G. NON TECHNICAL SUMMARY (NTS)

Project title: Use of next generation sequencing to identify the role of zinc oxide within the gastrointestinal tract of pigs and in seeking out appropriate alternatives to support the health and performance of the young pig at weaning.
Duration of project - years: 5
Duration of project - months: 0

Purpose of the project (as in ASPA Section 5C(3)):
(a) basic research: YES
(b) translational or applied research with one of the following aims:
   (i) avoidance, prevention, diagnosis or treatment of disease, ill-health or other abnormality, or their effects, in man, animals or plants: YES
   (ii) assessment, detection, regulation or modification of physiological conditions in man, animals or plants: YES
   (iii) improvement of the welfare of animals or of the production conditions for animals reared for agricultural purposes: YES
   (c) development, manufacture or testing of the quality, effectiveness and safety of drugs, foodstuffs and feedstuffs or any other substances or products, with one of the aims mentioned in paragraph (b): NO
   (d) protection of the natural environment in the interests of the health or welfare of man or animals: NO
   (e) research aimed at preserving the species of animal subjected to regulated procedures as part of the programme of work: NO
   (f) higher education or training for the acquisition, maintenance or improvement of vocational skills: NO
   (g) forensic inquiries: NO

Keywords:
pigs, zinc oxide, growth performance, microbiome, gut health

Describe the aims and objectives of the project (e.g. the scientific unknowns or scientific/clinical needs being addressed):
The aim is to understand why pigs fed a diet containing higher than required levels of zinc oxide (ZnO; 3.1 g/kg feed), have better growth and are healthier than pigs fed lower levels of ZnO (~0.15 g/kg feed), immediately after they are weaned. It is thought that the main influence of ZnO is within the gastrointestinal tract of the pig, but it is currently unknown exactly what this effect is and how ZnO is leading to the improvements seen in the pigs. The aim will be fulfilled by sampling pigs at numerous time points from weaning, to 28 days post-weaning, as this is considered the most critical time in a pigs life. Gut digest, tissue samples, blood samples, rectal swabs and rectal temperature will all be taken to allow for several analysis techniques to provide a greater chance of identifying the mode of action of ZnO.

What are the potential benefits likely to derive from this project (how science could be advanced or humans or animals could benefit from the project)?:
The current use of high levels of ZnO has reduced diarrhoea in pigs after weaning, and improved their growth performance. However, ZnO has provided concern as a result of high levels of Zinc, found in slurry, causing environmental problems. As a result, the EU has placed a phasing out ban of the current...
use of ZnO in weaner pig diets, by 2022. Currently, the mechanism by which ZnO improves health and performance of pigs is unknown, and has made identification of successful, more sustainable alternatives, problematic. Identification of alternatives before the ban is essential to prevent a sudden decrease in growth performance and an increased incidence of diarrhoea and ill-health in newly weaned pigs. This would impact on the majority of the EU pig industry.

What types and approximate numbers of animals do you expect to use and over what period of time?:
Approximately 600 production pigs would be used under the entire licence (across maximum of 5 years). This would allow for a maximum of 200 pigs to be used in 3 separate trials under licence.

In the context of what you propose to do to the animals, what are the expected adverse effects and the likely/expected levels of severity? What will happen to the animals at the end?:
Within each trial run under this project licence, blood samples will be taken from ~176 pigs at any one occasion. Approximately 96 pigs will be sampled from a maximum of 5 times. No adverse effects are expected to be seen from these pigs as this is considered mild level of severity. Rectal swabs will be used to collect faecal samples as this is the most efficient method of collection. Samples will be taken on 11 separate occasions, with ~96 pigs sampled on all occasions. This will be completed quickly, with no adverse effects expected. Alongside the first 8 rectal sampling points, rectal temperature will also be recorded from the piglets, this will not cause any adverse effects and is considered mild in severity. Approximately 72 pigs within each trial will be euthanized using Schedule 1 methods and used for dissection. This will leave ~96 pigs after 28 days post-weaning, to progress through the standard commercial farm before going to market as normal.

Application of the 3Rs
Replacement:
The programme of work aims to determine the use of zinc oxide in pig diets and therefore the only species appropriate for this line of research is pigs.

Reduction:
Given 32 pigs will be euthanized at D14 and D28 of the trial, and allowing for some pigs to be removed from the trial if treatment is required due to ill-health, all pigs will be sampled from at each time point. This will be a maximum of 5 times for blood sampling and 11 for rectal samples. The same pigs are required to be followed through given significant differences seen between pigs, and to assess long-term effects within the pig gastrointestinal tract and on their immune system response.

Refinement:

This research has the overall aim to benefit the pig industry and its current high use of ZnO, therefore, for results to be most applicable to the industry, work has to be carried out using commercial production pigs.

Blood samples will be taken by a trained technician to reduce any pain and suffering. Rectal swabs allow for limited disturbance to the pigs as it minimises contact time. Daily checks will be carried out on all pigs within the trial, and where required, pigs will be removed from the trial if medication or euthanasia is needed.