

Healthy nutrition solutions for poultry production

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Gut health is highly complex and encompasses the macro- and micro-structural integrity of the gut, the balance of the microflora and the status of the immune system. This was stated by Prof. Mingan Choct in 2009 and, in recent years, gut health management has become an important topic in our industry.

With increased concerns regarding the non-therapeutic use of antibiotics, the development of a healthy digestive system is not only key to ensure optimum bird performance, but also a way to address some of the issues related to food safety and animal welfare.

Feed additives represent one of the options available to the nutritionist in order to promote and maintain a healthy gut.

This article aims to provide an overview of the benefits associated with the use of feed additives in poultry production, with special emphasis on the role of exogenous enzymes, essential oils, direct-fed microbials and betaine.

Intestinal microbiota

Exogenous enzymes are known to improve nutrient utilisation by breaking down the anti-nutritional factors present in the feed and/or by complementing endogenous secretions in the digestive tract of the animal.

However, research has also shown that enzymes supplementation can contribute to better gut health through the positive modulation of bacterial populations.

In a series of trials, Jin and Hruby (2003) demonstrated that feed enzymes can successfully reduce the levels of zoonotic bacteria in the caeca of broilers inoculated with *Campylobacter jejuni* and *Salmonella enteritidis*.

By decreasing intestinal viscosity and/or the amount of undigested nutrients in the gut, exogenous enzymes initiate changes in the intestinal microflora and limit the risk of proliferation of potentially pathogenic bacteria.



Some studies also suggest that the action of exogenous carbohydrases releases short-chained oligomers that can be fermented by certain beneficial bacteria.

Other additives such as essential oils (EOs) and direct-fed microbials (DFMs), or probiotics, are known for their ability to modulate the gut microbiota. Mechanistically, these products can act in different ways.

They can inhibit the development of enteric pathogens by direct interaction, or they can act indirectly by promoting the normal microflora to competitively exclude pathogens.

The antimicrobial effect of EO compounds, such as cinnamaldehyde and thymol, on potentially pathogenic bacteria has been well documented in-vitro and in-vivo. The amount of information supporting the anti-parasitic effect of EOs is more limited.

However, some research suggests that these compounds could have a positive impact on the control of coccidiosis in poultry. DFMs also represent an interesting alternative to the use of antibiotics in animal production and, as for EOs, they have received renewed attention in recent years.

Studies have shown that DFMs can help maintain a normal microflora and beneficial microbial populations in the gut through antagonism (production of antimicrobial

substances such as bacteriocins) and competitive exclusion.

There is extensive evidence documenting the capacity of lactobacillus and bacillus based DFMs to reduce the levels of harmful enteric pathogenic bacteria and increase the levels of beneficial lactic acid producing bacteria in the normal microbiota of chickens.

Ultimately, the best solution to partially or totally replace antibiotics in poultry production may rely on the combination of several alternatives. So far, very little work has been done in order to assess the potential additivity or synergy of different types of feed additives.

The combination of exogenous enzymes and essential oil compounds may benefit gut health and animal performance beyond the effect of each additive added individually.

This may be related to the different modes of action of these additives, with feed enzymes reducing the quantity of undigested substrate reaching the lower gut, while essential oils inhibit the development of harmful micro-organisms.

Immunomodulation

A properly functioning immune system is of special importance to poultry because most commercial flocks are raised under intensive rearing conditions, making them vulnerable to rapid spread of infectious agent and disease outbreaks.

Besides their capacity to modulate the gut microflora, there is evidence suggesting that EOs and DFMs can stimulate the bird immune system.

Numerous studies have reported the positive influence of DFMs on the host immunity. Increased antibody production and up-regulation of cell-mediated immunity were among the main effects observed by the researchers.

However, the mechanisms whereby DFMs interact with the bird immune system remain to be fully understood. Unlike DFMs, very little work has dealt with the effect of EOs on bird immunity, and most of the evidence published in the scientific literature appears to describe benefits related to the use of plant extracts.

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It is important to note that the so-called 'plant extracts' contain more than just essential oils. They also include compounds such as flavonoids and oligosaccharides.

Therefore, it is unsure whether the immune responses observed in these studies were linked to the effect of EOs or related to the presence of the other molecules.

Nonetheless, there is some research suggesting that phenolic EO compounds can exhibit anti-inflammatory activity due to their capacity to inhibit cyclooxygenase, an enzyme which is involved in inflammatory responses.

Dietary supplementation of EOs can pro-

mote immunocompetence of young birds, as evidenced by increased immunoglobulin secretion in broilers fed different blends of essential oil compounds.

Gut integrity

One of the major functions of enterocytes is to act as a protective barrier shielding the body from organisms and substances that do not serve as nutrients. While most feed additives can provide gut health benefits via direct or indirect effects on the gut microflora, some compounds act directly on the intestinal epithelium.

Betaine is an additive that can support

intestinal growth and function. Because of its osmotic properties allowing for better maintenance of the water balance and cell volume, betaine has the ability to protect the intestinal wall and facilitate digestive processes.

These benefits may be especially pronounced in animals experiencing osmotic stress situations such as high environmental temperatures or coccidiosis. Intestinal lesions caused by coccidia infection lead to malabsorption and diarrhoea issues.

However, research indicates that dietary supplementation of betaine can counteract the morphological changes in the small intestine that generally occur during coccidiosis, and help to maintain villus integrity and mucosal structure.

In coccidia-challenged broilers, betaine addition resulted in greater tensile strength, increased villus height (or decreased crypt/villus ratio) and reduced lesion scores of the intestinal epithelium. The scientific literature also suggests that betaine could improve the efficacy of coccidiostats.

Exogenous enzymes, essential oils and direct-fed microbials have also been shown to positively affect the structure of the intestinal epithelium. Studies have reported increased villus height and decreased crypt/villus ratio when these additives were added to broiler diets.

But, unlike betaine, the benefits may not be related to a direct effect on intestinal cells. They are more likely a consequence of the feed additives capacity to breakdown anti-nutrients such as non-starch polysaccharides and reduce the levels of harmful bacteria, both factors being known for their negative influence on gut morphology.

Conclusion and perspectives

Changes in our industry are leading nutritionists to formulate diets that aim to optimise the development and health of the bird's digestive system, and the use of feed additives is one of the options available in order to achieve this goal.

All types of additives – enzymes, essential oils, direct-fed microbials and betaine – have the potential to promote the development of a healthy and functional gut. They can act in multiple and diverse ways, including promoting the establishment of beneficial gut microbes, reducing the pathogen load in the gastrointestinal tract, stimulating the bird's immune system and enhancing gut integrity.

Therefore, feed additives offer a useful addition to other management practices presently employed to improve animal welfare and food safety in poultry production.

However, more research will be required in order to understand the potential additivity or synergy between the different types of additives, and to maximise their benefits for the animal. ■

References are available from the author on request