Biological roles and efficacy of alkaline phosphatases (AP) for improving gut health, growth performance, physiological endpoints and gut microbiome in the weanling pig

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Why is this project important?

The experience of pork producers in the European Union (EU) has demonstrated that a ban on in-feed antibiotics as growth promoters did not fundamentally eliminate antimicrobial resistance concerns. This was because the use of antibiotics as a treatment during disease outbreaks had actually increased in food animal production. The effectiveness of current strategies in replacing therapeutic antimicrobials to improve food animal gut health and production performance is generally inconsistent and limited worldwide. Consequently, a novel and disruptive biological approach, which resolves the root cause of gut health concerns, is needed to replace therapeutic antimicrobial use in food animal production and minimize the threat of antimicrobial resistance to public health and environment.

What did researchers do?

When therapeutic antimicrobials were used, researchers observed significant improvements in growth performance (i.e., daily gain, feed conversion, and feed to gain ratio), in vivo gut permeability and gut health index of fecal scores of the weanling pigs.

They have completed in vivo efficacy, related biological mechanism, and gut microbiome response studies with weanling pigs. Scientists found that this supplemental exo-alkaline phosphatases (AP) (an enzyme that is found throughout the body) could greatly improve growth performance endpoints and the digestive utilization of major dietary nutrients. It does so by optimizing some of the low-abundance newly emerging probiotic gut bacterial species in weanling pigs without using therapeutic antimicrobials.

This exo-AP has already been scaled up at the commercial fermentation level and post-fermentation processing in collaboration with the project's industrial partner. It can be readily moved into the commercial application phase for adoption by the Canadian pork industry. This is provided

that the exo-AP enzyme technology can be successfully registered and approved with the Canadian Food Inspection Agency (CFIA) as a non-nutritive exogenous AP gut modifier feed additive.

The researchers have already moved through related technology disclosure and the transfer process at the University of Guelph. They are currently conducting related exo-AP enzyme technology IP filing and protection with their industrial partners. Interestingly, the process of registering the non-nutritive exogenous AP gut modifier feed additive as a novel microbial feed enzyme product registration, and approval with the federal CFIA Feed Division, will be the first of its kind in the world.

What will be the benefit of this research?

The success of this project will contribute to the development of an effective and affordable antibiotic alternative and non-nutritive exogenous AP gut modifier feed additive to improve weanling pig productivity and reduce overall costs of swine production.

As well, antibiotic-free pork and pork products meet the current demands of customers, thereby enhancing the value of those products. While Canada and the United States (U.S.) have banned the over-counter use of antimicrobials as growth promoters, the sustainability of this industry is challenged by the continued use of veterinarian prescribed therapeutic antimicrobials to maintain pig gut health. Most of the pork produced in Canada is destined for the export market, and consumers worldwide are demanding antimicrobial-free pork. Given that demand, the current trend in the swine industry is to minimize or eliminate the use of therapeutic antimicrobials. It is important for the Canadian pork industry to develop alternatives to these antimicrobials to stay competitive on a global scale and address the AMR threat to public health and the environment.

Collaborators

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Project status

Completed in 2023.

Additional resources and information about this project

R&D Featured Articles by Swine Innovation Porc

- Gut Check: A New Approach to Weanling Gut Health
  July 12, 2023

Peer-reviewed articles and abstracts

- Yin, X., Wang, W., Archbold, T., Burello, N., Scolaro, M., Zhou, K., Fan, M.Z. (2018, December 7). Genomic determinants of alkaline phosphatase catalytic affinity along the intestinal longitudinal axis of weanling pigs. Abstract and Poster Presented. *Journal of Animal Science, 96.* pp. 186-187. https://doi.org/10.1093/jas/sky404.405
- Yin, X., Archbold, T., Burello, N., Scolaro, M., Li, M., Wang, W., Zhou, K., Fan, M.Z. (2018, December 7). Increased intestinal alkaline phosphatase maximal activities mediate improvements in growth and gut health status in weanling pigs fed the antibiotic-supplemented diet. Abstract and Poster Presented. *Journal of Animal Science, 96:* pp. 181. https://doi.org/10.1093/jas/sky404.393

Related subprojects

The work presented in this fact sheet is one of two subprojects that make up a larger, nation-wide and multi-institutional Swine Cluster 3 project titled: Development *of novel feed additives to replace antibiotics and promote pig gut health*. The two subprojects are as follows:

- Biological roles and efficacy of alkaline phosphatases (AP) for improving gut health, growth performance, physiological endpoints and gut microbiome in the weanling pig *(this fact sheet)*
- Use of newly selected probiotic bacteria to control enteric infections and improve gut health and performance of piglets

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