The key to success: the microbiota of the piglet's gastrointestinal tract

From farm to fork, from sow maternity to pig fattening barns, swine production faces many challenges and threats. However, the weaning period has been identified as one of the most sensitive and critical physiological stages for the piglet. Diarrhoea, anorexia or pathogen infections are common issues faced during these few days of increased stress.

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To ensure high levels of growth performance, increased feed efficiency and maintaining a good health status for the animals, special attention should be paid to the microbiota of the piglet's gastrointestinal tract.

What is the microbiota and why is it essential?

The microbiota can be defined as the set of all the micro-organisms (bacteria, viruses, protozoa or even fungi) colonising a specific area, here the piglet stomach and intestines.

The gastrointestinal tract of mammals is estimated to be composed of approximately 10^{14} bacteria from five phyla (families): Firmicutes, Bacteroidetes, Proteobacteria, Actinobacteria and Spirochaetes – the first two alone accounting for 90%.

Repartition of the microbiota population varies in quantity and diversity along the gastrointestinal tract (Fig. 1), with three distinct areas: the stomach, proximal intestine (duodenum, jejunum and ileum) and distal intestine (caecum).

The numerous micro-organisms which colonise the intestinal wall provide many features and play a central role in metabolism and general health. First of all, the microbiota has the ability to transform indigestible particles of feed into absorbable nutrients providing an additional source of energy to the animal.

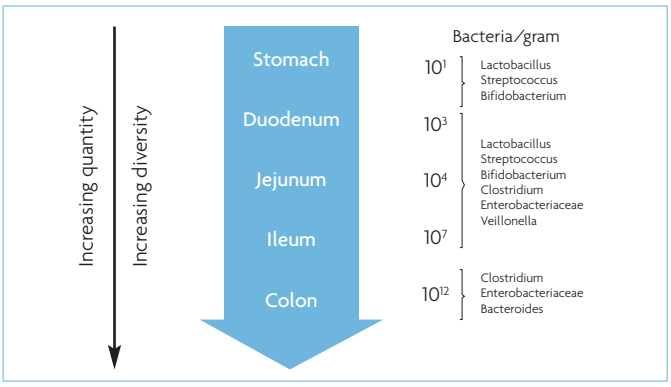
The microbiota also produces some vitamins and other metabolites useful for the pig's metabolism.

Last, but not least, beneficial micro-organisms play a critical role in host protection against pathogen infections. They act by maintaining the physical intestinal barrier, by producing natural antibiotics and by competitive exclusion of pathogens in the environment they colonise.

The microbiota also has an indirect influence on animal immunity with immune system stimulation or activation of an anti-inflammatory response.

There are many factors influencing the composition and development of the microbiota during the animal's life. At birth, piglets are considered sterile, but micro-organisms coming from the surrounding environment (faeces, sow's skin, air) will quickly colonise the intestinal walls.

Fig. 1. Density and major bacteria genus in the different digestive tract compartments (Blachier et al., 2013).



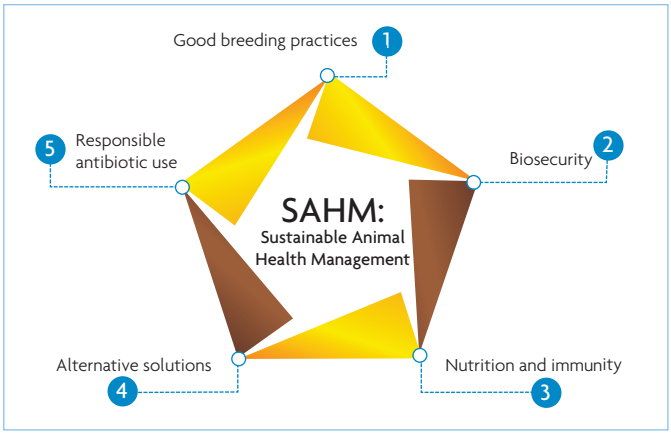


Fig. 2. The five pillars approach of MiXscience: Sustainable Animal Health Management (SAHM).

Gradually, and according to the feed provided, the piglet's intestinal microbial populations will succeed each other to adapt. The evolution is fast, critical and submitted to strong challenges from birth until maturity where the intestinal microflora is considered more stable and less subject to disturbance.

Due to its central role, this organ is essential for the animal. A well balanced intestinal tract microbiota will lead to good zootechnical performances.

However, events like an abrupt change of feed, periods of stress, or the administration of antibiotics can dramatically influence microbiome development and lead to an unbalanced situation (gut dysbiosis) where animal metabolism is impacted as well as zootechnical performances.

Weaning: a critical period

Stress can occur at every stage of the pig's life but there is a period where piglets are the most sensitive and vulnerable: the weaning period (and post-weaning).

At this stage the piglets face many challenges like maternal bond loss, a new environment, a change of social status and, most important, a new alimentation: from a milky to a solid feed.

As the central and most sensitive element, the intestinal microflora is the first to be altered – leading to a disturbance of the two main functions provided by the gut microflora: digestion and immunity.

Indeed, the feed change is the biggest source of stress for the piglet. At that time the flora is not adapted and needs to evolve to allow digestion. Important internal modifications occur, the microflora equilibrium is altered and the microbiome is not able to assume its habitual functions.

Weaning is a critical period because of a lower feed intake and a reduced capacity of feed digestion and absorption (enzymatic activities diminution, villi size reduction), which leads to frequent anorexia episodes.

In the meantime the piglet is weak and the disturbance to the microflora disrupts maintenance of gut wall integrity and prevention of pathogen invasion.

Coupled with the suppression of immunity provided by the sow's milk, the piglet is subjected to pathogen infections and inflammatory reactions, which will consume the major part of the little energy absorbed. The very common diarrhoeas will appear at this stage.

All these causes taken together can

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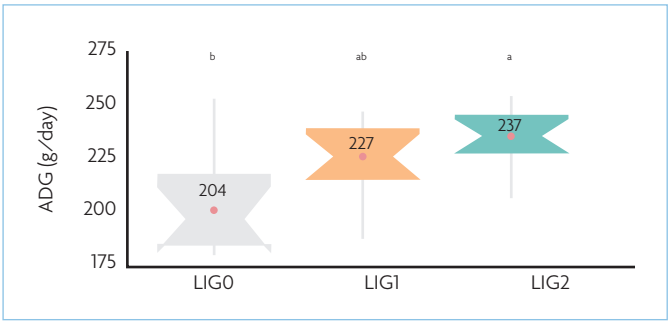

Fig. 3. Results of piglet performance with lignin supplementation at different quantities (LIG1 = 1.53% of lignin ; LIG2 zz= 2.45% of lignin) for a period of 21 days post weaning (results from MiXscience internal research).

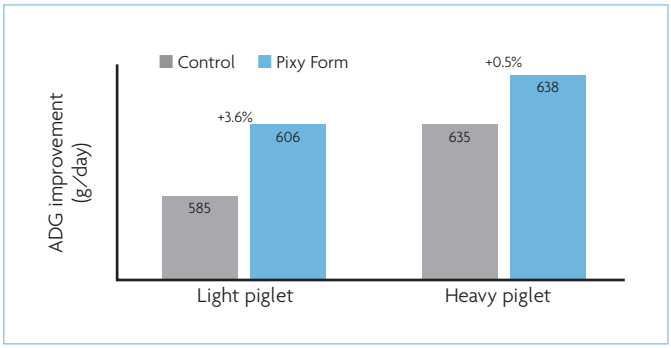

Fig. 4. Results of performance with Pixy Form supplementation (21-70 days).

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explain the poor zootechnical performance or even the mortality events often met during the weaning period.

Solutions against stress

Anorexia, diarrhoea or other symptoms of gut dysbiosis are treated with antibiotics. As they are efficient and easy to apply, they are really common in the pig industry and anchored in actual farming practices. However, as with other species, antibiotics have begun to be challenged and criticised. Indeed, antibiotic resistance due to frequent and inadequate use has become a major concern of public health. Their responsible use is then essential.

To meet this objective, MiXscience, through its SAHM program (Fig. 2), propose an approach based on five pillars: good farming practices, biosecurity, nutrition and immunity, alternative solutions and the responsible use of antibiotics.

Concerning nutrition, research has been conducted on the use of sunflower hulls to limit the consequences of an abrupt piglet nutrition change during the weaning period. The addition of particular fibres (lignin: insoluble fibres) will dilute the rich starter feed and slow down digestion. In this way, the digestive system of the piglet is progressively muscularly educated and the microbiota is gradually adapting through micro-organism composition and activities adjustments (new enzyme production like lipases).

Thanks to this method, piglets are slowly acclimatised to the new imposed regime and better performance can be achieved, as shown in the experiment results presented in Fig. 3. We can see that the increase of fibre-rich ingredients (lignin) during the three weeks after weaning have led to an increase of up to 19% in the average daily gain of the piglets. The inclusion of lignin in the diet has met the objective of reducing the occurrence of stress and its consequences.

The five pillar global approach also proposes some alternative solutions aiming to limit the impact of stress on piglets. Based on this idea, MiXscience have developed a feed additive (Pixy Form) composed of a blend of several ingredients:

- Aromatic substances which have shown a positive impact on the intestinal microbiota and long term performance.
- Mannans from yeast wall, which can limit pathogen invasion in the gut by blocking the attachment of the pathogenic bacteria on the intestinal cells receptors.
- Beta-glucans which are well known for their immunostimulant properties, improving the natural defence in the piglet gut by enhancement of the non-specific immune system.
- Organic acids which have shown a bacteria development inhibition effect in the stomach by reducing the pH.
- Natural anti-inflammatory, important to avoid an excessive inflammatory response which can consume up to 30% of the absorbed energy.
- Other prebiotics which are often used to favour the development of beneficial bacteria.

Fig. 4 shows that the use of Pixy Form from day 21 to day 70 (from weaning to fattening phase entry) has induced a gain of 12g/day on the average daily gain, so a gain of 588g for the whole period.

By its specific composition, the product contributes to the digestive comfort of piglets, improves the feed efficacy and participates in the reinforcement of natural defences.

Conclusion

Intensive farming (density, fast growth) leads to more stress, which has a direct impact on animals. Thus, a global approach is necessary to ensure high zootechnical performances, while maintaining the welfare and health status. Thanks to well thought out production, the pig industry will meet the expectations of tomorrow. ■

References are available from the author on request

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