

DIETARY STRATEGIES AS ONE OF THE PILLARS TO REDUCE ANTIBIOTIC USE IN SWINE

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The Dutch government and various stakeholders in the industry set a joint target to reduce prophylactic and therapeutic antibiotic use by 70% in 2015 compared to the reference year 2009. The use of anti-microbial growth promoters was already banned in the European Union in 2006. Various biosecurity measures and specific vaccination programs were implemented in the last decade to reduce the risk of animals being exposed to pathogens and to raise the level of disease resistance. These strategies were complemented with dietary measures to improve hygiene of feed and water and to support homeostasis and stability in the gastrointestinal tract contributing to disease resistance and resilience. The Netherlands succeeded in reducing antibiotic use by 58% in swine production in 2015 compared to 2009. Although the target of 70% was not completely reached, it is encouraging that the reduced use of antibiotics resulted in a reduction in anti-microbial resistance (MARAN, 2015).

A variety of learnings and best practices can be adopted in other markets and areas where programs to reduce antibiotics are being developed and implemented. It is important to emphasize that implementation of Hazard Analysis and Critical Control Points (HACCP) based quality assurance systems has contributed significantly to systematically work on improving animal health and performance. Suitable housing conditions, proper climate control, a well developed feeding and vaccination strategy, and strict biosecurity measures form the basis of a proper farm management. In case of disease occurrence, veterinarians should perform proper diagnostics and investigate risk factors for disease occurrence, before antibiotics are used. Subsequently reduction of risk factors for disease occurrence by improvement of farm management should lead to prevention of disease outbreaks instead of preventive use of antibiotics.

The sow has a significant impact on growth and survival of piglets and development of disease resistance and resilience (Funkhouser and Bordenstein, 2013). In early life, colostrum intake is key to neonatal intestinal development and survival. Growth factors in colostrum are important for the tremendous development of the gastro-intestinal tract during the first days of life. Other important factors in colostrum are steroids, vitamins, enzymes and immunoglobulins. Piglets with low birth weights have a higher than average neonatal mortality rate. However, if intake of colostrum in these piglets is sufficient, mortality rate drops dramatically. Therefore, nutritional strategies influencing mammary gland development and colostrum yield are of importance and currently under further investigation (Decaluwe et al., 2014; Farmer et al., 2016).

Moreover, the transfer of the microbiota from the sow to its offspring plays an important role in development of immune competence of piglets, growth and survival rate. Rapid and large changes in abundance, composition and diversity characterize the development of the microbiota in the gastrointestinal tract of neonatal piglets (Bauer et al., 2006). The composition of the microbiota is initially influenced by the vaginal flora of the sow and subsequently by colostrum intake and environmental influences including fecal composition of sow feces. Changes in the composition of the microbiota

not only have short term effects on health and growth but also will affect later life disease resistance and performance. Oral antibiotic treatment of sows has a significant effect on the microbiota composition in the intestinal tract of their offspring and can lead to impairment of intestinal integrity after weaning (de Greeff et al., 2015). Also direct antibiotic treatment of piglets may lead to permanent changes in their microbiota with similar long-lasting effect (Zang et al., 2014).

Piglet performance later in life is determined for 30% by birth weight, for 30% by the weaning weight, and for 70% by the weight at 14 days after weaning, which shows the importance of the weaning process (Paredes et al., 2012). After weaning, environmental stress leads to reduction of blood flow to the intestinal tract and a drop in feed intake and immunity, which reduce intestinal integrity and disturb microbial balance in the intestinal tract. Creep feed intake during the suckling period stimulates early postweaning feed intake and performance (Bruininkx et al., 2002). Specific feeding measures like increasing prebiotic fiber in milk replacer during the suckling period increase gut maturation before weaning resulting in a higher intestinal weight, more cell proliferation and increased metabolic fermentation in the intestinal tract and therefore may help the piglet through the transition period (de Greeff, 2016).

High quality and highly digestible proteins prevent diarrhea in young piglets after weaning. An overload of undigested protein entering the distal intestinal tract may lead to excessive putrefactive fermentation and induce undesired changes in microbiota composition in the hindgut. Lowering the crude protein content, but keeping the essential amino acid levels adequate by using purified amino acids, is a well-established nutritional strategy to create feeds with a lower potential for diarrhea (Wellock et al., 2008). Atrophy of intestinal villi in the first week post-weaning causes an impairment in digestion and absorptive capacity of dietary fat (Price et al., 2013). The fat digestion process is dependent on hydrolysis of fats by lipase and micelle formation by bile salts, which is a more complex process compared to the hydrolysis of starch. This is the main reason why a high starch diet instead of a high fat diet can improve piglet performance post-weaning. Thermal processing can enhance the digestion of starch, which may further benefit the piglet in the first week post-weaning. Thereafter, the benefit of processing starch usually disappears. Providing more structure to the diet, by inclusion of larger particles by coarser milling, can promote the peristalsis of secretions in the digestive system, which can help prevent gastrointestinal infections (Flis et al., 2014).

Organic acids and short and medium chain fatty acids are the most common applied feed additives to reduce antibiotic use and are also applied via the drinking water in critical transition phases such as weaning and after transport or relocation. These additives contribute to feed and water hygiene, support the function of the stomach as microbial barrier, support the digestibility of protein, and control microbial activity in the proximal gastrointestinal tract (FEFANA, 2014). In addition, specific non-digestible oligosaccharides functioning as receptor analogue can reduce the risk of colonization of the large intestine by pathogens such as *Salmonella* and *E.coli* (Adewole et al., 2016; Baurhoo et al., 2007; Ganner et al., 2013; Jahanian et al., 2015).

Besides the intervention route of modulation of microbiota, it is possible to strengthen the mucosal barrier with feed additives. Blood plasma supports barrier function in piglets and reduces mucosal permeability and inflammation (Bosque et al., 2016). Butyrate promotes mucus secretion, stimulates turnover of enterocytes and has anti-inflammatory properties (Berni Canini et al., 2014). Additives such as β -glucans from fungi, plant extracts containing specific phenolic compounds, specific prebiotic sugars and some probiotic strains have immune-modulatory effects, of which some have

shown benefits in infection challenge studies with piglets (Rop et al., 2009; Chaucheryas-Durand et al., 2010; Gaggia et al., 2010). All these measures may contribute toward the host defense system. Combining additives with a different mode of action enhances support of the small intestinal microbiota and mucosal barrier function.

Overall, well-targeted dietary intervention strategies form an important pillar to reduce the use of antibiotics in swine, whilst maintaining performance and product quality. Therefore, the global feed industry can play a major role by adopting new insights and novel technologies in feed formulations and feed additives. However, all stakeholders in the chain need to cooperate and work at high speed to win the battle against antimicrobial resistance.

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