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Science & Solutions

Antibiotic Reduction, Profit and Innovation

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How Mycotoxins Aggravate Coccidiosis

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Pullet Weight Management for More Eggs, Profits

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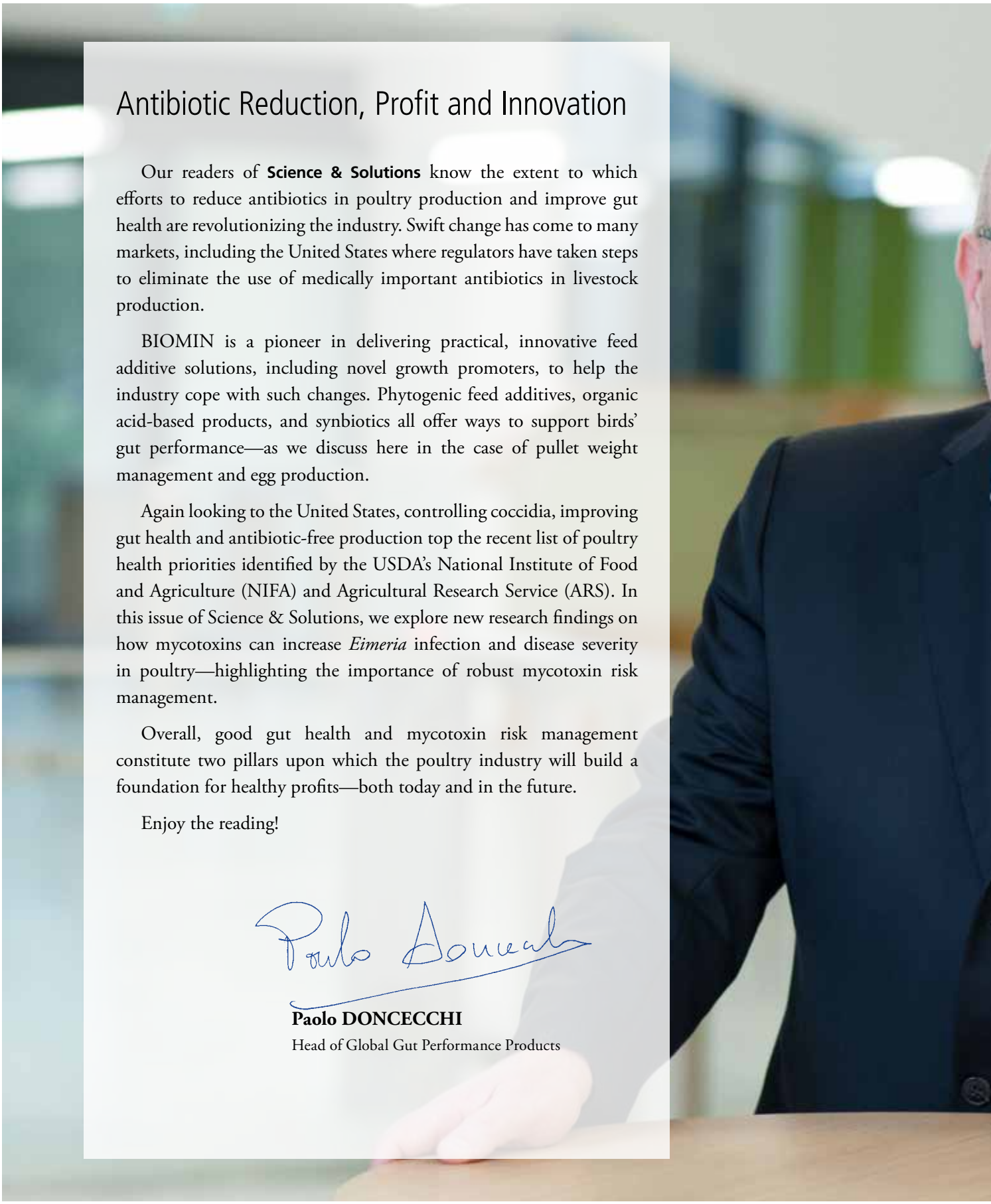
Editorial



Antibiotic Reduction, Profit and Innovation

Our readers of **Science & Solutions** know the extent to which efforts to reduce antibiotics in poultry production and improve gut health are revolutionizing the industry. Swift change has come to many markets, including the United States where regulators have taken steps to eliminate the use of medically important antibiotics in livestock production.

BIOMIN is a pioneer in delivering practical, innovative feed additive solutions, including novel growth promoters, to help the industry cope with such changes. Phytogenic feed additives, organic acid-based products, and synbiotics all offer ways to support birds' gut performance—as we discuss here in the case of pullet weight management and egg production.

Again looking to the United States, controlling coccidia, improving gut health and antibiotic-free production top the recent list of poultry health priorities identified by the USDA's National Institute of Food and Agriculture (NIFA) and Agricultural Research Service (ARS). In this issue of Science & Solutions, we explore new research findings on how mycotoxins can increase *Eimeria* infection and disease severity in poultry—highlighting the importance of robust mycotoxin risk management.

Overall, good gut health and mycotoxin risk management constitute two pillars upon which the poultry industry will build a foundation for healthy profits—both today and in the future.

Enjoy the reading!

Paolo DONCECCHI
Head of Global Gut Performance Products

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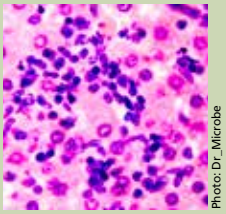
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How Mycotoxins Aggravate Coccidiosis in Poultry

By **Michele Muccio**, Mycotoxin Risk Management Product Manager

Mycotoxins, even at low levels, can increase *Eimeria* infection and disease severity in poultry.

This article originally appeared in Poultry International

Deoxynivalenol, fumonisins and a the incidence and severity of coccidiosis

Coccidiosis is estimated to cost poultry industry US$3 billion annually, and is also a well-known predisposing factor for necrotic enteritis—widespread in broilers and responsible for losses of US$5-6 billion worldwide each year.

Mycotoxins in feeds, even at permitted levels, aggravate coccidiosis in poultry. They can facilitate *Eimeria* colonization in the gut, and poultry producers looking to reduce the impact of coccidiosis on their flocks would do well to monitor feed for contamination.

Gate openers to infection

Further research is required to fully understand the underlying mechanism that results in mycotoxins' amplification of coccidiosis, however, possible explanations include increased immunosuppressive effects on modern high performing broilers, chronic low level mycotoxin exposure, and the potential for synergistic effects between mycotoxins.

Deoxynivalenol and fumonisins are known to interfere with several vital functions of cells, and disrupt intestinal cells that act as a barrier between pathogens and the birds' bodies. These disrupted intestinal cell components can be used as a growth substrate for pathogens such as *Eimeria*, *Clostridium* and *Escherischia coli*.

In this way, these mycotoxins play a main role as 'gate openers' favoring pathogen colonization throughout the host.

Unsafe at any level

Even at concentrations allowed under European and US guidelines for mycotoxins (*Table 1*), deoxynivalenol, fumonisins and a combination of the two can worsen the incidence and severity of coccidiosis in challenged poultry, studies have shown.

Chickens fed mycotoxin-contaminated feed at levels well below regulatory guidelines in starter and grower diets (*Table 2*) displayed considerably higher lesion scores, higher numbers of oocysts in both the jejunum and in excreta, and higher lymphocyte (white blood cell) counts.

Table 1. Mycotoxin guidelines (maximum levels) in poultry.

	DON	FUM
EFSA		
Maize and maize by-products	12 ppm	60 ppm
Poultry feed	5 ppm	20 ppm
FDA		
Poultry feed	10 ppm	30 ppm

Source: BIOMIN

Table 2. Experimental diets containing low levels of mycotoxins.

	Starter diet (0-20 days)	Grower diet (21-34 days)
DON	1.6 ppm	2.9 ppm
FUM	-	20.5 ppm
DON+FUM	1.3 ppm	20.8 ppm

Source: BIOMIN

Lesion scoring in the cecum was 1.33 for the mycotoxin groups versus 0.42 for birds fed control diets (*Figure 1*). The number of oocysts found in the jejunum was three times higher for birds fed mycotoxins versus control. Similarly, the number of oocysts recorded in feces was 29 percent higher for the deoxynivalenol + fumonisins group and 46 percent higher for the fumonisins group.

Overlooked risk

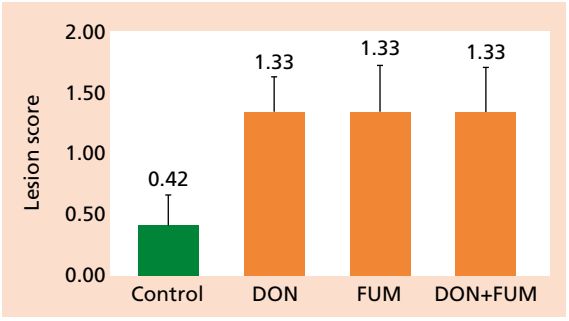
While the poultry industry has a general awareness of the dangers linked to certain mycotoxins, the threat posed by deoxynivalenol and fumonisins has been largely overlooked.

Yet, these mycotoxins occur frequently in the most common poultry diet ingredients, including finished feed, maize, wheat and soybean meal.

Michele MUCCIO
Mycotoxin Risk Management Product Manager

combination of the two can worsen in challenged poultry

Figure 1. Lesion scoring in the cecum of birds that received the coccidian challenge.



Groups fed mycotoxins all had considerably higher lesion scoring than the control group

Adapted from Grenier et al., 2016

Figure 2 reveals that deoxynivalenol was detected in 61 percent of maize, 54 percent of wheat, 71 percent of finished feed and 61 percent of soybean meal samples analyzed. Fumonisins were detected in 80 percent of maize, 27 percent of wheat, 66 percent of finished feed and 40 percent of soybean meal samples.

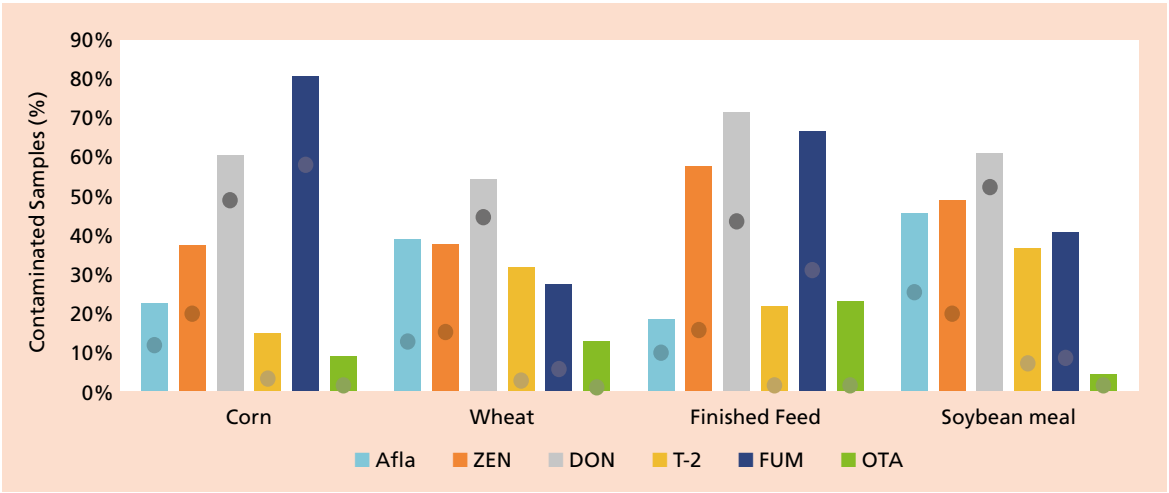
The implication for poultry producers looking to limit the use of antibiotics is to adopt robust mycotoxin risk management in order to protect flocks.

Antibiotic-free

For antibiotic-free feeding that does not permit the use of ionophores —a class of antibiotics used solely for the purpose of preventing coccidiosis— coccidiosis management must rely on non-antibiotic coccidiostats, or live coccidiosis vaccines, or more likely, a rotation between the two.

Probiotics and phytogenic feed additives, with or without the use of coccidiostats or vaccines, can help alleviate the negative effects of coccidial infection, having been shown to reduce oocyst shedding, severity of intestinal lesions, and adverse effects on performance.

Figure 2. BIOMIN Mycotoxin Survey results for poultry feed ingredients.



Mycotoxin contamination of maize (735), wheat (394), finished feed (1638), and soybean meal (298) samples analyzed from Jan. to July 2016. Dots display the occurrence of mycotoxins above risk threshold levels.

Source: BIOMIN

Improving Egg Production Profits with Pullet Weight Management

By **Eduardo A. Vicuña S.** and **Chasity M. Pender**, Poultry Technical Managers

Pullet body weight strongly influences sexual maturity and overall reproductive performance of the adult layer. Proper gut health management is key to achieving ideal body weight and ensuring optimal performance and profitability.

With regard to pullet body weight and layer performance, sexual maturity is directly correlated with the onset of the production cycle. Flock uniformity at sexual maturity allows producers to have a sooner start of production, higher peak lay, and better persistency of egg production. Another advantage of having flocks with uniform body weights is the ability to easily meet the nutrient requirements for the entire flock with one diet.

Ideally, the uniformity of body weights within a particular flock should be close to 85% (*Figure 1*). Pullets with body weights that are too low tend to reach sexual maturity later and produce less eggs over their lifetime than heavier birds. Furthermore, pullets not achieving target body weight could demonstrate poor physiological and anatomical conformation, particularly in the gastrointestinal and reproductive systems.

Off target

There are several consequences of having body weights that exceed the target during the growing period. Obese hens do not have normal vaginal mucosa retraction and often prolapse, thus exposing them

Photo: gojak

to pecking by other birds. This abnormality leads to increased mortality and early reduction of egg production. Other undesirable consequences, such as increased basal nutritional requirements and higher production of non-marketable eggs, may consequently reduce profitability.

Phytogenic Feed Additives

Phytogenic feed additives (PFA) have shown positive effects on gastrointestinal anatomy and physiology and nutrient digestion and absorption. These positive effects are due to increased production of pancreatic enzymes, improvement in intestinal integrity, and augmented bile secretion. Pancreatic enzymes aid in the digestion of nutrients such as lipids, carbohydrates, and amino acids in the intestinal lumen. By optimizing nutrient digestibility and improving intestinal morphology, nutrient absorption is also enhanced. Overall, phytogenic feed additives improve nutrient utilization, thus allowing more nutrients to be utilized by the bird to reach the ideal body weight.

Phytogenics are also able to decrease the amount of pathogens in the gastrointestinal tract. The increased digestibility when phytogenics are used leads to a decrease in free protein in the lumen of the intestine, diminishing the pathogen's ability to proliferate.

Probiotics

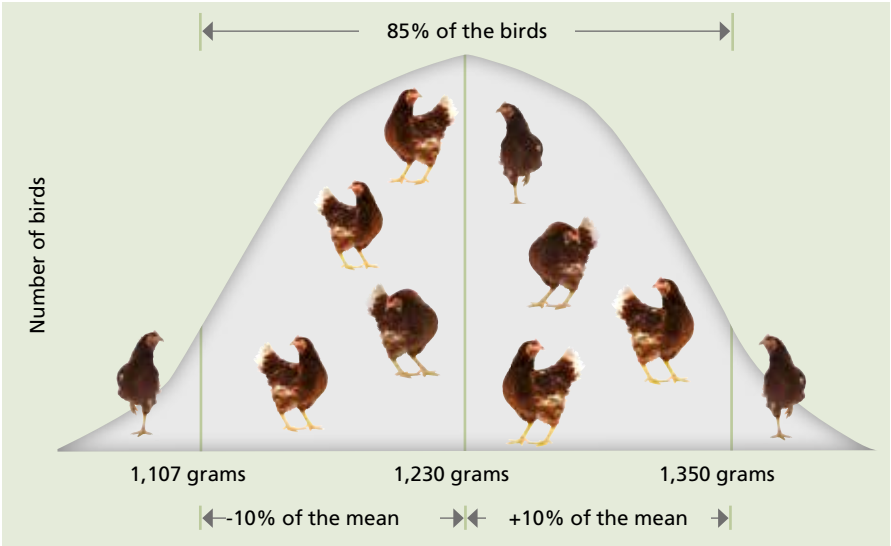
Probiotics stabilize the gastrointestinal microbiota by preventing the colonization of pathogens such as *Escherichia coli*, *Salmonella*, and *Clostridium*, supporting immunity against microbial and environmental insults, and enhancing intestinal integrity. The efficacy of probiotics may be modified by the amount and kind of strains being utilized. Often times, several strains used in conjunction can be more effective than a single one. Some of the beneficial effects caused by probiotics include enhanced nutrient absorption due to increased length and width of the intestinal villi and augmented secretion of important digestive enzymes such as amylase. Additionally, several studies have demonstrated that birds fed diets supplemented with probiotics display an enhanced immune response against pathogens and better performance than non-supplemented birds.

Organic Acids

Animal feed has been identified as a notable carrier for numerous bacteria that

Pullets with body weights that are too low tend to reach sexual maturity later and produce less eggs over their lifetime.

Figure 1. Ideal body weight uniformity.



Source: Hy-Line International, Technical Update: Growing Management of Commercial Pullets

Impact of Inflammation on Performance

Inflammation is an expensive physiological process that leads to a reduction in energy intake as a consequence of depressed feed intake (anorexia), and requires significant energy investment in immune cell activity, hyperemia, and tissue repair.

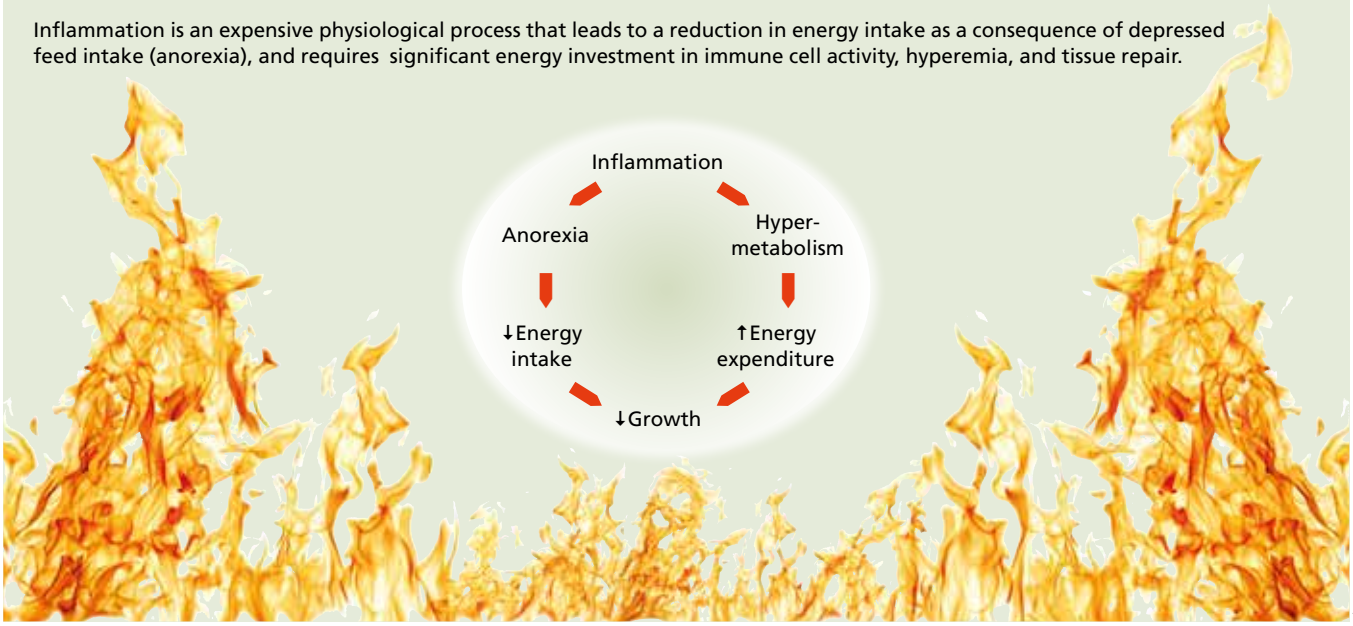


Photo: DrPAS

Phytogenic feed additives, organic acids and probiotics are able to optimize nutrient digestion and absorption, reduce pathogenic load in the intestine, modulate the immune response, and improve gastrointestinal integrity.

can cause health issues not only for the animal ingesting the contaminated feed, but also humans who may come in contact with products from those infected animals. Feed can become contaminated by pathogens during harvest, handling processes, transportation, processing, and storage. Once ingested, bacterial pathogens can gain access to the gastrointestinal tract and cause tremendous investment of metabolic energy and loss of performance. For many years, science has shown that organic acids can reduce bacterial load in animal feed. The mechanisms by which organic acids exert their beneficial effects include their ability to disrupt intracellular pH regulation, thus causing cell death, reduce intestinal pH, creating an environment unsuitable for pathogenic growth, and enhance digestive enzyme activity. Through these mechanisms, organic acids reduce pathogenic burden in the intestine and promote growth and improved performance in birds.

Costs of Inflammation

Intestinal health is fundamental to achieving and maintaining ideal body weight. Intestinal health may be disrupted by several situations such as pathogenic challenge, poor quality feed ingredients, and environmental stressors. These insults may trigger intestinal inflammation, which results in expensive costs in the physiological economy. When challenged with inflammatory processes, the body has less energy to spend because of lowered energy intake due to anorexia; on the other hand, energy expenditure is higher because of the increased metabolic rate caused by inflammation. Fortunately, nature offers some tools that are able to counteract the negative effects of inflammation such as phytogenic feed additives and probiotics.

Summary

Effective digestion, absorption, and investment of nutrients leads to the achievement of target pullet body weight and increased flock uniformity. Optimal production onset, peak, and persistency will occur only in pullets with ideal and uniform body weights. Furthermore, appropriate body structure and physiology lead to the production of more marketable eggs. Overall, these features ultimately determine the production cycle profitability.

Phytogenic feed additives, organic acids, and probiotics are able to optimize nutrient digestion and absorption, reduce pathogenic load in the intestine, modulate the immune response, and improve gastrointestinal integrity. Thus, these novel feed additives may allow the reallocation of resources from immunological responses against insult towards anatomical development and ideal body weight in pullets.

Cut & Keep Checklist

What's Wrong with My Birds?
Part 9: Lameness conditions (bacterial pathogens)

In 50 years, broiler growth rates have increased dramatically due to intense genetic selection and enhanced nutritional programs. Fast growth places great demands on birds' musculoskeletal systems, which can result in impaired locomotion and lameness. Lameness reduces animal well-being and has severe economic consequences from poor growth, increased culling and mortality, and increased carcase condemnation and downgrading at slaughter.

Lameness is often a multifactorial condition. Understanding the various causes can help producers identify areas for improvement and develop effective strategies to reduce the incidence of lameness in their flocks. Conditions responsible for lameness can be of infectious or non-infectious origin.
This table focuses on lameness conditions caused by bacterial pathogens and suggests solutions that can help prevent or alleviate lameness caused by these conditions.

Condition	Corrective action
Bacterial Chondronecrosis with Osteomyelitis (BCO)	
• **Etiology**: *Enterococcus cecorum*, *Streptococcus* spp., *Staphylococcus* spp, *E. coli* • **Symptoms**: Bird will be sitting on its breast/keel, with the legs directed forward, use of wings for walking support and hip flexion • **Lesions**: Necrotic degeneration and microbial infection, primarily within the proximal heads of the femur and tibia	• **Prevention**: Improve gut integrity by feeding multi-strain poultry-specific live probiotic • **Treatment**: Antibiotics depending on severity, but mostly birds are euthanised
Vertebral Osteomyelitis/Spondylitis/Spondylopathy/Spondylolisthesis/Kinkyback	
• **Etiology**: *Enterococcus cecorum*, *Staphylococcus* spp., *E. coli* • **Symptoms**: Typically starts from day 22, bird will be sitting on its breast/keel, with the legs directed forward, posterior paralysis due to spinal cord compression • **Lesions**: Abscess and/or necrosis in T4-T7 vertebrae, dorsal buckling of spinal cord (kyphosis), interstitial oedema, atrophy, degeneration of muscle fibres	• **Prevention**: Improve gut integrity by feeding multi-strain poultry-specific live probiotic • **Treatment**: Antibiotics depending on severity, but mostly birds are euthanised
Bumble Foot	
• **Etiology**: *Staphylococcus* spp. • **Symptoms**: Swelling above the hock and around the hocks and feet. • **Lesions**: Abscess on hock joint, infected joints may have clear exudate with fibrin clots	• **Prevention**: Improve gut integrity by feeding multi-strain poultry-specific live probiotic • **Treatment**: Antibiotics
Fowl Cholera	
• **Etiology**: *Pasteurella multocida* • **Symptoms**: Swollen hock joints, swollen wattles and comb, greenish diarrhoea • **Lesions**: Necrotic foci on liver, petechiae in the epicardial fatty tissues	• **Prevention**: Vaccines only if endemic • **Treatment**: Antibiotics
Osteomyelitis Complex	
• **Etiology**: Bacterial, but no specific pathogen has been identified • **Symptoms**: None • **Lesions**: Green discoloration of liver, inflammatory lesions in bones and joints	• **Prevention**: Improve gut integrity by feeding multi-strain poultry-specific live probiotic • Only identified at slaughter
Bacterial arthritis/Airsacculitis (MS)	
• **Etiology**: *Enterococcus faecalis*, *Mycoplasma synoviae* • **Symptoms**: Ruffled feathers, swollen hock joints and feet, tbilaterally asymmetrical legs • **Lesions**: Joints and tendon sheaths have viscous grey to yellow exudate, caseous exudate from the lesions	• **Prevention**: Improve gut integrity by feeding multi-strain poultry-specific live probiotic • **Treatment**: Antibiotics and eradication of infected breeding stock

References are available on request

For more information, visit **www.mycotoxins.info**

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