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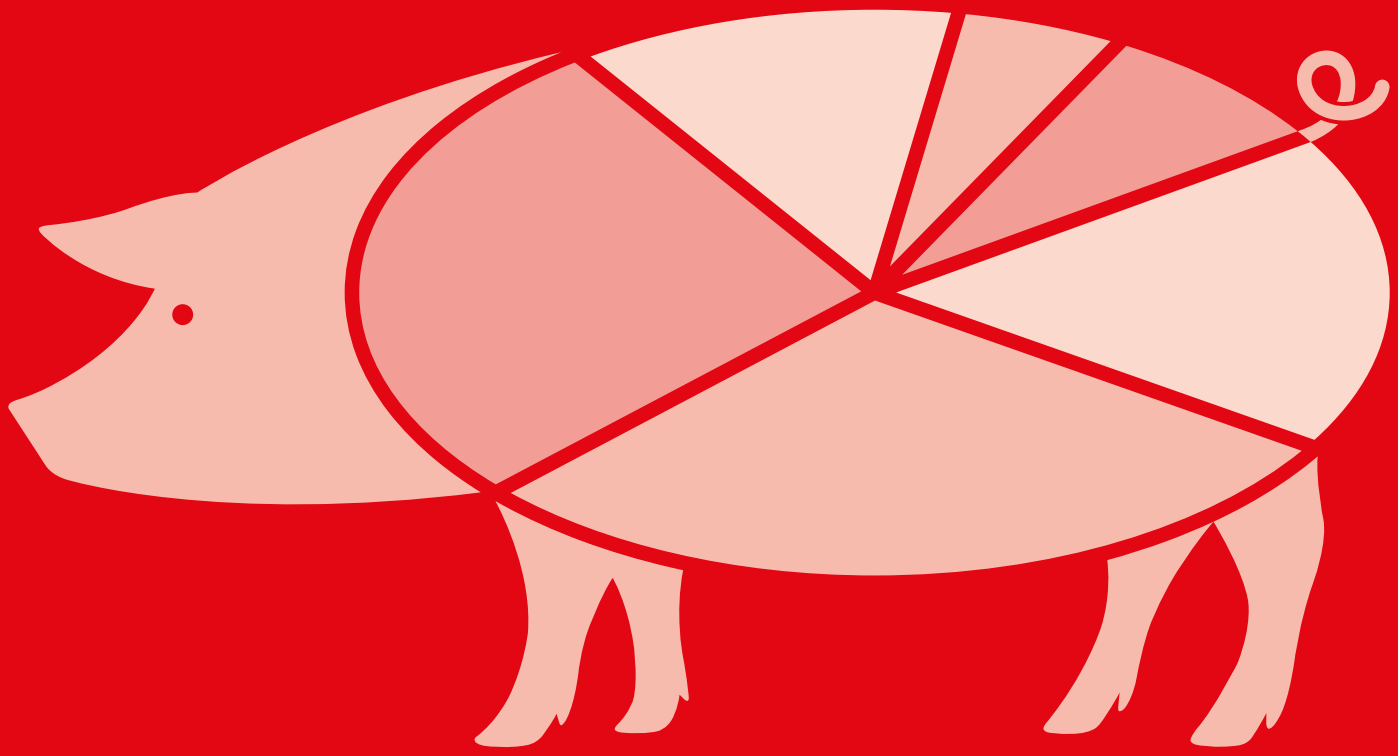
Keeping you naturally informed | Issue 60 | Swine

Are you managing your endotoxin risk?

Guarantee swine herd success by following these 10 management tips

Can antibiotic growth promoters be replaced with phytogenic feed additives?



Guarantee success through effective swine management

Managing gut performance challenges

Pigs in intensive production systems face many challenges that deserve to be managed carefully because of the greater genetic potential of highly prolific sows and the high levels of lean meat production during the fattening period.

There is a lot of pressure on feed conversion due to the limited accessibility to affordable and fresh feed ingredients, and from pathogenic and environmental stressors or toxins such as mycotoxins and endotoxins. To overcome these challenges, many countries have started to regulate antibiotic and feed additive usage because of potential risks to human health or environmental contamination.

Endotoxins are released during the replication or lysis of bacteria. In healthy animals, the gut acts as a barrier to endotoxins entering the blood. Yet in times of environmental, nutritional or metabolic stress, gut permeability can increase, allowing endotoxins to enter the blood stream, weakening the immune system and impairing animal performance. Pigs are continuously exposed to endotoxins throughout their lives.

In this issue of Science & Solutions, we keep you naturally ahead by sharing three articles containing different management tips on how to maximize feed conversion through establishing a stronger health status and higher body condition score at the early stage of the pig's life, as well as enhancing gut protection by adding selective feed additives to swine diets.

Industrial conditions are not always favorable for the production of high-quality pork that converts into high profits to producers. This edition of Science & Solutions provides you with a scientific and practical view, continuing our emphasis on natural and sustainable ways to help producers improve livestock productivity and profitability.

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

Siyeong Choi, DVM
Regional Technical Manager, Swine

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Are You Managing Your Endotoxin Risk?

Endotoxins are released during the replication or lysis of bacteria. In healthy animals, the gut acts as a barrier to endotoxins entering the blood. Yet in times of environmental, nutritional or metabolic stress, gut permeability can increase, allowing endotoxins to enter the blood stream, weakening the immune system and impairing animal performance. Mycofix® included in the diet can combat the negative impact of endotoxins.

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Michele Muccio MSc
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Endotoxins and negative effects in swine

Lipopolysaccharides (LPSs) are cell wall components of Gram-negative bacteria such as *E. coli* and *Salmonella*. They are also called endotoxins and are released during bacterial replication or death (lysis). LPSs vary depending on the originating bacteria, being more or less aggressive or pathogenic according to the variability of the O-specific polysaccharide chain. They also serve as a potential entry barrier to antimicrobials on the outer membrane of Gram-negative bacteria. Pigs are continuously exposed to LPSs throughout their lives. While the main route for swine LPS exposure is via the gastrointestinal tract, the concentration of endotoxins in the air and dust should not be overlooked: endotoxins are a major component of biological dust.

In healthy animals, the intestinal and other epithelia such as the skin or lungs represent an effective barrier preventing the passage of LPSs into the bloodstream. However, if they do gain entry, endotoxins can elicit strong immune responses, weakening immune systems and impairing performance. In swine species, endotoxins cause an inflammatory cascade that increases a pig's maintenance requirements due to fever. This, coupled with reduced feed intake, leaves less energy available for growth. Moreover, a severely pronounced immune response can lead to septic shock.

Endotoxins and feed efficiency

Endotoxins also impair feed efficiency. A recent study of common challenges in pig farms reported a decrease in growth response due to decreased feed intake for a number of reasons as listed in *Table 1*.

If they gain entry to the blood, endotoxins can elicit strong immune responses, weakening immune systems and impairing performance.

Table 1.
Percentage decrease in feed intake associated with various reasons

Reason for decrease in feed intake	Percentage decrease
Parasitic infections	3%
Poor housing conditions	4.1%
Digestive bacterial infections	10.2%
Respiratory diseases	17.3%
Mycotoxicoses (mycotoxin-induced diseases)	25.2%
Lipopolysaccharides (LPSs)	26.8%

The results are also displayed along with feed efficiency differences in *Figure 1*.

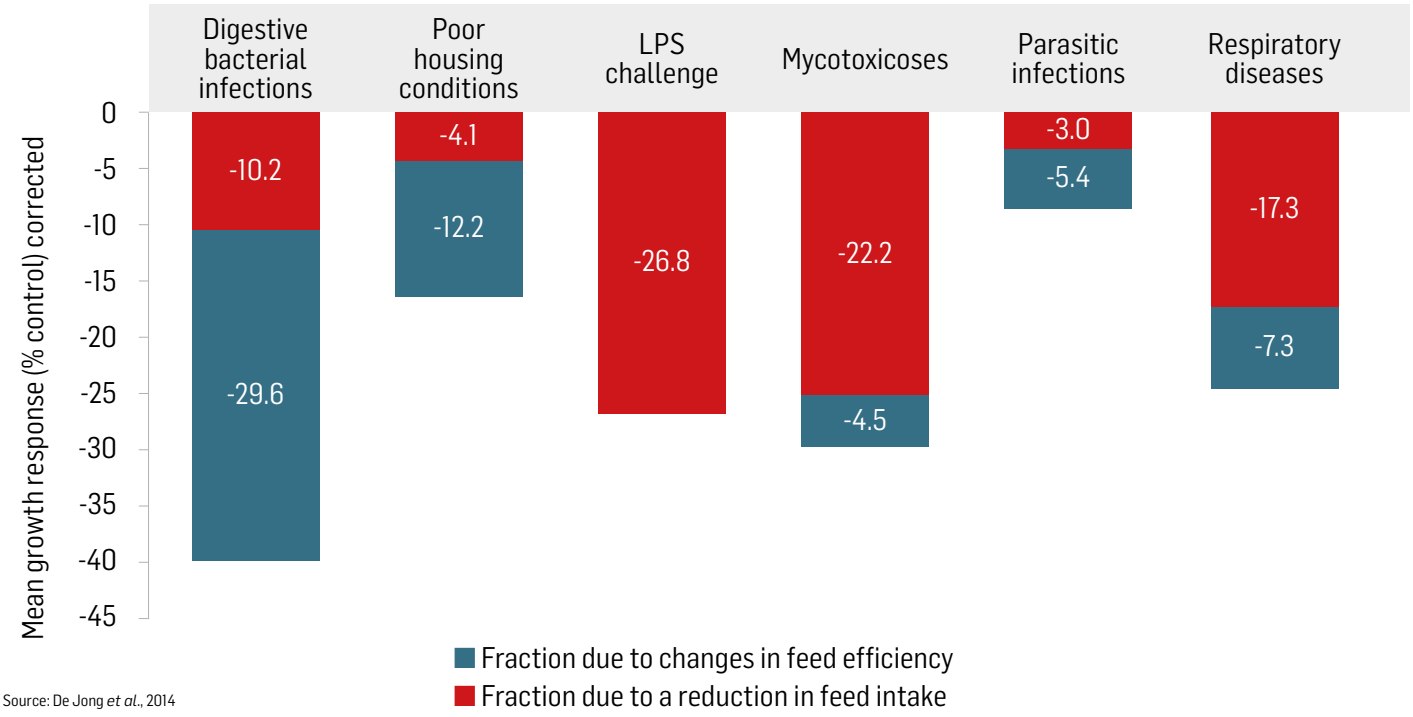
Prevention and management of endotoxin risk

In recent years, new concerns have emerged about nutritional, environmental, and social factors that may disrupt the gut barrier function and/or increase exposure to LPSs. The gut is the first line of defense against endotoxins and, if compromised with anti-nutritional, stress or metabolic factors, e.g. in times of heat stress, mycotoxin contamination or inflammation, endotoxin transport can increase. In several livestock species, it is commonly accepted that a 1 - 2°C increase in body

IN BRIEF

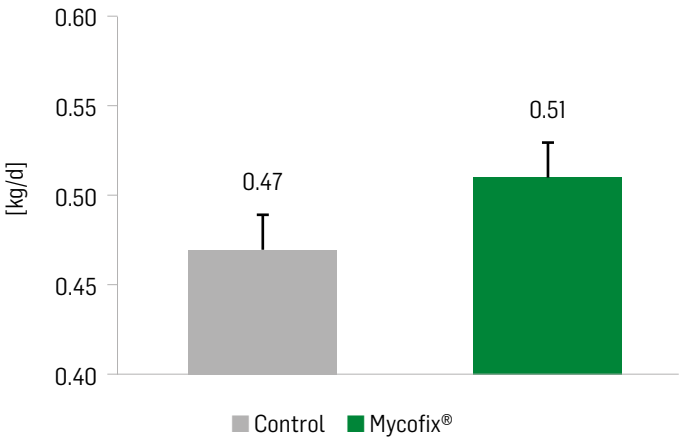
- The gut is the first line of defense against endotoxins, but if gut integrity is compromised, endotoxins can enter the blood stream.
- Endotoxins cause an immune response and impair feed efficiency, both of which reduce the amount of energy available to the animal for growth.
- Mycofix® is an effective solution against endotoxins as shown in two international trials.

Figure 1.
Metabolic consequences expressed in negative growth response of an activated immune system due to different challenges



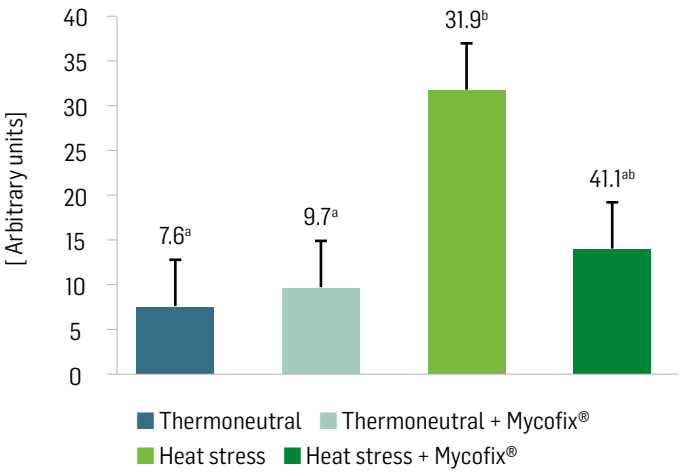
Source: De Jong *et al.*, 2014

Figure 2.
Average daily weight gain in pigs over 28 days of age receiving either the control diet or the Mycofix®-treated feed before heat stress (p=0.26). Bars represent pooled standard error of the mean.



Source: BIOMIN

Figure 3.
Effect of different conditions (thermoneutral vs heat stress) on gilts fed the control diet or the Mycofix®-treated feed on ileal endotoxin permeability. Bars represent pooled standard error of the mean.



Superscripts indicate statistically significant differences
Source: BIOMIN

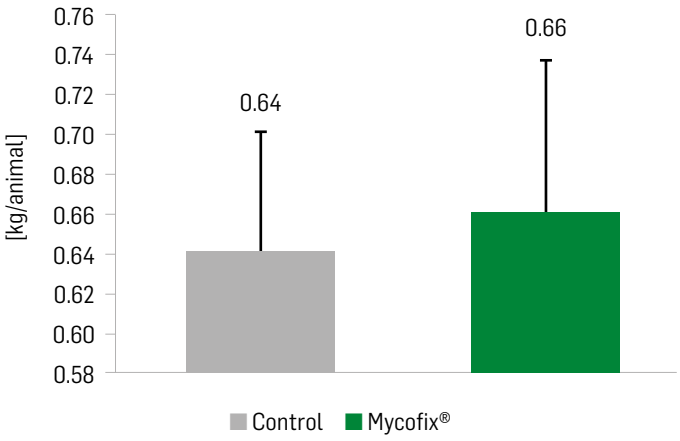
temperature causes the intestinal tight junction proteins to be affected, increasing intestinal permeability and allowing more LPSs to enter the blood stream. High calorific and high fat diets increase serum endotoxin concentrations and induce acute low-grade inflammation.

Starvation depresses the expression and function of intestinal alkaline phosphatase (IAP), a brush–border enzyme that detoxifies LPSs.

A BIOMIN solution for the management of endotoxins

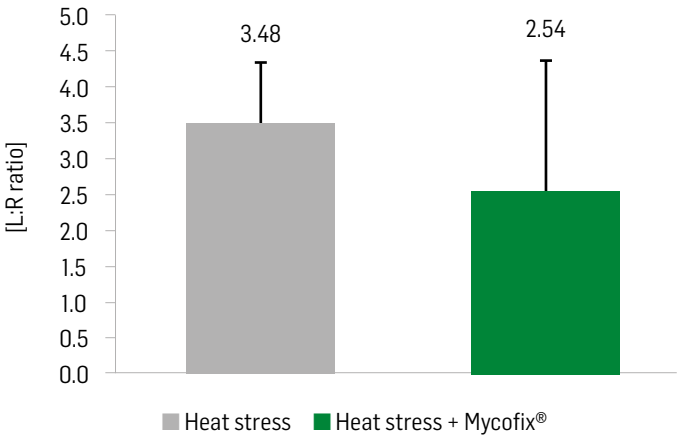
Mycofix® is a state-of-the-art, market-leading product for the deactivation of mycotoxins, which utilizes the three strategies of adsorption, biotransformation and bioprotection to provide 360° mycotoxin counteraction. The product has also demonstrated effectiveness against

Figure 4.
Average daily weight gain in pigs between 36 and 56 days of age receiving either the control diet or the Mycofix®-treated feed before heat stress (p=0.197). Bars represent standard deviation.



Source: BIOMIN

Figure 5.
Sugar permeability testing, measured as L:R ratio, of pigs receiving either the control diet or the Mycofix®-treated feed on the second day of heat stress. Bars represent standard deviation.

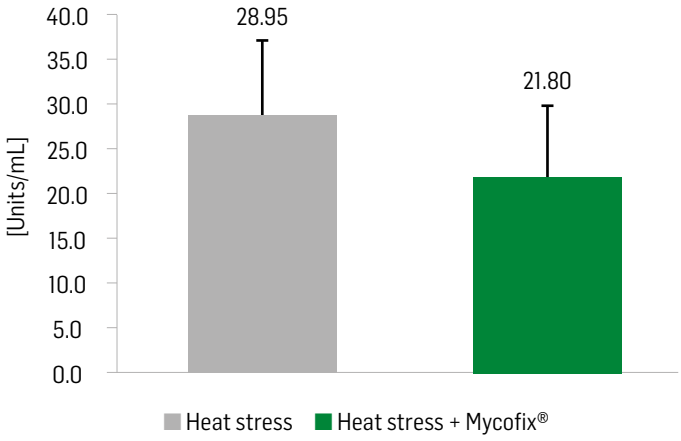


Source: BIOMIN

endotoxins, combining the strength of the only existing EU-registered adsorbent product on the market with the BIOMIN bioprotection mix: a combination of carefully selected plant and algae extracts that support the liver, immune system and gastrointestinal tract.

The performance of Mycofix® against endotoxins was recently evaluated in two trials conducted at Iowa State University (USA) and at the Center for Applied Animal Nutrition (CAN) in Austria. The aim of the trials was to evaluate the effects of Mycofix® on endotoxin permeability and inflammation response in piglets under heat stress conditions. In the Iowa State University trial, 32 one-week post-weaning gilts were assigned to two treatment groups: the control group and a group where 2.5 kg of Mycofix® per ton of feed was included in the diet. The duration of the trial was 28 days. Several parameters were evaluated including average daily weight gain and ileal endotoxin permeability (*Figures 2* and *3*).

Figure 6.
Endotoxin concentration in serum of pigs receiving either the control diet or the Mycofix®-treated feed on the first day of heat stress. Bars represent standard deviation.



Source: BIOMIN

In the second trial conducted at CAN, 36 piglets (at 21 days of age) were assigned to two treatment groups: a control group or a group fed a diet containing 2.5 kg of Mycofix® per ton of feed. The duration of the trial was 56 days. Several parameters were evaluated and included performance (average daily weight gain in kg/d) over the whole feeding period, gut permeability during heat stress measured via the sugar permeability assay (lactulose: rhamnose (L:R) ratio), and endotoxin concentration (Units/mL) in the blood during heat stress (*Figures 4*, *5* and *6*).

The results of both trials demonstrate that Mycofix®, at a concentration of 2.5 kg per ton of finished feed, is able to:

- counteract the negative effects of increased intestinal permeability induced by heat stress in weaning pigs
- decrease endotoxin concentration in the blood

All the results suggest that when Mycofix® is used, a counteraction of the triggering effects of endotoxins is observed, which leads to an improvement in performance during times of heat stress.

Reference

De Jong, J.A., DeRouchey, J.M., Tokach, M.D., Dritz, S.S. and Goodband, R.D. (2014). Effects of dietary wheat middlings, corn dried distillers grains with solubles, and net energy formulation on nursery pig performance. Journal of Animal Science. 92(8). 3471-3481.

Guarantee Swine Herd Success By Following These 10 Management Tips

Anita Urbańczyk MSc
Technical Sales Manager Swine

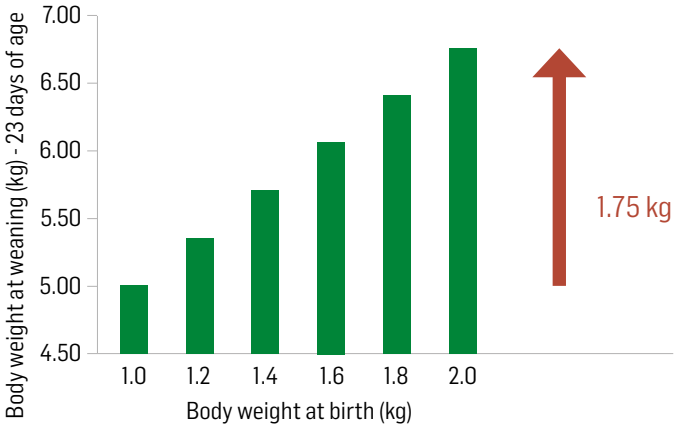
Piglets and sows are the two most important groups of animals in a swine herd. Follow these 10 tips to help get the most from your herd.

Operational efficiency is key for pig producers to stay competitive and be successful. That means effectively converting feed, which accounts for approximately 75% of total production costs, into pork.

In addition, the greater genetic potential of animals is changing the standard approach to production methods. Working with high-producing, prolific sows requires a change in management, improving environmental conditions and paying close attention to high biosecurity standards.

Sow management requires investment in feed, skilled labor and other overheads that are not directly linked to sow productivity. The conclusion is simple: the fewer piglets a sow produces per year, the more expensive production is. As the number of piglets weaned per sow per year increases, the profitability of production also increases.

Figure 1.
Correlation between birth body weight and weight at weaning



Source: BIOMIN

IN BRIEF

- Achieving optimal results in swine production involves close management of all animals, but piglets and sows in particular.
- Giving piglets the best possible start in life will positively affect the future performance of the herd.
- Nutritional supplements such as PFAs and acidifiers incorporated into sow diets promote newborn piglet health and sow performance during farrowing and lactation.

Management tip #1
Measure piglet birth weight

The first key area is ensuring the sow is properly prepared before farrowing. The second key area is farrowing itself, which has a big impact on newborn piglets. Piglet birth weights should be optimized to guarantee optimum survival rates. Depending on the number of piglets in a litter, the birth weight should not be lower than 1.4 kg. In large litters, piglets can weigh 1.2 kg at birth, but this difference in body weight leads to a difference in weight at weaning. For example, a difference of 1 kg in birth weight equates to a difference of 1.75 kg in body weight after 23 days of lactation (*Figure 1*).

As the number of piglets weaned per sow per year increases, the profitability of production also increases.

Management tip #2
Record farrowing times

The length of time taken for farrowing should be monitored. Usually, a sow needs 15 - 20 minutes to give birth to one piglet, which means that the farrowing process for a litter of 15 piglets should take no longer than 4.5 - 5 hours. This amount of time allows each newborn piglet enough time and strength to start searching their way to the mammary gland for their first feed of colostrum.

Table 1.
Comparison of nutrient content in sow colostrum and sow milk

	Colostrum (hours after birth)			Milk (week of lactation)	
	0	6	12	3	4
Dry matter (%)	24.4	21.1	19.8	18.4	18.1
Crude protein (%)	15.5	11.5	9.0	5.5	5.5
Crude fat (%)	5.0	5.0	6.0	5.6	6.1
Lactose (%)	3.3	4.0	4.2	5.5	5.5
Minerals (%)	0.6	0.6	0.6	1.0	1.1

Source: BIOMIN

Table 2.
Immunoglobulin content in sow colostrum and sow milk

Component	Colostrum	Mature milk
IgA (mg/ml)	21	5
IgG (mg/ml)	96	1
IgM (mg/ml)	9	1.5

Source: BIOMIN

Management tip #3
Monitor colostrum intake

The vitality of a piglet in the first hours after birth has a key influence on its future development. The intake of colostrum should occur as early as possible to guarantee assimilation of the immunoglobulins necessary to develop an active and robust immune system. The composition of colostrum changes very quickly in the hours after farrowing. Crude protein content decreases from 15% in colostrum to only 5.5% in milk. As crude protein contains immunoglobulins, that content also changes rapidly. A comparison of the nutrient content of sow colostrum and sow milk is shown in *Table 1*. The immunoglobulin content is shown in *Table 2*.

Management tip #4
Add nutritional supplements in early life

Special nutritional products can be used to support the vitality of small or weak piglets just after birth. Liquid compositions of essential oils are used for their appetizing, strong antimicrobial and anti-oxidative effects. Additionally, they may contain medium-chain fatty acids, which supply piglets with the rapid energy they need. Supplementation of vitamin E supports the development of the immune system. Such products are able to support weak piglets on their first day of life to reduce mortality during the first few hours after birth. A typical dose is 1 - 2 ml per piglet, administered directly into the mouth once, twice, or three times per day after which increased piglet vitality can be expected.

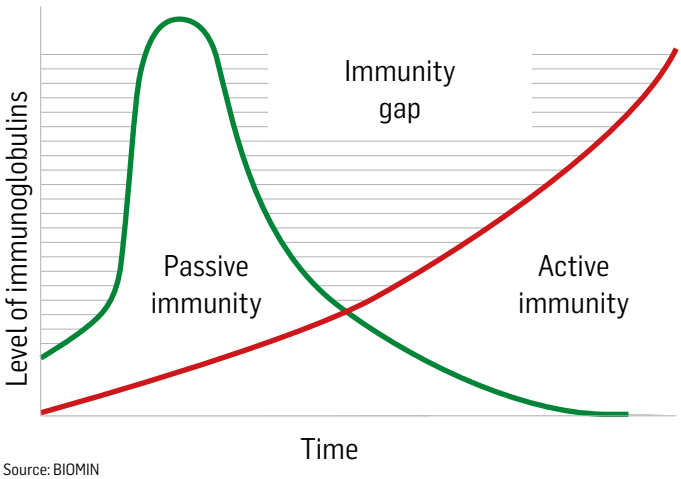
Management tip #5
Support early immune system development

Newborn piglets have passive immunity received from the mother during the prenatal period. After birth, passive immunity decreases over the course of several days, stimulating the development of the innate immune system based on early colostrum intake. The piglet absorbs the highest quantity of immunoglobulins from the colostrum in the first 12 hours after birth. Over time, the amount of immunoglobulins in the colostrum and milk decreases, as does the piglets' opportunity to absorb them.

Management tip #6
Bridge the immunity gap

Weaning is a critical life cycle stage for piglets. One of the reasons for this is the change from liquid feed (milk) to solid creep feed. The second reason is the immunity gap, which

Figure 2.
Level of immunoglobulins in blood



Source: BIOMIN

appears around the weaning period (*Figure 2*). Between the third and sixth week of life, passive immunity decreases and active immunity increases. In this critical period, piglets do not yet have enough active immunity, and they are no longer protected by passive immunity. If breeders make management mistakes during this time, for example the environment is not optimized for piglet development or the feed is not well adjusted, it creates a lot of problems including diarrhea, weight loss, and other health problems.

Management tip #7
Use phytogenic feed additives in sow diets to boost milk production

When managing prolific sows, additional feed supplementation to increase colostrum and milk production should be considered. Phytogenic feed additives (PFAs) added to sow diets during gestation and lactation help to improve both the quantity and the quality of colostrum and milk. Phytogenic components improve the digestibility of particular dietary nutrients. Endogenous enzyme secretion is much higher when diets are supplemented with PFAs compared to diets without PFA supplementation. By improving the digestibility of feed, sows absorb more nutrients and are therefore able to produce more, better quality milk, as proven by many scientific and commercial trials.

The best and easiest way to assess sow milk production is to monitor the weaning weight of piglets. Comparing data from before and after PFA supplementation will highlight differences. Piglets of sows fed PFA-supplemented feed are typically between 250 – 400 grams heavier at weaning than control piglets. Other factors to be considered include genetic potential, herd management, health status, nutrition and human labor.

Management tip #8
Use PFAs to improve sow health

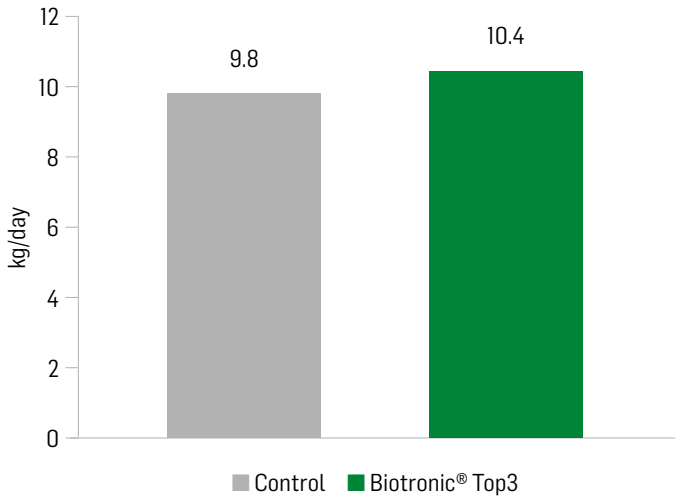
PFAs, which are products derived from essential oils, herbs and spices, have other properties including anti-inflammatory effects. This means that PFAs can help to create a barrier against pathogens in the gut, improving the health status of sows. This plays an important role for proper management of the main herd.

Management tip #9
Use acidifiers to promote feed intake

Another factor that can influence milk production is acidification. Using well-balanced acidifiers in the feed helps to control the acid-intolerant bacteria, e.g. Gram-negative bacteria, thus promoting a beneficial microflora in the gut. Acidification can also improve feed hygiene. When the right acids are included in the diet, sows are able to take in more feed which results in up to 0.5 l/day of extra milk as shown in *Figure 3*.

Additional feed supplementation to increase colostrum and milk production in sows should be considered.

Figure 3.
Increased milk yield with Biotronic® Top3



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Management tip #10
Ensure water supply is of adequate quality and quantity

The supply of fresh, clean water is often overlooked when managing sows. Sows need water just as piglets, and growing and finishing pigs do. However, sows have to produce milk and thus need to drink much more water compared to the other groups. To produce 1 l of milk, a sow needs to drink 2.5 l of water. During the gestation period, a sow drinks around 15-20 l of water per day. Sows in the lactation period need more than 22 l of water per day, depending on the size of their litter.

Water flow should be regularly checked to ensure the flow rate is not too low. The flow rate for sows in the gestation period should be at least 3 l/min, and for sows in the lactation period at least 4 l/min.

Taking care of piglets from the beginning by creating an optimal environment (with optimal temperature, humidity, air flow), advanced biosecurity and skilled labor is the only way to achieve high breeding results. The potential of the whole herd depends on the quality of the piglets.

Can Antibiotic Growth Promoters Be Replaced with Phytogenic Feed Additives?

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Product Manager Phytogenics

Growing consumer demand and increasing regulatory pressures mean many swine feed formulations no longer include antibiotic growth promoters (AGPs). Unless AGPs are replaced with a suitable alternative, a performance gap might open up due to energy being used to fight pathogenic challenges rather than for growth. Phytogenic feed additives (PFAs) have anti-inflammatory properties, making them a viable alternative.

IN BRIEF

Digestarom® is an effective replacement for AGPs thanks to:

- its volatile aroma and active constituents that improve the palatability of feed
- its ability to stimulate the release of endogenous enzymes to improve nutrient digestibility
- its positive effects on intestinal morphology, improving nutrient uptake
- its effect on the gut microbiome, promoting the growth of beneficial bacteria
- its direct anti-inflammatory effects, allowing more energy to be used for growth

The use of AGPs in the animal feed industry has been decreasing due to their link with antimicrobial resistance. Concerns around increasing levels of antimicrobial resistance has resulted in AGP bans in several countries. In 2006, the use of AGPs in animal feed was banned in the EU. In 2017, the Food and Drug Administration (FDA) brought in new rules sharply curtailing the routine use of antibiotics on farms across the US.

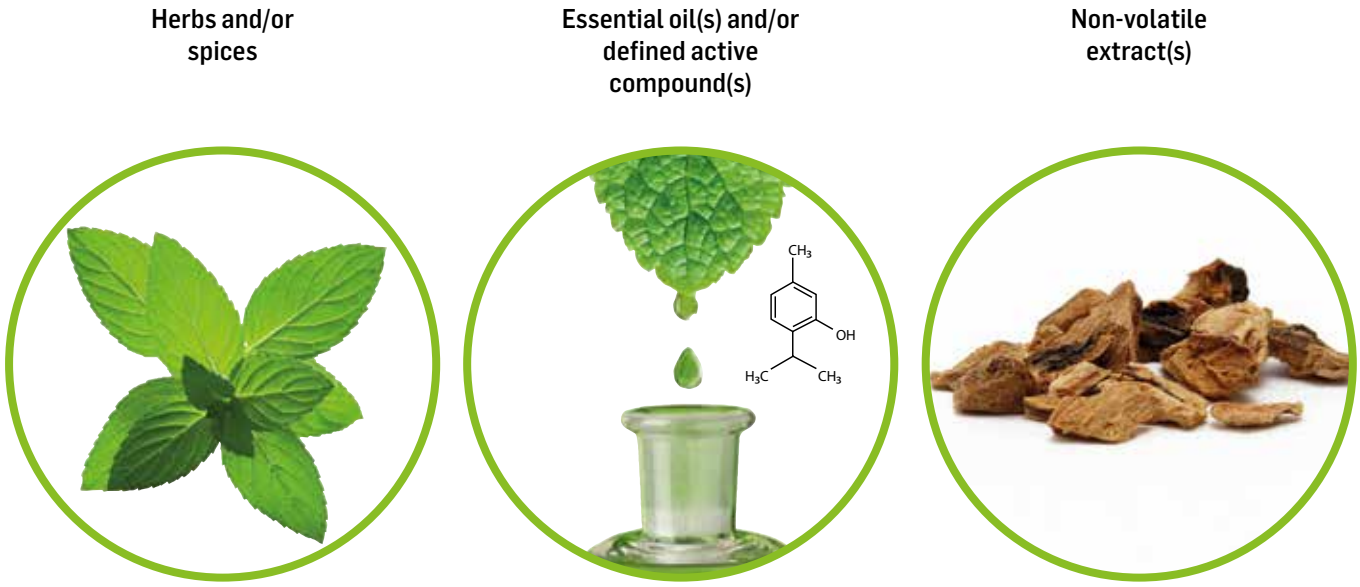
Since the restriction of AGPs, the animal feed industry has faced the big problem of finding adequate replacements in order to sustain and even increase output to meet the growing demand for animal protein worldwide. The main mode of action of AGPs is assumed to be their anti-inflammatory properties (Niewold, 2007), hence alternative products with similar effects on the inflammatory system are highly sought after.

PFAs are an alternative to AGPs

One alternative to AGPs are PFAs. PFAs have been used as natural performance enhancers for many centuries. PFAs are extracted from plants of different origins and include essential oils from herbs and spices, single essential oil compounds, plant extracts and mixtures thereof (*Figure 1*). PFAs have a broad spectrum of chemical compounds depending on their origin, extraction method and mode of application.

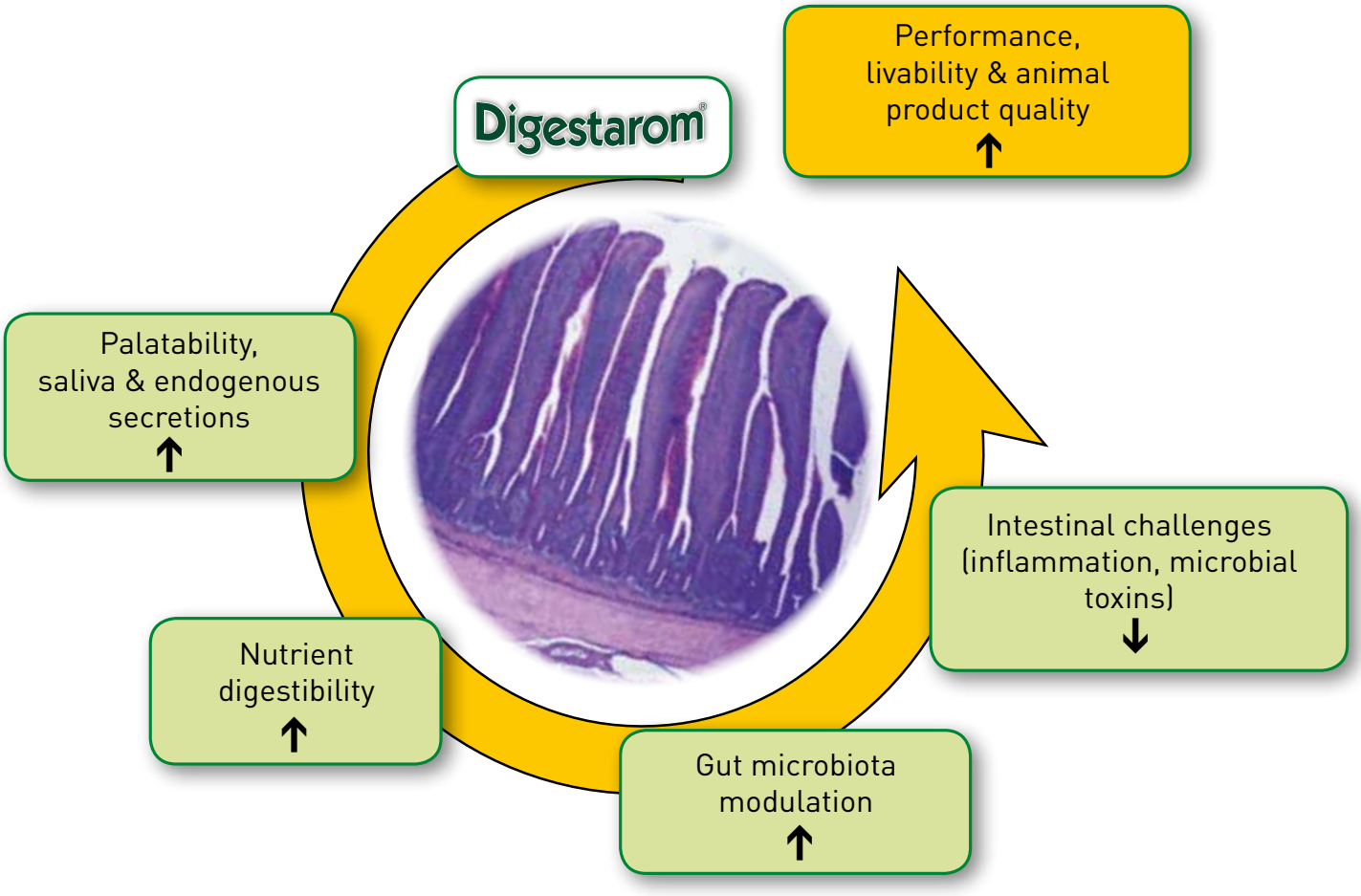
There are several PFAs commercially available on the market, ranging from products providing powder or essential oil from a single plant, to highly specialized PFAs comprising a mixture of different essential oils from herbs and spices and plant extracts. Such highly specialized PFAs have the advantage of showing additive and synergistic effects on animal performance.

Figure 1.
The origins of phytogenic feed additives



Source: BIOMIN

Figure 2.
Digestarom® mode of action



Source: BIOMIN

Photo: iStockphoto_Diana_Robova

Knowing what is in your PFA

It is very important to know the composition of the PFA to better understand its mode of action. BIOMIN supplies the phytogenic product line Digestarom®, a specialized PFA with a proven mode of action consisting of essential oils from herbs and spices, and non-volatile extracts. Digestarom® works in a number of ways (*Figure 2*) including:

- Enhancing the palatability of feed
- Increasing endogenous enzyme secretions
- Improving nutrient digestibility
- Modulating the gut microbiota
- Suppressing inflammatory processes
- Protecting the gut and promoting gut health

All of these effects lead to optimized feed conversion and performance enhancement.

Palatability improvements

Digestarom® has sensory effects due to its volatile aroma and active constituents. These influence the smell (olfactive) and taste (gustatory) perception of the animal, enhancing the palatability of the feed, and promoting and supporting feed intake. These sensory properties are of major relevance since many animal species have more taste buds than humans, making them more susceptible to taste perception.

Additionally, it has been shown that Digestarom® stimulates the release of endogenous enzymes such as maltase, sucrase and aminopeptidase, which results in better carbohydrate and protein digestion. Furthermore, the digestibility of essential amino acids can be improved with the inclusion of Digestarom®, which contributes to better animal performance and can provide nutrient-sparing effects.

Improving intestinal morphology

When Digestarom® was included in the feed, positive effects on intestinal morphology were demonstrated. Villi length increased, which resulted in an enhanced epithelial surface, and crypt depth decreased, which resulted in improved nutrient absorption.

In addition, Digestarom® has a positive influence on the gut microbiota of the animal. The main effects are a reduction in the total microbial number (aerobic and anaerobic) and a decrease in the pathogenic Gram-positive bacteria *Staphylococcus aureus* and *Clostridia*. At the same time, Digestarom® promotes the growth of beneficial bacteria such as *Lactobacilli*. This shift towards more eubiotic conditions in the gut contributes to fewer intestinal challenges, e.g. a reduction in the inflammatory processes in the gut wall.

Direct anti-inflammatory effects

Digestarom® also demonstrates direct anti-inflammatory effects through the down-regulation of NF-κB mediated intestinal inflammation markers (IL-6, ICAM-1, MCP-1), and increases cell protective effects by up-regulating Nrf2 mediated gut protection markers (CYP1A1, HO-1, UGT1A1). Hence, the animal is relieved from intestinal stress, meaning that energy can be utilized for optimizing performance rather than for fighting inflammation.

Conclusion

Digestarom®, a specialized PFA consisting of essential oils from herbs and spices and non-volatile extracts optimizes feed conversion and improves animal performance. With its proven mode of action, Digestarom® is therefore a powerful tool in any AGP replacement strategy.

Reference

Niewold, T, A. (2007). The Non-antibiotic Anti-Inflammatory Effect of Antimicrobial Growth Promoters, the Real Mode of Action? A Hypothesis. Poultry Science. 86(4). 605–609.

Mycofix®

Absolute protection

MYCOTOXIN RISK MANAGEMENT

Powered by science to actively defend against multiple mycotoxins*

With 3 combined strategies

- ADSORPTION
- BIOTRANSFORMATION
- BIOPROTECTION

* Authorized by EU Regulations No 1115/2014, 1060/2013 and 1016/2013 for the reduction of contamination with fumonisins, aflatoxins and trichothecenes.

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