The role of amino acids in feeding piglets for health and performance

High dosages of zinc oxide (ZnO) in piglet feed as a means of controlling post weaning diarrhoea (PWD) has been officially banned in the European Union since the start of this summer. At the same time the pressure on reducing antibiotics continues. So rethinking management, health and feed at the farm will be the key for success.

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More than ever there is a focus on 'feeding the gut', establishing a resilient microbiome and striving for gut homeostasis. Although the roles of protein and especially amino acid nutrition are often not considered as key in this gut health approach, they play an essential role in health and performance of piglets fed without antimicrobials.

Excess protein

One of the main reasons for the occurrence of PWD is related to protein nutrition. Young piglets have an immature digestive system including a limited acidification capacity in the stomach and a limited secretion of proteolytic enzymes in the small intestine.

However, this teamwork is needed to cleave protein into absorbable smaller peptides and amino acids. Protein which is not digested will end up being fermented in the hindgut, resulting in pathogen overgrowth, production of endotoxins and toxic metabolites, such as ammonia and biogenic amines, harming the intestinal integrity and leading to diarrhoea.

Evidently, increasing protein quality by using specific high digestible protein sources will limit the amount of protein available for fermentation in hindgut. However, these raw materials can be expensive and their availability is sometimes limited. Looking at the building blocks of protein, amino acids, can offer a way out.

The availability of unbound amino acids (for example L-lysine, L-threonine, L-tryptophan, L-methionine, etc) has contributed a lot in the economic and environmental efficiency of animal husbandry in the last decades.

In the post antimicrobial era, they will claim their role as important components of success, as newly available, next-limiting amino acids, such as L-isoleucine (Ile), L-valine (Val), L-histidine (His) and L-arginine (Arg) will enable safer, lower crude protein (CP) diets to be formulated and keep performance up.

CJ Bio (a major player in amino acid production using fermentation technology) showed that it is possible to reduce dietary crude protein concentration to 15% in nursery piglets with an adequate amino acid supply in a study performed at Wageningen Livestock Research in the Netherlands.

The study was carried out as a dose response study using a low protein basal diet (about 150g CP/kg – 12g/kg digestible lysine) and was limiting in isoleucine (4.4g/kg SID Ile). The basal diet (treatment 1) was supplemented with incremental levels of SID Ile by supplementing free L-Ile (Bestamino, CJ Bio) at the expense of corn starch until levels of 4.95, 5.50, 6.05, 6.60 and 7.15g SID Ile per kg were achieved in treatments 2 to 6, respectively.

All other amino acids were kept stable and were balanced according to the requirement. The overall health status of the piglets was good without using pharmacological levels of ZnO or other antimicrobials.

Over the entire experimental period (from six until 28 days post weaning), feed intake (FI) and average daily gain (ADG) were reduced significantly in piglets receiving the diets with the lowest levels of Ile (treatment 1 to 3; Fig. 1).

Adequate amino acid supply according to the assumed recommendation showed the highest average daily gain and feed intake. Although this study did not look specifically to differences in protein level, the health, obtained growth and intake values are good and indicate that correct amino acid supply is essential to wean resilient piglets when working with low CP diets.

More than just muscle protein building blocks

As intestinal disturbances and consequently performance loss was covered up by antimicrobials in the past, amino acids will become important for their so-called functional role in immunity, gut health, microbiome regulation, antioxidative capacity, etc.

Indeed, amino acids have a far bigger role than being only muscle protein building blocks, the first focus for the industry until now.

Amino acids play an important role in regulating the different barrier functions of the gut. Overall, the defence mechanism of the gut, the

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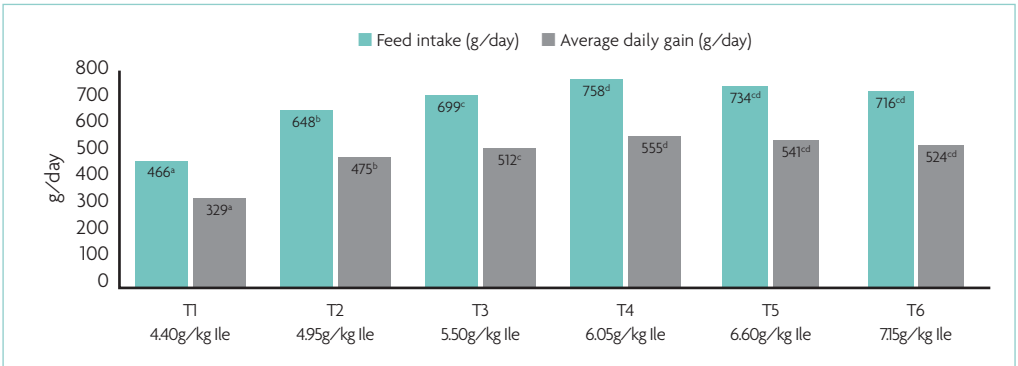
Fig. 1. Average daily weight gain and feed intake of treatment (T) group 1-6 from six until 28 days after weaning.



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largest immune organ in the body, can be divided into four protection layers (Fig. 2).

- The microbial barrier: a complex environment of which the metabolites, such as short chain fatty acids, are essential for gut health and limiting pathogen overgrowth.
- The chemical barrier: consisting of the mucus layer, harbouring huge amounts of antibodies protecting the host from pathogens.
- The physical barrier: consisting of the epithelial cells, exerting the complex task of keeping pathogens out and absorbing nutrients.
- The immunological barrier: harbouring the immune cells of the connective tissue (lamina propria).

When one or more of these protection mechanisms are compromised, the occurrence of PWD is most likely.

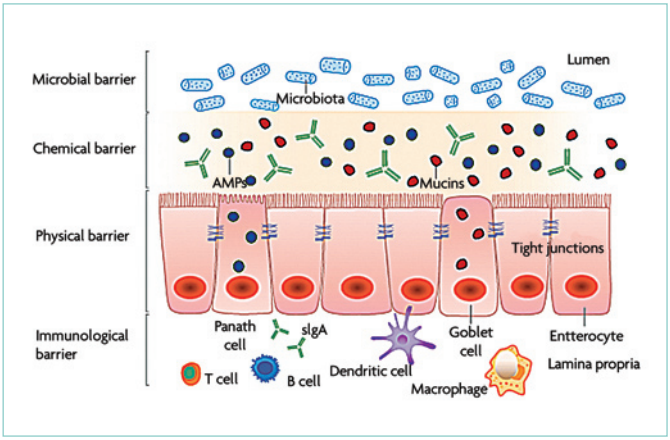

Fig. 2. The different layers of the intestinal barrier (modified after Gao et al., 2020).

Amino acid nutrition with gut health in mind

Challenging sanitary conditions have already been proven to increase certain amino acid requirements such as tryptophan, threonine and methionine. As an example, methionine, part of the sulphur containing amino acids and precursor of cysteine, plays an important role in the intestinal epithelial antioxidative status.

Less optimal sanitary conditions in combination with the stressful weaning period increases oxidative stress in the gut, jeopardising gut functionality, provoking leaky gut and leading to diarrhoea. Therefore, paying attention even to well-known and standardly used amino acids in your formulation will help to support the defence mechanism in the gut. In the last two decades, more and more studies have focused on how specific amino acids modulate overall gut health.

Recent reviews published in 2021 by Liao from Mississippi State University, USA and Montout and coworkers from INRAe, summarises in a comprehensive way how amino acids play a crucial role in gut health and immune response in pigs and other livestock.

Established amino acids mentioned above, but also for example Arg and Ile, are important contributors to gut homeostasis and thus cannot be neglected when thinking about healthy weaning. Arginine on the one hand has shown good effects on gut morphology, barrier function and inflammation, whilst isoleucine has shown positive effects on the immune function of infected animals.

Thus, requirements of animals not being supported preventively with antimicrobials, such as therapeutic dosages of ZnO, and therefore facing more immunological stress, will be increased compared to the current recommendations largely determined in good sanitary conditions. In addition, new ways of formulating feed, such as higher inclusion of fibre in the diet to support the gut microbiome, but also increased subclinical health challenges, will have its impact on amino acid nutrition.

Conclusion

Every detail counts when feeding piglets without antimicrobials. Lowering crude protein levels and assuring adequate amino acid supply, taking into account their important functions next to performance, in immune functioning and overall gut health, will lay the foundation of a proper nutritional strategy to raise healthy piglets without the use of antimicrobials. ■