

# Science & Solutions



## Taking poultry production to new levels

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**Taking mycotoxin protection to new levels**

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**How to manage your poultry house ammonia levels**

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# Editorial

## New levels of poultry production are now possible

2017 is an excellent year for BIOMIN poultry customers. We received two European authorizations for the use of BIOMIN BBSH 797 and FUMzyme® in all avian species. These two components are both crucial ingredients of the fifth generation of Mycofix®. Poultry customers all over the world can now benefit from a product that is proven to counteract the broadest spectrum of mycotoxins using adsorption and biotransformation.

A broad coverage is necessary due to (co-)occurrence of mycotoxins. In the last two years, an increased occurrence of different mycotoxins, especially deoxynivalenol and other trichothecenes, has been recorded in South American soya bean meal. Even with these higher levels of contamination, you still may not see any visible symptoms in your birds. But remember, mycotoxins do not always cause specific symptoms that can be uniquely attributed to one specific mycotoxin. Most of the time, mycotoxins impair performance or contribute to the development of diseases.

The integrity of the gastrointestinal tract is the most important factor when optimizing bird performance. Recent research has proven the negative impact of mycotoxins on the integrity of the gastrointestinal tract. Any damage to the gut will impact digestibility which can in turn affect ammonia levels in the poultry house. This issue is further explored in the article on page 6. Adverse environmental conditions challenge the birds, turning even low contaminations of mycotoxins into the drop that makes the barrel overflow.

In this issue of **Science & Solutions**, we highlight the benefits of the fifth generation of Mycofix® to the poultry industry, and discuss the important topic of ammonia levels in the poultry house. You will also find a short article on differential diagnosis of lameness conditions stemming from viral pathogens.

Enjoy reading this issue of **Science & Solutions**.



**Verena STARKL** MSc  
Senior Product Manager BIOMIN



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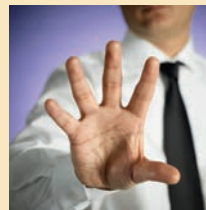


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A handy diagnostic checklist of symptoms, causes and remedies.

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Editors: Ryan Hines, Caroline Noonan  
Contributors: Verena Starkl, Mark Karimi  
Marketing: Herbert Kneissl, Karin Nährer  
Graphics: Reinhold Gallbrunner, Michaela Hössinger  
Research: Franz Waxenecker, Ursula Hofstetter  
Publisher: BIOMIN Holding GmbH  
Erber Campus, 3131 Getzersdorf, Austria  
Tel: +43 2782 8030  
[www.biomin.net](http://www.biomin.net)

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# The Latest in Mycotoxin Risk Management in Poultry

Damage caused by mycotoxin contamination costs the global poultry industry millions of dollars in losses each year. Recent advances have led to the development of the most effective mycotoxin deactivating feed additive to date.

By **Verena Starkl**, MSc - Product Manager, Mycotoxin Risk Management

## Samples can contain an average of 30 different mycotoxins and metabolites each.

**M**ost poultry producers are familiar with the harm that mycotoxins cause and recognize the need for monitoring and mitigation as part of a complete mycotoxin risk management program. Maize (corn) frequently contains harmful mycotoxins at levels that pose a known threat to poultry performance and health. Fumonisin (FUM), followed by deoxynivalenol (DON) and zearalenone (ZEN) are mycotoxins also commonly found in corn. Soya bean meal is frequently contaminated with different mycotoxins, especially DON, ZEN, T-2 toxin and aflatoxin (Afla). Average contamination levels of corn and soya bean meal account for the majority of the total mycotoxin contamination of a finished poultry diet.

### Find one, find many, find trouble

Extensive research into mycotoxins indicates that they tend to occur in groups. Co-exposure is not only common, but also more dangerous for birds. Samples can contain an average of 30 different mycotoxins and metabolites each. In the field, this can cause greater harm

to birds due to their synergistic effects; when mycotoxins occur together, the adverse consequences of each mycotoxin can be amplified.

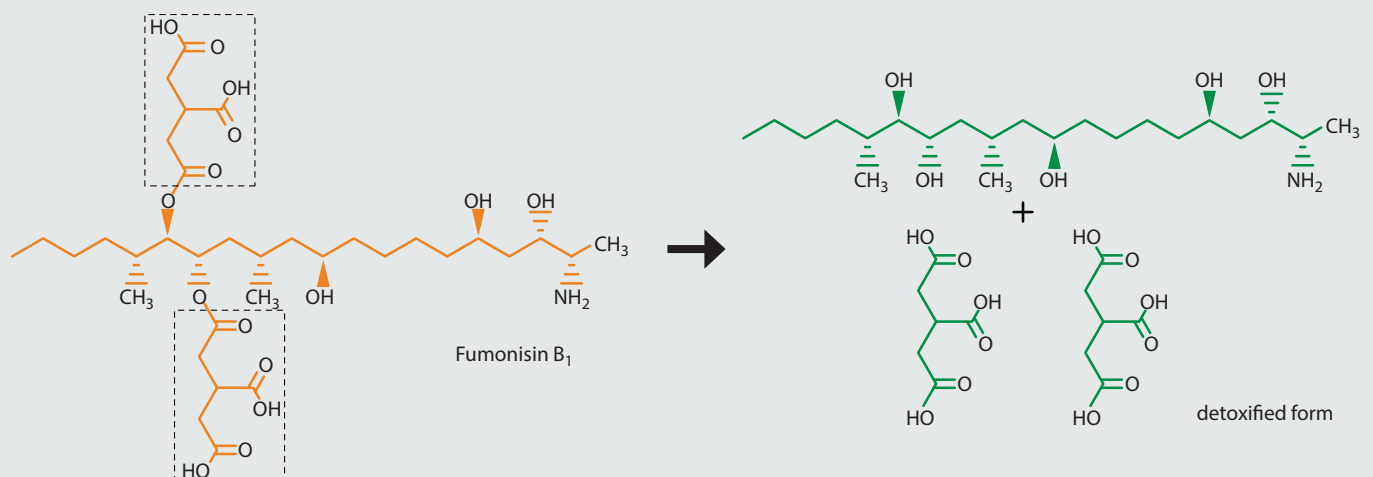
### What's new in protecting poultry

Due to the variety of mycotoxins that can impair poultry performance and health, a multi-pronged approach is needed. Mycofix<sup>®</sup> is an innovative, all-in-one feed additive that uses three modes of action – biotransformation, adsorption and bioprotection – to deliver absolute protection against mycotoxins. The fifth incarnation of the product introduces five new features.

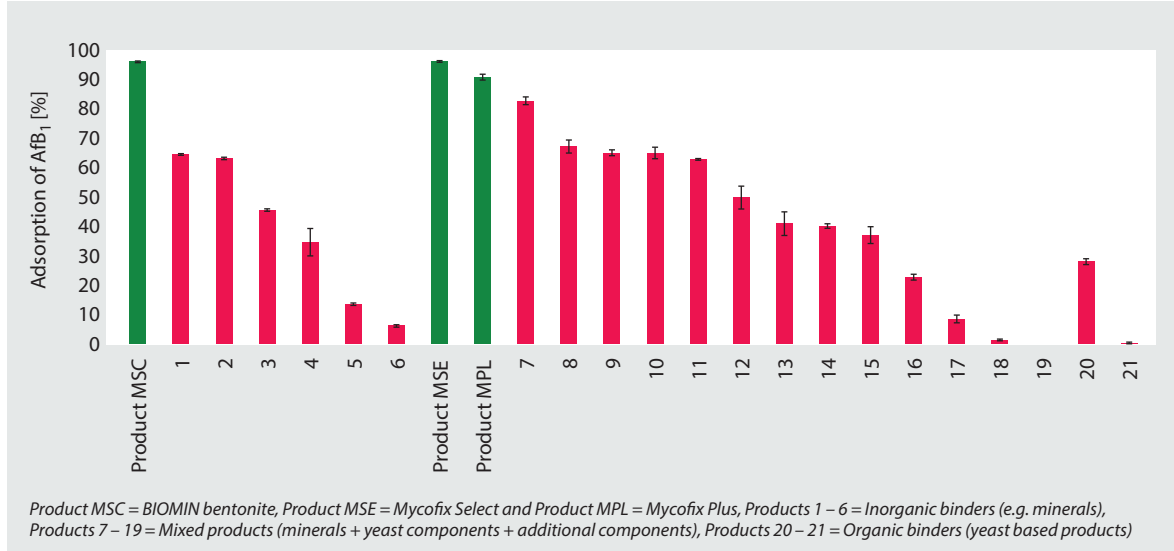
#### 1. Broader spectrum of mycotoxins

The components of Mycofix<sup>®</sup> work in ways that are both specific (target a single mycotoxin) and irreversible (cannot be undone) through biotransformation. In addition to components in Mycofix<sup>®</sup> that deactivate trichothecenes, ZEN, OTA and Afla, FUMzyme<sup>®</sup> is a patented, purified enzyme that specifically cleaves off the two tricarballic acid side chains of FUM molecules (*Figure 1*).

**Figure 1.** FUMzyme<sup>®</sup> detoxifies FUM molecules by cleaving the two tricarballic acid side chains.



**Figure 2.** Adsorption of aflatoxins by different products from the market analyzed according to the method published by EURL.



Experimental work confirms that fumonisins in feed increase the percentage of intestinal lesions due to necrotic enteritis, and also increases the excretion of *Eimeria* oocysts in the feces and mucosa of poultry. FUMzyme® renders FUMs non-toxic, protecting poultry from FUM-related problems such as decreased performance, impaired gut health, liver damage and weakened immune systems.

**2. Proven safety and effectiveness backed by three EU authorizations**

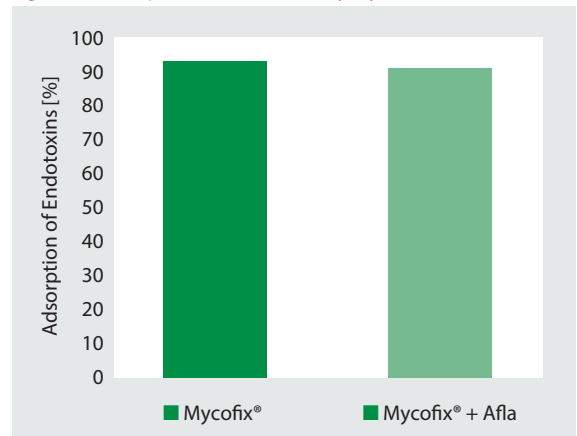
Mycofix® contains the only three EU authorized feed additives for mycotoxin deactivation in feed for poultry proven to adsorb harmful mycotoxins or to biotransform mycotoxins into nontoxic metabolites (Regulation No 1016/2013, No 2017/913 and No 2017/930).

**Identifying and including the best binder**

Bentonite is a natural clay with varying properties depending on its origin. Not all minerals on the market sold as binders are bentonite. Only very few bentonites fulfill the strict and selective EU requirement (Regulation (EU) No 1060/2013) installed in cooperation with the BIOMIN Research Center.

Many of the most common products making Afla-binding

**Figure 3.** Adsorption of endotoxins by Mycofix®.



Source: BIOMIN, 2017

claims, including inorganic, organic and mixed binders, were tested using the European Union Reference Laboratory (EURL) method for effectiveness. Only products from the BIOMIN Mycofix® range achieved the 90% aflatoxin adsorption level required to claim EU authorization (Figure 2).

**3. Enhanced bioprotection**

Mycotoxins affect immune cells, damage the liver, and also negatively affect the intestinal barrier function. The bioprotection mix in Mycofix® not only supports the liver and immune system but also improves the integrity of the intestinal barrier function. Mycotoxins reduce the barrier function of these cell layers by opening them up, making them more “leaky” and thus allowing pathogens

**Not all authorizations are equal**

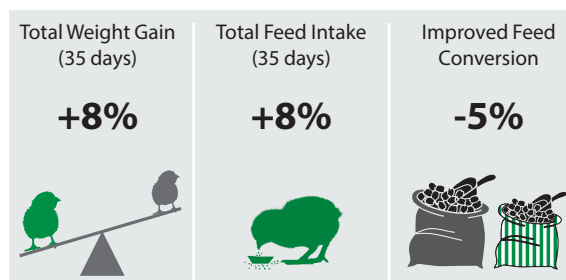
European Commission Regulation (EC) No 1831/2003 established the rules governing the EU authorization of additives for use in animal nutrition. Additives fall into various categories and functional groups. “Substances for reduction of the contamination of feed by mycotoxins” are a functional group (m) of the category “technological feed additives” (1). Only those authorized by the EU in category/functional group “1m” have the legal basis for official claims regarding mycotoxin deactivation and are subject to scrutiny by the European Food Safety Authority with regards to product safety and efficacy.

**Mycotoxins reduce the barrier function of these cell layers by opening them up, making them more “leaky” and thus allowing pathogens to enter the bloodstream more easily.**

**Figure 4.** Effects of Mycofix® Select on performance of broiler fed diets contaminated with DON and FUM.

		Control	Mycofix® Select
day 1-14	DON (ppb)	5,050	5,050
	FUM (ppb)	2,570	2,570
	Mycofix® Select (kg/ton)	--	1.5
day 15-35	DON (ppb)	3,360	3,360
	FUM (ppb)	1,180	1,180
	Mycofix® Select (kg/ton)	--	1.5

Increased total weight and reduced feed intake resulted in an improved feed conversion rate and an ROI of 4.00 when 1.5kg of Mycofix® Select/ton of feed was added to the feed.

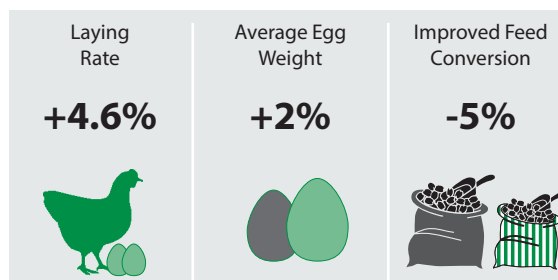


Broiler feed and live weight prices (based on average market prices Austria May / June 2017): Broiler feed = 362€/t, Live weight = 1.07€/kg

**Figure 5.** Effects of Mycofix® Plus on performance of laying hens fed diets contaminated with DON, ZEN and FUM.

		Control	Mycofix® Plus
DON (ppb)		2,100	2,100
DON-3-glucoside (ppb)		580	580
ZEN (ppb)		590	590
ZEN-sulfate (ppb)		480	480
FUM (ppb)		9,600	9,800
Mycofix® Plus (kg/ton)		--	2.0

The increase in sales and reduction in feed costs due to improved feed conversion rate (FCR) and due to the use of Mycofix® Plus resulted in an ROI of 1.27.



Layer feed and egg prices (based on average market prices Europe August 2017) Layer feed = 265 €/t, Egg price = 6.5 €/100 eggs


to enter the bloodstream more easily. Mycofix® reduces leakage, supporting the cell layer and the animal's intestinal barrier function.

#### 4. Protection against endotoxins

Endotoxins are part of the outer membrane of the cell wall of all Gram-negative bacteria (e.g. *E. coli*, *Salmonella*, *Shigella*, *Pseudomonas*). They can elicit strong immune responses, weakening animals' immune systems and impairing performance. Results show that 500g/ton of feed of Mycofix® adsorbed more than 90% of 500 Endotoxin Unit/ml.

Furthermore, the interlayer sheet structure of the bentonite contains enough binding sites to achieve a similar level of binding capacity in the presence of 4000 ppb of aflatoxin B<sub>1</sub> (Figure 3). The bioprotection strategy provides further support.

#### 5. Optimized formulation

Mycofix® is a fully revamped formulation of the Mycofix® product line, optimized to boost effectiveness in the field. A broiler trial (Figure 4) and a layer trial (Figure 5) prove a very positive impact on performance when Mycofix® is added to the diet. 

# 5 Tips to Successfully Manage Poultry House Ammonia Levels

Measures to reduce ammonia levels, including gut performance management, can promote the health, welfare and performance of your flocks.

By **Mark Karimi**, MSc - Technical Sales Manager Poultry

**A**mmonia (NH<sub>3</sub>) is an invisible, water-soluble alkaline gas, which is hazardous to the environment. If contamination of soil or water occurs, it may cause environmental problems such as acidification and eutrophication, which can harm sensitive vegetation systems, disrupt biodiversity and reduce water quality. In the European Union (EU), the agricultural sector is responsible for the vast majority (93.3%) of total ammonia emissions. Livestock manure management (collecting, storing and spreading on land) accounts for almost three fifths of agricultural ammonia emissions, while agricultural soil emissions account for the rest (*Figure 1*).

trachea cannot be cleared by the cilia and thus bacteria become trapped. When the bacteria reach the lungs or the air sacs, they cause infections.

Considering both human and animal health, guideline exposure levels for ammonia is set to 20-25ppm in many countries. However, in practice, the concentration of ammonia in some broiler houses may easily exceed 30-70 ppm, particularly in wintertime. The EU directive (Council Directive 2007/43/EC) states that the NH<sub>3</sub> concentration should not exceed 20 ppm over any eight-hour period or 35 ppm over any ten-minute period during the poultry production cycle.

## Effects of ammonia on birds' health and performance

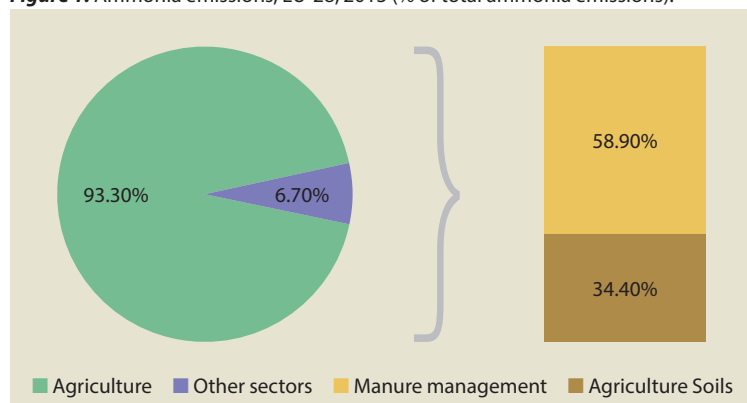
A high concentration of ammonia in the poultry house has adverse effects on the health and performance of birds. However, it is not easy to measure the magnitude of such adverse effects.

Birds are not usually exposed to a very high concentration of ammonia for long periods, unless there is poor ventilation, or birds are fed a nutritionally unbalanced diet. Recent research has revealed that many molecular changes can take place when birds are challenged with a high concentration of ammonia, even for short periods. The presence of excessively high levels of ammonia in the air, for any length of time, will cause discomfort for the birds.

Ammonia is a strong oxidative stressor that can cause inflammation. Trials have shown that high concentrations of ammonia can alter the normal organ function of animals, impair energy metabolism, induce cell apoptosis, and cause mitochondrial damage in the mucosa of the gastrointestinal tract.

Poor growth rate and performance of birds growing in high atmospheric ammonia concentrations is strongly related to the influence of ammonia on birds' immunity and their intestinal histomorphology. Exposure to high ammonia concentrations negatively affects the development of the birds' immune system as well as intestinal villi and mucosal proteome.

**Figure 1.** Ammonia emissions, EU-28, 2013 (% of total ammonia emissions).



Source: European Environment Agency

## Ammonia emissions in poultry houses

Ammonia in a poultry house comes from the birds themselves. Unused nitrogen is excreted as uric acid (80%), ammonia (10%), and urea (5%). When ammonia gas is exposed to moisture, it reacts and forms a basic, corrosive solution called ammonium. This aqueous ammonium solution causes harm to birds. The ammonium corrodes the lining of chickens' respiratory tract and paralyzes or even destroys the cilia of the epithelial cells. In such conditions, the mucus on the mucosal surface of the



**Figure 2.** An overview of ammonia volatilization.

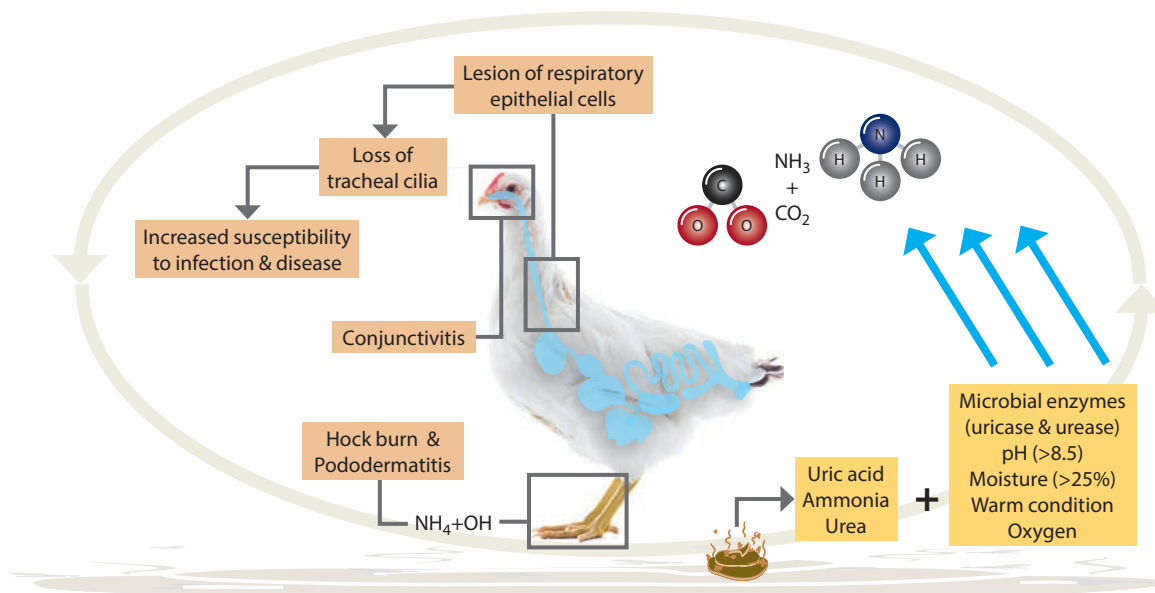


Photo: iStockphoto\_aluam

### Ammonia management in poultry production

The goal for most producers is either to avoid high concentrations of ammonia in the first place, or to control induced inflammations and minimize the impacts on bird health and performance. Here are five ways to reduce ammonia levels in poultry houses:

- 1. Ration composition and diet management**, provision of a balanced, complete diet is of the highest importance. Problems occurring due to high-performance genetics, feed formulation and medication can lead to production of wet manure, causing increased ammonia and odor release alongside reduced broiler performance and feed efficiency.
- 2. Optimize the poultry stocking density** to help limit excessive moisture in the poultry house, so reducing anaerobic processes.
- 3. Adjust the ventilation rate** – if ammonia levels increase, more ventilation is needed. However, this should only be in accordance with the climate and temperature of the poultry house.
- 4. Temperature adjustments** should be made relating to house climate and welfare.
- 5. Improve nutrient digestibility.** This could also be achieved by supplementing diets with additives.

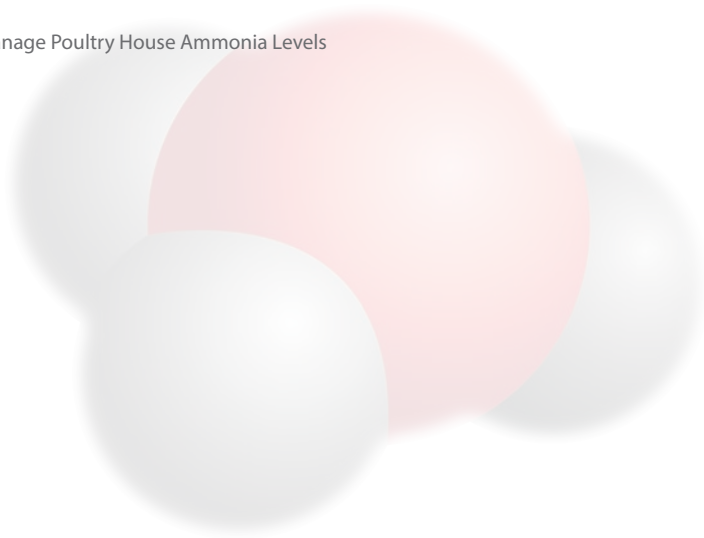
Of this list, dietary management is the most important preventative measure. The total amount of nitrogen within the birds' feces can be considerably reduced by formulating diets based on the birds' amino acid requirement instead of on total crude protein. As the percentage of crude protein in the diet is lowered

### A high concentration of ammonia in the poultry house has adverse effects on the health and performance of birds.

and replaced with conventional sources of protein (e.g. soybean meal, sunflower meal) with synthetic amino acids, nutrient retention is maximized. Reducing dietary protein by 3-5% may cause a reduction of 60% or more in total nitrogen excretion from broilers and laying hens.

A well-balanced diet contains highly digestible ingredients and functional feed additives that can improve the digestibility of nutrients in the small intestine of birds. Inflammation caused by stress may dramatically decrease the ability of the birds to digest and absorb nutrients including proteins.

An inflamed and unhealthy intestine is not capable of absorbing digested feed, even if the digestion has been enhanced by exogenous enzymes. Keeping the gastrointestinal tract healthy and functional during the whole growing period is key to reducing the excretion of undigested and unabsorbed feed in the feces which will in turn reduce the ammonia volatilization within the poultry house (*Figure 2*).



**The total amount of nitrogen within the birds’ feces can be considerably reduced by formulating diets based on the birds’ amino acid requirement instead of on total crude protein.**

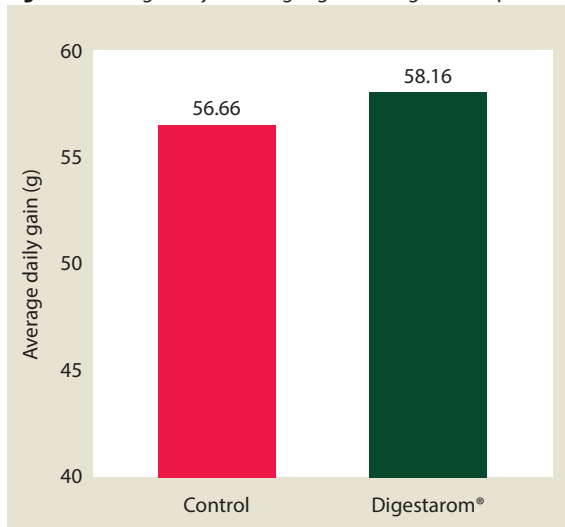
**Phytogenic Feed Additives (PFAs)**

Phytogenic feed additives are capable of increasing the digestibility of nutrients within the gastrointestinal tract and reducing gut inflammation caused by stressors. These two important effects of PFAs may considerably increase the gut integrity of the birds. Phytogenic feed additives also modulate gut microbiota, minimizing the negative effect of harmful bacteria on the gut. Less undigested and

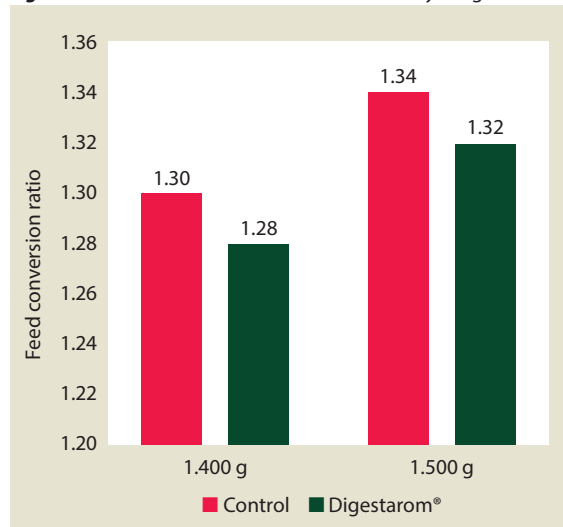
unabsorbed nutrients will be passed to the feces from a healthy gut, which means less nitrogen excretion from the birds to the environment. Less nitrogen excretion reduces ammonia volatilization within the chicken house to a great extent.

In a recent trial, Digestarom® Poultry, the PFA offered by BIOMIN, was added to the diet of one group of birds while the control group had no PFA added. Over the duration of the trial, the ammonia concentration in the Digestarom® Poultry house was 12.12% lower when compared to the control group. The airflow rate was 14.19% lower and the ammonia emissions were significantly reduced (11.71% lower) in the treated group compared to the control group. Total nitrogen in the litter of the treated group was 33.93 kg/t, 8.01% lower than 36.89 kg/t as measured in the control group. At the same time, the performance of the birds in the Digestarom® Poultry group increased both in terms of daily live weight gain and feed conversion ratio. The improvements were measured as 1.6 g/d and 4 FCR points - as shown in Figures 3 and 4 respectively.

**Figure 3.** Average daily live weight gain during the trial period.



**Figure 4.** Feed conversion ratio at different body weights.



# What's Wrong with My Birds?

## Part 10 - Lameness Conditions (Viral 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, increased carcass condemnation and downgrading at slaughter.

Lameness is often a multifactorial condition. Understanding various causes can help producers identify improvements 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.

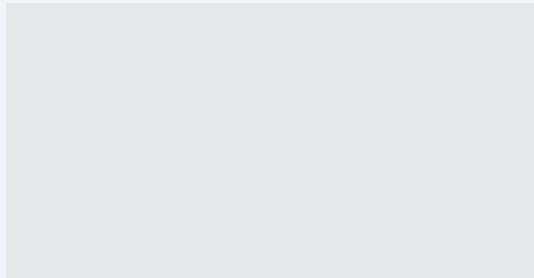
This table focuses on lameness conditions caused by pathogenic factors, namely viruses, and suggests solutions that can help prevent or alleviate lameness caused by these conditions.

Condition	Corrective action
<b>Tenosynovitis/Viral arthritis</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Avian reovirus</li> <li>• <b>Symptoms:</b> Soft swelling of the joints with turbid fluid in the capsule, swollen shanks</li> <li>• <b>Lesions:</b> Swelling and petechiae in the synovial membranes, small erosions on the articular cartilage, adhesions between the tendons and fibrosis of tissues</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Live vaccine followed by inactivated vaccine</li> <li>• <b>Treatment:</b> Euthanize the infected flock</li> </ul>
<b>Amyloidosis</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Corona virus</li> <li>• <b>Symptoms:</b> Swollen hock joint containing orange-yellowish material, muscular shivering</li> <li>• <b>Lesions:</b> Extracellular build up of amyloid protein in joints and internal organs</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Live vaccine</li> <li>• <b>Treatment:</b> Sodium salicylate 1g/litre (acute phase). Antibiotics to control secondary colibacillosis</li> </ul>
<b>Infectious bronchitis (IB)/Infectious laryngo tracheitis (ILT)</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Corona virus, Herpes virus</li> <li>• <b>Symptoms:</b> Sudden death, muscular shivering</li> <li>• <b>Lesions:</b> Edema of skeletal and pectoral muscles</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Live vaccine</li> <li>• <b>Treatment:</b> Sodium salicylate 1g/litre (acute phase). Antibiotics to control secondary colibacillosis</li> </ul>
<b>Marek's disease</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Avian Herpes virus 2</li> <li>• <b>Symptoms:</b> One leg stretched forward and the other backward</li> <li>• <b>Lesions:</b> Tumors in internal organs, unilateral enlargement of peripheral nerves</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Live vaccine</li> <li>• <b>Treatment:</b> Eradication of infected flock</li> </ul>
<b>Avian encephalomyelitis (AE)</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Picornavirus</li> <li>• <b>Symptoms:</b> Trembling of the head, neck, and wings, paralysis of both legs extended out to one side</li> <li>• <b>Lesions:</b> Gross lesions are mild or absent, focal white areas in gizzard muscle</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Vaccination of breeders</li> <li>• <b>Treatment:</b> None</li> </ul>
<b>Newcastle disease</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Avian paramyxovirus serotype 1</li> <li>• <b>Symptoms:</b> Twisting of neck and paralysis of wings and legs, cyanosis of comb, facial edema, green diarrhea, drop in egg production, sudden death</li> <li>• <b>Lesions:</b> Hemorrhage in intestine, petechial hemorrhage in proventriculus, congestion and mucoid exudates seen in the respiratory tract, especially in trachea</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Live vaccine</li> <li>• <b>Treatment:</b> None. Antibiotics to control secondary bacterial infections</li> </ul>
<b>Eastern equine encephalitis</b>	
<ul style="list-style-type: none"> <li>• <b>Etiology:</b> Arbovirus</li> <li>• <b>Symptoms:</b> Flaccid neck, staggering, paralysis</li> <li>• <b>Lesions:</b> No gross lesions</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Prevention:</b> Vaccination. Control mosquito population</li> <li>• <b>Treatment:</b> None</li> </ul>

For more information, visit [www.mycotoxins.info](http://www.mycotoxins.info)

DISCLAIMER: This table contains general advice on poultry-related matters which most commonly affect poultry and may be related to the presence of mycotoxins in feed. Poultry diseases and problems include, but are not confined to the ones present in the table. BIOMIN accepts no responsibility or liability whatsoever arising from or in any way connected with the use of this table or its content. Before acting on the basis of the contents of this table, advice should be obtained directly from your veterinarian.





# Mycofix<sup>®</sup>

## Absolute protection

Powered by science to actively defend against multiple mycotoxins\*



With 3 combined strategies



ADSORPTION



BIOTRANSFORMATION



BIOPROTECTION

\*Authorized by EU Regulation 1060/2013, 2017/913 and 2017/930.

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