By Carlos de la Cruz, global expert egg production, Evonik Nutrition & Care GmbH

Optimising feeding for egg production

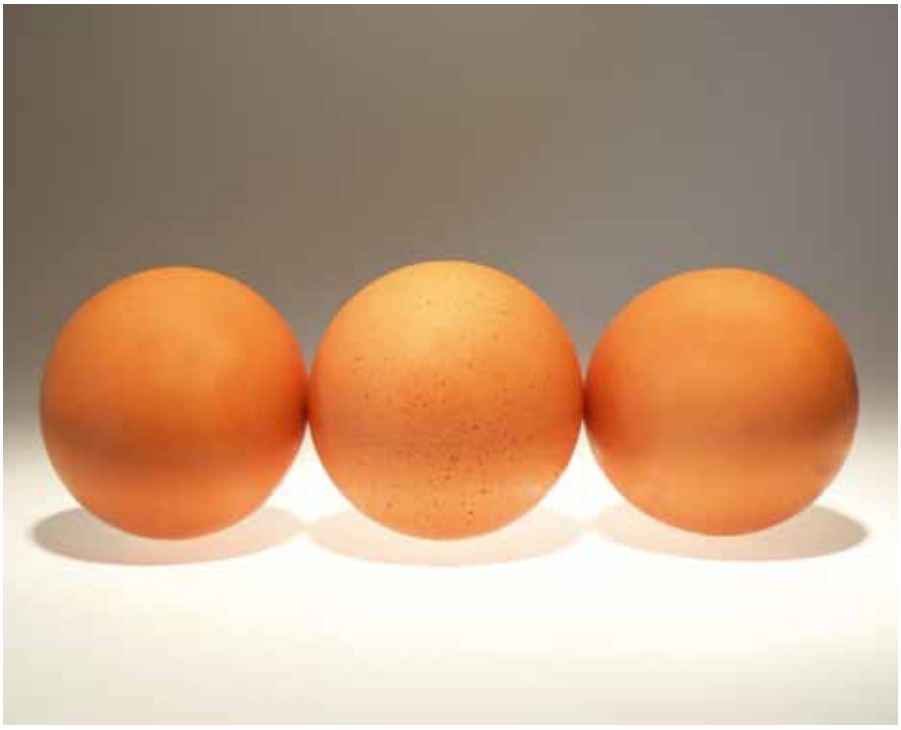
Feeding birds in the context of an antibiotics ban brings challenges, but also opportunities. Nutrition is about more than offering nutrients to meet requirements for maximum performance. Nutrition's role goes beyond this to embrace raw materials, feed additives selection and the ideal bacterial ecology. All this supports top digestion and absorption, along with balanced microflora, and an adequate immune response. Ensuring that the gastrointestinal system functions optimally is vital to successful egg production.

People are aware of food safety issues due to high profile food scandals linked to animal production. Nowadays, the public, government regulatory agencies and the animal feed industry are working to fulfil expectations to produce quality, safe products. The shift towards reduced antibiotic use worldwide brings new opportunities for improving gut health through nutrition to promote health in the egg industry.

In order to express an animal's genetic potential, the digestive tract must support optimal digestion and absorption of nutrients, which minimises gastrointestinal illness, stabilises and/or positively modulates the microbial ecology, and enables the bird to mount an effective immune response. Opportunities to optimise the gut health of pullets and layers, preventing pathogenic insults that may directly or indirectly affect performance, are often overlooked.

Gut health challenges

In the rearing house, birds are exposed to continuous stressors (vaccination programmes, beak trimming, medical treatment, etc.) that result in feed intake depression. In addition, the focus is on flock uniformity, body weight and sexual maturity at the expected age.



Gut development (physiologically and immunologically) and the microbial ecosystem are often not considered.

In some cases, birds are systematically treated with antibiotics during their first five days after arrival, when their digestive tract is still in an immature state, and microbiome establishment is an uphill struggle.

The challenges inherent in egg production, combined with physiological stress due to hormonal changes, make it difficult to accomplish optimal feed utilisation and maximum production while maintaining egg quality. Moreover, the reality is that many flocks in production suffer due to a lack of uniformity, bacterial enteritis, necrotic enteritis (NE), dysbiosis (microbial imbalance) and focal duodenal necrosis (an intestinal disease observed in egg-laying chickens, characterised by multifocal mucosal erosions mainly observed in the duodenal loop).

Health challenges

Later in the production cycle, further challenges are faced due to a leaky gut and a reduction in villi length associated with a reduction in nutrient absorption, mainly minerals. As a result, the incidence of cracked eggs, micro cracks and dirty eggs, plus a reduction of total eggs, increase.

Coccidiosis was ranked as the most important threat during rearing, regardless of the housing system (cage or non-cage), according to a 2014 survey conducted by the Association of Veterinarians in Egg Production in the United States. It also highlighted colibacillosis as the main issue in cage-housed layers.

The survey's participants indicated that gastrointestinal problems are responsible

Table 1: Recommendations for standardised ileal digestible amino acids for laying hens. AMINOHen®, percentage of diet and daily amino acid intake/mg.

	Lys	Met	Met+Cys	Thr	Trp	Arg	Ile	Val
Ratio to Lys	**100**	**50**	**91**	**70**	**21**	**104**	**80**	**88**
Intake, mg/d dig AA	**831**	415	756	582	174	864	665	731

for 50% of health issues in birds that are in production and 40% when they are growing. Other health problems also mentioned were viral diseases related to the respiratory system. It's important not to overlook the fact that such challenges may drive secondary bacterial diseases, leading to performance losses.

Importance of a healthy gut

If gut function is impacted by pathogens, there is not only an immunological response but also a change in passage rate, digestion, mucin secretion, and an increase in turnover rates of the intestinal epithelium. This results in a requirement for higher nutritional maintenance, but nutrients are instead diverted to bolster the immune system. As a consequence, this can trigger enteritis and noticeable performance losses.

Laying hens can maximise efficient feed utilisation for egg production when a healthy gut is developed. A healthy gut can be defined as "a steady state where the microbiome and the intestinal tract exist in symbiotic equilibrium and where the welfare and performance of the animal is not constrained by intestinal dysfunction".

Not only is the gut the major organ for nutrient digestion and absorption, but it also works as the first protective mechanism against exogenous pathogens that can colonise and/or enter the host cell tissues. The gut is the largest immunological organ in the body. A more robust gut should therefore make for a healthier animal that can utilise nutrients optimally.

Nutrition for gut health

Crude fibre has been regarded as an inert nutrient in monogastric animals. However, this is not the case, as it can play a role in improving gut health, enhancing nutrient digestion and modulating behaviour. A minimum constraint should be established – 5% in diets for laying hens, for instance.

Besides the fibre content in the diet, when coarse particles are fed it also benefits the digestive system of birds. Flocks fed with larger particles will develop larger and more muscular gizzards and longer intestinal tracts. Coarser feed particles require more time in the gizzard to be ground into smaller particles before they can enter the small intestine. Increased retention time stimulates pH drop, which has a bactericidal effect.

Larger feed particles have a longer transit time through the gut, which improves the length of microvilli and increases the absorptive surface area in the intestine, and thereby positively affects digestibility and nutrient absorption.

Layers have a preference for larger particles, and the preference becomes stronger with age. For that reason, hen behaviour also improves, not only due to birds having to spend more time eating, but also because they have less time for vices such as feather pecking and cannibalism.

Feeds containing high levels of powdery raw materials should be avoided. Birds find it more difficult to consume fine grist and, once consumed, there is a direct outflow through the gizzard without utilisation. A feed with a larger grit size is thus desirable. When 2% oil is added it also assists in achieving a homogenous feed with optimal particle distribution.

Effect of dietary 'protein'

In animals the primary role of amino acids from feed is to grow and develop organs and tissues, mainly to serve as building blocks in protein synthesis. However, amino acids are also essential in many metabolic pathways to regulate physiological functions and to modulate response in the body's immune system; mucin, epithelial cells, antibodies, enzymes, hormones, etc.

Nonetheless, a percentage of the amino acids and non-amino acid nitrogen offered through the feed is not completely processed in the digestive tract, generating substrates for microbes and toxins. This material can upset the ileum, causing overgrowth of pathogenic bacteria, imbalance in the gut ecosystem, gut irritation, dysbacteriosis, and in some cases subclinical necrotic enteritis.

Large and insoluble protein particles that are not assimilated by the animal go to the large intestine, leaving the digestive system through the faeces. However, small/soluble protein particles pass through the ileocecal junction into the caecum, where their breakdown (putrefaction) takes place and ammonia, amines, indoles and branched chain fatty acids are produced. These compounds can be toxic and problematic.

A 'protein' excess not only increases production costs, but it also generates health problems in the bird. However, a reduction of crude protein (total nitrogen) in feed must be accompanied by a balance in the amino acid profile and supply according to the requirements of the birds.

Precise (amino acids) nutrition implies raw material (amino acid) knowledge, digestibility, awareness of poor protein source processing, and the use of available pure amino acids. This approach can then meet the demand of maintenance, health challenges and egg production without excess nitrogen. The correct balance of digestible amino acids – also called the 'ideal amino acid profile' – is shown in *Table 1*.

In support of this, Drew *et al.* (2004) studied the effects of dietary protein source and level on intestinal populations of *Clostridium perfringens* in broiler chickens. Two studies demonstrated that the level of dietary crude protein (230 and 400g/kg) and the protein source (soya protein concentrate or low temperature-dried fishmeal) of diets affect the growth of *C. perfringens* populations in the lower intestine of the broiler chicken.

A significant interaction between protein source and level was observed where the number of *C. perfringens* present in the ileum and cecum increased as the level of crude protein in the diets increased in the birds fed fishmeal based diets, ($P < 0,05$) but not in the birds fed soya protein concentrate based diets. This suggests that the level of crude protein, protein source and amino acid content of diets might all be predisposing factors for outbreaks of clinical necrotic enteritis. ❖

For more information, contact Evonik Africa (Pty) Ltd on 011 697 0700 or visit *www.evonik.com*.