Australian Government
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Business Cooperative Research Centres Programme
Pork CRC
CRC for High Integrity Australian Pork

Project Number & Title : 2C-119: Alternatives to vitamin E for the cost-effective management of cellular antioxidant capacity in weaner pigs experimentally infected with entertoxigenic strain of *E. coli*

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Aims and Objectives The aim of this project was to explore the effectiveness of alternative feed additives that can partially replace vitamin E in diets for weaner pigs while maintaining cellular antioxidant and anti-inflammatory capacities. A standard commercial inclusion level of vitamin E (70IU/kg) in the diet was compared with high inclusion levels (200IU/kg) and partial inclusion levels (50IU/kg). The partial inclusion level diets included either quercetin (a plant flavonoid) (30mg/kg) or a combination of copper (175ppm) and vitamin C (500mg/kg). An in-feed antibiotic (amoxicillin) was also included as another treatment given the pork industry has traditionally used in-feed antibiotics to ameliorate pathogen infection and mitigate the post-weaning malaise. Five out of the six treatment groups were challenged with a strain of enterotoxigenic *E. coli* (ETEC) one week after weaning.
It was hypothesised that:

1. Supplementation of 200 IU vitamin E in *E. coli*-infected pigs would improve antioxidant and anti-inflammatory capacity compared with pigs in the infection control group, in addition to improvements in post-weaning performance.
2. Partial replacement of vitamin E with quercetin (replacing 150 IU vitamin E with 30 mg quercetin) would have comparable antioxidant and anti-inflammatory capacities to the infected pigs supplemented with 200 IU vitamin E.
3. Partial replacement of vitamin E (150 IU) with 175-ppm copper and 500 mg vitamin C would have comparable antioxidant and anti-inflammatory capacities to the infected pigs supplemented with 200 IU vitamin E.

Key Findings
The ETEC challenge induced an inflammatory and oxidative stress response, however, supplementation of 200IU vitamin E did not result in an improvement in performance, antioxidant or anti-inflammatory capacities compared with control pigs. Further to this, partial replacement of vitamin E with quercetin or a combination of copper and Vitamin C (replacing 150 IU of vitamin E) also had no effect on the immune response under the project's experimental conditions. The pigs fed an in-feed antibiotic along with the negative controls (pigs not infected with ETEC and fed a control diet) had the lowest growth of *E. coli* and pigs given the in-feed antibiotic had the lowest levels of plasma haptoglobin and C-reactive protein highlighting the anti-inflammatory effect of antibiotics.

Application to Industry
The lack of improvement in weaner performance and inflammatory response in weaner pigs supplemented with higher levels of vitamin E is unexpected based on previous reports. The inclusion of alternative antioxidant ingredients as partial replacements of vitamin E (quercetin and a combination of copper and vitamin C) also showed no extra benefit with regard to post-weaning performance and anti-inflammatory and anti-oxidant responses. The disparity between the current results and what has previously been reported could be explained by differences in experimental conditions, the selected inclusion levels for the diet supplements or the level of pathological state reached by the pigs subjected to the ETEC challenge. Nevertheless, these results do highlight the effectiveness of in-feed antibiotics at treating ETEC and the importance of the anti-inflammatory effect of antibiotics. Exploring the anti-inflammatory effect of antibiotics may assist swine industries worldwide as they explore alternatives to antibiotics.