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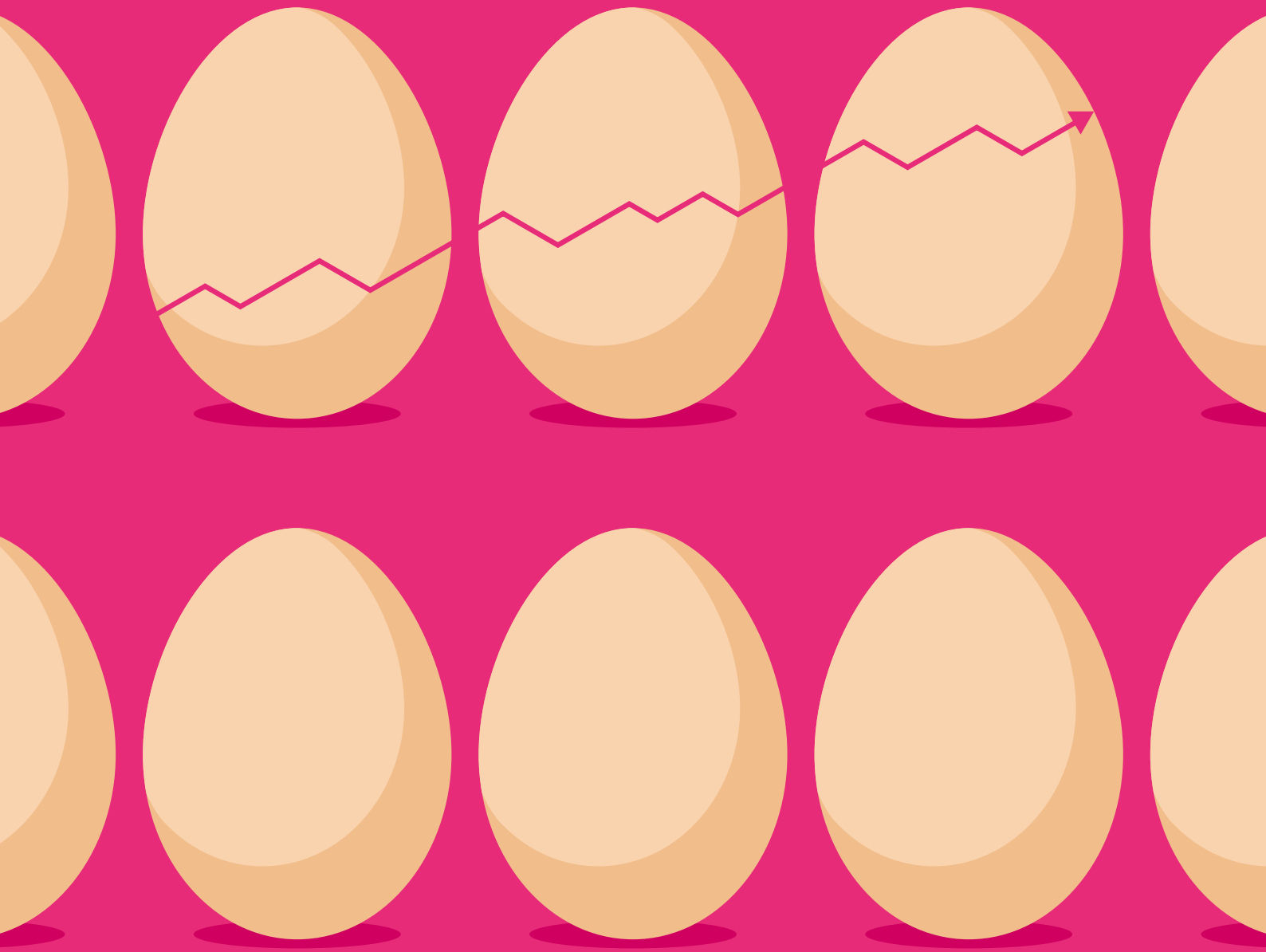
Keeping you naturally informed | Issue 59 | Poultry



Profitable egg production

How are you managing the recent poultry industry challenges?

The poultry industry is continuously evolving, adding extra pressure to poultry producers. It is important to stay naturally ahead in order to respond to challenges.

Lately in the USA and Europe, there has been increasing demand from the market for eggs produced by layers kept in welfare-friendly environments. The layer industry quickly embraced this new challenge, switching from cage to cage-free systems. This has led to a new way of keeping birds by altering the management, health and nutrition strategies adopted on the farm. Another challenge has been the extreme weather conditions seen this summer in the northern hemisphere with temperatures of over 30°C in the United Kingdom and Scandinavian Peninsula. High environmental temperatures are among the most important causes of poor performance in the poultry industry. Birds, when exposed to extreme conditions, are not able to establish an optimal thermic balance, causing heat stress.

A continual challenge is the reduction of antibiotics. In this issue of Science & Solutions, we discuss how to reduce the usage of antibiotics for prophylaxis and metaphylaxis or total replacement of antibiotic growth promoters. The first article shows the effect of a permeabilizing complex combined with a mix of organic acids for better management of Gram-negative pathogens.

In this issue, we also highlight the benefits of using phytogenics, synbiotics and enhanced organic acids to maintain good health status and high production performance levels of birds, especially in challenging situations such as heat stress, and during periods of adaptation to new environments (i.e. moving to a cage-free system).

Enjoy reading this issue of Science & Solutions, keeping you naturally informed.

Francesco Castellone MSc, DVM, MRCVS
Technical Sales Manager Poultry

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magazine@biomin.net

Editors: Ryan Hines, Caroline Noonan
Contributors: Francesco Castellone MSc, DVM, MRCVS, Antonia Tacconi PhD, Lesley Nerneberg MSc, Eduardo A. Vicuña S. DVM MSc.
Marketing: Herbert Kneissl, Karin Nährer
Graphics: GraphX ERBER AG
Research: Franz Waxenecker, Ursula Hofstetter
Publisher: BIOMIN Holding GmbH
Erber Campus, 3131 Getzersdorf, Austria
Tel: +43 2782 8030
www.biomin.net

New Scientific Results on Natural Growth Promotion in Broilers vs. An Antibiotic Growth Promoter

Antonia Tacconi PhD
Global Product Line Manager Acids

The reduced use of antibiotics for prophylaxis and metaphylaxis or total replacement of antibiotic growth promoters is one of the main topics in animal production. In a press release issued on 19 June 2018, the European Parliament informally agreed new rules on more responsible ways to produce, sell and use medicated animal feed to tackle the spread of antimicrobial resistance. Antonia Tacconi explains how Biotronic® Top3, an enhanced organic acid, positively influences broiler production in the absence of antibiotics.

Reducing the use of antibiotics, as well as replacing antibiotic growth promoters, is a very important objective. To implement and succeed with such an intention, it is mandatory to consider all of the main factors that can influence the performance and health of the animals (e.g. proper management, vaccination protocols, water quality and the correct nutritional formulation).

IN BRIEF

- Antibiotic use for the prevention of disease will likely be banned as a result of increasing consumer demands and regulatory pressure.
- Simply removing antibiotics from poultry diets will open up a performance gap caused by challenges from pathogens.
- Biotronic® Top3, an enhanced organic acid, bridges the performance gap by improving the digestibility of the feed and indirectly promoting gut health.

There are many alternatives to antibiotics available on the market. Most alternatives target gut health and function, and immunity as well as modulation of gut microbiota and inhibition of pathogen proliferation. With such a range, it can be very difficult to understand their mode of action, choose, and combine the right products. The three most important types of feed additive that are integral to any program to improve gut performance are:

- Phytogenic feed additives (PFAs)
- Synbiotics
- Organic acids

PFAs enhance feed efficiency and gut protection. Synbiotic products improve immune status and help to colonize the gut with beneficial bacteria. And organic acids fight against the uncontrolled proliferation of pathogens.

Biotronic® Top3: the enhanced organic acid

The use of organic acids or single chain fatty acids (SCFA) has recently become more and more attractive, not only to improve feed hygiene by reducing feed pH and positively influencing buffer capacity, but also to support gut health.

Table 1.
Trial groups and diets

Group	Diet
Negative control (NC)	Standard feed
Positive control (PC)	Standard feed plus avilamycin at 2.5 mg/kg
Biotronic® Top3 (BTR)	Standard feed plus Biotronic® Top3 at 1 g/kg
Both products (BTPC)	Standard feed with Biotronic® Top3 at 1 g/kg and avilamycin at 2.5 mg/kg

Source: BIOMIN

Organic acids can have a direct antimicrobial effect on many pathogens (e.g. *Salmonella* spp, *E. coli*) preventing an uncontrolled proliferation of pathogenic bacteria in the gastrointestinal tract. Furthermore, SCFAs contribute to gut health indirectly by improving digestibility. This ensures proper feed digestion, meaning that less undigested feed is present in the lower part of the intestine. This undigested feed may be used as a source of energy by opportunistic bacteria to consequently outgrow the beneficial bacteria, creating intestinal dysbiosis.

The control of pathogenic bacteria is even clearer when Biotronic® Top3, an enhanced organic acid feed additive, is used. Biotronic® Top3, an innovative formulation for better management of Gram-negative pathogens, combines a Permeabilizing Complex™ (a phytogenic substance and a blend of other substances that are able to permeate the outer membrane of Gram-negative bacteria) with the beneficial effects of organic acids. This special blend ensures that the antimicrobial activity of SCFAs have an optimal effect in the animal gut.

A science-backed solution

Scientific peer-reviewed papers (Palamidi *et al.*, 2016; Palamidi and Mountzouris, 2018) demonstrated how Biotronic® Top3 added to broiler feed positively affects the key gut ecosystem elements, improving performance. In a trial carried out in cooperation with the University of Athens, Greece, the use of Biotronic® Top3 was compared to the use of avilamycin, an antibiotic often used as a growth promoter in poultry production where regulations still allow. The birds (Cobb) received a corn-soybean basal diet formulated according to a three-phase feeding regime for 42 days. The four experimental treatments are listed in *Table 1*.

The results clearly indicated that the use of Biotronic® Top3 improved nutrient digestibility and thereby performance in a similar manner to avilamycin. Although nutrient digestibility was improved in both the BTR and the BTPC groups, the same effects cannot explain both of these improvements. Analysis of many different parameters revealed differences in the mode of action of the enhanced organic acid based feed additive and the antibiotic growth promoter.

The use of avilamycin and Biotronic® Top3 had no significant effect on the concentration of total bacteria, *Bacteroides* spp., *Lactobacillus*, *E. coli*, *C. leptum* and *C. coccoides* subgroups in the ileal digesta and ileal mucosa associated bacteria. However, the use of avilamycin significantly reduced the concentration of the *Clostridium perfringens* subgroup in the ileal digesta. This is not particularly surprising, as avilamycin is known to inhibit the growth of Gram-positive bacteria. On the other hand, avilamycin did not affect either the bacterial population in the cecal digesta or the mucosa-associated bacteria in the cecum.

Biotronic® Top3 significantly increased the concentration of *C. leptum* and *C. coccoides* subgroups in the cecal digesta. These two bacteria synergize with other intestinal microbiota and ferment unabsorbed dietary carbohydrate into SCFAs, mainly butyrate and propionate. These two SCFAs are the major energy source for the colonic epithelium and profoundly influence intestinal epithelial function. Hence, by stimulating the growth of these two bacterial subgroups, Biotronic® Top3 indirectly influences gut health, having a positive impact on broiler growth performance. Confirming these positive effects was a significant increase in the BTR group of microbial glycolytic enzymes in the ileal digesta, which are associated with better starch digestibility.

A holistic approach that includes proper management, proper vaccination protocols and the correct nutritional formulation is required in order to replace antibiotic growth promoters in commercial poultry production units.

Table 2.
Performance results of the trial

	Control	Avilamycin	Avilamycin and Biotronic® Top3	Biotronic® Top3
Body Weight Gain (kg/bird)	2.161	2.333	2.381	2.283
Feed Intake (kg/bird)	4.191	4.258	4.265	4.193
FCR	1.94	1.82	1.79	1.84
Production Efficiency Index	254.3	306.5	306.3	289.0

Source: adapted from Palamidi *et al.*, 2016

Table 3.
Cost-benefit analysis of the study groups; Broiler price* = €1.15/kg; Feed price* = €0.33/kg

		Control	Avilamycin	Biotronic® Top3
Revenue from sales	€	23,737.61	26,959.45	25,616.02
Total feed cost	€	12,625.25	13,678.28	13,120.72
Revenue - feed cost	€	11,112.36	13,281.17	12,495.30
Additional net income	€		2,168.81	1,382.93
Additional net income per bird	€/bird		0.22	0.14
Return on investment	ROI		**16.89**	**7.83**
Breakeven	g/bird		**11.34**	**16.06**

*Refers to spot prices taken during the trial period which may differ from current prices
Calculations are based on 10,000 broilers per group

Source: BIOMIN

The improvement of beneficial bacteria growth as well as the promotion of better microbial enzyme activities related to the use of Biotronic® Top3 resulted in better nutrient digestibility, thus improving the performance outcome of the trial (*Table 2*). This proves that although the mode of action of enhanced organic acids differs from that of antibiotics, enhanced organic acids can be successfully used in a program that aims to reduce the use of antibiotics in animal production.

Biotronic® Top3: a profitable solution

An economical comparison between the cost of the antibiotic solution and Biotronic® Top3 shows that with the use of organic acids it is possible to reduce the gap generated when antibiotic growth promoters are removed from the diet. At an average market price of €1.15/bird, the use of Biotronic® Top3 resulted in an additional net income of €0.22/bird, with a return on investment of 7.83:1 (*Table 3*).

Conclusion

However, the simple replacement of antibiotics with feed additives is not enough. A holistic approach that includes proper management, proper vaccination protocols and the correct nutritional formulation is required when replacing antibiotic growth promoters in commercial poultry production units. The use of feed additives like Biotronic® Top3 can be a helpful tool for implementing an antibiotic-free feeding program. The product allows the antibiotic to be replaced, while maintaining good performance levels at a low to moderate breakeven point.

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Palamidi I., Paraskeuas V., Theodorou G., Breitsma R., Schatzmayr G., Theodoropoulos G., Kostas F. and Mountzouris C.K. 2016. Effects of dietary acidifier supplementation on broiler growth performance, digestive and immune function indices. *Animal Production Science* 57(2). DOI: 10.1071/AN15061

Palamidi I. and Mountzouris C.K. 2018. Diet supplementation with an organic acid based formulation affects gut microbiota and expression of gut barrier genes in broilers. Article in Press. DOI: 10.1016/j.aninu.2018.03.007

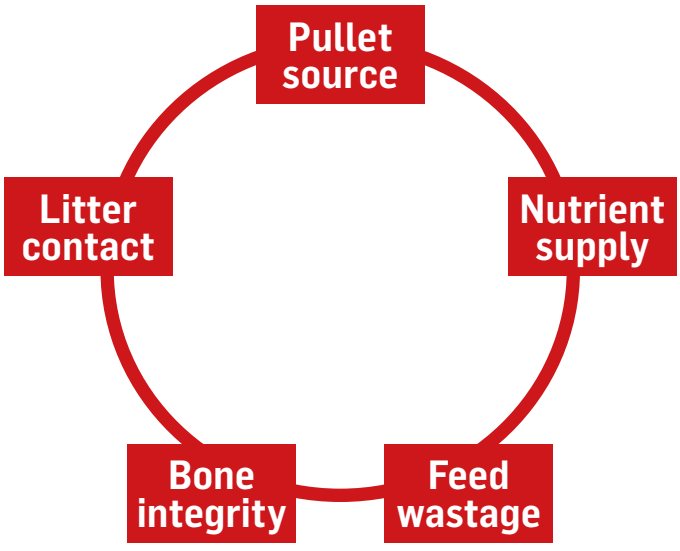
5 Tips to Increase Profits From Cage-Free Egg Production

Lesley Nernberg MSc
Regional Technical Services Manager

Egg producers can address the additional costs and new challenges of moving hens into cage-free environments by focusing on these five factors.

As birds in cage-free environments are more mobile versus those in conventional cages, their nutritional requirements are different. In addition, there is a need to alter the management, health, and nutritional strategies employed on the farm. The nutritional and health programs developed for conventional cage systems should be re-evaluated to account for the changes in bird welfare, health, and productivity associated with the cage-free environment. From experiences in North America and Europe, where cage-free systems have been widely adopted, egg producers should consider five factors (*Figure 1*) when converting to a cage-free housing system:

Figure 1.
Five factors to consider when converting to cage-free housing



Source: BIOMIN

There is a need to alter the management, health and nutritional strategies used when changing to cage-free systems.

IN BRIEF

Factor	Tip
1. Pullet source	Introduce birds to their new environment one to two weeks prior to lay.
2. Nutrient supply	Increase the amount of feed or the energy content of the diet. Maintain the correct energy-to-protein balance.
3. Feed wastage	Ensure proper feeder design. Provide less feed at more frequent intervals.
4. Bone integrity	Adjust the feed formulation to meet higher calcium requirements.
5. Litter Contact	Ensure strict biosecurity. Support gut performance through the application of novel feed additives.

Pullet source

In general, pullets may be raised in conventional cages, floor-raised, or in specifically designed aviary pullet systems (*Figure 2*). It may be desirable to ease transition from the pullet farm to the egg production facility by raising pullets in a system that resembles their future layer-house system. Although birds raised in an aviary system are more expensive, they will be better adapted to the additional movement, freedom and space afforded in the cage-free system. In this case, pullets obtained from aviary pullet systems will be more productive and the least problematic.

Figure 2.
Pullets in an aviary system

Photo used with kind permission by Maarten Hagens. 2018. Bolegg Gallery, Vencomatic.ca, Iowa, USA.

Tip #1.
Introduce birds to their new environment one to two weeks prior to lay.

Birds should be moved to cage-free systems at least one to two weeks prior to the onset of lay, no later than 17 weeks of age. This will allow birds to become familiar with their new surroundings and to adapt to the nesting systems before start of lay.

Nutrient supply

The feeding of cage-free layers will differ from that of caged laying hens so the nutrient requirements and diets provided will need to be revised accordingly. The additional movement of the birds and higher competition for feed means that more energy is utilized on a daily basis. With this increased energy expenditure, birds may require up to 10% more energy depending on their current or base level. The additional energy may be provided either as an increase in the amount of feed, or as an increase of the metabolizable energy content of the diet. Maintaining the energy-to-protein balance (digestible amino acids) also needs to be addressed to ensure achievement of body weight targets and proper frame development.

Tip #2.
Increase the amount of feed or the energy content of the diet. Maintain the correct energy-to-protein balance.

Feed wastage

When birds are removed from cages, competition for feed increases. Therefore, it is critical to have well-designed feeders to ensure feed wastage is limited. Less feed waste will help achieve more uniform body weights. It is important to provide an adequate number of feeders and the correct amount of feeder space so that all birds have free access to feed and a proper hierarchy can be established.

Flock uniformity may also be more difficult to control and manage in cage-free environments. Distributing feed across multiple locations in the barn will help to prevent overcrowding and will encourage subordinate hens to feed. Offering smaller meals at more frequent intervals may be a strategy to ensure adequate intake, resulting in the achievement of the desired uniform body weights, and reducing feed wastage.

Tip #3.
Ensure proper feeder design. Provide less feed at more frequent intervals.

Bone integrity

Cage-free laying birds that are allowed to have increased movement put more strain on their skeletal system. Bone strength will need to be monitored and optimized under these systems. It is important to examine the nutritional factors influencing bone integrity such as the level, type, and source of minerals – especially calcium and phosphorus.

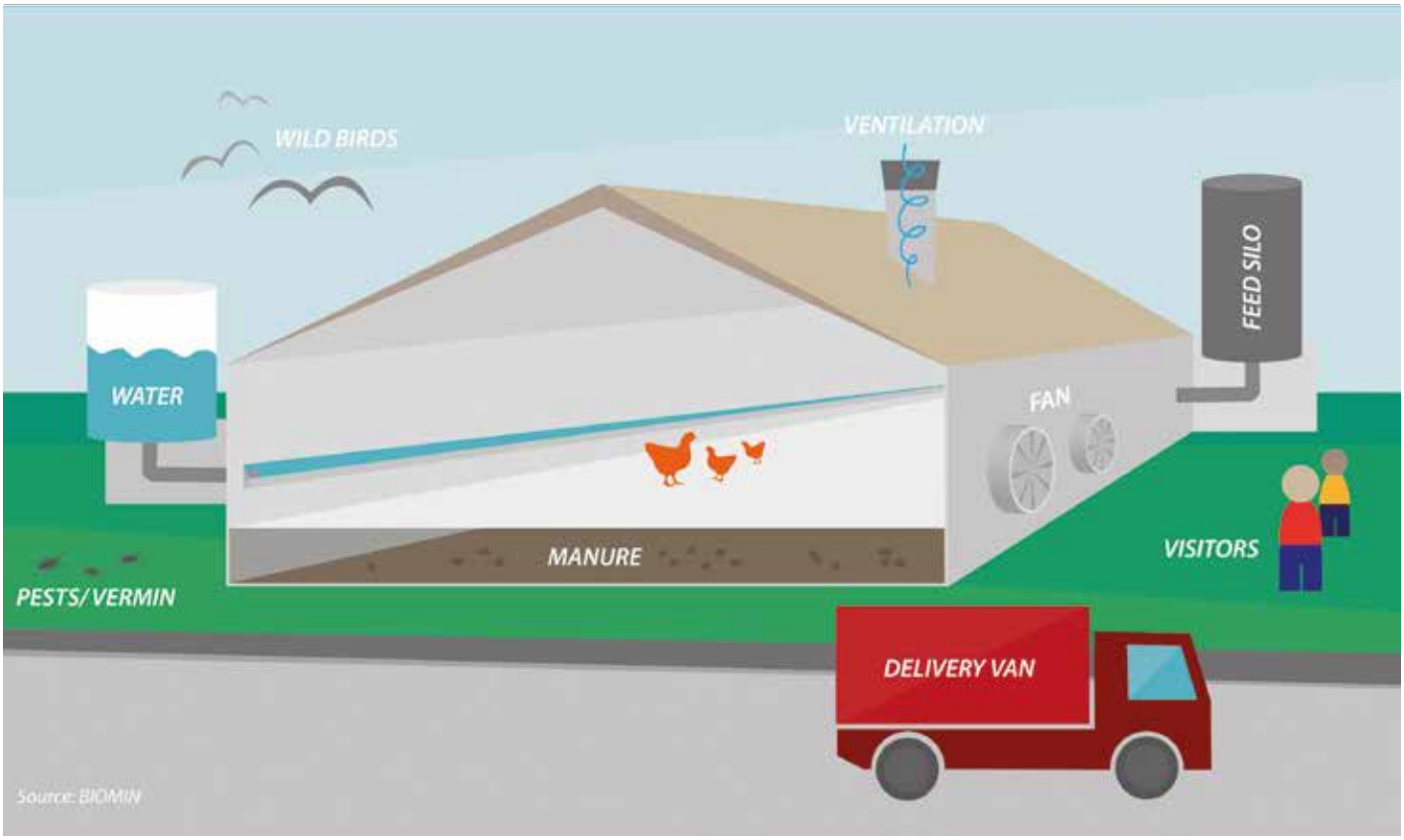
Since egg laying behavior and activity is altered in a cage-free system, there may be an increased calcium demand to consider. Limestone, oyster shells, and other calcium, phosphorus, and vitamin D sources may need to be further supplemented so that enough calcium is absorbed and available during peak egg formation. The inclusion of an enhanced acidifier such as Biotronic® Top3 and a phytogenic feed additive such as Digestarom® in the diet may also enhance calcium absorption and bone integrity.

Tip #4.
Adjust the feed formulation to meet higher calcium requirements.

Litter contact

There are many sources of contamination on poultry farms as shown in Figure 3. In cage-free systems, diseases are more easily transmitted within a flock due to increased bird movement, bird-to-bird contact, and exposure to litter. Cage-free birds will face additional health challenges as a result of being exposed to higher pathogen loads within these litter-based systems. Gut health challenges such as coccidiosis and

Figure 3.
Potential sources of contamination on poultry farms



necrotic enteritis will become more evident along with other zoonotic pathogens such as *E.coli* and *Salmonella*, posing concerns to both animal and human health.

It is important to maintain strict biosecurity measures and keep the litter dry to lower the risk of disease and other health issues. Establishing and maintaining gut health is also critical for the maintenance of bird health and performance. A tailored strategy involving acidifiers, synbiotics (combined prebiotic/probiotic additives such as PoultryStar®), and phytogenics may help in this regard, and can be considered for incorporation to the feeding program.

Tip #5.
Ensure strict biosecurity. Support gut performance through the application of novel feed additives.

Conclusion

By taking these five factors into consideration and applying these tips, you can ease the transition to cage-free housing and improve your likelihood of success. For further support, contact your local BIOMIN representative.

Reducing the Impact of Heat Stress Using Synbiotics

Eduardo A. Vicuña S. DVM MSc
Poultry Technical Manager

Heat stress negatively affects bird performance around the world. Synbiotics are an interesting tool for reducing this negative impact. Synbiotics modulate the immune response to the stress caused by high temperatures, consequently improving bird performance.

Heat stress

High environmental temperature is among the most important causes of poor performance in the poultry industry. Birds thermoregulate themselves within a certain temperature range, but when exposed to extreme conditions, their physiological mechanisms may not be able to establish an optimal thermic balance. This loss of temperature regulation is called heat stress (Lara and Rostagno, 2013).

Heat stress is the most important environmental influencer of poultry health and performance (Ayo *et al.*, 2011). Electrolytic, immunological, physiological, and anatomical changes are caused by heat stress; the extent of these changes depends on the length of exposure to high temperatures (Boddicker *et al.*, 2014), age and genetic susceptibilities (Felver-Gant *et al.*, 2012).

IN BRIEF

- High temperatures have an effect on a number of systems in broilers, including the immune system.
- When a heat-stressed animal is faced with a pathogen challenge, the immune response might not be sufficient to overcome it, allowing colonization of the gut.
- Synbiotics are a combination of prebiotics and probiotics that deliver beneficial bacteria to the gut, reducing the impact of heat stress on performance.

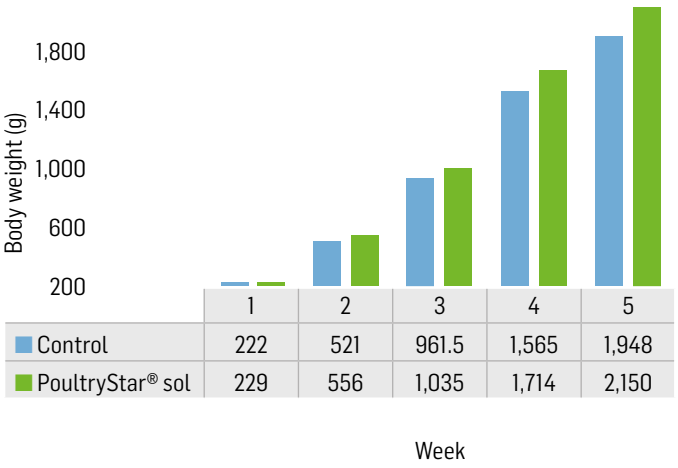
Heat stress may produce an electrolyte imbalance in poultry (Borges *et al.*, 2004) leading to poor performance (Gamba *et al.*, 2015). Heat stress has also been shown to reduce free blood calcium, a free blood mineral needed for eggshell formation (Odom *et al.*, 1986). Therefore, it is not only general physiology that is affected by this kind of stress, but also livability and meat quality in broilers (Muiruri and Harrison, 1991) as well as egg weight and shell thickness in layers (Wolfenson *et al.*, 2001).

The immune response may also be altered as a result of heat stress (Padgett and Glaser, 2003), affecting the immune system's capacity to cope with environmental challenges. Changes to the immune system due to heat stress may lead to a reduction in weight of the lymphoid organs, less antibodies circulating in the blood (Felver-Gant *et al.*, 2012), and depression of macrophage phagocytosis activity (Niu *et al.*, 2009). These changes may interfere with the cascade of effects that are triggered when the immune system is presented with an antigen, consequently increasing susceptibility to different pathologies. Important anatomical changes may occur as a consequence of corticosteroids and other substances produced in response to high environmental temperatures. One of these changes is damage to the enteric epithelial surface, which, in extreme cases, may be destroyed, exposing the underlying layers to the gut contents, and reducing the digestion and absorption capacity of the gut (Dokladny *et al.*, 2015).

Synbiotics

Synbiotics are scientifically developed additives that include both prebiotics and probiotics. Probiotics are live bacteria with beneficial activity for the host. Prebiotics are complex indigestible fiber molecules that offer nutrients for live micro-

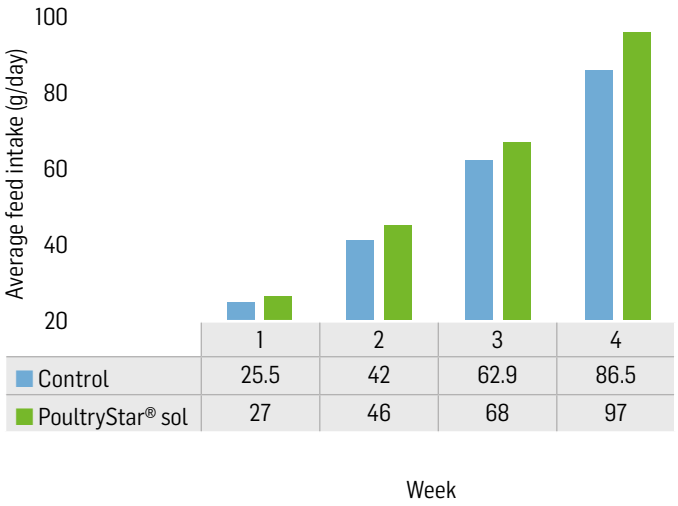
Figure 1.
Weekly body weight (g) over the duration of the trial



	1	2	3	4	5
Control	222	521	961.5	1,565	1,948
PoultryStar® sol	229	556	1,035	1,714	2,150

Source: BIOMIN

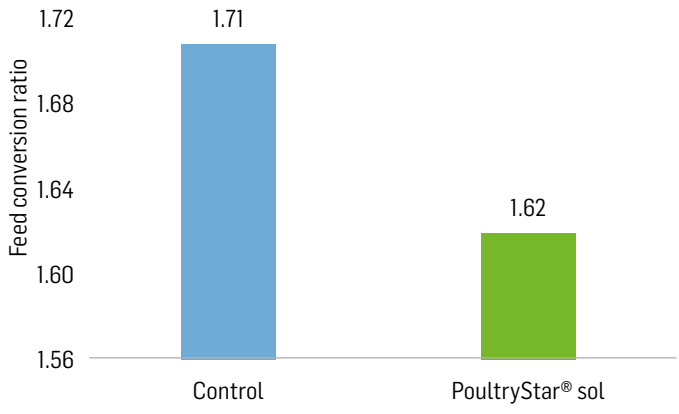
Figure 2.
Average feed intake (g/day) during the trial



	1	2	3	4
Control	25.5	42	62.9	86.5
PoultryStar® sol	27	46	68	97

Source: BIOMIN

Figure 3.
Feed conversion ratio at the end of the trial (5 weeks of age)



Source: BIOMIN

organisms (in this case, the bacteria in the prebiotic). Probiotics and prebiotics together have demonstrated a synergistic effect, improving the benefits of beneficial bacteria (Gmeiner *et al.*, 2000), such as the modulation of interleukin secretion, which triggers anti-inflammatory processes (Otte and Podolsky, 2004), the production of protective cytokines leading to a delay of the natural enterocyte cell apoptosis process, and enhancing epithelial cell regeneration (Rakoff-Nahoum *et al.*, 2004).

Synbiotics and heat stress

Knowing that heat stress has an impact on the gastrointestinal tract and the immune system, synbiotics can be used to reduce this impact through the biological activity of beneficial bacteria such as gut health protection, immunomodulation, and reduction of inflammatory processes. Thus, birds exposed to heat stress but fed diets supplemented with synbiotics have shown better weight gain compared to birds without synbiotic supplementation (Vicente *et al.*, 2007). It has been demonstrated that beneficial bacteria can improve epithelial morphology, feed conversion, and microbial profile (Fuller, 1989). These effects promote good gut health and decrease the impact of heat stress, improving bird performance under difficult environmental conditions.

Summary

Heat stress induces several physiological and anatomical changes in individuals exposed to high environmental temperatures. Some of these changes include electrolytic imbalance, gut health fragility, and a compromised immune response. Synbiotics are scientifically developed additives with biological activities that are able to reduce the impact of heat stress. Synbiotics are an interesting tool that may be used to reduce the economic impact caused by heat stress in the poultry industry.

Case study results

One commercial study was carried out in Colombia with broilers (from day-old to 5 weeks of age) split into two groups: control and treatment group. Intermittent application of PoultryStar® sol was adminstered to the treatment group on days 1, 2, 3, 7, 14, 21, 22, 28, and 35 days of age (nine applications in total). The average temperature throughout the trial was 30°C. The control group and the PoultryStar® sol group contained 5,000 birds each. Body weight (*Figure 1*) and feed intake (*Figure 2*) were measured every week. The average body weight of the birds in the PoultryStar® treatment group was heavier compared to the control group. In addition, feed intake and feed conversion ratio (*Figure 3*) were improved with the supplementation of PoultryStar® compared with the same variables in the control group. The results showed that the PoultryStar® treatment group had higher average body weight, higher feed intake and a lower feed conversion ratio during the trial.

References are available on request.

Biotronic® Top3

the breakthrough in pathogen control!

GUT PERFORMANCE MANAGEMENT

The **Permeabilizing Complex**™ blend in Biotronic® Top3 weakens the outer membrane of Gram-negative bacteria, thus boosting the synergistic effect of its components, the organic acids and the phytochemical.

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