

Feed Additive

INTERNATIONAL MAGAZINE FOR ANIMAL FEED & ADDITIVES INDUSTRY

www.feedandadditive.com

March 2026 Year: 6 Issue: 62

Issue Focus:

Feed Safety and Quality Control

Technology:

Smart Storage Technologies are Reshaping Feed Safety

Country Profile:

USA: Livestock and Feed Market



Neal Cass, Hydronix
Higher quality and more valuable feed with moisture control



Jisoo Tak, CJ Bio
Nucleotides in functional nutrition: Boosting growth and resilience



Alex Makol, Adisseo
How health drives aquaculture success



Feed safety continues to be a top priority for the sustainability of the livestock sector. Safe feed not only ensures the health and well-being of animals but also directly safeguards the integrity of the food chain and consumer confidence.

However, risks are becoming increasingly diverse, including toxins in raw

materials, pesticide residues, heavy metals, hygiene gaps in production processes, and spoilage during storage. On top of this, climate change-driven fluctuations in humidity and temperature are amplifying toxin risks, making raw material safety more fragile than ever. The acceleration of global trade, longer transport distances for feed raw materials, and limited availability of resources further highlight these threats. Therefore, protecting and minimizing losses of every single feed ingredient is now considered a necessity, as every loss carries significant economic and environmental costs.

Feed additives and advanced storage solutions play a critical role as a safety line in this context. Feed additives can extend shelf life and inhibit toxin formation in feed and raw materials, while modern storage technologies help prevent

deterioration by controlling moisture, temperature, and oxygen levels. Sensor-based monitoring systems, in particular, track changes in storage conditions in real time, enabling producers to intervene proactively. These tools not only reduce losses but also maintain feed quality at the highest level, boosting animal performance and productivity.

Moreover, digital transformation continues to reshape the sector. Blockchain-based traceability solutions allow every step from raw materials to the table to be monitored transparently. Through these technologies, any anomalies in production and logistics processes can be detected immediately. Sensor-supported quality management complements laboratory analyses, enabling early identification of risks and empowering producers to make data-driven decisions. Next-generation technologies therefore do more than maintain feed safety—they optimize resource use and strengthen sustainability across the sector.

In our March 2026 issue, we have explored feed safety and quality control from raw materials to additives, and from storage technologies to digital solutions, providing a broad perspective. Because we know that safe and high-quality feed, the cornerstone of food safety, remains indispensable for the sustainable success of the livestock and feed industry.

We look forward to meet you in the next issue...

From Raw Material to the Table: A New Era in Feed Safety

Feed Additive

INTERNATIONAL MAGAZINE FOR
ANIMAL FEED & ADDITIVES INDUSTRY

Publisher

Muhammed Akatay
akatay@feedandadditive.com

Sales & Marketing

Berfin Onçulu
berfin@feedandadditive.com

Editor-in-Chief

Derya Gülsoy Yıldız
derya@feedandadditive.com

SM Marketing

Lisa Atakul
marketing@feedandadditive.com

Editor

Editorial Team
editor@feedandadditive.com

Art Director

Burak Varol
graphic@feedandadditive.com

Advertising Coordinator

Özlem Akatay
ozlem@feedandadditive.com

Circulation & Data Responsible

Amine Şengün
info@threeplusmedia.com



Ataturk St. Metropol Istanbul Ste.
Block C1, No:376 Atasehir,
Istanbul/TURKEY
Phone: +90 850 220 5064
E-Mail: info@feedandadditive.com
Web: www.feedandadditive.com

Publication Type: Periodic (Monthly)



feedandadditive

***DISCLAIMER:** All views and ideas expressed in articles published in the magazine reflect the point of views of the author(s), not that of the Editor-in-Chief, Editors, Editorial Board or Publisher of Feed & Additive Magazine. The Editor-in-Chief, Editors, Editorial Board and Publisher assume no responsibility or liability in such cases.

The publisher does not give any warranty and representation to the accuracy or completeness of the contents and data published in the magazine. All responsibility of the contents, articles and information published in the magazine belongs to the authors.

The publisher and the authors cannot be held responsible for any damages resulting from the use of the whole or part of the content of the magazine.

© Three Plus Media | All rights reserved.
Reproduction, in whole or in part, is prohibited
without the written permission of the publisher.

PHYTOCOMPLEXES

HARNESSING THE POWER OF PLANTS

PhytoComplex solutions harness the power of plants to impact livestock profitability and economic growth. By targeting the animal and not the pathogen, these solutions provide a holistic approach to animal nutrition and maintaining optimal performance. The programme supports animal protein producers to excel and stay ahead of competition.

THE BENEFITS



Targeted
solutions



Designed for
profitability



Quality without
compromises

Learn more, visit www.trouwnutrition.com

C O N T E N T S

ISSUE FOCUS

22

FEED SAFETY AND QUALITY CONTROL



- 24** NEXT-GENERATION PRESERVATIVES FOR CEREALS AND FEED
David Díez Arias, Biovet S.A. Laboratories
- 29** HIGHER QUALITY AND MORE VALUABLE FEED WITH MOISTURE CONTROL
Neal Cass, Hydronix Ltd
- 32** SAFE FEED THROUGH SMART MYCOTOXIN CONTROL
Clement Soulet, Cargill Animal Nutrition & Health
- 36** ENHANCED FEED SAFETY ON FARMS ENSURES SERENITY IN UNCERTAIN TIMES
Romain D'Inca, Agrifirm
- 40** ADVANCED PROCESSING TECHNOLOGY FOR FEED SAFETY
Gero Zimmermann, Bühler Group
- 46** THE ROLE OF PROCESSING TECHNOLOGIES IN ENSURING FEED SAFETY
Ivan Harjacek & Anders Lydom, Andritz Feed & Biofuel
- 50** IDENTIFYING FORAGE QUALITY THROUGH TESTING
Dr. Robert Van Saun, Penn State University

CONTENTS



INTERVIEW

FROM SURVIVAL TO OPTIMAL PERFORMANCE: HOW HEALTH DRIVES AQUACULTURE SUCCESS

Alex Makol, Adisseo

66

ARTICLE

NUCLEOTIDES IN FUNCTIONAL NUTRITION: BOOSTING GROWTH AND RESILIENCE

Jisoo Tak, CJ Bio

56

MARINE MACROALGAE IN ANIMAL NUTRITION

Ewenn Helary, NUQO Feed Additives

62

THE IMPACT OF DRINKING WATER QUALITY ON PRODUCTIVITY IN PIGS AND POULTRY

Annie Metcalfe, Azelis UK

75

GLOBAL MYCOTOXIN REVIEW GUIDES FEED MILLS AND FARMERS IN 2026

By Trouw Nutrition

78

TECHNOLOGY



70

SMART STORAGE TECHNOLOGIES ARE RESHAPING FEED SAFETY

Derya Gulsoy Yildiz, Feed & Additive Magazine

COUNTRY PROFILE



82

USA: LIVESTOCK AND FEED MARKET ANALYSIS

Derya Gulsoy Yildiz, Feed & Additive Magazine

NEWS

- 10 Adisseo launches high-concentration Sanion Tetra butyrate solutions
- 13 CPM Crown to consolidate European operations at new Citivale site in UK
- 17 Ever.Ag introduces Feedlot IQ for smarter cattle management
- 20 Innovafeed's environmental data validated by Global Feed LCA Institute
- 96 Alltech Spain ranks in top 2% with EcoVadis Gold
- 99 FEFAC confirms speakers for 31st Congress in Bucharest



CERTIFICATION IS A DRIVER FOR SAFE & SUSTAINABLE FEED, WORLDWIDE

Martine Boon
Managing Director
GMP+ International



World population and animal product consumption are growing. As new feed markets emerge, certification will be the key to a fair and sustainable industry.

The start to 2026 has shown the world is still unpredictable. Legislative uncertainty, unexpected tariffs, supply disruption, and market volatility are not exactly desirable in an already competitive feed market with tight margins.

However, we should not lose sight of two important trends. Firstly, over the coming years we will see [significant population growth](#), notably in Africa and Asia, which will [increase the output for poultry and meat products by 13% by 2034](#). And secondly, while rising demand for safe feed will create opportunities in emerging markets, it will further strain our sector's impact on the planet.

CREDIBILITY AND TRUST

For more than 30 years we have fostered the world's most widely used scheme for feed safety, now with over 20,000 certified companies. In that time, incidents have significantly dropped, and the potential for contamination to spread through the feed chain is much reduced. Confidence in feed companies goes hand in hand with maintaining a strong feed safety culture -- it is something we should never be complacent about.

In that way, certification does more than address contamination risks, it safeguards the credibility of

a feed chain that connects farmers, traders, processors, and manufacturers across continents. Certification provides a common language, translating requirements into auditable practice, building trust between trading partners, and reducing the need for duplicate checks. In volatile times, that predictability is invaluable.

And, more recently our community has been asking us to do more. Independent research firm Ipsos asked our stakeholders what changes they want to see, and 85% said they want us to increase the scope of our work on sustainability. That message is clear; safety remains a prerequisite, but the expectations of the market have expanded.

Sustainability is not a passing trend; it is central to many companies' business continuity strategies, and another way to stand out in a competitive industry. Retailers, food brands, and financial institutions increasingly expect transparency on emissions, deforestation risk, responsible sourcing, and circularity. This is an opportunity for feed and additive companies.

Certification can support this transition. As an independent organisation, we can – and are – convening the right stakeholders and setting clear standards, aligned with international benchmarks, that help companies embed sustainability into everyday commercial practice. Like with feed safety, we can put in place impartial and workable data requirements that can be validated throughout the chain,

creating comparability across markets, which is much needed in a global trading environment.

Take Life Cycle Assessments (LCAs) as an example. The market lacks a unified, credible, and transparent approach to calculating and communicating the carbon footprint of feed. Later this year we will launch a harmonised Feed LCA standard that is globally applicable, aligned with international frameworks, and with an expanded scope that is intended for producing and trading compound feed and premixtures. And, crucially, it will be available internationally.

LICENSE TO OPERATE

But the added value of certification does not stop there. In practical terms, certification reduces friction. Buyers do not need to conduct extensive additional audits, authorities are more confident in imports that originate from recognised schemes, and trading partners know what to expect. For companies seeking growth beyond their domestic borders, this can be decisive.

Even in the short term the need for globally accepted feed certification is becoming starker. In a world where supply disruption, tariffs, and conflict are an ever-present possibility, certification functions as a license to operate, giving companies the option to find new customers in new regions more easily. For instance, a GMP+ Feed Safety Assurance certificate enables a domestic Brazilian soybean producer and trader to switch to export to the EU because they already meet the quality bar that is expected in the European market. In an unpredictable trade environment, the ability to shift markets rapidly when need arises is a game changer.

This is the immediate business case for becoming certified. Meeting recognised requirements not only provides access to established markets, but also emerging markets for the long term.

THE INTERNATIONAL STANDARD

Over the past decades, the GMP+ Feed Certification (FC) scheme has expanded far beyond its Euro-

pean roots. Today certified companies operate in 92 countries across Europe, Asia, the Americas, Africa, and the Middle East.

This global network makes it possible to connect markets that would otherwise remain fragmented. Our mutual recognition agreements with other assurance schemes reduce duplication and lower administrative burdens for companies active in multiple regions. And our engagement with governments and industry associations helps align the outcomes of private standards and public regulations, strengthening the overall safety net of the feed chain.

We are actively working with markets and governments in Asia and South America to support the development of the infrastructure surrounding feed safety and sustainability, and supporting companies to adopt practices that will, over time, meet the full requirements of GMP+ certification; enabling a step-wise approach to safe feed and fair competition on a level playing field around the globe.

Stakeholder dialogue is at the heart of this work. Feedback from certified companies, Certification Bodies, NGOs, and supply chain partners ensures that our standards maintain market relevance – because if we make a standard or provide a service that is not relevant to the market, it won't be used. If it isn't used, it will not lead to results.

A COMMUNITY OF FRONTRUNNERS

Certification is a mark of reassurance in our industry. It does not replace the need for strong action on safety and sustainability; it enables it.

For companies, if you are waiting for the market to stabilise before pursuing certification, or even waiting for regulations to require it, then you will not be surprised to hear that your competitors who think to the future are getting a head start. Safety and sustainability certification is crucial for companies in the feed chain to remain frontrunners, and being certified is what defines a frontrunner in both established and emerging markets.

ADM and Alltech combine feed businesses under Akralos

Akralos Animal Nutrition, a new North American animal feed and nutrition company, officially launched February 1, 2026. Formed through a joint venture between global agriculture leaders ADM and Alltech, Akralos combines Alltech's U.S.-based Hubbard Feeds and Canada-based Masterfeeds businesses with ADM's U.S. feed operations.

Operating an extensive network of more than 40 feed mills across North America and supported by more than 1,400 team members, Akralos aims to deliver reliable, high-quality feeds, minerals and supplements through its trusted brands, backed by advanced nutrition expertise, leading-edge science and personalized service.

"Akralos brings together proven scale, innovation and infrastructure with a deep commitment to service and results," said Akralos Chief Executive Officer Brian Gier, a leader with more than 30 years of experience in the commercial animal feed industry. "From day one, our focus is on delivering nutrition our customers can rely on, support they can count on and partnerships that help their animals and



businesses thrive."

Akralos aims to support customers in achieving measurable performance outcomes by bringing together experienced teams, established products and shared operational values. The company works closely with customers to provide tailored solutions, consistent performance and actionable insights, supported by research and development capabilities, logistical infrastructure and connections across the agri-food value chain.

[Read more>>](#)

dsm-firmenich agrees to sell ANH unit to CVC Capital Partners

dsm-firmenich, innovators in nutrition, health, and beauty, entered into an agreement with CVC, a leading global private markets manager, to divest its Animal Nutrition & Health (ANH) business for an enterprise value of about €2.2 billion, which includes an earnout of up to €0.5 billion. dsm-firmenich will retain a 20% equity stake in the divested ANH Companies, in partnership with CVC.

This transaction follows the sale of the feed enzymes activities to Novonesis for €1.5 billion in 2025 and marks the final strategic step for dsm-firmenich to become a fully focused consumer company active in nutrition, health, and beauty. The total enterprise value of ANH, including the prior sale of the feed enzymes activities, represents €3.7

billion.

The company intends to launch a new share repurchase program to buy back ordinary shares with an aggregate market value of €0.5 billion and reduce its issued capital. The program is planned to commence in Q1 2026. In addition, dsm-firmenich aims to deliver consistent and sustainable dividends to its shareholders. To achieve this, the company has adopted a 'stable to preferably rising' dividend policy, reflecting the company's commitment to long-term value creation. Under this policy, dsm-firmenich aims to maintain a stable dividend of €2.50 per ordinary share and progressively increase dividends over time.

Dimitri de Vreeze, CEO of dsm-firmenich, commented: "Since the creation of dsm-firmenich, we

have consistently delivered on every milestone in our strategic roadmap. From building a unique, integrated company to shaping a finely tuned portfolio with distinctive capabilities, we have now evolved into a leading consumer business focused on nutrition, health, and beauty. Today marks the final step in that journey.”

“We are delighted to partner with dsm-firmenich and the ANH team. This transaction represents a unique opportunity to create two new leading companies in the animal nutrition & health space. Both businesses offer significant potential for value creation. The Solutions Company will continue to drive innovation and efficiency in animal farming, delivering tailored solutions with high proximity to its global customer base. The Essential Products Company will be built as a resilient global leader



in essential feed, food and fragrance ingredients, providing customers with reliable, high-quality supply based on an independent and highly integrated value chain,” said Steven Buyse, Managing Partner at CVC.

[Read more>>](#)

Phytobiotics unveils third generation Sangrovit® formulation

Phytobiotics Futterzusatzstoffe GmbH introduced the 3rd generation of Sangrovit®, representing the most advanced development to date within its established portfolio of phytogenic feed additives. With this launch, the company aims to set new benchmarks in modern, science-based animal nutrition.

According to the company’s statement, the new Sangrovit® combines, for the first time, five bioactive alkaloids in a scientifically optimized formulation. A state-of-the-art protective mechanism based on natural, activated waxes reliably protects the sensitive active compounds from oxi-

dation and enables their precise, sequential release along the gastrointestinal tract. This results in enhanced stability, efficacy, and bioavailability.

The exclusive alkaloid complex includes the four well-established compounds sanguinarine, chelerythrine, protopine, and allocryptopine, together with the newly integrated canadine. Canadine was identified and standardized through a novel patent-driven approach and broadens the physiological mode of action of Sangrovit®, particularly in relation to stress management, anti-inflammatory effects, and improvements in carcass quality.



The company states that thanks to the innovative protection concept, the alkaloids remain stable during their passage through the digestive tract and are selectively released in multiple intestinal segments. This targeted release supports measurable improvements in resilience, gut health, and performance under stress conditions.

[Read more>>](#)

Adisseo launches high-concentration Sanion Tetra butyrate solutions

Adisseo launched Sanion Tetra 50 and Sanion Tetra 70, protected sodium butyrate additives with 50% and 70% active content. Produced in Adisseo's own state-of-the-art facilities, these products benefit from the company's strong expertise in chemical engineering, industrial production, and butyrate science.

According to Adisseo's statement, leveraging decades of technological know-how in butyrate solutions, Sanion Tetra is engineered for optimal physical

quality—low dust, free-flowing, and reduced smell—meeting the key expectations most valued by feed manufacturers, nutritionists, and animal health professionals. Part of Adisseo's Animal Resilience portfolio, Sanion Tetra supports the shift toward nutrition-based health solutions in response to global efforts to reduce the use of antibiotics and high dietary ZnO levels. The company notes that its proven gut health benefits, together with minimized use of palm-derived ingredients and an ecodesigned production process with no steam or water waste, make it a high quality and sustainable choice within one of the most comprehensive butyrate ranges on the market.



signed production process with no steam or water waste, make it a high quality and sustainable choice within one of the most comprehensive butyrate ranges on the market.

[Read more>>](#)

Amlan and Elanco to host calf health education seminars in Japan

Amlan® International, the animal health business of Oil-Dri® Corporation of America, is collaborating with Elanco Animal Health on a three-day educational seminar in Japan from March 10–12 titled: “Creating the Future for Calves: Latest Clinical Approaches for Suckling Calves.” The program will bring together veterinarians, producers, and industry stakeholders to exchange practical knowledge and field-based experience related to the management of diarrhea and pneumonia during the critical suckling period.

In Japan, calf rearing is supported by careful daily observation, precise feeding management, and close veterinary involvement. Health challenges during early life not only affect short-term survival but may also influence long-term herd stability and performance. The seminar aims to provide a forum for open discussion grounded in clinical practice and farm realities.

The event will feature a keynote presentation by Dr. Teppei Ikeda, Veterinarian at BRAFT Co., Ltd. Dr. Ikeda provides consulting support to both dairy and beef operations, covering calves through adult cattle and assisting farms from breeding through fattening.



Operating from two locations in Central Hokkaido and Tokachi, BRAFT's team of veterinarians supports producers throughout Hokkaido and beyond. His session, “Introducing Countermeasures for Diarrhea and Pneumonia During the Suckling Period,” will focus on clinical observations from the field and preventive veterinary approaches aimed at improving calf survivability while maintaining long-term herd consistency.

During the program, Amlan International will highlight Varium®, a patented feed additive with a synergistic blend of proprietary mineral technology, yeast, and a functional amino acid, with particular emphasis on calves during the suckling period.

[Read more>>](#)

**A FIRST
IN SCIENCE***

AN OASIS AT THE HEART OF YOUR FARM



During **heat stress**, Adisseo solutions for dairy cows protect performance in lactating cows and safeguard the next generation.

**Adisseo protects performance
Today and Tomorrow**



Discover our solution



*A pioneering research program, in partnership with four leading universities, over a four-year period.

www.adisseo.com

ADISSEO
A Bluestar Company

BioMar to double production capacity in China

BioMar is expanding its aquafeed production capacity in China by adding a second production line at its Wuxi facility, in collaboration with joint venture partner Tongwei. The expansion, scheduled for 2026, aims to double capacity in Wuxi, enable the production of specialty feeds for early growth stages, and support entry into new high-end species segments.

The expansion will add 50,000 tonnes of capacity and introduce advanced technological capabilities, allowing the Wuxi facility to serve new customer segments.

In addition to its current focus on high-end species, the upgraded plant will be able to produce advanced nursery feeds and diets for species such as Japanese eel, grouper, and mandarin fish. The new line is expected to be commissioned in the first quarter of 2027.

“In recent years, we have developed a substantial business presence in China, where we collaborate with customers to introduce innovative feed solutions grounded in BioMar’s research and global experience with high-value species and sustain-



able aquaculture nutrition. Our goal is to elevate this success by expanding the production capacity in Wuxi with 50,000 tonnes, while integrating advanced technological capabilities into our production facility,” says Carlos Diaz, CEO of BioMar Group.

[Read more>>](#)

AquaVision 2026 to explore the future of global aquaculture

The 16th edition of AquaVision will take place in Stavanger, Norway from 8-10 June 2026. Hosted by Skretting and its parent company Nutreco, the biennial aquaculture business conference brings together global leaders to discuss the role of sustainable blue food in feeding a growing world population.

“With AquaVision, Skretting and Nutreco are providing an arena for the aquaculture and food industries to build connections, hear diverse perspectives, and address shared challenges. We must remain agile – navigating global politics, keeping pace with technologies such as AI, and responding swiftly to shifting regulations and market expectations particularly on sustainability,” says Maarten Bijl, CEO of Skretting. “Striking the right balance between speed, collaboration, and scientific credibility is how the industry will ride the next wave and emerge stronger together. I look forward to AquaVision 2026, and seeing how we can collectively drive sustainable growth for the future of aquaculture.”

“Navigating the global geopolitical landscape: Impacts and opportunities for the aquaculture industry” and “Beyond tomorrow: Pioneering innovations shap-



ing the future of the industry” have been announced as the two key themes to be explored at AquaVision 2026.

According to Skretting, in a world increasingly shaped by geopolitical uncertainty, shifting alliances, and regulatory complexity, businesses must stay agile in order to thrive. The company emphasizes that at AquaVision 2026, participants will explore how the global geopolitical climate is influencing economic landscapes, international trade, supply chain resilience, and consumer behaviour in the aquaculture sector and beyond. Renowned experts from different regions will contribute their perspectives to these discussions.

[Read more>>](#)

CPM Crown to consolidate European operations at new Citivale site in UK

CPM Crown, a global leader in process solutions and engineered equipment, will officially relocate its European operations to a new, state-of-the-art facility in the UK at a Citivale-managed site in April, marking a major milestone in the company's continued growth. The move brings CPM Crown Europe together under one roof for the first time, creating a centralized hub designed to support collaboration and long-term expansion.

"Crown Europe has been based at our previous site since the 1990s, but our business has changed dramatically in recent years," said Chris Fisher, Director of Operations, EMEA at CPM Crown. "We've evolved from operating as individual geographic business units to becoming a centralized, global functional organization. With that shift has come growth—our team has nearly doubled—and we needed a space that enables the way we work today."



Previously spread across three aging buildings, the CPM Crown team will now operate from a single, modern facility designed to improve efficiency and integration.

"This new building also gives us the flexibility to grow in the future, including the potential to add a pilot plant where customers can see our innovations in action," Fisher added.

[Read more>>](#)



Superior Animal Feed Solutions

We build equipment that just runs. CPM is the world's leading provider of innovative and automated solutions for new equipment and aftermarket.



BETA RAVEN



BLISS



De Heus expands East African operations with Kenya feed mill

De Heus Animal Nutrition officially opened a state-of-the-art animal feed production facility in Athi River, Machakos County, marking a major milestone in its long-term commitment to Kenya's agricultural sector and regional development. The new plant has an annual production capacity of 240,000 metric tons and represents a total investment of KES 3 billion (USD 23 million).

Construction of the facility was completed successfully through strong collaboration with the local workforce, supported by technical expertise from De Heus business units across Africa. The company

stated that the transfer of specialised skills to the Kenyan team enables the consistent production of high-quality animal feed for poultry, pig, and cattle farmers.

De Heus continues to demonstrate its commitment to growth across Africa, marked by the recent commissioning of a new aquafeed factory in Uganda, the start-up of a second livestock feed factory in the Ivory Coast, and plans for further expansion across East Africa. The Athi River factory underscores De Heus's strategy to support the agricultural sector through innovation, job creation, and regional collaboration.



"This investment demonstrates our confidence in the Kenyan economy and the agricultural sector's potential. This factory opening signals a new era for our farmers, providing access to high-quality feed and technologies that will drive food security and economic growth," said Co de Heus, Chairman of the Board of De Heus Animal Nutrition.

[Read more>>](#)

WINCod microdiet targets cod hatchery challenges

SPAROS announced the launch of WINCod, a next-generation microdiet specifically developed for Atlantic cod larvae. Emerging from the EarlyCOD project, WINCod tackles key challenges in cod hatcheries—high mortality, skeletal deformities, and inconsistent juvenile quality.

Designed for early co-feeding protocols, WINCod pairs seamlessly with Planktonic AS's cryoplankton (frozen live plankton), delivering a synergistic nutritional strategy that supports larvae during the critical first feeding and weaning phases.

Extensive trials demonstrate that WINCod significantly improves larval robustness, while reducing skeletal anomalies and promoting healthier organ development. The result is higher-quality juveniles, giving hatcheries greater predictability and control over production outcomes.

According to SPAROS, by strengthening larvae early on, WINCod also reduces dependence on traditional live feeds, helping simplify hatchery operations. Its formulation is the result of years of targeted R&D com-



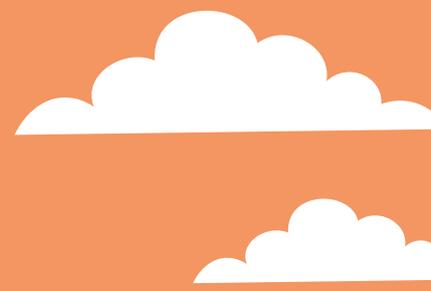
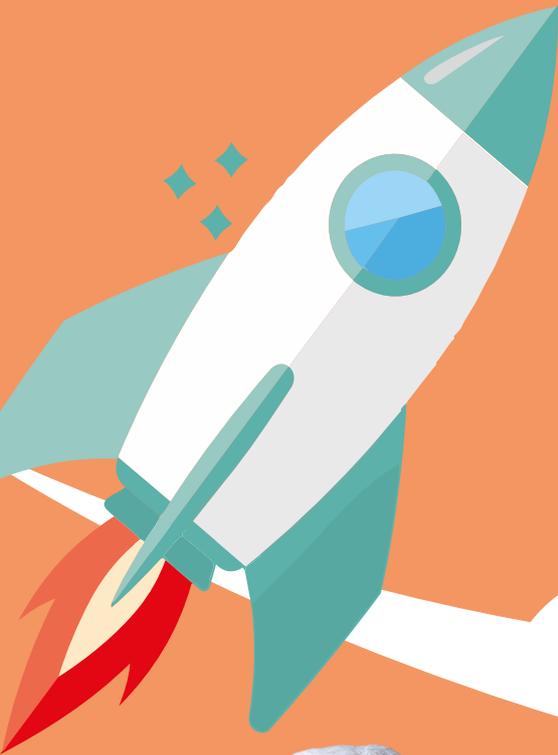
bined with industrial-scale validation, ensuring both biological performance and practical implementation.

WINCod is available in 150, 300, and 500 µm pellet sizes, allowing precise matching to larval developmental stages. Early adopters in Norway have already reported measurable improvements in hatchery performance. The product is ready for immediate deployment in commercial hatcheries, with SPAROS providing technical support for implementation and protocol optimisation.

[Read more>>](#)

ELVOR IMMUNE

Give them
the momentum
to reach higher !



Discover our technical newsletters on our website!



Elvor immune colostrum replacer can be used as a supplement or replacement for maternal colostrum.

To ensure the immunity of young animals, it contains:

- ✓ 50% colostrum powder and 10% egg products to enhance **immunity** and **intestinal health**
- ✓ Probiotics (live yeasts), **stabilisers of the intestinal flora**
- ✓ Fructo-oligosaccharides for a **good digestive microflora**

elvor
Feed, protect, grow.

www.elvor.com

Follow us on  LinkedIn

Denkavit Ingredients strengthens Benelux offer with expanded Adisseo range

Denkavit Ingredients and Adisseo announced a significant expansion of their product offering in the Benelux, effective 1 March 2026. The new offering introduces more than 40 Adisseo products across several advanced product categories designed to support animal performance, feed efficiency, and producer profitability across species. With this expansion, both companies aim to strengthen their role as complete solution partners for nutritionists, purchasers, and feed industry professionals in The Netherlands, Belgium, and Luxembourg.

“By expanding our portfolio for the Benelux, we ensure our customers gain access to a most complete and science-driven set of solutions for feeds from premix to on-farm products. This development strengthens our role as the trusted partner, supporting nutritionists and feed manufacturers to achieve reliable, consistent results,” says Oliver Schneider, Group Manager Ingredients Specialties at Denkavit.

“Through this extended product portfolio, customers in the area will have access to a broader, more integrated product and service package. It allows Adisseo to support customers even better with high-quality ad-



ditives, technical expertise, and a decisive focus on animal performance and sustainability,” adds Matthieu Le Bris, Area Director Northern Europe at Adisseo.

The expanded portfolio will support customers in improving feed efficiency, animal health, and production performance across all livestock species, aquaculture and petfood. This strategic expansion fills a growing market need for more integrated, evidence-based nutrition solutions. Customers increasingly seek consolidated supplier relationships, access to high-performing functional ingredients, and enhanced technical support, gaps that the broadened portfolio addresses.

[Read more>>](#)

New BioMar feed supports natural defences in seabass during bacterial pressure

BioMar launched SmartCare Defence, a new functional feed solution designed to support seabass health and reduce mortality linked to bacterial infections during high-risk periods in Mediterranean farming.

Bacterial diseases remain one of the most significant challenges for seabass production; the seasonality of the outbreaks is well known. While vaccination strategies have improved control against certain pathogens, bacterial outbreaks caused by species

within genera such as Photobacterium, Vibrio and Aeromonas continue to drive losses at farm level. At the same time, the sector is moving towards reduced reliance on medicated feeds, increasing the need for nutritional tools that support the fish’s natural defenses.

According to BioMar’s statement, SmartCare Defence is the result of more than five years of research and development, combining controlled laboratory trials with large-scale commercial



validation. The solution is part of BioMar’s SmartCare program, which focuses on functional nutrition strategies tailored to specific production challenges.

[Read more>>](#)

Ever.Ag introduces Feedlot IQ for smarter cattle management

Ever.Ag, one of the leading providers of innovative AgTech solutions and services, announced the launch of Feedlot IQ, an intelligent, connected feedlot management platform powered by artificial intelligence and built specifically for cattle feedlot operations. Designed to help feedyards improve consistency, support animal health, and make earlier, more informed decisions, Feedlot IQ uses advanced AI and connected data to give operators a clearer understanding of what's changing across the yard.

Feedlot IQ brings health, feed, performance, weather, and finan-

cial data together into one unified view, turning the information feedlots already capture into practical, usable insights. Built on real-world feedlot data, the platform helps teams spot intake shifts, emerging health concerns, and performance trends sooner, supporting more stable operational outcomes.

Developed in close collaboration with Production Animal Consultation (PAC), whose leadership in cattle research, diagnostic innovation, and feedlot team training has shaped modern animal health practices, Feedlot IQ builds on the instincts and experience of the people who know cattle best.



Photo: Ever.Ag

“Feedlot IQ applies AI and advanced analytics to bring together feed, health, weather, and operational data in a way that's truly actionable for feedlot teams,” said Fernando Logar, Group Product Leader at Ever.Ag. “By connecting these data sources, the platform helps operators see changes earlier and understand what's driving them.”

[Read more>>](#)

SANGROVIT®

“The 3rd generation of Sangrovit® offers a defined and standardized **canadine profile**,”

With its optimized formulation, it provides targeted support for operations striving for maximum efficiency and dependable results.

New!



Discover how you can benefit from the all-new Sangrovit®. Get in touch with our experts at sangrovit@phytobiotics.com or visit us at www.phytobiotics.com.

PHYTOBIOTICS
BASED ON SCIENCE

Alltech analysis reveals 2025 mycotoxin risk patterns

The 2025 harvest season has delivered new insights and fresh challenges for feed safety across Europe, the United States and Canada. Drawing on analysis of more than 2,000 new-crop samples, Alltech's latest Harvest Analysis provides a snapshot of global mycotoxin trends and highlights strategies for managing mycotoxin risks to animal health and nutrition.

Earlier this year, Alltech presented the findings during the global broadcast "From Field to Feed: 2025 Crop and Mycotoxin Analysis," streamed from its Kentucky headquarters. The event brought together industry experts to discuss harvest results, weather impacts, market outlooks and strategies for managing mycotoxin risks throughout the feed supply chain. One of the key themes highlighted during the broadcast was the growing role of artificial intelligence (AI) in predicting and managing mycotoxin risk.

Weather continues to play a major role in both crop performance and mycotoxin development. During the broadcast, Dr. Jan Dutton, CEO of Prescient Weather Ltd., emphasized that weather variability directly affects yield outcomes and toxin risk, noting that predictive tools such as CropProphet can help producers better manage production and market uncertainty.

According to Dr. Dutton, the 2025 season showed clear regional contrasts. In the United States, crops experienced periods of significant heat in early and



late July, while weather conditions were milder during corn silking. Canada's oat-growing regions faced notable dryness from May through June. In Europe, early-season temperatures were above average, followed by dry conditions in June and partial recovery in July.

Dr. Max Hawkins from Alltech added that regional variability was greater in 2025 than in 2024. In the U.S., crop health and mycotoxin levels were influenced by challenges such as Southern corn rust, tar spot, wind damage and excess rainfall, particularly affecting sensitive species like ruminants.

He also highlighted a geographical shift in risk patterns. Mycotoxin pressure moved westward in the U.S., while eastern regions saw some decline. This year-to-year movement underscores the importance of consistent testing of feedstuffs when formulating safe total mixed rations (TMRs).

[Read more>>](#)

Novus to present swine nutrition research at ASAS Midwest

NOVUS will present new research highlighting nutrition strategies that support pig health and performance during the American Society of Animal Science (ASAS) Midwest meeting, March 9 to 12 in Omaha, Nebraska. NOVUS scientists will share findings that address profit-limiting challenges facing swine producers, including nurs-

ery and growing pig health, survivability, and feed efficiency.

"These studies show how targeted nutrition strategies can support pigs during periods of stress while also aligning with producer goals for efficiency and survivability," says NOVUS Global Swine Research Manager Jesus Acosta, Ph.D. "Sharing this research at ASAS allows us to engage with nu-



tritionists, veterinarians, and producers who are looking for practical, science-based solutions."

[Read more>>](#)



MicroSaf

GO TECHNOLOGY

THE NEW POULTRY PROBIOTIC
POWERED BY GO TECHNOLOGY*



The information provided in this document is at the best of our knowledge, true and accurate. However, products must only be used in compliance with local laws and regulations, and we cannot guarantee freedom of use for every intended application or country. P45-P-880-AP-1804E1-en / Avalone

GO FASTER
STRONGER



* Germination Optimisation Technology patents: US 9,447,376 & US 9,932,543

phileo-lesaffre.com



Innovafeed's environmental data validated by Global Feed LCA Institute

Innovafeed, one of the leaders in the production of insect-based ingredients for pet food, animal feed, and plant nutrition, announced the validation of the Life Cycle Assessment (LCA) of its products (Branded Data) by the Global Feed LCA Institute (GFLI), an independent organization providing the world's reference database for the animal feed ingredients industry. This recognition confirms that Innovafeed's LCA data, covering insect protein, oil, and frass (organic fertilizer), complies with GFLI's rigorous meth-

odology, aligned with international standards from the FAO (LEAP) and the European Union (PEF).

"This major milestone, eagerly awaited by all our customers, provides tangible proof of the impact of Innovafeed's model, a model designed to transform agri-food value chains and accelerate their transition toward more resilient and responsible systems," says Maye Walraven, Chief Business Officer and Chief Impact Officer at Innovafeed.

Innovafeed emphasizes that this validation represents a major step forward for the insect protein in-



dustry, demonstrating the scientific robustness and positive impact of its model in addressing climate and food system sustainability challenges. It positions insect-based ingredients as a viable and innovative solution to diversifying protein sources and reducing pressure on natural resources, according to the company.

[Read more>>](#)

New partnership enhances feed environmental tracking

dsm-firmenich Animal Nutrition & Health, one of the global leaders in sustainable animal nutrition solutions, announced a data collaboration with Kynetec, a leading provider of agricultural and animal health data. The partnership strengthens the feed raw material data foundation of Sustell™, the industry-leading life cycle assessment platform, enabling more precise, science-based measurement of environmental footprints across the farm-to-fork animal protein value chain.

Since 2020, Kynetec has gathered representative, trusted, primary activity data from farmer surveys across 90+ crops in more than 50 countries, including all major and minor feed crops, supporting environmental footprint measurement across livestock and aquaculture systems.

"Partnering with Kynetec further strengthens the robust, data-driven approach of Sustell™, bringing high-quality, real-world crop data directly into our clients' life cycle assessments. This integration gives producers more accurate, regionally specific insights into the true footprint of their feed and farming systems, turning data into actionable improvements



that drive measurable progress across the animal protein value chain," said Dr. David Nickell, Global VP Sustainability and Business Solutions at dsm-firmenich Animal Nutrition & Health.

The Sustell™ platform now integrates globally harmonised, farm-level crop insights, delivering more representative environmental factors for major feed crops and bridging the crucial crop-feed-farm data gap. This integration enhances the precision and credibility of animal protein footprints, empowering sustainability teams to pinpoint and prioritise targeted improvement opportunities with greater accuracy and effectiveness.

[Read more>>](#)

Anavrin®

INNOVATION BY NATURE

ANAVRIN® is a natural feed compound.

Supported by multiple university studies, scientific publications and field evaluations, it has been demonstrated that:*

- ▶ It can be used as a natural replacement for Monensin as a growth promoter.
- ▶ It can enhance productive performance, both in terms of milk yield and meat gain.
- ▶ It can reduce methane emissions, based on trials conducted with approved measurement technologies and across different cattle breeds.

Moreover, **ANAVRIN®** participates in the **Verra Protocol** for the generation of **Voluntary Carbon Credits** in various countries worldwide.



**REDUCTION OF METHAN
EMISSIONS UP TO 21% ****

**INCREASES MEAT
PRODUCTION UP TO 6,8%**

**INCREASES MILK
YIELD UP TO 3,8%**

* Dependent on animal age and health, breed, feed regime, farm condition.

** In vivo trial.

Certified
GMP+



VetosEurope

vetoseurope.ch



**FEED SAFETY AND
QUALITY CONTROL**



- 
- Next-generation preservatives for cereals and feed
David Díez Arias, Biovet S.A. Laboratories
 - Higher quality and more valuable feed with moisture control
Neal Cass, Hydronix Ltd
 - Safe feed through smart mycotoxin control
Clement Soulet, Cargill Animal Nutrition & Health
 - Enhanced feed safety on farms ensures serenity in uncertain times
Romain D'Inca, Agrifirm
 - Advanced processing technology for feed safety
Gero Zimmermann, Bühler Group
 - The role of processing technologies in ensuring feed safety
Ivan Harjacek & Anders Lydom, Andritz Feed & Biofuel
 - Identifying forage quality through testing
Dr. Robert Van Saun, Penn State University



NEXT-GENERATION PRESERVATIVES FOR CEREALS AND FEED

David Díez Arias
Veterinary Manager
Biovet S.A. Laboratories

Preserving cereals and feed is no longer just about inhibiting spoilage, but about delivering long-term safety, performance, and health across the production chain. As limitations of traditional organic acids and formaldehyde become increasingly clear, next-generation natural preservatives are redefining feed protection. By combining broad-spectrum microbicidal efficacy with safety, durability, and added intestinal benefits, innovative technologies now offer a more sustainable and effective approach to safeguarding feed quality and animal productivity.

Preserving feed consists of maintaining its characteristics; i.e., preventing the loss of nutrients and energy value caused by the action of microorganisms (bacteria and fungi) present in the feed. Preserving these nutritional and energy properties is essential to achieve good productive parameters, while simultaneously preventing important pathologies.

The preservation of cereals and compound feed is carried out through the inclusion of products that minimize this deterioration — preservatives — which also help prevent digestive infectious diseases and other derived problems, such as mycotoxicosis.

ANALYSIS OF THE MOST COMMON PRESERVATIVES FOR FEED AND RAW MATERIALS

The most common preservatives on the market can be divided into three main types: organic acids, formaldehyde, and natural preservatives.

The first group has been used for decades to preserve both raw materials and compound feed. Their mechanism is based on reducing the intracellular pH of pathogens to inhibit their metabolic processes and, therefore, their multiplication. In other words, they mainly exert a bacteriostatic and fungistatic effect. Formaldehyde is usually applied to grains for the control, among others, of *Salmonella*, a bacterium of great concern to poultry and swine industries due to its consequences for animals and the zoonotic potential of some strains.

Finally, some natural preservatives have emerged in the industry, standing out for achieving equal or, in many cases, superior efficacy compared to the previously mentioned solutions. In this regard, a technology has been developed based on the synergy between cineole, cimenol ring, and isopropyl methyl-phenol, botanical molecules which, when combined with citric acid, are capable of eliminating a wide variety of microorganisms that cause feed deterioration through membrane disruption.

ORGANIC ACIDS: CHARACTERISTICS AND LIMITATIONS

Organic acids inhibit microbial growth in feed by reducing the internal pH of bacteria and fungi, thereby reducing their enzymatic activity to minimal levels and limiting their ability to reproduce. These products prevent the multiplication of microorganisms, but do not eliminate them completely.

Their spectrum of action is more or less limited: some acids are effective only against specific groups of microorganisms (i.e., gram-positive bacteria). The combination of propionic acid with formic acid is the most commonly used, as it broadens the preservative's spectrum of action.

The main limitations of these products are:

- They inhibit but do not completely eliminate microorganisms.
- A relatively short duration of effect: after approximately two months they lose efficacy, and microorganisms may use the acids as an energy source to multiply again.
- A limited spectrum of action: they are only effective against specific groups of microorganisms, meaning others may remain in the feed, or acid combinations become necessary.
- Corrosive potential: acids may damage machinery and their application can sometimes be hazardous for workers.

FORMALDEHYDE: SERIOUS CONSEQUENCES FOR ANIMALS AND HUMANS

Formaldehyde has a high capacity for controlling *Salmonella* and has therefore been widely used to eliminate this pathogen in grains and compound feed, as well as to prevent digestive infections.

Its harmful effects on human and animal health have led to a progressive reduction in the availability of formaldehyde-based products for animal feed. This is because it is a toxic and irritating substance upon contact with skin and the respiratory tract, and is potentially carcinogenic for both humans and animals.



Image 1. Lesion in the gizzard of a bird exposed to formaldehyde. Burns distributed throughout the organ can be observed.

Additionally, in the digestive tract, formaldehyde reacts with hydrochloric acid, causing thermal and chemical burns in the digestive epithelium, leading to significant deterioration of productive parameters (Image 1).

NATURAL PRESERVATIVES: SYNERGY BETWEEN ANTIMICROBIAL PHENOLIC COMPOUNDS

Natural preservatives represent a solution that has become more popular in the industry compared to organic acids and formaldehyde, as they offer advantages that overcome the limitations of other preservatives. Alquer mold Natural Plus is a clear example: a product based on the combination of cineole, cimenol ring, and isopropyl methyl-phenol, natural microbicidal molecules that synergistically eliminate a wide variety of microorganisms present in feed and cereals, including gram-positive and gram-negative bacteria, fungi, and yeasts.

As a microbicidal product, it completely eliminates microorganisms, its efficacy lasts for a long time, allowing preservation of grains and compound feed for at least six months. Its mechanism is based on the disruption of the cell membrane, leading to pathogen death.

RECENT SCIENTIFIC EVALUATION IN COLLABORATION WITH THE UNIVERSITY OF HELSINKI

Recently, Biovet carried out an *in vitro* evaluation of the preservative efficacy of Alquer mold Natural Plus compared with a combination of organic acids widely used in the industry.

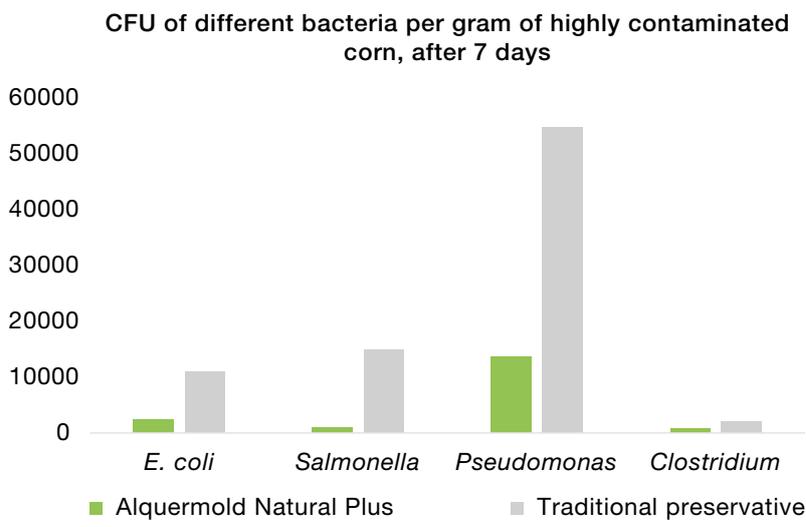


Figure 1. CFU per gram of corn highly contaminated with different bacteria. Results shown 7 days after contamination.

The objective of the study was to compare the percentage reduction of different microorganisms achieved by both preservatives. The effect against the most common sector-relevant microorganisms was also evaluated, including *Aspergillus*, *Clostridium*, *Escherichia coli*, *Salmonella*, *Pseudomonas*, *Rhizopus*, and *Fusarium*.

For the experimental design, two types of substrates, ground corn and compound feed, were contaminated with 10⁶ CFU/g of these microorganisms. After prod-

uct administration, microbial counts were performed at 24 hours and 7 days to assess microbial reduction.

Results showed that in the case of bacteria, Alquer mold Natural Plus achieved notably lower bacterial counts on day 7 compared with the other preservative for each bacterium tested, even starting from high initial contamination. Compared to control, reductions were: 99.91% for *Clostridium*, 99.8% for *E. coli*, 99.93% for *Salmonella*, and 98.88% for *Pseudomonas*.

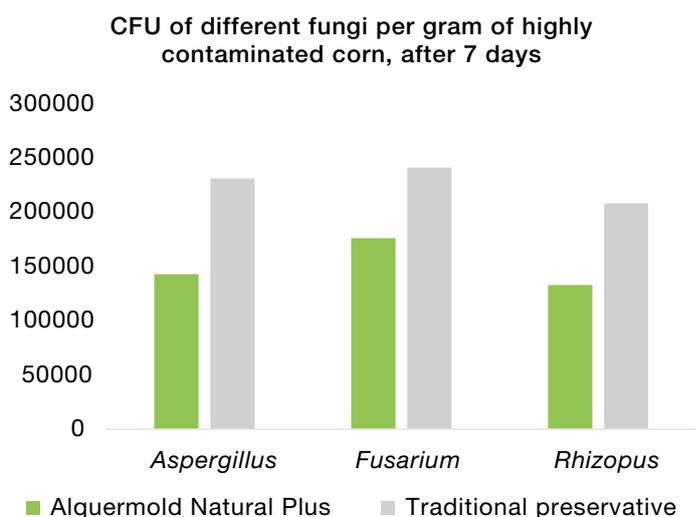


Figure 2. CFU per gram of corn highly contaminated with different fungi. Results shown 7 days after contamination.



Similarly, for fungi, Alquer mold Natural Plus also achieved the lowest counts on day 7 after application in highly contaminated corn samples. Compared with control, reductions were: 91.13% for *Aspergillus*, 88.48% for *Fusarium*, and 91.07% for *Rhizopus*.

Additionally, the preservative compared against Alquer mold Natural Plus was administered at four times the dosage, yet still produced lower bacterial and fungal reduction percentages than the natural product. These same results were observed in compound feed, with practically identical outcomes.

ADDED VALUE OF ALQUERMOLD NATURAL PLUS: INTESTINAL MICROBICIDAL EFFECT

An added value of this microbicidal technology is that, besides acting as a feed preservative, its efficacy persists in the digestive tract, acting as an intestinal antimicrobial and controlling pathogenic microorganisms that may colonize the intestine. Thus, animals consuming feed supplemented with Alquer mold

Natural Plus develop a more balanced intestinal flora, while digestive infections are prevented.

Field trials have shown that its inclusion in feed improves digestive flora balance without affecting beneficial flora such as *Lactobacillus spp.* Applications include prevention of infectious diseases associated with bacterial overgrowth in the intestine, such as necrotic enteritis (*Clostridium*), as well as reducing *Salmonella*, *E. coli*, and *Campylobacter* on farms.

In a trial conducted at Universidad Científica del Sur (Lima, Peru), broilers were challenged with *Clostridium perfringens* to evaluate the capacity of Alquer mold Natural Plus for prevention and treatment of necrotic enteritis and its impact on performance.

Administration of Alquer mold Natural Plus as prevention and treatment reduced mortality compared to the infected control by 87.5% and 62.5%, respectively. In addition, the preventive group, despite the challenge, showed lower mortality than the

ALQUERMOLD[®] Natural PLUS



Preservative and intestinal microbiocide: bactericidal and fungicidal

PATENTED

ALQUERMOLD NATURAL PLUS

It is a natural antimicrobial based on the synergy Cimenol Ring, Isopropyl-methylphenol and Cineole.

It is also effective as an intestinal microbiocide for the prevention and treatment of major digestive infections.



Clostridium



Aspergillus



Salmonella



Fusarium



E. coli



● **It drills microbial cell membrane**

Benefits:

- Effective in preventing digestive infections, such as necrotic enteritis
- Efficacy as a long-lasting preservative (tested for 180 days)
- Broad spectrum of action against fungi and bacteria
- It is not corrosive, does not damage machinery and is not dangerous to handle
- Double effect in a single product: preservative and intestinal biocide
- Improves productive parameters
- Alternative to organic acid based products

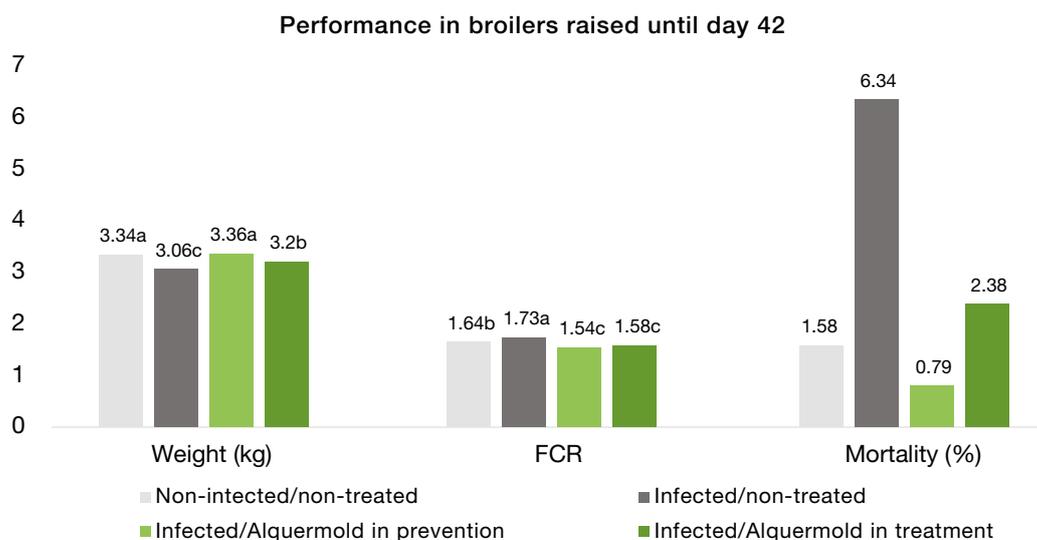


Figure 3. Results for body weight, FCR and mortality in broilers challenged with *Clostridium perfringens*, showing productive improvement with the use of Alquermold Natural Plus, both for prevention (powder mixed with feed) and treatment (liquid in drinking water when an outbreak is detected).

negative control (non-infected), thanks to better control of digestive flora balance.

Parameters such as uniformity also improved, being 12% higher in the preventive group compared to the challenged control and 6% better than the negative control; carcass yield improved by 6.7%.

Regarding body weight and feed conversion ratio, after the *Clostridium perfringens* challenge, animals receiving Alquermold Natural Plus as prevention maintained productive performance and weighed nearly 300 grams more on day 42 compared with the infected group, with a 6.36% better feed conversion ratio.

Animals receiving the product in drinking water as treatment also improved daily weight gain, body weight and, feed conversion compared to the infected group, demonstrating that Alquermold Natural Plus offers versatility for both prevention and treatment.

CONCLUSIONS

Traditional preservatives are mainly based on combinations of different organic acids. However, they only exert an inhibitory effect on microorgan-

isms without eliminating them, have limited spectrum and duration of action, and may be corrosive to facilities, animals and workers.

In contrast, Alquermold Natural Plus is a natural-based technology that, being microbicidal, completely eliminates microorganisms with a broad spectrum of action lasting at least six months, and is neither corrosive nor harmful to animals, workers, or machinery.

Scientific results have shown that in feed preservation it achieves higher reduction percentages for all tested microorganisms, even at doses four times lower than products based on organic acids. This represents not only improved feed preservation but also significant economic benefits.

Additionally, Alquermold Natural Plus remains effective after ingestion and controls enteric infections caused by *Salmonella*, *E. coli* or *Clostridium*, among others. In this sense, it can prevent important poultry sector diseases such as necrotic enteritis and improve performance and mortality rates. It has also been demonstrated that supplementation via drinking water as a treatment helps control digestive challenges during outbreak situations.



HIGHER QUALITY AND MORE VALUABLE FEED WITH MOISTURE CONTROL

Neal Cass
Sales Director
Hydronix Ltd

Controlling water in animal feed production processes is no longer just a quality issue, but a strategic lever for efficiency, consistency, and profitability. As feed mills handle increasingly variable raw materials, precise moisture control enables producers to stabilize operations, optimize additive dosing, and improve pellet quality. By integrating real-time moisture measurement across key production stages, feed manufacturers can reduce waste, lower energy consumption, and unlock higher-value output from every batch.

The world is becoming more integrated digitally, and this allows a lot more information to be both produced and consumed in industrial environments, including in modern production process plants.

One of the big challenges for feed producers is to get consistency into their production so that they can optimise the plant and get the same results for each batch. Addressing this challenge offers unique opportunities to stabilise production processes and improve repeatability and profitability. This article will explain how modern moisture sensors can be used to get the best yields and quality from the naturally varying raw materials in a typical feed mill.

Benefits of moisture control:

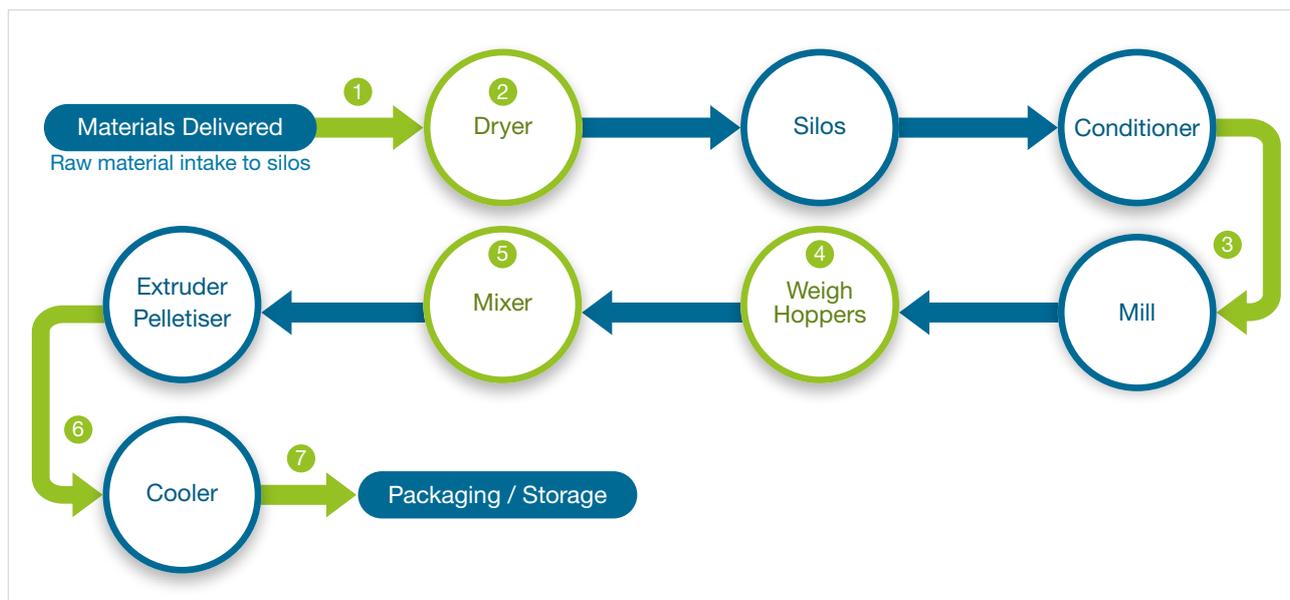
- Optimise dosing of feed additives,
- Improve nutritional consistency,
- Reduce spoilage and waste,
- Improve shelf life,
- Optimise pellet durability,
- Increase plant efficiency,
- Reduce process downtime.

THE FEED PROCESS

Animal feed is produced from a wide range of raw materials which are sourced from natural environments, and the vast quantity of those materials are delivered in bulk loads with wide variation in the moisture content.

1. During delivery, if the materials are being stored, then there are options on how any residual moisture is managed. Some feed producers will add an anti-microbial agent during the intake process to allow them to accept storage at higher moisture levels, whilst some will dry the grain to allow a longer storage life.





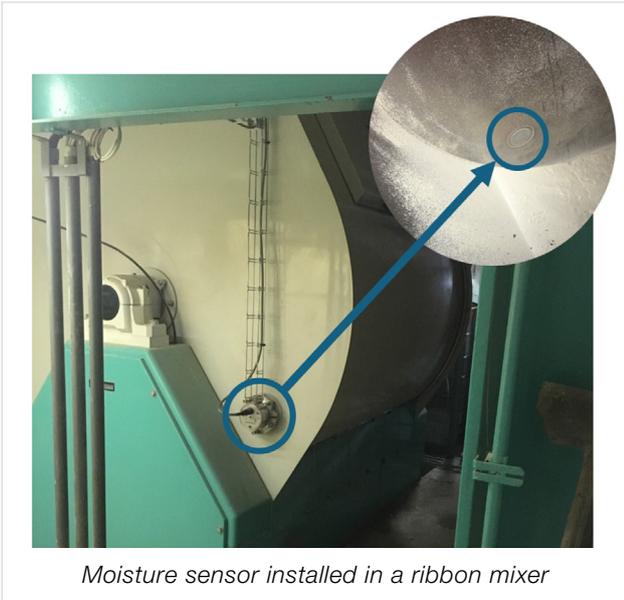
During any anti-microbial addition, it is important to monitor the moisture in real-time to add the agent at the most appropriate rate to avoid over-dosing.

2. When drying, it is important to precisely achieve the target moisture as under-drying creates obvious problems with mould growth and spoilage, and over-drying wastes energy and increases the amount of breakage due to brittle grains. This can, in turn, lead to dust accumulation and rodent infestation. Moisture sensors can be used in the dryer inlet and outlet flows to measure the material flow in real-time to allow the process temperature, exhaust fans, and residence time to be controlled.

3. During reduction processes, in the hammer or roller mills, the moisture in the raw material affects the size and shape of the ground material. In a hammer mill, higher moisture material absorbs the energy of the hammer, so instead of shattering cleanly, it flattens or tears. In a roller mill, higher moisture grain does not shear properly so, instead of a clean cut, the material gets mashed. At the opposite end of the moisture range, grain that is too dry can crack too easily and cause excess dust, and the moisture can affect capacity and energy consumption of the mill and can cause increases in heat generation. To get the correct moisture levels, it may be necessary to have a further drying step or (in drier climates) to have a water addition or conditioning step before the reduction operation.

4. To create the mix of materials for the formulation, the different ground ingredients are then batched into a weigh hopper to get a consistent mix. While each ingredient is being weighed, it is important to measure and compensate for the weight of the water in the material as 1000kg of grain at 10% moisture (by wet weight) is only 900kg of dry material and 100kg of water. After the material has been batched, it is then necessary to mix the ingredients together and add water to get the mix moisture to the required target level for the final processes. It is also important to adjust the addition of mycotoxin binders for the feed mix moisture level, to avoid wasting these expensive additives. For a pellet mill or extruder, steam is usually injected, which conditions the mash and raises the temperature, activating the starch, which helps the pellet to hold together. If the mash moisture level is incorrect, then there can be issues with the formation and stability of the pellets – pellets that are too dry tend to crack and break whereas if the mash is too wet then this can cause problems with feed plugging the holes in the die. In extreme circumstances, this can even lead to the die pressure increasing to a point where the die is cracked, needing costly repair and downtime.

5. After the mill, the feed pellets are then allowed to cool before going to storage and/or final product packing. It is important to measure the moisture



Moisture sensor installed in a ribbon mixer

content at this point to make sure the product is losing enough water during the cooling stage. Pellets that are too wet will have a reduced shelf life and are prone to mould. Pellets that are too dry can be less palatable for the animal consuming it. Optimising the moisture in the final feed pellets allows

producers to get the highest yield of product for the raw materials that have been consumed.

At each of these stages in the process, having points where the moisture is kept at a stable level makes it much simpler to predict the next step and to create an optimal environment for efficient feed production.

INDUSTRY EXPERT OPINION ON MOISTURE CONTROL

“...if we maintain the correct moisture on a real-time basis throughout the process, we see there is a positive impact on energy consumption as well inside the feed mill. We have seen, generally, there is a 10% reduction in the energy consumption of a pelletizer if a feed mill uses moisture optimization. The benefits are multi-faceted in my view,” said Dr. Prince Nanda, Global Product Manager at Trouw Nutrition¹.

¹Dr. Prince Nanda (April 2019, updated March 2022). *Moisture control in feed mills could result in real savings. Feed Navigator.*



Your Moisture Measurement Partner



Rice



Grain



Oil Seeds



Animal Feed

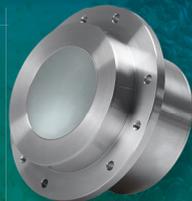


Coffee



Hydro-Probe XT

Hoppers, chutes, belt conveyors



Hydro-Mix XT-FS

Mixers, conveyors, Ducting System

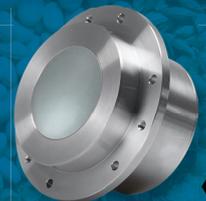
Non Food-Safe available



Hydro-Mix HT-EX

Mixers, conveyors, Ducting System, High Temperature

Non EX available



Hydro-Mix XT-EX

Certified for use in ATEX, IECEx and NEC/CSA Hazardous Locations (Dust)

Non EX available





SAFE FEED THROUGH SMART MYCOTOXIN CONTROL

Clement Soulet
Global Mycotoxin Expert
Cargill Animal Nutrition & Health

Mycotoxins remain one of the most unpredictable challenges in animal nutrition. By combining global data, rapid on-site testing, digital interpretation tools, and targeted mitigation strategies, producers across all species can finally stay ahead and protect feed quality with confidence.

Mycotoxins affect all animal species. Their impact is often subtle: reduced feed intake, weakened immunity, compromised gut integrity, slower growth, or impaired reproductive performance. Acute toxicity is rare, however low-level, chronic multi-contamination is frequent and can quietly erode animal performance. Traditional, reactive, year-round mitigation approaches fail to account for the dynamic, fluctuating nature of mycotoxin risk within feed safety and quality control.

Today, producers can adopt a more efficient model — one that adjusts to real-time conditions using data and technology. By integrating digital monitoring, data analysis, impact modeling, and mitigation decisions, proactive mycotoxin management becomes a strategic lever for P&L optimization rather than a line-item expense. Producers increasingly seek partners who can support their teams on this journey given its complexity — helping turn signals into action and success. Cargill Animal Nutrition & Health (ANH) provides integrated solutions for customers — the people, products, and platforms to mitigate mycotoxin risk and maintain competitive

advantage with simple core principles: **Monitor -> Identify -> Assess -> Treat.**

INTEGRATED SOLUTIONS FOR MYCOTOXIN MANAGEMENT

At Cargill Micronutrition & Health Solutions, we created MycoConnect, an online, virtual system that consolidates all four steps — Monitor, Identify, Assess, and Treat — into a practical, customer-friendly approach. Because the system operates entirely online, it delivers real-time information and results, eliminating the need for manual data entry and ensuring faster, more accurate decision-making. Each step is organized into dedicated modules, providing users with intuitive, actionable tools throughout the entire mycotoxin management process.

1. Monitor: Seeing the Bigger Picture

Mycotoxin patterns are never static. Weather variability, ingredient sourcing, storage conditions, and fungal ecology all influence contamination. Two shipments of the same ingredient may look identical but differ dramatically in risk. Detailed country-or region-specific mycotoxin reports can help nutritionists build risk-adapted procurement

and enhanced mycotoxin testing strategies. Monitoring does not eliminate uncertainty, but it brings clarity. With the Monitor module, producers can leverage Cargill's world-leading mycotoxin database (over 389,000 analyses from 41 countries) to access global and regional insights and explore contamination trends through www.mycotoxins.com. Cargill's [2025 Global Mycotoxin Report](#), one of the most comprehensive analyses of mycotoxin contamination in animal feed ingredients around the world, can be found on the site.

2. Identify: Fast, Easy Testing

Identification is not about testing everything — it is about testing the right materials at the right time. Ingredients with a history of higher mycotoxin prevalence, variable supplier quality, or abnormal physical appearance (e.g., damaged, moldy, or visibly altered grains) should be prioritized. Rapid on-site devices allow MycoConnect customers to test directly at the feed mill or farm and make timely decisions. Our Identify module includes specialized laboratory services and partnerships with lead-

ing rapid-test technology providers. Customers can easily implement testing routines in their feed mill or on-farm with expert support.

3. Assess: Turning Results into Decisions

A single test does not answer the question: “What does this mean for my animals and my business?” Proper feed assessment integrates toxin levels, species sensitivity, feed composition, and local conditions. This step is essential for choosing efficient, economical actions and maximizing performance. This is why our Assess module centralizes all test results — whether from on-farm devices, customer labs, or ANH labs — and generates species-specific risk reports. These include contamination summaries featuring risk severity, potential symptoms, estimated performance loss, financial impact, and recommended mitigation actions. A global network of ANH mycotoxin experts supports customers at every step.

“The MycoConnect module delivers instant, automated analysis that saves valuable time and sup-



Photo: Cargill



ports clear, confident decision-making — from quickly visualizing results to assessing ration impact and recommending the right anti-mycotoxin agent solutions adapted to risk level,” said Christelle Carfantan, Laboratory Manager at Garun Paysanne.

4. Treat: Applying the Right Action at the Right Time

When risk to feed safety and quality is confirmed, intervention must be targeted—not a fixed year-round cost. Mitigation may include formulation adjustments, reduced reliance on risky ingredients, or Anti-Mycotoxin Agents (AMA) when legally permitted. The module identifies the most appropriate solution by recommending, for example, a specific AMA and application rate. Thanks to an extensive and effective AMA product portfolio, customers can address each challenge with the right product at the right dose, maximizing return on investment.

“This integrated risk management approach transforms mycotoxin interpretation from guesswork into a data-driven decision process supported by ANH’s global expertise,” said Gwenaelle Boguenet, Cargill ANH Product Manager, Anti-Mycotoxin Solutions for Europe, Middle East, and Africa. “Customers who have implemented the system appreciate the simplicity of the tool, as it optimizes costs by intervening only when necessary and builds operational confidence through transparency and data.”

CONCLUSION: BETTER CONTROL, SAFE FEED, BIGGER SAVINGS

Mycotoxins will always be present, but their impact no longer needs to be unpredictable. By using a powerful network of integrated solutions, including people, products, and platforms, ANH helps producers find predictability and protect feed quality. The result is safe feed, more resilient animals, and stronger business outcomes across species.

About Clement Soulet

Clement Soulet is part of the global Micronutrition & Health Solution team in Cargill Animal Nutrition. Soulet supervises the strategy execution and deployment of Anti Mycotoxin Agents (Notox) category.

Originally from France, Clement Soulet has a Master of Science in Animal Production from AgroParisTech with a specialization in management, innovation and business performance.

After 4 years working in a global consulting company in Paris; he has been working since 2011 in the feed additive sector as category lead and business development manager. Soulet joined Cargill in 2018 where he occupied different roles in global feed additive teams.

FROM
simply adding
more

products to the animal diet,
the complete portfolio from Cargill
Micronutrition & Health Solutions
replaces volume with precision –
strengthening animal health,
building resilience, and delivering
measurable results that lead

TO
reaching deeper
impact.



Scan to
learn more


Diamond V™


Biostrong™


Cinergy™


Syrena™


TruPet™


TruEquine™


Notox™


Enzae™

**Cargill™ Micronutrition &
Health Solutions**



ENHANCED FEED SAFETY ON FARMS ENSURES SERENITY IN UNCERTAIN TIMES

Romain D'Inca
Category specialist MCFA
Agrifirm

Pig production faces constant economic, social, and geopolitical challenges beyond farmers' control. Therefore, focusing on controllable aspects like feed safety is critical. Since viral contaminations cannot be predicted, medium-chain fatty acids (MCFAs) offer a practical tool to manage such risks at the point of feed delivery.

Pig production is facing constant economic, social, and geopolitical challenges, over which farmers have limited control. Therefore, it is critical to focus on the controllable aspects of farm operations, such as feed safety. The occurrence, severity, and pathogen involved in viral contaminations cannot be predicted in advance. Therefore, medium-chain fatty acids (MCFAs) offer a practical tool to help manage such risks at the point where feed is supplied to the animals.

Managing a farm today requires other skills compared to 20 years ago. Just as any other CEO, farm owners and managers spend most of their time and energy focusing and monitoring the aspects of their farm via data. This data forms the basis for farm optimization and continuous improvement projects.

Obviously, proper management, high-quality nutrition, and complete biosecurity can be included. All of these are of paramount importance when it comes to technical results in swine production. Raw material quality is at a crossing point between high-quality nutrition and biosecurity. Unfortu-

nately, due to legislation, geo-political events, climate change, and other global events, finding high quality raw materials is becoming more and more a burden for our industry. Therefore, it is of utmost importance to monitor and measure all incoming raw materials on multiple levels like nutritional content, mycotoxin contamination, oxidation degree, Salmonella, and many more. New raw materials and/or feeds are entering our farms almost on a daily basis, so also on biosecurity they cannot be overlooked.

For example, what about the risk of pathogen transmission via feed? In the case of viruses, reference studies – such as [Niederwerder et al., 2019](#) – have confirmed that, even when feed is contaminated with a virus at low levels, the frequent direct contact among animals in the feeder can make the feed a more significant risk factor for transmission than water or other biosecurity considerations. It is very often extremely difficult to find out how the crops have been treated before, during, and after harvest. These factors can increase significantly the chance of contamination by important diseases (picture 1). Consequently, very often mitigation



Picture 1. Example of possible contamination via birds of raw materials that are dried in open air after harvesting. Birds can be seen as fomites transmitting virus via feed/beak from dead corpses in the wild to raw materials in the field.

measures against viral pathogens in the feed must be implemented – and they must follow local regulations that increasingly prohibit the use of chemical mitigants that can put operators at risk from feed mills to barns.

MEDIUM CHAIN FATTY ACIDS (MCFAs) – A NATURAL SOLUTION AGAINST VIRUS- ASSOCIATED RISKS

Medium Chain Fatty Acids (MCFAs) are molecules available naturally – for instance, in coconut oil. These molecules are used today in food, nutraceutical, and pharmaceutical industries for their proven action against various types of pathogenic microorganisms. Because MCFAs damage the phospholipid bilayers of potential pathogens, we recently developed a blend of free MCFAs (FeedLock; Royal Agrifirm Group, The Netherlands) that is specifically optimized in vitro against enveloped viruses ([Tran et al. 2021](#)). Furthermore, we investigated the impact of this blend using the “ice-block challenge” model described by [Dee et al., 2021](#), a model that mimics the natural contamination of animals with multiple viruses.

In brief, the experimental set-up involved preparing 1-lb ice blocks (–80 °C) inoculated with several

viruses: PRRSv, PEDv, and SVAv (Seneca virus, the only non-enveloped virus included in the study) at a concentration of 10^5 TCID₅₀/mL × 100 mL each. These blocks were placed in feed bins at the start of the study and again after 6 days, allowing the progressive release of viruses into the feed as it was consumed by the animals.

A total of 12 pens, each housing 7 to 8 weaned pigs, were used. Half of the pens received the contaminated diet alone (Control), while the other half was fed the same diet supplemented with FeedLock MCFA (Royal Agrifirm Group, NL). Clinical scores were recorded: dyspnea, weight loss, and rough hair coat for PRRSv; diarrhea for PEDv; and lameness for SVAv; along with post-mortem sampling of relevant biological compartments (e.g., serum for PRRSv, rectal swabs for PEDv, and tonsils for SVAv).

In addition, in order to assess the link between feed contamination and oral exposure, viral RNA was detected using dedicated PCR procedures in feeders and in chewing ropes available to the pigs in the different pens.

Supplementing the contaminated feed with FeedLock was associated with the absence of morbidity

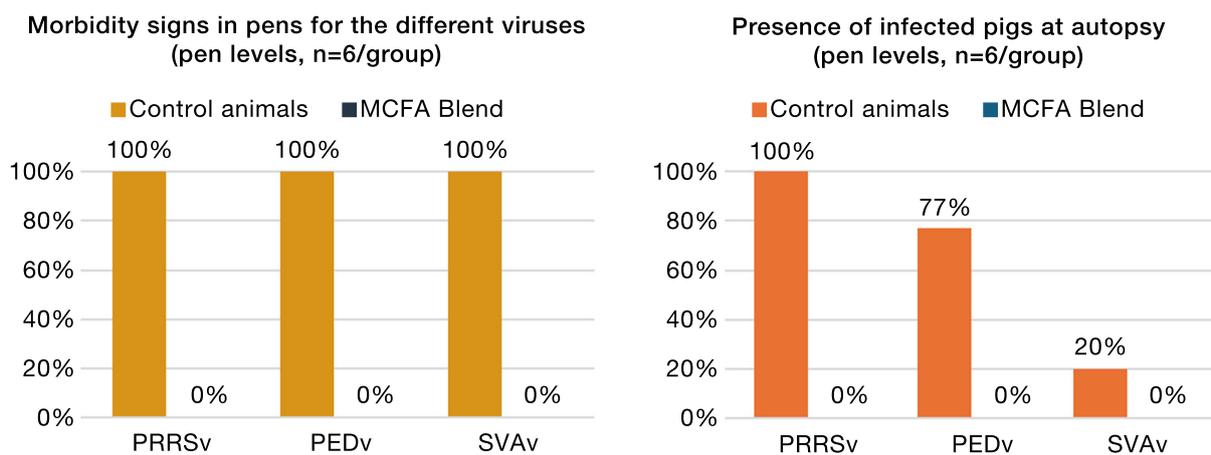


Figure 1. Impact of the virus challenge in animals according to each pathogen. Relevant virus-associated symptoms (left) as well as presence of the virus particle in targeted biological compartments (right) were assessed at pen level as described above.

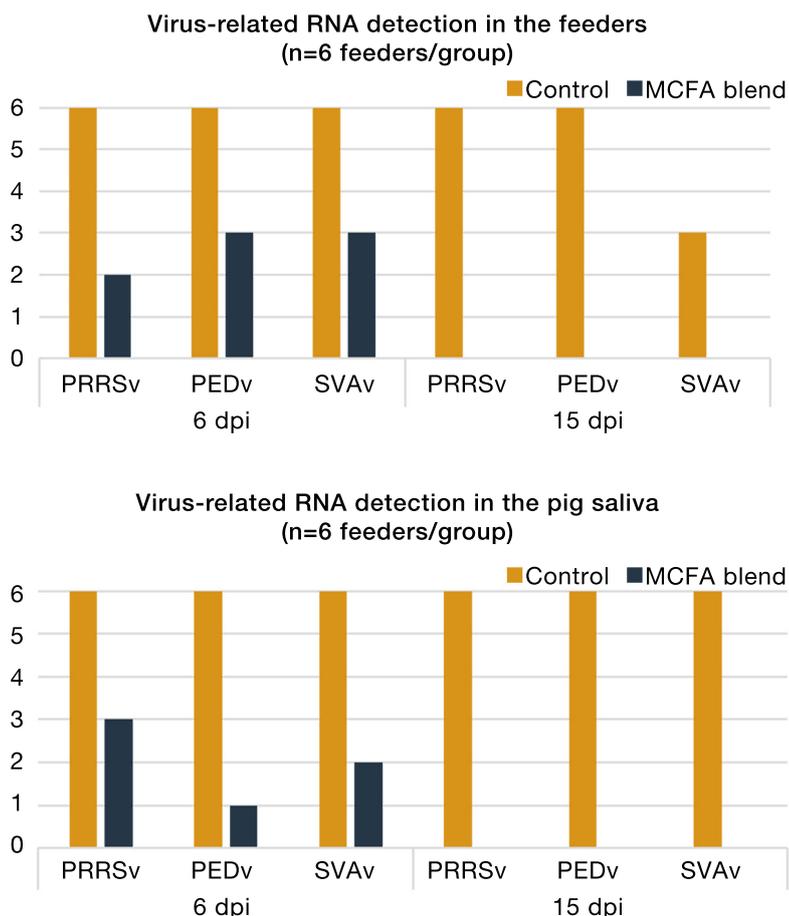


Figure 2. Impact of FeedLock on the prevalence of the different viral RNA sequences in the feeder (left) and in the pigs' saliva (right, collected from 1 chewing rope/pen) along the virus challenge 6 or 15 days post-infection (dpi).

signs in the related pens, while 1 (or more) animal per pen expressed morbidity in the control group (Figure 1, left). Similarly, for PRRSv and PEDv, autopsies confirmed the absence of signs of infection in the target biological compartments of pigs fed with FeedLock compared to the control group. In this test, infection by SVAv appeared to be insufficient to fully assess the impact of MCFA (Figure 1, right). These very discriminating results confirmed that incorporation of FeedLock in the feed exerts a preventive effect against the associated symptoms of PRRSv, PEDv and SVAv.

We also analyzed the presence of viral RNA in the feeder and in the pigs' saliva, in order to confirm that the lower incidence of viruses at the animal level was a result of the MCFA action on the viral particles at the feed level – minimizing, as a consequence, the risk for pigs to be exposed to the pathogens at the feeder level, where the interaction between the feed, the pathogens, and the animals is most likely to occur.

RESULTS: VIRAL RNA IN FEED AND SALIVA

Similarly to what was observed at the pig level, no viral RNA was detected 15 days post-infection (dpi) for any of the viruses tested in the MCFA-supplemented group, whereas RNA particles were detected in all the control samples at feeder or saliva level. Interestingly, at 6 dpi, some viral RNA could also be identified in the MCFA-supplemented group, although this was not finally associated with morbidity or symptoms in the animals. This can be explained by the fact that, in this study, we did not check for the complete viral particles, but rather for RNA using PCR. The target of the MCFA action was the phospholipid envelope of the virus and not the nucleic acids. With a half-life of minutes to hours for RNA and ice-block contaminations at d0 and d6, it is not surprising to still detect those nucleic acids in samples taken at 6 dpi, even when the virus envelopes have been destroyed.

The use of FeedLock as a natural and globally available technology to mitigate the risks of virus in



Photo: Thammachak Sotiya | Shutterstock

feed provides one of the most efficient solutions to enhance the biosecurity of swine farms by increasing feed safety in the operations. On top of this strong mitigation effect, farm owners will receive the same strong payback in performance, compared to other MCFA-based additives, making this feed biosecurity measure an insurance with payback in performance. By keeping farmers in control of their operations, FeedLock ensures their peace of mind for biosecurity without impacting their wallet.

FeedLock®

▶ **Closing the biosecurity gap**

- Mitigates pathogenic feed contamination
- Increases feed safety
- Sustainable protection
- Enhances performance

agrimprove.com

agrimprove
we farm ideas



ADVANCED PROCESSING TECHNOLOGY FOR FEED SAFETY

Gero Zimmermann
M2M Principal Product Management
Bühler Group

Feed safety starts with raw material intake and continues through every step of grinding, mixing, conditioning, pelleting, cooling, and handling. Hygienic equipment design matters - but consistent results increasingly depend on smart process integration, automation, and real-time data control.

ROLE OF PROCESSING TECHNOLOGIES IN ENSURING FEED SAFETY

There is no doubt that the processing technologies used to turn natural raw materials and by-products from other industries into compound feed play a crucial role in both, feed and food safety. At the same time, the use of additives such as vitamins, enzymes, probiotics, amino acids, and essential oils is constantly evolving. These additives support animal growth, health, and feed efficiency, and can help reduce the need for antibiotics. However, many of these bioactive ingredients are sensitive to processing conditions such as temperature and moisture. As a result, traditional hygienization steps need to be adapted - and carefully controlled with high precision.

Producing safe compound feed essentially means:

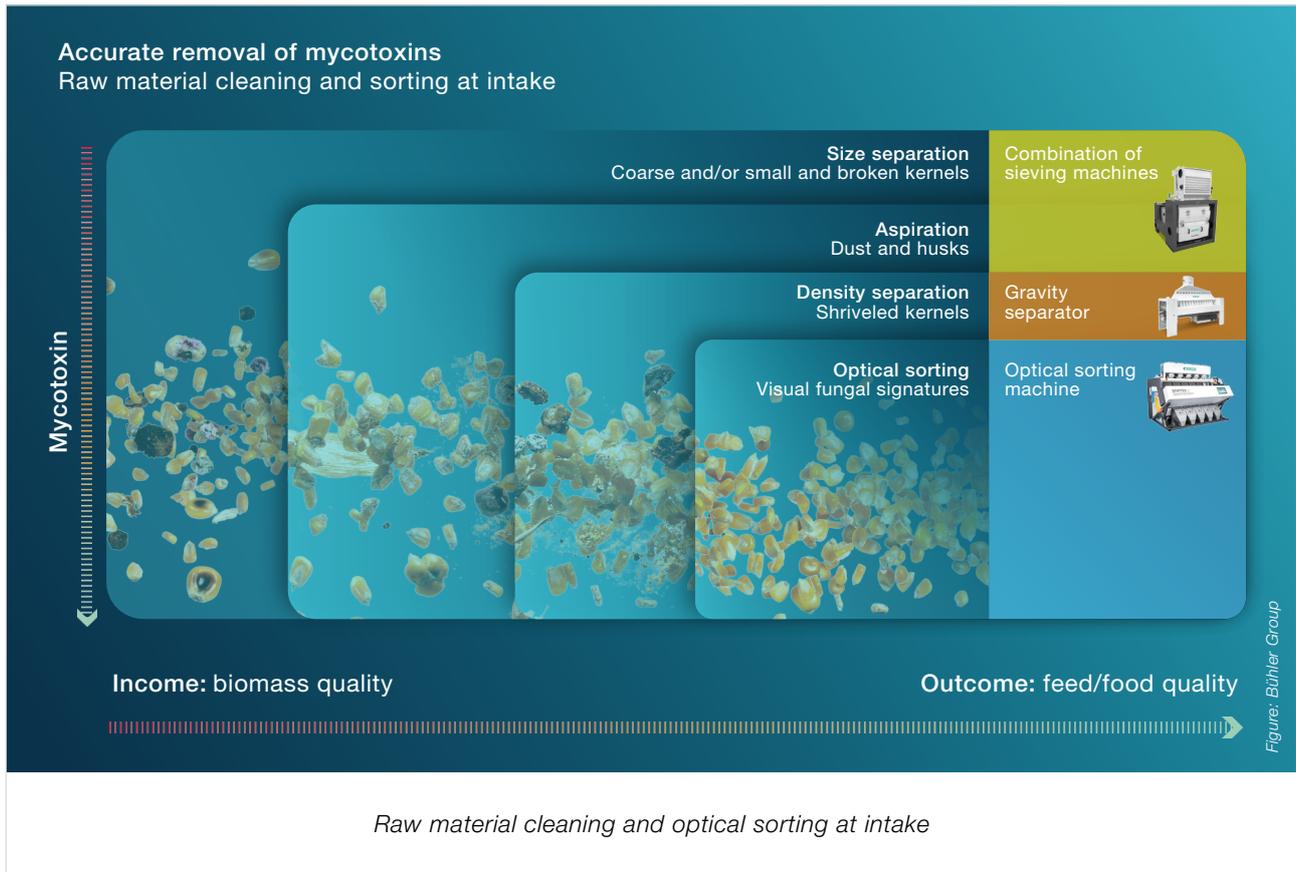
- removing contaminants, harmful substances, and pathogens from raw materials,
- preventing cross-contamination and product carryover,
- maintaining a high level of hygiene, and
- minimizing the risk of recontamination.

Given the increasing complexity of these challenges, end-to-end concepts must go beyond hygienically designed machines and equipment. They require the full potential of sophisticated process equipment combined with advanced automation and digital technologies to ensure safe, reliable, and efficient feed production.

CONTAMINATED RAW MATERIALS: THE FIRST GATEWAY TO UNSAFE FEED

Accepting raw materials contaminated with foreign and harmful substances - or pathogens - is often the first gateway to unsafe animal feed and must be addressed consistently. Disease outbreaks and costly recalls have led to stricter legal requirements and biosafety protocols, but also to a greater willingness to invest in advanced technical solutions.

Modern raw material cleaning goes far beyond simple screening. It still includes aspirated screening machines and gravity separators to remove coarse particles, fines, broken or shrunken kernels, dust, and husks. Beyond that, optical sorting technologies are increasingly used to detect and remove,



for example, fungal contamination or foreign materials that differ in color. One challenge is that many contaminants are not evenly distributed in a batch; they tend to concentrate in relatively small portions of a delivered load. This makes it essential to inspect - and, where needed, clean - the entire product stream at full throughput.

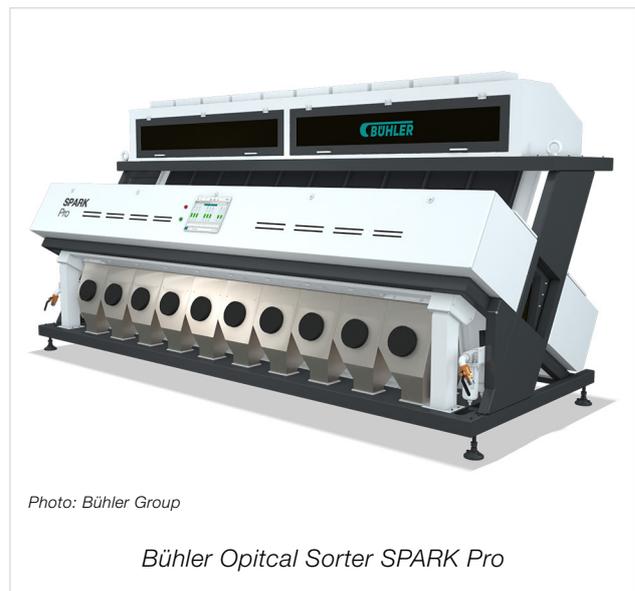
Example technology in practice: Optical sorting systems such as the Bühler Sortex Spark Pro are used to remove off-color kernels and foreign material at industrial scale, supporting consistent incoming raw material quality.

HYGIENIC DESIGN IS NECESSARY - PROCESS INTEGRATION MAKES IT EFFECTIVE

Along the process, even seemingly simple machines (such as batch mixers) must be designed with hygiene in mind. This includes:

- suitable materials,
- minimal product residue after discharge,
- fast access for easy cleaning and maintenance.

For example, the Bühler Speedmix achieves a variation coefficient (CV) of 2 - 5% within 90 seconds at a mixing ratio of 1:100,000. It is available in stainless steel and has a specified product residue of less than 0.05% after emptying - supporting both, optimum nutrient consistency and minimal carryover.





Bühler batch mixer Speedmix

However, machine design alone is not enough. Only by embedding machines into a connected Manufacturing Execution System (MES) can producers achieve full traceability of products and processes. As one example, an intelligent recipe sequence within an MES (such as Bühler Mercury MES) helps reduce cross-contamination while improving operational efficiency and daily reliability.

HYGIENIZATION WHILE PRESERVING BIOACTIVITY: THE CONDITIONING CHALLENGE

Independent studies and validation of Bühler's conditioning solutions have shown that steam conditioning before expansion or pelleting can be a highly effective hygienization step. For example, in broiler feed, salmonella can be reduced below the detection limit at 80–85°C with a retention time of 90 seconds - where the lower temperature applies only with high moisture and tight temperature control throughout the entire conditioned product volume. Consistently achieving the dual goal - sufficient hygienization and preservation of sensitive bioactive ingredients - requires more than sophisticated mechanical and thermal design of the equipment. It also requires precise, continuous monitoring, and control of both steam quantity and quality, which again highlights the importance of a consistently optimized and stabilized process.

At the same time, many producers are facing external pressure to push conditioning temperatures and retention times higher - up to 90°C and 360

seconds - for example driven by legal regulations or brand protection guidelines. These requirements can significantly reduce productivity and negatively impact nutritional value.

From a process perspective, one major challenge is that moisture of the product entering the pellet mill depends on fluctuating initial moisture and on the difference between the (also variable) meal temperature and conditioning temperature. Combined with long retention times, high conditioning temperatures can therefore cause poor flow behavior, unstable pellet mill performance, and even die blockages - often forcing mills to reduce throughput.

From a nutritional perspective, many bioactive additives lose effectiveness at higher temperatures, higher moisture, and longer residence times. A common response is overdosing, which increases formulation cost and the environmental footprint of the feed produced.

MOISTURE: THE OFTEN-OVERLOOKED LEVER FOR FEED SAFETY AND PRODUCTIVITY

In this complex situation, one key aspect is often overlooked: hygienization depends not only on temperature and time, but also on product moisture. Moisture is a powerful lever. At a given temperature, higher moisture can allow the same inactivation effect to be achieved in significantly less time.

If moisture can be reliably controlled across the entire process, it becomes possible to improve productivity, nutrient quality, and feed safety at the same time. This is where digitalization can deliver real operational value - provided it is stable, robust, and usable under day-to-day mill conditions across different recipes and raw material variations.

PRECISION FEED MILLING: TURNING DATA INTO SAFER, MORE STABLE PRODUCTION

Digitalization in a feed mill - the availability and use of relevant process and product data in suffi-

cient quality and in real time - is not an end in itself. It is the final building block of an integrated Precision Feed Milling concept.

When advanced machine and process design, modern automation solutions and fit-for-purpose sensor technology are combined with powerful, adaptive and robust data models, state-of-the-art control algorithms can enable fully automated operation of entire production lines. In a Bühler PelletingPro setup, the achievable accuracy of moisture control is remarkably high – better than 0.5 percentage points - from the batch mixer through the pelleting line to the final product. This level of control enables recipe-specific optimization of hygienization during conditioning and more efficient operation of both pellet press and pellet cooler, supported by a simple and intuitive user interface.

As demonstrated in multiple installations of the PelletingPro digital service, operator-independent control and continuous optimization can significantly reduce downtime. Fewer manual interven-

tions not only improve productivity but also lower the risk of product carryover and contamination - ultimately increasing the overall level of feed safety.

Given these strong and highly encouraging results, it is only logical to expand the Precision Feed Milling concept with additional autonomous controls for other product quality parameters and other process lines. Even though not all developments are fully completed yet, their potential for operational excellence, improved feed safety, nutrient consistency and the reliable use of innovative bioactive ingredients is already tangible today.

PRACTICAL TAKEAWAYS FOR FEED MILL OWNERS AND PLANT MANAGERS

For many mills, improving feed safety does not mean adding a single “extra” step - it means strengthening control at the most critical gateways:

- 1. Intake and cleaning:** Validate cleaning performance and remove contamination risk early, at full throughput (not by sampling only).
- 2. Hygienic equipment design:** Minimize resi-

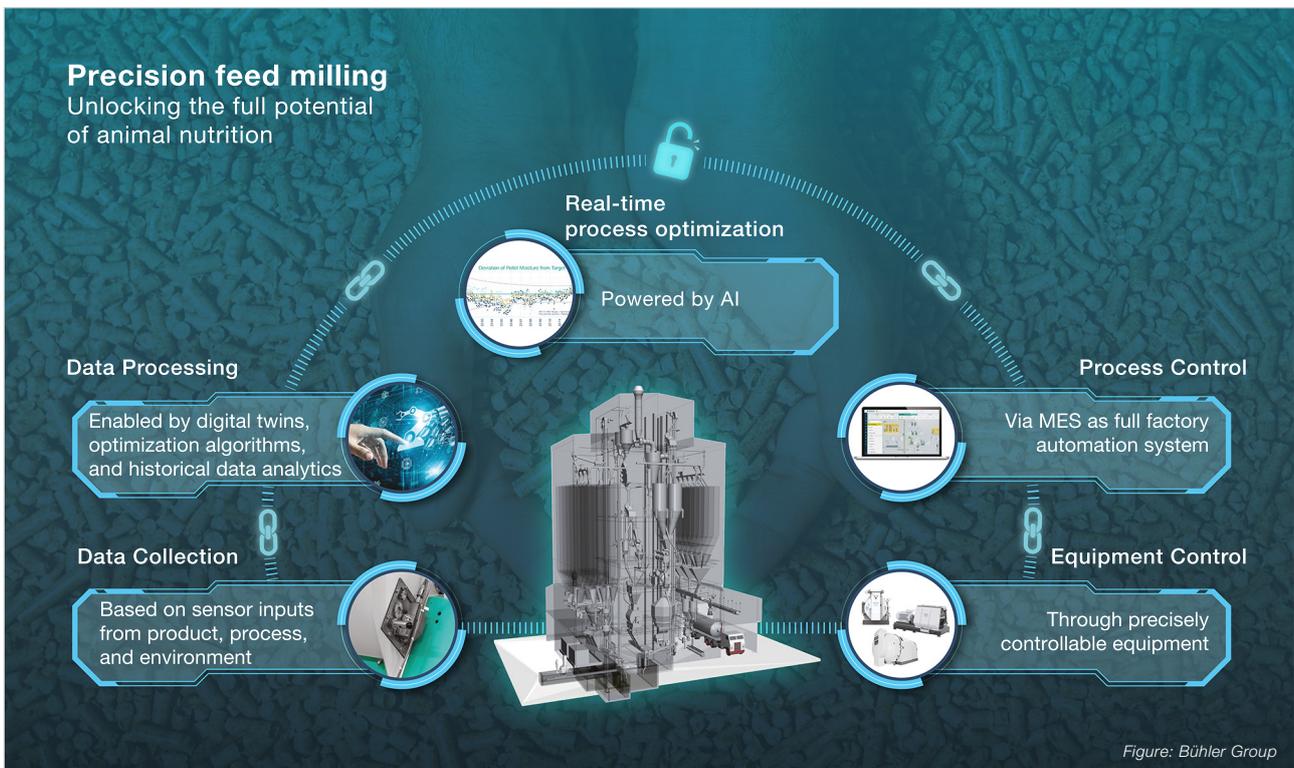


Figure: Bühler Group

Building blocks of precision feed milling



Photo: Bühler Group

due, enable fast cleaning, and reduce carryover risk through proven hygienic design details.

3. Traceability and recipe logic: Use MES functions (traceability, recipe sequencing) to reduce cross-contamination risk in daily operation.

4. Conditioning control: Manage not only temperature and time, but also moisture - because moisture strongly influences hygienization performance.

5. Digital control for stability: Use automation and real-time data to reduce variability, manual interventions, and downtime.

CONCLUSION

Feed safety is increasingly shaped by a combination of stricter requirements, more variable

raw materials, and more sensitive bioactive ingredients. In this environment, consistent results depend on more than individual machines. The strongest safety outcomes come from integrated solutions: hygienic equipment design, validated cleaning and sorting, controlled conditioning, and digital systems that stabilize production and support traceability.

With advanced cleaning and sorting, hygienically designed machines and plants, and automation and digital services that enable precise control (especially of moisture), modern processing technologies can help feed mills raise their safety level while protecting throughput and product quality.

About Gero Zimmermann

After completing his doctorate in electrical engineering, Gero Zimmermann held various technical management positions at a global manufacturer of electronic components and systems. Since joining Bühler in 2011, he has played a key role in the development, industrial implementation, and business development of modern processing technologies for the animal feed industry. His particular focus is on sustainability and digitalization, helping to ensure the industry's long-term competitiveness.

MEDIA KIT 2026



CLICK TO
DOWNLOAD



Feed 
Additive

INTERNATIONAL MAGAZINE FOR
ANIMAL FEED & ADDITIVES INDUSTRY



Ivan Harjacek
*Head of Digital Solutions
 Andritz Feed & Biofuel*



Anders Lydom
*Application and Technology Engineer for Animal Feed
 Andritz Feed & Biofuel*

THE ROLE OF PROCESSING TECHNOLOGIES IN ENSURING FEED SAFETY

Processing technologies are central to ensuring feed safety and, by extension, food safety. Controlled thermal treatment, informed raw material selection, robust engineering design, advanced automation, and reliable data management must work together to achieve predictable pathogen reduction. Feed safety is not driven by single interventions, but by integrated systems that reduce variability, maintain process stability, ensure traceability, and protect animal performance while meeting regulatory and market expectations.

FEED SAFETY IS FOOD SAFETY

Anders Lydom: When we talk about feed safety, we are in reality talking about food safety. Feed becomes meat, milk, and eggs, which ultimately reaches consumers. There is no separation between the two, and that connection fundamentally changes the level of responsibility we carry as technology providers and the responsibility you carry as feed producers.

Pathogen control in feed production is therefore not just an internal quality objective; it is a safeguard for the entire production food chain. At the same time, we must be precise in how we describe what we do. In feed production, we do not sterilize - we

reduce. If we were to fully sterilize feed, we would damage valuable enzymes and nutritional properties that are essential for animal performance. The objective is controlled pathogen reduction to a level where organisms such as Salmonella no longer pose a risk.

That distinction matters, because feed safety is not about applying extreme measures. It is about disciplined, scientifically controlled processing.

WINNING THE WAR ON MULTIPLE FRONTS

Lydom: Many believe temperature alone solves the pathogen challenge. It does not. Yes, achieving

82°C with sufficient retention time, for example 60 seconds in a controlled long-term heat treatment system, provides high certainty that pathogen levels are reduced to a safe threshold. Systems operating on first-in, first-out principles ensure uniform exposure and consistent results, which are essential for reliable, predictable pathogen reduction.

However, feed safety is best understood as a strategic defense rather than a single intervention. I often compare it to a war: you do not win by attacking head-on alone; you must also protect your flanks. In practical terms, this means combining thermal treatment with raw material strategy and formulation decisions like inclusion of probiotics.

Nutritionists play a key role by selecting raw materials based on the plant's technological capabilities. The more robust the thermal systems and automation controls, the more confidently higher-risk raw materials can be managed safely, like soybean meal or rendering products. In certain formulations, formic acid may be applied, as it penetrates pathogen cell walls, creates a hostile environment, and enhances the overall reduction effect. When combined with precise heat treatment by time and temperature, this creates a much stronger and more reliable safety barrier.

Temperature, chemistry, and raw material strategy must therefore work together within a controlled process framework. When these elements are aligned, feed safety becomes predictable rather than reactive.

ENGINEERING RESPONSIBILITY: PROCESS AND MATERIAL SELECTION

Lydom: Combining formic acid and steam introduces another important consideration: vaporized acids. These vapors can aggressively attack mild steel, leading to corrosion, hygiene challenges, and significantly reduced equipment lifetime. Feed safety therefore does not stop at temperature control. It extends into engineering design.

Selecting appropriate stainless-steel grades, such as SS304 or SS316 acid-resistant materials, ensures

that equipment withstands chemical exposure for decades. When your feed mill invests in new machinery, you expect more than short-term performance. Naturally, you expect safe, stable, and hygienic operation for more than 20 years. In this sense, equipment either supports feed safety over its lifetime or gradually undermines it. The difference lies in engineering foresight.

THE FOUNDATION: STABLE EQUIPMENT ENABLES SAFE PROCESSING

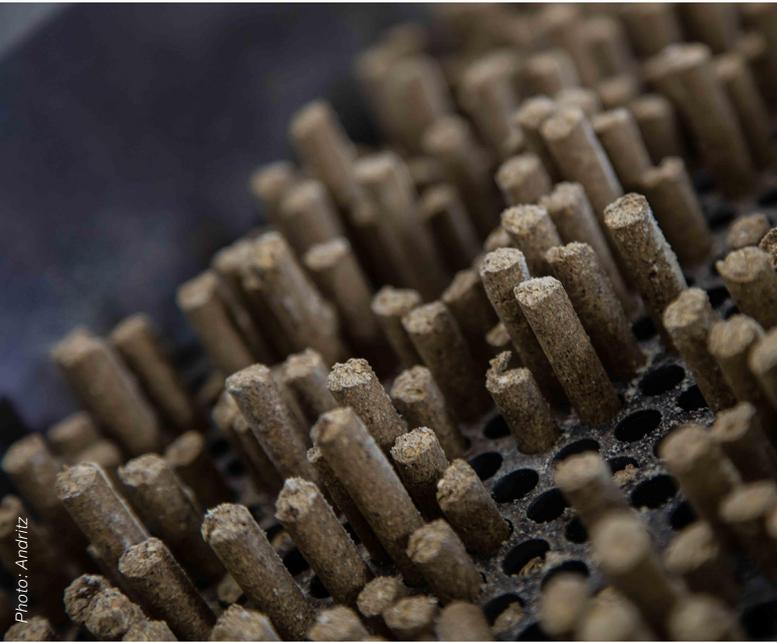
Ivan Harjacek: With more than 20 years of industrial experience across multiple sectors, I have learned one simple principle: without stable equipment, there is no stable process. Feed safety begins with reliability. The main objective of any operation must be to run without unexpected downtime and in accordance with the highest safety standards. Only when operational stability is secured can we seriously discuss optimization or performance improvements.

Processing technologies must deliver predictable mechanical performance, hygienic design that allows efficient cleaning, and maintenance concepts that support long-term stability. For example, Andritz OptiMix uses dual rotation and a cylindrical design to achieve a high level of self-cleaning and avoid dead space to eliminate residue build-up. By reducing build-up and limiting cross-contamination, the system supports consistent, reliable, and safe processing. Mechanical predictability underpins biological certainty. When equipment performs consistently, safety margins become measurable and defensible.

IF YOU CANNOT MEASURE IT, YOU CANNOT DEFEND IT

Harjacek: There is a well-known management principle often attributed to Peter Drucker: "If you can't measure it, you can't improve it." In feed production, I would extend that further - if you cannot measure it, you cannot defend it.

Authorities require documented proof of control. Temperatures must be logged, retention times recorded, moisture levels monitored and batch his-



tories retrievable. This demands integrated sensor technologies such as NIR systems, particle size distribution measurement, infrared or microwave moisture analysis and high-speed inspection systems operating within a unified automation environment. But sensors alone are not enough. The real challenge is integration. Multiple vendors, multiple data streams, multiple communication protocols, all without a unified automation architecture, can create fragmentation instead of control.

As system integrators, our responsibility is to bring these technologies together into a secure and structured platform that ensures transparency, traceability, and reliability. Feed safety today depends not only on physical processing but also on structured and retrievable data.

VARIABILITY IS THE REAL ENEMY

Harjacek: In many feed mills, production operates at around 80% of nominal capacity. Operators are often blamed for not pushing further. In my experience across pulp & paper, malting & brewing, and feed & biofuel industries, that threshold reflects uncertainty - not reluctance.

Variability in raw materials, recipe changes, seasonal shifts, and operator differences all introduce fluctuations into the process. When conditioning

parameters or other key upstream processes drift off, motor loads become unstable, forcing operators to maintain that safety margin because the system response becomes difficult to predict. This variability is not primarily a people issue; it is a control strategy problem. True improvement requires addressing core process-driven limitations and fundamental control constraints.

At Andritz, our ACE control suite is designed to reduce variability at its source by stabilizing key process parameters and aligning control strategies with physical process behavior. By reducing KPI variability by 40-60%, autonomous operations can be achieved, and we can operate closer to physical limits, without compromising safety margins. So, when variability is controlled, safety and performance move in the same optimized direction rather than competing with each other.

CYBERSECURITY IS PART OF FEED SAFETY

Harjacek: Feed safety today is not only biological and mechanical. It is digital. If a feed mill's automation system is compromised, production can stop entirely, but animals still need to be fed. If feed cannot be produced, animal welfare is directly affected. Secure control systems protect recipe management, temperature regulation, dosing accuracy, and traceability databases, ensuring that production continues without disruption.

As one of the world's leading system integrators and the first OEM provider to achieve IEC 62443 cybersecurity certification, we recognize that safety today is biological, mechanical, and digital. Cybersecurity is not an abstract IT concern. It is part of safeguarding operational continuity for tomorrow and, by extension, animal welfare.

TRACEABILITY AS A LEGAL AND OPERATIONAL SAFEGUARD

Harjacek: When deviations occur, and, in industrial environments, they sometimes do, response time is what truly matters. Integrated Track & Trace systems provide immediate insight into affected batches, enabling rapid isolation of risk and min-

imizing recall. Compliance with standards such as GMP+, ISO 22000, and FAMI-QS requires documented proof of control, and digital traceability ensures that data can be retrieved efficiently when required. Digital traceability therefore transforms feed safety from reactive investigation to proactive assurance. It allows producers not only to prevent risk, but also to demonstrate systematic control whenever required by authorities or customers.

SAFETY IS A SYSTEM, NOT A SINGLE TECHNOLOGY

Lydom: No single measure ensures feed safety. Not temperature alone. Not formic acid alone. Not automation alone. It is the combination that creates resilience.

The integration of process knowledge, raw material strategy, thermal treatment, material engineering, secure automation, and full traceability creates a resilient system. When these work together, feed safety becomes embedded in the plant itself rather than dependent on individual panic-driven interventions. That is how we protect animals, producers, and ultimately consumers.

A SHARED RESPONSIBILITY

Harjacek: There is no silver bullet in feed production. If there were, every plant would look identical. Because every plant operates under different raw material conditions, regulatory environments, and market pressures. What remains constant is the responsibility to design systems where safety is built into every feed mill.

Feed safety is built layer by layer: mechanical stability, biological reduction strategies, automation discipline, cybersecurity resilience, and documentation integrity. When these layers align, we move from risk management to risk prevention. In feed production, that level of control is not aspirational; it is essential!

CONCLUSION

Harjacek & Lydom: Feed safety is not about a single machine, a single process, or a single person—it is the product of a system working in harmony. When equipment runs reliably, processes are controlled, automation supports decision-making, data is secure, and traceability is built into every batch, safety becomes predictable rather than reactive.

Equally, skilled operators and nutritionists remain at the heart of that system. Technology amplifies their expertise, but it cannot replace it. The people on the floor, the decisions they make, and the knowledge they apply each day are what turn well-designed systems into consistently safe outcomes.

When these layers come together, feed safety stops being a box to tick. It becomes a living process. One that protects animals, secures the food chain, and ensures that every batch leaving the mill meets the highest standards. Feed safety isn't an afterthought - it is present in every decision, every piece of equipment, and every batch we produce.

About Ivan Harjaček

Ivan Harjaček is Head Digitalization at ANDRITZ Feed & Biofuel, leading global automation and optimization technologies for the animal feed, aqua feed, pet food, and biomass industries. His work focuses on advanced process control, digital twins, data intelligence, and reliable plant-level optimization to improve quality, throughput, and energy efficiency while enabling the transition to autonomous feed production.

About Anders Lydom

Anders Lydom is Application and Technology Engineer at ANDRITZ Feed & Biofuel. With 36 years of animal feed industry experience Lydom specializes in animal feed technology, supporting customers with performance optimization, and technology implementation.



IDENTIFYING FORAGE QUALITY THROUGH TESTING

Dr. Robert Van Saun
*Professor and Extension Veterinarian
Penn State University*

Forage quality cannot be reliably assessed by appearance alone. Accurate forage testing provides essential insight into nutrient composition, digestibility, and potential feeding risks, enabling producers to balance diets more precisely. Understanding key analytical parameters helps ensure that forage effectively supports microbial function, animal health, and productive performance.

Forage is the foundation of the herbivore diet and the primary source of essential nutrients to support body metabolism and productivity. How well a forage meets the nutritional requirements of a given animal will depend on the nutrient content of the forage being consumed and the amount of forage consumed. The ability of a forage to provide nutrients within a reasonable intake is characterized as “forage quality”. Most animal owners assess forage quality qualitatively through sensory parameters of color, smell, visual, and tactile estimation of maturity (leaf-to-stem ratio; rigidity of stems). An example of the limitation to visual differentiation of forage quality is provided in Figure 1. Producers’ use of forage testing through time-tested chemical parameters is limited for a variety of reasons, including costs, frequent forage purchases, and limited interpretive capabilities. However, more complex analytical procedures and biologic parameters are needed to truly differentiate between a higher and lower quality forage and their potential role in meeting microbial and animal needs. A properly balanced diet that meets the needs of the microbial flora and animal is essential to maintaining good health and productivity. An investment in forage testing is the single best way to

achieve this end. This article will provide an overview of forage testing and its interpretation as it applies to feeding forage-consuming production animals.

GETTING STARTED: SAMPLING AND LABORATORY SELECTION

Our ultimate goal in spending money to have forage testing completed is to have usable information on nutrient composition to provide a more complete and balanced diet for the animals. The adage “garbage in, garbage out” is applicable here; if we do not obtain a representative sample and have appropriate testing performed, the obtained numbers will not be of much use in fine-tuning your diets. A good place to start is referring to information provided on the National Forage Testing Association (NFTA) website (www.foragetesting.org). Here you can find information on hay probes to collect good samples and appropriate sampling methods to obtain accurate results. This organization has a searchable list of certified laboratories on their website. Use of a certified laboratory provides more confidence in the results obtained. Additionally, these labs are very willing to retest unusual results to confirm the numbers.



Figure 1. Comparison of two grass hay samples that have similar appearance. Although some tactile, visual, or smell perspectives may provide an idea of forage quality they are not directly related to nutrient content. The analysis of these two forages is shown in Table 2 at the end of the article.

Use of a hay probe is highly recommended in sample collection over taking “grab” samples from various hay bales. One should collect 2-3 cored samples of a minimum of 10% of the hay inventory. Obviously, more is better in obtaining the most representative sample. Different hay harvests should be sampled and tested separately rather than combined. Once the sampling is completed, the material should be mixed thoroughly in a clean, dry bucket then subsampled to send to the laboratory. Subsampling is accomplished by placing your total sample on a clean, impermeable surface and mixing it thoroughly, then using a yard stick or similar implement, divide the mixed material into four quarters. Combine the material from two opposing quarters to make your submitted sample. Communicate with the laboratory to determine the desired amount of sampled forage to send that is necessary to complete all the desired testing. If you send too much material, the laboratory will need to take a subsample, which may not be a representative sample of your forage. A simple Google search for “forage sampling methods” will provide several good extension-based videos on forage sampling techniques.

FORAGE TESTING METHODS

Standardized chemical methods of feed analysis were developed more than 200 years ago. The proximate analysis system that includes crude protein (CP), crude fiber (CF), ether extract (EE), and ash have been in use for more than 150 years. This system

was not adequate for differentiating feed composition relative to microbial fermentation and animal needs. Newer chemical and biological methods of feed analysis that best relate to nutritional function have been developed over the past 40 years and continue to be developed (Box A). Newer biological methods such as determining rumen degradable protein or neutral detergent fiber degradability are examples of characterizing forage components related to microbial fermentation in feeding ruminant animals.

Box A

Suggested nutrient parameters for feed testing

- Moisture/Dry Matter
- Crude Protein
- Soluble Crude Protein
- Acid Detergent Insoluble Protein
- Rumen Degradability
- Acid Detergent Fiber (ADF)
- Neutral Detergent Fiber (NDF)
- Lignin
- Degradability of Neutral Detergent Fiber
- Crude Fat or Total Fatty Acids
- Water-soluble Carbohydrates
- Starch
- Ash
- Macrominerals (Ca, P, Mg, K, Na, S)
- Microminerals (Cu, Fe, Mn, Zn, Mo)
- Energy content - calculated

The gold standard for testing procedures is wet chemistry methodologies. More recently, near-infrared spectroscopy (NIR) methods have been improved and become mainstream for routine analyses. One advantage of using NIR methods is the lower cost. One concern with NIR methods is the inability to accurately assess mineral content. Quality laboratories will indicate what feeds are appropriate for NIR testing as accurate calibrations have not been generated. Most forage samples will have good calibration criteria to assess nutrient content other than minerals.

FEED ANALYSIS TERMINOLOGY

A major hurdle in the use of feed testing and its application is the complex terminology associated with all the parameters determined. Here is a summary of the key parameters on a forage test that should be considered in evaluating the forage quality.

Moisture – Dry Matter. We talk about feeds on an “as fed” and “dry matter” basis relative to a feeding program. When you send a sample to the lab, the feed

contains both moisture and dry matter. Dry matter is where all the nutrients are found. The lab will weigh the sample, dry it, then reweigh it to determine the moisture loss, leaving only the dry matter. We want to compare feeds on a dry matter basis to compare “apples to apples” as the moisture content varies. For hay the moisture should be 15% or less. As the moisture increases, the risk of promoting mold growth increases. Mold growth increases the risk for heat generation and spontaneous combustion of hay bales. Moisture content of feeds to be ensiled is critical to successful fermentation. Large round hay bales often have enough moisture to allow mold growth, leading to the degeneration of the forage quality in the center of the bale. This process may become excessive, allowing for the growth of *Listeria* or the organism causing botulism.

Crude Protein (CP). Forage protein content is a reasonable marker of forage quality, with more immature plants having greater protein content compared to mature plants (Table 1). Feed protein content (termed Crude Protein [CP]) is determined by

Table 1. Typical test value of alfalfa and grass forages harvested at various stages of plant maturity (all values on dry matter basis).

Hay Type and Maturity Stage	CP % DM	ADF % DM	NDF % DM	ME Mcal/lb	TDN % DM
Alfalfa					
Pre-bloom	> 19	< 31	< 40	1.03 - 1.13	63 - 66
Early bloom	17-19	30-35	40-46	0.98 - 1.02	60 - 62
Mid bloom	13-16	36-41	46-51	0.92 - 0.97	56 - 59
Late bloom	< 13	> 41	> 51	< 0.90	< 55
Grass					
Prehead	> 18	< 33	< 55	0.98 - 1.07	60 - 65
Early head	13-18	34-38	55-60	0.85 - 0.91	52 - 56
Head	8-12	39-41	61-65	0.75 - 0.84	46 - 51
Post-head	< 8	> 41	> 65	< 0.75	< 46

Abbreviations: CP = crude protein; ADF = acid detergent fiber; NDF = neutral detergent fiber; ME = metabolizable energy; TDN = total digestible nutrients.

measured total nitrogen content, then converted to a crude protein basis by multiplying by 6.25 (proteins are assumed to contain 16% nitrogen). Sufficient dietary protein (>8% DM) is necessary to facilitate microbial fermentation in forestomach and, if deficient, reduced dry matter intake will result. Crude protein alone is not sufficient to understand how the forage will meet animal protein needs.

Unavailable or Bound Protein. Not all nitrogen in a feed is available to microbes or the animal. The portion of crude protein not capable of being degraded by the fermentation microbes or digested by the animal is termed "unavailable protein" or "bound protein." The amount of nitrogen (or crude protein; $N \times 6.25$) that is found in the acid detergent fiber residue is defined as ADIN (nitrogen) or ADIP (protein). This represents the nitrogen in a feed bound to the plant cell wall, which represents heat-damaged protein that is unavailable to both microbes and the animal. The Maillard reaction causes heat damage by covalently linking nitrogen from amino acids to sugar residues of the plant cell wall. Moisture and heat are needed to promote this reaction.

Soluble Crude Protein. Soluble Protein measures the total nitrogen in feed (expressed on percent of CP basis) that is potentially soluble in rumen fluid. Soluble protein contains both nonprotein nitrogen (NPN) and true protein compounds. These nitrogen sources are readily used by forestomach microbes for microbial protein production and contribute to a rapid increase in the forestomach ammonia pool. Fiber-fermenting bacteria are absolutely dependent upon the forestomach ammonia pool as their sole source of nitrogen for protein synthesis. Mature grasses may have low soluble protein, which may limit fiber digestion and intake.

Fiber Carbohydrates. Carbohydrates make up approximately 70% of the herbivore's diet and consist of a diverse group of compounds. Typically plant carbohydrates are divided into two groups, fiber and non-fiber carbohydrates, based on their degradability characteristics. Fiber carbohydrates are asso-

ciated with the rigid plant cell wall and moderately to slowly degraded by the forestomach microbes. Total plant cell wall carbohydrates are determined as neutral detergent fiber (NDF). A subset of NDF is acid detergent fiber (ADF), which measures the cellulose and other indigestible components of the plant cell wall. Both NDF and ADF will increase with plant growth and aging (see Table 1) and are good measures of forage quality when their values are lower. Relationships of NDF and ADF differ depending on whether the plant is a grass or a legume.

Degradable Carbohydrates. Those carbohydrates that are found in the plant cell cytoplasm (i.e., storage forms such as starch or sucrose) or the secondary plant cell wall are more readily fermented or digested. One method of defining these carbohydrates is calculating **nonfiber carbohydrates** (NFC), which comprise all carbohydrates in the plant not accounted for in the NDF fraction. The carbohydrates that make up NFC are quite diverse, as it includes sugars, starches, and fermentable neutral detergent soluble fiber. A directly measured parameter of degradable carbohydrates is **nonstructural carbohydrates** (NSC). This procedure enzymatically degrades starch and complex sugars into glucose molecules to determine the total sugar and starch content of a feed.

Minerals. One of the more important components of feed analysis is determining mineral content. Ash provides a perspective on total mineral content of the feed. Both macrominerals—calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), and sulfur (S)—and microminerals—iron (Fe), copper (Cu), manganese (Mn), and zinc (Zn)—should be determined by wet chemistry methods. Selenium can be determined at some forage laboratories; however, its cost is high, and one would be better off measuring selenium in blood samples. The use of near-infrared spectroscopy (NIR) method to determine forage/feed mineral content is not recommended, as mineral values are not adequately quantified. Additionally, molybdenum (Mo) should be requested due to its potential interaction with copper availability. Most labs will be able to measure all these minerals, though sulfur and Mo may require an additional cost.

A SYSTEMATIC APPROACH TO INTERPRETING FEED ANALYSIS REPORTS

A feed analysis report can be extremely overwhelming with all the abbreviations and numbers presented. Each laboratory has its own reporting format, which makes it more difficult if you use more than one laboratory for testing. Here is a sys-

tematic approach to reviewing a feed analysis report for determining forage quality:

1. Check moisture content of hay if below 15% (>85% dry matter). Ensiled forage will have higher moisture, and its amount will depend upon the storage method

Table 2. Determined nutrient content of the two hay forages shown in Figure 1. The two forages are visually very similar in leaf structure and maturity. Hay A is not as green as Hay B. The crude protein content of Hay A is nearly twice that of Hay B, thus limiting its usefulness in feeding more productive animals. Hay B would not meet the maintenance protein requirement for most herbivores.

Components	Hay A		Hay B	
	As Sampled	Dry matter	As Sampled	Dry matter
% Moisture	9.0	-----	8.9	-----
% Dry Matter	91.0	-----	91.1	-----
% Crude Protein	12.1	13.3	6.3	6.9
% Acid Detergent Fiber	32.3	35.5	34.0	37.3
% Neutral Detergent Fiber	46.5	51.1	52.8	58.0
% Nonfiber Carbohydrates	24.0	26.4	23.7	26.0
% Total Digestible Nutrients	56	62	55	60
Metabolizable Energy, Mcal/lb	0.92	1.02	0.90	0.98
% Calcium	0.46	0.51	0.32	0.35
% Phosphorus	0.23	0.25	0.15	0.16
% Magnesium	0.17	0.19	0.14	0.15
% Potassium	2.58	2.84	1.53	1.68
% Sodium	0.013	0.014	0.021	0.025
Iron, parts per million	97	107	95	104
Zinc, parts per million	20	22	19	21
Copper, parts per million	8	9	11	12
Manganese, parts per million	65	71	36	40
Molybdenum, parts per million	1.6	1.8	0.9	1.0

2. Review Crude Protein and protein fractions

- a. Crude protein should be a minimum of 8% if feeding forage only. Higher protein is better if you are feeding pregnant, lactating, or growing animals
- b. Soluble protein should be a minimum of 25% and preferably 30-35%
- c. Rumen degradable protein – Look for higher values (>65%)

3. Evaluate Fiber Carbohydrates

- a. Calculate the ADF to NDF ratio. Values close to 0.6 or lower indicate a grass forage. Values close to 0.8 or above indicate a legume forage. Values in between indicate mixed forages
- b. Grass forages with NDF > 65% should not be fed to higher-producing animals but could be used in maintenance and high body condition score animals
- c. Legume forages with NDF > 50% are very mature and will decrease potential feed intake
- d. If Lignin value is provided, calculate the lignin to NDF ratio as a percentage. With grasses, values < 8.5% will be more readily digested. With legumes, values < 17% will be more readily digested. Higher values within each forage type indicate a more lignified cell wall and more slowly fermented forage

4. Evaluate Degradable Carbohydrates

- a. Review the NFC and NSC values for the forage or feed
- b. With grass forage, a good NFC value would be 20-25%, whereas with legume forages the NFC will be much higher (35-45%), but this is mostly due to fermentable fiber from pectin substances
- c. Starch content of forages is typically less than 3%.

5. Review Macrominerals

- a. Calculate the calcium to phosphorus ratio. It should be 2:1 or slightly higher. Legume forages will be very high (> 6:1).
- b. Check calcium content in grass forages and be sure it is above 0.45%. Higher values will be needed for lactating and growing animals.
- c. If the phosphorus content is greater than the calcium content – DO NOT use! This will greatly increase potential for urinary calculi in males.
- d. Forages with phosphorus content > 0.25% typ-

ically are over-fertilized. See if the potassium value is also increased.

- e. Forage magnesium < 0.10% is low and typical of some grasses. Legumes typically have higher magnesium, at 0.2% or more
- f. Forage potassium is always higher than required. In most cases, this is not a problem. Potassium values >2.5% are very problematic.

6. Evaluate trace mineral values

- a. Typical iron content is between 100 and 300 ppm. Values over 1,000 ppm usually indicate soil contamination of the sample.
- b. Manganese is much higher in grass than legume forages. A value around 40 ppm in forage is desired.
- c. Zinc is typically low in all forages (<30 ppm).
- d. Copper is variable depending upon geography. Forage copper is higher east of the Mississippi River (> 9 ppm). Hay harvested from dairy farms may have higher copper (>15 ppm) due to their use of copper sulfate footbaths. Potential toxicosis could occur with forage with > 20 ppm copper
- e. Molybdenum concentration should be determined in all feeds due to its impact on copper status. High forage molybdenum is sporadic in many geographic regions. A copper to molybdenum ratio < 4:1 will risk possible copper deficiency issues. A high ratio (>16:1) places the animals at risk for copper toxicosis.

With this systematic approach to understanding the forage or feed analysis report, one can readily make informed decisions on the appropriateness of a forage for their feeding program or identify potential nutritional risks underlying an animal disease issue.

About Robert Van Saun

A professor of veterinary science and extension veterinarian with Pennsylvania State University, Dr. Robert Van Saun provides extension programs across species on various nutrition, animal health, and reproductive topics regionally, nationally, and internationally. His research interests include the role of nutrition in animal health and performance, especially pregnancy nutrition, and improving diagnostic tests to evaluate nutritional status.



Nucleotides in Functional Nutrition: **BOOSTING GROWTH AND RESILIENCE**

Jisoo Tak

*Animal Nutrition Technical Marketer
CJ Bio*

Nucleotides play a strategic role in functional nutrition, going beyond basic maintenance to actively enhance growth and physiological resilience across animal species. By supplementing diets with exogenous nucleotides, producers can conserve metabolic energy, support immune function, and accelerate gut and tissue development. This approach is particularly valuable during critical stress periods, such as weaning in pigs, early growth in broilers, or high-density aquaculture, optimizing both performance and animal health in modern intensive production systems.

In intensive livestock and aquaculture, the nutritional paradigm is shifting. The focus has moved beyond merely meeting maintenance requirements and maximizing protein deposition toward actively optimizing physiological resilience against environmental and health challenges through functional products. At the heart of this shift are nucleotides - low-molecular-weight intracellular compounds that are rapidly gaining recognition. While traditionally categorized as non-essential due to the existence of *de novo* synthesis and salvage pathways, nucleotides are now considered as conditionally essential for both terrestrial and aquatic animals. The metabolic cost of *de novo* nucleotide synthesis is high, requiring substantial energy and drawing heavily from the body's amino acid pool. During periods of extreme stress - such as rapid neonatal growth, environmental fluctuations, or disease outbreaks - internal synthesis often fails to meet demand.

By providing exogenous nucleotides, producers can “spare” these metabolic resources, redirecting energy and amino acids toward growth, immune function and

tissue repair rather than costly *de novo* nucleotide assembly (Salah et al., 2019; Weaver & Kim, 2014). This article summarizes the molecular basis and production responses to supplemental nucleotides in swine, poultry, and aquaculture, while presenting a strategic framework for their application in precision nutrition.

OPTIMIZING THE WEANING TRANSITION IN NURSERY PIGS

The weaning transition is a high-risk period characterized by social, environmental, and dietary stressors that frequently trigger a “post-weaning growth check”. This physiological setback is driven by impaired nutrient absorption and heightened oxidative stress, both of which can increase morbidity and compromise lifetime performance.

Performance evaluation and economic impact

Strategic supplementation with nucleotide mixtures high in inosine 5'-monophosphate (5'-IMP) has demonstrated a clear capacity to offset this growth check. Weaver & Kim (2014) evaluated a

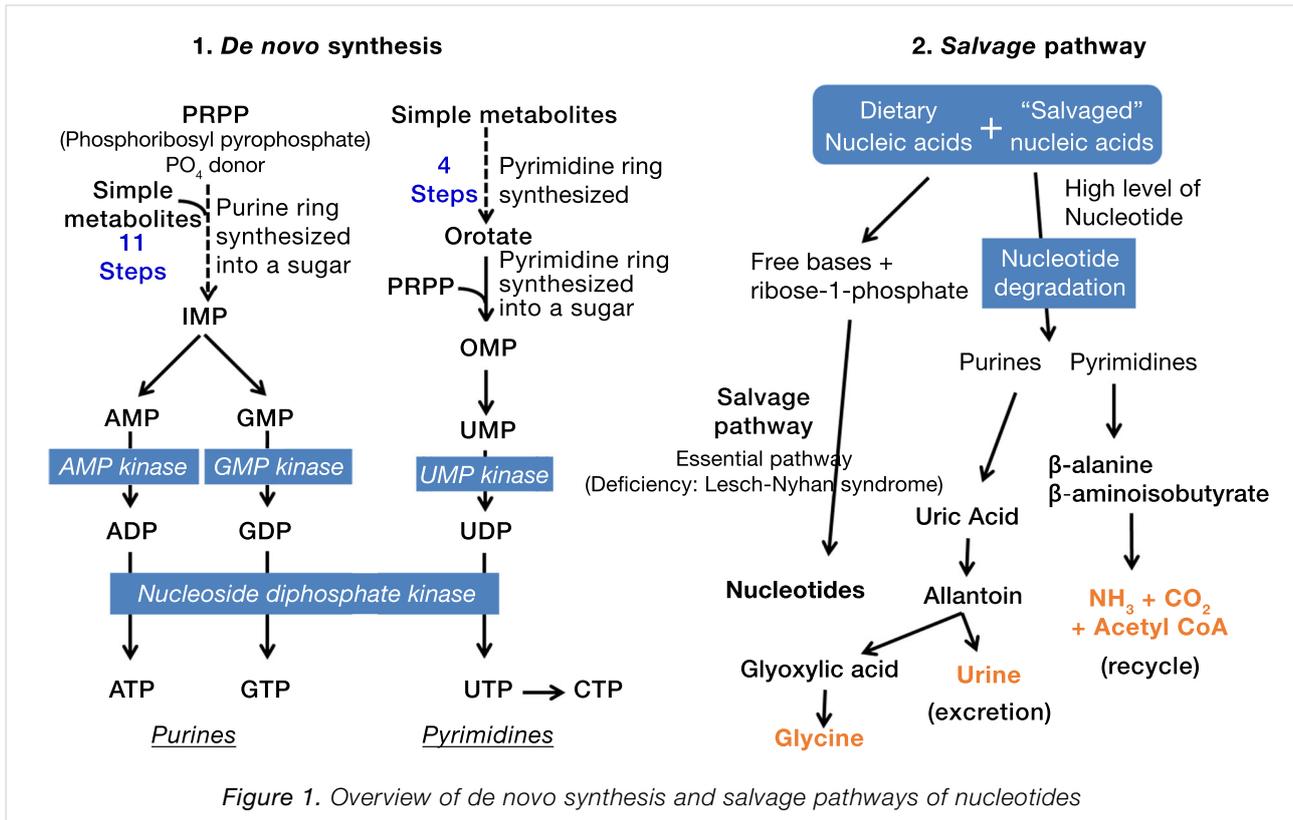


Figure 1. Overview of de novo synthesis and salvage pathways of nucleotides

nucleotide additive containing 53% total nucleotides (of which 51% was 5'-IMP) and reported linear improvements in both average daily gain (ADG) and average daily feed intake (ADFI) (See Table 1).

During the first week (Phase 1), ADG in the 1.0 g/

kg group more than tripled, surging by 225.7% (83.7 g/d vs 25.7 g/d) compared to the control group. For producers, this early stage boost is critical; accelerating the growth curve during Phase 1 reduces total days to market and optimizes nursery throughput.

Table 1. Effect of nucleotide supplementation on growth performance in nursery pigs

Performance Parameters	Phase 1 (Day 0-7)	Phase 2 (Day 7-28)	Overall (Day 0-28)
ADG	Linear increase (P = 0.007)	Significant Increase*	Linear increase (P = 0.031)
	25.7 vs 83.7 (g/d) [†]	363.9 vs 386 (g/d) [†]	270.9 vs 301.8 (g/d) [†]
ADFI	Linear increase (P = 0.005)	Linear increase (P < 0.001)	Linear increase (P < 0.001)
	150.9 vs 197.1 (g/d) [†]	512.1 vs 588 (g/d) [†]	412.5 vs 480.2 (g/d) [†]
G:F	Linear increase (P = 0.015)	No Effect	No Effect
	0.014 vs 0.401 (g/g) [†]		

* Observed significant increases specifically from d 14-21 (P = 0.043) and d 21-28 (P = 0.053).

[†] Values presented as 'vs' indicate the measurements for the 0 g/kg and 1.0 g/kg groups, respectively

Health markers and stress mitigation

Beyond growth performance, nucleotides play a vital role in modulating the immune-inflammatory axis. Research indicates that high-IMP supplementation at 0.5–1.0 g/kg provides the following benefits:

- **Reduced systemic inflammation:** A linear trend toward decreased pro-inflammatory cytokines, particularly Tumor Necrosis Factor- α (TNF- α), suggests a more controlled inflammatory response during the weaning transition.

- **Enhanced cellular protection:** The oxidative DNA damage marker 8-hydroxy-deoxyguanosine (8-OHdG) was lowest at the 0.5 g/kg supplementation level, indicating improved genomic stability under stress.

- **Improved gut health stability :** Diarrhea scores were lowest on Day 8 for pigs receiving 0.5 g/kg. This reflects reduced morbidity and leads to lower associated labor and treatment costs for the producers.

COMPREHENSIVE BENEFITS OF DIETARY NUCLEOTIDES IN FISH AND SHRIMP

Synergistic growth and cellular mechanisms

Dietary nucleotides significantly improve weight gain and FCR across multiple aquaculture species, including Pacific white shrimp and Nile tilapia (Xiong et al., 2018, Asaduzzaman et al., 2017). In tilapia, these growth-promoting mechanisms have been observed at the cellular level. Nucleotide supplementation stimulates both muscle hyperplasia (formation of new muscle fibers) and hypertrophy

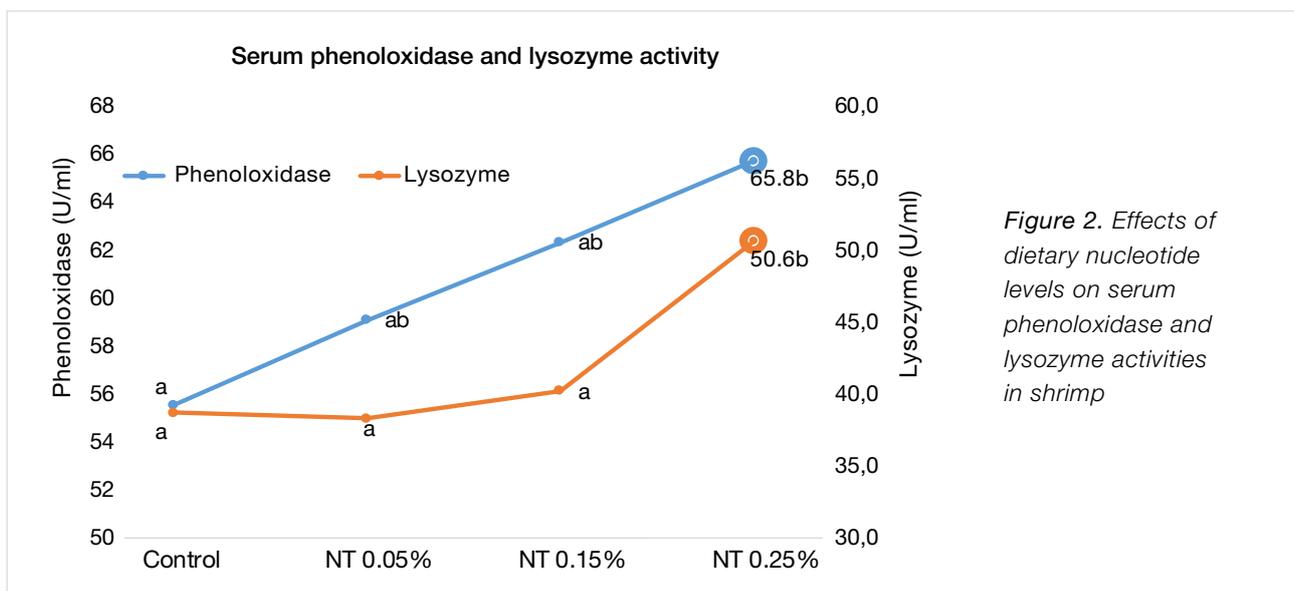
(expansion of existing fibers) (Asaduzzaman et al., 2017). Furthermore, nucleotides upregulate key growth-related genes, including pituitary Growth Hormone (GH) and hepatic Insulin-like Growth Factor-1 (IGF-1) (Asaduzzaman et al., 2017).

Fortification of innate immunity & disease resistance

Because invertebrates, such as shrimp, lack an adaptive immune system, they depend entirely on innate immunity for pathogen defense (Xiong et al., 2018). Nucleotide supplementation effectively activates this non-specific immune defenses, significantly increasing serum activities of phenoloxidase (PO) and lysozyme (Xiong et al., 2018) (See Figure 2). By upregulating immune-related genes, nucleotides markedly enhance disease resistance and survival in both shrimp and fish during severe pathogenic challenges (Xiong et al., 2018; Shiau et al., 2015; Burrells et al., 2001).

Alleviation of environmental stress in high-density farming

In intensive aquaculture systems, the accumulation of nitrogenous waste products, such as ammonia, represents a significant environmental stressor. During acute ammonia exposure, shrimp fed a nucleotide-supplemented diet exhibited significantly higher survival rates - up to 93.3% compared to just 66.7% in the control group (Yong et al., 2020).



Nucleotides help modulate hemolymph metabolites, including glucose and total protein, providing the critical energetic support required to maintain physiological homeostasis during periods of extreme stress (Yong et al., 2020).

Intestinal morphological development

Nucleotides are essential substrates for rapidly dividing tissues, particularly the intestinal mucosa. In shrimp, nucleotide supplementation significantly increases the height and width of intestinal villi, as well as microvilli height (Xiong et al., 2018). These structural enhancements expand the absorptive surface area, optimizing nutrient utilization and strengthening the intestinal barrier to prevent pathogen invasion (Xiong et al., 2018).

BROILER: MAXIMIZING EARLY GROWTH

The interdependence of early growth and gut development

In commercial broiler production, maximizing early growth is a primary objective. However, achieving this high genetic growth potential depends fundamentally on the rapid early development of the gastrointestinal tract (Jung & Batal, 2012). A well-developed small intestine with an intact mucosal structure is essential for efficient nutrient digestion and absorption (Kreuz et al., 2020). Therefore, early growth and gut health are not competing priorities; rather the rapid establishment of robust gut integrity is the prerequisite for achieving maximal early growth.

Impact of environmental stress on gut health and performance

In modern intensive farming systems, broilers are frequently exposed to environmental stressors - such as high stocking densities - which impair physiological function and intestinal health (Kamel et al., 2021). These stressors induce significant morphological damage, including reduced villus height and mucosal thickness, which severely hinders nutrient absorption (Kamel et al., 2021). This deterioration directly translates into stunted early growth, reduced weight gain, and an increased feed conversion ratio (FCR) (Kamel et al., 2021).



Accelerating early growth through nucleotide supplementation

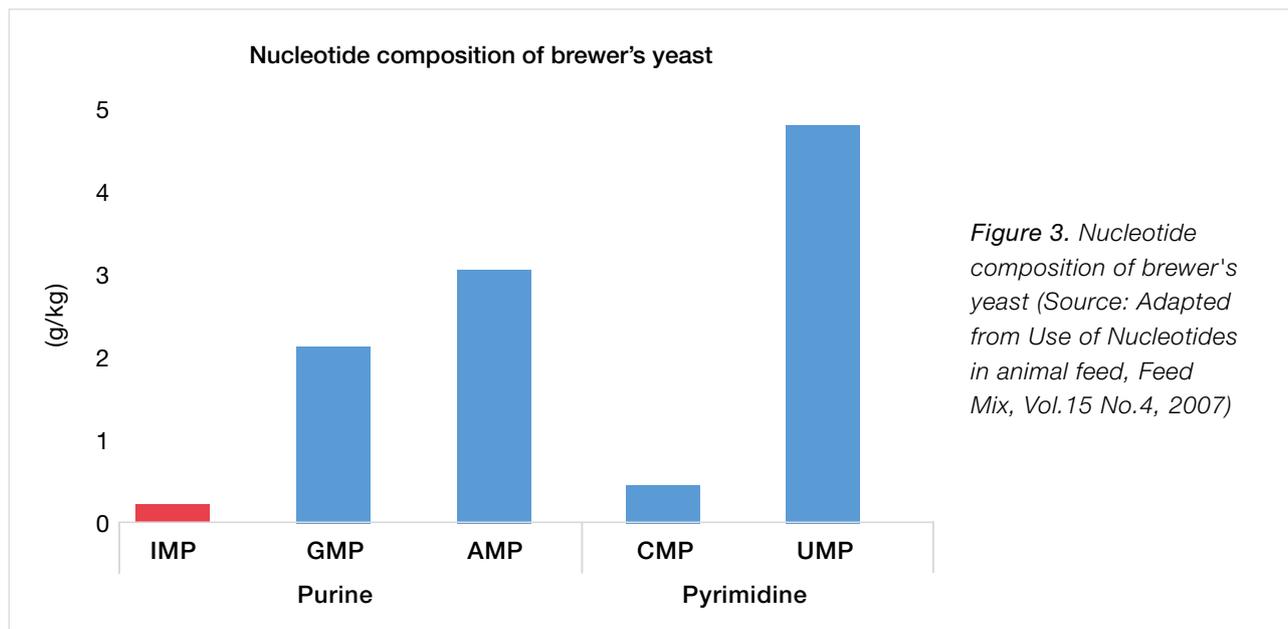
Functional nucleotide supplementation is an effective nutritional strategy to rapidly establish gut health and counteract stress-induced growth depression. Nucleotide supplementation significantly increases intestinal villus height and the villus height:crypt depth ratio during the critical starter phase (e.g., 0-14 or 7-20 days of age) (Jung & Batal, 2012; Kreuz et al., 2020). This morphological improvement expands the absorptive surface area, enabling chicks to utilize nutrients more efficiently.

Direct performance improvements and barrier integrity

Rapid intestinal development translates into superior early growth metrics. Broilers fed nucleotide-supplemented diets show significantly higher daily weight gain and improved FCR during critical early phases (Jung & Batal, 2012; Kreuz et al., 2020). Furthermore, nucleotides upregulate the expression of tight junction genes such as ZO-1 and Occludin, strengthening the intestinal barrier against pathogens and maintaining homeostasis during rapid growth (Wu et al., 2018).

THE BIOAVAILABILITY GAP: WHY PURIFIED IMP OUTPERFORMS YEAST SOURCES

While yeast-derived nucleotides are a common choice in market, not all sources offer the same effi-



ciency. A critical factor to consider is the “Bioavailability Gap.” Most common yeast-derived sources are protein-bound, which leads to limited intestinal release and often results in bioavailability levels around 20% or less. In contrast, purified, fermentation-based nucleotide (IMP or GMP) is protein-free and ready for immediate absorption, providing significantly higher intestinal availability.

Beyond absorption rates, the “Profile Balance” is equally important. Figure 3 illustrates this imbalance; it shows that Brewers Yeast contains disproportionately low levels of IMP, while other pyrimidines dominate the profile. Purified IMP, however, provides a consistent and high-potency supply that ensures efficient salvage pathway activation through direct nucleoside supply. For producers looking for reproducible results and maximal growth, choosing a purified form is a more reliable way to bridge the nutritional gap and achieve superior performance.

CONCLUSION

The strategic addition of nucleotides is no longer an “optional” luxury in high-efficiency antibiotic-free intensive production system. Nucleotides optimize natural growth and resilience by conserving metabolic energy and providing the essential building blocks for rapid cell turnover.

References

1. Asaduzzaman, M., et al. (2017). Dietary nucleotide administration influences growth, muscle fiber hyperplasia and hypertrophy in Nile tilapia. *Aquaculture*, 479, 1-9.
2. Collins, S. L., et al. (2023). Bile acids and the gut microbiota. *Nature Reviews Microbiology*, 21(4), 236-247.
3. Dawson, P. A. (1998). Bile secretion and the enterohepatic circulation of bile acids. *Sleisenger and Fordtran's Gastrointestinal and Liver Disease*.
4. Jung, B., & Batal, A. B. (2012). Effect of dietary nucleotide supplementation on broiler chicken performance. *Poultry Science*, 91(6), 1288-1297.
5. Kandell, R. L., & Bernstein, C. (1991). Bile salt/acid induction of DNA damage. *Infection and Immunity*, 59(1).
6. Luppi, A., et al. (2023). Diagnostic Approach to Enteric Disorders in Pigs. *Animals (Basel)*, 13(3), 338.
7. Park, S. J., et al. (2011). Prevalence of Enteric Bacterial Pathogens in Grower Pigs in Jeju-do. *J Vet Clin*, 28(1), 81-86.
8. Sun, Y., & Kim, S. W. (2017). Nutritional intervention to prevent postweaning diarrhea. *Animal Nutrition*, 3(4), 322-330.
9. Use of Nucleotides in animal feed, *Feed Mix*, Vol. 15 No.4, 2007.
10. Weaver, A. C., & Kim, S. W. (2014). Supplemental nucleotides high in inosine 5'-monophosphate to improve health and growth of newly weaned pigs. *Journal of Animal Science*, 92(2), 645-651.
11. Xiong, J., et al. (2018). Dietary nucleotide-rich yeast supplementation improves growth, innate immunity and intestinal morphology of Pacific white shrimp. *Aquaculture Nutrition*.

Nucleotide (IMP) for Swine & Aqua Nutrition

Fueling Growth, Strengthening Resilience



Intestinal Integrity &
Nutrient Absorption



Immune Function &
Stress Adaptation





MARINE MACROALGAE IN ANIMAL NUTRITION:

Current Market Landscape, Technical Challenges, and Future Potential

Ewenn Helary
CEO
NUQO Feed Additives

Marine macroalgae are gaining attention in animal nutrition as sustainable, multifunctional feed additives aligned with climate goals and evolving consumer expectations. While still a niche market, their applications span methane mitigation, immune and gut health support, antioxidant protection, mineral supplementation, palatability enhancement, and fiber provision. Understanding the current market dynamics, technical limitations, and innovation pathways is essential to assess how marine macroalgae can transition from specialized use to broader adoption in global feed systems.

In the quest for sustainable and functional animal nutrition solutions, marine macroalgae have emerged as a promising category of feed additives. Though still considered a niche segment, macroalgae are steadily gaining traction due to their natural origin, multifunctional benefits, and alignment with environmental and consumer trends. This article explores the current market for marine macroalgae in animal nutrition, highlights key applications, delves into the technical challenges inherent to algae-based products, and outlines exciting research directions poised to unlock their full potential.

THE CURRENT STATUS OF MACROALGAE USE IN ANIMAL FEED

Macroalgae, or seaweeds, are not yet widely adopted in mainstream livestock feed but are carving out growing niches. Their use is more advanced in ruminants and aquaculture, while experimental applications in monogastrics like swine and poultry, as well as companion animals, are gaining interest. Unlike bulk feed materials such as cereals or forages,

macroalgae are primarily employed as additive-level ingredients, targeting specific functional benefits rather than providing major nutritional energy.

Despite the current limited scale, the global market for macroalgae in animal feed is estimated at around USD 70 to 120 million in actual sales today, with future projections soaring to approximately USD 1.25 billion* in 2030 as sustainability goals, consumer demands for natural ingredients, and regulatory pressures intensify. The market is segmented into six primary application areas: methane mitigation, immune modulation and gut health, antioxidant support, mineral supplementation, flavor and palatants (particularly in aquafeed), and sustainable fiber sources (**Global seaweed new and emerging markets report – 2023 – World Bank*).

FUNCTIONAL APPLICATIONS AND TARGET SPECIES

Methane Mitigation is a flagship application for macroalgae, especially in ruminants. Certain red al-

gae species, notably *Asparagopsis taxiformis*, contain bioactive compounds like bromoform that disrupt methanogenic microbes in the rumen, achieving methane emission reductions of up to 80% in controlled trials. However, this application remains at an early commercial stage with current sales estimated between USD 5 and 10 million, poised to grow substantially as climate regulations pressure livestock producers to reduce greenhouse gases.

Immune Modulation and Gut Health applications are the most mature in the feed macroalgae market, with sales between USD 30 and 50 million. Brown seaweeds rich in phlorotannins, laminarin, and fucoidan provide anti-inflammatory and immunostimulant effects across ruminants, swine, poultry, and aquaculture. These polysaccharides also promote gut microbiota balance and intestinal barrier integrity, crucial for young or stressed animals.

Antioxidant Support leverages algae's rich polyphenols, carotenoids, and vitamin E-like compounds to mitigate oxidative stress arising from heat, transport, or immune challenges. This niche is estimated at USD 10–20 million today, with expanding demand amid growing awareness of animal welfare and production challenges.

Mineral Supplementation utilizes brown algae as natural reservoirs of iodine, zinc, selenium, and calcium, supporting thyroid function and trace element nutrition in all species. The market is stable at USD 10–20 million, responding to “clean label” trends seeking natural alternatives to synthetic minerals.

Flavor and Palatants, primarily in aquafeed, exploit species like *Palmaria palmata* (dulse) for their umami taste, improving feed acceptance in fish and shrimp. This specialized market is nascent, with sales around USD 5–10 million, but shows promise as aquaculture expands.

Finally, **Sustainable Fiber Sources** use green and brown algae cell wall polysaccharides as fermentable fibers to improve digestive health, especially in ruminants and pigs. Current sales are modest (USD

8–10 million) but are expected to grow as improved algal processing technologies enhance digestibility and functionality.

TYPES OF MACROALGAE AND THEIR ROLES

Macroalgae fall into three major groups, differentiated by pigmentation and bioactive profiles:

- **Brown Algae (Phaeophyceae)** are the most widely used in animal nutrition. Species like *Ascophyllum nodosum*, *Laminaria spp.*, and *Fucus vesiculosus* are valued for their phlorotannins, iodine, laminarin, and fucoidan content, contributing to immune support, antioxidant capacity, prebiotic effects, and mineral supplementation.

- **Red Algae (Rhodophyta)**, including *Asparagopsis taxiformis* and *Palmaria palmata*, are prized for methane mitigation and aquafeed palatants, with bioactives such as bromoform and carotenoids.

- **Green Algae (Chlorophyta)**, less utilized but gaining attention, include species like *Ulva spp.* These provide antioxidant compounds and fermentable fiber, suitable for prebiotic effects and gut health.

SOURCING AND GEOGRAPHIC CONSIDERATIONS

Macroalgae supply chains vary by species and region. Nordic countries such as Norway, Iceland, and Ireland are well-established sources of brown algae like *Ascophyllum* and *Laminaria*, relying on wild harvesting with developed logistics. In contrast, *Asparagopsis* cultivation for methane mitigation is progressing in Australia and Hawaii, with controlled aquaculture to ensure consistent quality and regulatory compliance.

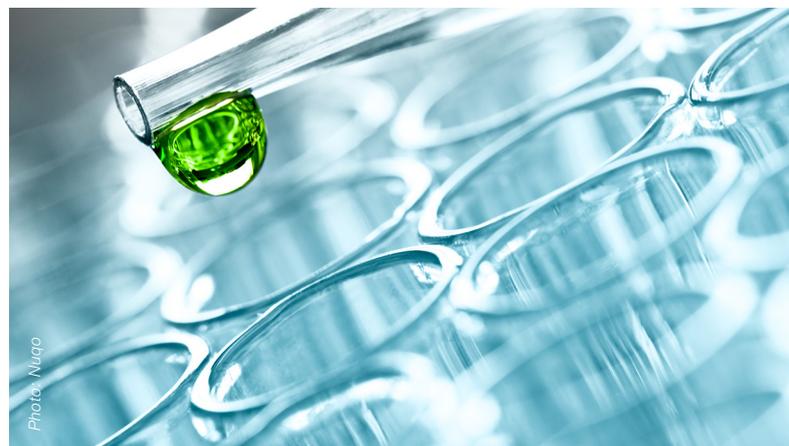


Photo: Nuno

France (especially Brittany) hosts pilot projects exploring *Ulva*, *Palmaria*, and *Laminaria* for aquafeed and livestock, aiming to localize supply and promote sustainable sourcing. Asia remains a large-scale producer of *Laminaria* and related species, primarily for human food but increasingly investigated for feed use.

TECHNICAL CHALLENGES OF MACROALGAE IN ANIMAL NUTRITION

Despite promising benefits, several hurdles limit the widespread adoption of macroalgae in feed. A primary challenge is the **variability of algae composition**, which fluctuates with species, season, harvest method, and geographic origin. This variability affects the concentration of key bioactives and minerals, complicating formulation and consistent efficacy.

Contaminant risk is another critical concern. Macroalgae can accumulate heavy metals, iodine in excess, and undesirable halogenated compounds. For instance, *Asparagopsis* contains bromoform, which, while effective for methane mitigation, raises food safety and regulatory scrutiny, necessitating precise dosing and monitoring.

Stability and bioavailability of algae bioactives during feed processing and digestion also pose significant challenges. Many active compounds degrade under heat, pressure, or extended storage. Furthermore, their release and activity in the gut environment are often unpredictable, undermining functional benefits.

Sometimes, the natural composition of certain macroalgae necessitates high inclusion rates in animal feed formulations to achieve the desired functional benefits. This can pose economic challenges for formulators, as using large quantities of algae increases feed costs significantly. Moreover, high inclusion levels may negatively impact the palatability of the feed, causing animals to reduce their intake or reject the feed altogether. These factors create important considerations when integrating algae-based ingredients into commercial feed formulations.

To address these issues, recent research focuses on advanced analytical methods to identify and quantify specific algae metabolites - so-called “phycogenics” - enabling targeted selection of strains and harvest conditions to optimize functional compound profiles. This screening accelerates product standardization and efficacy assurance.

Emerging micro-encapsulation technologies are also being explored to protect sensitive algae compounds during feed processing and storage, and to control their release in specific gut regions. Encapsulation improves stability and enhances bioactivity, making algae-based additives more reliable and potent.

An exciting frontier lies in fermentation and bioprocessing approaches that do not merely preserve but enhance the physiological activity of algae compounds. Controlled microbial fermentation can increase bioavailability, reduce unwanted compounds, and potentially produce novel metabolites with enhanced immunomodulatory or antioxidant properties.

MARKET OUTLOOK: BRIDGING TODAY'S REALITY AND TOMORROW'S POTENTIAL

Currently, marine macroalgae in animal feed represent a fragmented and emerging market, with aggregate sales estimated between USD 70 and 120 million. Immune modulation and gut health products lead today's revenue, followed by antioxidant support and mineral supplementation. Methane mitigation, flavor enhancement, and sustainable fiber applications remain smaller but are evolving quickly.

Looking ahead, the market's future value is forecasted around USD 1.25 billion, propelled by growing demand for natural, sustainable feed solutions that align with climate goals and consumer preferences. Among these, methane mitigation technology based on algae such as *Asparagopsis taxiformis* holds enormous potential due to its capacity to reduce enteric methane emissions by up to 80%. However, this promise comes with significant technical challenges. The production of *Asparagopsis* at commer-

cial scale is complex, and the regulatory landscape - especially concerning bromoform residues - is uncertain. Moreover, cost remains a critical constraint: current algae-based methane mitigation solutions often represent an additional expense rather than a direct financial gain for farmers, making widespread adoption highly dependent on policy incentives and carbon credit schemes, which remain unpredictable.

Beyond methane mitigation, algae have traditionally found use in segments such as toxin binders, which are increasingly commoditized. In these cases, it can be difficult to quantify the added value specifically attributable to algae, given the competitive nature of this market and the relatively generic functions of such products.

A promising frontier lies in the exploration of specific algae-derived extracts and metabolites—often referred to as phycogenics—including sulfated polysaccharides, phlorotannins, laminarins, and other bioactive compounds. These molecules possess diverse biological activities, such as immune modulation, antioxidant properties, and gut health benefits (Karlsberger et al, 2025). Yet, unlocking their full potential requires rigorous scientific research to identify, isolate, and characterize these metabolites, alongside the development of advanced manufacturing technologies like microencapsulation to enhance stability, targeted delivery, and cost-efficiency. Emerging fermentation techniques also offer exciting opportunities to preserve and even amplify the physiological activity of algae compounds.

Despite these hurdles, the feed and agricultural sectors remain vital fields for algae applications. As

producers seek new, sustainable feed additives, the technical advances and increasing market pressure for natural solutions ensure that macroalgae will continue to play a growing role. Successfully bridging the gap between current niche use and future mainstream adoption depends on overcoming economic, regulatory, and supply chain barriers while validating the functional benefits through robust science.

CONCLUSION

Marine macroalgae hold tremendous promise as multifunctional, natural ingredients in animal nutrition. Their proven benefits in methane mitigation, immune support, antioxidant protection, mineral supplementation, flavor enhancement, and sustainable fiber sourcing position them well for future growth. However, realizing their full market potential requires continued innovation to overcome variability, stability, and regulatory challenges.

Advances in phycogenic compound identification, micro-encapsulation, and fermentation-based enhancement technologies offer a path forward to more effective, consistent, and scalable algae-based feed solutions. As these technological and supply chain hurdles are addressed, marine macroalgae are poised to become a cornerstone of sustainable, science-driven animal nutrition in the coming decade.

Reference

Karlsberger, L.; Sandner, G.; Molčanová, L.; Rýpar, T.; Ladirat, S.; Weghuber, J. *Antioxidant Power of Brown Algae: *Ascophyllum nodosum* and *Fucus vesiculosus* Extracts Mitigate Oxidative Stress In Vitro and In Vivo*. *Mar. Drugs* 2025, 23, 322. <https://doi.org/10.3390/md23080322>

NUQO

● Independent ● Sustainable ● Transparent

Smarter technology enables us to grow more with less.

- XPR® Technology** – Targeted delivery for maximum efficacy
- Plant & Algae Metabolites** – For health and performance
- Measurable ROI** – Science-backed solutions to drive profitability
- Contact us: info@nuqo.eu  Learn more: www.nuqo.eu



Alex Makol, Global Product Manager for Aquaculture Health and Farm Care

at Adisseo: “In aquaculture, survival rates, harvest volumes, and growth curves are essential KPIs; however, they only tell part of the story. These KPIs are ultimately the final proof of performance and the basis on which the success of any product, including ours, is measured. However, health challenges do not always manifest as mortality, clear clinical signs, or sudden drops in KPIs that allow us to react in time. Many health alterations are silent.”



FROM SURVIVAL TO OPTIMAL PERFORMANCE: HOW HEALTH DRIVES AQUACULTURE SUCCESS

In aquaculture, success is often measured by survival rates, harvest volumes, and growth curves, yet these metrics tell only part of the story. Many underlying, “invisible” factors—such as chronic low-grade inflammation, oxidative stress, compromised gut integrity, and behavioral stress caused by handling, stocking density, or water quality fluctuations—can silently limit animals’ ability to express their full genetic and nutritional potential. Even when overt disease or mortality is avoided, subclinical health issues divert energy from growth, reduce feed efficiency, and ultimately impact overall productivity and profitability.

Alex Makol, Global Product Manager for Aquaculture Health and Farm Care at Adisseo, emphasizes the importance of shifting from a reactive, treatment-focused approach to proactive health management. By strengthening key tissues and physiological systems, supporting gut functionality, and mitigating both visible and hidden stressors,

producers can unlock higher performance, more predictable growth, and greater feed conversion efficiency. Functional feed additives play a critical role in this strategy, providing targeted solutions that enhance immunocompetence, resilience, and overall robustness. In this interview, Makol explains how integrated, evidence-based nutritional strategies allow aquaculture producers to maximize output, reduce variability, and achieve more sustainable and economically efficient production.

In aquaculture, success is often measured by survival rates, harvest volumes, and growth curves. However, you believe that addressing these alone is not enough. In your view, what are the “invisible” factors that prevent animals from reaching their full genetic and nutritional potential?

In aquaculture, survival rates, harvest volumes, and growth curves are essential KPIs; however, they only tell part of the story. These KPIs are ultimately the

final proof of performance and the basis on which the success of any product, including ours, is measured.

However, health challenges do not always manifest as mortality, clear clinical signs, or sudden drops in KPIs that allow us to react in time. Many health alterations are silent. They may remain subclinical or eventually evolve into more visible outbreaks, but long before that, they already limit the animal's ability to express its full genetic and nutritional potential.

These “invisible” constraints include chronic low-grade inflammation, repeated immune activation, oxidative stress, compromised gut integrity, and behavioral stress caused by handling, stocking density, or water quality fluctuations. Individually, they may seem minor, but together they divert energy away from growth and feed efficiency. The animal survives and even grows, but not optimally.

Our approach focuses on both ends of the spectrum: controlling and mitigating clinical outbreaks when they appear and addressing the non-visible stressors that silently erode performance long before KPIs show a red flag. This is what allows production systems to reach, not just approach, their full biological and economic potential.

While it is often easier to detect and intervene in clinical diseases, why is managing subclinical health issues more challenging? Could you explain these subclinical problems in aquaculture and their impact on feed efficiency, growth rates and biomass output?

Subclinical health issues are inherently more difficult to manage because they do not present clear and immediate warning signs. There is no mortality spike, no obvious lesions, and no single pathogen to target. Instead, producers observe gradual changes, such as lower growth rates, increased FCR, higher size variability, and inconsistent harvest outcomes.

In aquaculture, subclinical challenges often stem from gut dysbiosis, low-grade infections, mycotoxin exposure, and repeated environmental stressors. The impacts of these factors are cumulative. Feed efficiency declines because nutrients are used

to sustain immune responses rather than growth. Growth rates slow, cycles are extended, and total biomass output is reduced. These hidden losses can represent a significant share of unrealized profits.

Even if animals survive a clinical disease, why can performance loss persist for a long time afterward? How do you evaluate the impact of recovery time on economic performance from a producer's perspective?

Even when animals survive a clinical disease episode, the biological cost does not end with their survival. During illness, tissues are damaged, gut function is impaired, and immune reserves are depleted. Recovery requires time and resources, and during this period, the growth potential is permanently or partially lost.

From the producer's perspective, the recovery time has a direct economic impact. Delayed growth results in longer production cycles, higher fixed costs, and less efficient use of infrastructure. In many cases, animals never fully “catch up,” which translates into lower final biomass or downgraded size classes at the time of harvest. Therefore, evaluating the disease's impact must include not only mortality but also lost growth potential.

How should producers approach both clinical and subclinical challenges? As Adisseo, how do you define the shift from a “treatment-oriented” approach to a “proactive health management”?

Producers must address both clinical and subclinical challenges using a holistic and integrated

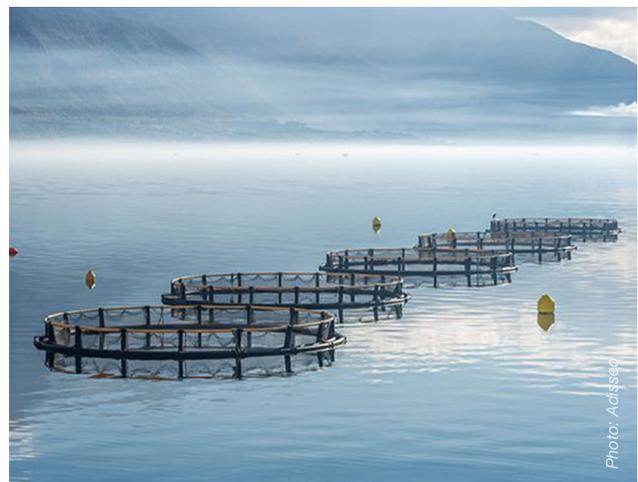


Photo: Adisseo



approach. Clinical diseases require rapid, targeted interventions; however, relying solely on treatments is reactive and often costly.

At Adisseo, we define the shift toward proactive health management as moving upstream—strengthening animals before problems arise. This means focusing on robustness, gut functionality, and stress resilience as part of the daily feeding strategies. The objective is not to cure diseases but to reduce the frequency, severity, and performance impact of health challenges across the entire production cycle.

What do functional feed additives promise producers in terms of health-based performance management? How would you define the impact of these additives on immunocompetence, resistance, and resilience?

Functional feed additives can strongly support health-driven performance, but their impact depends on choosing the *right* solution for the *specific* challenge present on the farm. Not all additives work through the same biological mechanisms, and applying a generic product does not guarantee results. What matters is aligning the additive's mode of action—whether targeting inflammation, oxidative stress, gut integrity, or immune balance—with the underlying stressor.

When this match is correct, animals maintain stronger immunocompetence, cope better with

challenges, and recover performance faster, which ultimately supports more stable growth and feed efficiency. At Adisseo, our focus is precisely this targeted approach: using well-characterized, evidence-based solutions that address defined biological constraints and contribute to more consistent outcomes under real farming conditions.

Why is it important to have multiple mechanisms of action working together rather than a single mechanism in health management? How can the synergy of these mechanisms be concretely observed in terms of performance indicators in the field?

In aquaculture, relying on a single mechanism of action is usually insufficient because animals are almost never exposed to just one challenge at a time. Farming occurs in open, dynamic environments where temperature, water quality, handling, and stocking conditions can shift rapidly. These fluctuations create overlapping layers of stress that interact and amplify each other. A good example is the behavior of opportunistic bacteria: the moment there is a disturbance in the animal's natural balance, whether from stress, gut integrity issues, or environmental fluctuations, these bacteria take advantage and intensify the problem.

This complexity implies that effective health support necessitates solutions with multiple complementary mechanisms of action. By simultaneously acting on inflammation, oxidative stress, gut func-

tion, microbiota balance, and immune modulation, we created a broader and more sustainable protective effect. In the field, the synergy between these mechanisms translates into clearer performance outcomes: more stable growth, better feed efficiency, and faster stress recovery. This multi-layered approach helps producers maintain consistent results despite the inherent variability of aquaculture environments.

At this point, what solutions does Adisseo provide to support aquaculture producers? Could you share the primary mechanisms of action behind these solutions and the performance outcomes observed in the field?

Adisseo supports aquaculture producers with functional solutions designed to help animals maintain their performance when facing real and unavoidable production stressors. Our approach focuses on strengthening key tissues, such as the gut, gills, skin, and liver (or hepatopancreas for shrimp), which play a central role in immunity, metabolism, and overall robustness. By acting on these critical interfaces, our solutions help stabilize physiological balance, allowing animals to better cope with environmental fluctuations and microbial pressure.

These products work through complementary mechanisms, including modulation of inflammation, reinforcement of epithelial barriers, optimization of microbiota, and improved oxidative stress management. In the field, this translates into clearer outcomes: better feed efficiency, consistent growth rates, and improved stability under challenging conditions. Importantly, producers observe benefits not only during disease pressure but also in day-to-day operations, where subtle, unnoticed stressors often erode performance. Our objective is to provide practical, evidence-based tools that help production systems achieve more predictable and resilient results.

How does Adisseo's SustainWay approach provide a roadmap for aquaculture producers in the long term?

Adisseo's SustainWay approach provides a long-

term- framework that integrates performance, health, and sustainability. It helps producers move from short-term problem solving to strategic production optimization by focusing on resource efficiency, animal robustness, and environmental responsibility.

Rather than offering isolated solutions, SustainWay connects nutrition, health, and sustainability objectives into a coherent roadmap, supporting producers as regulations, consumer expectations, and production systems evolve.

Finally, how does optimizing health to drive performance align with sustainability goals in aquaculture? What does the approach of "more consistent performance with fewer resources" mean for the producers?

Optimizing health to drive performance is fully aligned with the sustainability goals. Healthier animals convert feed more efficiently, require fewer interventions, and utilize resources such as feed, water, and energy more effectively.

Optimizing health to drive performance directly aligns with sustainability because healthier animals use resources more efficiently. When animals maintain better gut integrity, stronger immunity, and a more stable physiological balance, they convert feed more effectively, require fewer interventions, and show more predictable growth. All of these factors reduce the environmental footprint per kilogram of biomass produced.

For producers, the concept of "more consistent performance with fewer resources" means lowering risk while improving margins and reducing environmental footprint. Stable health translates into better feed efficiency, shorter cycles, fewer losses, and less variability, allowing each unit of feed, energy, or labor to generate more value. In the long term, this is what enables production systems to reach—not just approach—their full biological and economic potential, while meeting the increasing expectations for responsible and sustainable aquaculture.

SMART STORAGE TECHNOLOGIES ARE RESHAPING FEED SAFETY



Photo: Freepik.com

Smart storage technologies are transforming feed safety from a reactive practice into a proactive quality management approach. With the expansion of global supply chains and increasing climate variability, traditional storage methods are falling short of maintaining feed integrity. Advanced sensors, automation, and data-driven monitoring systems enable the early detection of mycotoxin risks, preservation of nutritional value, and reduction of losses, becoming a strategic tool for both safety and operational efficiency for feed producers.

By Derya Gulsoy Yildiz

Storing feed ingredients and compound feeds is no longer merely a logistical activity; it is a critical control point for ensuring feed safety, preserving nutritional value, and achieving economic sustainability. The expansion of global supply chains, the sourcing of raw materials from diverse climatic regions, and prolonged storage periods are increasingly exposing the inadequacies of traditional storage approaches.

Fluctuations in moisture and temperature, oxidative degradation, nutrient loss, and the formation of mycotoxins are among the primary challenges encountered during storage processes. Particularly in raw materials with high fat content, lipid oxidation

can lead to a decrease in the energy value of the feed and a reduction in palatability. Furthermore, vitamins and certain functional components are extremely sensitive to storage conditions.

Traditional storage systems are generally built upon routine manual inspections, fixed aeration schedules, and limited data tracking. This method, which fails to meet modern-day requirements, makes it difficult to detect sudden risk changes in the storage environment in a timely manner. In contrast, storage in the modern feed industry has moved beyond being a static process; it has evolved into a field of continuous surveillance and technology-driven quality management.

Storage Must Actively Contribute to Quality Preservation

Evaluating the reasons behind this evolution, **Alfonso Garrido, CEO of Symaga**, explains why modern storage has become a critical control point in the production chain: “The feed industry is operating in a far more demanding environment than ever before. Raw materials travel longer distances, climate variability is more pronounced, and quality standards are increasingly strict. Under these conditions, storage is no longer a passive phase between production and processing — it is a critical control point that directly impacts feed safety, nutritional value, and profitability.”

“The fundamental challenge is maintaining stability in a living biological product. Variations in temperature and moisture inside a silo can trigger condensation, microbial growth, oxidation of fats, nutrient degradation, and ultimately mycotoxin development. Even minor fluctuations can create localized “hot spots” that compromise an entire batch,” says **Garrido**, continuing: “Traditional storage approaches were largely reactive: periodic manual checks, limited monitoring points, and corrective actions taken after a problem appeared. Today, this is not sufficient. The industry requires continuous monitoring, predictive capability, and structural solutions that minimize risk from the outset. Storage infrastructure must actively contribute to quality preservation, not simply contain the product.”



Alfonso Garrido
Symaga

EMERGING TECHNOLOGIES IN STORAGE

At the heart of current feed storage technologies lie sensor-based monitoring systems. These systems measure temperature, relative humidity, oxygen, and carbon dioxide levels within silos and warehouses in real-time, enabling monitoring via digital platforms. These sensors typically operate integrated with IoT (Internet of Things) infrastructure. This allows operators to track storage conditions remotely and receive instant alerts when pre-defined threshold values are exceeded. This approach provides the opportunity for preventive control rather than intervening after problems have already emerged.

Another key component of next-generation storage systems is automated aeration and temperature control solutions. These systems analyze environmental conditions and activate only at optimal times. In doing so, they both reduce the risk of moisture condensation and molding while preventing unnecessary energy consumption. Furthermore, smart silo solutions enable the detection of “hot spots” by digitally mapping different zones within the silo. Working in tandem with digital traceability applications, these systems make it possible to record the storage conditions for every single batch.

Toward Smart, Connected, and Automated Systems

Providing information on the emerging technologies in feed and raw material storage, Garrido shares



the following: “The sector is clearly moving toward smart, connected, and automated systems. Among the most relevant technologies are:

- High-precision temperature and humidity sensors distributed throughout the silo.
- IoT-based remote monitoring platforms that provide real-time data access and alerts.
- Automated aeration systems that regulate airflow based on internal conditions rather than fixed schedules.
- Advanced structural engineering to optimize airflow, reduce condensation, and prevent material segregation.
- Digital traceability tools that integrate storage data into ERP and plant management systems.”

Touching upon the approach of Symaga, a globally recognized leading provider of storage solutions, **Garrido** notes that as a company, they focus on combining robust structural design with digital monitoring capabilities. **Garrido** shares the following regarding Symaga’s storage solutions: “Our silos are engineered to ensure optimal airtightness, efficient aeration, and structural stability under varying climatic conditions. We also integrate monitoring systems that allow operators to track temperature

evolution and respond before risks escalate. We supply grain stoppers, a loading system equipped with deflector plates to prevent grain damage and breakage, as well as solutions that minimize grain segregation and dust formation, thereby reducing explosion risks and the potential development of mycotoxins. The objective is to transform the silo into an intelligent asset — one that supports quality management, operational efficiency, and data-driven decision-making.”

FEED SAFETY AND QUALITY MANAGEMENT WITH SMART STORAGE SYSTEMS

Smart storage systems are shifting the feed safety paradigm from a reactive model to a preventive and predictive one. Thanks to continuous monitoring, conditions that lead to mycotoxin formation—such as moisture spikes and temperature rises—can now be detected early. These systems protect the integrity of nutrients by making the storage environment more stable and significantly reduce quality losses in oxidation-sensitive components like fats, amino acids, and vitamins. Simultaneously, they positively impact physical quality, shelf life, and feed processability. Batch-level traceability stands out as another advantage of

these systems. Thanks to digital records, all storage conditions for a specific lot can be analyzed retrospectively. This enables the rapid identification of the source of quality deviations, strengthens internal audit processes, and allows for targeted recalls when necessary. Consequently, smart storage systems are becoming more than just a technology investment for feed producers; they are a strategic quality and risk management tool.

This Strengthens Both Feed Safety and Brand Reputation

“Smart storage systems shift the approach from corrective to preventive. Continuous monitoring enables early detection of temperature increases or moisture imbalances, which are the primary precursors to mold growth and mycotoxin formation,” says **Alfonso Garrido**. He notes that the advantages provided by smart storage systems are quite clear and lists them as follows:

- **Mycotoxin prevention:** Early aeration or product movement can prevent fungal development before contamination occurs.
- **Nutrient stability:** Controlling oxidation and heat build-up protects vitamins, fats, and proteins.
- **Shelf-life extension:** Stable internal conditions reduce deterioration over time.
- **Batch traceability:** Digital records of storage conditions provide full documentation for audits and regulatory compliance.

Garrido states, “In practical terms, these technologies reduce uncertainty. They provide measurable control over variables that previously relied solely on operator experience. This strengthens both feed safety and brand reputation.”

SUSTAINABILITY AND COST MANAGEMENT WITH NEXT-GENERATION STORAGE TECHNOLOGIES

In the feed industry, sustainability and cost management are becoming increasingly intertwined. Next-generation storage technologies offer solutions that contribute to both goals simultaneously. Energy-efficient aeration and cooling systems reduce electricity consumption by operating only

when necessary. This not only lowers operational costs but also contributes to the reduction of greenhouse gas emissions.

Preventing storage-related degradation and shrinkage ensures that economic losses are minimized, particularly in high-value ingredients. At the same time, reducing losses within the food-feed chain decreases the need for production and transport, thereby helping to lower the carbon footprint. In this regard, modern storage technologies have become a key sustainability component that supports feed producers in achieving their environmental goals.

A Powerful Lever from Economic and Environmental Perspectives

“Efficiency and sustainability are now inseparable. Every ton of raw material lost due to spoilage represents not only a financial cost but also wasted energy, water, land use, and logistics emissions,” says **Symaga CEO Garrido**, listing the contributions of advanced storage solutions to sustainability and cost management as follows:

- **Energy optimization:** Automated aeration systems operate only when conditions require it, reducing unnecessary power consumption.
- **Loss reduction:** Early detection of spoilage prevents large-scale product disposal.
- **Lower shrink rates:** Improved structural sealing and moisture control minimize quantitative losses.
- **Extended infrastructure lifespan:** High-quality



Photo: Freepik.com



galvanization and corrosion-resistant materials reduce maintenance and replacement frequency.

Garrido adds: “By preventing waste along the food-feed chain, modern storage systems indirectly reduce the overall carbon footprint of feed production. In this context, technology is both an economic and environmental lever.”

TECHNOLOGIES OF THE FUTURE

In the future, automation and AI-powered systems are expected to become more prominent and widespread within the feed storage sector. AI-based algorithms will analyze historical storage data, environmental conditions, and raw material characteristics, contributing to the prediction of spoilage and mycotoxin risks at even earlier stages. Furthermore, the expansion of fully automated storage facilities—which reduce the risk of error by minimizing human intervention and enhancing operational efficiency—is among the key developments expected in the coming years. It is anticipated that such facilities, operating in tandem with supply chain management systems, will also support procurement, formulation, and logistics decision-making processes. In parallel, the importance of generating standardized and auditable digital data continues to grow in terms of regulatory compliance and sustainability reporting. In light of all these developments, it is evident that storage is evolving into a more strategic

and digitized control area within feed safety and quality management.

Storage Facilities – Intelligent Nodes within a Digital Ecosystem

Supporting this transformation in storage, Symaga CEO Garrido outlines several key areas where they foresee evolution in the coming period:

- **AI-driven predictive analytics:** Systems capable of analyzing historical and real-time data to forecast risk scenarios before they materialize.
- **Fully integrated supply chain visibility:** Storage data connected to procurement, production planning, and distribution platforms.
- **Advanced automation:** Minimal human intervention in aeration control, discharge sequencing, and quality alerts.
- **Stronger regulatory integration:** Automated compliance reporting aligned with evolving food and feed safety standards.

Garrido concludes his statement with these words: “In the near future, storage facilities will operate as intelligent nodes within a digital ecosystem. Artificial intelligence will not replace human expertise, but it will enhance decision-making accuracy and speed. For companies willing to invest in resilient infrastructure and digital integration, storage will no longer be a vulnerability — it will become a strategic advantage.”



THE IMPACT OF DRINKING WATER QUALITY ON PRODUCTIVITY IN PIGS AND POULTRY

Annie Metcalfe

*Monogastric Technical Sales Manager
Azelis UK*

Among the many factors influencing productivity in pigs and poultry, drinking water quality remains one of the most overlooked yet crucial elements. Encouragingly, the livestock industry is increasingly recognising the vital role that clean, high-quality water plays in supporting the health and performance of all farmed species.

The quality of water available exerts a significant effect on animal health and performance on any pig and poultry production unit. Productivity and profitability – not to mention animal welfare – can all be adversely impacted if a plentiful supply of clean, fresh water is not available.

Farmed livestock typically consume at least twice as much water as feed. Drinking water quality is vital for poultry because, as with humans, around 70% of the bird's body is made up of water and it is an essential nutrient for biological functions. Moreover, farm animals tend to decrease feed intake during stress or challenging situations, but they keep drinking water, which also makes the water a tool to address certain challenges. In most species, reduced water intake is directly linked to a reduction in feed consumption and production. Quality matters too.

Good water facilitates metabolic processes, chemical reactions, temperature regulation and waste product removal from any animal's body. Better water quality also facilitates improved effectiveness of drinking water vaccines, simply because the cleaner

the water, the fewer competing bacteria around to limit vaccine efficacy.

Poor water quality often leads to disease, reproductive issues and mortality – particularly in younger animals – so it is vital to test and improve any water supply destined for livestock consumption.

HOW DOES WATER BECOME CONTAMINATED?

Water can easily become contaminated on any farm. For example, hot weather can heat up the water supply and this not only adversely impacts intake – because, as with humans, livestock tend to avoid drinking warm water – but warmer water is a better breeding ground for bacteria.

Water quality concerns often stem from a farm's water source, particularly wells or boreholes. Often, leaching mineral ions from the land into the water can increase a water supply's salinity. Different animals have different tolerances for salty water, so keep checking the supply to ensure full compliance with the relevant animal health guidelines. One commonly overlooked example is the iron and sul-



phate content of drinking water. When these compounds attach to each other to form iron sulphate, this may contribute to the growth of *E. coli* and make it more resilient (Deumić *et al.*, 2025).

Contamination of the drinking water supply with potentially toxic debris can also be an issue on some production units. Debris such as animal faecal matter, sewage waste, or even dead birds and animal carcasses – somewhere in the water supply line – can result in low production, disease or even death. Pesticide runoff from arable land can also sometimes contaminate a farm's drinking water supply.

While most farms have a sanitisation system in place, many overlook the risk of recontamination from sources along the water lines post sanitisation.

Holding tanks or dead ends in pipes are optimal places for microbes to multiply and buildup to occur. Unmaintained waterlines can lead to the buildup of biofilm – a layer of microorganisms and organic matter that adheres to the inner surfaces of pipes and header tanks, often appearing as slime. The formation of biofilm can clog pipes and drinking nipples, restricting water flow and reducing water intake in pigs and poultry. Additionally, biofilm provides an ideal environment for harmful bacteria to thrive and multiply.

To prevent biofilm accumulation and ensure optimal water quality, drinking lines should be thoroughly flushed/cleaned before and after each production cycle and after medication/other additive use following a sanitisation programme to control and remove biofilm buildup. This helps prevent clogging of pipes and nipple drinkers and supports consistent water delivery.

HOW TO MAINTAIN WATER QUALITY?

Organic acids are now commonly used across the livestock industry – particularly within the pig and poultry sectors – to help maintain optimal water quality and gut health. Organic acids act as water acidifiers, helping to suppress biofilm formation within the supply line and so reduce the population of harmful bacteria that can potentially compromise animal performance, health, and food safety.

Organic acids can come in protected or free form. When added to drinking water, free organic acids are not only good at lowering the pH of the water, they are also effective at inhibiting pathogens in the water and upper gut when they dissociate to release their hydrogen ions. The site of dissociation depends on the type of organic acid: weaker acids can penetrate the cell walls of pathogenic bacteria. Once inside, the neutral internal pH of the bacteria triggers dissociation, lowering the cell's internal pH. The bacteria then expend energy attempting to remove the hydrogen ions to restore their internal pH. Over time, this energy depletion leads to bacterial cell death and prevents further replication. In contrast, stronger acids dissociate in the gut, reducing the gut pH and creating an inhospitable environment for many pathogens.

Organic acids are also available in both buffered and unbuffered forms, which affects the point at which they release hydrogen ions to exert their acidity. A combination of both buffered and unbuffered free organic acids is particularly important in drinking water, as this helps to steadily reduce and stabilise water pH, encouraging consistent water intake. Due to the various modes of dissociation

with different types of organic acids, water acidifier products which consist of a buffered and unbuffered free blend of organic acids, and at the correct concentrations work best for optimal performance.

THE BENEFITS OF USING ORGANIC ACIDS TO MAINTAIN WATER HYGIENE

Acidifying drinking water with organic acids improves water hygiene and provides the following benefits:

- Reduces biofilm formation and associated pathogen burden caused by species such as *E. coli* and *Salmonella*,

- Promotes growth of beneficial bacteria e.g. *Lactobacilli*,
- Encourages water and feed consumption,
- Supports digestion and gut health.

References

Deumić, S., El Sayed, A., Hsino, M., Glamočak, A., Crnčević, N., & Avdić, M. (2025). Investigating the Effect of Iron Salts on *E. coli* and *E. faecalis* Biofilm Formation in Water Distribution Pipelines. *Water*, 17(6), 886. <https://doi.org/10.3390/w17060886>

Water Acidification Options

Perstorp's the ProPhorce™ Water Solutions range consists of three products, all formulated with an optimal combination and high concentrations of both buffered and free organic acids.

Buffered organic acids do not dissociate as readily in the drinking water and therefore target the gut environment. This helps lower the pH of the small intestine, promoting the activity of beneficial bacteria such as *Lactobacillus*. In contrast, unbuffered organic acids dissociate in the drinking water to lower the water pH and aid water sanitisation. This combination ensures a steady and stabilised reduction of the water to an optimal pH of 4.

When organic acids dissociate, they form organic acid salts. These salts can be utilised by beneficial bacteria to produce gut-enhancing compounds such as butyric acid, which plays a key role in maintain-

ing tight junctions. Following dosing recommendations is essential to avoid underdosing and to make water lines less habitable for bacterial growth and biofilm formation.

Depending on individual farm needs, the ProPhorce™ Water Solutions range also includes organic acid blends enriched with additional additives, such as the essential oil cinnamaldehyde for further antimicrobial effects, and monoglycerides of butyric acid (butyrin) to further support gut health throughout the gastrointestinal tract.

Since animals consume at least twice as much water as feed – and tend to drink rather than eat when stressed or compromised by a health challenge – a fortified ProPhorce™ Water Solution provides a cost-effective option to maintain water hygiene and enhance bird performance.

About Annie Metcalf

Monogastric Technical Sales Manager for the UK at Azelis, Annie Metcalf specializes in nutritional solutions for pig and poultry production. Initially started her career as a pig nutritionist, Metcalf transitioned into this broader monogastric technical sales role with Azelis in Jan 2023. She completed a 'poultry feed, nutrition, and development' post graduate professional development at the University of Edinburgh in 2024

Working closely with feed manufacturers and producers, Metcalf delivers technically driven, practical strategies that optimise animal performance, gut health, and water quality management.

Annie Metcalf focuses on translating scientific insight into commercially viable applications for modern livestock systems.

GLOBAL MYCOTOXIN REVIEW GUIDES FEED MILLS AND FARMERS IN 2026



The 2025 Trouw Nutrition Global Mycotoxin Review provides feed mills and farmers with insights to safeguard feed quality and livestock performance in 2026. Dr. Swamy Haladi and Avinash Bhat highlight key contamination risks, predictive modeling, and mitigation strategies to help producers make informed decisions on raw material sourcing, storage, and feed formulation.

■ By Trouw Nutrition

Trouw Nutrition, Nutreco's livestock feed business, is sharing findings on the levels of mycotoxin contamination in 2025 feed ingredients, silage, and complete feeds. As climate change, global sourcing practices, and an ever-evolving mycotoxin landscape pose challenges to animal feed quality, livestock performance, and producers' businesses, these findings can inform critical decisions on the farm and at the feed mill.

A robust predictive model capable of assessing mycotoxin concentration levels globally and regionally analysed more than 120,000 samples from 47 countries. Farms and feed mills can use the data generated by the

model to bring more clarity and precision to strategies involving raw material sourcing, storage practices, mitigation efforts, and other critical decisions.

The most-detected mycotoxins included Deoxynivalenol (DON) and Zearalenone (ZEN), which were present in 57% and 62% of global samples, respectively. **Dr. Swamy Haladi, Global Category Manager for Mould and Mycotoxin Risk Management at Trouw Nutrition**, noted that it is unclear why the prevalence of ZEN is increasing. The increase could be a response to changes in climate and weather or an ongoing ingredient management issue. "In the last couple of years, there's been a significant increase in

ZEN contamination, even beyond the DON, and that is a bit of a concern,” Dr. Haladi said.

The mycotoxins found in the highest average concentrations include DON, at 583ppb, and fumonisins (FUM) at 961ppb, which also accounted for the highest maximum concentration. These numbers are most useful when considered in context with the vulnerability of different animal species and subspecies to various mycotoxins. “For sows, the 86ppb of ZEN could be a problem, while in the grow-finisher pigs, that might not be an issue, so you need to consider the animal you are feeding,” said Dr. Haladi.

CONSIDER SOURCING, SEASONALITY, AND SPECIES WHEN ASSESSING MYCOTOXIN RISK

Concentrations (amounts) of mycotoxins were similar between 2024 and 2025. However, concentrations tended to peak in different months for several mycotoxins. Livestock and feed producers should be aware of the regions from which feed ingredients are sourced.



Dr. Swamy Haladi

Many samples coming from countries in Asia tested high for levels of DON and ZEN, which are typically concerns in cooler climates. These levels highlight the importance of keeping an eye on the quality of imported raw materials.

Maize is just one source of mycotoxins that can contaminate feed. Other grains, byproducts, and protein meals contain different mycotoxins, which can increase the overall contamination level. When formulating diets, care needs to be paid to both

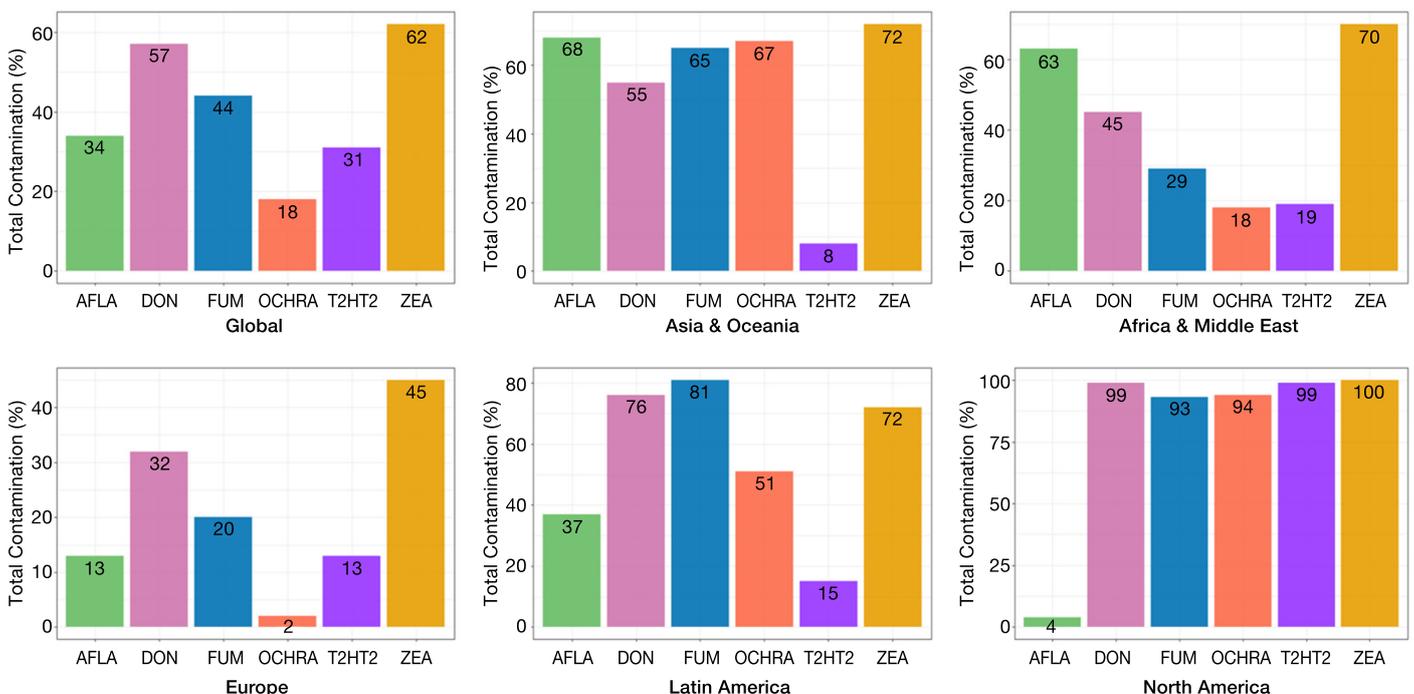


Figure 1. When crafting feeds from multiple ingredients, it can be important for producers to consider regional mycotoxin prevalence and the origins of any imported materials.



Avinash Bhat, MSc

which mycotoxins are likely to be present and the vulnerabilities of a specific species.

Analyses of broiler and laying hen diets highlighted a high feed risk potential from FUM and aflatoxin (AFLA). ZEN presented the largest risk factor for piglet diets, while FUM and AFLA were more of a challenge for sow and grow-finish pig feeds. In ruminants, ZEN and DON were a high risk for dairy calves, followed by AFLA and FUM. Dairy cows could face different challenges, with high risks from ZEN, T2/HT2, and DON in the total mixed ration, and DON and AFLA in concentrate feed.

Aquafeed samples had high risk levels for AFLA, FUM, and ZEN.

NEW MODEL FOR FORECASTING MYCOTOXIN PRESENCE, CONTAMINATION IN 2026

Avinash Bhat, MSc, Technical Specialist at MasterLab, noted that the dataset created by years of sample testing has allowed Trouw Nutrition to generate a new predictive model for mycotoxins. Globally, the system is designed to provide a predicted average contamination level and indicate a probable range of contamination.

For example, the predicted average for DON was 460ppb, with most of the contamination between 200ppb and 750ppb. Zearalenone results indicate an average of 73ppb, with about 95% of samples expected to contain the toxin at levels ranging from 50ppb to 150ppb.

The predictive system can also be used to focus on ingredients within a region. Results at those levels, however, could be influenced by limited historical data.

Q1 2026 Prediction for DON & ZEA

DON							
Month	Predicted Average (ppb)	90% CI (ppb)	% Probability Range of Contamination (ppb)				
			<250	250 to 750	>750 to 1500	>1500 to 3500	>3500
Jan 2026	464	402 - 580	0.0	100	0.0	0.0	0.0
Feb 2026	460	395 - 580	0.01	99.99	0.0	0.0	0.0
Mar 2026	464	402 - 580	0.0	100	0.0	0.0	0.0

ZEA							
Month	Predicted Average (ppb)	90% CI (ppb)	% Probability Range of Contamination (ppb)				
			<50	50 to 150	>150 to 250	>250 to 500	>500
Jan 2026	73.0	51.6 - 94.9	4.0	95.97	0.0	0.0	0.0
Feb 2026	73.0	50.0 - 94.9	4.6	95.40	0.0	0.0	0.0
Mar 2026	73.0	53.0 - 94.9	3.6	96.43	0.0	0.0	0.0

Figure 2. Like a weather forecast, the predictive model is most accurate in shorter windows, providing information on what contaminants may be lurking in feed ingredients.

Q1 2026 Mycotoxin Prediction by Country

Poland/Maize/DON

Month	Predicted Average (ppb)	90% CI (ppb)	% Probability Range of Contamination (ppb)				
			<250	250 to 750	>750 to 1500	>1500 to 3500	>3500
Jan 2026	828	152 - 1440	5.28	35.12	53.58	4.30	0.0
Feb 2026	1061	217 - 1408	1.09	18.25	69.21	11.28	0.0
Mar 2026	826	210 - 1355	4.01	36.46	56.01	2.64	0.0

France/Maize/ZEA

Month	Predicted Average (ppb)	90% CI (ppb)	% Probability Range of Contamination (ppb)				
			<50	50 to 150	>150 to 250	>250 to 500	>500
Jan 2026	533	8 - 1160	1.99	5.31	7.24	25.29	53.79
Feb 2026	735	56 - 1387	1.06	2.89	4.12	16.54	71.93
Mar 2026	503	109 - 989	1.52	4.83	7.87	32.35	50.43

Figure 3. Predictive models can provide a snapshot of regional challenges and help feed mixers plan mitigation efforts.

Results from the enhanced model can inform action plans for feed production in regions of concern. Early analysis in Poland suggests that DON will be present in most maize, while producers in France may consider steps to protect reproductive health in breeding herds and incorporate ZEN-targeted mitigation efforts into diets and management plans. In Latin America, FUM are the most common high intensity threat, while DON is predicted to be an industrial risk in the milling and ethanol sectors, which would influence DDGS contamination levels.

ADDRESSING EMERGING AND MASKED MYCOTOXINS

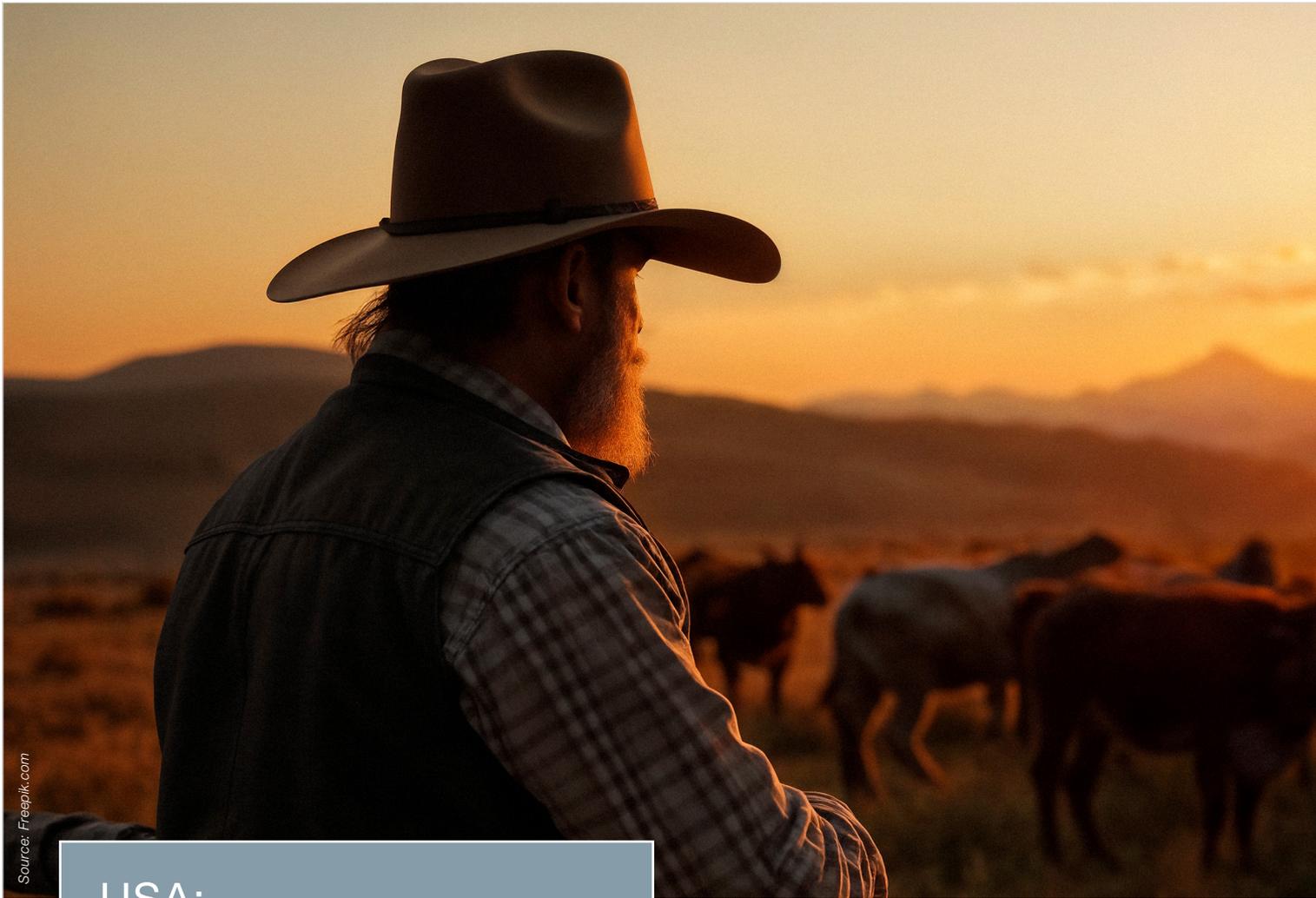
Emerging and masked mycotoxins remain a concern, and enniatins are gaining attention. As the most common emerging mycotoxin in some regions, enniatins have been detected in a range of feed ingredients including barley, oats, and wheat. Enniatins have been found to increase the toxicity of other mycotoxins, including DON and ZEN, even when other toxins are only present in low levels. It is possible enniatins could be responsible when animals have unexplained diarrhoea, or when pro-

ducers observe increases in FCR, declines in average daily gain, or issues with reproductive health, said Dr. Haladi. The TOXO-XL broad-spectrum mycotoxin mitigation product has been found to help manage enniatins and other emerging mycotoxins.

Overall, analyses, findings, and predictive modeling demonstrate the prevalence of mycotoxins and remind producers to be aware of threats in local feed ingredients as well as those imported. Research continues to demonstrate animal sensitivity to different mycotoxins, including new findings that highlight a negative response in poultry to feeds containing DON and FUM.

“Understanding the specific mycotoxin risks in your raw materials and finished feeds is essential. It enables producers to select the right mitigation strategies at the right time—protecting animal health, performance, and business outcomes,” said Dr. Haladi.

Both the English and Spanish recordings of the 2025 Global Mycotoxin Review are available by registering on [the Trouw Nutrition website](#).



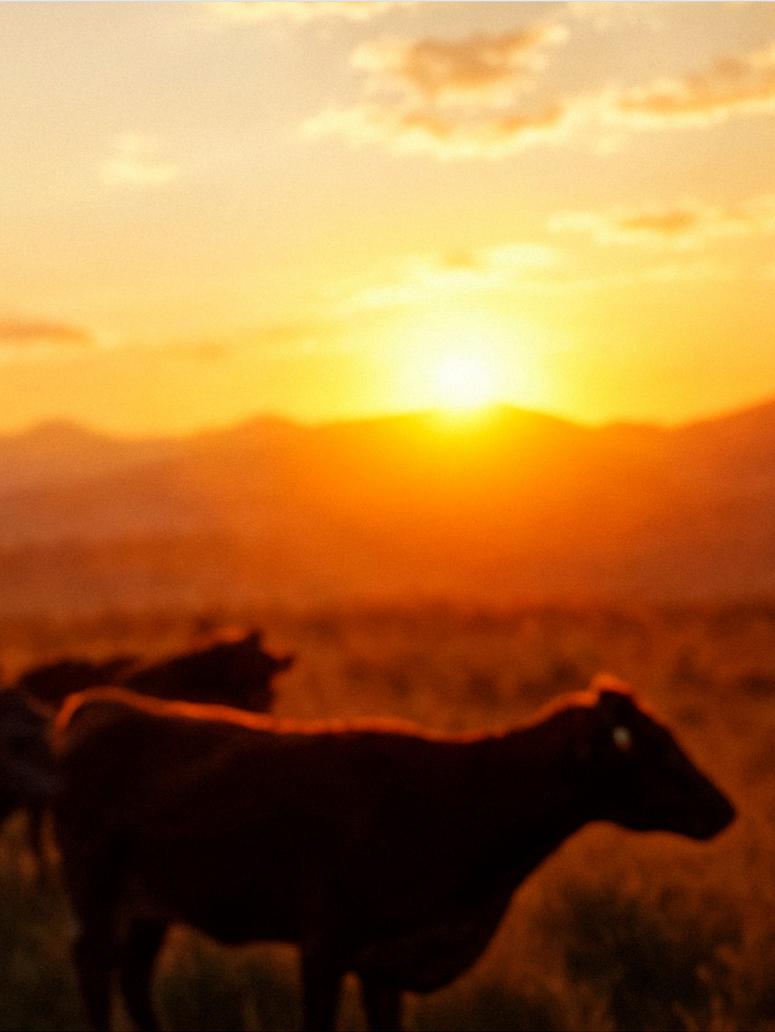
Source: Freepik.com

USA: Livestock and Feed Market Analysis

The United States is a global leader in the livestock and feed sectors in terms of technology, scale, and logistical efficiency. In the 2024-2026 period, total compound feed production reached 270 million tons, with productivity gains and ration optimization taking center stage in the cattle, poultry, and swine sectors. Soy and corn-based production, circular economy practices, and innovative feed additives strengthen the USA's strategic position in both the domestic market and exports.

By Derya Gulsoy Yildiz

The United States of America (USA) represents one of the most advanced ecosystems in the global livestock and feed industry in terms of technological innovation, production scale, and logistical efficiency. Data from the 2024–2026 period confirms that the U.S. livestock economy is not merely a food production mechanism, but a powerhouse at the center of vertical integration and digitalization, boasting a massive economic footprint of \$267.1 billion. The country is reinforcing its leadership in animal protein production and industrial feed technologies through productivity gains, circular economy practices, and the modernization of regulatory frameworks. With a total compound feed production vol-



ume reaching 270 million tons in 2024, the U.S. feed sector stands as a strategic actor that determines global commodity balances.

LIVESTOCK SECTOR AND ANIMAL PROTEIN CONSUMPTION

While the U.S. livestock sector has historically been centered on red meat, a shift in modern consumer preferences and economic factors has led to aggressive growth in poultry consumption. According to USDA reports, total red meat and poultry consumption is estimated to have reached 227.3 pounds (103.1 kg) per capita in 2025. This figure is projected to rise to 230 pounds (104.3 kg) in 2026. This level of demand has accelerated the transformation of the livestock sector from traditional family farms into technology-driven,

capital-intensive industrial complexes. Providing more than 80,000 direct jobs and contributing \$18.5 billion in annual tax revenue, the sector remains one of the primary drivers of rural development.

Beef and Dairy Sector: Historical Contraction and Price Pressure

The U.S. beef sector is undergoing one of the most critical phases of a biological contraction cycle during the 2024–2026 period. The decline of the U.S. cattle inventory to 86.2 million head at the beginning of 2026 indicates that the sector has continued to shrink for the seventh consecutive year. Rising input costs, driven by a reduction in pasture quality due to drought and limited feed capacity, are prompting producers to direct breeding females to slaughter. While this situation increases slaughter numbers in the short term, it leads to a reduction in herd size and causes a decline in beef production in the medium term. According to recent reports, total beef production in the country, which was 26,001 million pounds (approximately 11.79 million tons) in 2025, is projected to decrease to 25,920 million pounds (approximately 11.76 million tons) in 2026. On the consumption side, per capita beef consumption, which was 59.2 pounds (26.9 kg) in 2025, is expected to remain around 59.5 pounds (27 kg) in 2026.

The dairy sector exhibits a more technology-intensive and efficiency-oriented structure compared to the beef sector. The increase in milk yield per cow to 24,392 pounds (11,065 kg) in 2025 is a result of improved nutritional rations and herd management technologies. This yield is expected to reach 24,585 pounds (11,152 kg) in 2026. However, dairy farming operations are under significant margin pressure due to volatile milk prices and high interest rates. Current projections indicate that despite the decline in the number of dairy cows, the increase in yield per animal will drive total milk production from 231.5 billion pounds (approx. 105.0 million tons) in 2025 to 234.5 billion pounds (approx. 106.37 million tons) in 2026.

U.S. Red Meat and Poultry Forecasts

	Per capita disappearance, retail pounds 1/		Production, million pounds	
	2025	2026	2025	2026
Beef	59.2	59.5	26,001	25,920
Pork	49.3	50.5	27,577	28,275
Lamb and mutton	1.3	1.3	134	134
Broilers	102.9	103.8	48,003	48,500
Turkeys	13.2	13.4	4,844	4,965
Total red meat and poultry	227.3	230.0	107,093	108,363
Table eggs, million dozen	259.8	272.3	7,382	7,875

Source: USDA, ERS, Livestock, Dairy, and Poultry Outlook Reports, February 2026

Poultry and Egg Sector: The Dominant Force in the Market

The poultry sector is the most resilient and fastest-growing branch of U.S. livestock. Broiler (meat-type chicken) meat has become the "budget-friendly" protein choice for consumers due to price increases in beef. Broiler meat production, which was 48,003 million pounds (approx. 21.77 million tons) in 2025, is estimated to reach 48,500 million pounds (approx. 22.00 million tons) in 2026. On the consumption side, per capita broiler consumption—which hit a historical record of 102.9 pounds (46.7 kg) in 2025—is projected to climb further to 103.8 pounds (47.1 kg) in 2026.

In the layer industry, the U.S. poultry sector is contending with risks posed by Highly Pathogenic Avian Influenza (HPAI) outbreaks. Current estimates show that egg production dipped to 7,382 million dozen (approximately 88.6 billion units)

in 2025 due to disease pressure; however, modern facilities are beginning to absorb these shocks through biosecurity investments. Production is projected to rebound in 2026, reaching 7,875 million dozen (approximately 94.5 billion units). Annual per capita egg consumption in the country is estimated at approximately 260 units for 2025, representing a significant decline compared to previous years. Nevertheless, current forecasts indicate this figure will rise again in 2026, reaching 272 units.

Pork Sector

Standing out for its high biosecurity standards and level of integration, the U.S. pork sector maintains its production capacity through productivity gains. Although the breeding herd size has remained stable, total pork production rose by 3% in 2025 to reach 27,577 million pounds (approximately 12.51 million tons) due to increased yield per animal. This volume is projected to rise to 28,275 million pounds (approximately 12.82 million tons) in 2026. This productivity growth is supported by continuous improvements in the litter rate (number of piglets per litter). On the consumption side, per capita pork consumption reached 49.3 pounds (22.4 kg) in 2025 and is estimated to hit 50.5 pounds (22.9 kg) in 2026. Additionally, the country exports approximately 25% of its total pork production.

Dairy Forecasts

	2025	2026
Milk cows (thousands)	9,490	9,540
Milk per cow (pounds)	24,392	24,585
Milk production (billion pounds)	231.5	234.5

Source: USDA, ERS, Livestock, Dairy, and Poultry Outlook Reports, February 2026

Aquaculture Sector

Despite high consumption levels, the U.S. aquaculture sector is characterized by a heavy reliance on imports due to limited domestic production capacity. Current estimates indicate that 75–90% of seafood consumed in the U.S. is met through imports. While annual commercial fishing production reached approximately 8.4 billion pounds (3.8 million tons) in 2023, aquaculture production stands at around 688 million pounds (approximately 312,000 tons). Annual per capita seafood consumption was recorded at approximately 20.8 pounds (9.4 kg) in 2022. Nevertheless, the aquaculture sector stands out as a relatively small but one of the most technologically innovative segments of the U.S. agri-food system. Investments in high-value species (salmon, trout, bass, and shrimp), Recirculating Aquaculture Systems (RAS), precision feeding technologies, and sustainable feed ingredients—such as insect protein and algae oil—are enhancing the sector's long-term growth potential.

INDUSTRIAL FEED PRODUCTION AND CONSUMPTION IN THE USA

The United States is the world's second-largest producer of compound feed. According to the 2025 Alltech Agri-Food Outlook report, global compound feed production reached approximate-

ly 1.4 billion metric tons in 2024. North America accounted for 291 million metric tons (20.8%) of this global total. As the largest producer in the region, the US alone accounted for 270 million metric tons (approximately 92.8%) of this production, representing a slight increase of 0.68% compared to the previous year. This massive volume is the collective output of approximately 5,650 feed mills, supported by advanced logistical networks and an abundance of raw materials.

U.S. **ruminant feed** production represents approximately 41.6% of the country's total feed output. In 2024, out of the total ruminant feed production of around 112 million metric tons, the largest portion—approximately 71 million metric tons—was attributed to beef feed. During the same period, the total amount of dairy feed produced in the country was approximately 42 million metric tons.

The production within the U.S. ruminant feed segment is supported by modern feed optimization technologies and nutritional programs that enhance animal performance. Through feed quality control and ration optimization, farms aim for maximum performance in both growth and milk yield. Furthermore, sustainability trends are gaining prominence in the sector; some producers are implement-





ing circular economy practices by increasing the use of by-products and upcycled ingredients.

In 2024, **poultry feed** production reached approximately 72 million tons, representing the second-largest segment and accounting for 26.7% of total compound feed production in the USA. Within the poultry category, broiler feed production stood at approximately 57 million metric tons in 2024, corresponding to 21% of the country's total compound feed output. During the same period, layer feed (egg production feed) reached approximately 15 million metric tons.

The poultry sector in the U.S. stands out with

Total Feed Production for USA	
Feed Type	Production*
Beef	70,51
Broiler	56,57
Pig	56,18
Dairy	41,82
Layer	15,32
Pet	10,59
Equine	4,85
Aqua	0,56

Source: Alltech Agri-Food Outlook 2025, Map
*All numbers are in million metric tons

its intensive vertical integration and automation. Production facilities manage almost every stage of the production process—from feed manufacturing to grow-out—under a single organizational umbrella. This structure allows for rations to be optimized on a weekly basis, significantly improving feed conversion efficiency. Furthermore, modern facilities utilize substantial biosecurity investments and control systems to minimize disease risks. This segment possesses rapid growth potential in both the broiler and layer sub-sectors and supports the industry's overall efficiency and sustainability goals.

In 2024, **pig feed** production reached 56 million metric tons, representing 20.8% of the total compound feed production in the USA. In this segment, productivity and production standards are of primary importance. Producers enhance animal performance per head by utilizing mixtures with high balance protein and energy balance. Furthermore, the sector maintains high biosecurity and hygiene standards, while initiatives for the use of sustainable ingredients are becoming more widespread. These practices contribute to supporting both growth and export potential.

The U.S. **pet food** sector, which produced approximately 11 million metric tons in 2024, stands out as the most profitable and resilient segment of the country's feed industry. Growth in this segment is

directly linked to the "humanization of pets" trend; consumers now demand functional nutrients, fresh/frozen ingredients, and premium products for their pets. Pet food manufacturers led the entire feed industry in sustainability in 2024 by utilizing more than 4.1 million tons of upcycled ingredients.

In the **aquafeed segment**, production volume remains quite limited. According to current reports, U.S. aquafeed production in 2024 totaled 560,000 tons, accounting for a very small fraction—approximately 0.2%—of total feed production. Despite its small volume, aquafeed is a segment that requires high nutrient density and specialized formulations. In the U.S., the nutrition of fish and crustacean species is managed through precision feeding technologies, supporting the farming of high-value species. Furthermore, the segment holds significant future growth potential through the use of sustainable ingredients (such as insect protein and algae oil) and Recirculating Aquaculture Systems (RAS).

On the consumption side, the most current data pertains to 2023. According to a comprehensive report published in 2025 by IFEEDER in partnership with AFIA and NARA, a total of 283.6 million tons of feed were consumed in the U.S. in 2023. Beef cattle feed took the lion's share of this consumption at 76.7 million tons, followed by broiler feed at 61.5 million tons, pig feed at 60.9 million tons, dairy feed at 48.7 million tons, and layer feed at 17.7 million tons.

STRUCTURAL SHIFTS IN FEED RAW MATERIALS AND THE "CIRCULAR" FUTURE

The raw material composition of the U.S. feed sector relies heavily on corn and soybean meal. However, the strategy to reduce soy inclusion is primarily driven by "resource efficiency" and "circular economy" goals. The sector is a global pioneer in transforming by-products from the human food industry into high-quality animal feed.

Corn and Energy Sources

Corn remains the unshakeable cornerstone of U.S. feed rations and serves as the primary energy source in diets. Additionally, Distillers Dried

Grains with Solubles (DDGS), a co-product of corn ethanol production, is heavily consumed to provide both energy and protein balance in rations.

The United States alone accounts for approximately 378.3 million tons—or 30.8%—of the global corn production, which reached 1.23 billion tons in the 2024/25 season. This production is expected to remain strong in the 2025/26 season, reaching 432.3 million tons, which is anticipated to keep feed prices under control.

Soybean Meal and Export Dynamics

The United States is one of the largest suppliers in the global soybean market. In the 2024/25 season, the U.S. accounted for 128.6 million metric tons—or 30.1%—of the 427.2 million metric tons produced globally. Regarding soybean meal, the U.S. produced 55.3 million metric tons (19.6%) of the 281.9 million metric ton global total during the same season. Projections for the 2025/26 season indicate a decline in soybean production but an underlying strength in soybean meal output. According to these forecasts, 2025/26 soybean production will reach 115.9 million metric tons, while soybean meal production is expected to reach 55.1 million metric tons.

Soybean meal, an indispensable part of domestic poultry and pig rations, is also a significant export item for the USA. In the 2024/25 season, the country exported 16.8 million metric tons of its production.

Circular Ingredients and the "Upcycling" Strategy

One of the most unique aspects of the U.S. feed industry is the integration of agricultural and industrial by-products into rations. Today, 37% of livestock feed and 50% of pet food consist of "circular" or upcycled ingredients. These ingredients encompass fruit and vegetable pulp, spent grains from the human food chain, and animal by-products. Rendered products (animal fats and protein meals) make a critical contribution to sustainability goals by reducing the carbon footprint by up to 50%. However, the past five years have seen a 25%

COUNTRY PROFILE

decrease in the share of animal protein meals in rations, indicating a shift toward diets more focused on plant-based proteins and synthetic amino acids.

THE FEED ADDITIVES MARKET IN THE USA

The U.S. feed additives market is growing rapidly as a critical field that bridges livestock productivity and sustainability. According to recent reports, the sector is expected to reach a volume of \$7.55 billion in 2026, with a particular shift toward natural and functional additives that replace Antibiotic Growth Promoters (AGPs). The most significant development accelerating this transition is the "Innovative FEED Act" regulation; this new legislation will shorten the approval processes for substances that influence the gut microbiome or reduce emissions, enabling the FDA to rapidly evaluate them as feed additives.

Trends in the sector are shifting toward functional additives and micro-nutrition solutions. Probiotics, enzymes, and optimized amino acids are being used more intensively in rations to both increase productivity and reduce environmental impact. Furthermore, artificial intelligence (AI) and data-driven systems ensure that these products are applied at the correct dose per animal and according to specific needs, thereby minimizing waste.

This integrated structure ensures that the U.S. feed additives market remains a leader not only in terms of scale but also in its capacity for technological and sustainability-focused innovation.

FEED MILLS AND PRODUCTION INFRASTRUCTURE

The U.S. feed industry, which includes approximately 5,650 feed mills, is built upon vertical integration and massive-scale facilities. In 2024, 38% of the total regional compound feed production—amounting to 110.8 million metric tons—was carried out by the 30 largest feed companies in North America. Notably, 27 of these top 30 companies are based in the United States.

Feed production facilities in the U.S. range from small-scale local mills to fully automated and digitally controlled mega-plants with annual capacities exceeding millions of tons. These large-scale facilities, concentrated primarily in the Midwest and the Southern states, play a critical role in corn and soy-based compound feed production. This infrastructure not only boosts production volume but also enables ration optimization, energy efficiency, and the minimization of logistical costs.

In terms of regional distribution, the states of Illinois, Iowa, Minnesota, Arkansas, and Georgia serve as the hubs with the highest production capacities. These facilities, each capable of producing around 5–10 million tons of compound feed annually, represent the strategic infrastructure that supports both U.S. feed exports and domestic supply security. Furthermore, modernization efforts in the industry have gained momentum through the renovation of previously small and inefficient plants, alongside the integration of energy-efficient equipment and eco-friendly processes.

THE TOP 10 FEED PRODUCERS IN THE U.S.

1. Cargill
2. Land O'Lakes
3. Tyson Foods
4. Wayne-Sanderson Farms
5. Alltech
6. Smithfield Foods
7. ADM Animal Nutrition
8. Koch Foods
9. Mountaire Farms
10. Perdue Farms



CONCLUSION AND FUTURE PROJECTIONS

The United States livestock and feed sector is navigating a period of "transition and efficiency" between 2024 and 2026. While the biological contraction in the beef sector triggers a search for higher efficiency in rations, the poultry and pig segments continue to serve as the market's primary engines of growth. The most significant transformation in the industry is the zootechnical nutritional revolution, which is gaining legal standing through the "Innovative FEED Act."

In the coming decade, the primary engine of growth in the U.S. feed market will shift from volume expansion toward "precision nutrition" and "low-carbon production." Key areas such as premiumization in pet food, AI-supported feeding technologies, and methane-reducing additives are emerging as the most attractive fields for global investors. As U.S. giants increase their economies of scale through strategic mergers, the sector will become more resilient to global commodity market uncertainties, strengthening the United States' position as the technological hub defining the future of animal protein production.

References:

1. *Alltech Agri-Food Outlook 2025*, <https://www.alltech.com/agri-food-outlook/results>
2. *Animal food state of the industry report released*, Feedstuffs, September 2025, <https://www.feedstuffs.com/agribusiness-news/animal-food-state-of-the-industry-report-released>
3. *United States cattle inventory down slightly*, USDA National Agricultural Statistics Service, <https://www.nass.usda.gov/Newsroom/2026/01-30-2026.php>
4. *Livestock and Poultry Outlook*, USDA, February 2026, <https://www.usda.gov/sites/default/files/documents/2026AOF-livestock-poultry-outlook.pdf>
5. *Livestock, Dairy, and Poultry Outlook: February 2026*, Economic Research Service - USDA, <https://ers.usda.gov/sites/default/files/laserfiche/outlooks/113844/LDP-M-380.pdf>
6. *North America Animal Feed Market - Forecasts from 2025 to 2030*, Market Research, December 2024, <https://www.marketresearch.com/Knowledge-Sourcing-Intelligence-LLP-v4221/North-America-Animal-Feed-Forecasts-40960851/>
7. *Aquaculture*, Economic Research Service - USDA, September 2025, <https://www.ers.usda.gov/topics/animal-products/aquaculture>
8. *Fisheries of the United States 2023*, February 2026, NOAA Fisheries Office of Science and Technology Fisheries Statistics Division, <https://s3.amazonaws.com/media.fisheries.noaa.gov/2026-02/FUS-2023-web.pdf>
9. *Animal Feed Consumption*, February 2025, The Institute for Feed Education and Research (IFEEDER), <https://www.afia.org/pub/?id=0e89a761-ca2e-f503-29dd-dc7ae4f2d3dc>
10. *2024-25 State of the U.S. Animal Food Industry Report*, AFIA, <https://www.afia.org/pub/?id=7698c5ead1ee-8271-f0be-3bafd924e12e>
11. *Pet Food Production and Ingredient Analysis*, IFEEDER, March 2025, <https://www.afia.org/pub/?id=acc22f76-f91e-ba27-3fdd-7cc941cb1c34>
12. *Grain: World Markets and Trade | USDA Foreign Agricultural Service*, February 2026, <https://www.fas.usda.gov/sites/default/files/2026-02/grain.pdf>
13. *Oilseeds: World Markets and Trade | USDA Foreign Agricultural Service*, February 2026, <https://www.fas.usda.gov/sites/default/files/2026-02/oilseeds.pdf>
14. *United States Feed Additives Market Size & Share Analysis - Growth Trends and Forecast (2026 - 2031)*, Mordor Intelligence, <https://www.mordorintelligence.com/industry-reports/us-feed-additives-market-industry>
15. *Congressman Langworthy Introduces Bill to Support American Farmers on National Agriculture Day*, March 2025, <https://langworthy.house.gov/media/press-releases/congressman-langworthy-introduces-bill-support-american-farmers-national>
16. *Special report: Top 20 US feed manufacturers*, Feed Strategy, January 2025, <https://www.feedstrategy.com/animal-feed-manufacturing/article/15711734/top-20-us-feed-manufacturers>
17. *United States Compound Feed Market Size & Share Analysis - Growth Trends & Forecasts (2025 - 2030)*, Mordor Intelligence, <https://www.mordorintelligence.com/industry-reports/united-states-compound-feed-market>
18. *2025 North American Top Feed Companies: 30 manufacturers reach 1 million metric tons of production volume*, Feed & Grain, February 2026, <https://www.feedandgrain.com/animal-feed-manufacturing/article/15773510/2025-north-american-top-feed-companies-30-manufacturers-reach-1-million-metric-tons-of-production-volume>

Vilomix accelerates global growth with record results

Danish Agro Group subsidiary Vilomix International Holding delivered another record financial statement in 2025. The premix and minerals company increased its turnover by 15% to EUR 590 million. This means that revenue has grown by almost 50% over the past five years. At the same time, operating profit (EBITDA) rose to EUR 49.4 million in 2025, which is the highest in the company's history and an improvement of EUR 10.2 million compared to the previous year.

“Vilomix has delivered a very strong result, which confirms both our strategic direction and the high level of professionalism within the organisation. This is the result of targeted efforts across the group and a clear focus on growth, quality, efficiency, and synergy effects,” says Henning Haahr, CEO of Danish Agro.

The strong financial performance is broadly based across the business and reflects both increased activity and significant market share gains across most markets and key product areas. This performance is also reflected in production, where the total tonnage produced at the group's factories grew by 13% in 2025.



Building on the significant growth of recent years, Vilomix launched the Feed Forward group strategy at the end of 2024, which aims to ensure continued significant growth in the coming years. A key element of the strategy is to strengthen Vilomix's position in selected international growth markets where the group has already achieved strong results. This applies, in particular, to Poland, Spain, Brazil and Paraguay. These initiatives were launched in 2025, and in 2026, further investments are expected in these markets, where the South American activities are the newest in the group.

[Read more>>](#)

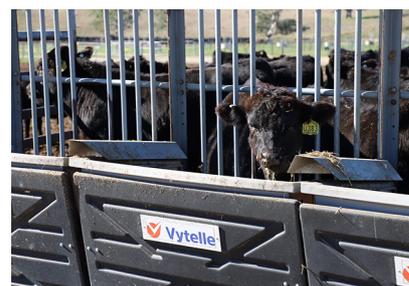
Vytelle launches integrated, low-cost methane monitoring for cattle producers

Data-enabled cattle biotechnology company Vytelle announced the commercial launch of Vytelle SENSE™ Methane Powered by Integrity™, a methane phenotyping system designed to make individual-animal emissions monitoring economically viable while simultaneously measuring feed intake and efficiency. The technology was unveiled at the National Cattlemen's Beef Association CattleCon in Nashville.

The new system integrates methane sensors developed in partnership with Integrity Communications Solutions, Inc. into

existing Vytelle SENSE™ feed intake nodes. This allows producers to capture methane emissions and feed efficiency data concurrently, without additional labor or the need for voluntary animal participation. According to the company, the solution operates at a fraction of the cost of existing methane measurement technologies and can be retrofitted into current infrastructure.

“Cattle producers need cost-effective, scalable tools backed by robust data to navigate the sustainability landscape with confidence,” said Dr. Jason Osterstock,



Vytelle's Chief Science Officer. “Field trials of Vytelle SENSE Methane Powered by Integrity have delivered strong results, and we're rapidly expanding the Vytelle methane database to give producers the information they need to make profitable decisions.”

[Read more>>](#)

TFM expands South and Southeast Asia aquaculture cooperation

Thai Union Feedmill Public Company Limited (TFM), a leading Thai manufacturer and distributor of aquafeed and economical animal feed, strengthens its regional presence by signing a Memorandum of Understanding (MOU) with partners from Bangladesh. The collaboration aims to support technology transfer from Thailand's advanced aquaculture sector and enhance the global competitiveness of aquatic animal production in line with sustainable standards.

According to Peerasak Boonmechote, Chief Executive Officer of Thai Union Feedmill Public Company Limited (TFM), the company has been steadily expanding its regional footprint. Most recently, TFM entered into an MOU with Bangladeshi partners to jointly develop and advance the aquaculture industry, covering whiteleg shrimp, black tiger shrimp, giant freshwater prawn, and barramundi.



The signing ceremony was attended by H.E. Faiyaz Murshid Kazi, Ambassador of the People's Republic of Bangladesh to Thailand, alongside Syed Mahmudul Huq, Chairman of the Bangladesh Shrimp and Fish Foundation (BSFF), and Hathai Nantatong, Director – Feed Commercial, representing Thai Union Feedmill Public Company Limited.

[Read more>>](#)

Barentz adds probiotic solution to US dairy portfolio

Barentz, a leading global specialty ingredients solution provider, announced a new distribution partnership with NexGen Innovations, LLC. Under this agreement, Barentz will serve as the exclusive distributor of ProbiCon Pro™ for dairy cattle in the United States.

According to Barentz's statement, ProbiCon Pro™ provides dairy farmers with a proactive and innovative solution designed to help lower operation-wide digestive risk in growing and lactating dairy cattle, supporting overall herd health and productivity.

"We are very excited to work with NexGen Innovations to bring ProbiCon Pro™ to the dairy industry in the United States,"



said Dari Brown, Director of Sales and Technical Services, Animal Nutrition at Barentz. "ProbiCon Pro™ is a product that can positively impact dairy herd health and is backed by strong science and research. Using it on every cow, every day can benefit producers' bottom line."

The company notes that Probi-

con Pro™ is a highly researched, peer-reviewed organism (Lactobacillus salivarius L28) developed using modern approaches to probiotic pathogen control. Its viability protection technology supports extended shelf life and enables use across a broad range of dairy feeding applications.

[Read more>>](#)

Kerry joins GAPFA under new Affiliate Membership

The Global Alliance of Pet Food Associations (GAPFA) announced that Kerry has been approved as the Alliance's first Affiliate Member, following the recent introduction of GAPFA's new Affiliate Membership category. The appointment of Kerry as the inaugural Affiliate Member represents an important milestone for GAPFA and underscores the Alliance's commitment to strengthening collaboration across the global pet food value chain. The Affiliate Membership category was created to engage organizations that provide essential expertise, ingredients, and

services supporting the pet food sector worldwide.

"Kerry's approval as GAPFA's first Affiliate Member marks a significant step in broadening our global community," said Loretta Hunter, President of GAPFA. "Their expertise will support our collective efforts to advance GAPFA's vision to improve the health and wellbeing of pets globally through access to safe, nutritious and sustainable pet food."

Commenting on the announcement, David Corley, Global Director, Regulatory Affairs at Kerry, said: "Thank you very much for your warm welcoming



Photo: Freepik.com

of Kerry as an Affiliate Member to GAPFA. We look forward to contributing to GAPFA and its trade-facilitating, science-based international standards."

Affiliate Members do not hold voting rights or Board representation, and GAPFA activities remain strictly non-commercial.

[Read more>>](#)

ALCIVIA sells agronomy unit to focus on feed, energy, and grain

ALCIVIA announced the sale of its agronomy business unit, a strategic move that strengthens the cooperative's financial position and enables increased investment and growth in its core businesses of animal nutrition/feed, energy, and grain.

"This decision underscores our commitment to long term strength and member value," said Rodney Balvitsch, President and CEO of ALCIVIA. "By focusing our resources on animal nutrition, energy, and grain—where we consistently excel—we can accelerate investment, enhance service, and expand opportunities for our members and employees."

As part of the transaction, Ag Partners has assumed ALCIVIA's north region agronomy operations (Durand, New Richmond, Osseo) effective December 16, 2025, while United Cooperative has assumed the south region agronomy operations (Evansville, Genoa City, Markesan, Union Grove) effective February 23, 2026.

ALCIVIA, Ag Partners, and United Cooperative have coordinated detailed transition plans to ensure no service gaps for agronomy patrons. Existing contracts



and quotes will be honored, and prepaid agronomy dollars previously remitted to ALCIVIA have transitioned to the acquiring cooperatives. Members can continue working with their current sales agronomists, with account representation evolving as Ag Partners and United Cooperative optimize service coverage.

For the north region, all affected ALCIVIA agronomy employees received employment offers from Ag Partners or moved to other ALCIVIA roles, resulting in no layoffs associated with the transaction. In the south region, United Cooperative is engaging impacted employees, with a majority expected to receive offers.

[Read more>>](#)

Representatives of the insect sector join forces

The UK Edible Insect Association (UKEIA) and the International Platform of Insects for Food and Feed (IPIFF) agreed in principle to establish a formal strategic partnership aimed at strengthening international coordination across the insect sector. Together, the two organisations represent more than 100 industry players operating across over 15 countries, spanning applications in insects for food, feed, fertiliser, and the wider circular economy.

According to a statement, the partnership will prioritise: Align-

ment of core sector messaging and international communications; coordination of global industry events to maximise participation and visibility; exchange of best practices across production, sustainability, and market development; Cooperation on science-based, proportionate, and innovation-enabling regulatory engagement.

As regulatory frameworks continue to evolve globally, both organisations underline the importance of coordinated leadership among regional industry bodies to ensure clarity, credibility, and



long-term investor confidence. The collaboration reflects a shared commitment to responsible growth, scientific integrity, and pragmatic policy engagement, while fully preserving each organisation's autonomy and governance independence.

[Read more>>](#)

Bounty Plus expands Aviagen partnership with Ross genetics

Aviagen® Asia Pacific announced that Bounty Plus Inc. has entered into a new supply agreement to become the authorized distributor of Ross® genetic stock in the Philippines, marking a significant evolution in the long-standing relationship between the two companies.

For nearly 15 years, Bounty has collaborated closely with Aviagen through the distribution and internal use of Indian River® Parent Stock and broilers. While Indian River initially supplied a modest portion of Bounty's total requirements, confidence in the breed grew rapidly as Bounty and its customers gained experience with its performance. In recent years, Indian River has become the majority breed used within Bounty's integrated operations and client network. Bounty will continue to distribute Indian River in the Philippines.

According to the statement from Aviagen, the continued collaboration has given Bounty leadership's deep insight into Aviagen's balanced breeding philosophy and its focus on performance, welfare, and sustainability – priorities that align closely with



Bounty's own direction. Bounty has also gained first-hand exposure to the Ross 308 through its New Zealand subsidiary, Tegel Foods Ltd, which is a long-time Ross user known for delivering some of the best broiler performance globally, while maintaining excellent welfare outcomes.

Larry Blackstone, Ross Brand Manager for Asia Pacific, added, "Ross has a new home in the Philippines now, and we couldn't be more pleased to be strengthening our partnership with Bounty."

[Read more>>](#)

Bühler demonstrates resilience amid global uncertainty

Bühler demonstrated its reliability and strength as a trusted partner for its stakeholders in 2025. Thanks to its broad and innovative product portfolio, global footprint, and strong supply chain, Bühler expanded into new markets and grew its market share in key sectors. In a challenging global climate for investment goods, order intake in local currencies was stable. Turnover decreased, reflecting the low order intake in the prior year. Through strong cost discipline and a focus on internal productivity gains, the company was able to increase its EBIT margin to 8.0% (prior year: 7.6%). This enables Bühler to continue to invest in innovative solutions for customers.

In a climate of high uncertainty, Bühler seized growth opportunities in various regions and grew its market share in key sectors. “We demonstrated resilience and strength to continuously innovate for our customers and invest in future growth,” says Stefan Scheiber, CEO up to the end of 2025 and Chairman of the Board.

“We largely offset negative business effects thanks to our global setup, strong supply chain network, and strong customer orientation. Our business has proven it can withstand challenging market conditions. We are grateful for our customers’ trust and confidence in our solutions and services. I am very proud and thankful for what our employees have achieved this

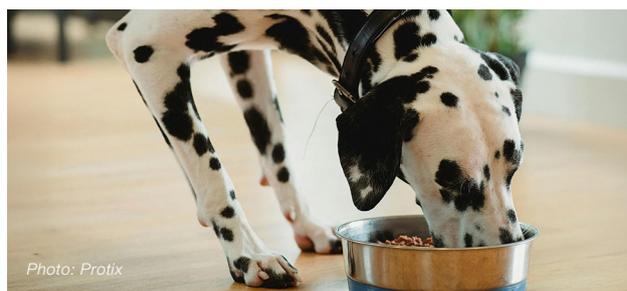


year. Our company is built on remarkable talent, and we will continue to invest in our culture of lifelong learning to anticipate and shape the future of our industry,” Stefan Scheiber adds. He also points out how Bühler successfully managed transitions at the Board level, ensuring continuity, renewal, and long-term business success as a strong and independent family enterprise.

[Read more>>](#)

New study highlights dogs’ positive response to insect-based diets

Protix, a leading company in insect ingredients for pet food, aquaculture and livestock feed, drew attention to the effects of insect-based ingredients on pet food flavor and shared the results of a new study. According to the statement, the study has shown that dogs fed a wet diet containing PureeX insect meat and ProteinX insect meal responded positively, with wagging tails, lip-licking, and empty dishes. The research demonstrated that two different diets with the PureeX/ProteinX combination were highly accepted and readily consumed by dogs, indicating excellent palatability. The study also investigated dog owners’ perceptions of the insect-based wet food, concluding that they rated the texture, aroma, and appearance of the food highly. The company noted that in addition to being highly palatable to dogs and appealing to owners, insect ingredients are increasingly recognised for their functional benefits. They thus offer an innovative option



for pet food manufacturers aiming to provide health and wellbeing advantages in tasty products.

The objectives of the study were to assess the dogs’ acceptance of wet food with a substantial inclusion of PureeX, Protix’s fresh insect meat, and to gather pet owners’ opinions of the food. The study involved 170 privately owned small and medium-sized dogs fed two different diets. These sizes were selected because dogs of this stature tend to be pickier eaters.

[Read more>>](#)

CH4 Global honoured for cutting cattle methane emissions

CH4 Global won two international awards recognising business sustainability and the impacts being made with its proprietary Methane Tamer feed supplement, which the company says can reduce methane emissions from cows by up to 90 per cent.

Announced in the US, the SEAL (Sustainability, Environmental Achievement and Leadership) Awards recognise the 50 most sustainable companies in the world and the most impactful and innovative environmental initiatives, while also funding research and environmental impact campaigns.

CH4 Global won both the SEAL Environmental Initiative Award for its role in reducing

global methane emissions, and the SEAL Sustainable Product Award, for the production of Methane Tamer. The SEAL Environmental Initiative Award honours specific environmental and sustainability initiatives, recognising the efforts CH4 Global has taken to establish the world's first EcoPark, on Eyre Peninsula, to grow Asparagopsis. When dried and formulated into Methane Tamer and fed to cattle, it significantly reduces the methane emissions in their burps.

CH4 Global Founder and CEO Steve Meller said that it was an honour to be recognised internationally for the years of effort taken to build a new seaweed industry in South Australia, which was work-



ing towards reducing greenhouse gas emissions at a global level.

“It’s rewarding to be recognised for our efforts to bend the climate curve, alongside other major international organisations taking steps to change, whether it be embedding circular economy principles into their activities, recycling plastics, reducing carbon footprints or building living sea walls,” stated Meller.

[Read more>>](#)

Certified Argentine soy enters Vietnam feed sector via COFCO

COFCO International delivered its first shipment of soy certified under the COFCO Responsible Agriculture Standard to Vietnam, marking the introduction of certified South American supply into one of Southeast Asia’s fastest-growing feed markets. The cargo also represents the first export of COFCO Responsible Agriculture Standard-certified soy or soymeal from Argentina to any international destination.

The shipment originated from COFCO International’s operations in Argentina and was transported by MV El Juniper to Phu My Port near Ho Chi Minh City. It follows recent certified deliveries by COFCO International to Asian markets including China, Thailand, and Bangladesh.

Sold to a leading Vietnamese supplier of animal feed ingredients, the cargo will support Vietnam’s export-oriented poultry and aquaculture sectors, where traceability and sustainability standards are increasingly linked to market access and global customer requirements.



“Vietnam’s feed industry is closely connected to global markets where sustainability and traceability are increasingly important,” said Vu Chanh Ly, Commercial Director Vietnam at COFCO International. “This shipment demonstrates that competitively sourced South American soy can meet robust, independently recognised sustainability standards at scale, supporting customers’ export competitiveness.”

[Read more>>](#)

New Denkavit-AGRAVIS venture targets German calf nutrition sector

Denkavit and AGRAVIS Raiffeisen AG announced plans to combine their expertise in calf milk replacers through a new joint venture in Germany. The partnership between Denkavit Futtermittel GmbH and AGRAVIS Nutztier GmbH is scheduled to launch on 1 June 2026, subject to approval by the German Federal Cartel Office. Under the name Denkavit MILCH plus, the new company will assume nationwide responsibility for the sales of milk replacers for calf rearing, including feeder and rosé calves, supplying agricultural trade partners across Germany.

“We aim to further professionalise our activities in this demanding market by specializing in the segment of rearing calves and feeders,” emphasises Henk Botter, Commercial Director at Denkavit, and Bernd Schmitz, Managing Director of AGRAVIS Nutztier GmbH.

Both partners bring extensive experience in milk replacers. Denkavit contributes its strong European position in young animal nutrition, modern research capabilities, innovative product development



under the Denkamilk brand, established market partnerships, and efficient production structures. AGRAVIS complements this with a strong sales network, its well-known brands Combimilk, Blattina, and Multana, close links to the agricultural trade, and comprehensive logistics capabilities.

According to both partners, this combination will enable targeted market development with a clear focus on the needs of German agriculture. A powerful team will be able to further strengthen the consulting and support provided to trading partners and farmers.

[Read more>>](#)

Alltech Spain ranks in top 2% with EcoVadis Gold

Alltech Spain was awarded a Gold Medal from EcoVadis, the leading provider of business sustainability ratings, with an overall result of 85 out of 100 — putting the office in the 98th percentile of all companies assessed.

“This means our performance in Spain places us in the top 2% of companies globally, across all industries,” said Tara McCarthy, Alltech’s Global Vice President of ESG. “Four years ago, Alltech outlined a strategic vision for our ESG ambitions with a focus on proof points and team confidence. Over that time, we’ve ex-

panded our policies, introduced new systems, conducted training and partnered with our value chain — in short, we’ve taken a lot of action. It gives a great sense of achievement to the entire Alltech team to see that EcoVadis has recognized these efforts.”

That achievement was even more impressive than usual this year, as the competitive landscape was especially strong. The companies assessed in the current 12-month cycle achieved higher average results than in prior years, making percentile positioning even more demanding than usual. According to the company,



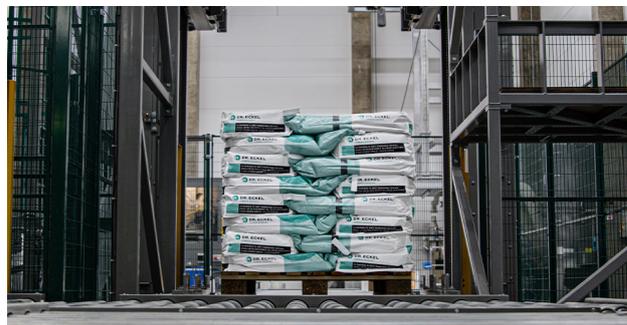
achieving this recognition in a more competitive benchmarking environment reflects the powerful performance of Alltech Spain over the past year and is a testament to the team’s disciplined work and commitment to sustainability.

[Read more>>](#)

Dr. Eckel strengthens supply reliability with new bagging line

Dr. Eckel Animal Nutrition, a German family-owned producer of innovative feed additives, put a new filling and packaging line into operation at its Niedertzissen (Germany) site. In addition to the installation itself, the investment also includes the associated IT infrastructure. Together, these measures increase capacity, improve internal processes and ensure reliable supply for customers in both national and international markets. At the same time, the company underlines its commitment to developing a modern, future-oriented production site and to setting new standards in excellence and quality.

The company notes that the smooth transition to the new line was made possible above all by the strong commitment of the production staff and the entire project team. Project Manager Ingrid Bauschinger draws a consistently positive conclusion: “In recent weeks, we were finally able to see with our own eyes what we had prepared over more than two years. This was made possible by everyone involved, from product development to quality management.”



Managing Director Dr. Victor Eckel already considers the new line a success: “With this investment, we are ideally positioned to meet growing demand in our customer markets. I am extremely proud of our team for implementing this important future project with such care, reliability and commitment.”

For Head of Operations Waldemar Berg, dismantling the old line marked the most challenging phase of the project. “It is quite a moment when everything in production is shut down and complete silence sets in,” he says.

[Read more>>](#)

IFFO Members’ Meeting returns to Madrid in 2026

IFFO – The Marine Ingredients Organisation announced that its 2026 Members’ Meeting will take place 27–29 April 2026 in Madrid, Spain, marking the second consecutive year that the Spanish capital hosts this flagship gathering of the global marine ingredients value chain.

The meeting will bring together industry leaders from across the world to discuss the latest developments related to marine ingre-

dients, market trends, sustainability challenges, innovation, and global supply dynamics.

“Bringing the Members’ Meeting back to Madrid reflects the overwhelmingly positive feedback from last year’s event and underlines the city’s strategic role as a hub for our global community. In 2026, we will again gather industry stakeholders to exchange knowledge, address shared challenges, and explore the future of



marine ingredients with a forward-looking mindset,” says Petter Martin Johannessen, Director General at IFFO.

[Read more>>](#)

JBS boosts Saudi operations to build global Halal hub

JBS, one of the world's largest food companies, announced a major expansion of its manufacturing facility in the Kingdom of Saudi Arabia, reinforcing its long-term commitment to the local market and its strategy to develop the country as a halal production center. With an investment of US\$ 85 million, the facility expansion will double production capacity by the end of 2026 and support Saudi Arabia's positioning as a global halal export hub serving the Middle East, Southeast Asia, and other international markets.

Covering the company's operations in Jeddah and Dammam, the expansion includes a strategic partnership with the Arabian Compa-

ny for Agricultural and Industrial Investment (Entaj) to launch a line of whole chickens and other poultry cuts in Saudi Arabia. This new step is considered a key milestone in JBS's growth strategy. JBS operates locally through Seara, with manufacturing, distribution, and sales activities serving retail, food-service, and wholesale customers across the country.

"Saudi Arabia is a priority growth market for Seara, and this expansion reflects our long-term commitment to the Kingdom and the wider MENA region," said Gilberto Tomazoni, Global CEO of JBS. "By investing in local production in Jeddah, we are strengthening food security, expanding halal ca-



capacity, and supporting Vision 2030 through resilient supply chains and local talent development."

"The expansion and the partnership we announced today with Arabian Company for Agricultural and Industrial Investment (ENTAJ) are strategic steps in strengthening JBS's global production and supply network," said João Campos, CEO of Seara.

[Read more>>](#)

Haid Group invests in Singapore to support livestock and aquaculture growth

Haid Group launched its new production and R&D facility in Singapore — Haid Singapore — reinforcing its commitment to serving Southeast Asia's modern livestock and aquaculture industries. The establishment of this facility is described as a key step in Haid's global expansion. Supported by the Singapore Economic Development Board (EDB), the new facility is expected to contribute significantly to regional food security, agricultural technology advancement, and precision animal nutrition.

According to a statement, Haid Singapore will embark on three key missions: Act as a bridgehead for technology transfer, adapting Haid's latest R&D achievements for products and processes suited to Southeast Asian markets. Set a quality benchmark by implementing full traceability from sourcing to production, meeting stringent international safety and quality standards. Build a collaborative ecosystem by establishing long-term partnerships with suppliers



and stakeholders across Singapore and the Asia-Pacific region, driving sustainable industry growth.

"Singapore's outstanding business environment, robust legal framework, rich talent pool, and global connectivity align seamlessly with Haid Group's vision of globalisation, professionalism, and high quality." said Dr. Qian Xueqiao, Vice President of Haid Group.

[Read more>>](#)

Tebrio raises B Corp score by 11 points

Tebrio, a pioneering Spanish biotechnology company specializing in the comprehensive utilization of the *Tenebrio molitor* insect to produce sustainable natural ingredients, achieved its B Corp recertification after successfully completing the rigorous social, environmental, and governance impact assessment conducted by the international organization B Lab.

According to Tebrio, with this recognition, the company solidifies its position within a global community of 10,000 companies

that meet high standards of social and environmental impact and share a common purpose: harnessing the power of business to drive positive change in the world. It has done so by exceeding its initial 2022 certification score by 11 points, reaching 96.1 points, more than 15 points above the 80 required for certification.

During this process, B Lab particularly recognized the company's responsible governance, commitment to the circular economy, ethical resource management, and contribution to social and eco-



conomic development in rural areas. Since its first certification in 2022, Tebrio has continued to advance in integrating people-focused well-being policies, environmental efficiency, and transparency across its entire value chain.

[Read more>>](#)

FEFAC confirms speakers for 31st Congress in Bucharest

FEFAC, the European Feed Manufacturers' Federation, confirmed the high-level speaker line up for the 31st FEFAC Congress, taking place on 20 May 2026 in Bucharest, Romania. Co-hosted by ANFNC, the Romanian National Association of Compound Feed Manufacturers, the event runs back-to-back with the 13th ANFNC Annual Conference from May 19-21, offering high-level debate, innovation showcases, and site visits.

The events begin on 19 May with the 13th ANFNC Annual Conference, FEED & FORESIGHT 2026 – Vision and Innovation Driving the Future of the Sustainable Feed and Meat Industry in Europe. The day will conclude with a Welcome Reception and Festive Dinner at the Romanian Athenaeum, a landmark UNESCO Heritage concert hall in Bucharest dating back to the late 19th century. This informal evening will provide delegates with valuable networking opportunities with policymakers, researchers, and industry leaders.

On 20 May, the 31st FEFAC Congress will address the central theme: “European livestock sector – QUO VADIS? Outlook to EU livestock and



feed production in the Circular Bioeconomy.” EU policymakers, industry leaders, and international experts will explore the challenges and opportunities on how to maintain competitiveness and resilience while delivering on sustainability and circularity ambitions via innovative feed solutions. The event precedes the EU's anticipated report on the long-term livestock strategy, which aims to enhance the competitiveness and resilience of the EU livestock sector while reducing its climate footprint.

[Read more>>](#)

ForFarmers expands Polish poultry footprint through new joint venture

ForFarmers and KPS signed an agreement to form a joint venture in which ForFarmers will have a 50.5% majority share. The current owners of KPS, who are also the co-shareholders in Tasomix, will hold the other 49.5% stake. This joint venture will incorporate KPS's poultry farms and slaughtering and food processing activities, as well as all of Tasomix's feed activities. The transaction is subject to approval by the Polish competition authority and the shareholders of ForFarmers.

ForFarmers states that this step is in line with its strategy to strengthen its market position in the growing Polish poultry sector and to further develop value chain integration. Tasomix and KPS have a long standing track record of effective collaboration. The intensified cooperation will continue in this joint venture under the name ForFarmers Polska, under which both the Tasomix and KPS brand names will continue to exist. ForFarmers will fully consolidate the joint venture.

“In the markets in which we operate, value chain integration is more and more important for a future-proof



poultry sector. I am therefore very optimistic about this strategically important step for ForFarmers,” said Pieter Wolleswinkel, CEO of ForFarmers. “The combination of Tasomix and one of Poland's most modern poultry processing companies enables us to consolidate our strengths into an integrated organisation, capable of responding effectively to market demands. This new joint venture enables us to strengthen our position in the Polish poultry market and benefit from the growth opportunities in Poland.”

[Read more>>](#)

Aquafeed shifts reshape Europe's aquaculture footprint

The research, led by Björn Kok and Dr. Wesley Malcorps from the university's world-renowned Institute of Aquaculture, found that the lower inclusion of fishmeal and fish oil in aquafeed has dramatically reduced dependence on marine resources. However, it has also shown that the shift away from marine ingredients has had significant unintended consequences on the environmental footprint of European aquaculture.

Between 2000 and 2020, the European aquaculture industry reduced its overall use of wild caught fish as feed by 13%, even as the sec-

tor nearly doubled in size — largely driven by the expansion of Atlantic salmon farming in Norway. However, the new study suggests a substantial increase in overall impact was observed across several key environmental indicators: greenhouse gas emissions rose by 314%, land use by 594% and water consumption by 236%. Marine eutrophication, the build-up of excess nutrients that triggers harmful algal growth in water, also showed a significant rise of 630%, and freshwater eutrophication increased by 468%.

The pioneering study used Index Decomposition Analysis, a tech-



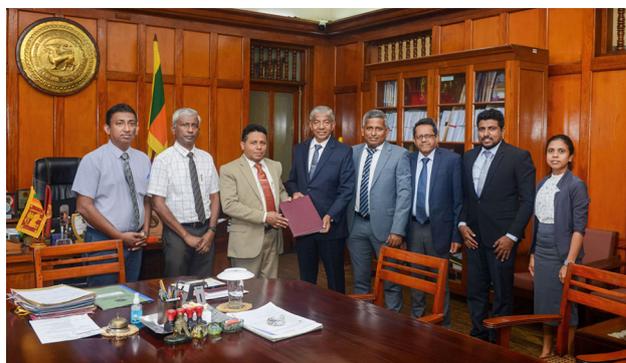
nique capable of separating the effects of different drivers, such as sector growth and efficiency gains, to the impact of individual ingredients within specific sub-sectors. This approach delivered an unprecedented breakdown of what is driving change across the entire European aquaculture industry.

[Read more>>](#)

Third-party verification program set for antibiotic-free chicken in Sri Lanka

The University of Peradeniya entered into a Memorandum of Understanding (MoU) with New Anthony's Farms (Pvt) Ltd., a next-generation poultry company, to establish a collaborative framework for third-party verification of chicken meat raised without antibiotics in Sri Lanka.

The collaboration will be implemented through the Food Safety and Quality Assurance Laboratory (FSQAL UPDN) of the Faculty of Veterinary Medicine and Animal Science, which is the only ISO/IEC 17025-accredited laboratory within the Sri Lankan university system. Under the MoU, FSQAL-UPDN will conduct testing of chicken meat samples produced by the company, in accordance with an agreed and established protocol, to verify the absence of antibiotic residues at different stages of broiler production. This will provide independent third-party verification of the company's claims and established procedures for raising broiler birds without the use of antibiotics, representing a major milestone in the Sri Lankan poultry industry.



The development of antimicrobial resistance (AMR) resulting from the extensive use of antibiotics for disease prevention and treatment in food-producing animals is a major global public health concern. Widely cited global estimates indicate that, if no urgent action is taken, antimicrobial resistance could account for up to 10 million deaths annually and result in economic losses of up to US\$ 100 trillion by 2050, underscoring the importance of responsible antibiotic use and robust verification mechanisms in food animal production systems.

[Read more>>](#)

JBS and Oman Food Capital partner to build global multiprotein export hub

JBS, a leading global food company, announced the creation of a new multiprotein production platform in Oman, covering beef, poultry and lamb, to serve as an export hub. With a total investment of US\$150 million, JBS acquired an 80% stake in a newly established food holding company that consolidates two production assets in the country. Oman Food Capital (OFC) will retain the remaining 20% stake. The initiative reinforces JBS's strategy of diversification by geography and protein and proximity

to key consumer markets.

Designed to serve the global halal market—currently encompassing an estimated 2 billion consumers worldwide—the joint venture will contribute to strengthening food security in Oman, in line with the Sultanate's Vision 2040, while positioning the country as a strategic platform for the production of halal food products for export to multiple markets.

The investment will be directed primarily toward completing A'Namaa's integrated poultry



plant, located in the Ibri region in northern Oman, approximately 380 kilometers west of Muscat (the nation's capital) and 280 kilometers south of Dubai, United Arab Emirates; and Al Bashayer's beef and lamb processing facility in Thumrait, in southern Oman.

[Read more>>](#)

Global aquaculture update: Strong demand amid uncertainty

Resilient demand continues to underpin prices across key species, even as tight supply conditions, shifting trade flows, and ongoing geopolitical uncertainty shape global seafood markets in early 2026, according to a new RaboResearch report.

Global seafood markets enter 2026 on a cautiously optimistic footing, as steady demand in key markets contrasts with a supply landscape shaped by shifting trade flows and lingering geopolitical uncertainty. “While inflation has eased in major economies, supporting demand, the industry still faces headwinds from macroeconomic uncertainty, evolving tariff

regimes, and climate related pressures,” says Novel Sharma, Seafood analyst at RaboResearch.

Global salmon output is expected to rise by just 0% to 2% in the first half of the year. Norway, the world’s largest producer, and Chile, the second largest, both enter 2026 with constrained biomass following strong late 2025 harvesting, according to Sharma. “The heavy harvesting at the end of 2025 really reduced biomass levels, so we’re only expecting very modest, low single digit growth in early 2026. That said, there is still some upside if biological conditions turn out as favorable as they were early last year. We’re already seeing tight-



er supply push prices higher, with a clear rebound underway in both Europe and the US. And despite the broader economic headwinds, global demand has held up remarkably well – salmon continues to offer great value for consumers across Europe, Asia, and Latin America,” he adds.

[Read more>>](#)

EFSA: High compliance in EU veterinary residue controls

According to the European Food Safety Authority (EFSA), its yearly report on residues of veterinary medicinal products in live animals and animal products shows continued high compliance with official limits in 2024. The EFSA review looks at the presence of authorised and banned pharmacologically active substances and their residues in food derived from animals, including meat (farmed and game), dairy products, eggs, and honey. The types of substances covered are hormones (including steroids), beta-agonists (muscle-soothers), antibacterials, anti-parasitic drugs, and insect repellents, among others.

The data in this year’s report, covering 2024, came from the EU Member States, plus Iceland and Norway. Overall, the percentage of non-compliant samples was 0.13% (629 of 493,664 samples), which is comparable to the previous year, when non-compliance was 0.11%

The report features a division of the samples under three plans:



- National risk-based control plan for production in the Member States - 0.16% non-compliance
- National randomised surveillance plan - 0.22% non-compliance
- National risk-based control plan for third-country imports - 0.2% non-compliance.

According to the 2025 Eurobarometer on food safety, ‘antibiotic, steroid or hormone residues in meat’ is one of the top food safety concerns for over one-third (36%) of EU citizens, albeit 3 percentage points less than in the previous survey in 2022.

[Read more>>](#)

Nuscience recognised again with Factory of the Future Award

Nuscience, part of the Royal Agrifirm Group, has received the Factory of the Future Award for the third time. This award recognises forward-looking companies that are preparing for the challenges of Industry 5.0 through seven key transformation areas: Advanced Manufacturing, Digital Factory, Eco Factory, Integrated Engineering, Human-Centered Organisation, Smart Factory and Networked Factory.

Based in Belgium, Nuscience develops and produces premixes, concentrates, mineral blends, young animal feeds and functional ingredients for pigs, poultry and cattle. With a strong focus on scientific expertise, innovation and sustainability, the company supports farmers and feed producers worldwide in improving animal health, performance, and efficiency.

The production site in Drogen plays a key role in this recognition. For years, the factory has been



an important hub within Royal Agrifirm Group's international operations. The company emphasizes that it is proud of the people who work there every day: colleagues from production, logistics, quality, maintenance, engineering, R&D and support services.

[Read more>>](#)



AGRILIVESTOCK & FEED TAIWAN

8 - 10 SEPTEMBER 2026 | TaiNEX 1, TAIPEI

CALL FOR EXHIBITORS! Are you involved in



Aquafeed & Additive



Pet Food & Health Care



Livestock Feed Additive



Precision Feeding Equipment



Feed Processing Equipment



Smart Livestock Environmental Control System



Book a Stand



About the Show

Expand Your Agribusiness in Taiwan

AgriLivestock & Feed Taiwan brings together livestock, aquaculture, feed and pet food stakeholders from across Asia — giving you the ideal platform to meet buyers, build partnerships and grow your market.



RaboResearch: Global pork markets take cautious growth path in 2026

RaboResearch published its updated Global Pork Quarterly Q1 2026 report. According to the latest report, global pork markets in 2026 are defined by tightening herds, shifting trade policies, and persistent disease pressures. The sow herd is likely to decline in 2026 as the industry works to rebalance supply and demand. China aims to cut the sow herd to address oversupply, targeting a reduction of 1m head by leading companies between September 2025 and January 2026. Combined with the reduction by medium-sized players, the Chinese sow herd is projected to decline to 39m head in 2026, down from 40.3m head in September 2025. In the US, sow rebuilding remains slow, given biosecurity challenges. The EU faces rising

pressures from ASF outbreaks in wild boars in Spain, from November 2025, and from China's anti-dumping duties, following only limited sow herd growth in 2025. The analysts from RaboResearch say: "We expect sufficient supply to keep prices subdued in 1H, with tighter supply in 2H supporting a price rebound. Across the globe, productivity improvement remains a key focus, as producers navigate ongoing challenges."

Trade is expected to remain volatile due to policy changes. According to the report, global pork trade showed an uneven performance in 2025, as Brazil recorded 12% export growth, while other key exporting countries, such as the US and Canada, saw single-digit declines. Into 2026, major import-



Photo: Manop Boonpeng / Shutterstock

ing countries, including China and Mexico, are adjusting import policies. Mexico will introduce import quota to non-FTA suppliers and launch anti-dumping and anti-subsidy investigations into US pork, while China imposes anti-dumping duties on EU pork imports. Japan and the Philippines, major importers, still ban Spanish pork due to ASF concerns. All these developments suggest trade volatility will continue in 2026.

[Read more>>](#)

Strategic alliance targets industrial-scale insect bioconversion

Nasekomo, a European biotechnology company specializing in industrial insect bioconversion systems, and Reinartz, a German mechanical engineering company with more than 170 years of experience in plant engineering and mechanical separation process technologies, signed a strategic partnership agreement to accelerate the industrial-scale deployment of insect bioconversion solutions worldwide.

The agreement sets the basis for a long-term technological and commercial collaboration focused on

scaling the industry through a bioconversion technology, developed by Nasekomo – Automated Insect Rearing Beds & Bots (AIR2B). The platform, an innovative technology inspired by vertical farms, redefines industrial insect farming through deep-substrate rearing, robotics and full environmental control — all without the use of crates. Under the partnership framework, the two companies will jointly work on the platform's commercialization and global deployment.

"The insect industry does not lack innovation or market demand,"



said Marc Bolard, Co-founder and CEO of Nasekomo. "What it needs is proven industrial-grade technology — systems that can be produced consistently, operated efficiently, and integrated into existing food, feed, and waste-processing value chains across the globe."

[Read more>>](#)

Malindo and USSEC partner for poultry feed research innovation

Malaysia-based animal feed producer PT Malindo Feedmill Tbk signed a feed trial protocol with the U.S. Soybean Export Council (USSEC) at an event at the Rinjani Room of the Grand Hyatt Jakarta on February 4, 2026. The signing of this trial protocol is the result of cooperation between USSEC and the Malindo Research and Development Centre (MRDC) and is intended to support the implementation of a joint feed trial between USSEC and PT Malindo Feedmill Tbk. This collaboration forms part of efforts to strengthen research and development in soybean-based poultry feed nutrition, particularly in the Southeast Asia region.

The event was opened with remarks by Jim Sutter, CEO of USSEC, followed by brief remarks from Luke Lindberg, Under Secretary of Agriculture for Trade and Foreign Agricultural Affairs at



United States Department of Agriculture (USDA). The main highlight of the event was the signing of the USSEC–Malindo Joint Feed Trial Protocol by Jim Sutter, Timothy Loh, Regional Director for Southeast Asia at USSEC, Lau Joo Kiang, Director of PT Malindo Feedmill Tbk, and Dr. Chee Seng Huan, Head of Nutrition Services of PT Malindo Feedmill Tbk.

[Read more>>](#)

60

YEARS

VICTAM International 2026

IN CO-LOCATION WITH  

THE WORLDS LARGEST DEDICATED EVENT
FOR THE ANIMAL FEED AND FLOUR
PROCESSING INDUSTRIES

**2-4 JUNE
2026**
JAARBEURS UTRECHT
THE NETHERLANDS

**REGISTER
FOR FREE**



Scan the qr code or visit victaminternational.com
Register and visit VICTAM International 2026 for FREE

Feed Additive

INTERNATIONAL MAGAZINE FOR
ANIMAL FEED & ADDITIVES INDUSTRY

Join us
TO GET STRONGER



SCAN or CLICK for
FREE SUBSCRIPTION!

Stay informed with the latest news,
trends, and innovations in the
animal nutrition and health industry...

www.feedandadditive.com

 [feedandadditive](#)

