Optimizing the Use of DDGS in Poultry Feeds with Xylanase

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As the poultry industry seeks economical and nutritious feed ingredients, distillers' dried grains with solubles (DDGS), a co-product of grain-based ethanol production, presents a valuable option providing beneficial protein, energy, water-soluble vitamins, xanthophylls, and linoleic acid. However, the inherent variability in DDGS nutrient composition and high fiber content can pose challenges for consistent inclusion in poultry feeds. The strategic use of feed enzymes has become a significant area of focus to overcome these limitations and further enhance the nutritional value of DDGS in poultry diets. This article will explore the optimization of DDGS utilization in poultry feeds by emphasizing the inclusion of xylanase enzyme that can efficiently degrade the insoluble arabinoxylans. By understanding the factors affecting DDGS quality and strategically employing xylanase, poultry producers can potentially achieve higher inclusion rates of this readily available byproduct, aiming to reduce feed costs while maintaining or even improving production performance and overall health.

Price competitiveness of DDGS

The price of DDGS relative to other feed ingredients, primarily corn and soybean meal, is a significant factor in its global utilization. DDGS often partially replaces these traditional energy (corn) and protein (soybean meal) sources in animal feeds, leading to significant diet cost savings for poultry producers. DDGS contains a high amount of a combination of energy, amino acids, and phosphorus. However, it is usually undervalued as its price is mainly determined based on the prevailing prices of corn and soybean meal.

Variability in the nutritional quality of DDGS

The nutrient composition of DDGS varies based on the starting grain, ethanol production methods, and drying processes. Generally, DDGS contains high levels of protein, fiber, and minerals, with varying amounts of fat and starch depending on the type of grain used and how it is processed. DDGS has a reputation for having variable nutrient composition, protein quality, and a high content of mycotoxins (Stein et al., 2006; Pedersen et al., 2007; Anderson et al., 2012). High quantities of DDGS in feed increase dietary fiber, adversely affecting nutrient digestibility.

The variations in production methods lead to significant differences in the following nutritional components of DDGS:

Crude Fat: This is one of the most variable components, ranging from 5 to 9 percent in reduced-oil DDGS and greater than 10 percent in traditional high-oil DDGS.

Energy: The apparent metabolizable energy (AMEn) for poultry varies among DDGS sources. Fiber digestibility and the digestibility of the extracted oil also contribute to this variability. The high temperatures during the drying stage of DDGS production accelerate lipid peroxidation, forming breakdown products from the fats. This peroxidation contributes to the changes and variability observed in the fat component of DDGS and is a factor that can affect nutrient digestibility and overall energy value.

Crude Protein and Amino Acids (especially Lysine): While crude protein content might not always increase inversely with fat reduction, the digestibility of amino acids, especially lysine, can be affected by drying temperatures. Lysine digestibility of DDGS is a primary concern of poultry nutritionists due to the susceptibility of this amino acid to Maillard reactions during the drying process of DDGS, which can reduce both the concentration and digestibility of lysine (Almeida et al. 2013). Prediction equations have been developed to accurately estimate actual AMEn and standardized ileal digestible amino acid content of DDGS sources based on chemical composition.

Phosphorus: The phosphorus content can vary depending on the amount of Condensed Distiller’s Solubles (CDS) added. The bioavailability of phosphorus can also be influenced by processing. The phosphorus content in the corn DDGS may vary from 0.69 to 0.98 % (Olukosi and Adebiyi, 2013).

Fiber: The neutral detergent fiber (NDF) content is another variable component. Differences in processing conditions among ethanol plants can lead to variations in fiber digestibility.

Table 1. Variation in composition of corn DDGS sources (dry matter basis; adapted from (Pederson et al., 2014)

Analyte	Average	Range
Moisture %	8.7	6.5 – 12.5
Crude protein %	31.4	27.1 – 36.4
Crude fiber %	7.7	6.4 – 9.5
Ether Extract %	9.1	6.5 – 11.8
NDF %	35.1	30.2 – 39.7
ADF %	10.1	8.9 – 11.9

Nonstarch Polysaccharides (NSP) in DDGS

Non-starch polysaccharides (NSP) are a significant component of DDGS. The NSP profile of DDGS is crucial for understanding its digestibility and energy content. The corn DDGS has a complex fiber structure that may limit its digestibility in swine and poultry. NSPs in corn DDGS represent 25-34% of its composition, primarily insoluble (Pedersen et al. 2014). The complexity of the fiber structure in corn DDGS makes it more challenging to degrade with enzymes than wheat DDGS. Therefore, while including DDGS in the poultry feeds, choosing an exogenous xylanase enzyme that is highly efficient in breaking down both soluble and insoluble arabinoxylans is essential for maximum energy utilization.

Use of xylanase in DDGS diets for poultry

Supplementing exogenous enzymes in swine and poultry diets have numerous potential benefits including: reduction of digesta viscosity to enhance lipid and protein digestion; increase the metabolizable energy content of the diet; increase feed intake, growth rate and feed conversion; decreased size and alter the microbial population of the gastrointestinal tract; reduce water consumption and water content of excreta in poultry; reduce the amount of excreta as well as ammonia, nitrogen and phosphorus content (Khattak et al., 2006). The selection of a specific enzyme must be based on the type and availability of the target substrate in the diet.

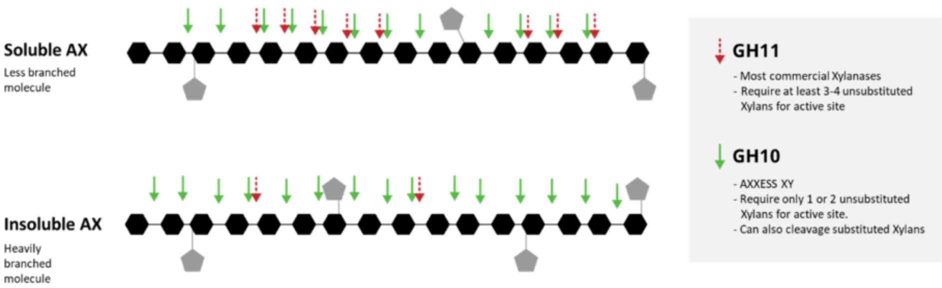
The improved energy utilization of DDGS in poultry can be achieved through the enzymatic degradation of fiber (NSP). Nonstarch polysaccharides within DDGS exist in matrices with starch and protein, so NSP degradation via exogenous enzymes can also release other nutrients for subsequent digestion and absorption (Jha et al. 2015).

The cell wall matrix in corn DDGS is more complex. Moreover, the most readily degradable arabinoxylan for the fiber-degrading enzymes is modified during DDGS production (Pedersen et al. 2014). Many studies reported a greater branch density and complexity of corn arabinoxylan than wheat (Bedford, 1995; Saulnier et al.,1995a; Jilek and Bunzel, 2013; Yang et al., 2013). These observations indicate that the fiber-degrading enzymes applied for the degradation of corn DDGS need to be targeted towards highly complex substrates. This calls for selecting xylanase, which effectively breaks down the insoluble arabinoxylans in diets.

Axxess XY: Highly effective xylanase in breaking down soluble and insoluble arabinoxylans

A bacterial GH10 family xylanase, like Axxess XY, is more beneficial in animal production due to their efficient mechanism of action, broader substrate specificity, and better thermostability. Generally, the GH10 xylanases exhibit broader substrate specificity and can efficiently hydrolyze various forms of xylan, including soluble and insoluble substrates. GH10 xylanases exhibit higher catalytic versatility and can catalyze the cleavage of the xylan backbone at the non-reducing side of substituted xylose residues, whereas GH11 enzymes require unsubstituted regions of the xylan backbone (Collins et al., 2005; Chakdar et al., 2016).

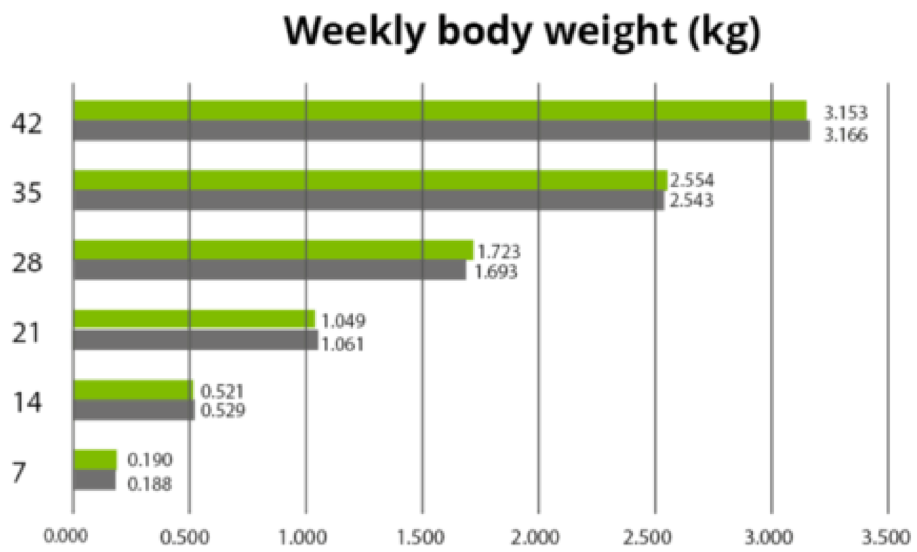
Fig.1. Activity of a bacterial GH10 xylanase against soluble and insoluble arabinoxylans

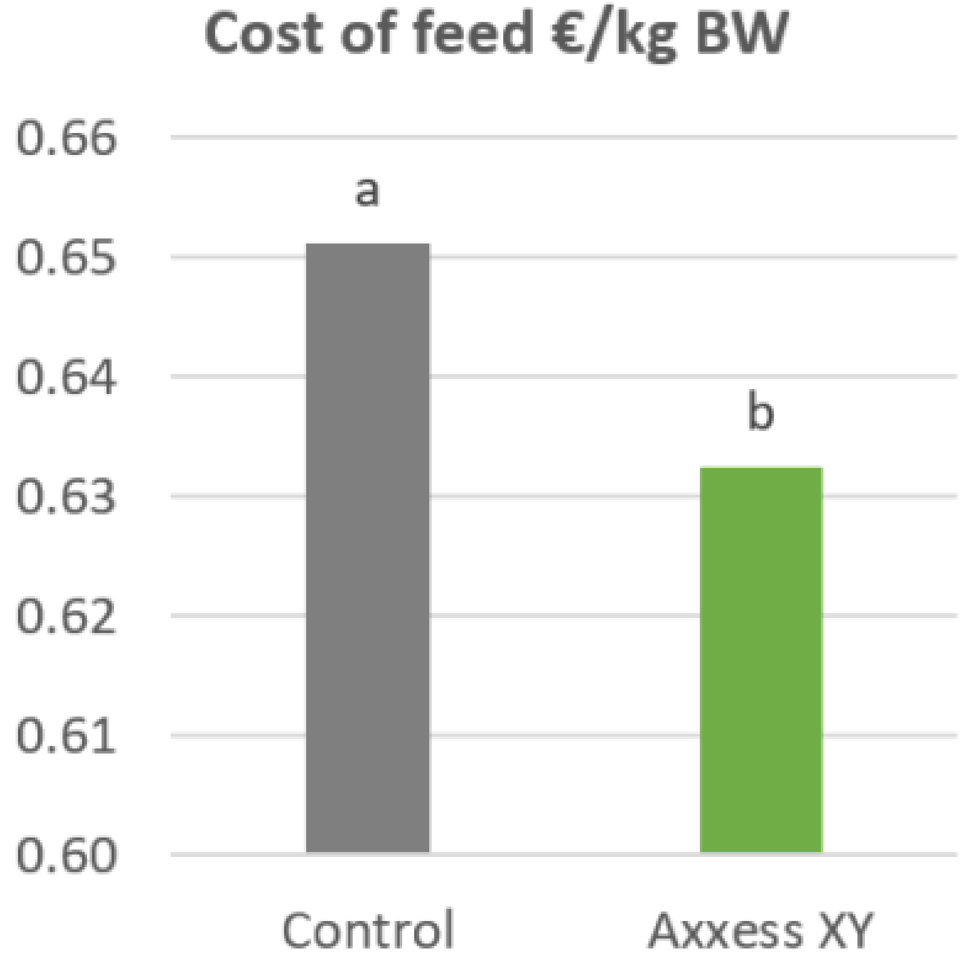


Axxess XY facilitates DDGS use and reduces the cost of broiler production.

Including xylanase enzyme, which is highly effective in breaking down soluble and insoluble arabinoxylans in poultry feeds, can reduce feed costs, allowing higher inclusion of DDGS while maintaining the bird's commercial performance.

In a recently conducted 42-day trial at a commercial farm, Axxess XY maintained broiler performance with a 100 kcal/kg reduction in metabolizable energy and 8% use of Corn DDGS in a corn-SBM based diet (Figure 2). This significantly reduced feed cost/kg body weight.





Incorporating DDGS into poultry diets presents a sustainable and cost-effective solution, but its full potential is often limited by variability in nutrient composition and high fiber content. Xylanase enzymes, particularly those in the GH10 family like Axxess XY, can overcome these barriers by breaking down complex arabinoxylans and unlocking inaccessible nutrients. With proven benefits in energy utilization, nutrient digestibility, and overall production efficiency, xylanase inclusion emerges as a strategic approach to optimize DDGS usage, ultimately supporting economic and environmental sustainability goals in poultry production.

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The big challenge: Keeping sows healthy and productive – Part 1 General aspects to be observed

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Sow mortality critically impacts herd performance and efficiency in modern pig production. Keeping the sows healthy is, therefore, the best strategy to keep them alive and productive and the farm's profitability high.

Rising mortality rates are alarming

In recent years, sow mortality has increased across pig-raising regions in many countries. Eckberg's (2022) findings from the MetaFarms Ag Platform (including farms across the United States, Canada, Australia, and the Philippines) determined an increase of 66.2% between 2012 and 2021.

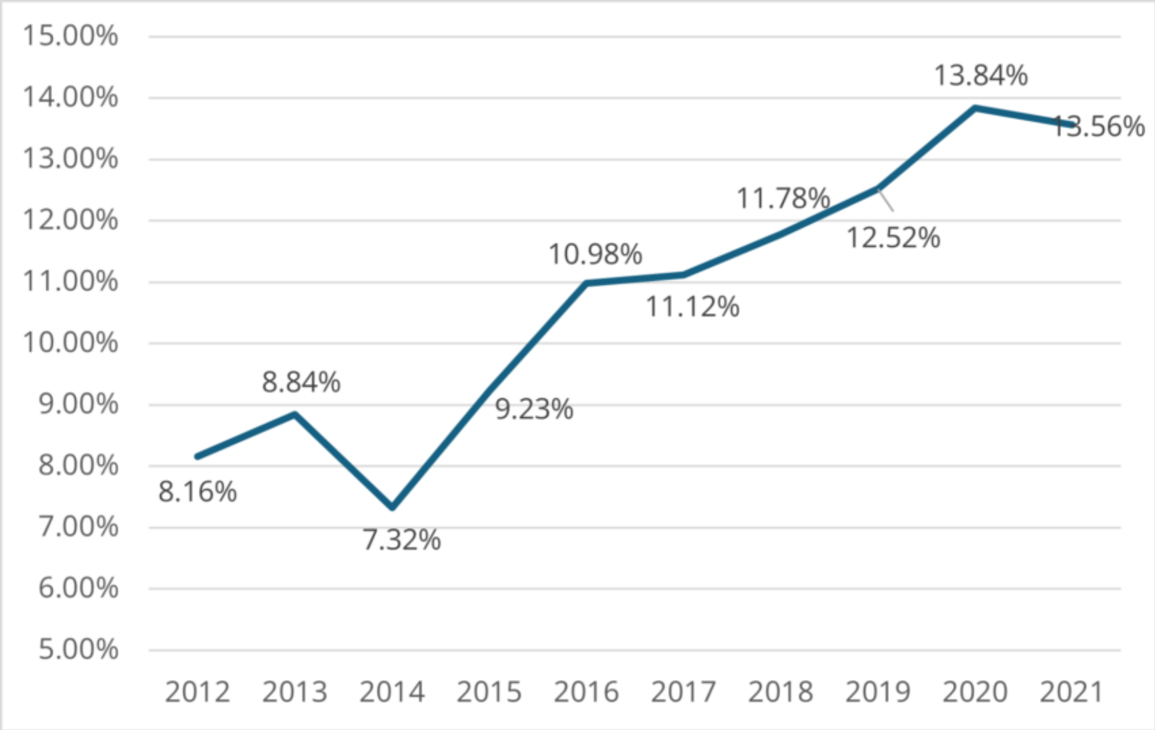


Figure 1: Sow mortality rates from 2012 to 2021 (Eckberg, 2022)

What can be done to decrease mortality rates?

Several measures can be taken to reach a particular stock of healthy and high-performing sows. In the following, the main remedial actions will be explained.

1. Determination of the cause of death

If a sow is dead, it must first be clarified why it has died. If the sow is culled, the reason for this decision is usually apparent. If the sow suddenly dies, investigations, including a thorough postmortem, are extremely valuable to determine the cause of death. Kikuti et al. (2022) provided a collection of the most-occurring causes of death in the years 2009 to 2018. As often, no necropsy is conducted, and the causes of death remain unclear, as shown by the high numbers of “other”. Locomotory (e.g., lameness) and reproductive (e.g., prolapse, endotoxemic shock from retained fetuses) incidents account for approximately half of the recorded sow mortalities (Kikuti et al., 2022), especially during the first three parities. (Marco, 2024).

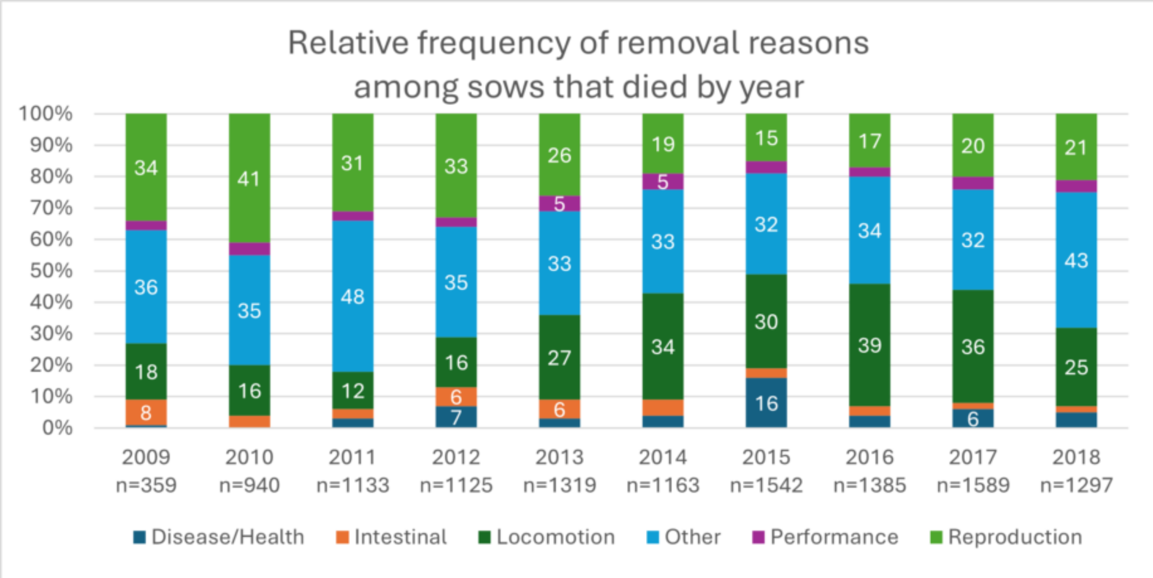


Figure 2: Removal reasons and their frequency from 2009 to 2018 (Kikuti et al., 2022)

Evaluating detailed breeding history together with the cause of death will provide perspective and assist veterinary, nutritionist, and husbandry teams with interventions to prevent similar events and early sow mortality.

Selection of the gilts

After selecting the best genetics and rearing the gilts under the best conditions, further selection must focus on physical traits such as structure, weight, height, leg, and hoof integrity.

Additionally, as we have more and more group housing for sows, the **selection for stress resilience** can positively impact piglet performance (Luttmann and Ernst, 2024). The following table compares stress-resilient and stress-vulnerable sows concerning piglet performance and shows the piglets of the vulnerable sows with worse performance.

Table 1: Influence of stress resilience on performance (Luttmann and Ernst, 2024)

Trait	SR	SV	p-Value
Birth weight (kg)	1.350 ± 0.039	1.246 ± 0.041	0.083
Wean weight(kg)	6.299 ± 0.185	5.639 ± 0.202	0.033*
Suckling ADG (kg/d)	0.191 ± 0.005	0.165 ± 0.005	0.004**

Least square means and standard error of stress resilient (SR) and stress vulnerable (SV) for each trait; significance threshold of $p<0.05$ with * indicating $0.01<p<0.05$, ** indicating $0.001<p<0.01$

How to manage the gilts best

The management of the gilts must consider the following:

1. Age at first estrus should be <195 days:
   Gilts having their first estrus earlier show higher daily gain and usually higher lifetime productivity. In a study conducted by Roongsitthichai et al. (2013), sows culled at parity 0 or 1 exhibited first estrus at 204.4±0.7 days of age, while those culled at parity ≥5 exhibited first estrus at 198.9±2.1 days of age (P=0.015).
2. Age at first breeding should lay between 200 and 225 days:
   If the sows are bred at a higher age, they have the risk of being overweight, leading to smaller second-parity litters, longer wean-to-service intervals, and shorter production life.
3. The body weight at first mating should be between 135 and 160 kg:
   To reach this target within 200-225 days, the gilts must have 600-800 g of average daily gain.

Breeding underweight gilts reduces first-litter size and lactation performance. Overweight gilts (>160 kg) face higher maintenance costs and locomotion issues.

4. The number of estruses at first mating should be 2 or 3:
   Accurately track estrus and breed on the second estrus. Research shows that delaying breeding to the second estrus positively affects litter size. Only delay breeding to the third estrus to meet minimum weight targets.

Housing

Gestating sows are more and more held in groups. Understanding the process of group housing is essential for success. The following graphic shows factors impacting successful grouping.

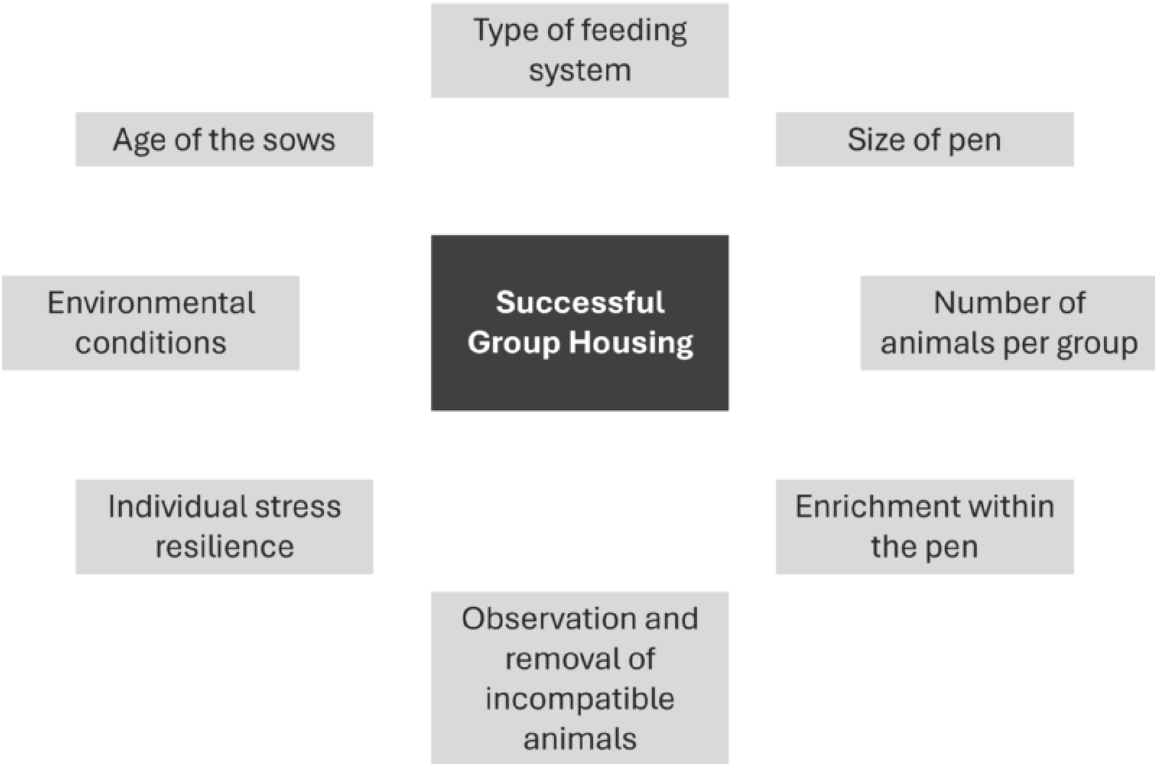
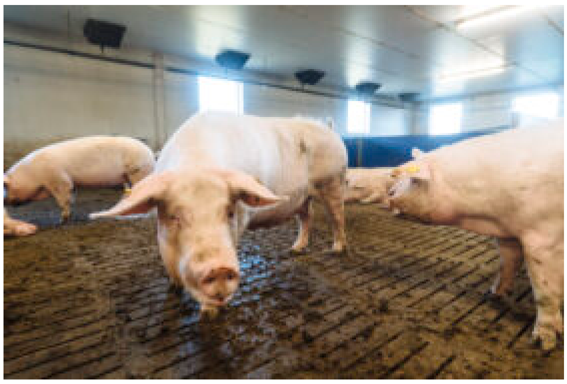


Figure 3: Factors influencing group housing

If the groups are not well-established yet, the stress levels among sows are higher, leading to

- More leg injuries due to aggressive behavior or fighting for resources
- Higher rates of abortions and returns to service
- Reduced sow performance, including decreased productivity, lower milk yield, and poor piglet growth due to compromised immune function and overall health



To mitigate stress in group housing, it is crucial to implement proper group management practices, which include gradual introductions, maintaining stable social structures, and ensuring adequate space and resources. This helps promote a calmer environment, improving animal welfare and herd performance.

Responsible on-farm pig care

Caregivers must be well-trained and equipped to provide high-quality care. Insufficient or unskilled pig caregivers can significantly affect the growth and development of prospective replacement gilts, ultimately influencing their suitability for the breeding herd:

- **Growth Rates**: Suboptimal nutrition and health management result in slower growth rates and poor body condition.
- **Health Issues**: Unskilled handling may increase the risk of disease transmission, injuries, and stress, all of which can adversely affect growth and overall development.
- **Behavioral Problems**: Poorly managed environments can increase aggression and competition among animals, hindering growth and health.
- **Selection Criteria**: Ineffective growth and health monitoring can result in misjudging the potential of gilts, leading to the selection of less suitable candidates for the breeding herd.

Table 2: Influence of handling on growth performance and corticosteroid concentration of female grower pigs from 7-13 weeks of age (Hemsworth et al., 1987)

	Unpleasant	**Pleasant**	**Inconsistent**	**Minimal**
ADG (g)	404^{a}	455^{b}	420^{ab}	4.58^{b}
FCR (F:G)	2.62^{b}	2.46^{a}	2.56^{b}	2.42^{a}
Corticosteroid conc (ng/mL)	2.5a	1.6b	2.6a	1.7b

Responsible on-farm pig care is crucial to keep sows healthy and performing. Poor sow observations (e.g., failure to identify stressed, anorexic, or heat-stressed sows) or inappropriate farrowing interventions can directly influence sow health and potentially reduce subsequent performance or mortality. On the contrary, rapid and proactive identification of sows needing intervention can save many animals that would otherwise die or need to be culled.

Keeping sows healthy and performing is manageable

The maintenance of sows' health is a challenge but manageable. Observing all the points mentioned, from selecting the right genetics over rearing the piglets under the best conditions to managing the young gilts, can help prevent disease and performance drops. For all these tasks, farmers and farm workers who do their jobs responsibly and passionately are needed. The following article will show nutritional interventions supporting the sow's gut and overall health.

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Sustainability: The Road Ahead

Conference Report

Nowadays, climate change is an omnipresent topic. Extreme weather events, such as high temperatures and heavy rainfall, are becoming more frequent, and there has been a rapid increase in greenhouse gas concentrations since the 1850s. Climate change will also have consequences for the pig industry. Dr. Jan Fledderus, Schothorst Feed Research, discussed upcoming issues for the pig industry at EW Nutrition’s Swine Academy.

Shift in mycotoxin-producing fungi

Climate change is likely to expand the geographical range of mycotoxin-producing fungi, exposing new crops and areas previously considered low risk to higher contamination levels. For instance, regions in South and Eastern Europe have reported increased occurrences of aflatoxins due to hotter and drier conditions favoring *Aspergillus flavus* over *Fusarium* species.

European Green Deal

The European Commission has adopted the European Green Deal, a comprehensive policy initiative to address climate change and promote sustainability within the European Union (EU). It sets ambitious targets and outlines a roadmap for reducing greenhouse gases by at least 55% by 2030, compared to 1990 levels, and achieving climate neutrality by 2050. The EU's primary goal is to ensure food security while reducing environmental and climate footprint.

The EU regulation on deforestation-free products includes soybeans and palm oil. The objective is to guarantee that the products EU citizens consume do not contribute to deforestation or forest degradation worldwide. Effective 1 January 2026, all imported soy must be free of deforestation. This means soybeans must be from areas not deforested since 1 January 2021.

The Green Deal will affect pig production

While it is still early to fully assess the impacts of the European Green Deal on pig farmers, it is clear that regulatory changes, economic pressures, and shifts in consumer behavior will shape the future of pig farming in the EU. Several potential consequences are still being assessed, including:

- Halving nutrient losses, particularly nitrogen, influences the eutrophication of natural areas and surface water, which will likely require pig farmers to adjust their feeding strategies and potentially reduce herd sizes.
- The use of food waste and by-products, such as wheat bran, in pig diets will be encouraged, promoting a circular economy approach that minimizes waste and enhances resource efficiency.
- Costs (notably related to feed) are likely to increase due to manure management and a reduction in crop production due to stricter environmental regulations.
- Farmers may need to invest in more sustainable practices and technologies to comply with new regulations, which could strain finances unless supported by subsidies or compensatory payments.
- Reduced supply and higher consumer prices for pigmeat products.
- Encouraging a shift towards plant-based diets in humans, which may reduce demand for pork (and other animal proteins).
- There may be opportunities for the pig industry to develop premium products that meet sustainability criteria or cater to specific consumer preferences.

Defining sustainability

It is necessary to apply a uniform method to calculate sustainability parameters and define objectives for "sustainable pig feed." The Global Feed LCA Institute (GFLI) is the global standard for raw material parameters. It gives data by different methods to calculate carbon dioxide (feed/food), with detailed data per country of origin, including peat oxidation. It includes 16 environmental impact categories.

Climate-neutral pig production

How does this impact pig production? Firstly, feed contributes 50-70% of CO_2 equivalents/kg of pigmeat. Secondly, it is essential to have a uniform method to calculate the CO_2 equivalents/kg of pigmeat. Currently, there are no financial benefits for pig farmers to improve sustainability.

Based on scenario calculations, Dr. Fledderus concluded that it is challenging to realize 'zero emissions' and that improving on all environmental impact parameters is not realistic. Formulating pig diets to reduce CO2 equivalents to produce 'green pork' increases feed costs. The obvious question is, who will pay for this?

EW Nutrition's Swine Academy took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Jan Fledderus, Product Manager and Consultant at the S&C team at Schothorst Feed Research, one of the founders of the Advanced Feed Package and with a strong focus on continuously improving the price/quality ratio of the diets for a competitive pig sector, was a reputable guest speaker in these events.

Immunoglobulins – Novel solutions for swine health

Conference Report

Unlike humans and most mammals, piglets do not receive any maternal immunoglobulins (antibodies) via the placenta. Therefore, it is vital for piglets to receive maternal antibodies via the colostrum within 24 hours of birth. Otherwise, they are more vulnerable to illnesses in their early stages of life. In situations where piglets do not receive enough colostrum, such as due to large litter sizes or weak sows following a prolonged farrowing — supplemental colostrum or IgY products can provide essential immune protection.

In the following, Dr. Shofiqur Rahman describes the innovative role of IgY – yolk immunoglobulins in enhancing swine health.

IgY – modes of action

IgY is an antibody found in egg yolk. It is an entirely natural product; each egg contains approximately 100 mg of IgY. These egg-derived antibodies primarily function in the gut through several mechanisms:

- Adherence inhibition – IgY antibodies bind to specific structures on the surface of pathogens (such as fimbriae, flagella, and lipopolysaccharides), preventing them from adhering to the intestinal mucosa and blocking the initial stages of infection. This is particularly significant for enterotoxigenic *E. coli* (ETEC), which causes piglet diarrhea by attaching to intestinal cells.
- Neutralization – IgY can neutralize toxins produced by pathogens, preventing them from exerting harmful effects on host cells.
- Agglutination – IgY promotes the clumping of pathogens by binding them together, effectively immobilizing them, and facilitating their removal from the animal's gut.
- Cell damage – IgY can damage the integrity of bacterial cell walls leading to cell lysis and reduced bacterial viability.

Furthermore, because these pathogens are bound in complexes with IgY and eliminated through feces in an inactivated form, IgY helps prevent environmental re-infection through manure.

IgY and IgG – functional differences

Both IgY and Immunoglobulin G (IgG) (IgG, the most abundant immunoglobulin in mammals) are antibodies. They, however, exhibit significant differences due to their distinct structural characteristics. “IgY, for instance, does not activate the complement system, a key function of IgG that enhances immune responses against infections. Additionally, IgY promotes more rapid phagocytosis and reduces inflammation compared to IgG. These effects contribute to energy conservation, thereby facilitating improved animal growth performance,” he explained.

IgY is more hydrophobic than IgG, which increases its stability and resistance to proteolytic degradation. This property is beneficial for maintaining its functionality in the gastrointestinal tract.

Production and quality control

IgY develops in hens in response to the pathogens they encounter, regardless of their relevance to the hens themselves. For instance, hens immunized with an infectious pathogen affecting pigs can produce IgY, effectively preventing the disease caused by that pathogen.

There are different methods of IgY production. One possibility is to hyperimmunize the hens simultaneously with multiple antigens. This method seems convenient, but it does not produce products with standardized levels of immunoglobulins for each antigen.

Another approach involves immunizing different groups of hens, each with a single antigen (e.g., transmissible gastroenteritis virus, rotavirus, *E. coli*) that commonly challenges piglets during the first weeks of life. The immunoglobulin content is then quantified, and the resulting egg powders are spray-dried, pasteurized, and mixed. This process yields an IgY product with standardized amounts of specific immunoglobulins that exhibit high affinity for the target pathogens.

One health application in swine

“The benefits of IgY have been demonstrated through extensive trials and commercial experiences, highlighting its potential for various applications not only in swine but also in other animals and humans,” said Dr. Rahman.

Due to concerns about antibiotic resistance, regulatory and consumer scrutiny increased over the use of in-feed antibiotics. IgY can serve as an effective and natural alternative for improving overall gut health, reducing the incidence and severity of diarrhea, reducing morbidity during the critical pre- and post-weaning periods, and, thereby, increasing performance.

Unlike antibiotics, which can indiscriminately kill both harmful and beneficial bacteria, IgY selectively targets specific pathogens. This selective action helps maintain a balanced gut microbiome, which is crucial for overall health and digestion in piglets. Disruption of the gut microbiota by antibiotics can lead to issues such as antibiotic-associated diarrhea and increased susceptibility to opportunistic infections due to the loss of beneficial microbes.

In contrast to antibiotics, IgY targets multiple antigenic sites on pathogens, requiring various genes for their protection, thereby avoiding resistance issues among pathogenic microorganisms. Additionally, IgY is effective not only against bacteria but also demonstrates significant efficacy against viruses and coccidia.

Conclusion

Dr. Rahman concluded that “the use of IgY as a passive immunization strategy, incorporated into a holistic approach to reducing piglet diarrhea, offers a safe and natural alternative to traditional antibiotics, particularly in the light of rising antibiotic resistance and the need for effective treatments also for viral diseases.”

EW Nutrition’s Swine Academy took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Shofiqur Rahman, Senior Researcher at the Immunology Research Institute Gifu (IRIG) in Japan was one of the highly experienced speakers of EW Nutrition. Originally a microbiologist, Dr. Rahman focuses on researching and developing IgY products for Human, Animal, Pet, Fish, Plant, and Environmental health.

Enhancing Poultry Gut Health with Novel Xylanase: A Sustainable Path to Reduced Antimicrobial Use

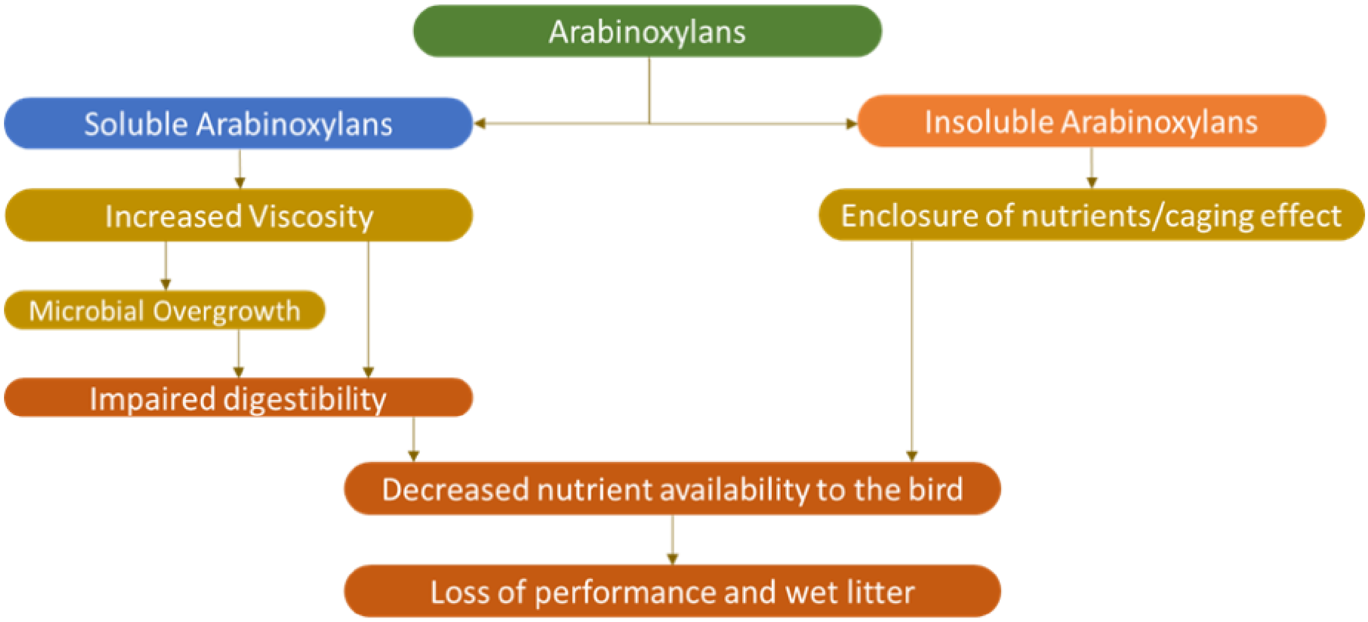
By **Ajay Bhoyar**, Senior Global Technical Manager, EW Nutrition

Gut health is pivotal to profitable poultry production, as the gastrointestinal tract (GIT) enables nutrient digestion and absorption while acting as a defense against pathogens. A healthy gut improves feed conversion, boosts immune resilience, and reduces reliance on antimicrobials—critical in the fight against antimicrobial resistance (AMR). With AMR posing significant threats to public health and animal agriculture, strategies like biosecurity, sustainable management, and effective dietary interventions are gaining traction. Feed enzymes have emerged as essential tools for managing feed costs, mitigating anti-nutritional factors, and improving nutrient utilization. Among these, feed enzymes like xylanase stand out. By breaking down xylan, a major component of non-starch polysaccharides (NSPs) in plant-based feed ingredients, xylanase reduces gut viscosity, enhances nutrient utilization, and supports optimal gut health and productivity. This article explores the innovative application of novel GH10 xylanases, such as Axxess XY, as a sustainable solution for improving feed efficiency and gut health in poultry production.

Xylanase in Poultry Nutrition

Xylanase plays a pivotal role in enhancing nutrient availability by addressing the limitations of endogenous enzyme synthesis in poultry. Xylanase enzymes belong to the carbohydrase class, catalyzing the breakdown of xylan, a major NSP in plant-based feed ingredients. They hydrolyze xylan into simple sugars like arabino-xylo-oligosaccharides (AXOs) and xylo-oligosaccharides (XOs), reducing the encapsulation of nutrients and digesta viscosity. These actions improve overall nutrient digestibility and bird performance.

Fig.1: Arabinoxylans – anti-nutrient mode of action in chicken



The primary benefit of feed xylanase lies in its ability to reduce digesta viscosity. By partially hydrolyzing NSPs in the upper digestive tract, xylanase ensures better nutrient absorption in the small intestine. Studies (Matthiesen et al., 2021; Choct & Annison, 1992) confirm that reduced viscosity enhances feed digestibility, leading to improved performance in poultry. Further, to realize the optimum benefits, it is crucial that xylanase efficiently degrades both soluble and insoluble arabinoxylans. The insoluble arabinoxylans are part of the cell wall structure of plant cells, resulting in a cage effect, entrapping nutrients like starch and protein. Effectively breaking down insoluble arabinoxylans ensures that the nutrients trapped in plant cell walls are released for growth and production.

Mechanisms Supporting Gut Health

Viscosity Reduction

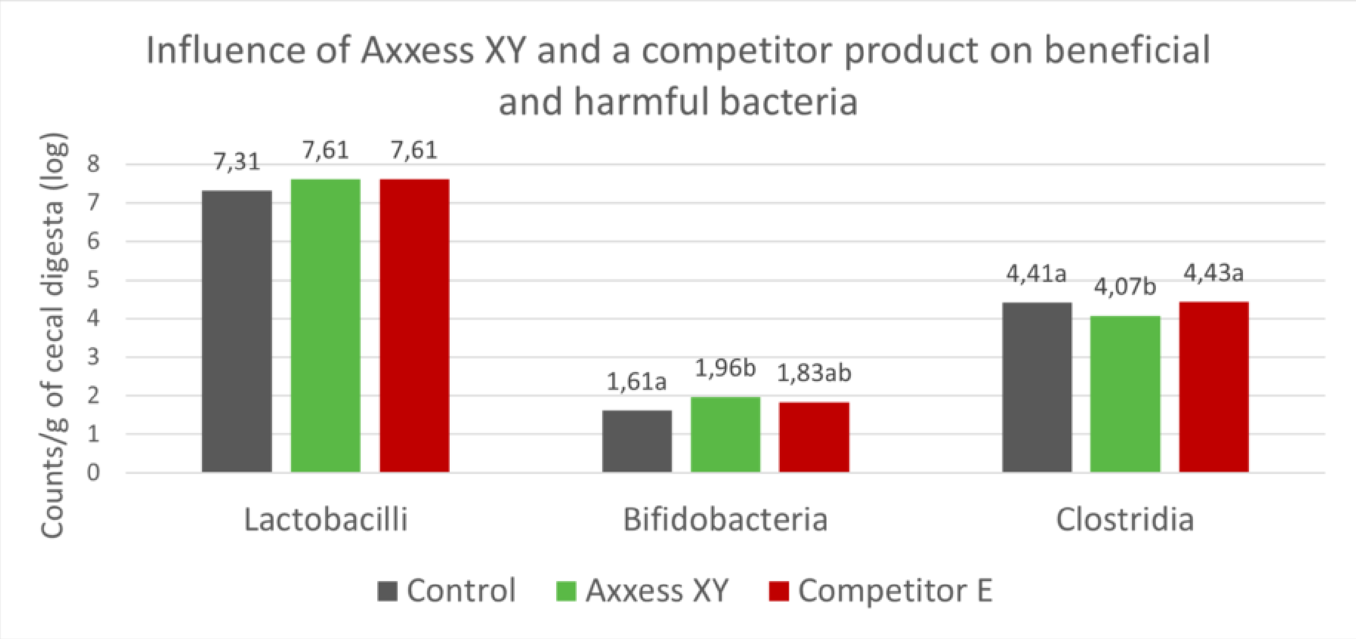
High NSP content increases digesta viscosity and slows digestion and nutrient absorption. Soluble arabinoxylan is not digested in the small intestine of broilers. It produces a viscous chime, leading to the proliferation of pathogenic bacteria, intestinal inflammation, impairment of barrier function in the intestine, and severe intestinal lesions (Teirlynck et al., 2009). Xylanase mitigates this by breaking down xylans, a major component of NSPs in common feed ingredients. This results in a better flow of digesta and reduced energy losses.

Microbial Metabolites

Xylo-oligosaccharides (XOS) can also be produced in the intestine of monogastric animals to some extent when exogenous enzymes, such as xylanase, are added to the feed (Baker et al., 2021).

The XOS generated by xylanase action on arabinoxylans can act as prebiotics, fostering beneficial bacteria like Lactobacillus and Bifidobacterium, which can outcompete harmful species. XOS can positively impact the gut microbiota, enhance short-chain fatty acid (SCFA) production, stimulate immune activity in the gastrointestinal tract, and improve energy utilization.

Fig. 2. Axxess XY improved beneficial microbes and reduced the clostridial population in broilers.



Barrier Function

By lowering inflammation and irritation in the intestine, xylanase helps maintain gut integrity, reducing the risk of pathogen translocation from the intestinal lumen. In a broiler study, xylanase decreases epithelial apoptosis index, up-regulates tight junction gene expression, and inhibits mucin synthesis in the small intestine, likewise alleviating the intestinal mucosal barrier impairment from *Clostridium perfringens* challenge (Liu et al., 2012).

Practical Considerations for Xylanase Use

Enzyme Stability

Enzymes are proteins that tend to lose their catalytic activity at high temperatures. When exposed to excessive heat, an enzyme's protein structure can irreversibly unfold, disrupting its active site and causing loss of function. Therefore, ensuring enzyme stability during feed processing is critical for maintaining its activity in the intestine. Intrinsically heat-stable enzymes have an inherent ability to withstand higher temperatures without the need for a protective coating and are immediately available for action upon ingestion.

Feed Composition

Xylanase efficacy is influenced by diet composition, particularly the NSP content and the presence of xylanase inhibitors in common feedstuffs. It is important to choose a xylanase that can resist the activity of xylanase inhibitors and is effective against both soluble and insoluble arabinoxylans.

The recommended energy matrix value for the xylanase enzyme should be used while formulating the feeds to create energy-deficient diets to reap the full benefits of xylanase use.

Optimal Dosage

Proper dosing is essential to maximizing the benefits of feed enzymes while avoiding unnecessary costs. It is important to follow manufacturers' recommendations and avoid underdosing an enzyme.

GH10 Xylanases: The Superior Choice for Animal Nutrition

Most feed xylanases are classified into glycoside hydrolase families 10 (GH10) and 11 (GH11) based on their substrate specificity, catalytic action, and structural features.

Why GH10 Xylanases Are More Effective

1. ### Broader Substrate Specificity:

   Unlike GH11 xylanases, GH10 xylanases can effectively hydrolyze both soluble and insoluble xylan substrates. This broader activity ensures an efficient breakdown of xylans in a wide range of feed ingredients.

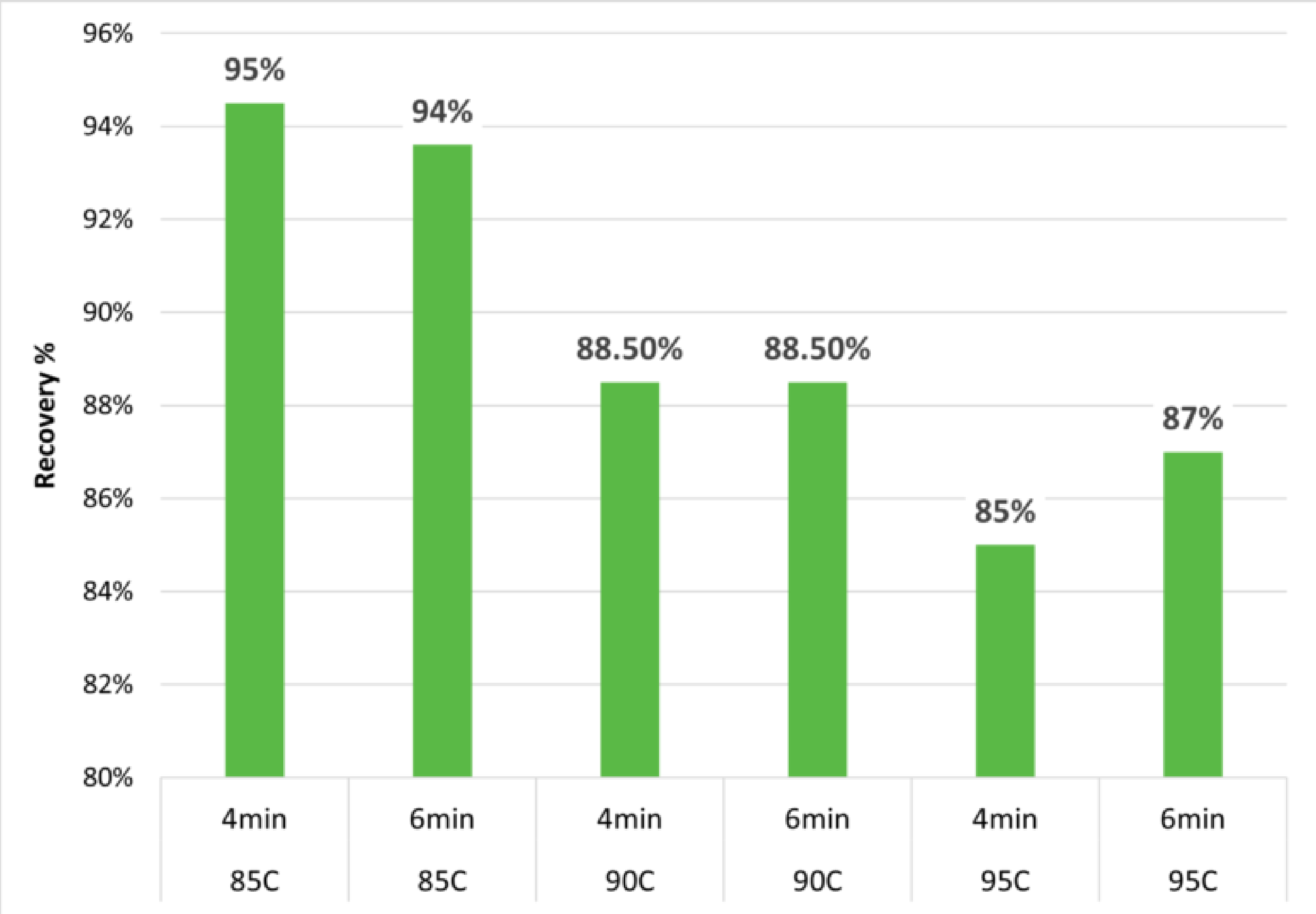
2. ### Higher Catalytic Efficiency:

   GH10 enzymes cleave xylan at substituted regions, yielding shorter xylo-oligosaccharides that can positively impact gut health and maximize nutrient availability.

3. ### Thermostability:

   Feed processing often involves high temperatures during pelleting. Axxess XY, a GH10 family xylanase, demonstrates remarkable thermostability, maintaining over 85% activity even at 95°C for extended conditioning times. This resilience ensures consistent enzyme performance during feed manufacturing and digestion.

Fig.3: Optimum recovery of Axxess XY at elevated conditioning time and temperatures



Novel Applications of Axxess XY: A GH10 Xylanase

Axxess XY exemplifies the advantages of GH10 xylanases in poultry nutrition. Its ability to efficiently act on both soluble and insoluble arabinoxylans makes it a versatile feed enzyme. The enzyme's high thermostability ensures efficient enzyme activity in the gut and subsequent optimum nutrient utilization under challenging processing conditions, promoting gut health and maximizing performance.

Key Benefits of Axxess XY

1. **Enhanced Nutrient Utilization:**

   By unlocking nutrients trapped in NSPs, Axxess XY promotes better feed conversion ratios (FCRs).

2. **Improved Gut Health:**

   Reducing the digest's viscosity reduces gut health challenges and predisposition to gut infections. Further, the short-chain oligosaccharides released by Axxess XY support beneficial gut microbiota, improving digestive health.

3. **Economic Efficiency:**

   Enabling the optimum use of high-fiber, cost-effective, locally available feed ingredients without compromising performance makes Axxess XY an asset for profitability.

In a recently conducted 42-day trial at a commercial farm, Axxess XY maintained the average body weight of broilers with a 100 kcal/kg reduction in metabolizable energy while significantly reducing feed cost/kg body weight. The diets were based on corn, DDGS, and soybean meal.

Figures 4 and 5: Body weight and cost of feed in broilers fed a diet reduced by 100 kcal/kg in metabolizable energy compared to a standard diet without Axxess XY

Conclusion

Xylanase exemplifies how feed enzymes can transcend their traditional role in feed cost reduction to support enhanced gut health. Xylanase supports reduced antimicrobial use in poultry production by improving nutrient utilization, reducing digesta viscosity, and fostering healthy microbiota. Its integration into comprehensive gut health management strategies offers a sustainable pathway to combat AMR and ensure the long-term viability of poultry farming. By targeting NSPs, these enzymes enhance nutrient digestibility, reduce feed costs, and support sustainable production practices.

GH10 xylanases, particularly Axxess XY, stand out for their superior substrate specificity, catalytic efficiency, and thermostability. By incorporating **Axxess XY** into feed formulations, poultry producers can unlock the full nutritional potential of feed ingredients, ensuring optimal performance and profitability. As the poultry industry continues to evolve, adopting advanced enzyme technologies like Axxess XY represents a strategic step toward sustainable and efficient animal nutrition.

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Managing heat stress in pigs in Asia

Conference Report

Heat stress poses a significant challenge to pig production, particularly in Asia, due to the region's warm and humid climate. In the following, Dr. Merideth Parke, Global Application Manager Swine at EW Nutrition, discusses effective management strategies to mitigate the adverse effects of heat stress on pig health and productivity.

Understanding Heat Stress

Pigs are particularly vulnerable to heat stress due to their limited ability to dissipate heat. “This is because they lack functional sweat glands, have relatively small lungs, a thick subcutaneous fat layer, and a narrow thermoneutral zone. The pigs’ thermoneutral or ‘comfort’ zone varies by age and weight. For instance, sows require 18-22°C, grow-finish pigs less than 25°C, while newborn piglets need a much warmer 35°C,” she explained.

Furthermore, today’s lean and efficient pigs have higher metabolic demands and produce more body heat, making them more susceptible to heat stress than pigs from the 1980s.

Symptoms of heat stress include:

- Increased respiration rates (>50/minute)
- Elevated rectal temperature (>39.5 oC)
- Decreased feed intake
- Reduced growth rates
- Lower reproductive performance
- Lower reproductive performance

Pigs naturally reduce their feed intake as a response to heat stress, which is a mechanism to decrease metabolic heat production from digestion. For example, research on sows has shown that for each 10°C increase between 25-27°C at 50-60% relative humidity, they reduce their feed intake by 214 g/day.

Managing Heat Stress

Managing heat stress is complex. It requires a combination of solutions specific to each production system. Additionally, it must be considered that heat stress is not only about temperature. Its impact can be exacerbated by relative humidity, which hinders heat dissipation through evaporation. The heat index chart below demonstrates the relationship between temperature, humidity, and comfort levels for a grow-finish pig. Pigs require an environment where the heat index is within the thermoneutral zone, enabling them to shed heat and maintain efficient feed utilization and growth.

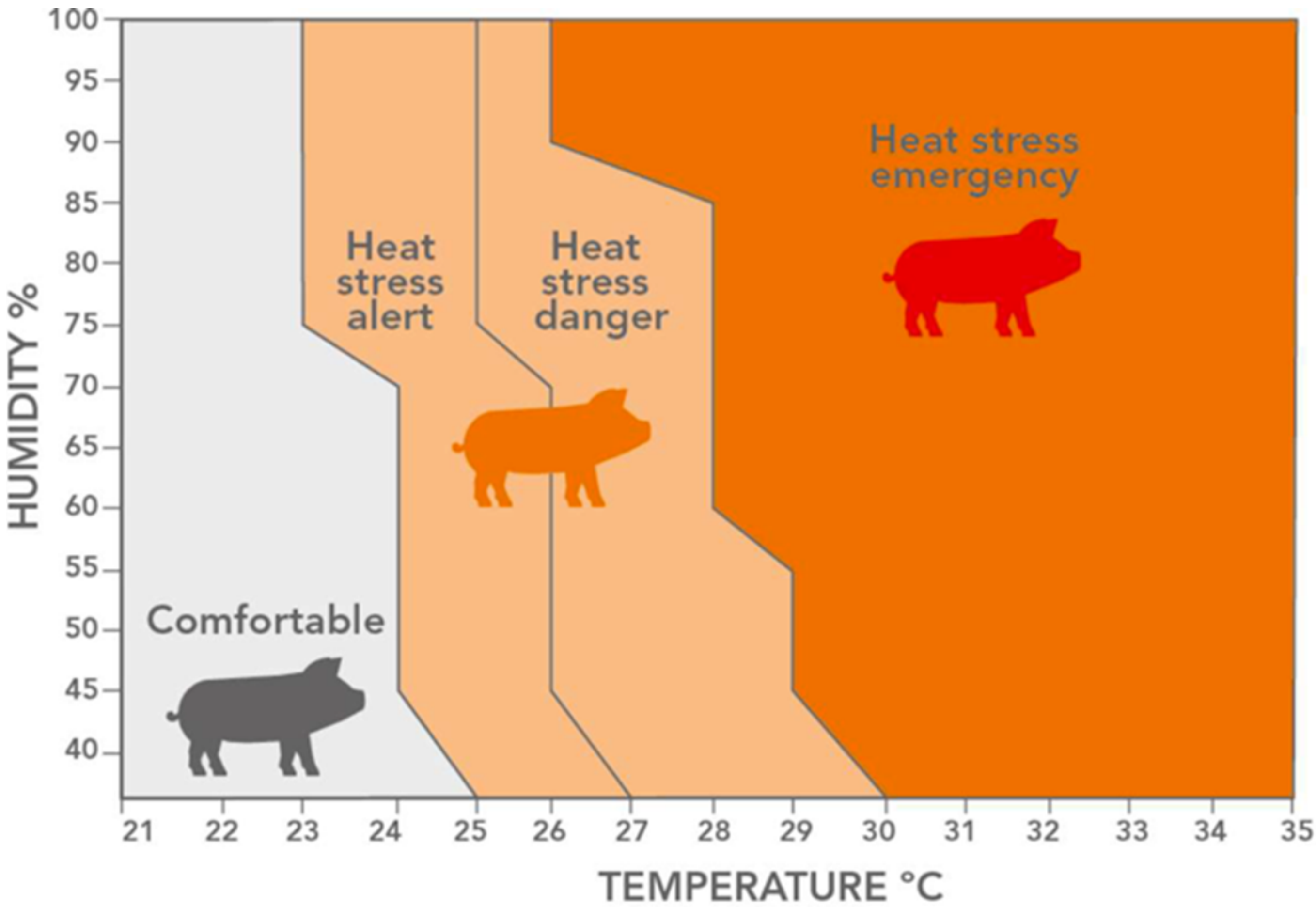


Figure 1: Heat stress index chart *(kepro.nl)*

While we often initially look to nutritional interventions, such as reducing dietary crude protein levels, increasing fats, or adding feed additives such as betaine, the effectiveness of these heat mitigation strategies is limited if the pigs are not eating well. Therefore, we must first focus on environmental management to reduce external heat absorption and increase heat load shedding. Pigs with the highest metabolic demands – lactating and gestating sows and finisher pigs – are especially susceptible to heat stress and should be given priority.

Several strategies to effectively manage heat stress can be used:

1. ## Misters and sprinklers

   Misters or sprinklers can help cool pigs through evaporation. However, these should be used strategically – running them for short periods followed by breaks – to maximize cooling effects without creating excessive moisture and wet conditions that could lead to other health issues, such as skin lesions or respiratory problems.

   However, water-based cooling systems can inadvertently raise the heat index in humid environments. When water is sprayed into a humid environment, it will further increase the moisture levels in the air, exacerbating the heat stress situation. If humidity is too high, alternative cooling methods, such as evaporative cooling pads or high-pressure fogging systems, may be more effective.

   Snout and flank drip systems deliver water directly onto the pig's body, mainly targeting areas more sensitive to heat. This localized approach enables heat dissipation without excessively increasing humidity in the surrounding environment.

2. ## Ventilation and airflow

   Increased air movement, combined with misting or sprinkling (in low-humidity environments), can enhance the cooling effect by enhancing evaporative and convective heat loss. This combination helps reduce the temperature the pigs 'feel', making them more comfortable.

Producers should assess their ventilation systems and consider modifications to improve air circulation. This can be achieved by installing additional fans. However, the fans must be maintained – clean fan blades and louvers can increase efficiency by 30%. Furthermore, it must be evaluated if there are dead spots and drafts at the pig level, not along the walkways.

Using suspended ceilings can effectively reduce the airspace that needs cooling and can lead to lower energy costs for cooling systems.

3. Housing and surroundings

Adding insulation to roofs and walls can help reduce heat transfer inside the pig housing. Applying reflective coatings (such as white paint) to rooves and walls can help deflect solar radiation, reducing heat accumulation inside the shed by several degrees.

Dense vegetation surrounding a piggery can provide shade and reduce reflective heat. However, it can also obstruct airflow and trap moisture, increasing local humidity and exacerbating the pigs' heat index and heat stress.

4. Drinking water

Providing fresh, chilled drinking water (10°C) is a highly effective method for mitigating heat stress in pigs and increasing feed intake to improve overall performance. Insulating header tanks and water pipes can help to maintain cool temperatures.

Regular checks on water supply systems are essential to ensure they function correctly and provide adequate flow rates to the end of the line. For example, lactating sows need a flow rate of 4 L/minute.

5. Stocking density and body condition

Higher stocking densities can exacerbate heat stress in pigs. Increased animal density leads to higher ambient temperatures due to the combined metabolic heat produced by the animals and reduced airflow at the pig level. Lower stocking densities can allow pigs to manage their body temperature better.

Pigs with higher body condition scores (more body fat) may be more susceptible to heat stress. Excess fat can hinder effective heat dissipation, making it more difficult for these pigs to regulate their body temperature during hot weather.

6. Monitoring and evaluation

Continuous monitoring of temperature, humidity levels, and airflow is vital to adjust cooling strategies as necessary. A common mistake when monitoring the pigs' thermal environment is placing sensors in walkways at head height for workers because they are easier to read than at pig level in the pens. Sensors should be positioned in several locations throughout the shed. Regardless of sensor readings, stockpersons need to observe behavioral changes that provide immediate insights into the welfare and comfort of pigs during high-temperature periods.

7. Husbandry

Pigs must be regularly observed for signs of heat stress, such as rapid breathing, reduced activity and feeding, lateral recumbency, and changes in vocalization. Aggressive behaviors may increase among pigs during heat stress as they compete for cooler spaces and water. Early detection of behavioral changes allows for timely interventions.

"Schedule feeding during cooler parts of the day, such as early mornings or late evenings. This practice helps minimize additional heat production from digestion during peak temperatures", according to Dr. Parke.

> “When moving pigs, especially pregnant sows, to the farrowing room, do so during the coolest times of the day and allow them to walk at their own pace.”

Conclusion

In conclusion, in the first run, each aspect of a production system must be critically evaluated, and existing housing or husbandry procedures must be modified to reduce the severity of the adverse effects of high temperatures on pig health and performance.

EW Nutrition’s Swine Academies took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Merideth Parke, Global Application Manager, Swine, was one of the highly experienced speakers of EW Nutrition. She is a veterinarian who strongly focuses on swine health and preventive medicine.

The Science Behind Phytogenics

Conference Report

Essential oils, secondary plant compounds, phytogenics – all these expressions can be found in the context of animal feed. In the following, Dr. Sabiha Kadari, Regional Technical Director Southeast Asia/Pacific at EW Nutrition, will show the difference between essential oils and phytomolecules and the science behind phytogenics.

Essential oils and phytomolecules– not the same

Let us first show what are essential oils using the example of oregano oil. Essential oils are extracted from plants and unpurified mixes of different phytomolecules. The raw oregano oil extract contains carvacrol, thymol, P-cymene, and several other phytomolecules. The concentration and composition of these phytomolecules can vary significantly, depending on factors such as geographical origin, seasonal variations, plant part, plant growth stage and harvest time, extraction methods, and post-harvest processing. As a result, there can be significant batch-to-batch variations, resulting in differences in animal performance. Furthermore, there is the potential for the presence of undesirable contaminants.

In contrast, **phytomolecules** are the active ingredients in essential oils or other plant materials. They are clearly defined as one active compound (IUPAC name/CAS number) by their unique chemical structures, such as carvacrol. By focusing on specific active compounds, standardized products don't have batch-to-batch variation, enhancing consistent animal performance.

Stringent screening processes

To yield the best phytogenic formulations for animal production, a rigorous screening process is required:

The initial screening process consists of ensuring the bioactives are generally recognized as safe (GRAS) by the US Department of Agriculture and approved by the European Food Safety Authority (EFSA). This step is crucial to ensure that any compounds used in formulations do not pose health risks to animals or humans.

In addition to being selected for their chemical-physical properties, which play a significant role in determining how well the phytogenics will perform in various applications, and a thorough cost-benefit analysis, the phytogenics are mapped for their following biological activities.

Antioxidant

Phytomolecules exert their antioxidant effects through various mechanisms, including scavenging free radicals. The ORAC (Oxygen Radical Absorbance Capacity) test is widely regarded as a gold standard for measuring the antioxidant potential of phytomolecules. It quantitatively assesses the ability of compounds to scavenge free radicals, providing a reliable comparison against a known standard, specifically Trolox, a vitamin E analog. Trolox has well-documented antioxidant properties, making it a reliable benchmark for evaluating the effectiveness of other antioxidants.

Antimicrobial

Incorporating a comprehensive approach to testing the antibacterial properties of phytogenics is essential for developing effective feed additives. The antibacterial properties should not only be tested against harmful enteropathogenic bacteria, such as *Clostridium perfringens*, *E. coli*, and *Salmonella*. It should also be evaluated if beneficial species such as *Lactobacilli*, *the proliferation of which is wanted*, are preserved.

By evaluating both pathogenic and beneficial bacteria, researchers can ensure that phytogenic formulations support optimal gut health and reduce the reliance on antibiotics.

Anti-inflammatory

Anti-inflammatory properties also help to modulate the gut-associated immune system and mitigate excessive immune response so that animals can allocate more energy towards growth and production. This shift is vital for optimizing feed conversion ratios and overall performance.

Dr. Kadari noted that "EW Nutrition uses nuclear factor kappa beta (NFkß), which regulates the expression of various pro-inflammatory cytokines, and interleukin 6 (pro-inflammatory) and 10 (anti-inflammatory) cytokines as biomarkers, for measuring anti-inflammatory activity. A reduction in NFkß and the ratio of IL-6/ IL-10 indicates a decrease in inflammatory response."

Anti-conjugation

Conjugation is a common mechanism of horizontal gene transfer that is instrumental in spreading antibiotic resistance between bacteria. "Most resistance genes are found on mobile genetic elements named plasmids and primarily spread by conjugation," explained Dr. Kadari.

Cell stress of bacteria modulates the conjugation frequency. Among these stressors are antimicrobial phytogenics. The goal is to keep the conjugation frequency below the one that could occur under unchallenged conditions.

Figure 1: High throughput screening allows EW Nutrition researchers to quickly conduct millions of chemical, genetic, or pharmacological tests

Delivery mechanism

Lastly, to optimize the benefit of the selected phytogenics and deliver consistent results, the substances must be protected by, e.g., encapsulation to ensure homogenous distribution in feed and thermostability in pelleted feed. A special delivery system provides for the targeted release of the active ingredients within the organism, specifically ensuring that these compounds are effectively utilized within the body rather than eliminated through the feces. This is crucial for optimizing their benefits in animal production.

Phytomolecules are an essential support in antibiotic reduction

"Phytogenics are increasingly recognized as effective alternatives in antimicrobial reduction programs. The combination of stringent screening processes alongside rigorous in *vitro* and in *vivo* testing is essential for ensuring that phytogenics deliver optimal and consistent performance in animal production," noted Dr. Kadari.

EW Nutrition's Swine Academies took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Sabiha Kadari, Regional Technical Director at EW Nutrition SEAP, was one of the highly experienced speakers of EW Nutrition. With expertise in feed cost optimization, feed additive management, audits, and lab support, she provides customized technical solutions and troubleshooting challenges for customers.

Consequences of genetic improvements and nutrient quality on production performance in swine

Conference Report

Achieving high performance and superior meat quality with preferably low investment – and here, we speak about feed costs, which account for up to 70% of the total costs – is a considerable challenge for pig producers. The following will focus on the effects of genetic enhancements and nutrient quality on overall pig performance.

Effect of body weight and gender on protein deposition

Based on Schothorst Feed Research recommendations for tailoring nutritional strategies to enhance feed efficiency and overall productivity, the following facts must be considered:

- Castrates, boars, and gilts have significantly different nutritional requirements due to variations in growth rates, body composition, and hormonal influences. For instance, testosterone significantly impacts muscle development and protein metabolism, increasing muscle mass in males. In contrast, ovarian hormones may inhibit muscle protein synthesis in females, contributing to differences in overall protein deposition. Boars, therefore, require higher protein levels to support muscle growth. Castrates typically have a higher FCR compared to gilts and boars due to higher feed intake. Split-sex feeding allows for diet adjustments to optimize growth rates and reduce feed costs per kilogram gained.
- Different body weight ranges: because puberty is delayed in modern genetics, we can produce heavier pigs without compromising carcass quality. Given that a finisher pig with 80-120 kg bodyweight consumes about half of the total feed of that pig, Dr. Fledderus concluded that extra profit could be realized with an extra feed phase diet for heavy pigs. Implementing multiple finisher diets can help reduce feed costs by allowing for lower nutrient concentrations, such as reducing the net energy and standardized ileal digestible lysine in later phases, without compromising performance.

Decision-making according to feedstuff prices

Least cost formulation is commonly used by nutritionists to formulate feeds for the lowest costs possible while meeting all nutrient requirements and feedstuff restrictions at the actual market prices of feedstuffs. However, diet optimization is more complex. The real question is, “How do you formulate diets for the lowest cost per kilogram of body weight gain?” You must always consider your specific situation, as economic results vary greatly and depend mainly on the prices of pork and feed and pig growth performance (e.g., feed efficiency, slaughter weight, and lean percentage).

How can you optimize your feeding strategy? Reducing net energy (NE) value will result in more fiber entering the diet. This makes sense if fiber by-products are cheaper than cereals. In contrast, an increase in the NE value will increase the inclusion of high-quality proteins and synthetic amino acids. It will use more energy from fat and less from carbohydrates.

The effects of diet composition on meat quality and fat composition also need to be considered.

How can nutrition improve meat quality?

Nutritional strategies not only improve the sensory attributes of pork but also enhance its shelf life, ultimately leading to higher consumer satisfaction and better marketability. Some of the factors Dr Fledderus considered included:

Improving fat quality

The source of dietary fat significantly impacts the quality of pork fat. Saturated fats tend to produce firmer fat, while unsaturated fats can lead to softer, less stable fat deposits. Diets high in unsaturated fats are more prone to lipid oxidation, negatively affecting shelf life and overall meat quality. The deposition of polyunsaturated fatty acids is only from dietary fat. Saturated fats in pork, partly originates from dietary fat and are also synthesized de novo. So, the amount of polyunsaturated fatty acids in pork depends on the content and composition of dietary fat, which can negatively affect the shelf life and perception of pork meat.

The iodine value (IV) is a measure of the degree of unsaturation in fats. A higher IV indicates a higher proportion of unsaturated fatty acids, leading to softer fat. Pork fat with an IV lower than 70 is considered high quality, as it tends to be firmer and more desirable for processing.

As per the American Oil Chemists Society, IV is calculated as:

$$IV = [C16:1] \times 0.95 + [C18:1] \times 0.86 + [C18:2] \times 1.732 + [C18:3] \times 2.616 + [C20:1] \times 0.785 + [C22:1] \times 0.723$$

(brackets indicate concentration (%) of C16:1 palmitoleic acid, C18:1 oleic acid, C18:2 linoleic acid, C18:3□-linoleic acid, C20:1 eicosenoic acid, C22:1 erucic acid per crude fat)

Implications

Dr. Fledderus concluded that the pigs’ nutritional requirements are dynamic and influenced by factors such as required meat and fat quality, heat stress, slaughter weight, and genetic developments. Tailoring diets based on gender and body weight is crucial for optimizing protein deposition. Accurate information is essential to formulate diets that achieve optimum economic results, not just the least cost.

Continuous monitoring of feedstuff prices and nutritional content allows for timely adjustments in diet formulations, ensuring that producers capitalize on cost-effective ingredients while maintaining nutritional quality.

EW Nutrition’s Swine Academy took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Jan Fledderus, Product Manager and Consultant at the S&C team at Schothorst Feed Research, with a strong focus on continuously improving the price/quality ratio of the diets for a competitive pig sector and one of the founders of the Advanced Feed Package, was a reputable guest speaker in these events.

Recent advances in energy evaluation in pigs

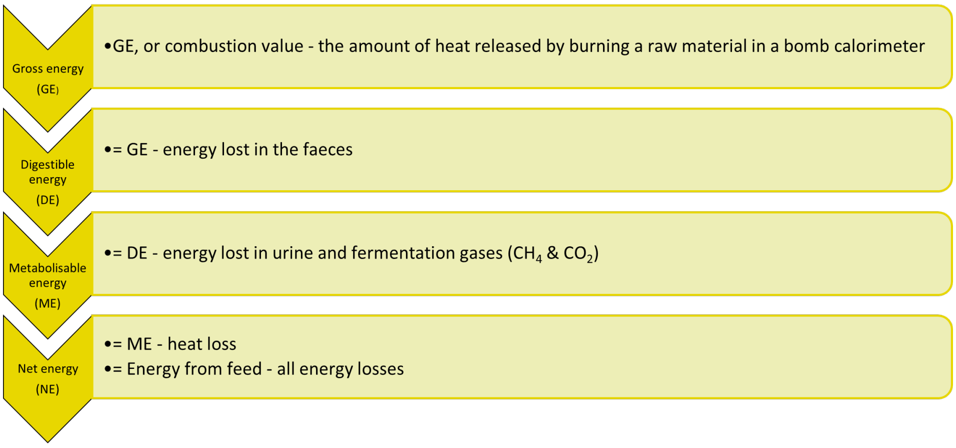
Conference Report

During the recent EW Nutrition Swine Academies in Ho Chi Minh City and Bangkok, Dr. Jan Fledderus, Product Manager and Consultant at Schothorst Feed Research, discussed that much money is involved in a correct energy evaluation system. Net energy is 70% of feed costs, and feed is about 70% of total costs.” Therefore, an accurate energy evaluation system is important as it will give:

- Flexibility to use different raw materials
- Reduction of formulation costs
- Best prediction of pig performance
- Match the available dietary energy requirement of the feed to the pig’s requirement

Energy evaluation systems for pigs

The energy value of a raw material or complete feed can be expressed using different energy evaluation systems. Net energy (NE) in pigs refers to the amount of energy available for maintenance and production after accounting for energy losses during digestion, metabolism, and heat production. It is a crucial concept in swine nutrition as it provides a more accurate measure of the energy value of feed ingredients compared to other systems like digestible energy (DE) and metabolizable energy (ME). Diets formulated using NE are lower in crude protein than those using DE or ME because the heat lost during catabolism and excretion of excess nitrogen is considered in the NE system.



Effect of energy

Energy is derived from three nutrients: lipids (fats and oils), carbohydrates, and proteins. Using NE values instead of DE or ME values can lead to changes in ingredient ranking when formulating diets. For example:

- Ingredients high in fat or starch may be undervalued in DE systems but receive appropriate recognition in NE evaluations.
- Conversely, protein-rich or fibrous ingredients may be favored in DE systems.

Table 1: Energy values (kcal/kg) of nutrients

Nutrient	Energy	Starch	Protein	Fat
Gross energy	GE	4,486 (100)	5,489 (122)	9,283 (207)
Digestible energy	DE	4,176 (100)	4,916 (118)	8,424 (202)
Metabolizable energy	ME	4,176 (100)	4,295 (103)	8,424 (202)
Net energy	NE	3,436 (100)	2,434 (71)	7,517 (219)
Heat production (kcal/kg)		740	1,861	907
Heat production (% of NE)		22%	76%	12%

Calculation of net energy

Net energy (kcal/kg dry matter) is calculated as:
= 2,577 x digestible crude protein
+ 8,615 x digestible crude fat
+ 3,269 x ileal digestible starch
+ 2,959 x ileal digestible sugars
+ 2,291x fermentable carbohydrates

Factors affecting nutrient digestibility

This raises the obvious question, 'What is the nutrient digestibility of your raw materials?' Dr. Fledderus considered several factors that affect nutrient digestibility and, therefore, NE values, including

- **Age:** as pigs grow, their digestive systems mature, leading to improved nutrient digestibility. Younger pigs typically have lower digestibility rates due to an underdeveloped gastrointestinal tract. Older pigs typically exhibit higher digestibility, especially for fibrous diets, as their digestive systems become more efficient at breaking down complex nutrients.
- **Physiological stage:** the digestibility of diets can vary between pregnant and lactating sows. Digestibility is generally higher for gestating sows; lactating sows may have slightly lower digestibility due to higher feed intake. Also, lactating sows do not consume enough feed to meet their energy needs, leading to body tissue mobilization and weight loss.
- **Feed intake and number of meals per day:** Increased feed intake and more frequent meals can enhance nutrient digestibility. Regular feeding helps maintain gut motility and reduces the risk of digestive disturbances. Studies indicate that pigs fed multiple smaller meals exhibit better nutrient absorption than those fed larger meals less frequently.

- **Use of antibiotics and feed additives:** including exogenous enzymes and other additives can improve nutrient breakdown and overall digestibility of complex feed components, further influencing ingredient rankings within different energy evaluation systems. Antibiotics can lead to dysbiosis, negatively impacting overall gut health and digestion.
- **Feed processing:** gelatinized starch is more easily broken down by digestive enzymes, resulting in higher and faster digestibility compared to raw or unprocessed starch. This increased digestibility leads to a greater proportion of energy being absorbed in the small intestine, contributing positively to the NE value of the feed. As the particle size of feed ingredients decreases, the NE increases. While smaller particles generally improve digestibility, excessively fine grinding can lead to adverse effects such as increased risk of gastric ulcers in pigs.
- **Intestinal health:** a healthy gut is crucial for optimal nutrient absorption. Factors such as the presence of beneficial microbiota and the integrity of the intestinal barrier play significant roles in nutrient digestibility. Conditions like inflammation or dysbiosis can impair nutrient absorption and decrease overall performance.

NE system shows better the “true” energy of the diet

Dr. Fledderus concluded that the NE system offers a closer estimate of pigs’ “true” energy available for maintenance and production (growth, lactation, etc.). This leads to better ingredient rankings, reduced crude protein levels, which decreases nitrogen excretion, and enhanced nutrient utilization, contributing to more sustainable pig production practices. This aligns with increasing demands for environmentally responsible farming methods.

EW Nutrition’s Swine Academy took place in Ho Chi Minh City and Bangkok in October 2024. Dr. Jan Fledderus, Product Manager and Consultant at the S&C team at Schothorst Feed Research, one of the founders of the Advanced Feed Package and with a strong focus on continuously improving the price/quality ratio of the diets for a competitive pig sector, was a reputable guest speaker in these events.

Start right with your piglet nutrition

Conference Report

“A good start is half the battle” can be said if we talk about piglet rearing. For this promising start, piglets must eat solid feed as soon as possible to be prepared for weaning. Dr. Jan Fledderus, Product Manager and Consultant at the S&C team at Schothorst Feed Research, shows some nutritional measures that can be taken to keep piglets healthy and facilitate the critical phase of weaning.

Higher number of low-birth-weight pigs in larger litters

Litter size affects piglet quality. Larger litter sizes from hyperprolific sows often result in higher within-litter variation in birth weights. This variability can lead to a higher proportion of low-birth-weight piglets, which are more susceptible to health issues and have lower survival rates. Additionally, low birthweight pigs have an increased risk of mortality, and an improvement in birth weight from 1kg to 1.8 kg can result in 10 kg more body weight at slaughter.

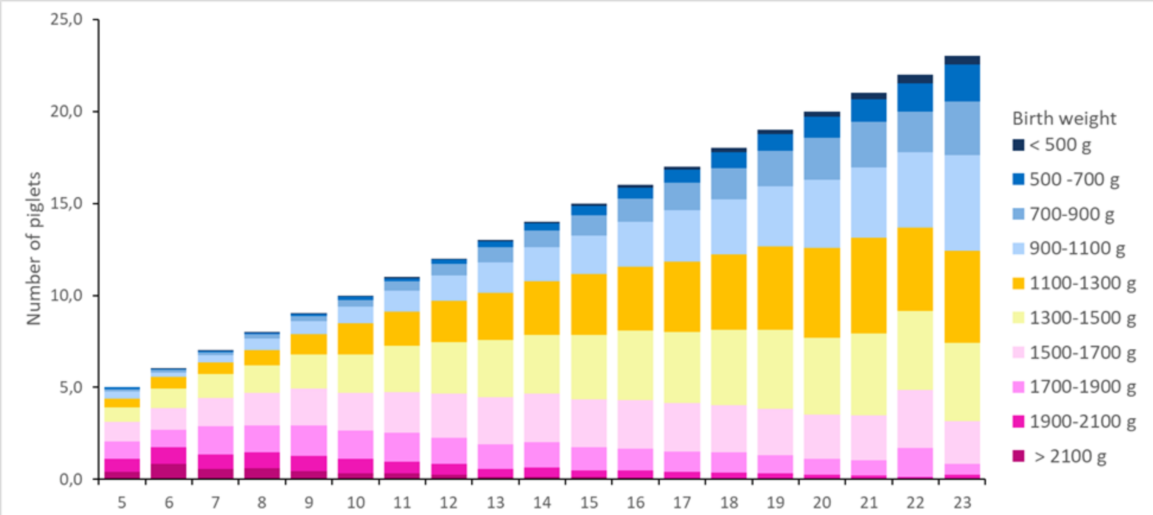


Figure 1: Effect of litter size on birth weight distribution (Schothorst Feed Research Data were collected from 2011 to 2020, based on 114,984 piglets born alive from 7,952 litters).

Implementing management practices for low-birth-weight pigs, such as split suckling, can significantly enhance nutrient intake, support immune function, and ultimately contribute to better survival rates and overall health for these vulnerable piglets.

Weaning age determines intake of creep feed

Pigs that consume creep feed before weaning restart faster to eat, have a higher feed intake, and less diarrhea after weaning. For instance, in a field trial, pigs that consumed feed 10 days before weaning had a 62% incidence of diarrhea, whereas in pigs that consumed feed only 3 days pre-weaning, diarrhea incidence increased to 86%.

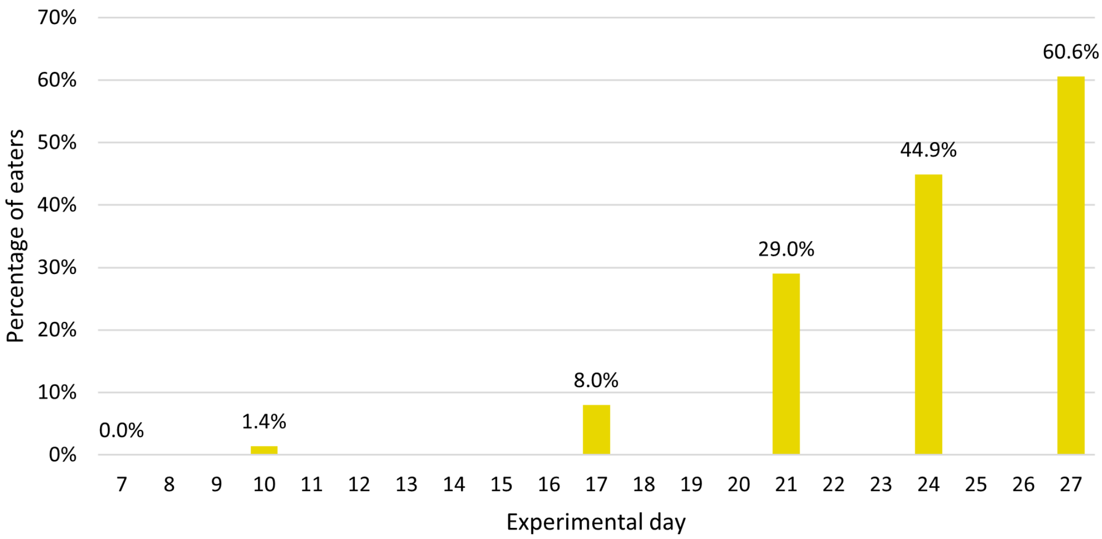


Figure 2: Influence of age on the percentage of pigs consuming creep feed

“As age is the most critical factor for a high percentage of pigs eating before weaning, there is a trend in the EU to increase the weaning age, where some farmers go to 35 days,” remarked Dr. Fledderus.

Furthermore, weaning age is positively correlated with weaning weight. Every day older at weaning improves post-weaning performance and reduces health problems.

Feed management

Creep feed for 7-10 days pre-weaning is essential, not to increase total feed intake, but to train the piglet to eat solid feed to avoid the ‘post-weaning dip.’ After about 15 days of age, piglets can consume more than is provided by milk alone. Dr. Fledderus strongly recommended creep feeding for at least one week before weaning. “Consuming feed before weaning will result in fewer problems with post-weaning diarrhea,” he said.

In addition to creep feeding, a transition diet, from 7 days pre- and 7 days post-weaning, is advised. The composition or form of the transition diet should not be changed.

The key objective of post-weaning diets is to achieve a pH of 2-3.5 in the distal stomach. Pepsin, the primary enzyme responsible for protein digestion, is activated at a pH of around 2.0. Its activity declines significantly at a pH above 3.5, which can lead to poor protein digestion and nutrient absorption.

Fiber as a functional ingredient

Fiber was previously considered a nutritional burden or diluent, but now it is regarded as a functional ingredient. Including dietary fiber, mainly inert fiber such as rice or wheat brans, can increase the retention time of the digesta in the stomach. This extended retention allows for more prolonged contact between digestive enzymes and nutrients, facilitating improved digestion and absorption of proteins and other nutrients. Not only is pH reduced, but because more proteins are hydrolyzed to peptides, there is less undigested protein as a substrate for the growth of pathogenic bacteria and the production of toxic metabolites in the hindgut.

“Size of fiber particles also matters,” said Dr. Fledderus. Coarse wheat bran particles (1,088 µm) have been shown to be more effective than finer particles (445 µm) in reducing E. coli levels in the gut. The larger particle size helps prevent E. coli from binding to the intestinal epithelium, allowing these bacteria to be excreted rather than colonizing the gut.

The understanding of dietary fiber’s role in pig nutrition has evolved, with recent findings indicating that fiber can actually increase feed intake in piglets, contrary to earlier beliefs that it might decrease intake. High-fiber diets often increase feed intake as pigs compensate for lower energy density. This can help maintain growth rates when formulated correctly.

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