The importance of gut health for optimal poultry performance

Gut health is crucial for performance, health and welfare of production animals. Next to common pathogen-induced intestinal pathologies, more subtle digestive disorders are an increasing problem. These are often characterised by intestinal inflammation and villus shortening, which affect performance.

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Dietary stressors and/or subclinical bacterial infections may be the underlying causes. Protection throughout the whole intestinal tract is needed and will result in a balanced and healthy microflora which is essential for optimal technical performance.

N-Force has unique antimicrobial, physiological and immunological properties and this leads to overall enhanced gut health and performance.

The main infectious causes that impair gut health in poultry are mainly from bacterial and parasitological origin. Although necrotic enteritis (Clostridium perfringens) outbreaks are becoming rare under EU farming conditions, bacterial enteritis or dysbacteriosis is emerging since 2000. Preventive additives for gut health issues range from antimicrobial growth promoters and anticoccidials to alternative gut health additives.

Due to microbial resistance, preventive use of antimicrobial growth promoters is now banned in most countries. This has led to increased problems with necrotic and bacterial enteritis. Since coccidiosis is the main predisposing factor for necrotic and bacterial enteritis, good gut health starts with coccidiosis control.

The use of ionophore and chemical anticoccidials in rotation and shuttle programs prevents the risk of necrotic enteritis, but should be used with care to prevent resistance. Anticoccidials and cox-vaccines, however, will not protect the animals against bacterial enteritis. Although some of the contributing factors between necrotic enteritis and bacterial enteritis are the same (coccidiosis, feed quality) and the same antibiotics are used as a therapy, they are not the same.

Necrotic enteritis is induced by Clostridium perfringens and not too common in the EU, whereas bacterial enteritis is omnipresent in poultry production. Bacterial enteritis or dysbacteriosis is an inflammatory response in the gut induced by a general bacterial challenge, not one single bacterial species. It is a complicated interaction between microbiota and mucosa that does not lead to necrosis, but to inflammation and morphological changes. It creates a favourable environment for further multiplication of involved bacterial groups.

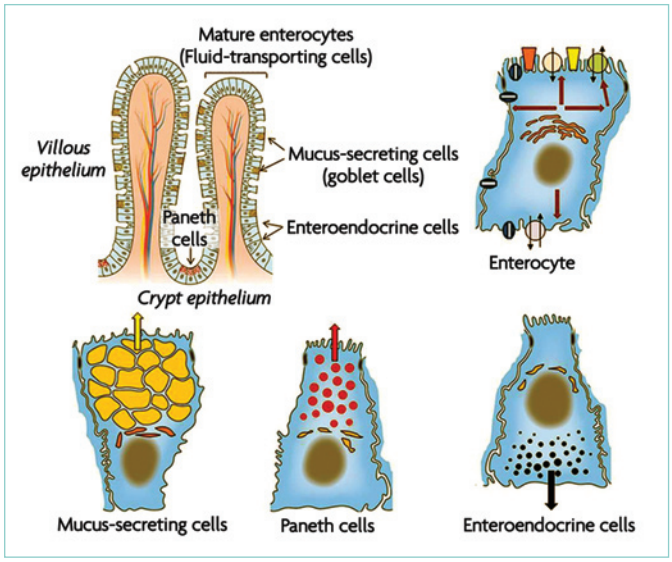

Fig. 2. The intestinal tract consists of a single layer of cells. These cells have different functions to optimise gut barrier functioning and gut integrity (adapted from lievin-Le Moal and Servin, Microbiol. Mol. Biol. Rev. 2013: 77 p 380-439).

Typical signs are wet litter, diarrhoea, feed intake stagnation and increased water/feed ratio. Bacterial enteritis is a vicious circle, starting with oversupply of nutrients in the lumen, leading to a shift in microbiota, inducing morphological and functional alterations, resulting in poor digestion of feed and absorption of nutrients, leading again to oversupply of nutrients in the lumen. To prevent this vicious circle it is highly recommended to use preventive additives that interact with all four steps of this vicious circle (see Fig. 1).

Genetic selection for growth has increased feed intake as a consequence. Modern broilers eat almost twice their own body weight every day. Antinutritional compounds such as non-starch polysaccharides (NSPs) and mycotoxins in the feed could lead to

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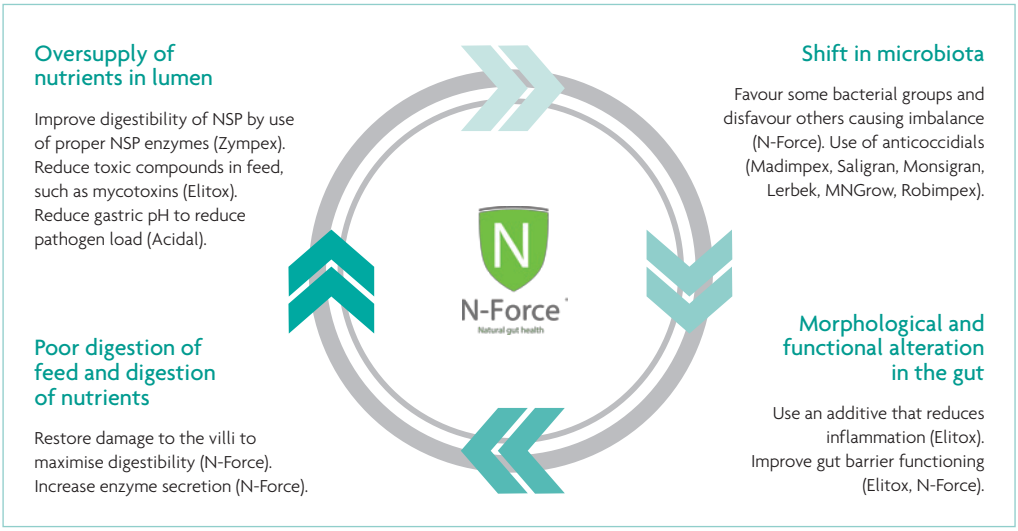
Fig. 1. The vicious circle of bacterial enteritis and the use of feed additives to interact at the different stages.



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bad digestibility, resulting in more undigested protein in the lumen on which pathogenic bacteria can be fed.

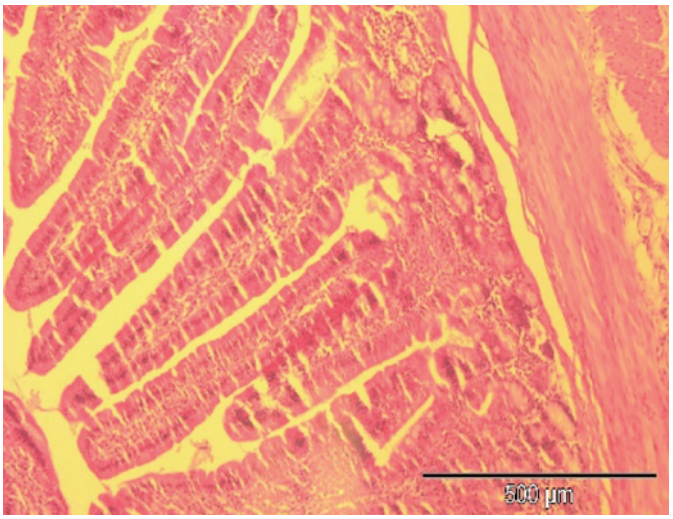
Increased presence of proteins will lead to more available amino acids to produce more branched chain fatty acids, NH3, H2S, biogenic amines and indoles, but also methanogenic bacteria will produce more methane, increasing the incidence of footpad lesions. NSPs present in the feed are also able to bind large amounts of water and increase viscosity in the gut, decreasing the passage rate of digesta. This leads to decreased absorption of digesta and increased incidence of wet litter. The presence of mycotoxins in the feed harms the intestinal barrier functioning and is one of the predisposing factors for secondary diseases and dysbacteriosis.

The gut microbiome consists of more than 10^{12} bacteria from which the host benefits in different ways: they expand the digestive capacity, they produce essential nutrients, they increase colonisation resistance against pathogenic intruders and they assist in detoxification. The more diverse and rich the microbiome, the healthier the host.

The population in the ileum mainly consists of lactobacillaceae, whereas in the caecum it mainly consists of clostridiaceae. But it is important to know that not all clostridia are bad, nor are all bacilli good. For example, the ruminococcaceae and the lachnospiraceae (clusters within the clostridiaceae) produce butyric acid which is very beneficial.

The microbial community depends on the microbial substrate preference coming from the host diet, but also from bacterial metabolites (bacterial fermentation products). Cross feeding occurs between microbiota, for example butyrate and lactate producers. Polysaccharides will be broken down to oligosaccharides and monosaccharides by bacteroidetes spp.

These monosaccharides will be further metabolised by Firmicutes spp to form short chain fatty acids, lactate and gases. The SCFA (acetic acid, butyric acid and propionic acid) formed will be consumed by other bacteria (cross feeding) or will serve as an energy source for the enterocytes. Gut health can hence be improved by steering the intestinal microbial community with feed composition and additives.



Gut samples were taken from nine animals per treatment for gut morphology analysis at day 23 of age (see trial results in Fig. 3).

Historically there is more focus on controlling the bacterial element, but an additional need is to focus on the host defence, gut barrier functioning and integrity.

The main functions of the gut are digestion and absorption of nutrients and the interface between the organism and the outer world.

The surface area is enormously increased by the presence of villi and microvilli to maximise its absorption area. But the efficiency of feed digestion and absorption is directly proportional to the healthy surface of the intestine. The longer the villi, the greater the surface for absorption and the healthier the microvilli, the more production of enzymes to break down the complex molecules.

Moreover, the enterocyte lining is the physical barrier between intestinal lumen and blood, tightly sealed together by tight junction, preventing bacteria and toxic substances entering the blood and causing inflammation and a leaky gut.

Together with the gut associated lymphoid tissue, the intestine is also the largest immune organ mounting an adequate innate/adaptive immune response to pathogens, but also preventing an inflammatory response and keeping a state of oral tolerance against commensals and dietary compounds.

The intestine is composed of different cells with different functions: enterocytes for absorption, goblet cells for mucus secretion, Peyer's patches and mesenteric lymph nodes for immunity, Paneth cells for antimicrobial peptide production and enteroendocrine cells for hormone production. These last cells, also make the gut a sensory organ.

The receptors recognise specific molecules (for example butyrate) and send signals to the brain and other organs for proper adaptation (for example increased glucagon-like- peptite (GLP) secretion). Increased concentrations of butyrate in the lumen will lead to a reduced inflammatory response by countering the typical inflammation responses, such as vasodilatation, muscle breakdown and loss of appetite, orchestrated by GLP receptors on different organs such as artery, myofibroblast and brain, respectively.

Alternative approaches

Alternatives to enhance gut health are gaining field. Mainly anti-coccidials are used for their indirect effect (less coccidiosis) and direct effect (ionophores) against dysbacteriosis. Other alternative approaches support host defence, gut barrier management and integrity and recovery of the intestine, or control the microbial ecosystem directly.

Fig. 3 summarises the results of a broiler trial that was conducted with male broiler chicks (Cobb) which were fed a corn-soya diet. The trial was set up as a randomised block design with three treatments, 40 birds/pen and nine replicates/treatment.

The addition of N-Force to a standard commercial diet resulted in an improved body weight gain and FCR compared to a control diet. Villi length was statistically increased on day 23.

An improved guth health is known to result in better digestion and nutrient absorption, explaining enhanced growth and FCR.

Conclusion

In conclusion, bacterial enteritis is an important disease in poultry, causing loss of performance. It is a multi-factorial disease with several predisposing factors. The use of N-Force in combination with proper management and prevention of coccidiosis allows you to grow your flock to their maximum genetic potential. ■

Fig. 3. A trial was conducted on 1,080 male Cobb broilers, divided over 27 pens of 40 animals each, during 39 days. Each pen was randomly assigned to one of the three treatments: Control, N-Force at 1.5kg/T in the starter, 1kg/T in grower and 0.5kg/T in finisher phase or an antibiotic growth promoter Flavimpex.