Advances in Nutrition for Improved Pig Health

Dan Columbus, Ph.D.
Research Scientist,
Nutrition
Prairie Swine Centre

Antimicrobial stewardship has become an increasingly important topic and there has been an increasing pressure to reduce antibiotic use in livestock. This has raised the question how we can feed pigs to prevent disease and to reduce negative outcomes from illness. Dan Columbus, nutrition researcher at Prairie Swine Centre, presented his work regarding advances in nutrition for pig health at the 2024 PSC Producer Meetings.

As producers know, sick pigs grow more slowly and cost more money. Even sub-clinical disease reduces lean gain by 20-35% and feed efficiency by 10-20% and results in a financial loss of ~$8-30 USD per market pig. This is excluding costs for increased antibiotic use, diagnostic fees, etc. Because sick pigs are less efficient, they produce ~6% higher CO_2 emissions than healthy pigs, which is another reason why we should address this topic. A lot of research has been done in the past 10 years looking at alternatives to antibiotics. While there is no such thing as a true alternative to antibiotics (nothing works quite like antibiotics do), we can look at what we can include in the diet to support the animal's growth, immune function and gut health. Some things that seem to work, such as spray-dried plasma, zinc and copper, have their own health and regulatory issues. Instead, nutritionists are now looking more at the functional value of ingredients and including gut friendly nutrients like omega-3 fatty acids and different types of fibres.

In his research, Dan focused on the functional value of amino acids (AA) for disease. Amino acid requirements are currently based on growth performance and have been developed under high health conditions with fast growing animals with appropriate feed intake. It can be argued that these requirements are not appropriate for unhealthy pigs or pigs being disease challenged. In a study by Rodrigues et al. (2021), pigs challenged with different types of diseases, mycotoxins, or poor housing conditions all had reduced growth performance, but only part of that reduction was due to a change in feed intake while the rest was due to a change in maintenance requirements. In addition, young animals have a more drastic initial response to a disease challenge but recover faster than older pigs.

> "Nutrient requirements for development and immune response will be different than for growth performance."

In a healthy pig, a small amount of the dietary AA gets used for maintenance and the majority is used for growth. When an animal gets sick, this shifts so that the majority of AA gets used for the immune response and less gets used for growth. Because feed intake is reduced in sick animals and the nutrient profile is based on healthy animals, sick animals start to catabolize protein from their muscle stores to get the AA they need for the immune response, which makes the problem worse. Several research trials have shown that some specific AA have benefits beyond growth to support the health of the animal. These include the sulfur AA – methionine and cysteine – as well as threonine and tryptophan. For some of these AA, the research has shown that the requirements are increased during a disease challenge, which is not the case for all AA. This shows that the AA profile needs to be different for sick pigs vs. healthy pigs.

Dan looked at the effect of dietary fibre and immune stimulation on threonine requirements in growing pigs. He fed either a low or high fibre diet to either healthy or disease-challenged pigs. Results showed that the threonine requirements increased both when feeding a high fibre diet vs. a low fibre diet and when

feeding a sick pig vs. a healthy pig. However, when feeding a high fibre diet to a sick pig, the threonine requirements did not increase further. The dietary fibre increased the barrier function in the gut. Gut leakiness increased in pigs on the low fibre diet that were disease challenged but feeding high dietary fibre prevented the gut from becoming leaky.

A set of research trials looked at the effect of a blend of functional AA, consisting of 120% of the NRC (2012) requirements for threonine, methionine and tryptophan, in nursery pigs challenged with Salmonella. The first trial looked at the effect in low or high protein diets and showed that for the 7 days before the disease challenge, the functional AA blend did not affect growth rates. However, after the Salmonella challenge, growth was reduced much more in pigs not fed the functional AA blend, regardless of the protein content in the diet. The functional AA prevented some of the growth reduction after the Salmonella challenge in both the low and high protein diets. This shows that the functional AA don't have an effect in healthy pigs but become important once pigs go through a disease challenge. Indeed, pigs fed the functional AA had reduced Salmonella shedding and improved fecal score. Feeding the functional AA blend for two weeks before a disease challenge resulted in better growth than when fed one week before the challenge or at the start of the challenge, but growth was still improved to some extent when starting the functional AA blend at the start of the disease challenge.

The second trial looked at functional AA in plant vs. animal protein-based nursery diets. This trial was set up in a different way, such that the plant and animal protein diets and the functional AA were provided for 4 weeks after weaning, and then pigs were switched to a common grower diet a week before the disease challenge. So measurements to the response of the disease challenge happened at a time that the pigs were not receiving the functional AA supplementation anymore. Results showed that pigs on the plant protein-based diet did not do well after a disease challenge. The functional AA blend attenuated some of the negative effects in these animals. Pigs fed animal protein-based diet grew much better after a Salmonella challenge and the functional AA did not have much of an effect in these animals. This suggests that there are other active compounds in animal-based protein that are useful for pigs in a disease outbreak.

The last research trial looked at functional AA in low (average 1.1 kg) vs. normal (average 1.6 kg) birth weight pigs, again feeding the functional AA for 4 weeks in the nursery period, and then switching them to a common grower diet a week before the Salmonella challenge. Functional AA supplementation improved growth performance after the Salmonella challenge in normal birth weight pigs, but not in low birth weight pigs.

In summary, nutrient requirements for development and immune response will be different from those for growth performance. The response of pigs to challenges such as diseases or unclean environments is affected by age and sex of the pigs, and the type of challenge. Adjusting dietary amino acid content can improve growth performance, development and immune response in a disease challenge, but the positive effects will depend on the time supplementation is given, the protein source, and the birth weight of the pigs.