Gut health is key to reducing antimicrobial use

There is a global movement to reduce antimicrobial use in livestock production and increasing numbers of farmers are showing that it is possible to reduce antimicrobial use without sacrificing animal performance and health, with a key focus being placed on gut health.

by Dr Anna Catharina Berge,
Berge Veterinary Consulting BVBA.
www.alltech.com

Antimicrobials have historically, and are still, used extensively to address gut health issues in piglets, and a major challenge is finding alternatives to antimicrobials in order to support the gut during the period when it is developing. The goal to reduce antibiotic use should be modified and instead viewed as a goal to produce healthy production systems that support the animal in all stages of production.

In-feed prophylactic antibiotic use in pig production is not used to treat sick pigs – it is used to treat suboptimal production systems. The first step in any antibiotic reduction programme should, therefore, be to optimise the comprehensive health of the production system, which will make systematic prophylactic use redundant.

Such an approach will not result in increased disease and loss in productivity; on the contrary, productivity will most likely increase, and the reduced expenditures on antibiotics can be invested in other areas in order to optimise the overall welfare and health of the pigs.

This article will discuss how the healthy gut is a key feature of systemic health, immunity and performance as well as give some examples of how focusing on a healthy gut can result in drastic reductions in antimicrobial use.

Gut health and immunity

A healthy gut is key to a healthy animal and, increasingly, emphasis is being placed on optimising gut health in our production animals. According to Kogut and Arsenault (2016), a healthy gut has been defined as the absence, prevention and/or avoidance of disease so that the animal is able to perform its physiological functions in order to withstand exogenous and endogenous stressors.

A healthy gut involves a number of physiological and functional components, including the digestion and absorption of nutrients, host metabolism, energy production, a balanced gut microbiota, mucus layer, barrier function and mucosal immunity. A healthy gut is therefore not only a gut without disease; a healthy gut is an effective digestive organ that can mount a good defence against disease and easily cope with change.

The gut is one of the largest organs and has the most extensive exposed surface inside the body. This surface is a selective barrier with physical, chemical, immunological and microbiological parts, where digested feed and water is absorbed, but where disease-causing agents should be kept under control.

The gut is also the organ that has the most immune cells in the body (approximately 70%) and many of these are located in gut-associated lymphoid tissue (Peyer's patches). These immune cells are the first line of active defence against pathogens and the majority of immune cells are found in the large intestines.

Immunity, as defined by Merriam-Webster dictionary, is 'a condition of being able to resist a particular disease, especially through preventing the development of a pathogenic micro-organism or by counteracting the effects of its products'. Immunity is the body's internal defence against the 'enemy'. One can think of the gut in the simplified form of a fortress, where the intestinal cells and the mucus barrier form the wall, the immune tissue act like towers with fighters, immune cells are foot soldiers and there are several ports where food can enter to support the fort, where only authorised personnel can enter (nutrient absorption). The enemies are viruses, bacteria and protozoa, and they can sometimes use toxic weapons, such as bacterial toxins, or can assist mould toxins in order to break down the fortress.

The commensal gut microbiota is a population outside the fortress that can prevent enemies from invading and inhibit them from attacking the walls. It is clear that this defence mechanism is intricate, takes time to build and can be damaged by many factors.

Building a healthy gut

The establishment and maintenance of good gut function are vitally important in reducing neonatal morbidity and mortality. There is an immediate demand on the gut after birth to digest and absorb nutrients efficiently for growth in the newborn piglet. Neonatal nutrition is a critical component in the establishment of normal gut function, from digestion and absorption to barrier function and the development of the immune system.

There is a single layer of epithelium (cells lining the gut) that is simultaneously responsible for the secretion of fluid and the absorption of water, electrolytes and nutrients as well as providing a selective barrier against the complex and potentially dangerous environment of the gut lumen. The intestinal epithelium is constantly exposed to many commensal and pathogenic microbes as well as antigens, which are important for the development of immunity.

The colostrum feed that the piglet receives during the first 24 hours after birth is crucial for the development of the gut and provides antibodies to protect the piglet while its own immunity (antibody defence) is developing and while the digestive enzymes in the gut are optimised for the digestion of milk. It is important to ensure that the sow produces sufficient colostrum of high quality to feed her litter, which is a huge challenge in hyperprolific sow breeds, in which colostrum production is often insufficient to feed all piglets. Special attention to providing all piglets with colostrum, such as split suckling, has become an important preventive health measure in many herds. In the farrowing unit, special attention should be paid to the environmental conditions and hygiene, as diarrhoea can be a problem.

Weaning disorders are one of the most common, and damaging, problems in pig husbandry, resulting in antibiotics being used post-weaning to protect the stressed

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guts and immune systems of the piglets. A challenge in a large proportion of our production system is that the shortened suckling period, which can cause neonatal piglets to be weaned at three to four weeks of life, or even earlier, does not respect the time the piglets need for intestinal development and maturation.

The piglets' digestive enzymes are still targeted for milk digestion at this point in time; the immunity derived from colostrum has waned and the piglet's own immunity is still immature. The stress associated with weaning leads to a reduction in feed intake that creates multiple challenges for the already stressed gut, and this will many times be seen as post-weaning diarrhoea.

It has been shown that the weight gain in the first week post-weaning is associated with the total days to market. Thus, it is essential to evaluate performance post-weaning, since the absence of diarrhoea may not be a sufficient measurement of good health and performance.

In a healthy production system, it is essential to do everything possible in order to help prepare the piglet for weaning as soon as in the farrowing unit. Birth weight, colostrum intake, milk production, enteric diseases and creep feed intake are all important factors that influence weaning performance.

Furthermore, at the time of weaning, it is important to minimise stressors: for example, early weaning, transportation, comingling of litters, large weaner groups, diet, poor air quality and unhygienic conditions. In addition, when looking for alternatives to antimicrobials, such as zinc oxide, and feed supplements to reduce disease in the weaners, producers need to be open to alternative systems and management solutions for future productivity.

The pathogens

The presence of disease-causing micro-organisms in the gut is not sufficient to cause disease. Disease occurs once the pathogen (the 'enemy') breaks down the gut defence (the fortress walls and defence structures). At least 16 different pathogens, including bacteria, viruses and parasites, can cause primary intestinal disease.

Trillions of micro-organisms inhabit the intestinal tract and form a complex ecosystem that can influence the immune system both in and out of the gut in addition to overall host health. When this commensal microflora is disturbed in the gut of the pig, the pig has dysbiosis, or dysbacteriosis, which means that there is a microbial imbalance or maladaptation between the beneficial microbiota and potential disease-causing organisms. Dysbiosis, therefore, makes it easier for pathogens to damage the gut structures and functions.

Any dietary change leads to changes in the microbiota. If dietary changes are made gradually, then the gut has the ability to alter the microbial community in order to adapt to the change. A strong and healthy microbiota can tolerate certain variations in the diet; however, the piglets' guts and their microbiota are developing, which decreases adaptability, and therefore dysbiosis and disease occur. Prebiotics, probiotics and mannan-oligosaccharides can assist the gut in adapting and minimising dysbiosis.

Often, viral pathogens pave the way for bacterial pathogens by destroying part of the host's delicate defence system in the gut. A good external and internal biosecurity and vaccination programme is important to minimise the impact of viral 'enemies'. Coccidiosis is a small parasite that replicates in the intestinal cell wall and will result in diarrhoea in piglets. This parasite also lowers the fort's defence against bacteria. Most countries are not as concerned about coccidiostat use in pig production as antibiotic use, and, hopefully, there will be continued access to coccidiostat to protect the gut structure. High levels of hygiene are necessary in the farrowing unit in order to minimise the exposure of the piglets to coccidiosis.

Mycotoxins

Mycotoxins are toxins produced from moulds that cause serious health problems in pig production and can result in severe economic losses worldwide. There are more than 400 known mycotoxins with varying toxic effects, and multiple toxins present in feed can compound the problem. Due to current climatic conditions and production systems with long distribution chains of feed, the risks associated with mycotoxins in feed and bedding material are high.

However, it is hard to evaluate the impact of these subclinical immune suppressors or subclinical disease factors, and therefore many producers fail to take appropriate precautions in terms of feed storage, feed sourcing and the inclusion of good mycotoxin binders in the feed.

Intestinal cells are the first cells to be exposed to mycotoxins, and often at higher concentrations than other tissues.

Mycotoxins specifically target cells, such as gut epithelium, that have a high protein turnover and protein-activated cells. For example, deoxynivalenol (DON) is one of the most prevalent toxic cereal contaminants and causes damage even when present at low levels in feed.

Once ingested, DON targets epithelial cells in the gastrointestinal tract, whose proper functioning, as the first line of defence, is vital for gut health. The toxic disruption of the gut barrier function increases the permeability of the gut and impairs the absorption of nutrients.

Furthermore, it disrupts gut immunity and thereby facilitates the survival and persistence of pathogens in the gut. This leads to inflammation in the gut and further destruction of the intestinal barrier. In order to improve the overall health status of the herd, appropriate measures need to be taken to minimise the exposure of pigs to mycotoxins.

Antibiotic reduction programme

The aim of the Alltech Antibiotic Reduction programme is to create a consistently healthy pig and make prophylactic and metaphylaxis antibiotic use redundant.

The programme can assist the farmer in developing an action plan. Alltech's programme largely focuses on gut health in order to cease in-feed prophylactic or metaphylactic antibiotics.

Various feed additives and nutritional solutions are valuable tools for gut health in pig production, but these supplements alone are not sufficient for a healthy production system. Many times, there are more difficult steps that must be taken than simply including feed additives, including updates to management routines and resource allocation and needs.

This programme is for pig producers who are interested in achieving higher levels of health in their herd and are committed to taking steps to achieve these goals. The producer is guided and coached by a team of enthusiastic, dedicated and competent industry consultants, veterinarians, nutritionists and other experts, such as building engineers, in order to aid in updating processes after decades of prophylactic antibiotic use.

Audits to establish the baseline current situation and recurrent audits to monitor progress are important to keep the momentum going and to re-evaluate programme improvements and targets.

The team assesses the weaknesses and strengths of the production system and sets up an action plan. Systems that benchmark production against peers and set targets that are objective and clearly defined are important in order to stay motivated and continue a steady rate of progress.

In addition to gut health and nutrition components, the Alltech Antibiotic Reduction programme audits include evaluations of performance, pig welfare, pig respiratory and systemic health, reproductive performance, management, housing, antimicrobial use, biosecurity and the cost-effectiveness of production.

Recommendations include nutritional solutions, management, antimicrobial use strategy, biosecurity measures, reproductive performance and productivity goals in order to optimise pig health at all stages of production. ■

References are available from the author on request