Boosting gut agility for cost-effective poultry nutrition

Poultry production is highly competitive and it is not getting any easier with consumers and key restaurant chains increasing the demands for the reduction of antibiotics in poultry feed and setting new standards for production methods, food quality and animal welfare.

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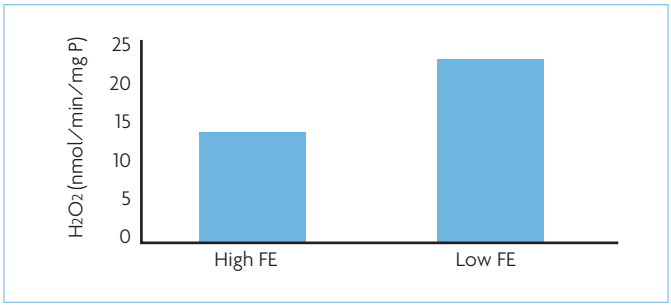

Fig. 1. Negative relationship: Reactive oxygen species (ROS) in liver mitochondria and feed efficiency of broilers (Igbal et al 2005).

Poultry producers must continuously adapt – respond faster to challenges and drive production and cost-efficiency. In a fast-moving business environment, operational agility becomes key to profitability and success. New nutritional solutions based on the concept of agility help to manage consistency in the cost-effectiveness of diets and are designed to contribute to the operational agility of modern poultry production systems.

With up to 70% of production costs coming from the cost of feed, consistency in the cost-effectiveness of diets is key to profitability.

However, nutritional stressors in the diet, such as dietary changes, reduced nutrient digestibility, endotoxins, antinutritional factors and mycotoxins, often throw a spanner in the works of consistency in performance in response to diets.

Depending on the increased presence or absence of those stressors the same diet can differ in cost-effectiveness. These stressors are often not easy to control for the nutritionist and are part of the reality that animals are facing in modern production systems.

Stress reactions reduce efficiency

When challenged with nutritional stress factors, stress reactions such as oxidative stress, leaky gut, inflammation and shifts in gut microflora will be triggered in the bird. This not only reduces growth performance, but also feed efficiency and thus the cost-effectiveness of diets. Feed efficiency is reduced due to energy wasted on stress reactions instead of being used for productive purposes.

For instance, under oxidative stress and inflammation, 30% of the performance drop is explained by the catabolism and feed conversion needed to manage inflammation.

Oxidative stress is defined as the presence of reactive oxygen species (ROS) in excess of the available antioxidant capacity of animal cells.

Oxidative stress is a major factor related to the development of inflammatory diseases.

Impact of mycotoxins

Meta-analysis studies can provide an objective overview on the impact of different types of mycotoxins on performance and efficiency of poultry.

A meta-analysis study including 98 broiler trials showed that diets with average levels of either 0.95ppm of aflatoxin, 4.29 deoxynivalenol (DON) or 2.87ppm of T2-toxin showed significant negative impact on all major performance parameters (Table 1).

This study also highlighted that the mycotoxin type had a differentiated influence on animal weight gain. There was an expected reduction of 16% in broiler weight gain for each ppm of aflatoxins in diets, whereas the expected reduction in weight gain for DON and T2 toxin was 1.2% and 4.25% per ppm respectively.

A similar meta-analysis study carried out in growing pigs, but also comparing the impact of individual mycotoxin challenges vs. combined mycotoxin challenges with different types of mycotoxins, reported that the same mycotoxin concentration showed a stronger effect on pig performance when present in combination with other mycotoxins than in a single contamination.

Direct disturbance in the functions of some organs, especially the liver, and the partition of nutrients for activities other than body growth also increase a mycotoxin challenged animal's demands for protein and energy.

Those activities include stress reactions to mycotoxins at the cellular level. For instance, scientific trials have shown that aflatoxins, zearalenone and DON can all increase oxidative stress in animals, which again will also lead to increased inflammatory responses.

DON induced stress

Deoxynivalenol (DON) is a trichothecene mycotoxin produced by several fungal species, such as fusarium, myrothecium, cephalosporium, verticimonosporium, and stachybotrys.

Globally it is the most prevalent mycotoxin in animal feed stuffs and so far, the impact of this mycotoxin on animals has been the most difficult to control. The binding capacity of mycotoxin binding materials such as clays and yeast is very low for DON and therefore ineffective in protecting animals from DON.

Consumption of DON has not only been shown to increase oxidative stress in broilers, but several further stress reactions particularly at the gut level in the bird that will decrease feed efficiency.

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Table 1. Mycotoxin impact on performance in broilers from a meta-analysis based on 98 trials (Andretta et al 2011).

	Aflatoxin	DON	T2-toxin
Average mycotoxin level (ppm)	0.95	4.29	2.87
Average trial duration (days)	18	18	18
Feed Intake (%)	-11	-9	-7
Growth rate (%)	-11	-8	-5
FCR (%)	-6	-12	-6
Significance of effect on mortality	***	*	NS
Production efficiency index (%)	-42	-24	-31

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Consumption of DON contaminated feed leads to epithelial injuries in the digestive tract, causing intestinal inflammatory responses. Studies have also demonstrated that DON compromises the intestinal barrier function and increases gut permeability, i.e. resulting in leaky gut syndrome.

The latter is proven to predispose birds to necrotic enteritis, because decreased adsorption of protein and increased leakage of plasma amino acids provides the necessary growth substrate for C. perfringens proliferation in the intestinal lumen.

Self-optimisation in birds

Ideally the response to nutritional stress factors should consume as little energy as possible or stress reactions should be minimal for better and more consistent feed efficiency. This would be the case if animals were inherently more resistant to nutritional stress factors or were able to adapt to nutritional stressors more energy efficiently.

Defence systems in the body that prevent damages caused by reactive oxygen species (ROS) during exposure to infections, inflammation, and stressors are called antioxidant defence systems.

Antioxidant defence systems prevent lipid peroxidation by blocking peroxidation chain reactions and acting as ROS scavengers. However, if the endogenous system is overwhelmed by stressors it will trigger oxidative stress.

It has been proposed that genetic predisposition to possessing mitochondria, which are less vulnerable to oxidative stress, has the potential to increase feed efficiency in broilers. Higher levels of reactive oxygen species were found in mitochondria from broilers with low feed efficiency compared to broilers with high feed efficiency (Fig. 1).

Hence there is some evidence for genetic differences in how animals respond to stressors and some are more resistant than others.

There are ways to increase the resistance in birds to stressors by nutritional means. For instance, adding anti-oxidant substances to the diet that either scavenge ROS or upregulate and protect endogenous antioxidant defences has been shown to enhance the ROS detoxifying capacity of the animal, thus reducing oxidative stress in response to stressors.

Several bioactive substances derived from herbs and spices have also been shown to have high anti-inflammatory properties. Others are known for their ability to help maintain gut integrity and sustain a healthy gut microflora through improved digestion of protein.

So, there is scope for genetic improvement and nutritional means to optimise the response of animals to nutritional stressors, including mycotoxins and thus manage the consistency in cost-effectiveness of poultry diets.

Operational agility

Agility is the capacity to anticipate change, respond, adapt quickly and thrive in a challenging environment.

Agile companies in the modern business world can maintain a performance edge, despite significant change in their business environments. They have the ability to move quickly and effectively in anticipating and taking advantage of change. Given the challenges for poultry production to remain competitive, operational agility is precisely a capability also increasingly required by poultry producers.

A key question is whether the natural ability of animals to adapt to nutritional challenges and other stressors can be deliberately accelerated and optimised to benefit animal performance efficiency and the operational agility of animal production systems.

Gut agility

Applying the concept of agility to the bird can help to further develop efficiency in poultry production.

The gut is particularly responsive to stressors, hence why the emphasis is on the gut when improving the animal's adaptive response.

Gut agility is a new term coined to describe the bird's ability to adapt to nutritional stressors in a faster and more energy-efficient response than it normally would.

Agile nutritional concepts are designed to boost gut agility and empower animals to adapt to a variety of nutritional stress factors, including mycotoxins, making them more robust and energy efficient.

They rely on bioactive substances derived from plants that reduce some of the negative stress reactions seen at the cellular level in response to stressors.

The animal becomes more agile in the face of dietary challenges, resulting in more consistent high performance and well-being.

This, in turn, will contribute to consistency in the cost-effectiveness of diets under commercial conditions. ■

References are available from the author on request