Issue 27 • Poultry
A magazine of Biomin®

Science & Solutions

Going Antibiotic-Free

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Photo: Palto

Objective: Growth Promotion

Photo: fotostorm

What's Wrong with My Birds?

Part 6: Feathering

Editorial

Challenges: Sustainable Production for an Antibiotic-Free System

As the global population increases, a substantially higher demand for food is expected. The poultry industry, being among the fastest growing markets in terms of production, has the potential to become the principal food source for animal protein.

However, the industry will face challenges regarding how to sustain productivity and performance with the pressure of reducing antibiotic dependency. We all know that foods from animal origin are considered vehicles of food-borne diseases in humans. Antibiotics and AGPs were used to treat and prevent a disease, for growth promotion and to improve performance. Concerns over these practices have mounted. Antibiotic residues in meat. Potential threats to humans. Low level antibiotic resulting in microflora alteration or even causing disease. The possible emergence of resistant strains of bacteria (superbugs) undermining the efficacy of antibiotic therapies in human medicine.

With the increasing consumer demand for antibiotic-free meat, timely natural approaches can be considered to replace antibiotics/AGP in the production. BIOMIN offers a range of innovative, natural feed additives, including synbiotic and phytogenic feed additives, that are proven to control enteric pathogens, support performance and maintain gut health.

We hope that you find this issue of **Science&Solutions** informative to your thinking about strategies on how to produce meat in an antibiotic-free system, and how to overcome challenges and problems you face in the field.

Finally, this issue brings the sixth part of our series on differential diagnosis covering feathering.

Happy reading!

Randy PAYAWAL
Technical Manager, Poultry

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Science & Solutions is a monthly publication of BIOMIN Holding GmbH, distributed free-of-charge to our customers and partners. Each issue of **Science & Solutions** presents topics on the most current scientific insights in animal nutrition and health with a focus on one species (aquaculture, poultry, swine or ruminant) per issue.
ISSN: 2309-5954

For a digital copy and details, visit: http://magazine.biomin.net
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Publisher:	BIOMIN Holding GmbH Erber Campus 1, 3131 Getzersdorf, Austria Tel: +43 2782 8030 www.biomin.net

Printed in Austria by: Johann Sandler GesmbH & Co KG
Printed on eco-friendly paper: Austrian Ecolabel (Österreichisches Umweltzeichen)

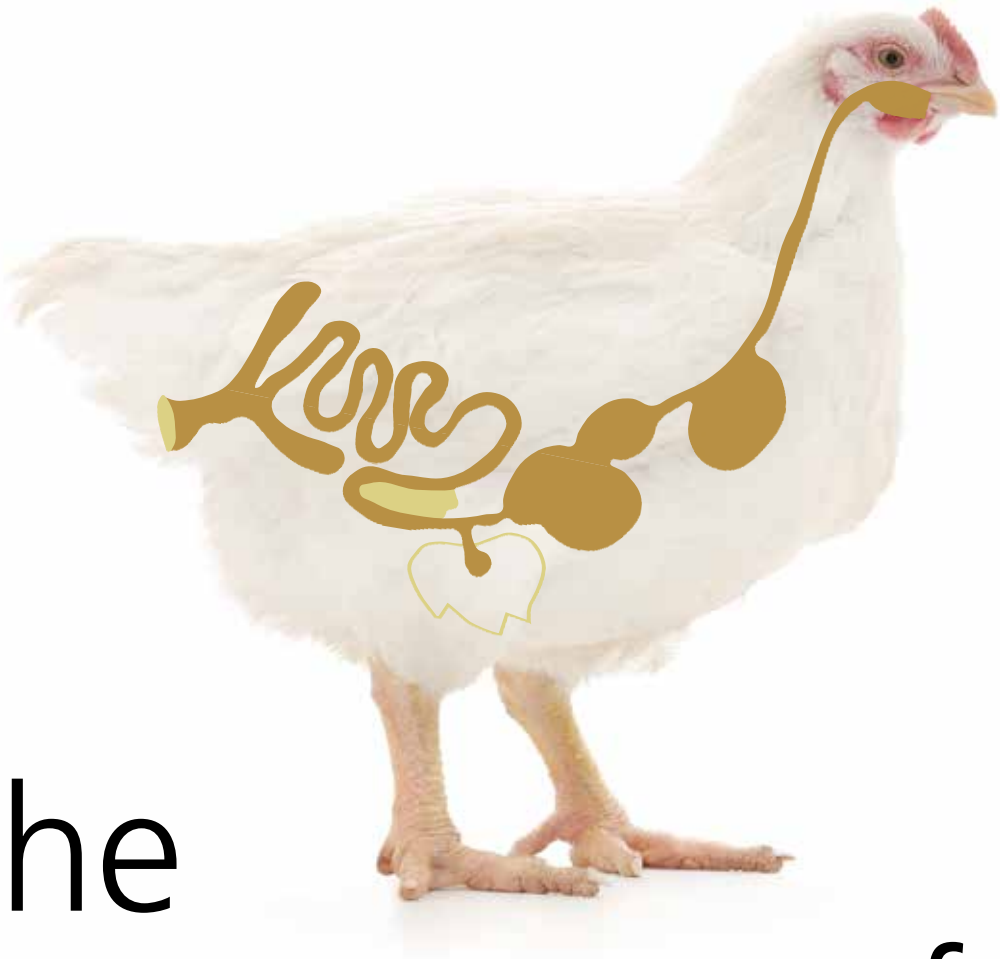


Photo: Stepanyda

The Importance of Gut Health in Antibiotic-Free Production

By **Chasity Pender**, Poultry Technical Manager

Poultry producers face many challenges as they increase the number of flocks managed without antibiotics. Sound management practices and natural feed additives that support gut health will help producers manage the transition and protect flocks.

As consumer and regulatory opinions have evolved over the last several years, poultry producers are increasing the number of flocks raised without antibiotics. While dozens of countries have already banned the use of antibiotic growth promoters, many places where their use is not banned have seen a surge in demand for antibiotic-free products. The primary challenge that producers face in implementing antibiotic-free programs is to maintain intestinal health in order to prevent necrotic enteritis, one of the world's most common and financially crippling poultry diseases with mortality rates of up to 50%, without the use of in-feed medications.

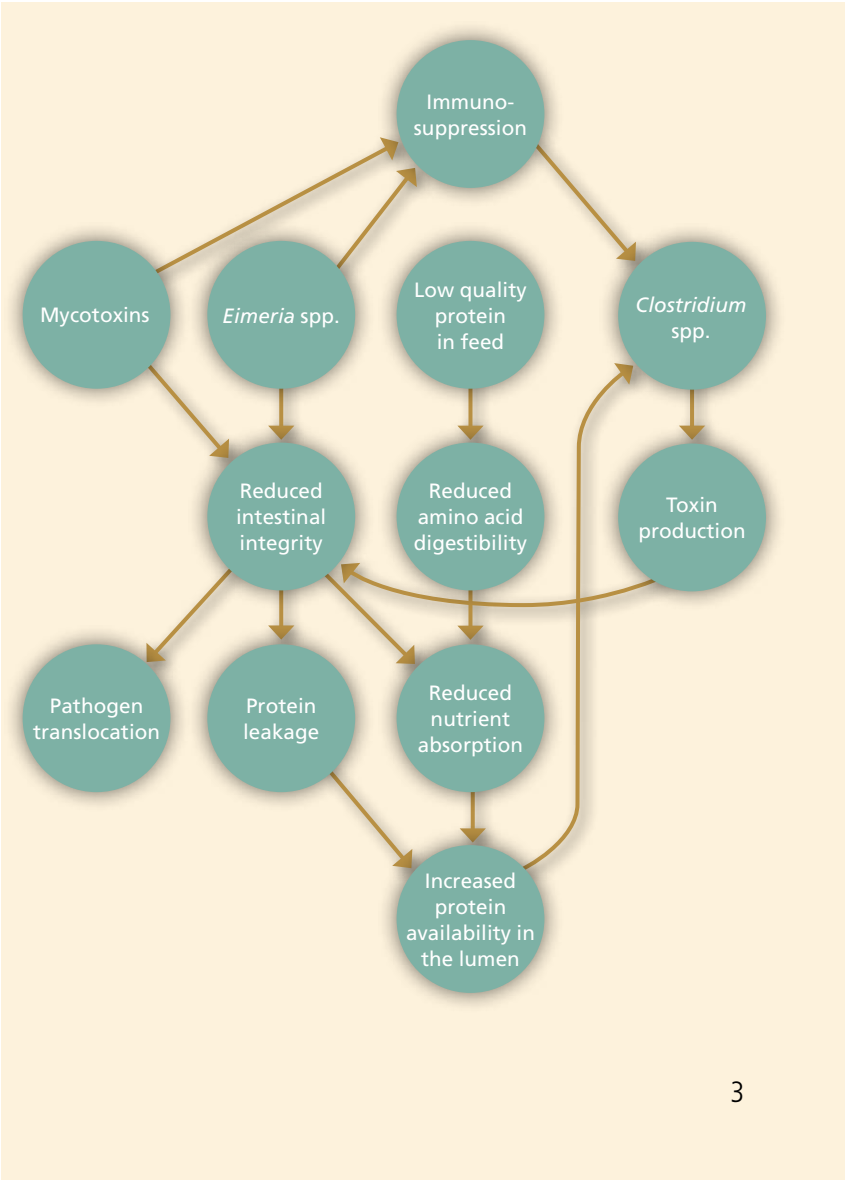
Less tools in the toolbox

Standard antibiotic-free (ABF) programs prohibit the use of several antibacterial agents, including antibiotic growth promoters, therapeutic antibiotics, and ionophores. **Antibiotic growth promoters**, or AGPs, are fed continuously at low (sub-therapeutic) levels to improve performance and flock uniformity, reduce bacterial infections and sub-clinical challenges, and improve flock health. **Therapeutic antibiotics** are used to treat bacterial diseases by impeding bacterial growth, provided they are used at recommended levels and the microorganism is not resistant. Treatment of clinical outbreaks shortens the duration of disease and reduces the spread of bacteria, resulting in reduced mortality. Lastly, **ionophores** are a class of antibiotics used solely for the purpose of preventing coccidiosis: a well-known predisposing factor for necrotic enteritis.

Making the shift

Eliminating these tools in ABF programs brings legitimate concerns for producers regarding performance, flock uniformity, and disease incidence –particularly necrotic enteritis and other bacterial pathogens. Furthermore, since flocks treated with an antibiotic must be removed from the program, hesitance to treat birds and compromise their antibiotic-free status could lead to health and welfare issues and increased mortality due to disease. Several factors can have a considerable impact on the proliferation of *Clostridium perfringens* and the successful shift to antibiotic-free production, including management practices, nutritional factors, coccidiosis, and mycotoxin contamination (*Figure 1*).

Figure 1. Factors influencing the development of necrotic enteritis.



The primary challenge that producers face in implementing antibiotic-free programs is to maintain intestinal health in order to prevent necrotic enteritis

Management practices

The biggest aspect to consider is the environmental bacterial load. A number of factors are known to increase the risk of bacterial challenges, including attenuated breeder health, improper hatchery and egg sanitation, reduced house down-time, increased stocking density, poor litter management, and contamination through service personnel, visitors, and vehicle traffic.

Nutritional factors

Diet constitutes a key risk factor having a strong impact on the incidence of necrotic enteritis in broiler chickens. Indigestible dietary protein, such as that found in animal proteins like meat and bone meal or fish meal, cannot be digested and absorbed in the upper part of the intestinal tract.

Instead, protein builds up in the lower portion of the intestinal tract which can then act as a substrate for the gut microbiota. The fermentation of protein produces unfavorable by-products such as amines and ammonia, increasing intestinal pH and encouraging the proliferation of pathogenic bacteria.

Coccidiosis control

Coccidial infection, resulting either from natural disease outbreak or from introduction at low levels through live coccidiosis vaccination, can damage the intestinal epithelium, allowing the leakage of plasma proteins into the intestinal lumen –a rich nutrient substrate that *C. perfringens* can exploit for proliferation and toxin production. This can reduce performance and predispose birds to necrotic enteritis.

By removing ionophores, coccidiosis management must rely on non-antibiotic coccidiostats, or live coccidiosis vaccines, or more likely, a rotation between the two. Unfortunately, many coccidiostats can build coccidial resistance and, unlike ionophores, coccidiostats do not have antibiotic properties.

Photo: decade3d

Clostridium perfringens

Mycotoxin contamination

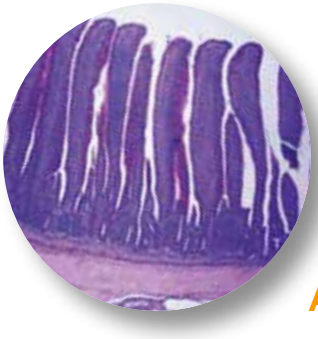
Mycotoxins—toxic fungal metabolites produced by common molds found in many components of poultry diets—can directly reduce gut integrity, thus leading to decreased absorption and digestion of dietary nutrients and increased intestinal barrier permeability. Reduced nutrient uptake and leakage of plasma proteins into the lumen due to this breach results in increased protein concentration in the intestinal lumen, providing a substrate for *C. perfringens* proliferation. Mycotoxins also adversely affect immunity and have a strong correlation with enteric infections.

Gut health management solutions

Sound management practices will help limit exposing birds to conditions where *C. perfringens* can easily gain a foothold (*Table 1*). Breeder health and proper hatchery and egg sanitation needs to be monitored and sustained to prevent bacterial contamination in the hatchery. Increased down-time allows bacterial populations to diminish between flocks and prevent carryover of bacteria from flock to flock. Proper litter management and reduced stocking density will also help alleviate the risk of bacterial challenges and decrease shedding of coccidial oocysts by reducing litter moisture. Furthermore, establishing and maintaining effective biosecurity measures regarding personnel sanitation, visitors, and vehicle traffic are essential in preventing contamination from outside sources.

The immediate post-hatch period is a critical time for the development of a chick's intestinal tract. The changes

Chasity Pender
Poultry Technical Manager



Achieving good gut health will help producers manage the transition to ABF production and protect flocks

Table 1. Gut health checklist.

	Factor	Corrective action
Management	Hatchery contamination	Maintain breeder health and proper hatchery and egg sanitation
	Reduced house down-time	Increase down-time between flocks
	Increased stocking density	Reduce stocking density and establish an adequate litter management strategy
	Poor litter management	
	Contamination from outside sources	Implement effective biosecurity plan regarding personnel sanitation, farm access, and traffic control
Development	Insufficient microbial gut colonization	Apply PoultryStar® at correct dosage level starting in the hatchery
Nutrition	Indigestible (animal) protein	Switch to an all-vegetable diet
		Apply Digestarom® at correct dosage level
		Supplement with exogenous proteolytic enzymes
Pathogens	Coccidiosis	Rotation of non-antibiotic coccidiostats and live coccidiosis vaccines Apply PoultryStar® and/or Digestarom® at correct dosage level
Mycotoxins	Mycotoxin contamination of feed	Monitor feed and apply Mycofix® at correct dosage level

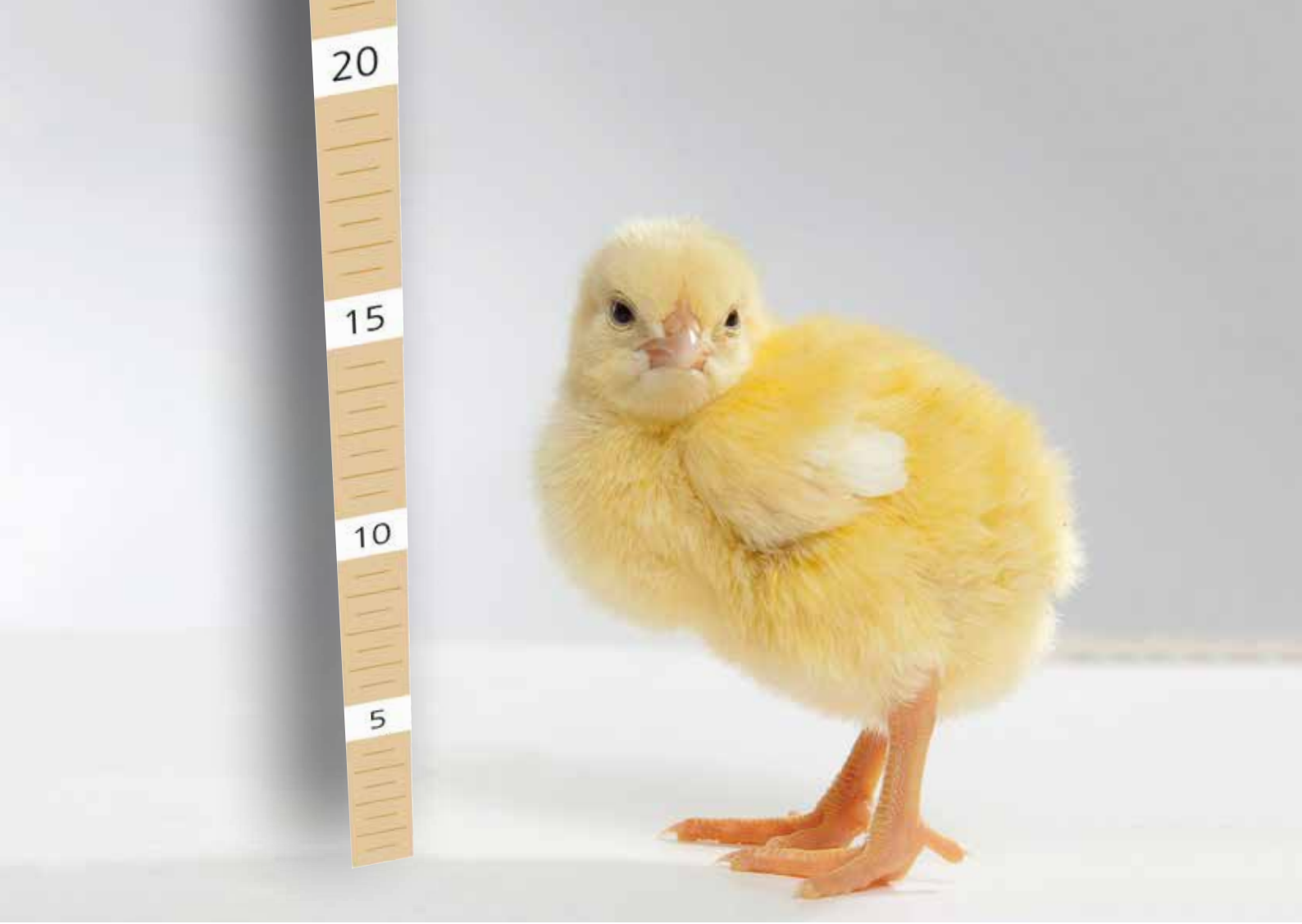
occurring during this period depend entirely upon appropriate microbial colonization. Application of probiotics in the hatchery provides an ideal opportunity for beneficial bacteria to colonize the digestive tract before chicks are exposed to potentially pathogenic bacteria and fungi in the broiler house, aiding the development of the digestive tract and helping to protect against enteric infections. One solution to reduce bacterial growth and activity is to limit their access to protein, a key nutrient source. Many producers switch to an all-vegetable diet, for example. Increasing digestibility of nutrients so they are absorbed and utilized by the bird instead of the microbiota is another option. Some phytogenic feed additives are capable of increasing endogenous digestive enzyme activity so the bird is better able to break down and absorb protein and other nutrients making them unavailable to the microbiota. Supplementation of exogenous proteolytic enzymes is another method that can help break down excess protein.

Probiotics and phytogenic feed additives, with or without the use of coccidiostats or vaccines, can help alleviate the negative effects of coccidial infection. They have been shown to reduce oocyst shedding, severity of intestinal lesions, and adverse effects on performance, demonstrating their status as a promising 'anticoccidial.'

Mycotoxin contamination also poses a serious threat to livestock and poultry production globally. Given the numerous harmful effects of mycotoxins, a proper mycotoxin management program is essential to protect intestinal integrity.

Conclusion

The main challenges producers face as they transition to ABF systems hinge upon intestinal health and prevention of coccidiosis and necrotic enteritis. Switching to an ABF program requires a paradigm shift: there is no single solution that can act as a substitute for antibiotics. Numerous adjustments are necessary to succeed and a solid gut health program needs to be an essential component.



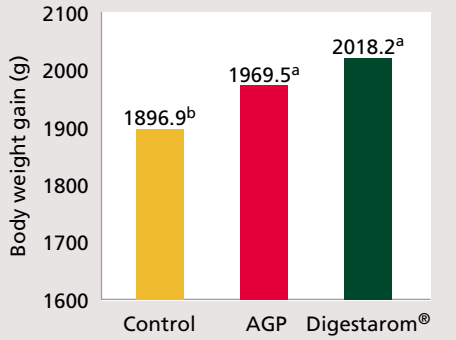
Objective: Growth Promotion

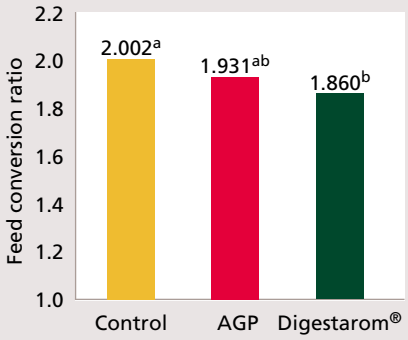
By **Carina Schieder**, Product Manager Phytogenics, **Attila Kovács**, Global Product Line Manager and **Wael Abdelrahman**, Technical Consultant

The trend towards the reduction or elimination of antibiotic growth promoters (AGPs) in poultry production continues, though at different speeds, across the globe. The search is on for the next generation of growth promoters that deliver consistent production improvements. Finding the right solution means revising management practices and tailoring objectives for feed additive application.

Antibiotics are one of the crucial medical discoveries of the 20th century and still have significance for treating humans and animals in the 21st century. Risks of antibiotic resistance and antibiotic residues in products of animal origin and in the environment have raised health concerns among the public and scientific community about the risk of so-called 'superbugs'. The banning of AGPs has had a negative impact on animal performance in some countries. The next generation of growth promoters includes novel, natural strategies tailored to mimic growth promotional effects of AGPs and even have additional benefits, such as the promotion of beneficial gut bacteria, meat and egg quality improvement or reduced environmental emissions.

Figure 1. Phytogenic feed additive delivers best broiler performance in trial up to 39 days of age.





a, b indicate statistically significant differences

Source: Murugesan et al.*, 2015*

Aiming for performance

Plant-derived substances have been used for centuries for the purposes of flavoring as well for their beneficial effect on the organism (biological effect). Digestarom®, a selected and standardized blend of herbs, spices, essential oils and extracts, has shown to be able to achieve comparable results in animal production as with applying selected AGPs.

Scientific findings demonstrate that a phytogenic feed additive (PFA) such as Digestarom® can improve broiler performance, delivering similar or better results compared to AGPs. In one study, broilers receiving a Digestarom® supplemented diet recorded higher body weight gain and improved feed conversion compared to both the control and AGP groups (*Figure 1*).

Three keys to growth promotion

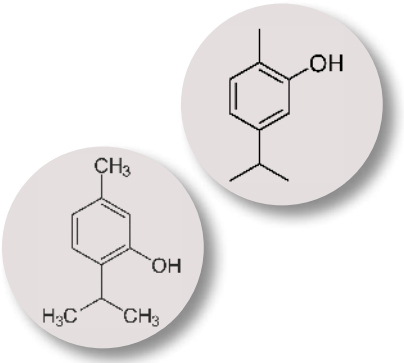
The formulation of Digestarom®, a phytogenic feed additive, contains three major modules that target: (1) appetizing and digestive secretion enhancement, (2) gut microbiota modulation and (3) gut protection. For the first module, digestive secretion enhancing effects support nitrogen retention and improved digestibility that contribute to better feed efficiency. The second module shifts the intestinal microbiota balance towards more favorable bacteria. The third module decreases the inflammatory response in animals, preserving that otherwise spent energy for growth, and increases the anti-oxidant status of gastrointestinal cells. Combined, these modules deliver not just performance enhancement, but also additional benefits, such as the promotion of beneficial gut bacteria, meat and egg quality improvement or reduced environmental emissions.

The mode of action of AGPs has been discussed considerably in literature. Aside from the antimicrobial effect, several hypotheses were proposed to explain the resulting growth enhancement. Explanations included an interference with the microbial toxin production or increased nutrient absorption due to changes in the intestine. Studies have also shown that some but not all AGPs are involved in the inhibition of the inflammatory response.

Given that feed additives and antibiotic growth promoters only partly rely upon identical modes of action, it comes as no surprise that their effects can also vary. Selecting the appropriate management goal tailored to specific farm conditions can help to achieve the desired outcome. Farm management plays a crucial role in the achievement of positive results.

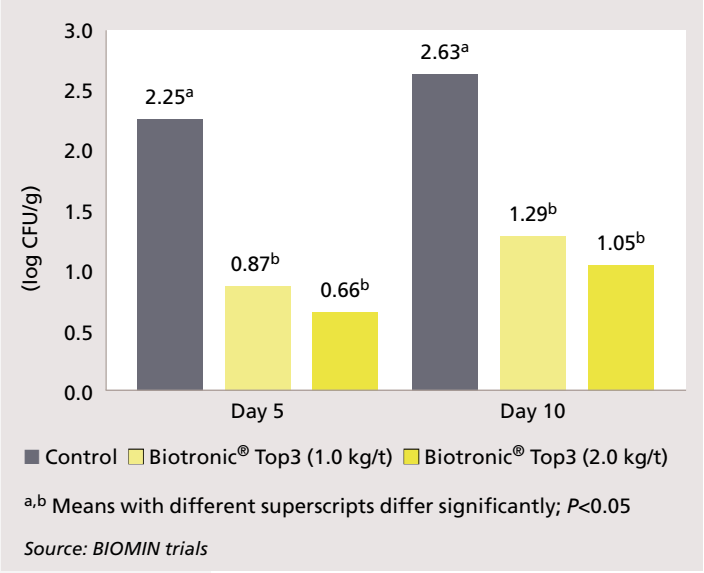
Phytogenics counteract gram-positive bacteria

Phenolic compounds (a group which includes e.g. thymol and carvacrol; major active compound in thyme and oregano) within essential oils and other essential oil



Phenolic compounds including thymol and carvacrol, major active compound in thyme and oregano, have been shown to have antimicrobial properties, mainly against gram-positive bacteria.

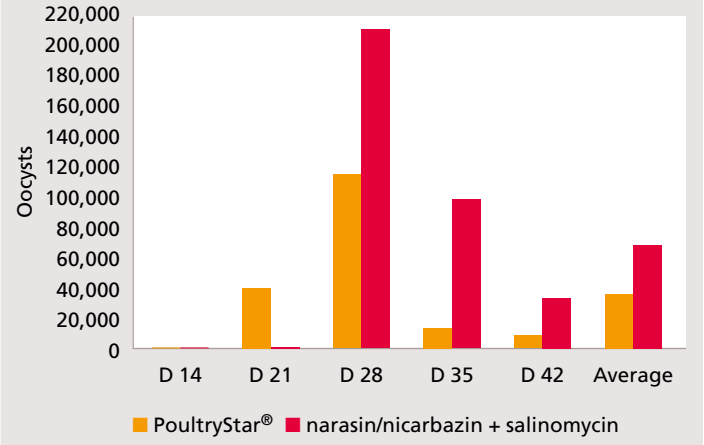
Figure 2. S. *enteritidis* counts in the cecal content of broilers on day 5 and day 10 post infection.



a,b Means with different superscripts differ significantly; *P*<0.05

Source: BIOMIN trials

Figure 3. Weekly oocysts shedding per gram of dropping in Ross 308 broilers. On day 2 all birds received an artificial coccidiosis infection.



Source: BIOMIN field trial, Belgium 2014.

derivatives have all been shown to have antimicrobial properties, though these tend to target gram-positive bacteria. Gram-negative bacteria, however, possess an outer cell membrane that limit the antimicrobial effect of phytogenic constituents. A permeabilizing substance that weakens this outer membrane can allow antimicrobial agents, including phytochemical and a blend of organic acids, to act effectively to reduce the Gram-negative bacterial load.

Figure 2 illustrates the effectiveness of the Biotronic® Top product line, which combines selected organic acids and their salts with a phytochemical and the unique Biomin® Permeabilizing Complex, in combatting gram-negative bacteria such as *Salmonella enteritidis* in broilers. (*See also "Is Zero Salmonella Possible?" in* **Science & Solutions** *Issue 4*). Besides the reduction of the pathogenic bacteria, Biotronic® products are also known to increase the number of beneficial bacteria in the intestinal tract of poultry. Overall, a healthy digestive tract will lead to a better performance of the animals.

Coccidioisis challenge

Probiotics and phytogenic feed additives, with or without the use of coccidiostats or vaccines, can help alleviate the negative effects of coccidia infection. Both, but particularly probiotics, have shown to be a novel strategy to manage coccidiosis in poultry. The host-specific multispecies synbiotic, PoultryStar®, reduces intestinal lesions, oocyst count in dropping and mortality which are positively reflected on performance (*Figure 3*). Hence it is able to alleviate the impact of internal parasite infection on chickens by improving gut integrity, reducing sporozoite invasion into the intestinal epithelium and modulating the bird's immune response.

Conclusion

The reduction of sub therapeutic antibiotic use is set to continue. Numerous trials and studies indicate the effectiveness of Digestarom® in promoting growth and feed efficiency. In the case of a Gram-negative bacteria challenge and growth promoting effect, Biotronic® has demonstrated effectiveness in both scientific and field trials. PoultryStar® has demonstrated high efficacy in the competitive exclusion of pathogenic bacteria. A more granular framework that allows for the distinction between health and production efficiency — two closely related objectives — can help to guide the application of feed additives that deliver the greatest benefit to birds and producers.

Cut & Keep Checklist

What's wrong with my birds? Part 6: Impaired feathering/feather loss

In poultry, feathers serve important roles in terms of protection and insulation of the body. While moulting, or renovation of older feathers by new ones, is a natural process occurring in mature layers upon completion of a laying cycle (which itself can be influenced by many factors), feather loss or impaired feathering may be indicative of other problems in the farm.

Feather-related problems in poultry can be roughly divided into two groups, either:

- They are not properly developed (linked to feather formation) which is often related to nutrition or the presence of mycotoxins.
- They are pulled off by birds (feather pecking), which is a management-related issue.

In each case it is critical to understand the foundation of the problem so that it can be properly solved (see table right).

Stressful conditions in the barn, especially during brooding, such as heat, cold and existence of air currents, amongst others, can result in feather loss and poor feather quality in the birds. In this case, it is crucial that the behavior and interaction of animals is observed. Often, feather pecking and pulling can also be triggered by inadequate intake of nutrients. Due to the high protein content in feathers, higher protein levels in feed may encourage faster feather development and shedding.

Imbalance of amino acids in the feed, particularly sulphur amino acids cysteine and methionine, may cause feather abnormalities and/or rough feather appearance.

The dermotoxic effect of trichothecene mycotoxins, such as T-2 toxin and others, may also contribute to low feather quality along with other negative effects, such as oral lesions and decreased performance.

Overall, excessive feather loss or impaired feathering adversely affects feed conversion as birds have to allocate extra energy from the diet to compensate for heat loss.

As such, management, housing and nutrition should be optimized to reduce this occurrence. In terms of mycotoxins, prevention can be undertaken through the use of a proper mycotoxin risk management tool which adsorbs and/or biotransforms mycotoxins, thus eliminating their toxic effects for the animals, while guaranteeing liver and immune protection.

Check list	Corrective action
Potential cause: MANAGEMENT: Temperature of barn	
• Temperature of barn • Humidity of barn • Ventilation system	• Improve management of barn • Correct temperature, ventilation rate and humidity according to management manuals
Potential cause: MYCOTOXINS: T-2 toxin (T-2)/Deoxynivalenol (DON)/ Other trichothecenes	
• Positive for trichothecenes in raw materials (ELISA) or feed (HPLC) • Raw materials originating from supplier/ region with a history of trichothecenes contamination • Histopathology: Check other target organs for trichothecenes (ex. liver, for hepatic vacuolisation) • Decline in overall flock performance	• Check the average contamination levels • Use Mycofix® at the correct dosage level • Avoid contamination of feed bins or feed/water lines by stale, wet or mouldy feed
Potential cause: NUTRITION: Amino acid (AA) deficiency/unbalance	
• Level of Total Sulphur Amino Acids (TSAA) in diet • Ratio TSAA/Lys/Arg/Thr • AA scale at feed mill	• Increase level of synthetic Amino Acids (AA) in low digestible diets (high levels of by-products)
Potential cause: MANAGEMENT: Red mites	
• Presence of red mites in the barn during the night.	• Flame cages during withdrawal period • Clean egg belts during withdrawal period. • Increase biosecurity level • Use plastic egg belts whenever possible
Note: Pathogens were excluded from the table due to space constraints but may be important to consider.	

References are available on request

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

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