tetA(P)	Tetracycline	x	x	x	x		x
lnu(C), lnu(AN2), lnu(A), lnu(B), lsa(E), cfr(C), lsa(E)	Lincosamide	x	x	x	x	x	x
CfxA, CfxA6	Beta-lactam		x		x		
mef(A)	Macrolide		x	x	x	x	x
SAT-4	Streptothricin		x	x	x	x	x
sul2	Sulfonamide		x				
dfrF	Trimethoprim				x		
lsa(E), cfr(C)	Streptogramin		x			x	x

Acknowledgements Supported in part by ARCLinkage. The author would like to acknowledge Sally Taylor and Flore Marie Janine Hincelin for help with sample collection. Ethics approval; UQ Production and Companion Animals Committee (2022/AE000737).

References

Cutler, R., Gleeson, B., Page, S., Norris, J., Browning, G., on behalf of the Australian Veterinary Association Ltd and Animal Medicines Australia, 2020. Antimicrobial prescribing guidelines for pigs. Aust. Vet. J. 98, 105–134.

Feldgarden, M., Brover, V., Gonzalez-Escalona, N., Frye, J.G., Haendiges, J., Haft, D.H., Hoffmann, M., Pettengill, J.B., Prasad, A.B., Tillman, G.E., Tyson, G.H., Klimke, W., 2021. AMRFinderPlus and the Reference Gene Catalog facilitate examination of the genomic links among antimicrobial resistance, stress response, and virulence. Sci. Rep. 11, 12728.

Kolmogorov, M., Bickhart, D.M., Behsaz, B., Gurevich, A., Rayko, M., Shin, S.B., Kuhn, K., Yuan, J., Polevikov, E., Smith, T.P.L., Pevzner, P.A., 2020. metaFlye: Scalable long-read metagenome assembly using repeat graphs. Nat. Methods 17, 1103–1110.

doi: 10.1016/j.anscip.2023.09.062

62. How does weaning age affect the microbiome of piglets fed zinc oxide free diets?

J. Taylor [a,*], C.C. Mulvenna [a], A. Strain [a], O. Gundogdu [b], N. Corcionivoschi [a], R. Muns [a]

[a] Agri-Food and Biosciences Institute (AFBI), Belfast BT9 5PX, United Kingdom
[b] Faculty of Infectious and Tropical Diseases, London School of Hygiene and Tropical Medicine, London WC1E 7HT, United Kingdom

* Corresponding author: James Taylor. E-mail: james.taylor@afbini.gov.uk

Introduction Since 2022 the EU has enforced a ban on the use of medicinal zinc oxide (ZnO), due to the substantial environmental damage it causes. However, the UK and other EU countries with remaining stock were granted an extension until the existing stocks are depleted. This has led to significant interest in finding alternatives to ZnO to overcome issues such as post-weaning diarrhoea (PWD) in piglets. Weaning is a particularly stressful event for piglets as they move from liquid to solid feed which can result in high incidences of PWD on farm. Post-weaning diarrhoea is thought to be caused by several factors including changes in the gut microbiome (Su et al., 2021). It is thought that an extended lactation period would reduce the occurrence of PWD since the piglet and its gut would be more mature. Previous work has found that there were no differences in lifetime performance of piglets given extended lactation periods and ZnO free diets (Mulvenna et al., 2022). The objective of this study was to investigate whether an extended lactation period would alter the microbiome of piglets fed diets without ZnO. We hypothesised that a longer lactation period would lead to a more diverse gut microbiome which would allow the piglets to better cope with the stress of weaning.

Material and methods One week after farrowing, sows and their litters from three production batches (10 sows and 110 piglets per batch) were distributed into one of two experimental groups: 28, sows and litters weaned at 28 days of lactation; and 35, sows and litters weaned at 35 days lactation. At weaning, piglets were allocated into pens (10 piglets/pen) according to weaning body weight and provided with antibiotic-free starter diets with ZnO (zinc; 16.5 MJ digestible energy (DE)/kg, 22.5% crude protein (CP), 1.7% lysine, 2 500 mg/kg ZnO) or without ZnO and reduced levels of CP (no zinc; 15 MJ DE/kg, 18.5% CP), resulting in a 2 × 2 factorial arrangement: 28 zinc, 28 no zinc, 35 zinc, and 35 no zinc. All diets were offered as dry pellets. At day 42 of age, eight piglets per treatment were euthanised and digesta samples were taken from the rectum for microbiome analysis. Bioinformatics and statistical analysis were performed as per our previous studies (Ijaz et al., 2018; McKenna et al., 2020). Briefly, community analyses were performed using alpha and beta diversity metrics (i.e., Richness and Shannon entropy) to investigate correlations between changes in microbial population structure based on lactation period and presence of ZnO.

Results Preliminary analyses showed that there was no correlation between length of lactation period and presence of ZnO on microbial diversity (Fig. 1). Moreover, there was no effect of ZnO or length of lactation period on Richness or Shannon entropy ($P > 0.05$).

Conclusion and implications There was no effect of removing ZnO from piglet diets on the gut microbiome. These preliminary results suggest that there is no benefit to extended lactation periods on the gut microbiome of weaning piglets and ZnO can indeed be successfully removed from piglet diets without impacting on the gut microbiome. However, the piglets in the experiments were raised in a challenge-free facility which is not representative of a commercial setting and so there may indeed be a need to find an alternative to ZnO in practice.

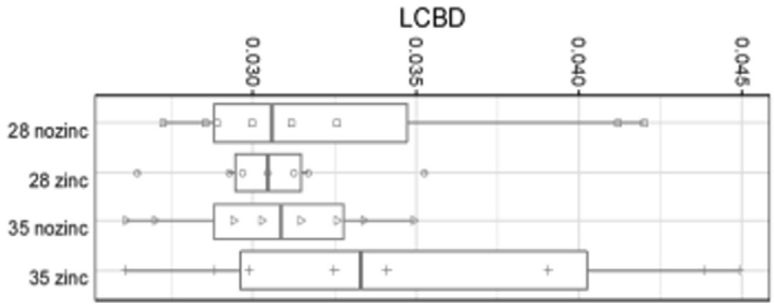

Fig. 1. The effect of lactation length (28 *vs* 35 days) and zinc oxide (zinc *vs* no zinc) in weaning diets on Local contributions to Beta diversity (LCBD) in the gut microbiota of piglets using the Otus Bray hypothesis.

Acknowledgements Supported in part by the Department of Agriculture, Environment and Rural Affairs. Ethics approval. Conducted under the project licence PPL2851 according to the 'Animal (Scientific Procedures) Act 1986'.

References

Ijaz, U.Z., Sivaloganathan, L., McKenna, A., Richmond, A., Kelly, C., Linton, M., Stratakos, A.C., Lavery, U., Elmi, A., Wren, B.W., Dorrell, N., 2018. Comprehensive longitudinal microbiome analysis of the chicken cecum reveals a shift from competitive to environmental drivers and a window of opportunity for Campylobacter. Front. Microbiol. 9, 2452.

McKenna, A., Ijaz, U.Z., Kelly, C., Linton, M., Sloan, W.T., Green, B.D., Lavery, U., Dorrell, N., Wren, B.W., Richmond, A., Corcionivoschi, N., 2020. Impact of industrial production system parameters on chicken microbiomes: mechanisms to improve performance and reduce Campylobacter. Microbiome 8, 1–13.

Mulvenna, C., Strain, M.A., Muns, R., 2022. Delayed weaning and medicinal ZnO removal from post-weaning diets-the effects on finisher pig growth performance. Anim. – Sci. Proc. 149, 109–110.

Su, Y., Li, X., Li, D., Sun, J., 2021. Fecal microbiota transplantation shows marked shifts in the multi-omic profiles of porcine post-weaning diarrhea. Front. Microbiol. 12, 619460.

doi: 10.1016/j.anscip.2023.09.063

63. Supplementation of a protected complex of biofactors and antioxidants reduces inflammation in weaner pigs

R.J.E. Hewitt [a,*], M.O. Sampaio [a], A.C. Corso [a], W. Bradshaw [b], K.J. Plush [a], D.N. D'Souza [a]

[a] SunPork Group, Eagle Farm, QLD 4009, Australia
[b] Jefo Australia Pty Ltd, Toowoomba, QLD 4350, Australia

* Corresponding author: Robert Hewitt. E-mail: robert.hewitt@sunporkfarms.com.au

Introduction The weaning transition is a major stress event in a pig's life that is commonly accompanied by adverse changes in intestinal morphology, including reduced villus height and increased crypt depth reducing the absorptive capacity of the gastrointestinal tract (GIT). Depressed feed consumption has been demonstrated to correlate with villus atrophy and inflammatory responses (McCracken et al., 1999), that resolves when normal feed intake resumes. Supporting the GIT during its development, with specific vitamins, antioxidants and other compounds, has been shown to improve the performance of early-life broilers (Bortoluzzi et al., 2021) through anti-inflammatory and improved immune response. We hypothesised that the supplementation of a protected, lipid encapsulated, complex of biofactors and antioxidants, P(BF+AOx) to weaner pigs, would reduce markers of inflammation in the GIT, supporting improved growth performance.

Material and methods Five hundred and sixty male and female pigs (~20 days of age, 6.42 ± 0.05 kg, 50:50 male:female) entered the experiment over four weeks, were sorted by sex and size and assigned to pens (n = 14). Pens were allocated to one of four treatments using a randomised block design, resulting in 10 replicates per treatment, with pen as the replicate. A first stage weaner diet (14.9 MJ digestible energy (DE)/kg, 0.89 g standardised ileal digestible lysine/MJ DE) was fed to all treatments, with diets only differing in the volume of commercial vitamin and mineral premix and the addition of P(BF+AOx) (Jefo Nutrition Inc, Saint-Hyacinthe, Québec, Canada). The Control treatment contained a standard inclusion rate of vitamin and mineral premix (VMP, 2 kg/t) and the Control+P(BF+AOx) treatment had the addition of 0.6 kg/t of P(BF+AOx) to the control diet. The RedVMP treatment reduced the commercial VMP to 70% of normal levels (1.4 kg/t), with the RedVMP +P(BF+AOx) treatment having the reduced VMP inclusion rate (1.4 kg/t) plus 0.6 kg/t of P(BF+AOx). Performance data analysis was described in Hewitt et al. (2021). On day 28, a blood sample was collected from one animal per pen via jugular venepuncture, centrifuged and serum extracted into multiple aliquots and frozen at -20 °C. Blood samples were analysed for markers of inflammation and antioxidant capacity with circulating levels of haptoglobin (In-house method NTM-62 based on Eckersall et al., 1999), calprotectin (ELISA kit MBS033848), C-reactive protein (C-RP) (ELISA kit RDSDY2648) and total antioxidant capacity (TAC) (STA-360 Assay kit) measured. Statistical analysis of markers of inflammation and antioxidant capacity was via ANOVA with treatment as a fixed factor (Genstat, 20th ed, VSN International, Hemel Hempstead, UK), with pairwise differences between treatments determined by LSD (P < 0.05).

Results There was no significant difference in the serum levels of haptoglobin, C-RP or TAC at the end of the experimental period (Table 1). Pigs receiving the P(BF+AOx) treatment on top of the standard commercial premix (Control +P(BF+AOx)) had significantly lower (P = 0.041) calprotectin concentrations compared to other treatments. Exit weights at the end of the experiment were significantly higher in the same treatment (P = 0.021).