Biomin

SCIENCE & SOLUTIONS

Keeping you naturally informed | Issue 51 | Poultry

Antibiotic resistance key to understanding efforts to curtail antibiotics in poultry

Your toolbox for antibiotic reduction

What's wrong with my birds? Part 11

How to successfully reduce antibiotics

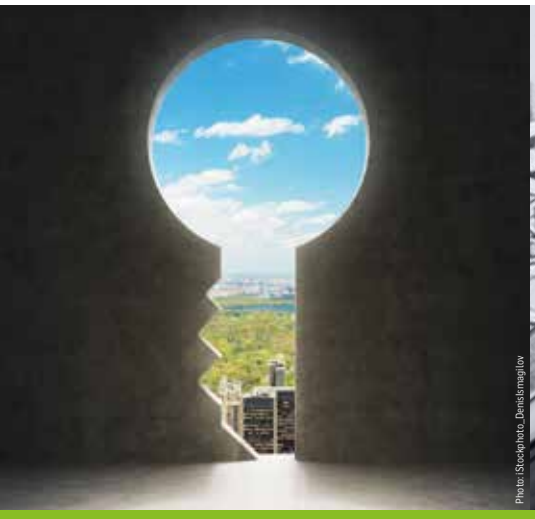


Photo: iStockphoto_Denis Ismagilov

Photo: iStockphoto_Andrei Kuzmik tsou

Supporting You at Each Step Along the Way

It is difficult to overlook the ongoing, long-term, global trend to reduce the application of antibiotics in farm animals, which appears driven by regulation, consumer demand and a lack of new antibiotic molecules.

Increasingly, our clients have embraced the responsible use of antibiotics, helping to preserve their medicinal value for the treatment of humans and animals. Addressing antibiotic resistance and closing the performance gap that opens up when antibiotics are removed from the diet constitute the two biggest challenges to ensuring sustainable profitability for the poultry industry while also keeping antibiotics working as intended well into the future.

Success entails a long-term journey with an overall objective, rather than a specific endpoint. At BIOMIN, we have been committed to providing natural and scientifically advanced nutrition solutions since our founding in 1983.

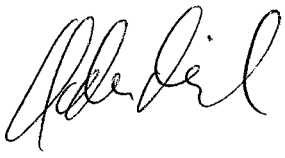
We have made it our mission to accompany you along the journey, and to help you stay naturally ahead in your business.

BIOMIN brings the most scientifically advanced toolkit to market so that you can achieve the most successful outcomes for your business. Our solutions can be applied to help partially or completely reduce antibiotic use while supporting animal health and welfare, and maintaining profitability.

The reduction and removal of antibiotics from poultry diets requires a 360-degree approach including good farm management, nutrition, biosecurity, hygiene and a robust health and vaccination program. We recognize that each farm has its own unique set of conditions, which is why our international expert team is available to assist you in the identification of on-site challenges while also providing you with tailor-made solutions from our toolkit to help you attain the desired level of performance.

In addition, our involvement in industry discussions, our extensive scientific research and development program, and our on-farm application strategies have continually provided expertise and knowledge to the industry—as does our magazine, Science & Solutions.

The new look and feel of Science & Solutions, along with the new tagline "Keeping you naturally informed" reflects our commitment to you, our clients, and reaffirms the value we place on scientific discovery, knowledge sharing and supporting your ultimate success.



Hannes Binder PhD
Managing Director

SCIENCE& SOLUTIONS

ISSN: 2309-5954
For a digital copy and details, visit:
http://magazine.biomin.net
For article reprints or to subscribe to Science & Solutions, please contact us:
magazine@biomin.net

Editors: Ryan Hines, Caroline Noonan
Contributors: Hannes Binder PhD, Daniel Petri PhD, Nataliya Roth DI (MSc), Franz Waxenecker DI (MSc), Chasity Pender PhD and Raj Murugesan DVM PhD.
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

Antibiotic Resistance Key to Understanding Efforts to Curtail Antibiotics in Poultry

Franz Waxenecker DI (MSc)
Development Director

Nataliya Roth DI (MSc)
Development Scientist

The reduction and removal of antibiotics from poultry feeds is now a common theme for producers. This is due to rising levels of antimicrobial resistance and not because of the antibiotics themselves. Ensuring that antibiotics are only used for the treatment of disease in birds will relieve pressure on the industry, but at what price to poultry performance?

Antimicrobial resistance, not antibiotics themselves, motivate the drive for antibiotic reduction.

Consumer demand, regulation and a lack of new antimicrobial molecules all contribute to the current, long-term trend to reduce antibiotics in modern poultry systems. While the need for consumer education around food production remains an open question, it is the ability of bacteria to become resistant to one or more antibiotics –rendering those drugs ineffective– and the profound implications for both human and animal health that account for the need to reduce antibiotics.

Resistance in the crosshairs

According to the World Health Organization (2011), "any kind of antibiotic use in people, animals or plants can promote the development and spread of antibiotic resistance." The identification of antibiotic use in farm animals as a risk factor in the development of antibiotic resistant bacteria explains why antimicrobial resistance has continued to garner greater attention from health authorities and regulators worldwide, particularly for antibiotics deemed important to human medicine.

This concern is separate from antibiotic residues potentially finding their way into meat and eggs: withdrawal periods and monitoring have already been established to ensure that antibiotics do not enter the food supply.

Protecting valuable health tools

The need to preserve antimicrobial substances stems from the fact that they represent, to some extent, a limited resource. The most recent class of antibiotics was discovered in 1987. The research and development pipeline for new

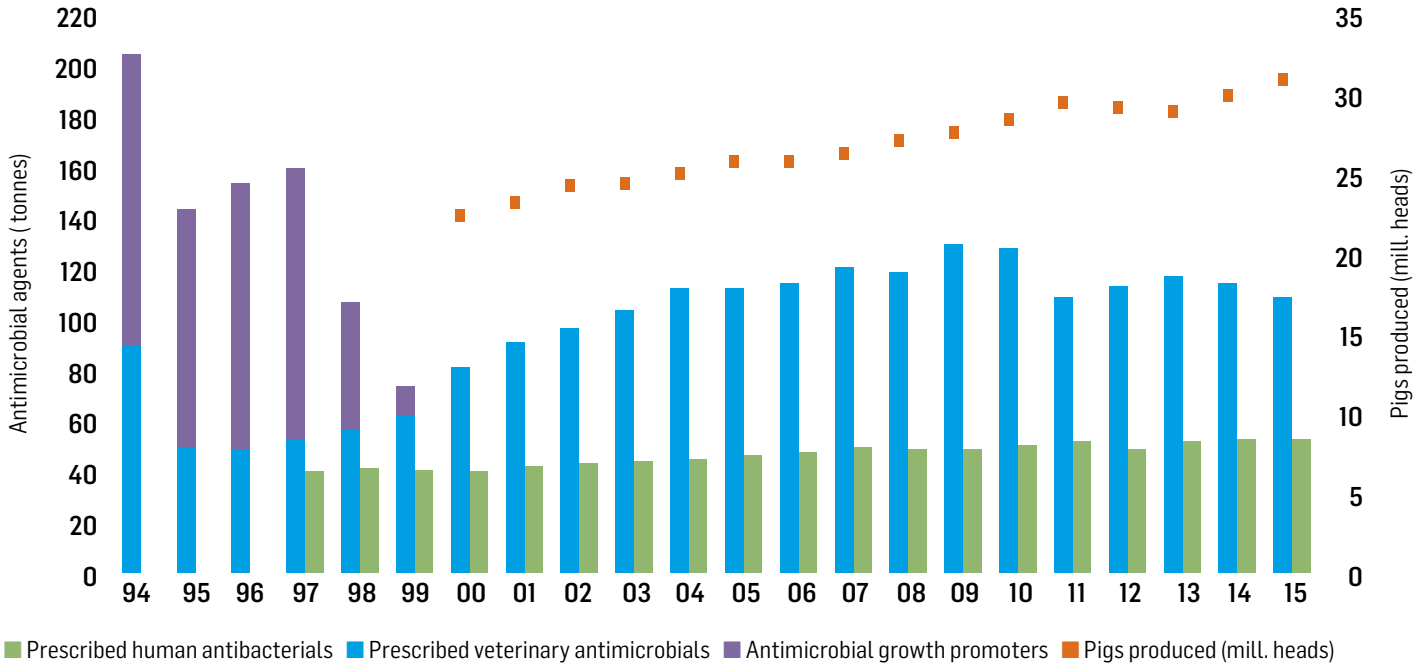
IN BRIEF

- Extensive use of antibiotics is resulting in rising levels of antimicrobial resistance
- There is global concern over the role antibiotics will be able to play in disease treatment if antimicrobial resistance continues to rise
- In countries where antibiotic use is low, antimicrobial resistance is also low
- Antibiotics added to animal feeds to promote growth have been banned in several countries, being replaced with a combination of feed additives to close the performance gap

Figure 1

Prescribed antimicrobial agents for human and all animal species

Danmap 2015



Source: Danish Integrated Antimicrobial Resistance Monitoring and Research Programme, 2015

antimicrobials has remained largely unfilled. According to the Organisation for Economic Co-operation and Development (OECD, 2016), only five new classes of antibiotics have been brought to market since 2000.

The development of bacterial resistance to an antibiotic in the years following its introduction, estimated by some to be on average eight years, places limits on the economic viability and lifespan of new molecules, discouraging innovation (Schmieder and Edwards, 2012). The lack of new antibiotic substances reinforces the importance of preserving those already in existence.

A pattern of antibiotic restrictions

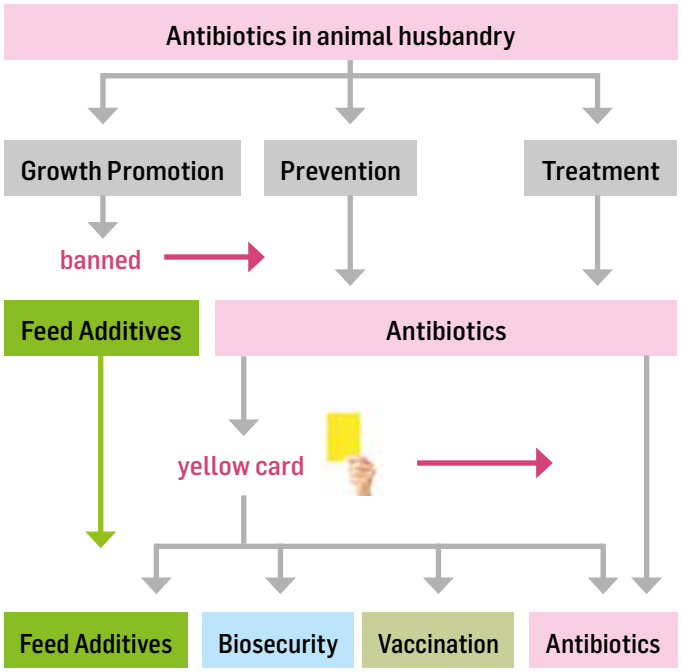
Historically, motivations for antibiotic use in animal husbandry fall into three categories: growth promotion, disease prevention and treatment. The trend when it comes to governmental restrictions on antibiotics has been rather clear: antibiotics for growth promotion will be discouraged. (*See callout box 'The G20 aims to limit antibiotics'*).

Countries looking to limit the application of antibiotics in animals typically start with restrictions on one or several antibiotic growth promoters (AGPs) often followed by a ban on AGPs. At least 32 countries have imposed a nationwide ban on AGPs, and 35 have a veterinary prescription requirement.

As a second step, some –though not all– countries then look to address preventive or prophylactic antibiotic use—thereby limiting the use of antibiotics to treat disease. Yet, these alone are not always sufficient to reduce antibiotic use in livestock.

Figure 2.

The move toward prudent antibiotics use

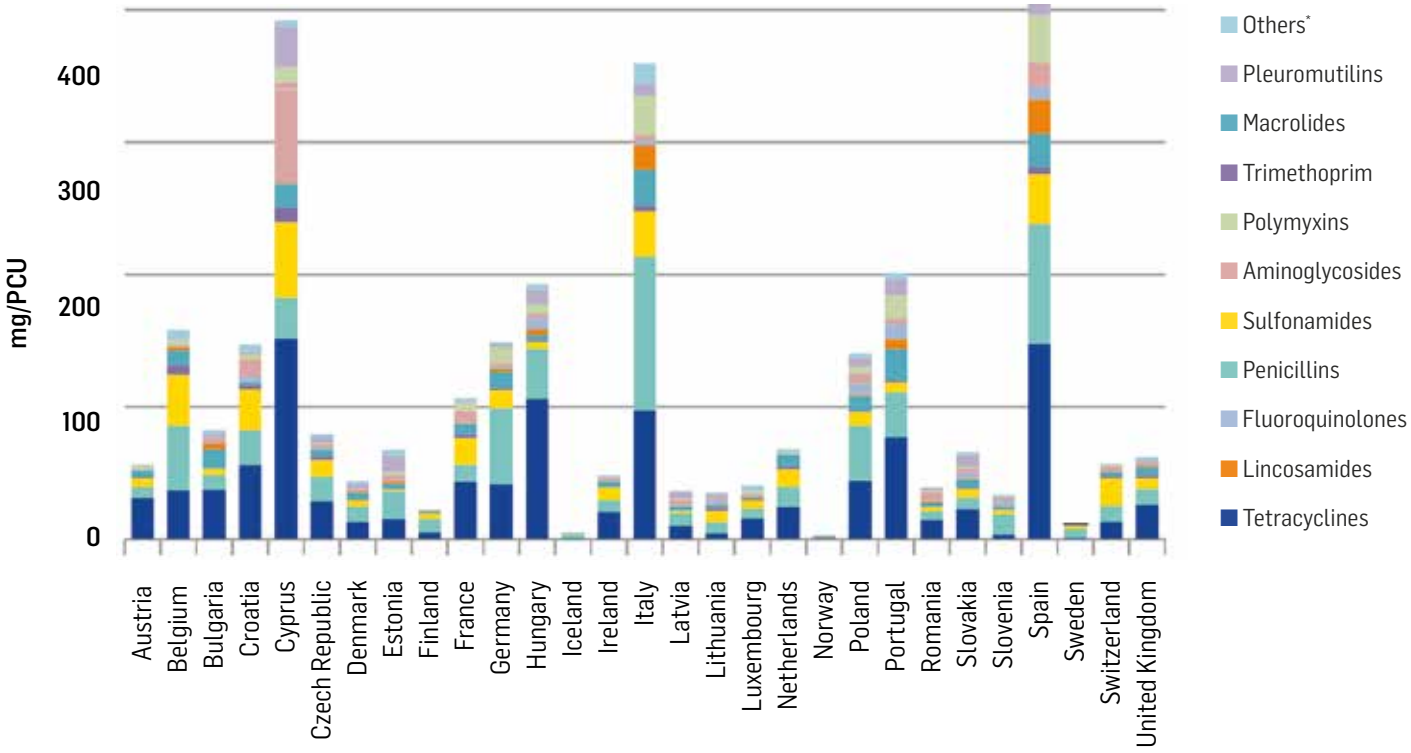


Source: BIOMIN

The European example

In 2005, Europe banned the use of AGPs. For the regulators, the ban did not initially have the intended effect—namely, the reduction of antibiotics applied in livestock. The elimination of AGPs was met with a rise in prescribed

Figure 3.
Sales of veterinary antimicrobials for food producing species in 2014



Source: European Surveillance of Veterinary Antimicrobial Consumption, 2016

veterinary antimicrobials for preventive use in subsequent years (*Figure 1*).

To address the preventive use of antibiotics, regulators in several European countries introduced a so-called 'yellow card' system that uses a series of different metrics to encourage further reductions in antibiotic use for preventive reasons.

This system proved effective in restricting antibiotic use to disease treatment (*Figure 2*), which explains why within Europe, Northern European countries have comparatively lower levels of antibiotic use in animals, taking into consideration the amount of antibiotics sold and size of the respective animal populations—referred to as a population correction unit (PCU) basis (*Figure 3*).

The G20 aims to limit antibiotics

"We will promote the prudent use of antibiotics in all sectors and strive to restrict their use in veterinary medicine to therapeutic uses alone. Responsible and prudent use of antibiotics in food producing animals does not include the use for growth promotion in the absence of risk analysis. We underline that treatments should be available through prescription or the veterinary equivalent only."

- G20 Agriculture Ministers' Declaration 2017

Prevalence of resistance in poultry

Numerous monitoring programs that survey levels of antibiotic-resistant bacteria in animals exist throughout the world. Aggregating surveillance data from 19 countries that record antimicrobial resistance of *E. coli* in poultry shows that countries such as Norway and Sweden that have less intensive antibiotic use (*Figure 3*) also have lower levels of *E. coli* resistant to antibiotics including ampicillin, ciprofloxacin and tetracycline (*Figures 4*, *5* and *6*). This observation, along with continued pressure from consumers frequenting retailers and fast food outlets, increases the likelihood that more countries will eventually move to restrict antibiotic use to disease treatment.

Progress varies by country

Based on the number of antimicrobial-resistant *E. coli* in poultry, and taking into account the historical path that early-mover countries have taken towards antibiotic reduction and removal, we can broadly observe three sets of situations.

1. In the first group of countries –including Vietnam, the United States and several in South America– the process of antibiotic exit has yet to begin or is still in the early stages. In these countries, we often see high levels of resistance for many classes of antibiotics.

2. In the second group, AGPs have been banned, though they have yet to adopt a yellow card system or other measures

Figure 4.

Percentages of tetracycline-resistant *E. coli* isolates from poultry

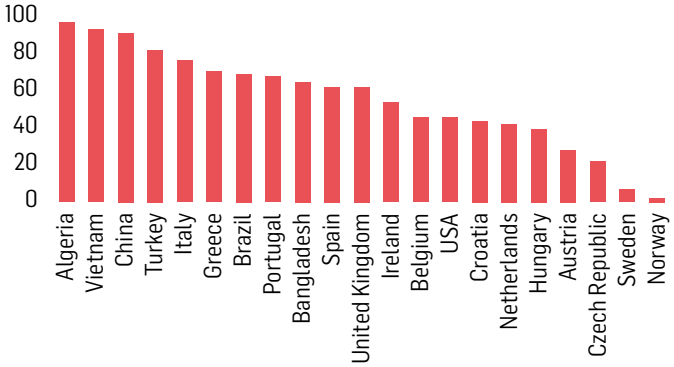


Figure 5.

Percentages of ciprofloxacin-resistant *E. coli* isolates from poultry

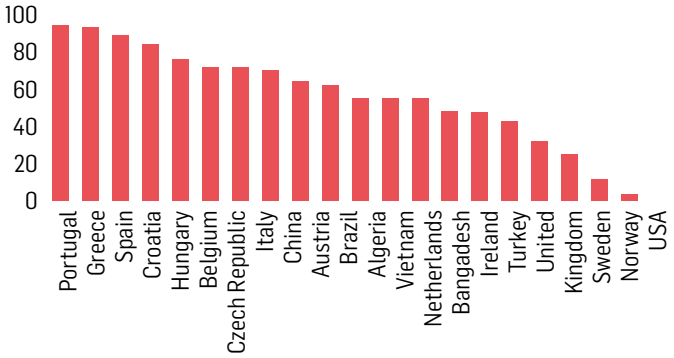
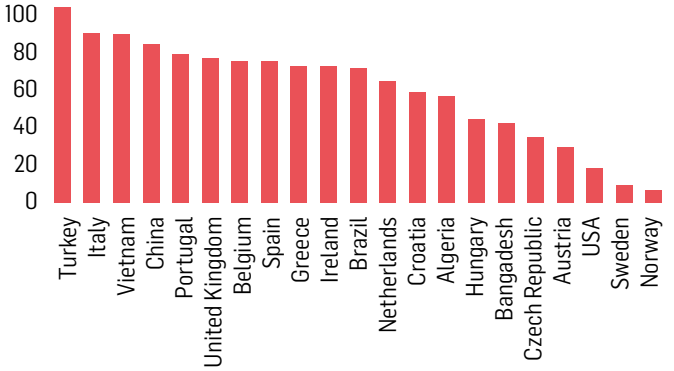


Figure 6.

Percentages of ampicillin-resistant *E. coli* isolates from poultry



Sources for Figures 4-6. EU: The European Union summary report on antimicrobial resistance in zoonotic and indicator bacteria from humans, animals and food in 2015, 2017. China: Zhang et al, 2017. South Africa: Iwu et al, 2017. Vietnam: Dang et al, 2011.

to further clamp down on antibiotic use. In these countries –including Italy, Spain and Turkey– we can still find high levels of resistant *E. coli*, at least to a selected list of antibiotics.

3. In the third group of countries, where the prudent use of antibiotics is already implemented –including most of the countries in Northern Europe– resistance levels are considerably lower than elsewhere in the world.

At least 32 countries have imposed a nationwide ban on antimicrobial growth promoters, and 35 have a veterinary prescription requirement.

The road ahead

The challenge for producers who have adopted antibiotic exit programs or find themselves in countries where antibiotic use is being curtailed, is to reduce antibiotics while keeping performance high. Alternative measures are required to substitute the role of antibiotics in relation to growth promotion and disease prevention if they are to retain their necessary role in disease treatment.

In modern animal production, there is a need for growth promoters in feed, just as there is a need for disease prevention. Some combination of feed additives, enhanced biosecurity, vaccination programs and better management practices will be the way forward—as evidenced by producers and geographies that have already made the switch.

Looking ahead, the key to addressing the antibiotics question will be to control resistances and close the performance gap.

References

Danish Integrated Antimicrobial Resistance Monitoring and Research Programme. (2015). Use of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from food animals, food and humans in Denmark. Report available from: www.danmap.org

European Medicines Agency, European Surveillance of Veterinary Antimicrobial Consumption. (2016). Sales of veterinary antimicrobial agents in 29 European countries in 2014. EMA/61769/2016.

Organisation for Economic Co-operation and Development. (2016). Antimicrobial resistance: Policy insights. Organisation for Economic Co-operation and Development.

Schmieder, R and Edwards, R. (2012). Insights into Antibiotic Resistance Through Metagenomic Approaches. Future Microbiology. 7(1):73-89.

World Health Organization. (2011). Tackling antibiotic resistance from a food safety perspective in Europe. World Health Organization.

Your Toolbox for Antibiotic Reduction

Daniel Petri PhD,
Global Product Line Manager - Microbials

The steady pursuit of antibiotic reduction in livestock across the globe means that the industry will have to learn to master a new set of tools to support performance and maintain competitiveness.

Photo: iStockphoto_AndreiKuzmiatsou

IN BRIEF

- Problems such as mycotoxin contamination, pathogen challenges and poor management practices are exposed when antibiotics are removed from the diet, resulting in lower performance
- There are many products available on the market to help close the performance gap
- Each production facility needs to identify their specific requirements and tailor a solution to fit

Photo: Argonne National Laboratory LLC and University of Chicago Medicine and Biological Sciences, USA

Clostridium spp., example visual for virulent *Clostridium perfringens*

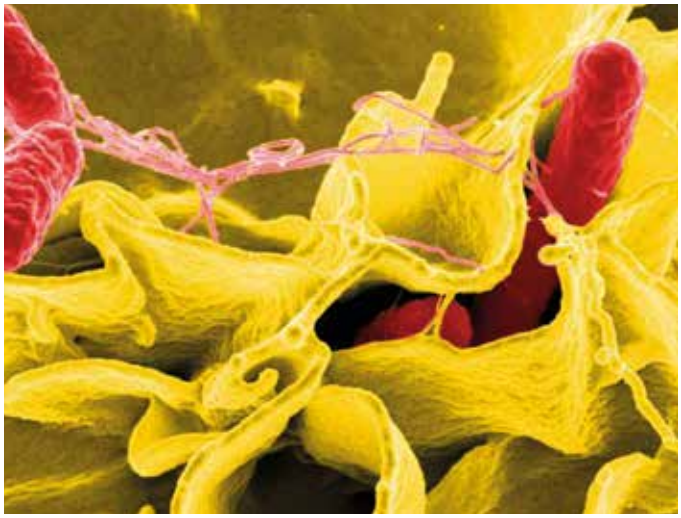


Photo: Rocky Mountain Laboratories, NIAID, NIH, U.S. Department of Health & Human Services

Salmonella enterica serovar Typhimurium

When antibiotics are removed from modern production, other issues frequently emerge.

As countries begin down the path of antibiotic reduction, often starting with restrictions on the use of antibiotic growth promoters (AGPs), feed and livestock producers quickly find themselves searching for ways to raise animals without antibiotics. There is no silver bullet product that can take their place. The answer is a 360-degree approach that combines proper nutrition, biosecurity, hygiene, genetics, health and good farm management practices. And innovative feed additives can also play a key role.

Pulling back the curtain

According to Warren Buffet, only when the tide goes out do you discover who has been swimming naked. Part of the reason why the right solutions for one farm may be different from that of another relates to the fact that sub-therapeutic antibiotic application such as those used for growth promotion or disease prevention may mask other areas that would otherwise need attention.

When antibiotics are removed from modern production, other issues frequently emerge. Mycotoxin contamination becomes more important, pathogen challenges flare and poor management practices are laid bare—all in addition to the performance gap that must be closed.

Replacing antibiotics in livestock production opens up considerable complexity in terms of species, climate, production stage, age, production system and geography. What is needed therefore is a customizable solution that can accommodate all of these factors. This can be done by identifying the right combination of probiotic, phytogenic, organic-acid based and/or mycotoxin deactivator products that deliver the right results in a given situation.

Examination of the following scenarios shows how different poultry production systems in different countries can benefit from varying combinations of feed additives in order to best address the specific on-site challenges.

Pathogen challenge in the United States

Consider a deep litter facility in the southeastern US in which there is a high background level of spore-forming *Clostridium perfringens* and too much nitrogen in the diet—the result of higher dietary protein possibly from animal by-products. *C. perfringens*, which excretes α-toxin, is not particularly virulent, though its overgrowth can decrease flock performance unless it carries specific toxin genes like NetB. Taking out antibiotics requires a solution focused on pathogen control in addition to reviewing protein source and quality.

One suitable solution would be to apply a phytogenic feed additive (PFA) to put pressure on Gram-positive bacteria,

Ultimately, a long-term strategy to support your animals must be cost-competitive and effective.

and apply an organic acid-based product to help counteract Gram-negative bacteria.

Gram-negative in Latin America

In another scenario, consider the case of *Salmonella* challenge, poor chick quality and inconsistent breeder flocks. Antibiotics are allowed in production and currency fluctuations discourage the prospect of switching to novel growth promoters (NGPs). Here, it would make sense to apply a probiotic early on, and an acid-based product throughout the production stages. The poultry-specific synbiotic (prebiotic + probiotic) would ideally deliver essential bacterial strains to the gastrointestinal tract to promote gut development, and to competitively exclude pathogens from colonizing the gut. The acid-based product would keep the gut environment hostile to Gram-negative bacteria. Both products can be co-applied either through feed or water application, providing full flexibility.

Europe

One example broiler facility in Europe is in fact, through excellent hygiene, overly sanitary resulting in the elimination of both the harmful and beneficial gut bacteria from the gut environment. Water application of a poultry-specific synbiotic in the first three days would quickly establish a healthy gut microbiome and support immune development. Feed application of a PFA would support digestibility, and lower inflammation, leading to optimized feed conversion. The combination could be reintroduced in the final feed.

Mycotoxins

When antibiotics are removed, mycotoxins become more important because they can impair animal health and performance, disrupt the gut barrier and worsen vaccine effectiveness. Any of the scenarios described above would be worsened from a producer's perspective. A robust mycotoxin risk management program should include regular testing of feed ingredients and preventive measures so that animals can reach their full potential. Regular application of a mycotoxin deactivator is the surest way to avoid issues.

Benefits for those sticking with AGPs

While we expect the application of antibiotics for growth promotion and preventative treatment to be sharply reduced in the years ahead, NGPs can offer benefits to producers. In fact, it is possible to use NGPs, AGPs and a robust mycotoxin risk management program simultaneously. In a recent commercial trial in New Zealand, BIOMIN experts devised an NGP solution for a high performing broiler farm that was already using a mycotoxin deactivator. In the trial, a PFA was used to reinforce the mucosa in the lumen and improve feed efficiency. In addition, a symbiotic was used to stabilize the epithelial and cecal microbiota and properly set up the birds' immune systems, all while still using the farm's existing multiple AGP regimen. The combination resulted in improved performance and significant positive return on investment.

1000 possibilities, your solution

The feed additives market offers a wide variety of options, each with their own modes of action and advantages. Ultimately, a long-term strategy to support your animals must be cost-competitive and effective. To assure a clear benefit in production, application of feed additives must be tailored to the individual situation and circumstances. There is no "one-size-fits-all" approach. BIOMIN has conducted decades of research and development to produce some of the most innovative products in their respective categories.

The choice of product relies on a host of factors, including species, geography, production stage, specific challenge and customer preferences. To further complicate matters, different combinations of additives may prove to be the best option. However, finding a solution does not have to be complicated.

At BIOMIN, our sales teams and technical support experts rely on local and global support to accompany clients through the process of identifying the right solution and ensuring that they have the knowledge and skills for successful implementation–part of a long-term partnership to deliver profitable results.

A practical guide to differential diagnosis
11 – Lameness Conditions (Management)


Chasity Pender PhD,
Technical Manager, and
Raj Murugesan DVM PhD,
Technical & Marketing Director, BIOMIN America

Due to intense genetic selection for increased growth and feed efficiency, lameness has become a growing issue in today's global broiler industry. Lameness is not only a concern in terms of animal welfare; it also poses a serious financial threat to poultry producers, as it is a significant cause of culling, mortality, and condemnations. Overall, the economic cost associated with lameness problems in poultry can add up to several hundred million dollars each year.

Many risk factors, including both non-pathogenic and pathogenic causes, could be associated with the occurrence of lameness in broilers and the condition is usually multifactorial. It is important to differentiate the multiple causes of lameness in order to develop proper prevention and treatment strategies as these strategies will change based on the causative agent identified. Management factors, such as litter quality and stocking density, can play a major role in the development of leg issues and lameness. This table highlights several management factors that are commonly associated with increased occurrence of lameness and offers solutions to help mitigate the consequences of these conditions.

Management Factors

Condition	Causation	Symptoms	Lesions	Solution
Pododermatitis/ Footpad dermatitis/ Foot burn/ Ammonia burn	• Poor litter quality • Biotin deficiency	• Ulceration of the metatarsal and digital footpads	• Necrotic lesions on the plantar surface of the footpads	• Lower litter moisture with proper ventilation and avoid water spillage • Improve gut integrity by feeding poultry-specific, live probiotics • Supplement biotin in the feed
Tibial dyschondroplasia/ Osteochondrosis	• Genetic selection • Late rapid growth rate • Calcium-Phosphorus ratio • Excess chloride in feed leading to metabolic acidosis • Acid/base balance • Mycotoxins	• Swelling and bowing in the region of the knee joints • Angulations of legs • Typically in birds >35 days	• Plug of cartilage in proximal end of tibia, distal tibia, and proximal metatarsus, in decreasing order of frequency	• Lower the energy and protein density of feed to slow down growth • Correct the nutritional imbalances • Add an effective mycotoxin deactivator to the feed
Twisted leg	• Genetic selection • Stocking density	• Distortion at hock • Valgus / Varus • Various angulations of leg	• Linear twisting of tibia and femur • Changed angulation of tibial condyles	• Euthanize affected bird
Degenerative joint disease	• Developmental defects • Physical damage	• Imbalanced walking • Huddling	• Damaged epiphyseal articular cartilage, especially of femoral anti-trochanter, but also other leg joints, resulting in erosions and cartilage flaps	• Euthanize affected bird
Ionophore toxicity	• Monensin	• Legs extended backward	• No specific lesions	• Mix feed properly • Withdraw the ionophore

For more information, visit www.mycotoxins.info

References are available on request

NEW!

Digestarom® DC

The Feed Converter.

GUT PERFORMANCE MANAGEMENT

Digestarom® DC
provides crystal clear benefits for your animals and your operation.

- Latest innovation in phytogenics for **improved feed intake**
- Triple action formulation for **better performance**
- Unique Biomin® Duplex Capsule technology for **optimized feed conversion**

www.thefeedconverter.com

Naturally ahead

Biomin®