

Feed Additive

INTERNATIONAL MAGAZINE FOR
ANIMAL FEED & ADDITIVES INDUSTRY

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Issue Focus:

Effects of Plant-Based and
Natural Feed Additives
on Animal Health & Performance

Special Story:

Nutritional Additives:
Vitamins & Pro-vitamins &
Amino Acids & Trace Elements



Isabelle Coudray, MiXscience
Using plant-based products
to improve ruminants'
performance



Dr Kane Miller, Axitan
Axitan focuses on antibiotic-free
production and improving
productivity



Jason Lee, CJ BIO
Understanding the role of dietary
leucine on valine requirement
in poultry diets



Dear Readers,

Today's consumers are paying more attention to the connection between food and factors such as health, environment and well-being when choosing foods. This natural nutrition trend, which includes concepts such as sustainability, plant-based nutrition, proactive health and functional foods, means consumers are making better choices for themselves and the planet.

The intensification of this trend among consumers with increasing awareness has started to affect all sides of the food production sectors. The livestock sector cannot be independent from this trend. These effects can be both positive and negative. On the positive side, we can say that this trend encourages the raising of animals in a healthy, high quality and environmentally friendly way. Feed produced with more natural and plant-based ingredients improves digestion, immunity, stress tolerance and productivity. But this trend is also driving up costs. This is because the production, processing and distribution of these feeds require more labor, time and resources. This drives up feed prices and reduces the profit margin of animal breeders. Therefore, parties in the animal nutrition industry are focusing

on solutions to enhance the positive effects of natural ingredients and animal feed on health and performance, thus offsetting the additional costs with increased productivity.

Along with this trend, there are other factors that are also emerging such as the growing demand for plant-based foods and the resulting reduction in animal food consumption. But this is not our topic today. Suffice it to say that we will focus on this topic in the following issues.

Our main topic in this issue is the effects of natural feed additives on the health and performance of animals. These additives can be derived from a variety of sources such as plant-based substances, plant extracts, essential oils, spices, herbs and microorganisms. And they have positive effects on animal health, performance and product quality. They can reduce the need for human health risks such as antibiotics. So they are sustainable and therefore extremely important.

Today, due to all these positive aspects, many representatives of the animal nutrition sector are working intensively on this subject. You can see some of them in this issue. We hope it will be useful and wish you a pleasant reading...

Hope to see you in the next issue...

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Adisseo builds new methionine plant in China

Adisseo, one of the world's leading companies in feed additives, announced that it will build a new powder methionine plant with an annual production capacity of 150K tons in Fujian Province in China. The total investment amount is expected to be around RMB 4.9 billion. The plant is expected to operate in 2027.

"By demonstrating unparalleled cost and size leadership in the liquid methionine, Adisseo is willing to also complement its leadership in the powder methionine to become one of the global frontrunners in 2030. This project will strengthen our leading position in the methionine industry as well as optimize our methionine product portfolios and global production capacity layout, thereby creating value for our customers," said Dr. Zhigang Hao, Chairman and CEO of Adisseo. "Sustainability and digitalization are key success

factors of the project. Adisseo is fully committed to implementing FORUS (SinoChem HSE strategy: For Runner Strategy), to fully leverage digital capabilities to design a smart plant, apply green technologies and source low-carbon raw materials, etc., aiming to build a greener, smarter, and more competitive plant."

Adisseo can produce liquid and solid methionine simultaneously. The Adisseo Nanjing plant is one of the world's largest, most technologically advanced, and most competitive liquid methionine production platforms in the world. In China and other emerging markets, the demand for powder methionine is still strong. The global demand for various types of methionine is expected to continue especially in China and other Asia Pacific countries (APAC). With this investment, Adisseo is willing to become one of the global front-



runners in the powder methionine market in the future.

The 150Ktons/year powder methionine project will be located at Quanhui Petrochemical Industrial Zone, Quanzhou City, Fujian Province, China, with an estimated investment amount of around RMB 4.9 billion. Thanks to the adjacent SinoChem sister company, the project is expected to benefit from strong synergies in the supply chain, receiving operational support and further gaining cost advantages by optimizing capital investments and operating costs as well as enhanced whole value-chain sustainability.

[Read more>>](#)

Cargill Aqua Nutrition releases its Sustainability Report 2022

Cargill Aqua Nutrition released its 2022 Sustainability Report. This is Cargill's 14th year in reporting its continued progress in making a positive impact from the center of the aqua value chain and building on its transparency on key sustainability topics, providing reports on its supply chain, its operations, and its product performance.

Key highlights from the Cargill Aqua Nutrition Sustainability Report 2022 include:

- With our signature SeaFurther™ Sustainability program, we work with salmon farmers as well as ingredient suppliers to reduce greenhouse gas (GHG) sources embedded in the value chain. we aim to help reduce carbon emissions from salmon farming by 30% by 2030.
- Aquaculture's carbon footprint mainly stems from the mix of raw materials in the feed. In 2022, we teamed up with eight U.K. farms to pilot climate-friendly regenerative agriculture practices to achieve a 1,000-tonne carbon reduction. In 2023, our goal is to sign up more farmers and avoid over 10,000 tonnes of emissions.
- Our work to improve the sustainability of marine ingredients continues by buying certified fishmeal and

oil as before, but with an increased engagement in fishery improvement programs to develop more sustainable management and fishing practices, and an increase in the use of fishery by-products as feed ingredients.

- We continue to increase our use of alternative ingredients like insect meal and algae oil, for instance, to help expand our raw material basket so we can produce more feeds sustainably, as well as develop better feed packaging solutions that keep many tonnes of plastic out of the environment.

- In 2022, sales of functional feeds, which help keep fish healthy, reducing the need for medication like antibiotics, reached their highest level since



2017. We saw a 71% reduction in coldwater antibiotic feed sales since 2017.

[Read more>>](#)

Alltech celebrates three decades of making a difference in the community

Alltech, a leading global animal health and nutrition company, celebrated 30 years of operations at its production facility in the Mexican city of Serdán, in a ceremony on Tuesday that included Dr. Mark Lyons, president and CEO of the company, local officials, and Alltech team members.

Thirty years ago, Alltech's research into the benefits of Yucca schidigera extract for animal health, performance, and welfare paved the way for the company to establish a Yucca schidigera processor in the city of Serdán. The place was chosen for its semi-desert climate, where the yucca plant grows naturally. Serdán is located 190 kilometers southeast of Mexico City and has access to one of the most important ports in the country: Veracruz; from which two of its most important technologies are exported: De-Odorase® and Allzyme® SFF.

Alltech's investment in Serdán increased Alltech's operational



footprint and offered new nutritional solutions that improve animal health and production efficiency. However, the resulting partnership between Alltech and the community of Serdán has been even more significant.

“The way the community and our company work together is incredible,” said Dr. Mark Lyons. “From the very beginning, we have been linked, as the success of one builds the success of the other.”

Alltech and the residents of Serdán have worked together on numerous community engagement projects that support un-

derstood families and vulnerable populations. The collaboration began with supporting a local orphanage, Casa Hogar, and has now grown to 23 active projects.

“Serdán has served as a template for Alltech's community involvement activities all around the world,” Lyons said. “We ask our colleagues in 350 communities around the world to ‘make a difference’ as our founder Dr. Pearse Lyons encouraged us, and Alltech Serdán is the best example of this spirit. This is a place where the culture of Alltech is truly alive.”

[Read more>>](#)

AB Agri partners with agri-tech firm Aceae Nutra

AB Agri partnered with agri-tech company Aceae Nutra on the development of an innovative new product made from tomatoes that could offer a new natural way to reduce traditional treatments in animals.

AB Agri and Aceae Nutra are now working together to assess its application in livestock animals. AB Agri is currently growing the tomatoes for use in trials which will determine the product's effectiveness in animals as a feed material.

Aceae Nutra is an IP-focused SME founded in 2018 specializing in research, innovation, and

product development of plant-based solutions. The company's approach incorporates plant sciences and agronomic expertise to generate viable solutions for conditions affecting human and animal health.

"We're committed to nurturing new technologies that have the potential to make a real impact in the production of responsible, affordable food – and turning those ideas into industry-relevant solutions," said Natasha Whenham, Head of Innovation at AB Agri. "The industry is looking for ways to responsibly reduce the use of



traditional treatments that bring either environmental or resistance concerns and this product is an exciting new prospect that offers real potential to achieve this goal."

[Read more>>](#)

Novozymes and Arla Foods join forces to develop protein ingredients

Novozymes and Arla Foods Ingredients agreed on a partnership to develop advanced protein ingredients using precision fermentation. Biotechnology company Novozymes is a world leader in precision fermentation, a technique that fine-tunes the molecular output of microorganisms, offering greater control over the fermentation process and enabling tailor-made protein compositions. Specializing in the production of enzymes through precision fermentation, it has focused on the exploration of new protein solutions for health and nutrition since 2019.

In the co-funded partnership with nutrition leader Arla Foods Ingredients, it will contribute its expertise in the creation of microbial strains for the industrial-scale production of proteins by precision fermentation. This will be combined with Arla Foods Ingredients' food technology know-how – in particular about separation and drying processes – and its knowledge of the regulatory landscape.



The initial focus of the collaboration will be a solution for disease-specific medical nutrition – a category in which protein is an essential component – with expansion into other segments anticipated in the future. Henrik Andersen, Group Vice President of Arla Foods Ingredients, said: "This partnership brings together two market leaders in our respective areas. Collaborating with Novozymes fits perfectly with our ambition to explore alternative nutrition platforms and complement our portfolio of dairy and whey solutions."

[Read more>>](#)

3rd & 4th OCTOBER 2023

Microbiota days are coming back this year on October 3 and 4, 2023. Phileo's global virtual event giving easy access to top talks from your own desk.



Thanks to last year success, Phileo accelerates its focus on microbiota and invests in a virtual industry event taking place **October 3 and 4, 2023**.

High level keynote speeches will be given by scientists from academia, institutes, and industry from Europa, USA and Asia. Followed by well-known scientists & key opinion leaders, and our own Phileo experts, who will elaborate further on microbiota specie specific topics.

More than 28 presentations centered around 4 topics :

- Impact of pathogens on microbiota
- Interaction between microbiota and the host response
- The force of nutrition to positively influence microbiota
- Technological tools and strategies for culturing a healthy microbiota.

The aim of the Microbiota days is to promote the unifying concept that a balanced microbiota drives animal health and performance. Participants at the Phileo Microbiota days will have two days of live presentations focused on the role of gut and rumen microbiome in animal production and the dynamic and essential role gut health plays.

The full programme will be available soonest.



Our event speakers



Prof. S. BLANQUET
Université de Clermont-Ferrand. Fr.



Prof. T. OPRIESSNIG
University of Edinburgh. UK



Prof. P. TREVISI
University of Bologna. Italy



Prof. G. ROSSI
University of Camerino. Italy



Prof. L.F. CARON
Immunova - Brazil



Dr. I. RYCHLIK
Veterinary Research Inst. of Brno - CZ Rep.



Dr. H. DERAKHSHANI
University of Manitoba. Canada



Prof. G. ANTONISSEN
University of Ghent. Belgium



Dr. M. KOGUT
USDA USA



Dr. M. TERRA-LONG
Phileo by Lesaffre



J.B. DARODES DE TAILLY
Phileo by Lesaffre



Dr. A. RIGGI
Phileo by Lesaffre



Dr. A. ADIB-LESAUX
Phileo by Lesaffre



Dr. E. SANTIN
Advisor for R&D and Sustainability - Brazil



Prof. L. BAUMGARD
Iowa State University USA



Dr. L. RHAYAT
Phileo by Lesaffre



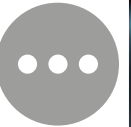
Dr. R. GUABARIBA
INRAe Fr.



Dr. A.T. GONÇALVES
SPAROS Portugal



Dr. S. KANTI KAR
Wageningen Livestock Research - NL



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Anchor launches its new technical services division

Anchor Ingredients, a trusted name in the pet food industry, introduced its new Technical Services division which is dedicated to providing unbiased and comprehensive support to pet food manufacturers and brands, catering to their unique production and formulation needs. With a diverse range of services aimed at optimizing processes, troubleshooting quality issues, and fostering innovation, Anchor Ingredients' new Technical Services division is set to revolutionize the industry's approach to challenges and advancements.

The new division will offer an array of services, including production process optimization, product quality troubleshooting, ingredient technology support, product development, and for-



mulation expertise, facility and process flow design services, as well as educational seminars and training opportunities. Anchor Ingredients is committed to sharing its expertise and insights to empower manufacturers and brands with the tools they need to excel in an evolving landscape.

Heading this division is Brian Streit, an industry veteran with a 27-year track record of operations, quality control, equipment technology, formulation, and in-

novation within pet food manufacturing and related sectors. Brian's leadership will infuse the division with a wealth of practical knowledge, enabling it to serve as a resource for manufacturers and brands seeking excellence in every aspect of their business.

"We are very excited to bring this service to the pet food industry and our customers," commented Brian Streit, Director of Technical Services at Anchor Ingredients.

[Read more>>](#)

Innovasea adds Atlantic salmon algorithm to BiomassPro

Innovasea, a global leader in technologically advanced aquatic solutions for aquaculture and fish tracking, announced that its AI-driven biomass estimation solution, BiomassPro, is now available for use with Atlantic salmon.

Recent field trials in British Columbia, Canada, have shown the solution's algorithm for Atlantic salmon is highly effective at estimating the size and weight of that species in real-time.

"The technology behind BiomassPro continues to perform well in the field, which is really exciting," said Rafael Cordero, vice president of engineering at Innovasea. "Customers have been asking for some time when it would be available for Atlantic salmon, but we wanted to take time to fine-tune the algorithm and ensure we were bringing a quality



product to the marketplace."

BiomassPro is an AI-powered solution that estimates the size and weight of fish stocks in real-time to help farms optimize production and reduce feeding costs. It also provides accurate growth projections to improve resource planning and sales forecasting and ultimately boost revenues.

[Read more>>](#)

CULT Food Science announces world's first cat treat with cell-cultivated fish

CULT Food Science Corp., a pioneer in the investment, development, and commercialization of cellular agriculture technologies and products, introduced Marina Cat™, a hybrid cell-cultivated pet food brand for cats developed in partnership with Umami Bioworks.

"My vision for the future is that we no longer have to slaughter other animals to feed our cats," said Joshua Errett, VP of Product at CULT. "This brand brings me one very great step closer to making that a reality."

"We are pleased to be embarking on this partnership with Marina Cat to power a new category of

cultivated pet food products that are healthier for cats and better for our oceans. As a platform technology provider, we are committed to delivering the technology stack that powers the commercialization of cultivated products across a range of applications. This first collaboration with Marina Cat and CULT Food Science is the first step to delivering on that promise," said Mihir Pershad, CEO of Umami Bioworks.

Marina Cat™ is a blend of ocean snapper, cultivated by Singapore-based biotech startup Umami Bioworks, and enriched with Bm-mune® to provide a high protein, low-calorie snack with super savory



umami flavors that cats enjoy. With its unique nutritional properties, this first-of-its-kind treat provides benefits to a cat's cognitive function, based on its high levels of omega 3, 6, and 9 fatty acid chains. Studies have shown that DHA and EPA provided in the treat can boost brain, vision, and nervous system development in cats and kittens.

[Read more>>](#)

Feed ingredients distributor Origination rebranded as Barentz

Barentz, one of the leading global distributors of life science and specialty ingredients, announced that Origination rebranded as Barentz, effective immediately. The name change follows the acquisition of Origination by Barentz International (Barentz) in August 2021.

For nearly eight decades, Origination has been a leading distributor of high-quality animal feed ingredients. Its focus on production automation as well as a strong supply chain has provided a long history of stability through economic and commodity cycles. In order to better serve its customers, the company enjoys the advantage of strategic access to river, rail, and road transport, which allows for extensive domestic and international distribution.

With this rebranding, the company will be focusing on expanding its feed additive portfolio through



strategic partnerships and M&A, as well as making its DCAD products more accessible to customers globally.

"This is a significant milestone for our company as we accelerate our growth under Barentz," commented John DeVos, President, of Animal Nutrition of Barentz North America. "I am pleased by our organization's commitment to market leadership and continuous improvement to deliver better solutions for our customers and principal partners."

[Read more>>](#)

Kemin opens first facility to produce Proteus® for meat and poultry industry

Kemin Industries, a global ingredient manufacturer that strives to sustainably transform the quality of life every day for 80 percent of the world with its products and services, opened a new manufacturing facility in Verona, Missouri, to produce its Proteus® line of clean-label functional proteins that are used to increase yield and enhance the quality of meat and poultry products within the food industry.

Kemin broke ground on the new building in November 2021, and on August 23, the company hosted a ribbon-cutting ceremony to officially open the 38,000-square-foot facility. The operation is a \$70 million investment that employs nearly 30 full-time workers in the Verona community.

The facility, which will run under FSSC 22000 Certification and completed its first run under United States Department of Agriculture (USDA) inspection on July 25, 2023, will manufacture Kemin Food Technologies – North America's patented Proteus line of clean-label, functional protein ingredients for a variety of meat and poultry applications. The Proteus portfolio of muscle-based protein ingredients can help food processors naturally retain moisture typi-



cally lost in processing, which translates to processing efficiencies with improved quality.

The state-of-the-art Proteus production plant will have an initial capacity to produce enough functional protein to treat more than a billion pounds of meat, poultry, and protein-based applications.

"Since acquiring Proteus in April 2021, we've been eager to open this site and serve customers, who continue to demand sustainably sourced, technologically advanced solutions," said Marc Scantlin, President, of Kemin Food Technologies – North America. "Opening our first-ever Proteus dry production plant provides the opportunity to partner with more meat and poultry manufacturers, positively impacting the quality of our global food supply."

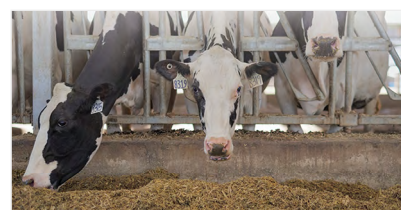
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Neogen launches Igenity Enhanced Dairy

Neogen Corporation announced that it launched Igenity® Enhanced Dairy, a new and progressive genomic data management tool. Igenity Enhanced Dairy is a new digital service that empowers dairy producers to make better selection and mating decisions. By integrating in-herd phenotypic data, pedigree information, and existing predicted transmitting abilities (PTAs) from the Council on Dairy Cattle Breeding (CDCB), the platform delivers a genomic evaluation of dairy cattle.

Producers are able to utilize the data provided by Igenity Enhanced Dairy to make an in-herd assessment of the genetic potential by pairing each animal's performance data with the results received from an Igenity Select profile. The ability to apply on-farm phenotype data to a standard genetic assessment leverages the management and geography of the individual animals to ultimately enable better decision-making.

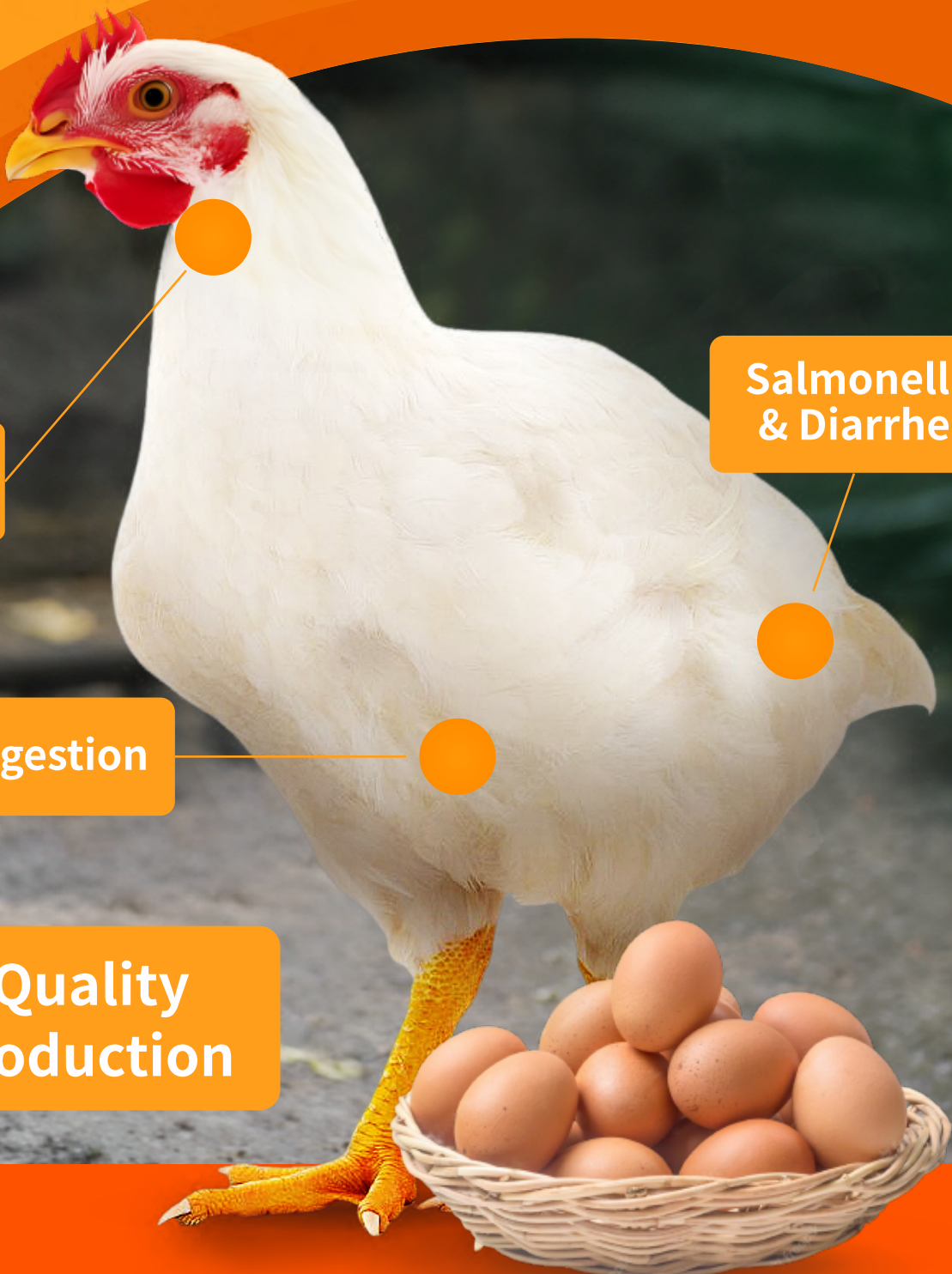
"Neogen is thrilled to introduce a useful tool that contributes to the



improvement of genetic selection in the dairy cattle market," said Dr. Victor Pedrosa, Neogen's Director of Genetic Prediction. "Data plays a crucial role in decision-making, and the Igenity Enhanced Dairy platform allows producers to take an additional step forward.

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Status

Salmonella
& Diarrhea

pH & Digestion

Egg Quality
& Production

Bühler and Entocycle join forces for industrial insect production

Bühler, one of the world's leading processing technology groups, and Entocycle, an insect technology company, joined forces to drive the adoption of large-scale black soldier fly (BSF) farms. The companies will provide solutions and expertise to serve customers in this segment, covering the multiple steps of the journey, from concept and basic engineering to execution of BSF facilities worldwide.

The non-exclusive partnership creates a highly complementary offering with Entocycle delivering proprietary breeding technology and Bühler bringing proven industrial-scale technologies in feedstock processing, larvae rearing, and product processing.

One of the challenges of the highly promising, emerging insect industry has been how to ensure a steady supply of young larvae at an industrial scale. "While the pioneers in this industry had to develop their own technology out of necessity to ensure a robust BSF breeding, companies now venturing into this industry will be able to rely on a proven and scalable solution," says Andreas Baumann, Head of Market Segment Insect Technology at Bühler. Although there are specialized breeding service companies in certain regions, in large parts of



the world, there is no alternative to having an in-house breeding operation. With this partnership, Bühler and Entocycle address this challenge by offering scalable end-to-end solutions that significantly reduce the time to market for companies building an insect facility.

"We are incredibly proud to partner with Bühler, a company with 163 years of illustrious history. Our team is really excited to work with Andreas Baumann and his team to deliver large-scale BSF facilities around the world and make the impact that we know BSF farming can make in creating a more sustainable and efficient global food system," says Keiran Whitaker, Founder, and CEO of Entocycle.

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BioZyme partners with Hirshberg Brothers in Israel

BioZyme® Inc. entered into a distribution partnership with the Hirshberg Brothers Group in Herzliya, Israel. Hirshberg Brothers started as a single company in 1925, founded by brothers Avraham and Yakov Hirshberg, and has since grown to be one of the leading companies in Israel.

"We are very happy with the addition of Hirshberg Brothers as our distribution partner. The company has an important relationship with the Israeli feed manufacturers," said Volker Al-

tenbokum, Director of International Business Development. "As most of the rations in the highly technical Israeli dairy industry are concentrate based, the incentive of using AO-Biotics® Amaferm® to support digestive health and performance is very high."

"AO-Biotics® EQE, the first-and-only AO postbiotic developed specifically for layers, is also a great addition to the portfolio of Hirshberg. The market is asking for more natural solutions and we are able to provide them



with such," added Peter Windhausen, Ph.D., Business Development and Innovation Manager at BioZyme. "We are excited to move forward with Hirshberg to provide AO-Biotics products to customers in Israel."

[Read more>>>](#)

GFI announces creation of pet food ingredients subsidiary

Global Food and Ingredients Ltd. announced that it created a new subsidiary named Big Sky Milling Inc. as part of the previously announced planned minority investment in its pet food ingredients division (the Pet Food Transaction) with 35 Oak Holdings Ltd. GFI will be transferring all of its pet food ingredients assets and business into Big Sky, which will be fully dedicated to serving the North American pet food industry with existing products as well as new growth planned through product expansion and new investments. As GFI completes the formation of the new dedicated pet food operations under the Big Sky brand, 35 Oak has advanced a \$3.0 million deposit for the pending investment. GFI may immediately use such advance in funding its day-to-day operations. GFI is working to



complete the Pet Food Transaction reorganization in September 2023, subject to the completion of definitive agreements, satisfaction of customary closing conditions, and receipt of regulatory approvals, including the approval of the TSXV.

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- Supports egg production persistency
- Enhances day old chick vitality
- Ameliorates skeleton strength

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 **agrifirm**

IFF expands innovation footprint in North America Creative Center

IFF announced the completion of its new North American Creation and Design Center in New Century. The IFF Creative Center brings together the company's flavor and ingredient expertise with its food design capabilities to better support the growth of the region's food industry.

The infrastructure upgrade includes the addition of two new flavor creation labs, the expansion of existing food application design labs for dairy, bars, culinary, and bakery, and a new lab solely for pet food development. The New Century facility is now the company's second-largest creative center in North America and houses ten labs, and six state-of-the-art pilot plants, which serve two purposes: – providing better customer support and enhancing innovative product development.

"Our capability expansion in New Century provides a significant advantage to our customers," said Carmen Cain, regional president for IFF's Nourish division. "By integrating flavors, ingredients, and food design in one space, we can increase our speed-to-market while offering a breadth of knowledge and resources across multiple food categories. This



investment strengthens our end-to-end IFF PRODUCT DESIGN™ approach in which we reimagine future-proof concepts and experiences by combining our expertise in ingredients and flavors with a deep understanding of consumer behavior."

The two new flavor creation labs – for sweet and savory flavors, respectively – mark the first time flavorists will be based at the New Century facility. The expert flavorists will develop alongside the dairy, bakery, bars, culinary, and pet food product application and design teams.

[Read more>>](#)

Hill's Pet Nutrition and Harvard researcher collaborate to create One Health Microbiome Resource

Hill's Pet Nutrition, one of the global leaders in science-led nutrition, and Harvard T.H. Chan School of Public Health researcher Dr. Curtis Huttenhower are joining forces to create the One Health Microbiome Resource (OHMR).

Not only will the OHMR be the first of its kind, it will also be the largest and most comprehensive reference database of human and companion animal microbiomes, which provides

unique opportunities to understand the health of both pets and pet owners.

"Because pets are members of the family, many consider their nutrition to be just as crucial as that of our human family members," said Dr. Huttenhower, Professor of Computational Biology and Bioinformatics at Harvard Chan School and Co-director of the Harvard Chan Microbiome in Public Health Center. "The same can

be said for their microbial communities. The OHMR provides a new way to improve both human and animal health through nutrition, better environmental exposures, and inter-individual resource sharing on a day-to-day basis. We believe improving a pet's microbiome positively impacts a pet parent's well-being and vice versa."

The OHMR includes microbial genomes, companion animal microbial community profiles,

and tools to utilize them together. This is a key development for researchers, as microbiome research has become an increasingly important area of focus in maintaining health, as well as understanding diseases. This is in turn increasingly applicable to pet health specifically.

"We're excited to build on the foundation of human microbiome research to bring better nutrition and immune health to companion animals as well," said Dr. Huttenhower. "In the past decade, we've learned quite a bit about the human microbiome that can be applied to pets, and with the OHMR, we hope to expand this and make



the reverse true as well. Living with pets is already known to improve immune development in infants, and the OHMR will help us to understand how

and why this occurs. Plus, it's especially important to build healthy, microbiome-aware diets for pets."

[Read more>>](#)

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- Holistic Mycotoxin Risk Management: From A to Z

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EFFECTS OF **PLANT-BASED AND NATURAL** FEED ADDITIVES ON ANIMAL HEALTH & PERFORMANCE





- Using plant-based products to improve ruminants' performance
Isabelle Coudray, miXscience
- The future of coccidiosis control
Madalina Diaconu & Twan van Gerwe, Ph.D., EW Nutrition
- Polyphenols as a natural strategy to effectively control oxidative stress in layers
Steven Beckers, Impextraco - Belgium
- Overcoming regulatory hurdles for plant-based feed additives
By Pen & Tec Consulting, part of the Argenta Group
- Innovative bio-ingredients for feed and pet food: It's all about the olive
Kathrin Schilling, BioPowder
- Plant-based ingredients offer a route to enhanced livestock health
Irene Trigueros, Golden Agri-Resources
- Harnessing heat shock protein responses: It's about more than heat stress
David Harrington, teamTWO Solutions & Reginaldo Teixeira Filho, Natturo Agronegócios & Charles Saliba, Nutri Biotech Services
- Beyond chemicals: The rise of himalayan flora in promoting animal health and wellness
Naveed A. Chikan, Daskdan Innovations



USING PLANT-BASED PRODUCTS TO IMPROVE RUMINANTS' PERFORMANCE

Isabelle Coudray
Product Manager
 miXscience

"There is a significant economic advantage to monitor feed efficiency. It allows farmers to regularly adjust the nutrition of the herd in order to maximize income from milk production regarding feed price of the moment. The use of single or blend of phytochemicals can be part of the global approach to increase feed efficiency."

In dairy farming, performance can be expressed by Energy Corrected Milk (ECM), which takes into account milk yield, but also protein and fat contents. ECM is an accurate herd indicator reflecting diet valorization and herd's productivity.

Economic performance is key to control farm rentability taking into account that milk prices are still volatile in different markets and tend to decrease, whereas raw materials prices globally increase.

RUMEN FLORA MODULATION IS ONE OF THE LEVERS TO IMPROVE PERFORMANCE

Dietary proteins are more or less degraded by ruminal flora to produce microbial proteins and ammonia. Microbial proteins and certain dietary proteins not degraded in the rumen are then digested in the intestine to produce milk. Protein supply in the feed and protein degradation level in the rumen need to be adjusted in order to provide sufficient essential amino acids supply for absorption in the gut to maximize performance and limit ammonia production.

Research has demonstrated that usually less than 30% of protein intake can be retrieved in milk protein content form.

Up to 80% of energy supply to ruminants comes from volatile fatty acids. Rumen fermentations produce mainly acetic, butyric, lactic and propionic acids. Levels and ratio of each volatile fatty acids for optimum rumen efficiency have been determined after years of research and constitute nutrition standards. Due to high level of concentrates in modern dairy farming, rumen functioning can be disturbed and this can lead to misbalanced ratios of volatile fatty acids. Increase of concentrates intake has been shown to increase acetic and lactic acids production and to decrease ruminal pH. At short term this strategy can in fact lead to more volatile fatty acids production from important and rapid starch degradation of concentrates. But constant drops in ruminal pH cause non-ideal condition for cellulolytic flora development. This leads to the decrease of fiber digestibility, whereas it accounts for a consequent amount of ruminants' diets.

Both protein and energy valorization are important and furthermore, correlated. Indeed, microbial synthesis of protein is energy dependent, and research has shown that “synchronizing” the timing of energy supply with protein degradation may maximize protein synthesis and minimize nitrogen waste into ammonia.

HOW PHYTOGENICS CAN IMPROVE ENERGY AND PROTEIN USE IN THE RUMEN?

Phytogenics are added to the overall diet and can affect protein and energy from all the different feed components (forages, cereals, meals, etc.). There are numerous types of phytogenics and some of the most effective ones for feed efficiency are:

- **Tannins:** Complex polyphenol compounds of plants. They can vary a lot in types and concentration from extraction. Their nature allows binding with protein, notably, but the quantity and the quality of the extract is very important to ensure adequate binding in the rumen and liberation in the gut.
- **Essential oils:** There are various families with different mode of actions. In the literature, these compounds have shown antimicrobial activities used to modify ruminal fermentations of protein and energy, to secure digestion and improve, and to improve nutrient digestibility and increase productivity.
- **Spices:** Spices have shown to increase dairy cows’

intake in different trials, and have been linked to increase of natural buffer from salivation positively affecting ruminal pH.

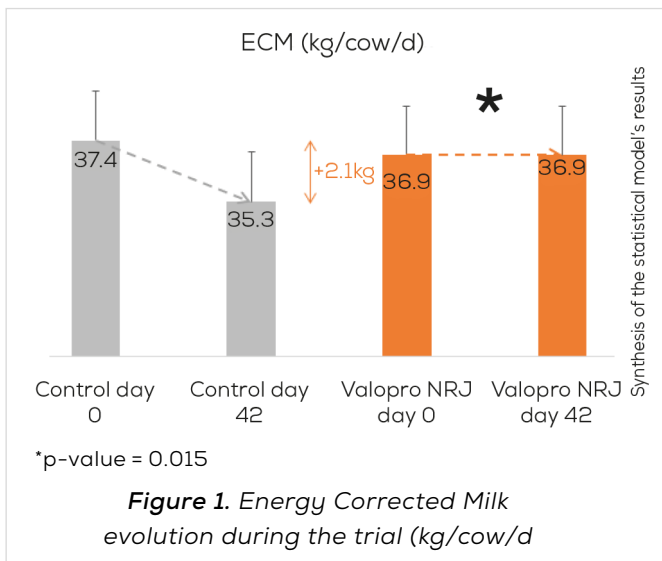
MiXscience has developed a specific range of products including different combination of these components. These products have been developed and tested in the Mixscience Research Center (MRC, Saint-Symphorien, France) in order to increase protein and energy efficiency of ruminants.

In studies, high doses of essential oils have been associated with detrimental effect on rumen microorganisms but doses and effects were varying. One of these products, Valopro NRJ, has been recently tested at MRC with higher dosage to assess cows’ response:

- 30 lactating Holstein dairy cows (60% primiparous cows; 184 ± 64 days in milk (DIM); 35.6 ± 6.8 kg of milk/day; 723 ± 67 kg body weight)
- Herd diet: 16.2% protein, 34.8% NDF, 1.65 MCal/kg
- Cows blocked by lactation number, DIM, milk yield, protein and fat contents
- Two groups: Herd diet (42 days) with 0 g/cow/d (control group) or 30 g/cow/d of Valopro NRJ group.
- Individual milk yield and composition (protein, fat, urea, SCC) monitored daily and weekly respectively
- Individual intake and body weight assessed every day



Per cow per day	Control	Valopro NRJ
Partial Mixed Ration	Corn silage 10kg DM	
	Grass silage 3.3kg DM	
	Liquid feed 1.0 kg	
	Basemix 0.23 kg	
	Rumen protected Fat 0.1 kg	
	Protein concentrate 1.7 kg	
	Energy concentrate 2.0 kg	
AMS* Feeder	Control feed 3.0 kg	Trial feed 3.0 kg
AMS Feeder	Production concentrate from 0 to 5 kg linked to Milk Yield (average 3 kg)	
AMS* = Automatic Milking System		



Milk production was more stable for cows fed with Valopro NRJ during the trial so persistency is improved with Valopro NRJ.

At the end of the trial, milk composition was similar between the two groups (+1.7 g protein/kg and +1.8 g protein/kg for Valopro NRJ and Control groups respectively and +1.1 g fat/kg for both Valopro NRJ and Control groups) so that energy corrected milk was improved. There was no difference between groups for milk urea, intake and body weight.

CONCLUSION

Results indicates that 30 g/cow/d of Valopro NRJ can significantly improve milk yield and ECM and is a suitable solution to increase profitability in dairy cows system.

There is a significant economic advantage to monitor feed efficiency. It allows farmers to regularly adjust the nutrition of the herd in order to maximize income from milk production regarding feed price of the moment. The use of single or blend of phytogenics can be part of the global approach to increase feed efficiency. The implementation of this kind of products can be performed in two different ways: in top feeding or in diet optimization, to increase performance or decrease the feed cost of diets without degrading animal performance. A lower diet cost thanks to optimization is very interesting especially in contexts of low milk prices and high raw materials cost.

Diet optimization with Valopro solutions also makes it possible to limit the environmental impact of the feed or diet by selecting more local raw materials or by-products with a lower environmental impact.

miXscience has developed the MatriCiel tool to calculate the environmental impact of feed according to various criteria, including a Climate Change Impact Criterion in CO² equivalent. These calculations depend on the context (area and period).

References are available upon request. Product not available in all countries, local regulations should be consulted. Intended only for the export outside the European Union.





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Improve performance
thanks to ruminal
degradation modulation



Decrease carbon
footprint per kg
of milk or meat



Multiple solutions and
services to fit with diet
diversity



Madalina Diaconu
Product Manager Prelect D
 EW Nutrition



Twan van Gerwe, Ph.D.
Technical Director
 EW Nutrition

THE FUTURE OF COCCIDIOSIS CONTROL

Due to still rising antimicrobial resistance, consumers push for meat production without antimicrobial usage. However, antibiotic reduction must also target ionophores for producers and regulators alike. As a natural solution, phytomolecules might be the optimal completion to current coccidiosis control programs and create opportunities to make poultry production more sustainable by reducing dependency on harmful drugs.

With costs of over 14 billion USD per year (Blake, 2020), coccidiosis is one of the most devastating enteric challenges in the poultry industry. With regard to costs, subclinical forms of coccidiosis account for the majority of production losses, as damage to intestinal cells results in lower body weight, higher feed conversion rates, lack of flock uniformity, and failures in skin pigmentation. This challenge can only be tackled, if we understand the basics of coccidiosis control in poultry and what options producers have to manage coccidiosis risks.

CURRENT STRATEGIES SHOW WEAK POINTS

Good farm management, litter management, and coccidiosis control programs such as shuttle and rotation programs form the basis for preventing clin-

ical coccidiosis. More successful strategies include disease monitoring, strategic use of coccidiostats, and increasingly coccidiosis vaccines. However, the intrinsic properties of coccidia make these parasites often frustrating to control. Acquired resistance to available coccidiostats is the most difficult and challenging factor to overcome.

Optimally, coccidiosis control programs are developed based on the farm history and the severity of infection. The coccidiostats traditionally used were chemicals and ionophores, with ionophores being polyether antibiotics. To prevent the development of resistance, the coccidiostats were used in shuttle or rotation programs, at which in the rotation program, the anticoccidial changes from flock to flock, and in the shuttle program within one production cycle (Chapman, 1997).

The control strategies, however, are not 100% effective. The reason for that is a lack of diversity in available drug molecules and the overuse of some molecules within programs. An additional lack of sufficient coccidiosis monitoring and rigorous financial optimization often leads to cost-saving but only marginally effective solutions. At first glance, they seem effective, but in reality, they promote resistance, the development of subclinical coccidiosis, expressed in a worsened feed conversion rate, and possibly also clinical coccidiosis.

MARKET REQUESTS AND REGULATIONS DRIVE COCCIDIOSIS CONTROL STRATEGIES

Changing coccidiosis control strategies has two main drivers: the global interest in mitigating antimicrobial resistance and the consumer's demand for antibiotic-free meat production.

AUTHORITIES HAVE LEFT IONOPHORES UNTOUCHED

Already in the late 1990s, due to the fear of growing antimicrobial resistance, the EU withdrew the authorization for Avoparcin, Bacitracin zinc, Spiramycin, Virginiamycin, and Tylosin phosphate, typical growth promoters, to "help decrease resistance to antibiotics used in medical therapy". However,

ionophores, being also antibiotics, were left untouched: The regulation (EC) No 1831/2003 [13] of the European Parliament and the Council of 22 September 2003 clearly distinguished between coccidiostats and antibiotic growth promoters. Unlike the antibiotic growth promoters, whose primary action site is the gut microflora, coccidiostats only have a secondary and residual activity against the gut microflora. Furthermore, the Commission declared in 2022 that the use of coccidiostats would not presently be ruled out "even if of antibiotic origin" (MEMO/02/66, 2022) as "hygienic precautions and adaptive husbandry measures are not sufficient to keep poultry free of coccidiosis" and that "modern poultry husbandry is currently only practicable if coccidiosis can be prevented by inhibiting or killing parasites during their development". In other words, the Commission acknowledged that ionophores were only still authorized because it believed there were no other means of controlling coccidiosis in profitable poultry production.

CONSUMER TRENDS DROVE RESEARCH ON NATURAL SOLUTIONS

Due to consumers' demand for antibiotic-reduced or, even better, antibiotic-free meat production, intensified industrial research to fight coccidiosis with





natural solutions has shown success. Knowledge, research, and technological developments are now at the stage of offering solutions that can be an effective part of the coccidia control program and open up opportunities to make poultry production even more sustainable by reducing drug dependency.

Producers from other countries have already reacted. Different from the handling of ionophores regime in the EU, where they are allowed as feed additives, in the United States, coccidiostats belonging to the polyether-ionophore class are not permitted in NAE (No Antibiotics Ever) and RWE (Raised Without Antibiotics) programs. Instead of using ionophores, coccidiosis is controlled with a veterinary-led combination of live vaccines, synthetic compounds, phytomolecules, and farm management. This approach can be successful, as demonstrated by the fact that over 50% of broiler meat production in the US is NAE. Another example is Australia, where the two leading retail store chains also exclude chemical coccidiostats from broiler production. In certain European countries, e.g., Norway, the focus is increasingly on banning ionophores.

THE TRANSITION TO NATURAL SOLUTIONS NEEDS KNOWLEDGE AND FINESSE

In the beginning, the transition from conventional to NAE production can be difficult. There is the possibility to leave out the ionophores and manage the control program only with chemicals of different

modes of action. More effective, however, is a combination of vaccination and chemicals (bio-shuttle program) or the combination of phytomolecules with vaccination and/or chemicals (Gaydos, 2022).

COCCIDIOSIS VACCINATION ESSENTIALS

When it is decided that natural solutions shall be used to control coccidiosis, some things about vaccination must be known:

1. There are different strains of vaccines, natural ones selected from the field and attenuated strains. The formers show medium pathogenicity and enable a controlled infection of the flock. The latter, being early mature lower pathogenicity strains, usually cause only low or no post-vaccinal reactions.

2. A coccidiosis program that includes vaccination should cover the period from the hatchery till the end of the production cycle. Perfect application of the vaccines and effective recirculation of vaccine strains amongst the broilers are only two examples of preconditions that must be fulfilled for striking success and, therefore, early and homogenous immunity of the flock.

3. Perfect handling of the vaccines is of vital importance. For that purpose, the personnel conducting the vaccinations in the hatchery or on the farms must be trained. In some situations, consistent high-quality application at the farm has shown to be challenging. As a result, interest in vaccine application at the hatchery is growing.

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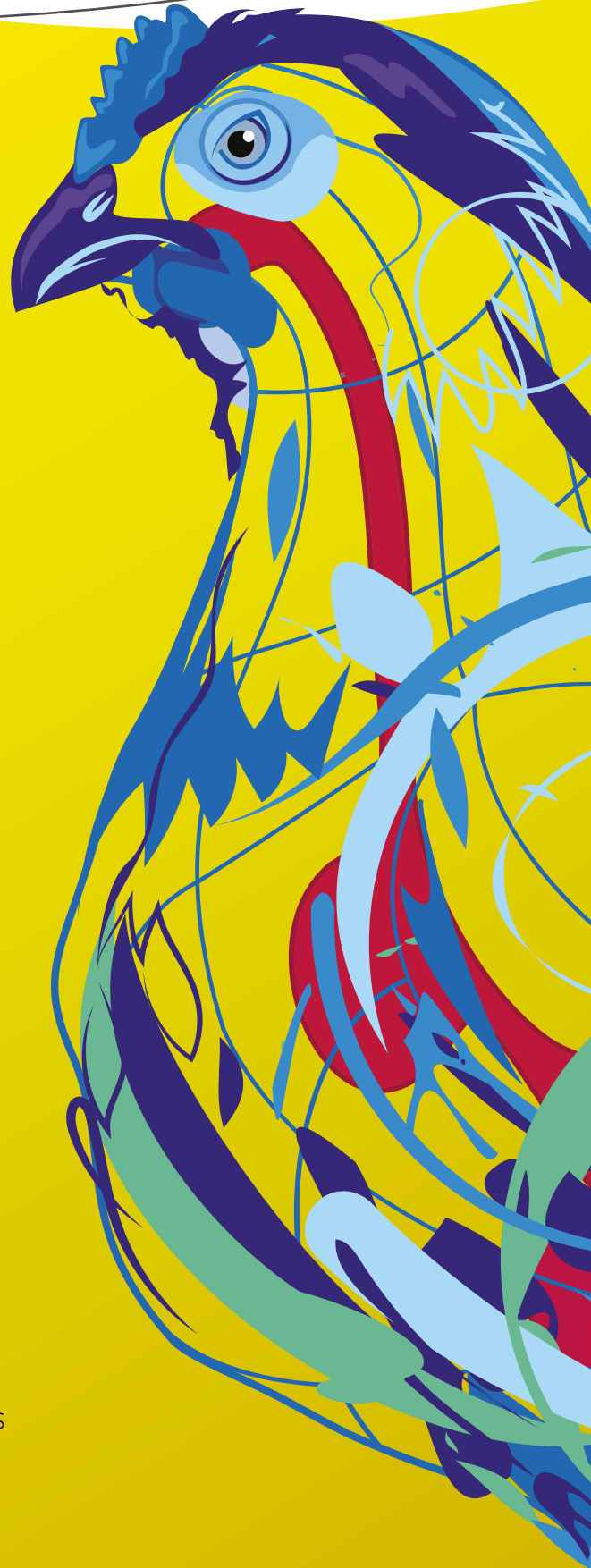
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- » Reduce mortality
- » Use in combination with vaccines, ionophores and chemicals, as part of the shuttle or rotation programs
- » A phytomolecule-based solution



PHYTOCHEMICALS ARE A PERFECT TOOL TO COMPLEMENT COCCIDIOSIS CONTROL PROGRAMS

As the availability of vaccines is limited and the application costs are relatively high, the industry has been researching supportive measures or products and discovered phytochemicals as the best choice.

Effective phytochemical substances have antimicrobial and antiparasitic properties and enhance protective immunity in poultry infected by coccidiosis. They can be used in rotation with vaccination, to curtail vaccination reactions of (non-attenuated) wild strain vaccines, or in combination with chemical coccidiostats in a shuttle program.

Bioactive compound	Effect
Saponins	<p><i>Inhibition of coccidia:</i> By binding to membrane cholesterol, the saponins disturb the lipids in the parasite cell membrane. The impact on the enzymatic activity and metabolism leads to cell death, which then induces a toxic effect in mature enterocytes in the intestinal mucosa. As a result, sporozoite-infected cells are released before the protozoa reach the merozoite phase.</p> <p><i>Support for the chicken:</i> Saponins enhance non-specific immunity and increase productive performance (higher daily gain and improved FCR, lower mortality rate). They decrease fecal oocyst shedding and reduce ammonia production.</p>
Tannins	<p><i>Inhibition of coccidia:</i> Tannins penetrate the coccidia oocyst wall and inactivate the endogenous enzymes responsible for sporulation.</p> <p><i>Support for the chicken:</i> Additionally, they enhance anticoccidial antibodies' activity by increasing cellular and humoral immunity.</p>
Flavonoids and terpenoids	<p><i>Inhibition of coccidia:</i> They inhibit the invasion and replication of different species of coccidia.</p> <p><i>Support for the chicken:</i> They bind to the mannose receptor on macrophages and stimulate them to produce inflammatory cytokines such as IL-1 through IL-6 and TNF. Higher weight gain and lower fecal oocyst output are an indication of suppression of coccidiosis.</p>
Artemisinin	<p><i>Inhibition of coccidia:</i> Its impact on calcium homeostasis compromises the oocyst wall formation and leads to a defective cell wall and, in the end, to the death of the oocyst. Enhancing the production of ROS directly inhibits sporulation and also wall formation and, therefore, affects the Eimeria life cycle.</p> <p><i>Support for the chicken:</i> Reduction of oocyst shedding</p>
Leaf powder of Artemisia annua	<p><i>Support for the chicken:</i> Protection from pathological symptoms and mortality associated with Eimeria tenella infection. Reduced lesion score and fecal oocyst output.</p> <p>The leaf powder was more efficient than the essential oil, which could be due to a lack of Artemisinin in the oil, and to the greater antioxidant ability of A. annua leaves than the oil.</p>
Phenols	<p><i>Inhibition of coccidia:</i> Phenols change the cytoplasmic membrane's permeability for cations (H⁺ and K⁺), impairing essential processes in the cell. The resulting leakage of cellular constituents leads to water unbalance, collapse of the membrane potential, inhibition of ATP synthesis, and, finally, cell death. Due to their toxic effect on the upper layer of mature enterocytes of the intestinal mucosa, they accelerate the natural renewal process, and, therefore, sporozoite-infected cells are shed before the coccidia reaches the merozoite phase.</p>



"Instead of using ionophores, coccidiosis is controlled with a veterinary-led combination of live vaccines, synthetic compounds, phytomolecules, and farm management. This approach can be successful, as demonstrated by the fact that over 50% of broiler meat production in the US is NAE. Another example is Australia, where the two leading retail store chains also exclude chemical coccidiostats from broiler production. In certain European countries, e.g., Norway, the focus is increasingly on banning ionophores."

In a recent review paper (El-Shall et al., 2022), natural herbal products and their extracts have been described to effectively reduce oocyst output by inhibiting *Eimeria* species' invasion, replication, and development in chicken gut tissues. Phenolic compounds in herbal extracts cause coccidia cell death and lower oocyst counts. Additionally, herbal additives offer benefits such as reducing intestinal lipid peroxidation, facilitating epithelial repair, and decreasing *Eimeria*-induced intestinal permeability.

Various phytochemical remedies are shown in this simplified adaptation of a table from El-Shall et al.

(2022), indicating the effects exerted on poultry in connection to coccidia infection.

CONSUMERS VOTE FOR NATURAL – PHYTOCHEMICALS ARE THE SOLUTION

Due to still rising antimicrobial resistance, consumers push for meat production without antimicrobial usage. Phytomolecules, as a natural solution, create opportunities to make poultry production more sustainable by reducing dependency on harmful drugs. With their advent, there is hope that antibiotic resistance can be held in check without affecting the profitability of poultry farming.

About Madalina Diaconu

Madalina Diaconu has more than a decade of experience in farm management and experimental trials, product development and project management (Group Roullier – Centre Mondial d'Innovation) and gut health management (EW Nutrition). She studied Animal Breeding and Communication Sciences, and has a Master's in Animal breeding and aquaculture. As Global Product Manager in EW Nutrition, she focuses on poultry gut health in challenging situations, especially coccidiosis management. She is also working on developments related to organic acids for several animal species.

About Twan van Gerwe

Twan van Gerwe graduated as veterinarian from Utrecht University in 2000. After working as poultry field vet, he re-joined Utrecht University to start a PhD project (Campylobacter in broilers) and taught poultry health. From 2009 until 2017, he worked in various R&D positions within multinational premix/feed companies. He joined EW Nutrition GmbH in 2017 and currently acts as Global Technical Director. In this role, he leads a team of species experts that support the regional teams and directly interact with customers around the globe.



POLYPHENOLS AS A NATURAL STRATEGY TO EFFECTIVELY CONTROL OXIDATIVE STRESS IN LAYERS

Steven Beckers

Global Product Manager Antioxidants

Impextraco - Belgium

Stress affects the performance, health status and thus economic profitability of layers during their egg production cycle. Oxidizing agents are formed throughout the body exceeding the hen's antioxidant capacity. Such oxidative stress leads to a suboptimal functioning of vital organs, lower egg production or -quality, as well as higher susceptibility to diseases. Therefore, productive hens are often in need of preventive tools such as highly effective bioactive antioxidants added sufficiently to their diet, for an adequate level of protection.

O XIDATIVE STRESS, AN IMPORTANT METABOLIC CHALLENGE

Oxidative stress is a major and still underestimated issue in animal production leading to significant performance losses. It is caused by multiple factors such as

- antibiotic treatments
- climatic stress, e.g. heat stress
- high animal stocking densities
- pathogenic pressure (low hygiene)
- animal handling
- feed quality and -transitioning
- ventilation
- induced molting

Also a high metabolic activity, linked to intensive production systems, represents a key disposal factor. When too much of these stressors impact the animal, an imbalance occurs between the formation of unstable oxidants (i.e. *free radicals*) and the biological capacity of body cells to detoxify them. Thus, during such challenging conditions, the animal fails

to produce sufficient endogenous antioxidants itself. An overload of *free radicals* – mainly Reactive Oxygen Species (ROS) - is generated *in vivo*. An important source of these unstable intermediates is the cell's mitochondria as these are characterized by an intense oxidative metabolism (i.e. aerobic respiration), and their functioning is very sensitive to ROS-induced damage. Excess radicals attack and damage macromolecules in vital constituents of all types of body cells, such as the cell membrane (i.e. phospholipid peroxidation), mitochondria and the genetic material. Such oxidative biological injuries provoke an impaired integrity, functioning or even death of cells, resulting in inflammation which further enhances oxidative stress. Oxidative damage on a cellular level affects several tissues and eventually the whole body, i.e. systemic level.

HEAT STRESS, A KEY DRIVER FOR OXIDATIVE STRESS ALSO IN LAYERS

Similar to other farmed livestock species, laying hens face cellular oxidative stress during their pro-

ductive life cycle. Especially environmental heat stress has shown to be one of the most crucial drivers, next to an intense metabolic rate of highly productive genetic breeds. Just like pigs, poultry have a low capacity to dissipate excess body heat to the environment, as they lack the ability to sweat. This makes them very sensitive to thermal stress, and consequently a state of oxidative stress. In particular chronic heat stress increases the formation of ROS to a problematic level, by promoting intestinal inflammation and –ischemia (i.e. a reduced blood flow of nutrients and oxygen to the intestines). It also reduces the animal's antioxidant response of gut epithelial cells, including reductions in the gene expression of endogenous antioxidant enzymes. The main way for layers to cool down their body or thermoregulate, is by evaporative cooling via panting (i.e. hyperventilation). But this in fact involves a high production of ROS and thus further enlarges the 'antioxidant gap'. All these intrinsic processes under persistent heat conditions will favor the manifesting of oxidative stress, tissue damage and consequently metabolic energy losses in layers.

The redox imbalance that oxidative stress encompasses, affects the oxidative status of laying hens' different corporal tissues, like their intestines, liver, bones and reproductive tract. An excess of ROS is

a burden that increases their requirements for body maintenance, as the repair of oxidative injuries to biological compounds demands a lot of endogenous resources like cellular energy and proteins. Inevitably, such a metabolic drainage will undermine the genetic potential of layers and thus restrict their overall egg output.

KEY CRITERIA FOR BIOACTIVE DIETARY ANTIOXIDANTS

A body state of oxidative stress requires extra dietary supplementation of more effective bioactive antioxidants, thus beyond Vitamin E, C, A or Selenium. Distinct classes of polyphenols originating from specific botanical sources have proven to be powerful and versatile antioxidant solutions. Not all polyphenolic types are as suitable or efficacious in mitigating the stress level. For polyphenols to be truly impactful *in vivo* antioxidants, they require particular characteristics. First, they should have a moderate chain length or molecular weight to guarantee an adequate gut absorption. Secondly, a high water solubility is of utmost importance to also provide intra-cellular protection of key biological structures. Moreover, a sufficiently low redox potential value is a crucial chemical property for an effective electron donation to different radical species (incl. used antioxidants like oxidized Vit. E). Over-



all, selected polyphenols should dispose of multiple antioxidant mechanisms such as a

1. **broad-spectrum neutralization** of different radical types (i.e. scavenging power),
2. **significant recycling** of oxidized *in vivo* antioxidants (i.e. regenerating power),
3. **active stimulation** of the endogenous antioxidant system (i.e. upregulating power)

Dietary polyphenols of such a versatile nature will reduce oxidative body damage to a significant level. Firstly, this will allow a higher integrity of cells or in other words save endogenous resources. Secondly, such diverse antioxidant modes of protection against radicals, will result in a better or more efficient functioning of mitochondria in producing metabolic energy (ATP). By doing so, much more nutrients will become available for production and will not be redirected or lost to the oxidative repair of injured cells for body maintenance. Therefore, under stressful field conditions, such polyphenols will keep the animal's metabolism in a balanced state of (energy) *homeostasis*, by efficiently closing the 'antioxidant gap'.

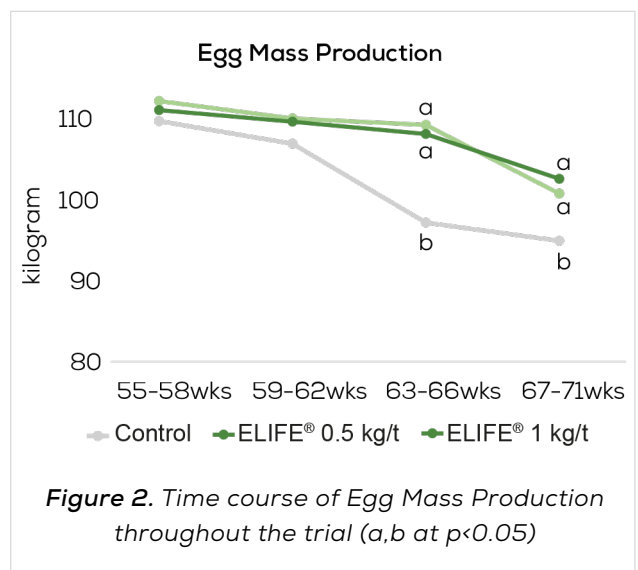
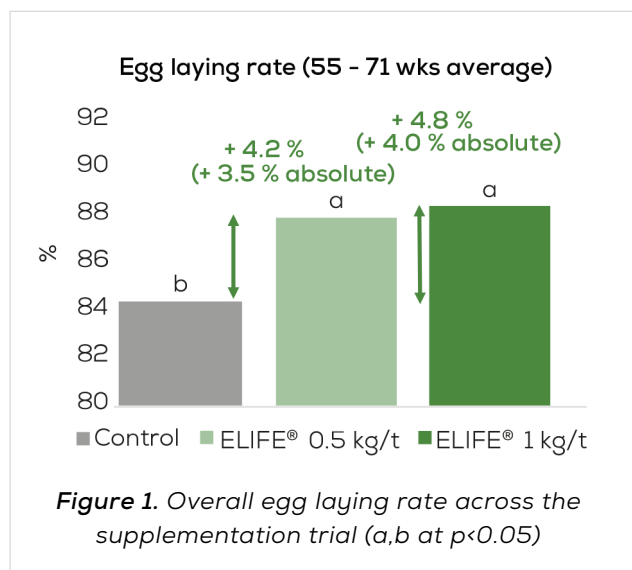
IMPROVED EGG PRODUCTION

In this article, an interesting layer trial is described. A synergistic and concentrated blend of carefully selected natural extracts – fully complying with above polyphenolic criteria - was evaluated as a possible antioxidant solution in a practical research

facility (Brazil, 2022). A total of 192 Hisex Brown® phase 2 laying hens of 55 weeks old, were kept for 4 subperiods of each 30-days long in the same house. All birds were randomly assigned to 3 treatment groups (Control, 0.5 and 1 kg/t ELIFE® antioxidant supplementation). This way, all groups were standardized on equal body weight and egg production rate at the start of the trial. All birds had free access to water and feed, being a standard commercial corn-soy based diet.

Throughout the entire experiment, laying rate was consistently higher for both antioxidant dosages compared to control. Overall, over the 16 weeks of trial, both supplementation groups achieved a significant improvement ($p < 0.05$) of resp. 3.5 and 4.0 percentage points compared to the control group (Figure 1). This translated into resp. 4.0 and 4.5 eggs more per hen over the entire test period (or resp. 35 and 41 eggs more per 1000 hens per day). Therefore, the phytogetic blend improved persistency of the hens' laying curve (i.e. prolonged their high egg production rate during phase 2 of lay).

Due to an additional improvement in average egg weight, both supplemented groups yielded a higher Egg Mass Production versus control during the entire experiment (Figure 2). Overall, across the total evaluation period, this resulted in a significant ($p < 0.05$) increase in EMP of resp. 5.8 and 5.7 % compared to the control group.



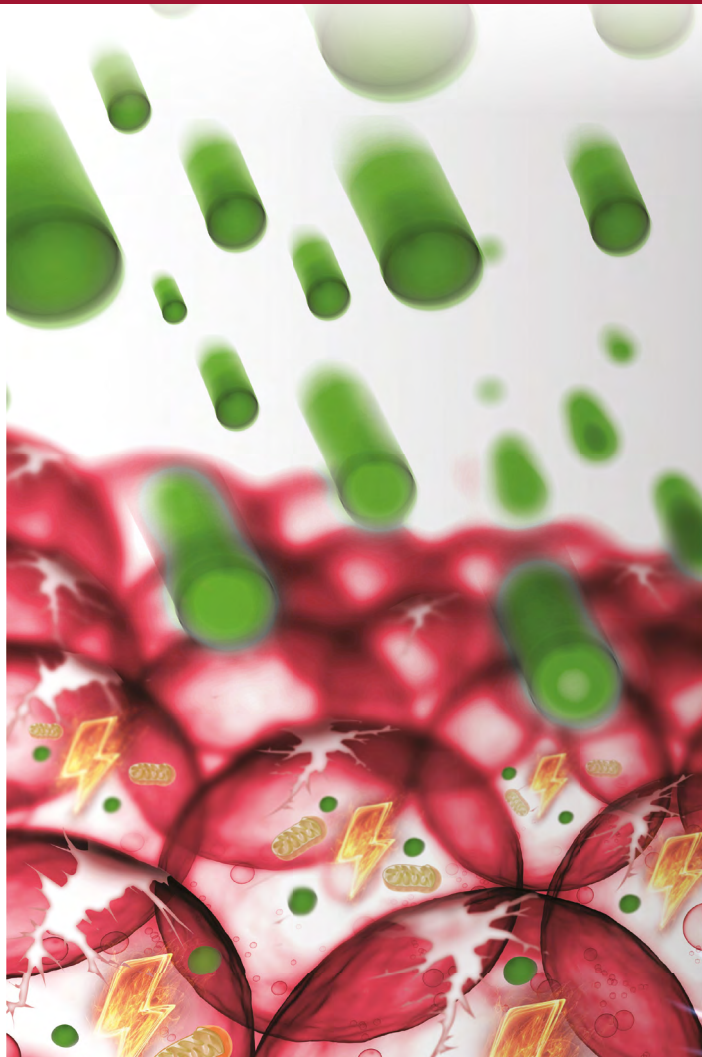
HOW TO DEAL WITH OXIDATIVE STRESS?

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Natural cell protection



**Oxidative stress is an attack on the integrity of animals' body cells.
To solve this problem and increase your profitability use ELIFE®:**

- **100% natural** dietary blend of antioxidants of EU origin
- **better live performance, meat yield & animal product quality** as shown in supplementation trials
- **cost-effective benefits** as consistently proven at major integration systems worldwide

Do you also want to benefit from the commitment of Impextraco? Contact your sales representative at info@impextraco.com or take a look at www.impextraco.com



 **Impextraco®**
Optimizing feed ingredients

Moreover, the balanced polyphenolic mixture enabled a more efficient egg production during phase 2 of lay, by reducing the feed conversion ratio. Over the entire trial, hens from the 0.5 and 1 kg/t ELIFE® treatment groups showed a significant ($p < 0.05$) reduction of resp. 10 and 13 points versus hens from the control (Figure 3). All this, presumably, by strongly alleviating the level of cellular oxidative stress and thus body tissue damage within these high-performing hens (i.e. fewer nutrient losses).

BENEFITS BEYOND LAYING PERFORMANCE

Next to hindering egg production, oxidative stress also leads to a suboptimal egg quality. This was illustrated in the same trial by an improved overall egg quality, especially at the highest ELIFE® dosage. Firstly, eggshell strength was significantly ($p < 0.05$) improved (Figure 4). This most probably can be explained by a better neutralization of inflammation-inducing ROS, which are omnipresent in the gut. In other words, ELIFE® allowed for a higher integrity of epithelial cells on the intestinal villi, and thus improved the absorption of dietary calcium. Secondly, the level of yolk Vit. E (antioxidant capacity) was drastically increased by 53 % ($p = 0.1208$), thus also contributing to a higher nutritive value for consumption (Figure 5). Finally, at this same dosage of 1 kg/t, the sampled eggs displayed a significant ($p < 0.05$) reduction in yolk TBARS level, which indicated less lipid per-

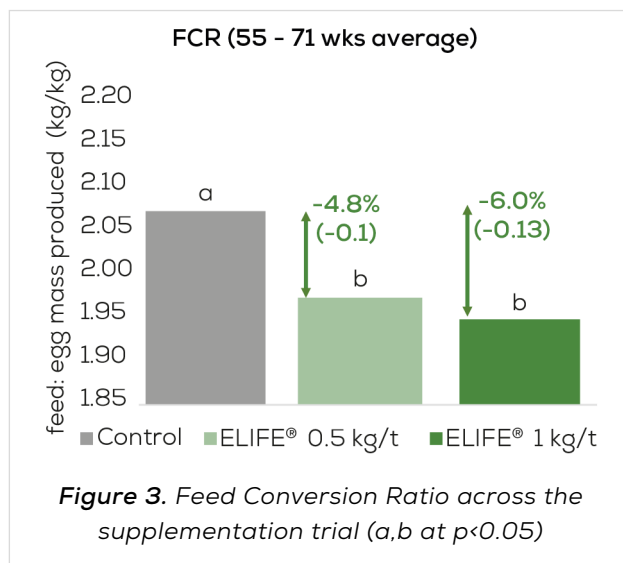


Figure 3. Feed Conversion Ratio across the supplementation trial (a,b at $p < 0.05$)

oxidation or an improved shelf life (Figure 6). This last finding was in line with the yolk ROS level, which was significantly ($p < 0.05$) reduced by 49.1 % at the 1 kg/t ELIFE® antioxidant dosage.

CONCLUSIONS

The body tissues of adult layers, especially the digestive and reproductive organs, are considerably affected under conditions of oxidative stress, induced by factors such as heat stress or a high metabolic rate. This leads to several metabolic losses in the laying hen and thus a suboptimal egg performance for farmers, but also an impaired egg quality for processors and end consumers. However, treating the diet of hens with ELIFE® natural antioxidant blend during phase 2 of lay, has shown to maxi-

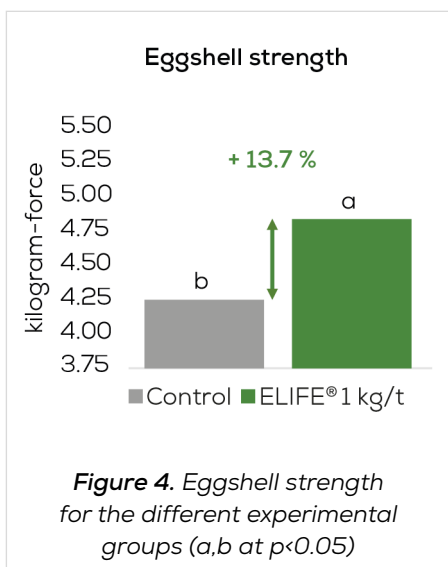


Figure 4. Eggshell strength for the different experimental groups (a,b at $p < 0.05$)

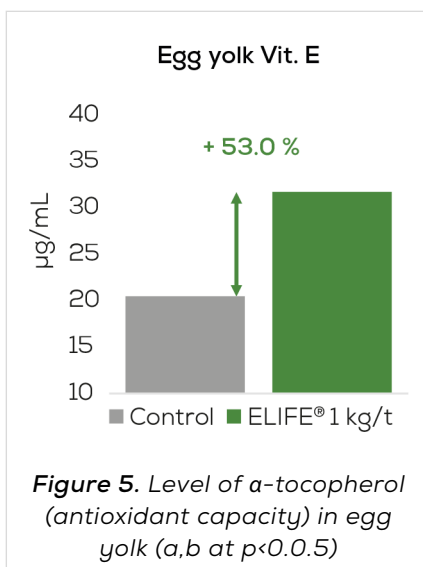


Figure 5. Level of α -tocopherol (antioxidant capacity) in egg yolk (a,b at $p < 0.05$)

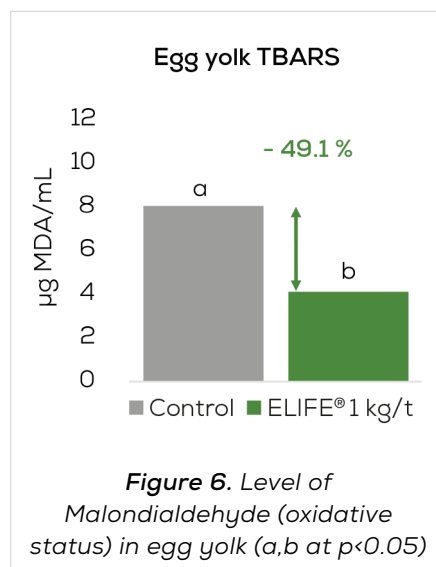


Figure 6. Level of Malondialdehyde (oxidative status) in egg yolk (a,b at $p < 0.05$)

mize productivity and thus increase persistency of egg production significantly. Moreover, average egg weight and consequently egg mass production were improved as well. This as a result of controlling the level of oxidative cell damage (e.g. energy expenditures) throughout the hen's entire body, incl. its reproductive tract. It was also empirically proven that dietary supplementation with ELIFE® significantly reduced FCR (feed to egg mass), confirming a lowered requirement for body maintenance. Such a better redox balance was backed by a lower oxida-

tive status and higher antioxidant capacity of eggs' yolk. By also preserving the integrity of the gut's epithelium as an antioxidant, ELIFE® additionally supported a higher nutrient absorption like calcium, resulting in a significantly improved eggshell strength. Finally, such promising results also invite to evaluate the polyphenolic concept in the breeder chickens application.

References are available upon request via elife@impextraco.com

About Steven Beckers



Steven Beckers is a poultry nutritionist with a Master's degree in Applied Bio-Sciences Engineering from the University of Leuven (Belgium). Since 2019, Steven is a Global Product Manager of multiple specialty feed additives at Impextraco. Here he provides technical support to customers and end users, to help establish innovative concepts in different agricultural markets. He is devoted to maximizing animal health and performance, by correctly advising and optimizing the application of value-added products.

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OVERCOMING REGULATORY HURDLES FOR PLANT-BASED FEED ADDITIVES



The growing animal feed additives market combined with surging interest from consumers in plant-based products offers a significant opportunity for developers. However, launching such products and maintaining market access involves navigating complex EU and US regulations. Here we explore how developers can successfully and efficiently secure regulatory approval to maximize their return on investment.

By Pen & Tec Consulting, part of the Argenta Group

Nutrition is crucial to maintaining animal health and condition — a key responsibility of pet and livestock owners. There is a growing awareness of the importance of feed additives among consumers who want to ensure their animals are receiving the optimal balance of vitamins, pro-vitamins, amino acids, and trace elements. But the interest in macro and micronutrients isn't the only consumer behavior change facing developers.

Now, consumers are also increasingly looking

for more environmentally friendly and sustainable products. As a result, in the animal nutritional additives market, consumers are more frequently opting for plant-based products where possible. While this presents developers with a significant opportunity, navigating the complex regulations in the EU and US to bring plant-based nutritional additives to market poses many challenges. In fact, securing regulatory approval for plant-based products can be more difficult than additives that include more 'traditional' ingredients.

Fortunately, there are actions developers can take to streamline the path to regulatory success. The first being to understand the regulatory landscapes they face.

DECIPHERING THE REGULATORY FRAMEWORK IN THE EU

In the EU, the approval and ongoing market access of plant-based additives is governed by regulations that focus on the rigorous assessments of quality, safety, and efficacy. At the helm of the regulatory framework is the European Food Safety Authority (EFSA), which undertakes an independent, detailed scientific review of the submitted dossier before reporting findings and offering advice to the European Member States and European Commission. Together, the EU Member States and European Commission then assess the EFSA's findings and original submissions to decide whether the product is approved.

This process typically takes 2–3 years. However, the authorization timeline can be drastically extended. To minimize approval timelines, the importance of compiling a comprehensive and high-quality dossier cannot be overstated. EU Regulations and EFSA guidance documents are not merely suggestions, but detailed and stringent frameworks that must be cautiously followed. Any gaps in information or lapses in adherence can result in a “stop-the-clock” approach, which elongates the approval timeline. While the EFSA provides written guidance to aid dossier creation, there are many nuances that developers have to get to grips with that even those working in regulatory roles can find challenging.

And that's not all. Developers of plant-based nutritional additives also face the dynamic nature of EU regulations. Frequent changes, such as the enforcement of the Transparency Regulation in 2021 often introduce new hurdles. For example, since the 2021 update, developers must notify the EFSA of studies involving any analytical work conducted for the registration of a feed additive prior to their commencement. Failure to do so results in a 6-month penalty period levied on the review of the application.¹

As explained by Laura Payo Lewis, Regulatory Af-

fairs Director, Animal Nutrition at Pen & Tec Consulting, Part of the Argenta Group, staying abreast of regulatory changes is paramount. *“Developers need to ensure they're receiving regulatory news as it's released. This is the best way to prepare for any changes and avoid penalties for failing to adapt to new regulations.”*

“Staying on top of regulatory updates, and what they mean for your organization is difficult and time consuming. For example, by June 2024, the EFSA is expected to release the update of four pieces of guidance, one which will impact developers in the planning of efficacy studies for plant-based nutritional additives, and another which will impact the requirements for demonstrating safety for the users handling the additives. At Pen & Tec Consulting, we proactively track and share how we expect regulatory changes to impact developers on our website, and with our subscribers via email.”

NAVIGATING THE REGULATORY LANDSCAPE IN THE US

The regulatory landscape in the US is different to that in Europe, but no less complex. There are multiple approval pathways, including:

1. GRAS (Generally Recognized as Safe): The GRAS route offers two possibilities to developers. The first involves self-determining a substance as GRAS, while the second involves submitting a GRAS determination to the FDA for review. The latter, requiring FDA approval, typically carries greater weight with industry stakeholders and regulators.

2. FAP (Food Additive Petition): FAP is an application process to the FDA for approval of a new food additive. The petition must present convincing evidence of the safety of the substance.

3. AAFCO New Ingredient Determination (American Association of Food Control Officials): The third major pathway involves a new ingredient determination made by AAFCO, an authoritative assembly providing guidance on animal feed ingredients.

When selecting the regulatory approval pathway, developers should consider the nature of their plant-



based nutritional feed additive, the public availability of safety and efficacy information, and the recognition of the approval pathway in the industry. Conventional approval timelines take around 2-3 years but can extend further if the authorities require additional clarifications, studies, or documents.

Success in maneuvering through the U.S. regulatory landscape requires a thorough understanding of all potential pathways, bolstered by strategic planning and careful dossier preparation. By choosing the most suitable pathway, developers can ensure dossiers are prepared to regulatory expectations and potential delays are minimized.

Notably, in contrast to the EU model, which relies heavily on written guidance, the US authorities propose a more ‘open’ approach to pre-submission engagement, encouraging developers to clarify questions and concerns before formal submission. As such, having contacts within the regulatory bodies, or working with an external party who does, is of great benefit to developers.

THE REGULATORY CHALLENGES FOR PRODUCERS

No matter which territory, the regulatory journey towards introducing plant-based nutritional feed additives to the market is fraught with common hurdles that developers often stumble at.

UNDERSTANDING AND KEEPING UP WITH REGULATIONS

Ensuring a comprehensive grasp of regulatory intricacies is essential to navigate the approval process smoothly. This knowledge must evolve in line with ever-changing regulations, which is a time-consuming endeavor. Failing to keep up with updates can result in delayed market entry or, in worst-case scenarios, the need to repeat costly and lengthy studies.

CONSTRUCTING COMPREHENSIVE AND HIGH-QUALITY DOSSIERS

A comprehensive dossier isn't prepared just to satisfy an item on a checklist; it's an integral element that if done well will minimize the need for regulators to ask follow-up questions and their associated delays. In contrast, a dossier that does not satisfy all requirements contributes significantly towards increased resource expenditure, cost escalation, and loss of potential earnings due to a delayed market presence.

MAINTAINING REGULATORY COMPLIANCE POST-APPROVAL

Plant-based nutritional additives don't just have to earn regulatory approval — they have to maintain it. This involves making any product, label or packaging updates as required, particularly in response to changing regulations, and submitting renewal dossiers in a timely manner. Failure to do so can result in the loss of market access and therefore a loss of earn-

ings, as well as increased scrutiny from regulators.

GEOGRAPHICAL NUANCES: UPHOLDING BRAND REPUTATION

In addition to these common challenges, each territory has its own. For example, in Europe, the non-confidential parts of applications and the opinion reflecting EFSA's findings are published and can be accessed by competitors and consumers alike. As a result, if the EFSA determines there is a toxicity risk, for instance, this information can become widely known and potentially damage the brand's reputation. The consequences of this can be so great that some companies choose to withdraw EFSA applications to avoid this outcome. In these cases, although the brand's reputation may not be damaged, there will still be wasted resources and efforts from having prepared the dossier and all the associated activities with it.

PRE-EMPTING AND OVERCOMING REGULATORY CHALLENGES

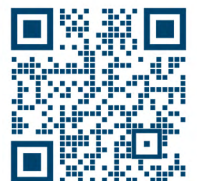
When carving your path to regulatory success, stra-

tegic planning from the outset is critical. It begins with identifying territories of interest. If a developer wants to sell their plant-based nutritional feed additive in both the US and EU, with meticulous planning, certain studies can serve approval requirements for both regions simultaneously — a strategic move that saves resources, time, and cost. What's more, gaining approval in the US and/or EU can serve as a gateway to approval in other territories. For example, securing regulatory approval in the EU can expedite the process in countries like Turkey.

In fact, the importance of strategic planning cannot be underestimated: fail to prepare; prepare to fail. As Laura described, *“Strategic planning isn't just an aspect of delivering a successful product to market; it's the fundamental bedrock of the whole process. From identifying key territories to streamlining study designs for optimal approval in multiple regions, every move we make for our clients is strategic. Having a deep understanding of regulatory intricacies is like having a roadmap to success. By working with regula-*

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tory experts, developers can access a clear path to follow that avoids costly missteps along the way."

Given the complexities associated with achieving approval for plant-based feed additives, investing in significant regulatory expertise is invaluable. Regardless of size, and whether or not an internal regulatory team exists, all developers can benefit from outsourcing at least some regulatory activities to experienced partners. These partnerships can help to shorten timelines, provide cost-saving benefits, streamline approval processes, reduce setbacks, and ultimately, maximize potential earnings.

But remember, not all CROs or consultants are the same. When selecting an organization to work with, look for one that has a close working relationship with regulatory authorities, holds an impressive track record, and offers services tailored to meet your specific needs. At the core, the best outsourced partners are those who simplify complexities and guide developers toward a smooth and successful entry into the plant-based nutritional additives market.

SECURING REGULATORY SUCCESS FOR PLANT-BASED NUTRITIONAL FEED ADDITIVES

As we navigate through the era of growing consumer interest in sustainable and natural products, the demand for plant-based nutritional additives for both pets and livestock continue to climb. This

growing market provides a great opportunity to feed additive developers. But the pathway to success is not without sizeable hurdles.

The regulatory terrain, particularly in key markets like the US and the EU, is complex and dynamic. From selecting and obtaining approval via one of the routes (GRAS, FAP, and AAFCO) in the US, to navigating stringent EFSA guidance and regulations in the EU, a successful journey entails meticulously crafted strategies and in-depth knowledge of frequently changing regulations.

While the journey into the market of plant-based nutritional additives may appear intimidating, the path can be significantly eased with robust planning, a wealth of regulatory expertise, and the right partnership. By working with an experienced partner with in-depth knowledge and expertise, developers can avoid common pitfalls and achieve regulatory approval in the most efficient way to maximize potential earnings and gain a competitive edge.

References

¹*EC Regulation (EU) 2019/1381 of the European Parliament and of the Council of 20 June 2019 on the transparency and sustainability of the EU risk assessment in the food chain and amending Regulations (EC) No 178/2002, (EC) No 1829/2003, (EC) No 1831/2003, (EC. EUR-Lex. [Online] 17 08 2023). <https://eur-lex.europa.eu/legal-content/EN/TX-/?uri=CELEX:32019R1381>.*





Innovative bio-ingredients for feed and pet food: **IT'S ALL ABOUT THE OLIVE**

Kathrin Schilling
Managing Director
BioPowder

"According to the International Olive Council, an estimate of 3.1 million metric tonnes of olive oil was produced during the season of 2021/22, up 2.9% from the year before. This translates to a massive quantity of by-products left behind, which comes with certain disposal challenges because of its fat and salt content. Fortunately, new technologies have emerged to upcycle the solid residue: modern separation, milling and sieving techniques facilitate the upcycling into distinct end products."

The trend towards healthy and sustainable nutrition has also changed the demands and priorities of the feed industry. Conscious consumers are equally conscious about the food habits of their beloved pets; dairy and meat consumers take a closer look at the food chain of cows, chickens, fish, and other farm animals. Important criteria for feed additives are mainly

- Vegan (and/or free of any animal-derived components)
- Grain-free (i.e., free of gluten and possible allergens)
- Carbon footprint (derived from by-products instead of crops)

BioPowder's mission has been to provide a fibre solution with excellent nutritive properties while ensuring maximum environmental sustainability. The company has developed a line of fine powder additives that tick many boxes, both in terms of sustainability and composition.

THE OLIVE – A VERY VERSATILE FRUIT

Olive (oil) by-products have been gaining wider attention of late, in particular the olive pit. It is a side stream from the olive oil mill or the preparation of stoneless olives, such as pickled or canned. Besides, the peel of the olive is often overlooked as a source of valuable compounds.

Olive oil manufacturing involves compressing the whole olive, which produces a solid residue of pulp, peel, and fragmented pits. According to the International Olive Council¹, an estimate of 3.1 million metric tonnes of olive oil was produced during the season of 2021/22, up 2.9% from the year before. This translates to a massive quantity of by-products left behind, which comes with certain disposal challenges because of its fat and salt content. Fortunately, new technologies have emerged to upcycle the solid residue: modern separation, milling and sieving techniques facilitate the upcycling into distinct end products.

Table 1. Chemical and dietary fibre composition of olive stone powder

Compositional data			
Dry matter (DM)	[g/100 g DM]	90.61	± 0.01
Protein	[g/100 g]	0.94	± 0.01
Ash	[g/100 g DM]	0.70	± 0.01
Total dietary fibre	[g/100 g DM]	96.54	± 0.39
Soluble dietary fibre	[g/100 g DM]	0.88	± 0.24
Insoluble dietary fibre	[g/100 g DM]	95.67	± 0.16

"An ingredient that stands out for its high content of maslinic acid and polyunsaturated fats, the olive peel flour is a truly multifunctional product, particularly indicated as a plant-based alternative to fishmeal."

INNOVATIVE FEED POWDERS AS PROTEIN AND FIBRE SOURCES

Feed and pet food manufacturers have successfully formulated unique, nutritious recipes with BioPowder products, and top choices of ingredients include **Grade AA olive stone powder**, pulverized whole olive stones, and olive peel flour.

BioPowder's most versatile food and feed ingredient is made of olive stones. In other words, the crushed olive pits that are separated from pulp and shell at the olive oil mill. While still in a wet state, the pits come out extremely clean, free of

fatty residues and dust. From this raw material, the company manufactures its Grade AA olive stone powder, which is a homogeneous light beige powder with a neutral smell and taste. It is characterized by a high fibre and a low fat and protein content.

Recommended applications include:

- Vegan, grain-free flour as a source of energy and dietary fibre
- Thickener, bulking agent, or carrier for flavours and pigments
- Soluble fibre, e.g., for extruded feed items





At first sight, the **pulverized whole olive stones** look similar to the AA grade olive stone powder. However, this product originates from the production of stoneless olives. It contains not only the ligno-cellulosic crushed stone, but also the olive seed and residues of dry pulp. Its nutritional profile is an excellent combination of fibre, proteins, and bio-active compounds. The flour contains a significant amount of olive seeds, which are a rich source of

antioxidants and vitamins. And its consistency is pasty, yet dry and well dispersible.

An ingredient that stands out for its high content of maslinic acid and polyunsaturated fats, the **olive peel flour** is a truly multifunctional product, particularly indicated as a plant-based alternative to fishmeal. In addition and similar to olive leaves, it has been a proven raw material for extraction processes and concentrate manufacturing.

ECOLOGY AND CARBON FOOTPRINT: A CRUCIAL STEP AHEAD WITH BY-PRODUCTS

BioPowder's strategy focuses solely on the transformation of by-products. Side-streams of the olive that would otherwise be burnt or recycled are now upcycled. In contrast to crops, no water, land use or chemicals are involved in the process. Everything occurs locally as an integral part of the olive ecosystem with a zero-waste outcome. In fact, the olive stone consists of approximately 45-50% bio-carbon.

Regulatory Framework:

Olive stone powder is derived exclusively from the edible olive – a recognized staple food. It is further regulated according to:

- **GMP+**

Olive stone flour is registered and approved according to GMP+

- **REACH legislation**

Olive stone flour is exempt according to Annex 5 (recently Annex 2), point 8

¹*International Olive Council, [The World of Olive Oil](#), 13 Jan 2022*

About Kathrin Schilling

Kathrin Schilling is a serial entrepreneur and specialist in waste-to-value business models. After 15 years in solid biofuels manufacturing, she created a new business line of powder additives from renewable sources. This involves innovative functional fillers, texture particles and matting agents for bio-based coating applications. Schilling has participated in numerous R&D initiatives, e.g. at Fraunhofer IVV, U.S. Department of Agriculture, KTH Royal Institute of Technology and University of North Dakota.



PLANT-BASED INGREDIENTS OFFER A ROUTE TO ENHANCED LIVESTOCK HEALTH –

while improving outcomes for planet and people

Irene Trigueros

Feed Business Unit Manager, Iberia

Golden Agri-Resources

"A more holistic approach to livestock welfare is needed. High-quality feed with key nutrients and beneficial ingredients can play an important role in animal welfare and comes with other benefits such as promoting growth and boosting productivity. For example, lauric acid – a medium chain fatty acid (MCFA) which is derived from palm kernel oil and coconut oil – has potent antibacterial and anti-inflammatory properties that support immune function."

In 2019 the World Health Organization declared antimicrobial resistance (AMR) as one of the top [10 global public health threats to humanity](#). That year, deaths associated with bacterial AMR were estimated to reach [1.27 million globally](#). If left unchecked, this figure is predicted to hit 10 million by 2050.

These warnings have contributed to successful reductions in antibiotic use, not least in the animal agriculture sector. In the ten years leading up to 2021, global sales of antibiotics for veterinary use were [down by over one-quarter](#), according to the World Organisation for Animal Health (WOAH). Some major livestock-producing countries in Europe and the United Kingdom cut sales by more than 50 percent.

Legislation is helping to consolidate these advances and further reduce reliance on antibiotics in farming. The EU's 2022 Veterinary Medicines Regulation prohibited the routine use of antibiotics in livestock, preventing the use of these powerful medicines to compensate for inadequate animal husbandry or poor hygiene.

Falling in line with new rules has proved harder in some European markets than others. Before 2022, farmers in Poland, Italy and Spain, where 'group' antibiotic treatments at the herd rather than individual level were prevalent, used [up to 20 times more antibiotics per livestock unit](#) than the lowest users, which included Iceland, Norway and Sweden. The continuing challenge for farmers in the EU – and elsewhere – is not just how to keep animals healthy without resorting to antibiotics; it's how to prioritise health without making sacrifices in other areas.

SAFE FOOD BEGINS WITH SAFE FEED

A more holistic approach to livestock welfare is needed. High-quality feed with key nutrients and beneficial ingredients can play an important role in animal welfare and comes with other benefits such as promoting growth and boosting productivity.

For example, lauric acid – a medium chain fatty acid (MCFA) which is derived from palm kernel oil and coconut oil – has potent antibacterial and anti-in-

flammatory properties that support immune function. Lauric acid has [proved to be effective](#) against bacteria such as Streptococci and Staphylococci, whilst also improving gut health, which provides material benefits for producers in the form of better nutrient absorption and improved feed conversion rate.

Similarly, alpha-glycerol monolaurates, created from a combination of lauric acid and glycerine, offer bactericidal effects around ten times more potent than their corresponding free fatty acids. Thanks to their fast lymphatic absorption, they have a systemic effect which goes beyond the gut to deliver benefits for the whole animal.

These ingredients, whether used alone or in combination, can control infections and improve intestinal health, resulting in [improved production rates in poultry and swine](#).

IMPROVING OUTCOMES FOR THE PLANET THROUGH SUSTAINABLY SOURCED FEED

In addition to functional benefits, plant-based feed inputs can contribute to a more sustainable animal agriculture sector.

[Close to half](#) of global greenhouse gas emissions from livestock production are linked to the production and processing of animal feed. Addressing these inputs is an important step to reduce the sector's overall sustainability impact.

Sustainably-produced palm oil is the [highest-yielding vegetable oil per hectare](#) and represents a more efficient use of land than alternative feed inputs such as maize and soy. Indeed, the palm industry has taken significant steps towards eradicating deforestation from its supply chains. Data from Trase



Insights shows that deforestation linked to palm oil production in Indonesia, the world's largest palm oil producer, is at its [lowest level for a decade](#), while palm oil production has increased.

This industry-wide focus on tackling deforestation also puts the palm oil industry on a strong footing to comply with the 2024 deadline for implementation of the EU Deforestation Regulation. Golden-Agri Resources (GAR) has worked hard to create traceable, sustainable and deforestation-free palm oil supply chains that support growers and their communities in the palm oil sector, achieving 98% traceability to plantation across our Indonesian palm supply at the end of 2022.

COLLABORATING FOR SUCCESS

Collaboration between farmers, scientists and industry is essential to continue to enhance livestock health – while improving outcomes for the planet and people – and to support sustainable and resilient food systems.

GAR's tailored animal nutrition products, under the GoNutri brand, use sustainably-sourced palm and palm kernel oil that meets global [traceability and sustainability standards](#). As part of GAR's integrated supply chain, GoNutri is also GMP+ certified, meaning it meets the highest industry standards for managing feed safety risks.

About Irene Trigueros

A trained veterinarian, Irene Trigueros brings more than 30 years' experience in the animal feed and nutrition sector to her role as Feed Business Unit Manager for GAR in Iberia. She has extensive commercial experience in both animal health and nutrition and commodities settings, and is closely attuned to the commercial and operational needs of European farmers and feed manufacturers.



David Harrington
teamTWO Solutions, Denmark



Reginaldo Teixeira Filho
Natturo Agronegócios, Brazil



Charles Saliba
Nutri Biotech Services, Malta

Harnessing heat shock protein responses: IT'S ABOUT MORE THAN HEAT STRESS

Heat shock proteins (Hsps) are essential for cell homeostasis and therefore, animal health. Despite their name, Hsps are for an animals' response to a wide range of stressors other than heat including pathogens, nutritional stress and even exercise. Using cactus extract, we can modulate the Hsp response, bolster disease resistance and enhance bird productivity.

HEAT SHOCK PROTEINS AND THEIR DISCOVERY

The concept of biological molecules related to genetic responses to thermal stresses were first shown in the early 1960's by Ritossa in *Drosophila busckii*. In 1962, he observed that temperature shocks induced changes in both the metabolic activities and puffing patterns of the salivary gland chromosomes of *Drosophila* larvae (Ritossa, 1962). The puffs indicated that genes were being activated in that region of the genome and the encoded proteins synthesised. Ritossa further identified the puffing pattern in response to other stressors such as endotoxins and hypoxia. Later work by other researchers identified the main group of proteins corresponding to the individual puffs, calling them "heat shock proteins" (Hsps). It was later demonstrated that Hsps, in par-

ticular members of the Hps60 and Hsp70 families, were exceptionally well conserved across organisms. For example, Hsp70 in humans is 99% identical to the mouse (*Mus musculus*), 74% identical to *D. melanogaster* and 44% identical to *Escherichia coli* (Desai et al., 2010).

HSP CLASSIFICATION

Currently, Hsps are classified based on their molecular masses into the following major groups: small heat shock proteins (sHsps) family (molecular masses 10-30 kDa); Hsp40 family (40 kDa); Hsp60 (or chaperonins) (molecular mass close to 60 kDa); Hsp70 family (70 kDa); Hsp90 family (83-90 kDa); and Hsp100/110 family (≥ 100 kDa). Each family can also include homologues with similar or slightly different functions which

may significantly differ by molecular masses (up to 10 kDa). Furthermore, Hsps can also be classified based on expression patterns, constitutive cognate (Hsc) or inducible (Hsp). Hsps share 50-80% homology with their Hsp counterparts but are either silent or play a housekeeping function. Hsps on the other hand, are synthesized at very low levels in the cell under normal conditions but on exposure to a stressor, induction of Hsp synthesis increases hundreds fold.

HSP FUNCTION

What are these highly conserved group of proteins and what do they do? Typically, when Hsps are mentioned in the same moment as livestock, it is often assumed that heat stress is the topic of discussion. This is unfortunate, as Hsps are involved with so much more than just heat stress; they are integral to cellular homeostasis.

Hsps act as molecular chaperones with a role in protein secretion and maintenance of cellular protein structures, for example, refolding proteins that denature due to cellular stress, helping to prevent cell apoptosis and contributing to cell survival. Hsps are upregulated in response to numerous stressors including nutritional deficiency, toxins, UV radiation, pathogens, microbial damage or, indeed, any cellular stress. When the cell is stressed, there is up-regulation of the Hsps to produce newly formed HSPs, which can be detected in the cell at concentrations significantly greater than the constitutive chaperones. Hsps act as an interconnected network of cell signals, a cascade of Hsps driving cellular responses. For example, numerous Hsps are involved in the innate and adaptive immune response (e.g., Hsp60, Hsp70 and Hsp90; a response which is also dependent upon Hsp regulation (e.g., Hsp70) of oxidative stress via the Nrf2-Keap1 pathway. Crucially, Hsps have also been observed to have a protective immune function e.g., restoring tolerance in autoimmune diseases, in part due to their upregulation during inflammatory stress (Van Eden et al., 2017). Malfunction of HSPs is related with many diseases, including cancers, neurodegeneration, and other diseases.

HARNESSING THE POWER OF HSP USING PLANT EXTRACTS

As discussed earlier, Hsps are not confined to higher organisms. In fact, Hsps are also found in plants, and a good example is nopal or the prickly cactus pear (*Opuntia ficus indica*) and its fruits (Figure 1). *O. ficus* tends to be found in arid and semi-arid regions and is rich in phytosterols, flavonoids and phytols and in many cultures was a source of food, drink and medicine for centuries. Importantly, the environment where *O. ficus* is found can be exposed to extremes of temperature. It was observed that *O. ficus* rapidly produces high levels of Hsps (including 71-75kDa and 62 kDa) on exposure to extreme temperature (Somers et al., 1991). Recently, the potential of *O. ficus* cactus extract (CE) to stimulate Hsps in cell lines and subsequently aquatic and terrestrial species was explored with interesting results. Using sustainable practices, the fruits of *O. ficus* are harvested, and the cactus juice extracted, concentrated and combined with a novel carrier to increase bioavailability for use in animal production (as the product Opuntech, Nutri Biotech Services, Malta).



Figure 1. Fruits of the prickly cactus pear (*Opuntia ficus indica*)

When (CE) was applied to *Artemia*, Hsp70 was expressed within 1 hour of application and provided protection against abiotic stressors as well as increasing resistance to disease infection (Baruah et al., 2012; 2014). In horses, exercise was shown to increase the production of Hsp72 after 120 minutes. However, when horses were fed CE prior to exercise, Hsp72 was significantly increased within 30 minutes



of the start of exercise (Martinod et al., 2007). In exercising horses, Hsp72 mRNA expression in skeletal muscles has been positively correlated with the peak concentration of blood lactate, indicating the role of Hsp 72 in exercise endurance and the potential for CE to improve resistance to physical stress. These two extremes of aquatic and terrestrial species, suggest the conserved nature of Hsps could extend to the stimulation of a protective response in many other species. Furthermore, a protective cellular response could also lead to improved growth, particularly in livestock species, since less energy might be diverted into mounting immune responses and the impact of disease could perhaps be mitigated.

APPLICATION OF CE IN POULTRY

Like *Artemia*, the application of CE to day-old chicks via spray leads to a large increase in Hsps (Hsp72) after 1 hour (Figure 2). Furthermore,

Hsp72 remains elevated for at least 24 hours (Parker et al., 2014).

To explore the potential performance benefits of CE in broilers, trials were undertaken in Brazil over consecutive months on several different farms. Poultry houses were naturally ventilated, bedding comprised wood shavings and birds fed a corn-soy ration with a nicarbazin/salinomycin anticoccidial shuttle. Over 3 trial periods, birds given CE at day-old via spray were compared to the production average (Control). CE was administered in addition to the standard programme and no other changes made (neither feed nor management were changed to implement cost savings, for example). Different farms were selected each time for CE application. Across all trials, birds administered CE at day-old via spray were on average 6.3% heavier, had a 1% lower mortality and FCR with an associated 9% improvement in EPEF (Table 1).

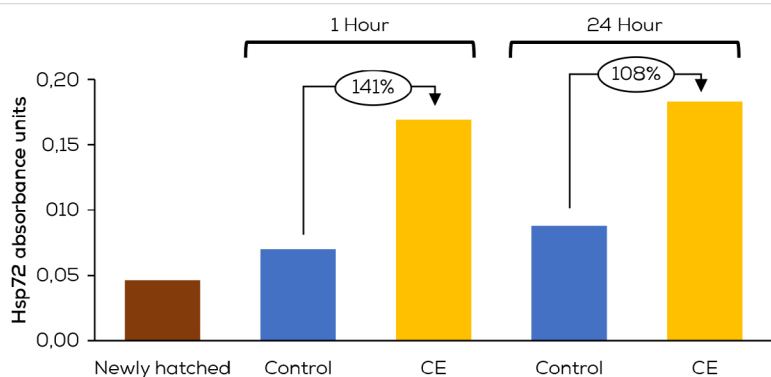


Figure 2. Hsp72 serum levels (via ELISA) in day-old chicks at hatch, 1 hour and 24-hours after CE application

Table 1. Field performance (average) of birds sprayed with cactus extract at day-old versus rest of production

Parameter	Control	CE
Duration (days)	40.0	39.7
Total no. of birds placed	828,481	120,523
Liveability (%)	96.1	97.1
Final BW bird (kg)	2.671	2.838
FCR	1.668	1.653
ADG (g/day)	66.71	71.47
EPEF	384	420

Further trials where only the early stage of production was followed (112,000 birds), showed that CE administration led to 21% and 24% lower mortality at 7 and 14 days, respectively, and 5% and 8% higher liveweight for the same periods. A key factor in the adoption of any additive (feed or water) in livestock production, is return on investment; can the producer return a profit when applying the additive? The use of CE had an average ROI 2 when applied to over 120,000 birds across 3 production cycles, including CE crops that broke with infectious bronchitis. This financial benefit of using CE is attributed mainly to the improved liveability and additional body weight, particularly noteworthy when 10,000 birds were reared in temperatures > 33°C and still achieved 6 points lower FCR, 100g higher liveweight and 1.5% higher liveability.

SUMMARY

Hsps are recognised for their importance in cell homeostasis and protecting the cell against stressors. Due to the conserved nature of Hsps across taxonomic classes, stimulation of Hsps via a plant extract such as cactus extract (CE) can stimulate similar protective responses in vastly different animals. We can potentially enhance endurance in ex-



ercising horses, survivability of aquatic species and improve the performance of livestock species.

For poultry producers, the use of cactus extract presented as Opuntech could be game changer. A single application at day-old can improve early chick viability and weight and lead to more efficient, healthier birds with the potential to reduce medicine usage, even when there is no heat stress. Hsps serve several essential and protective functions in the bird; we are simply giving nature a helping hand!

About Dr David Harrington

Dr David Harrington is the Managing Director at teamTWO Solutions (Denmark). He obtained his BSc (Hons) and MSc from Edinburgh University, UK, and his Ph.D from Newcastle University, UK researching avian immune responses to ectoparasite infections. His early career was focused on the development and commercial support of swine and poultry vaccines mainly in the EU before moving into feed additives in both commercial/strategic and technical roles globally.

About Dr Reginaldo Teixeira Filho

Reginaldo Teixeira Filho, graduated in Animal Science in 1990 from UNESP- Botucatu, MBA in commercial management, specialist in monogastric animals, with experience in national and multinational companies, currently CEO of Natturo Agrogócio's focused on the southern region of Brazil, co-author of publications presented at world congresses mainly in the line of non-antibiotics.

About Dr Charles Saliba

Dr Charles Saliba is an entrepreneur with a strong technical background in the area of biotechnology and more than thirty years experience. After graduating in Applied Biological Sciences and undertaking a Ph.D thesis in vitro modelling he worked in the Agribusiness and Life Sciences sector setting up a number of research institutes and production facilities in various countries. He also lectures at the University of Malta and has supervised over forty theses focusing on stress related issues in animal welfare. He has also served as an advisor on the board of various companies, education establishments and governmental agencies.



BEYOND CHEMICALS: THE RISE OF HIMALAYAN FLORA IN PROMOTING ANIMAL HEALTH AND WELLNESS

Naveed A. Chikan

Founder/CSO

Daskdan Innovations

The significance of utilizing Himalayan flora to enhance animal health and well-being cannot be overstated. In an era marked by a growing preference for natural and holistic approaches to animal care, there is an intensified focus on solutions originating from the Himalayan region. This article embarks on a journey to uncover the multifaceted benefits that Himalayan flora offers to animals, surpassing the prevalence of chemical-based solutions.

Herbal remedies are at the centre of phytotherapy, a practice that is nearly as old as human civilisation itself and focuses on the medicinal properties of plants. It is at the centre of traditional medical systems and has played a crucial role as a fundamental component in the process of healing in a wide variety of nations and civilisations. This practise has been passed down through the practitioners of Ayurvedic medicine, Unani medicine, and traditional Chinese medicine. These schools of medicine make use of a wide variety of plants, plant parts, and derivatives, all of which have their own unique therapeutic benefits. The shared dependence of these various systems on the phytobiome that thrives within the Himalayan vastness is what brings them together as a single entity.

As we go deeper into this investigation, a fundamental relationship between the flora of the Himalayas and the health of animals begins to emerge. This connection sheds light on the increasing significance of Himalayan flora in a world that seeks alternatives that are in harmony with the natural order of the world. In addition, the vast biome that

comprises the Himalayas has the potential to act as a veritable treasure trove for the research and development of novel feed additives that improve animal health without the use of artificial substances.

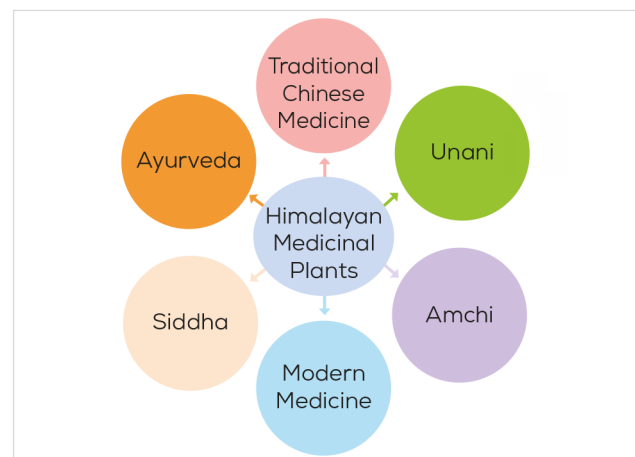
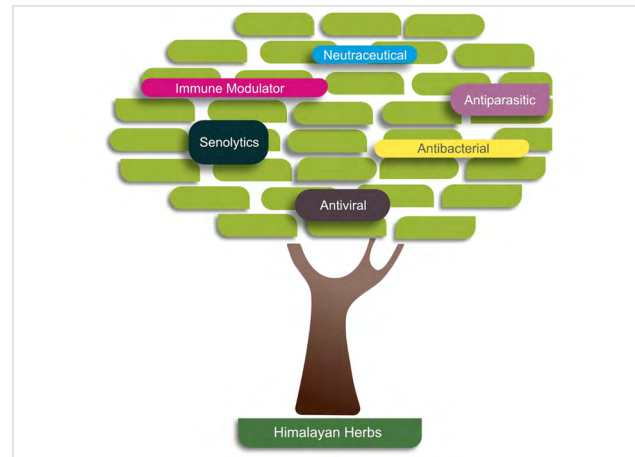
Phytotherapy, which refers to the practise of using plants and substances produced from plants for therapeutic reasons, plays an important part in the effort to improve the health of animals in the Himalayas. This is a significant part of the function that Himalayan plants play in maintaining animal well-being. The Himalayan Flora, which is home to over 25,000 different species, turns into the main attraction. This botanical diversity accounts for fifty percent of India's endemic flora and ten percent of the world's known species, which highlights the importance of the topic. Notably, over 1200 of these plants have been used medicinally for millennia and continue to play an important role in traditional medical practises such as Ayurveda, Unani, Siddha, and Traditional Chinese Medicine.

Because of the abundance of plants in the Hima-

layas, there is the possibility of developing novel, plant-based treatments to improve animal health. These treatments would be in line with the principles of responsible and sustainable animal agriculture, and they would be of value to both animals and the environment. Himalayan plants have a long history of use as medicine, but their potential as alternative treatments is only beginning to be realised. This is especially true in areas where rural communities struggle to overcome economic challenges and inadequate access to contemporary medical care. The exceptional biodiversity of the Himalayas, in conjunction with the one-of-a-kind difficulties of the region, has contributed to the development of a long-standing practise of employing the native flora for remedial reasons.

Traditional medicinal practises, such as Ayurveda, have withstood the test of time and found a place of resonance in the field of animal care thanks to the abundance of botanical resources. Ayurveda, which has its origins in India around 6000 BC, integrated its guiding principles to veterinary medicine, giving treatment, management, and animal welfare the highest priority. The inclusion of Ayurvedic botanicals for animal well-being was given credence when King Ashoka in 1463 BC established the first veterinary hospital in the world.

In addition, approximately one quarter of all human medications are derived from plants. Due to the diversity of biological roles that phytochemicals play, there has been a major uptick in interest in the role that phytochemicals play in human health and disease during the past two decades. At the moment, research efforts are being put towards determining whether or if there is a connection between phytochemicals and animal health. There is a possibility



that novel molecules that can treat animal ailments could be found in the abundant phytochemical content of the Himalayan phyto-biome. It is in the nature of animals themselves to have the intrinsic ability to recognise plants that have medicinal potential. The study of zoopharmacognosy, in which animals seek for herbs for the purpose of disease prevention and therapy, demonstrates animals' capacity for self-directed natural healing. The Himalayan flora emerges as a beacon for fostering animal welfare that is in tune with the equilibrium of nature as a result of this multidimensional interplay between ancient knowledge and contemporary investigation.

About Naveed A. Chikan

Naveed A. Chikan is a cancer biologist turned entrepreneur and the founder/CSO of Daskdan Innovations, a pioneering animal health start-up in Srinagar, Kashmir, India. With a mission to introduce plant-based alternatives to antibiotics/chemicals for food-producing animal farmers, Naveed at Daskdan has secured a \$100k grant for his proof-of-concept development. His prior experience includes working in rational drug discovery for cancer biology.



AXITAN FOCUSES ON ANTIBIOTIC-FREE PRODUCTION AND IMPROVING PRODUCTIVITY

Dr Kane Miller, Founder & CEO of Axitan

“Axitan uses a type of antimicrobial enzyme called an endolysin. Endolysins are unique in that they performs two functions. Firstly, they specifically bind only to the cell wall of the intended target bacterial species. Secondly, they then cut the bonds of the peptidoglycan layer causing the cell to burst and safely disintegrate.”

UK biotech company Axitan focuses on eliminating antibiotics from animal feed and improving productivity. It is developing a library of endolysins, and associated products, capable of targeting those pathogens that impact livestock farming historically managed through antibiotic supplements in animal feed and, in so doing, improve productivity yields. Its focus forms part of the wider WHO

One Health initiative to combat the threat posed by antimicrobial resistance caused by the overuse of antibiotics, animals accounting for two thirds of the antibiotics consumed globally each year.

In October 2022, Axitan obtained US FDA GRAS (Generally Recognised As Safe) status for the algal biomass ingredient used in its first product, FORC3®.

which promotes healthy growth in poultry by targeting the pathogen *Clostridium perfringens* that causes \$6b of economic loss each year to the poultry industry.

We asked Axitan's Founder and CEO, Dr Kane Miller, for detailed information about the company and its products. Dr Miller answered the questions:

Dr Miller, your company has been focusing on reducing the use of antibiotics in animals. Why is this issue so important to you?

Quite simply, the threat of antimicrobial resistance (AMR) is real. It already accounts for over 1m human deaths a year and the World Health Organisation expects this number to increase to 10m per annum by 2050 if left unchecked.

What is less recognised outside of the livestock industry is that the majority of antibiotics (66%) are consumed by animals. As a business we are therefore focused on developing novel antibiotic alternatives that offer the potential to both manage a range of bacteria impacting livestock farming that have historically been managed through antibiotics and improve productivity.

And what is your solution or solutions to reduce antibiotics? How are these solutions being used and how do they eliminate the need for antibiotics?

Axitan uses a type of antimicrobial enzyme called an endolysin. Endolysins are unique in that they perform two functions. Firstly, they specifically bind only to the cell wall of the intended target bacterial species. Secondly, they then cut the bonds of the peptidoglycan layer causing the cell to burst and safely disintegrate.

Our endolysins are the core component of FORC3®. In terms of usage, it is like any regular feed additive in the sense that it is a dried powder mixed into the feed at the feed mill. To give a sense of quantities required, for our FORC3® *Clostridium perfringens* poultry product, the inclusion rate is around 0.5kg per metric tonne (or 1lb/US Ton).

In terms of performance, we have seen significant drops in mortality in challenge studies. Important-

ly, we are also seeing material productivity gains in key KPI criteria such as weight gain, and Feed Conversion Ratios.

You are working intensively on pathogenic bacteria such as *Clostridium perfringens*, which is an important problem for the poultry industry. Could you give us some information about your work on this subject and your goals?

We have developed a product called FORC3® which contains endolysins specific to *Clostridium perfringens*. The formulation also contains a proprietary strain of microalgae in addition to other complementary natural ingredients. The goal is to ensure we manage *Clostridium perfringens* whilst also working to ensure the product generates an economic uplift for the farmer, even when the bacteria isn't causing any significant production issues.

Is your goal only to eliminate antibiotics? What are the other impacts of your solutions on the performance and health of animals?

Ultimately, yes. But for us that means we have to recognise that our products have to generate both an economic performance uplift as well as control problematic bacteria. This means they have to generate a return on investment across an entire complex, not just at a problematic farm.

Can you share some information about the ingredients/combination of the solutions you offer? Are your solutions completely natural?

Endolysins are ubiquitous in nature. For our *Clos-*





tridium perfringens product, we have identified the two endolysins that best target and destroy *C. perfringens* strains. The endolysins have been coupled with microalgae and other natural ingredients that help to deliver the performance uplift we are seeing in our trials.

As part of your research, you also conduct many trials for your products. Can you share with us the details of some of the trials you have conducted and the results you have obtained?

Of course, in one challenge study, mortality was reduced from 14% to below 2%, statistically matching the antibiotic control. In recent field studies the FORC3® formulation has managed to obtain FCR improvements of 4 points in an NAE farm environment. We are currently running field studies with several US producers both in NAE and non NAE settings, and are looking forward to obtaining additional data.

What is the worldwide availability of the solutions you currently offer? In which regions or countries are your products available?

Whilst our current focus is in the US, we are of

course keen to explore opportunities to offer our solutions to other regions. We welcome the opportunity to speak with producers, feed mills operators and other members of the value chain about bringing our products to markets outside the US.

Are there any new topics you will focus on in the coming period and any new solutions you are preparing to launch?

Yes, there are two strands to our ongoing product development:

1. Branching out into different animal species
2. Looking to address other economically important bacteria in poultry.

Finally, what would you like to add?

Yes, we are rapidly evolving, so if you are reading this and think what we might be doing is of interest – whether from the perspective of JV's, Strategic Partnerships, or being an integrator in need of non-antibiotic based solutions for managing a specific pathogen – please get in touch via our website.

About Kane Miller

Kane Miller, EngD., obtained his engineering doctorate in biochemical engineering from University College London (UCL). It was during his postdoctoral research at UCL that he conceived the idea of applying endolysin biotechnology to animal agriculture as a potential mechanism for managing pathogens. Miller subsequently authored a successful Innovate UK government grant that, coupled with private capital, initially funded the business. Axitan now operates out of two locations. Its pilot manufacturing centre is in Georgia, USA, and its HQ & R&D centre is located within the UK's biotech "Golden Triangle", just outside London.



UNDERSTANDING THE ROLE OF DIETARY LEUCINE ON VALINE REQUIREMENT IN POULTRY DIETS

Jason Lee

Product Development Senior Manager at CJ BIO America

PH.D. Poultry Science at Texas A&M University (USA)

“Swine nutritionists in the US were the first to consider the impacts of leucine on animal performance as many finishing swine diets contain numerous synthetic amino acids to reduce crude protein and high levels of DDGS which is a high leucine ingredient. Researchers at Kansas State University conducted a thorough literature review and meta-analysis of published BCAA data and developed a predictive model which suggested that adjustments to valine and isoleucine ratios should be made based on the diets leucine level...”

Historically, poultry production nutritionists focused on meeting minimum requirements in their diet formulations especially when focusing on amino acids. Typically, this would include lysine, methionine, total sulfur containing amino acids, threonine (Thr), valine (Val), arginine (Arg) and tryptophan (Trp). In recent years, the use of feed grade amino acids has increased in number and volume with the introduction and expanded use of first L-threonine and more recently with L-valine, L-arginine, and L-isoleucine. The expanded use of synthetic amino acids results in lower crude protein diets which has beneficial impacts on the environment, performance and welfare of the animal. As the crude protein level of the diet decreases, the actual nutrient value of the diet is closer to the minimum specification or requirement of the animal. Most nutritionists do not include a minimum requirement for the essential amino acid leucine, as it is typical in far excess of animal requirement, at least in US diets as many ingredients used in US diets contain elevated levels of leucine in relation to the other branched chain amino acids (BCAA), valine and isoleucine, especially in corn and corn products (Fig-

ure 1). Corn and DDGS have 2.5 times the amount of leucine as valine and 3.2 time the amount of leucine as isoleucine. Corn gluten meal has over 4 time the amount of leucine as valine and isoleucine.

The importance of this relationship and distribution of BCAA in ingredients is due to the common metabolic pathways that BCAA share (Figure 2). All three BCAA share common enzymes in their catabolism to include BCAA aminotransferase (BCAT) and BCAA α -keto acid dehydrogenase (BCKD) complex. The BCAT reaction takes place in muscle and involves a reversible transfer of leucine, valine, and isoleucine to their corresponding branched-chain α -keto acids. The KIC, the α -keto acid of leucine, activates the BCKD complex (Harris et al., 2005), which increases an irreversible catabolism of both Val and Ile. Thus having excessive levels of dietary leucine can cause either a valine or isoleucine inadequacy when these are in the diet at the animal's requirement which is more common in lower protein diets and diets that are utilizing L-threonine, L-valine, L-isoleucine, and/or L-arginine.

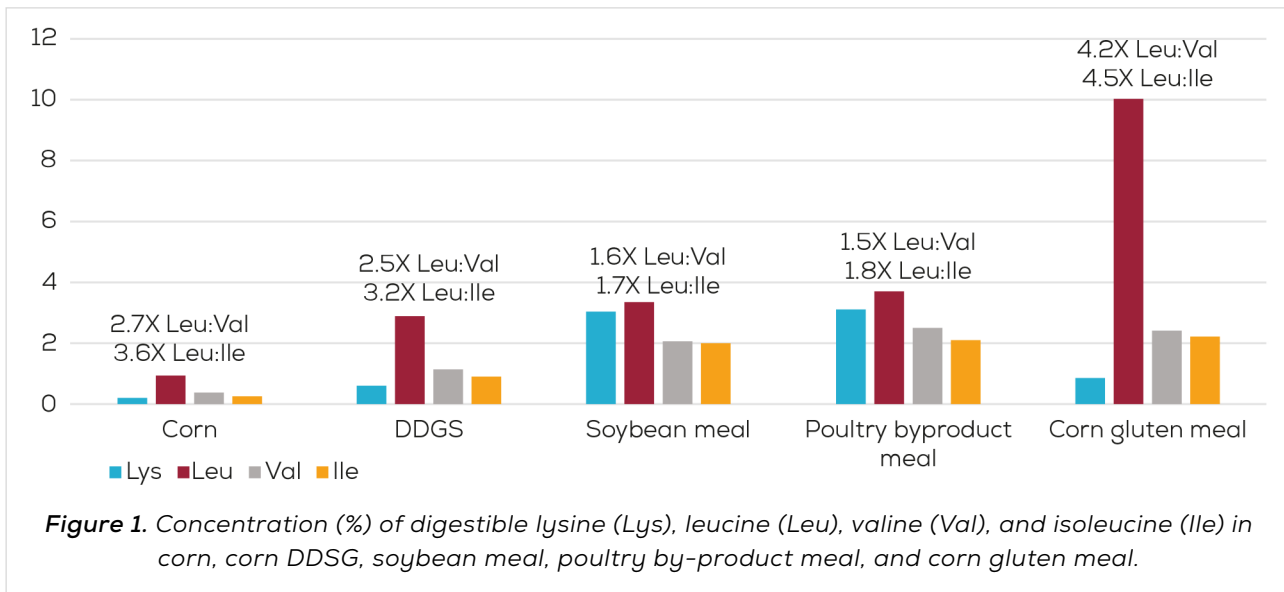


Figure 1. Concentration (%) of digestible lysine (Lys), leucine (Leu), valine (Val), and isoleucine (Ile) in corn, corn DDGS, soybean meal, poultry by-product meal, and corn gluten meal.

IMPACTS OF LEUCINE ON POULTRY PERFORMANCE

Swine nutritionists in the US were the first to consider the impacts of leucine on animal performance as many finishing swine diets contain numerous synthetic amino acids to reduce crude protein and high levels of DDGS which is a high leucine ingredient. Researchers at Kansas State University conducted a thorough literature search and meta-analysis of

published BCAA data and developed a predictive model which suggested that adjustments to valine and isoleucine ratios should be made based on the diets leucine level (Cemin et al., 2019).

Currently, US broiler diets are higher protein, contain less synthetic amino acids (typically 3 or 4), and lower levels of by-product meals such as DDGS as compared to swine finisher diets. Therefore, it was unclear if the level of leucine in the broiler diets was sufficient to elicit a negative performance response. Maynard et al. (2021) conducted an experiment utilizing a Box-Behnken response surface design investigating increasing levels of dig leucine in a broiler grower diet between 15 and 35 days of age. They reported linear increases in feed conversion ratio with incremental increases in dig leucine from 110% of dig Lysine, to 130% and 150% of dig Lysine (Figure 3). As observed in the figure, the surface curves suggest a plane separation of 4 points in feed conversion ratio between the 110% and 150% leucine diets confirming that in fact, excess dig leucine does result in performance loss of market broilers. Typical US broiler diets will vary in dig leucine ratio usually between 135% and 165% depending on dietary phase and ingredient profile. Digestible leucine will increase in diets as the bird ages and is usually higher in all vegetable diets as compared to diets containing animal protein. Regardless, Maynard et al. (2021) confirms that an increase from 110% to 130% dLeu: dLys will negatively influence

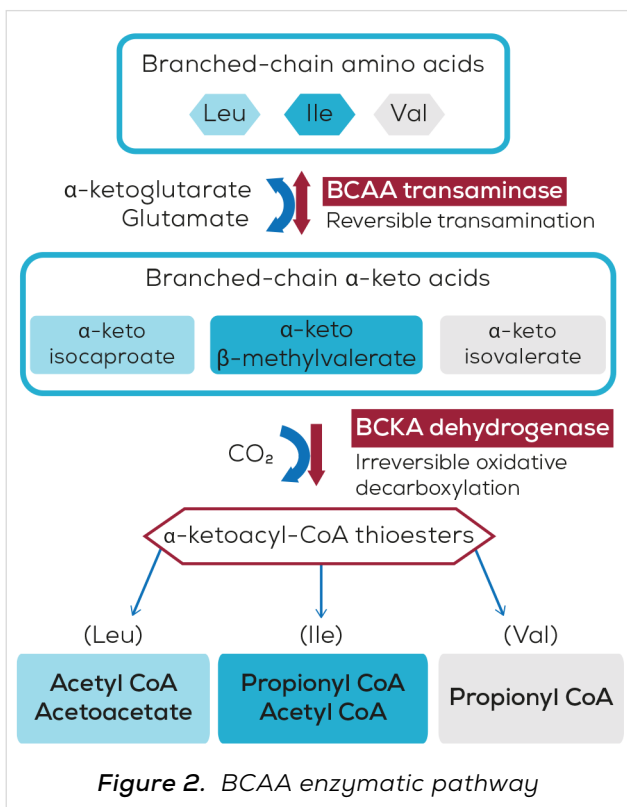
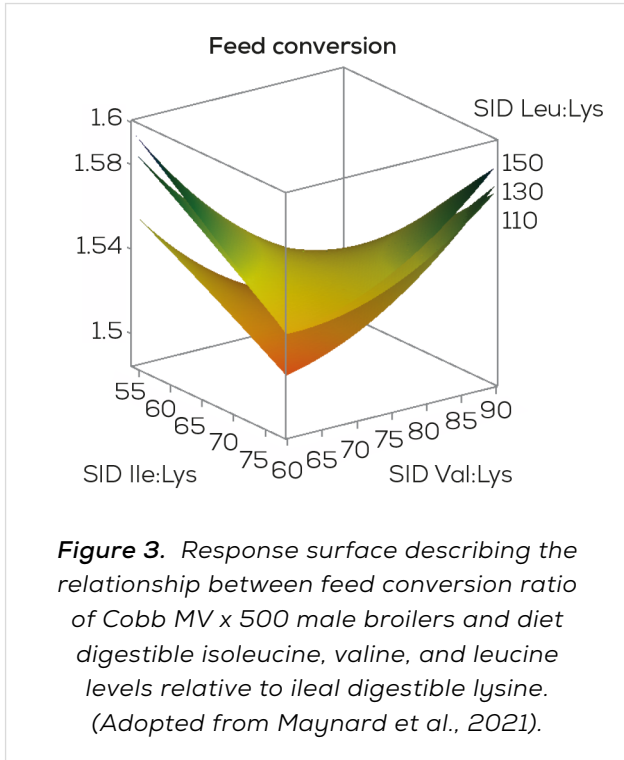


Figure 2. BCAA enzymatic pathway

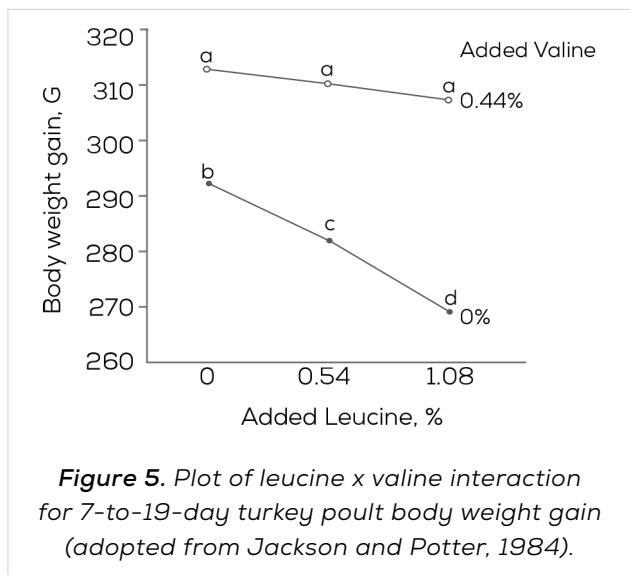
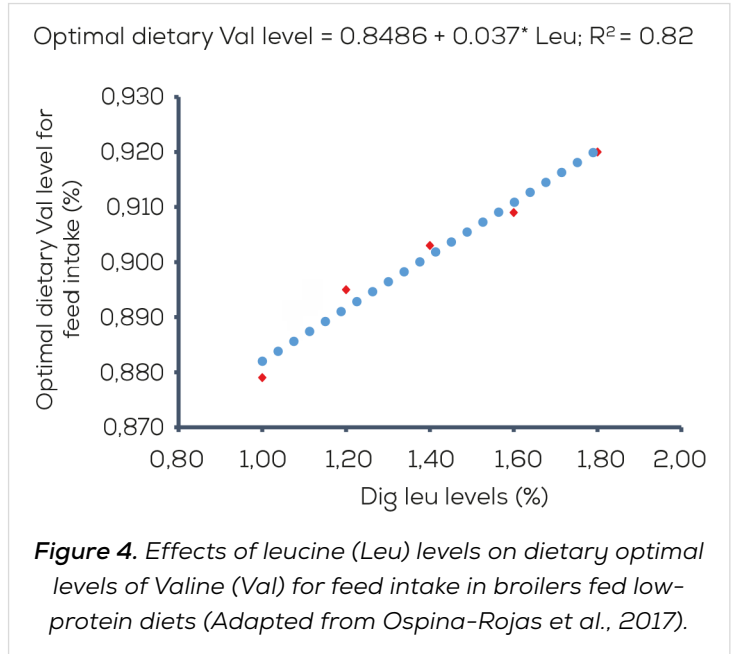


feed conversion and thus must be considered in all US broiler diets.

INFLUENCE OF LEUCINE ON THE OTHER BCAA REQUIREMENTS

As previously discussed, excess dietary leucine will increase the catabolism of valine and isoleucine and have a negative impact on animal performance if either or both of these amino acids are at or near the requirement. Cemin's et al. (2019) model recommended consideration of and potential adjustment (increase) to valine, isoleucine, and tryptophan ratios based on the dietary leucine content. It is unclear currently, if tryptophan will/should be considered in any potential poultry model as tryptophan is typically present in most poultry diets at levels beyond genetic recommendations. Regardless, Maynard et al. (2021) data demonstrates that a valine and isoleucine ratio adjustment may be needed to avoid negative performance influences of high dietary leucine.

Ospina-Rojas et al. (2017) reported that increasing levels of dig valine were required to optimize feed intake in broilers as dietary leucine increased (Figure 4) confirming that excess leucine stimulates the catabolism of valine. Interestingly, this concept/result is not



a new idea nor is it unique to only broiler chickens. Jackson and Potter (1984) reported that increasing dietary leucine had significant stepwise negative effects on turkey poult body weight gain, however, the addition of added valine eliminated the reduction in body weight at all evaluated leucine levels (Figure 5). However, more recently as research has begun to focus on the relationship of dietary leucine on valine and isoleucine requirements, researchers have aimed to not only demonstrate the antagonism but to quantify the valine ratio adjustment necessary based on dietary leucine ratio. While conducting an experiment that included two titration curves in diets containing either 115% dLeu: dLys (low) or 145% dLeu: dLys (High),

Kidd (2021) reported that the optimum valine ratio to optimize feed conversion ratio was increased from 74% dVal to 79% dVal when increasing the dietary leucine concentration (Figure 6). Corn based diets will typically have dLeu levels between 140 and 160% depending on available by-product meals.

IMPLICATIONS AND CONCLUSIONS

Prior to adoption of L-threonine use, multiple reports were unable to demonstrate the BCAA antagonism in industry type diets, most likely due to all BCAA being above the actual bird's requirement allowing for a "proper" balance. However, as the industry continues to adopt the use of additional feed grade amino acids such as L-valine, L-isoleucine, and L-arginine and we continue to understand the benefits of reducing dietary crude protein, valine and isoleucine ratios are at or near the requirement which increases the potential of the presence of an antagonism when leucine is in excess. The presence of an antagonism, specifically with valine, can not only result in reduced animal performance but also impact feather condition and bone density (Farran and Thomas 1992a; Farran and Thomas 1992b).

As we evaluate diets that may fall into this category, broiler and turkey corn-based finisher and withdrawal diets will always have higher leucine ratios as compared to starter and grower diets. Similarly, depending on the ingredient profile, broiler breeder, replacement pullet, and laying hen diets will undoubtedly have excess leucine with some US based diet approaching a dLeu: dLys ratio of 200. Thus, as an industry, we must begin to consider adjusting valine and/or isoleucine ratios used in industry diets based on dLeu, however, additional data is necessary to more accurately identify these ratio adjustments. Regardless, the most recent research demonstrating the BCAA antagonism clearly confirms the needs for BCAA prediction model in poultry similar to the Cemin et al. (2019) model in swine. The only question is must we develop a model based on species or strain?

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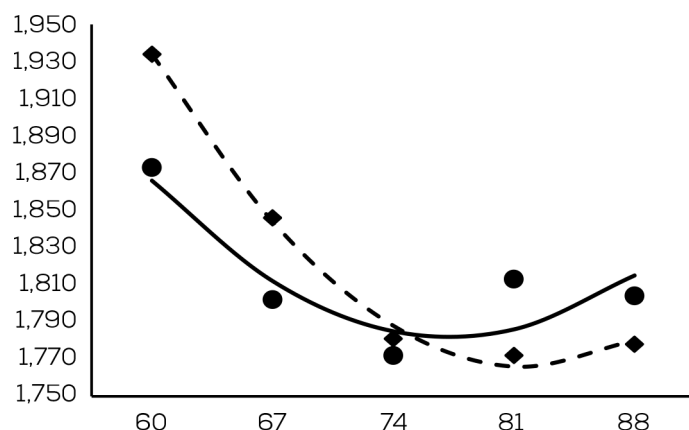


Figure 6. Feed conversion ratio response curves of 28 to 42 d Cobb 500 broilers responses to increasing dietary valine content amid low (solid line -115%) or high (dashed line -145%) dietary leucine (Adopted from Kidd, 2021).

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Axel Minetto
Product Manager Monogastric
Animine France

Zinc supplementation to cover nutritional requirements: FOCUS ON BONE ZINC

“Zinc (Zn) is one of the major trace minerals supplemented in animal feed diets.

Zinc oxide (ZnO) is a form commonly supplemented and is sometimes wrongly considered to have a lower bioavailability than sulfates. In a recent trial, published in the British Poultry Science journal, researchers investigated the correlation between the physicochemical properties of different ZnO sources and their bioavailability in broilers.”

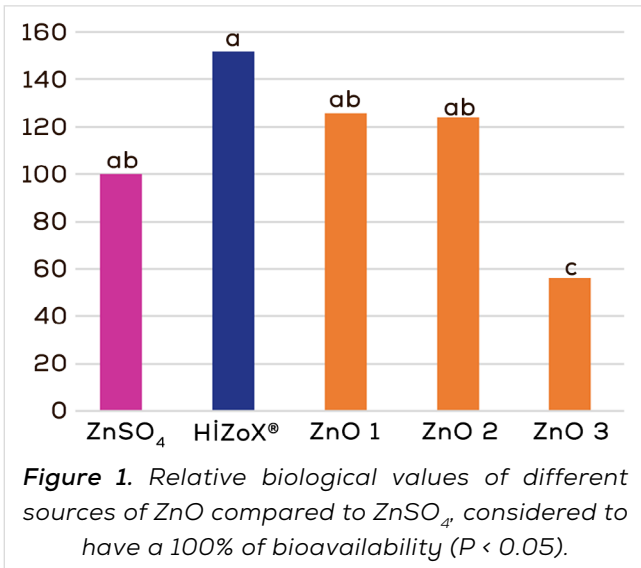
Sulfates sources of trace minerals are often assumed to have 100% bioavailability due to their high solubility in water. However, when referring to trace minerals, solubility and bioavailability are not always directly related.

Indeed, it is important that a trace mineral source can solubilize so its free ions can be taken up by the intestinal cell. Nevertheless, if this solubilization happens too early in the upper part of the gastrointestinal tract, the release of those ions will interact with other feed compounds (e.g: acid phytic and calcium) forming insoluble complexes and becoming unavailable for animal absorption.

Zinc (Zn) is one of the major trace minerals sup-

plemented in animal feed diets. Zinc oxide (ZnO) is a form commonly supplemented and is sometimes wrongly considered to have a lower bioavailability than sulfates. In a recent trial, published in the British Poultry Science journal, researchers investigated the correlation between the physicochemical properties of different ZnO sources and their bioavailability in broilers.

First, an *in vitro* trial was carried out to evaluate the properties of feed-grade ZnO sources and their dissolution kinetic behavior. Then, an *in vivo* trial was performed at INRAE (France) to evaluate the bioavailability of these sources in broiler chickens. The objective was to assess the dose response of Zn supplementation. Treatments consisted of a con-



trol diet (containing 23 ppm of native Zn) and Zn supplemented at 6 or 12 ppm, either from ZnSO₄, a potentiated source of ZnO (HiZox®, Animine, France), or 3 ZnO sources. In the last day, the right tibia of birds was collected to assess the relative bioavailability of bone Zn (Figure 1).

The experiment demonstrated that sources with a quick dissolution kinetic in acidic condition like gastric pH (similar to the ZnSO₄ ones), have similar bioavailability to the sulfate reference (ZnO 1 and 2). In the opposite, ZnO sources with an inert dissolution kinetic showed the lowest bioavailability values (ZnO 3). Finally, in between, the study demonstrated the specific properties of HiZox®: a source with small aggregates and agglomerated particles. HiZox® showed the highest bioavailability, compared not only to the other ZnO sources, but also to ZnSO₄.

The bioavailability of HiZox®, which proved to be superior to the ZnSO₄, can be considered at least the same as the best chelates in the market. Two recent trials performed by Animine compared the concentration of Zn in bone (the best biomarker of the zinc bioavailability in farm animals) from broilers fed HiZox® versus other chelated sources. The first trial compared HiZox® to a methionine hydroxy analog (MHA) source of Zn in European conditions. Levels tested were 70 or 35 ppm of Zn. Native Zn concentration was 34 mg/kg and the



animals were slaughtered at 35d (Figure 2, Trial 1). The second trial compared HiZox® to an amino acid source of Zn in North American conditions. Levels tested were according to genetic lines recommendation (100 ppm of Zn). Native Zn concentration was 29 mg/kg and the animals were slaughtered at 28d.

Animine, an international and independent supplier of precision minerals

	HiZox® POTENTIATED ZINC	
CoRouge® MONOVALENT COPPER		ManGrin® PURIFIED MANGANESE
	AniMix® UNIQUE BLENDS	

High

- ✓ Concentration
- ✓ Flowability
- ✓ Safety standards
- ✓ Stability
- ✓ Bioavailability
- ✓ Animal performance



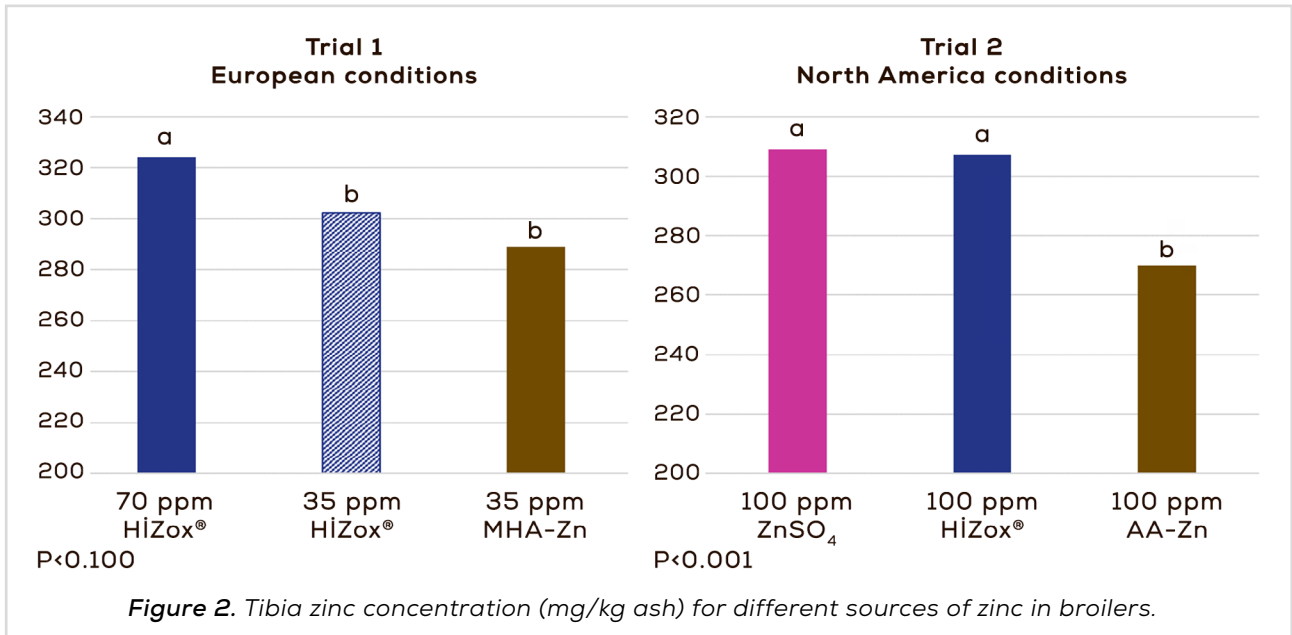


Figure 2. Tibia zinc concentration (mg/kg ash) for different sources of zinc in broilers.

Although these two trials were not designed to evaluate bioavailability, by tibia Zn results we can see that HiZox® provide at least the same or better Zn deposition than the Zn-chelate. Regarding performance parameters, HiZox® provided the same values as chelates: in trial 1 no differences on average daily gain (ADG) were observed (60.5 g/d on average); in trial 2, a tendency for a better ADG and FCR for HiZox® (61 g/d, and 1.39 g/g) in comparison to sulfate (58 g/d, 1.41 g/g) and chelates (57 g/d, 1.42 g/g) was observed.

What happened? The unique physicochemical properties of HiZox® led to slow dissolution kinetics behavior under the acid conditions of the gizzard and proventriculus. This slow release of ions allowed this source to dissociate later and to be better absorbed by the enterocytes in the small intestine. The delay on

its dissolution also avoided interactions with other feed compounds, specially phytate and calcium.

CONCLUSION

Zinc sulfates, although considered to be the reference source, can suffer a compromised bioavailability due to its fast solubilization and to interactions with feed compounds.

Zinc oxide sources can have very different bioavailability values according to their physicochemical properties and dissolution kinetics behavior.

HiZox®, a potentiated source of zinc oxide with small aggregates and agglomerated particles, has proven data on high bioavailability, not only compared with other oxides and sulfates, but also with the more known chelates in the market.

About Dr. Alessandra Monteiro

Dr. Alessandra Monteiro is an animal scientist graduated in Brazil. In 2014 she started her PhD degree in Animal Production in partnership between the State University of Maringá (Brazil) and INRAe (France). In 2017, she worked as a Postdoctoral Research Associate at INRAe. Alessandra joined Animine in 2018 and have been working with the research and development group since then. Since 2023, Dr Alessandra Monteiro became the new R&D Director of Animine.

About Axel Minetto

He is an agronomic engineer and worked for the past 8 years in Valorex (France) where he gained solid monogastric and international skills to push nutritional solutions. His particular skills are trace minerals, essential fatty acids, omega 3 enrichment, feed formulations, protein sources evaluations, nutritional matrix development and applications.



BIOACTIVE MOLECULES IN EGG POWDER CONTRIBUTE TO PIGLET'S HEALTH

Jordi Ysamat, MVetMed

Technical Sales Manager ACTIPRO

VEOS Group

"Egg powder, a nutrient with bioactive molecules, helps piglet's growth, performance and increases immunity in piglets during the first two weeks after weaning."

Egg powder is a source of essential nutrients and bioactive molecules that has a significant potential to improve piglet's health. These bioactive molecules present in egg powder include immunoglobulins, antimicrobial proteins, vitamins, omega-3 fatty acids and antioxidants. The synergistic effects of these bioactive molecules contribute to improved growth, immunity and health of young piglets.

PASSIVE IMMUNITY

The consumption of egg powder rich in IgY supplies passive immunity and offers immediate protection against a wide range of pathogens like viruses and bacteria. Immunoglobulin Y (IgY) is mostly found in the yolk part of the egg and has a structure with two heavy chains (H), each one with a molecular weight of 67 to 70 kDa, and two light chains (L), with 25 kDa. IgY significantly reduces the risk of infections, supplying better health and immunity to piglets during the first and the second week post weaning.

IgY against the antigen K88 is able to significantly inhibit the growth of *E. coli* K88, block the binding of *E. coli* to small intestinal mucus, and protect piglets from *E. coli*-induced diarrhea. *Escherichia coli* (ETEC) are bacteria that colonize the small intestine and cause severe diarrhea in neonatal and weaned piglets. The pathogenesis of *E. coli* is due to

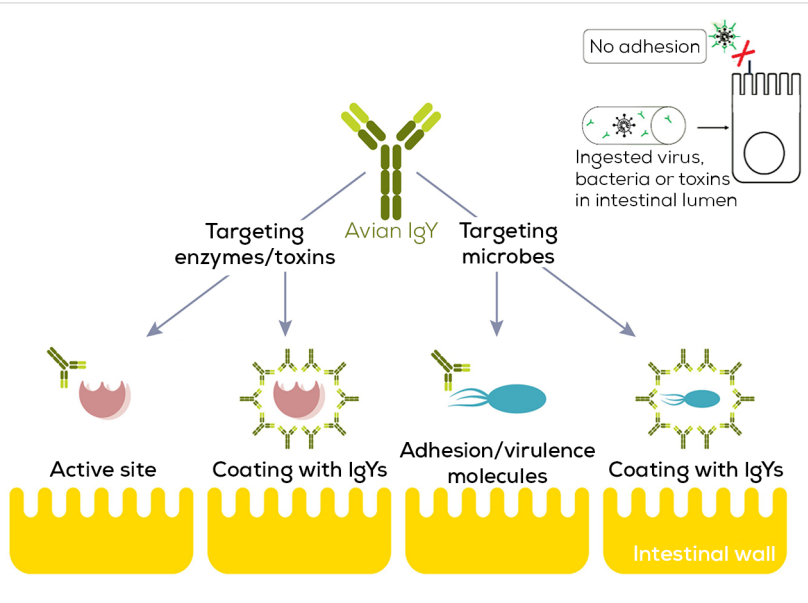
the adhesion of bacteria to the mucus of the small intestine using surface proteins like fimbriae.

Fimbriae are long filamentous polymeric protein structures found at the surface of bacterial cells. They enable the bacteria to bind to specific receptor structures and thereby colonize specific surfaces. IgY is highly effective against a wide variety of intestinal pathogenic microorganisms which cause diarrhea in animals, such as *Salmonella* spp., *Eimeria* spp., as well as porcine epidemic diarrhea virus.

Also, Ig Y significantly prevents *E. coli* K88 adhering to the jejunal and ileal mucosa of piglets with *E. coli* infection and significantly decreased *E. coli* and enterotoxin expression in colonic contents (Zhaobin Wang-Veterinary research).

ANTIMICROBIAL PROTEINS

The most common antimicrobial proteins are Lysozyme, Ovomucin and Ovotransferrin. Lysozyme is a multifunctional enzyme that serves as nonspecific innate immunity molecule responsible for the antibacterial defense. If piglets consume egg powder having lysozyme, then the health microbiota increases, and the proliferation of damage bacteria reduces. This balance is essential for an optimal digestion, good nutrient absorption and gut health in piglets.



Plenty of studies prove that Lysozyme improves gut performance and protects against enterotoxigenic *Escherichia coli* infection in neonatal piglets (Guanping Huang-Veterinary research-2018). Ovomucin is a heterogeneous mixture of glycoproteins responsible for the gel-like structure of egg white and it increases the number of macrophages.

Ovomucin and its derivatives have good anti-inflammatory, antioxidant and immunity-regulating properties. These activities keep the physical-junctions barrier, and immune associated with good intestinal health (Aobai Tu-2020). Ovotransferrin has an antibacterial effect by binding iron and preventing that it can be used by bacteria. Ovotransferrin has an antifungal, antiviral, antioxidative, antihypertensive, and immunomodulatory properties (Alexandra Acero-Lopez-2012-International food research).

VITAMINS

Vitamin D, prominently present in egg yolks, plays a significant role in the bone health and calcium metabolism. This nutrient ensures the proper development of strong skeletal structures in piglets. The vitamin D receptor can be found in the intestinal enterocyte, the osteoblast, and the renal cells, but also in the intestine, pancreas, heart, eye, brain, thyroid, parathyroid, and muscle. Deficits of Vit D can produce weak and fragile bones, at the end also paralysis in the piglets.

Vitamin A is vital in sustaining a healthy skin, supporting the immune function, keeping good vision, and promoting general reproductive health. Deficiency of vitamin A can make pathologies of the eyes and the epithelial tissues but also in the respiratory, reproductive, nervous, urinary, and digestive systems.

Vitamin B12 (Cyanocobalamin) is essential for the energy metabolism and neurological function. Piglets with deficits of Vit B 12 can make hyperirritability, pain, and incoordination. This Vitamin B 12 is mostly present in the yolk part of the egg.

Vitamin B2, Riboflavin helps to convert the feed eaten by a piglet into the energy that they need for growth. Deficits of Vitamin B2 can reduce weight gain and these piglets usually have a poor appetite.

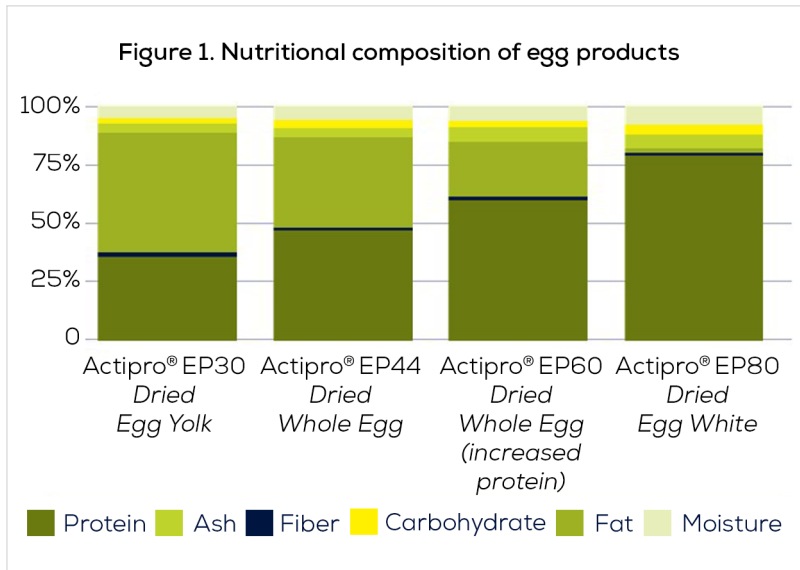
Vitamin B3, Niacin helps the functioning of the digestive system of the piglets. Deficits of Niacin can produce inflammatory lesions of the digestive tract and diarrhea and can reduce weight of the piglets.

Choline is a vital nutrient crucial for the piglet brain development and cognitive function and protects the liver functions. Choline contributes to the formation of cell membranes. It is necessary for the synthesis of the neurotransmitter acetylcholine, the synthesis of betaine and phosphatidylcholine.

Piglets' deficits of Choline can produce fatty livers and kidney damage. According to the 2012 Nutrient Requirements of Swine, choline requirements for starter/grower/finisher pigs are 400-600 mg/kg diet; and for gestation/lactation are 600-1,250 mg/kg diet.

HIGH-QUALITY PROTEIN

The high-quality protein content of egg powder supplies essential amino acids (Tryptophan, Alanine, Valine, Lysine, Methionine...) for piglet's growth and development. The ten essential amino acids for pigs are: lysine, methionine, tryptophan, threonine, valine, isoleucine, leucine, arginine, his-



tidine, and phenylalanine. Inside the egg we can find nine of these ten amino acids except only one, arginine. Egg white has all these amino acids, as well as non-essential amino acids, making egg powder a source of protein for piglets. The consumption of egg powder proteins supports optimal muscle development, organ function and overall body composition in piglets.

YOLKINE

Yolkine is a protein found in egg yolk and supplies a positive influence on piglet's immune system by regulating its activity. Yolkine helps in the efficient defense against infections while reducing the risk of inflammatory diseases. Yolkine's anti-inflammatory properties contribute to the immune system equilibrium and support piglet's well-being and health.

OMEGA-3 FATTY ACIDS

The omega-3 fatty acids present in egg yolk are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). These fatty acids provide anti-inflammatory properties which are integral to promote cardiovascular health. Omega-3 fatty acids support blood health,

decrease inflammatory processes and increase heart function. Also in sows, supplements with omega-3 during gestation and later lactation increase the number of pigs born alive (Smits et al., 2011) and reduce mortality (Rooke et al., 2001)

ANTIOXIDANTS

Egg yolks are rich in antioxidants, including lutein and zeaxanthin, which play a critical role and avoid piglet cells from oxidative stress. The fundamental role of lutein and zeaxanthin is to prevent the formation of free radicals and oxidative molecules.

Lutein also stimulates the production of antibodies. Guimarães Alarça et al. (2016) could show an increase of CD4+ and CD8+ T-lymphocyte subtypes. Kim et al. (2000) demonstrated the increase of lymphocytes and cells expressing CD5, CD4, CD8, and major histocompatibility complex class II (MHC II) molecules.

Zeaxanthin has several beneficial health effects thanks to its ability to catch free radicals, and antioxidant effects, as well as decrease inflammation. (Ana Gabriela Murillo 2019)

CONCLUSION

Egg powder, a nutrient with bioactive molecules, helps piglet's growth, performance and increases immunity in piglets during the first two weeks after weaning.

Egg powder offers a suitable alternative to the nutritionists to formulate with a high quality and safe functional protein source, with multiple benefits in piglets' diets.

References available upon request

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About Jordi Yamat

Jordi Yamat graduated from the University of Barcelona with a degree in Veterinary Medicine, specialized in nutrition. Later he completed his education with a Business Administration master's degree at the Open University of Barcelona. With more than 30 years' experience in the animal health and nutrition sector, he is now involved in business development and R&D management at the VEOS Group as Technical Sales Manager ACTIPRO, a brand dedicated to animal nutrition.



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METHIONINE ANALOGS IN RUMINANTS: DATA-DRIVEN INSIGHTS

“Isopropyl ester of the hydroxy analog of methionine (HMBi) stands out as the only reliable way to fulfill Met requirements in ruminant diets to encapsulated forms due to their stability against handling and aggressive thermo-physical processing.”

Thermo-physical processing, such as pelleting and extrusion technologies, is still the most popular compound feed industry method. Due to high operating temperatures and tremendous pressure on the matrix during the processes, surface coating cannot provide enough coating capacity for encapsulated or coated methionine (Met) sources. Isopropyl ester of the hydroxy analog of methionine (HMBi) stands out as the only reliable way to fulfill Met requirements in ruminant diets to encapsulated forms due to their stability against handling and aggressive thermo-physical processing. To achieve expected performance from HMBi in sustainable and profitable ruminant nutrition, it is vital to center our attention on the journey of Met analogs from feed bunk to ultimate site in the body.

FATE OF HMBI IN THE RUMEN AND BEYOND

Methionine additive used in the animal indus-

try (Table 1) can be categorized into three different sources as DL-Met, DL-Met sodium salt and Met analog-based. Currently, there are 5 major DL-Met-based products, one DL-Met sodium salt-based and three Met analog-based categories available in the market. The Met analog-based additives are the hydroxy analog of Met (HMBA), the calcium salt of the Met hydroxy analog (HMBA-Ca) and HMBi.

The HMBi escapes microbial degradation, unlike free methionine and 2-hydroxy-4-methylthiobutanoate (HMBA), due to rapid and effective absorption through the rumen wall (Graulet et al., 2004, 2005) and omasum (McCollum et al., 2000). In brief, absorbed HMBi is converted to HMBA and subsequently Met in peripheral tissues and transported to the mammary gland to contribute to milk protein yield (St-Pierre and Sylvester, 2005). Al-

Table 1. A summary of the sources of Met additives in the feed industry

Category	Additive ¹	Animal species	Proposed incorporation via		
			Premixture	Final feed	Water for drinking
DL-Met based	DL-Met ²	All	Yes	Yes	Yes
DL-Met based	DL-Met-fat ³	Ruminants	Yes	Yes	No
DL-Met based	DL-Met-min ³	Ruminants	Yes	Yes	No
DL-Met based	DL-Met-cop ²	Dairy cows	Yes	Yes	No
DL-Met based	DL-Met-ec ²	Ruminants	Yes	Yes	No
DL-Met sodium salt based	DL-Met-Na ²	All	No	Yes	Yes
DL-Met analog-based	HMBa ²	All	No	Yes	Yes
DL-Met analog-based	HMBa-Ca ²	All	Yes	Yes	No
DL-Met analog-based	HMBi ^{2,3}	Ruminants	Yes	Yes	No

¹DL-Met = DL-methionine; DL-Met-fat = encapsulated DL-Met by using fat, and saturated fatty acids; DL-Met-min = encapsulated DL-Met by using mineral matrices; DL-Met-cop = encapsulated DL-Met by using copolymer vinylpyridine/styrene; DL-Met-ec = encapsulated DL-Met by using ethyl cellulose; HMBa = the hydroxy analog of Met; HMBa-Ca = the calcium salt of the Met hydroxy analog; HMBi = the isopropyl ester of methionine hydroxy analog; ²EFSA, 2012; ³Graulet et al., 2005

though omasum is accepted as an absorption site of HMBA, Noftsker et al. (2005) recovered only 2.3 percent of the ingested HMBi as HMBA in omasal digesta from rumen cannulated cows, while having a positive response in milk protein concentration of the same cows following HMBi supplementation during the same study. This data showed HMBi absorption occurred before the omasal site. Dietary HMBi intake in ruminants results in an increase of seven times higher plasma Met within two hours (Kihal et al., 2021). However, because of various testing techniques and limited data on ruminal escape, intestinal absorption and Met conversion site or rate, there is still no agreement on the final Met bioavailability value of HMBi (NRC, 2021), although there is sufficient scientific evidence to understand that it is a reasonable source of metabolizable Met.

At the rumen

Breves et al. (2010) observed the fate of HMBi via the in vitro using chamber system, which keeps tissues alive in buffer to monitor absorption kinetics. To better understand rumen wall absorption, they

separated rumen side and serosal side (outside of the organ) and treated them separately with HMBi. They recovered a minimal amount of total HMBi from serosal buffer while obtaining greater HMBi from the rumen-side buffer. Evidence suggests that HMBi cannot pass the rumen wall intact, is hydrolyzed to HMB at tissue surface and carried over out of epithelium via passive diffusion or possibly at low rates of MCT-1 transport. Remarkably, the concentration gradient between the mucosal and serosal sides of rumen tissue serves as the driving force in both scenarios. This implies that a higher HMBi level in KESSENT[®] MF (Kemin Europa, Belgium) may accelerate the rate of rumen absorption compared to any counterparts with lower levels of HMBi, even though ultimately available MP is estimated to be identical in the widely used nutritional models. On the other hand, there was also no Met available from HMBi in the artificial tissue system without any esterase enzymes. Earlier in vitro reports showed that HMBi remained intact up to 60% of total amount against microbial degradation (Robert et al., 2000). Although EU Commission (2003) concluded HMBi hydrolysis

is a result of microbial degradation (non-specific microbial esterase activity), the incubation loss of HMBi (Breves et al., 2010) in both rumen tissue or Parafilm membrane (unless any enzyme or microflora) suggests that ruminal behavior of HMBi remains unclear.

Both recent in vitro and in vivo research showed that dietary HMBi had significant effects on rumen microbial environment and various final products of fermentation processes as well as the well-known systemic effects (Li et al., 2023, 2022; Qin et al., 2022). Evidence shows that “the remaining part of the HMBi in rumen” deserves more attention to better understand the mode of action of the molecule. For example, the flora can release isopropanol, which can be transformed into acetone by the enzyme alcohol dehydrogenase, and it is essential to note that this conversion is not permanent, as some of the generated acetone can be converted back into the initial form, the secondary alcohol (European Commission, 2003). Based on the previous data, Kemin is working on several product innovation projects to obtain scientific data and improve knowledge of scientific gaps in mode of

action of the molecules described by different researchers in previous reports.

Beyond the rumen

The biological action of HMBi has still been discussed by researchers with various cow-side or in vitro approaches unless there is any current consensus. European Commission (2003) observed in vivo activity of labeled both [carbonyl-14C]-HMBi and [isopropyl-14C]-HMBi (per oral) in cows.

However, this is only a “tracer study,” and incorporating the labeled compound in the tissues does not indicate direct HMB or HMBi presence (European Commission, 2003). Therefore, this data should support other bioavailability data to understand biological fate of the HMBi.

A retrospective review of HMBi bioavailability trials was compiled by recent NRC (2021) committee in a separate section. In dairy cows, up to 50% of ingested dose was reported to flow from the rumen in earlier trials (Robert et al., 2000). This data was validated with “Met availability in the circulated blood of HMBi supplemented cows” perspec-

Table 2. In vivo activity of labeled both [carbonyl-14C]-HMBi and [isopropyl-14C]-HMBi (per oral) in cows (European Commission, 2003)


Sample	Carbonyl group % of total oral sup			Isopropyl group % of total oral sup		
	24h	72h	168h	24h	72h	168h
Urine	6.1	7.3	6.7	2	3.5	2.7
Feces	2.5	3.2	3.0	1.6	1.7	1.9
Milk	8.1	12.0	16.1	11.7	14.6	15.1
Total	16.7	22.5	25.8	16.5	19.8	19.7
Fat	0.6	0.6	0.5	1.9	1.2	0.7
Kidney	0.3	0.2	0.1	0.1	Trace	0.2
Liver	2.1	1.8	1.4	0.3	0.5	0.4
Muscle	5.5	7.2	5.5	5.0	4.0	2.8
Rumen	0.3	0.1	0.1	0.2	Trace	Trace
Blood	Trace	Trace	Trace	0	0	0
Total	25.5	32.4	33.4	24.0	26.3	23.8

tive via nonlinear models (area under curve; AUC) (Graulet et al., 2005; Kihal et al., 2021), which is the accepted golden standard for nutritional models. The second study aimed to shed light on the current bioavailability of Kessent MF, sponsored by Kemin as a part of product innovation efforts.

In dairy cattle, Lapierre et al. (2011) infused labeled HMBA [1-13C] and L[methyl-2H3] Met to the jugular vein (neck vein) to determine fate of HMBA via continuous samples from arterial portal, hepatic portal (central liver vein), and mammary veins. Evidence shows that the infused HMBA provided directly 15% of the Met required for milk protein secretion, with 0.2 mmol/h synthesized within the mammary gland. Among this 15%, about 33% originates from the metabolism that occurs in splanchnic tissues, 15% takes place in the mammary gland, and the remaining 52% comes from conversions happening in peripheral tissues. The remaining 85% of HMBA is indirectly metabo-

lized, wherein Met synthesized from HMBA within tissues is utilized for intracellular protein synthesis. This process allows the Met released from protein breakdown to be exported and used by the mammary gland. In vitro, (McCollum et al., 2000) and ovine (Lobley et al., 2006) research showed that L-Met synthesis from HMBA occurs in many tissues of ruminants. It is similar to both D- and L- isomers of HMBA. L-HMBA oxidase exists predominantly in the liver and kidney; however, dehydrogenase of D-HMBA was available in most of the tissue (NRC, 2021). This data can be considered similar in terms of post-absorptive HMBi behaviours due to conversion to HMBA.

The cow liver removed approximately 38% of the infused HMBA. However, this removed HMBA was not converted into Met in the liver, as there was a decrease in the net release of Met from the liver (Lapierre et al., 2011). The data mentioned above suggests that relying solely on plasma Met concen-



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tration may not be an appropriate method for estimating the availability of HMBi and its potential to supply Met (Ardalan et al., 2021; NRC, 2021), although the linear/nonlinear plasma responses of Met to HMBi supplementation have been considered the best approach.

CONCLUSION

Altogether, the cumulative scientific data based on isotope enrichments (Lapierre et al., 2011), nonlinear area under curve responses (Kihal et al., 2021), linear plasma-free AA responses (Ardalan et al., 2021), in vitro tissue batches (Breves et al., 2010), indirect milk responses (European Commission, 2003), and ruminal microbiota assays (Li et al., 2023) indicate that HMBi is a reasonable additive to meet Met requirements of ruminants and to balance individual dietary amino acids for sustainable production. However, science-driven sophisticated approaches and specific expertise are needed to enhance the maximum performance of the Met analogs in ruminant nutrition due to complexity of biological fate of the HMBi.

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NEW SWINE VITAMIN RECOMMENDATIONS FOR MORE PRODUCTIVE AND SUSTAINABLE FARMING

Most vitamin recommendations from international scientific associations were created more than 20 years ago, but today's livestock industry has little in common with the industry as it was then. Nutritional requirements must change to address genetic selection, and modern nutrition, sanitary and environmental conditions, as well as regulatory changes. The right vitamins in the right amounts for an animal's life stage improve both performance and sustainability.

ADDRESSING THE CHALLENGES OF TODAY AND TOMORROW

Continuous development in the field of animal nutrition is essential to meet current and future challenges such as replacement of antibiotics, higher incidence of more aggressive animal diseases and a growing focus on sustainable farming.

The right levels of quality and sustainable vitamins will help farmers improve animal health, wellbeing and performance, while also protecting the environment, succeeding in a dynamic and ever-changing global market, enhancing both profits and environmental sustainability.

Vitamins play a decisive role in both human and animal nutrition. As organic catalysts present in small quantities in most foods, they are essential for the normal functioning of metabolic and physiological processes. Vitamin requirements in animals are dynamic: they vary according to new genotypes, levels of yield and production systems. The inclusion of a nutritional programme with appropriate levels of vitamins in an animal's diet not only allows to completely realise its genetic potential but, at the same time, improves various aspects related to health and well-being, its productivity and the ultimate quality of the food produced, be it meat, milk, or eggs. Healthier animals will produce more and healthier food.

Optimum Vitamin Nutrition® (OVN™) is a dynamic concept which regularly review and update vitamin supplementation in feed. OVN™ is about feeding animals high-quality vitamins, produced with the lowest environmental footprint, in the right amounts, appropriate to their life stage and growing conditions, to optimize Animal Health and Welfare, Animal Performance and Food Quality & Food Waste.

WHY VITAMIN RECOMMENDATIONS FOR SWINE NEED TO CHANGE

Vitamin recommendations from international scientific associations such as NRC and ARC were developed to prevent nutritional deficiencies. Some of the studies on which they are based are more than 20 or 30 years old. Thanks to improvements in genetic selection, nutrition, sanitary and environmental conditions, today's livestock industry has little in common with the industry as it was—not only at that time but even just a few years ago. For example, sows' performance parameters have improved 1% to 2% per year in the last five years as reported by Pig Champ, which analyzed data from hundreds of commercial pig farms. In the same period, mortality and culling rates of sows and gilts improved (+9.7% and +0.8% per year respectively), indicating that especially in breeder animals, more attention to lifetime performance must be paid, and vitamins can play an important role. Genetic companies are forecasting additional performance improvements, of even higher order of magnitude. Accordingly, vitamin nutrition guidelines will also require continuous adjustment.

Likewise, legislative changes are limiting the use of compounds such as antibiotics and growth promoters, substances which until recently had formed a habitual part of animals' diets, including those of the animal trials on which vitamins requirements were based on. At the same time many countries are developing new rules on animal welfare and environmental protection which will entail less "intensiveness" in the livestock industry, with the aim of improving the health and well-being of the animals and sustainability of the planet. Meanwhile, our farmers need to be competitive about livestock productivity (weight gain, conversion indices, final weight of the animal, mortality, etc.) to be able to face strong international competition where free trade is a tangible reality.

Nutrition programs for farm animals, including vitamin supplements, need to be adjusted in a manner consistent with improved animal management techniques and genetic development.

This adjustment should be based on the most recent scientific studies, besides considering practical experience from farmers and feed producers as well as nutritional recommendations from breeding companies which have the best knowledge on the animals they produce.

SCIENCE, INDUSTRY EXPERTISE AND VITAMIN LEVELS

Testing different levels of individual vitamins is one way to define the optimal use of vitamins in feed. Re-

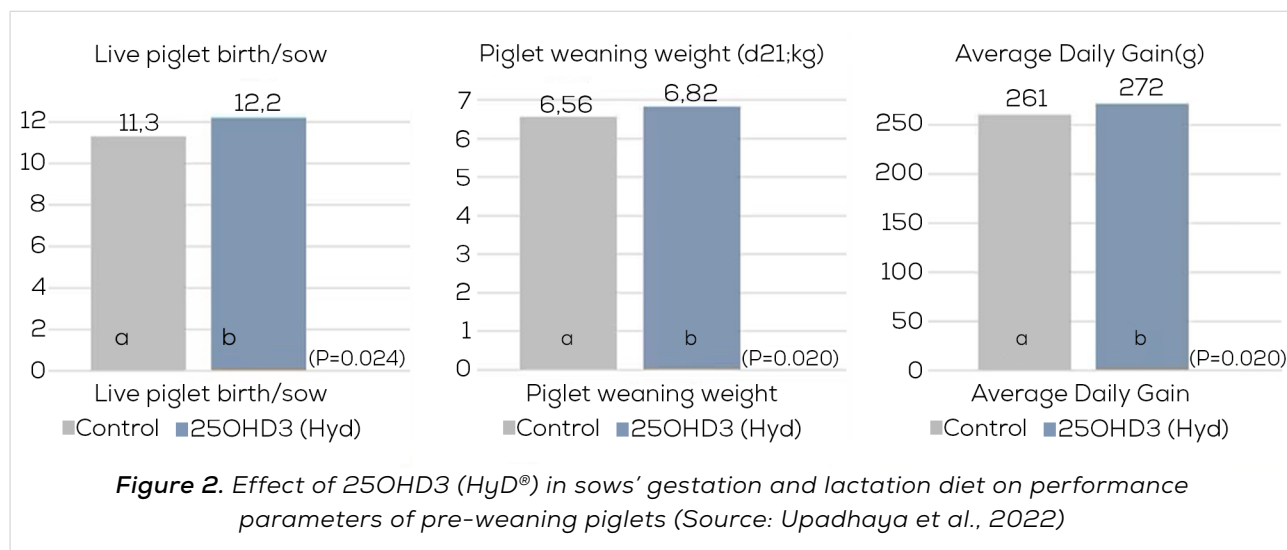
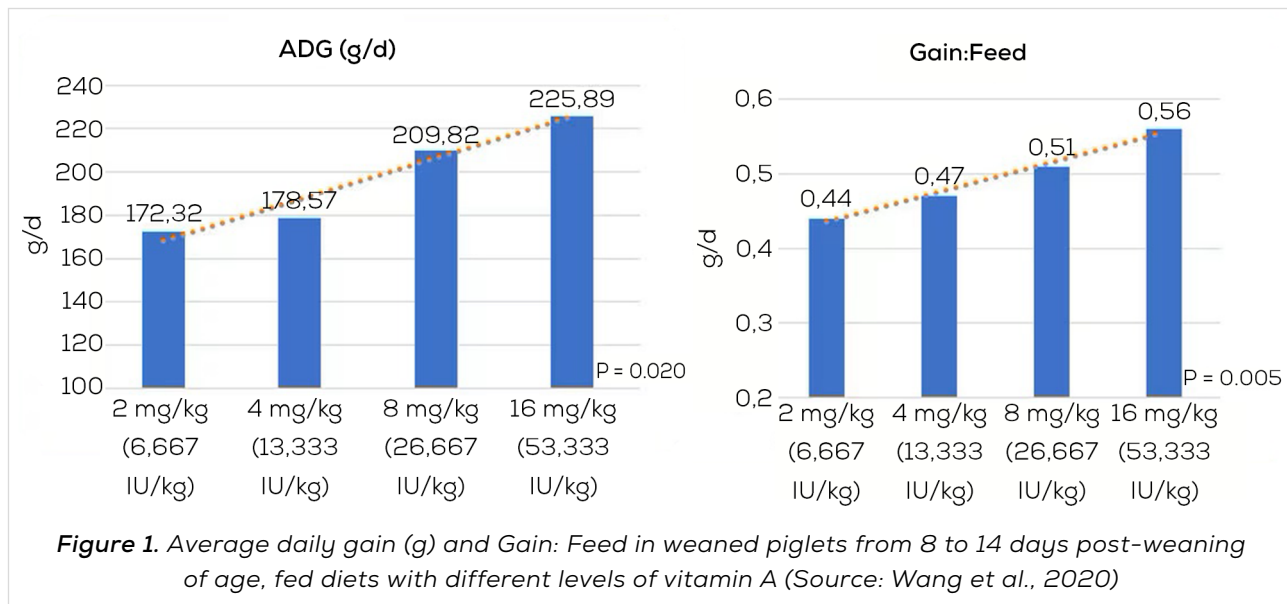


cent dsm-firmenich OVN™ webinars have reviewed experimental data extracted from more than 50 papers on individual vitamins published during the last 10 years (information available through the authors). Some examples of this research are in figures 1-3 and table 1.

Nevertheless, vitamins play complementary catalytic roles on important metabolic processes with multiple interactions among them. Therefore, we might not see the full effect of increasing levels of individual vitamins if levels of other vitamins are a limiting factor and we must better understand and quantify the effect of good levels of all vitamins in the same diet since probably we will not find an additive effect of all benefits seen in the individual vitamin trials.

Poulsen and Krogdahl (2018) compared the OVN™ supplementation levels against the Danish standard recommendations (Table 2) in 1,250 weaning piglets from 7 to 30 kg of weight and concluded that the OVN™ supplementation significantly improved daily weight gain, feed conversion ratio and production value (Table 3).

Hinson et al. (2022) confronted the average vitamin supplementation levels used by swine producers in the United States, which are close to OVN™ recommendations, and a reduced vitamin level, either to NRC recommendations for vitamins A, D, E and K (NRC, Nutrient requirements of swine, 2012) or half (or even lower) the industry average for B-vitamins. Feeding the lower vitamin levels to sows (n=245) tended to



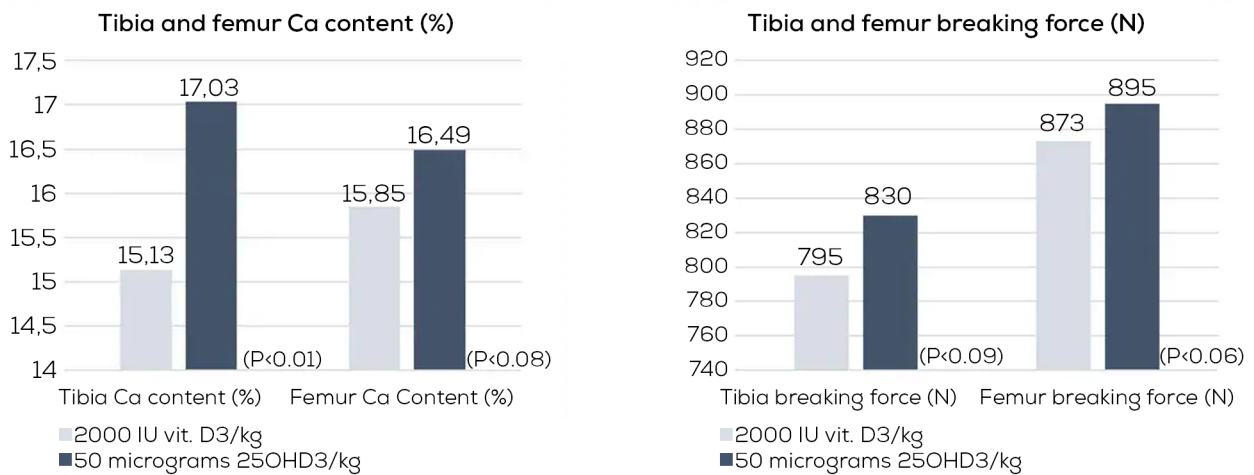


Figure 3. Effect of 25OHD3 (HyD®) in sows' gestation and lactation diet on bone mineral content and bone strength parameters of pre-weaning piglets (Source: Zhang et al., 2019)

Table 1. Effect of vitamin E in sows' diet (last week of gestation and lactation) improved α-tocopherol concentration, immunoglobulin concentration and antioxidant capacity in piglets' plasma (Source: Wang et al., 2017)

Piglets' Plasm	Vitamin E 44 mg/kg	Vitamin E 250 mg/kg	P
α-tocopherol (µg/l)	3.88	5.29	<0.01
IgG (g/l)	0.44	0.49	<0.05
IgA (g/l)	0.33	0.36	<0.05
T-AOC (IU/ml)	6.82	7.65	<0.05
GSH-Px (mmol/l)	621.69	651.34	n.s
CAT (U/ml)	7.38	8.78	<0.05

Table 3. Effect of OVN™ levels on performance of 7 to 30 kg piglets' (Source: Poulsen and Krogsdahl, 2018)

Entire trial period	Danish standard	OVN™	P value
Feed intake, FUgp/pig/day	0.88	0.89	0.016
Daily gain, g	551	566	<0.0001
FCR, FUgp/kg gain	1.60	1.58	0.0003
Production value	1.67	1.72	<0.0001
Index	100	103.5	<0.0001

Table 2. Vitamin supplementation level in 7 to 30 kg piglets' diet (Source: Poulsen and Krogsdahl, 2018)

Vitamin levels (unit/kg feed)	Danish standart	OVN™
A, IU	6,250	15,000
D3, IU	750	-
HyD, µg	-	50
C, mg	-	150
E, mg	150	150
B1, mg	3	5
B2, mg	6	15
B6, mg	4.5	8
K3, mg	4.8	6
Niacin, mg	30	55
Folic Acid, mg	-	2.5
D-Pantothenic acid, mg	15	45

FUgp: Danish feed units for weaners, growers and finishers

• **Production Value = (Growth Value - Feed Costs)/Feed Days**

• **Growth Value = Growth in Trial * FU/kg Gain * Price/FU**
 • **Feed Costs = (Weight Out - Weight In) * FU/kg Gain * Price /FU**

• **Unit: kr./pig/day**

• **Feed Price: 5 years average**

reduce litter performance and applying the same strategy to nursery piglets (n=765) significantly reduced their performance (Figure 4). Moreover, the authors observed that the reduced vitamin supplementation decreased circulating and stored vitamin levels in both sows – with potential negative impact on long-term reproductive performance – and nursery piglets.

CORRECT VITAMIN FORMULATION ADDS VALUE TO FEED

To meet the highest quality standards, nutritional and legal requirements for animal feed production, premix producers and feed manufacturers need to handle additives safely and with great precision.

Vitamins are rarely added as pure substances to feed because they are often degraded due to instability towards oxygen, light or temperature: as such they are not suited to the rigors of the feed manufacturing processes and their handling properties can be poor. Therefore, they must be properly formulated as feed additives to be added into premix, feed or drinking water before the animal access them.

It is about mixing grams or milligrams in one ton of feed with animals eating grams feed per day: certainly not an easy task. The best way to do it is following strict product formulation fundamentals where the high safety and quality of both the active substance and raw materials, combined with appropriate formulation technology, result in product forms consistently delivering an optimal combination of desirable characteristics.

For maximum efficacy feed additives like vitamins should be formulated for:

- low dust and best handling: safe for workers
- good flowability: more efficient dosing operations and less product losses
- best homogeneity in premix and feed
- superior stability in premix and feed: right daily intake of nutrients by animals
- high bioavailability: allowing an efficient absorption and best biological use by the animal
- manufactured with the lowest environmental footprint for more sustainable farming

The final goal is to achieve the best balance between handling, mixing, stability and bioavailability depending on the specific application challenges that each nutrient may face.

Table 4 illustrates a recent example on an important industry concern: large overages (up to 100%) may be required to match vitamin A nutritional requirements in poultry feed if not-stable enough vitamin products are used, as seen in this trial run by an independent premixer in Scandinavia.

IMPROVING SUSTAINABILITY ALONGSIDE PERFORMANCE

The right levels of high-quality, sustainable micro-nutrients provided to feed millers, integrators and farmers can help them improve animal health, wellbeing, and performance, while also protecting the environment, succeeding in a dynamic and ever-changing global market, enhancing both profits and environmental sustainability.

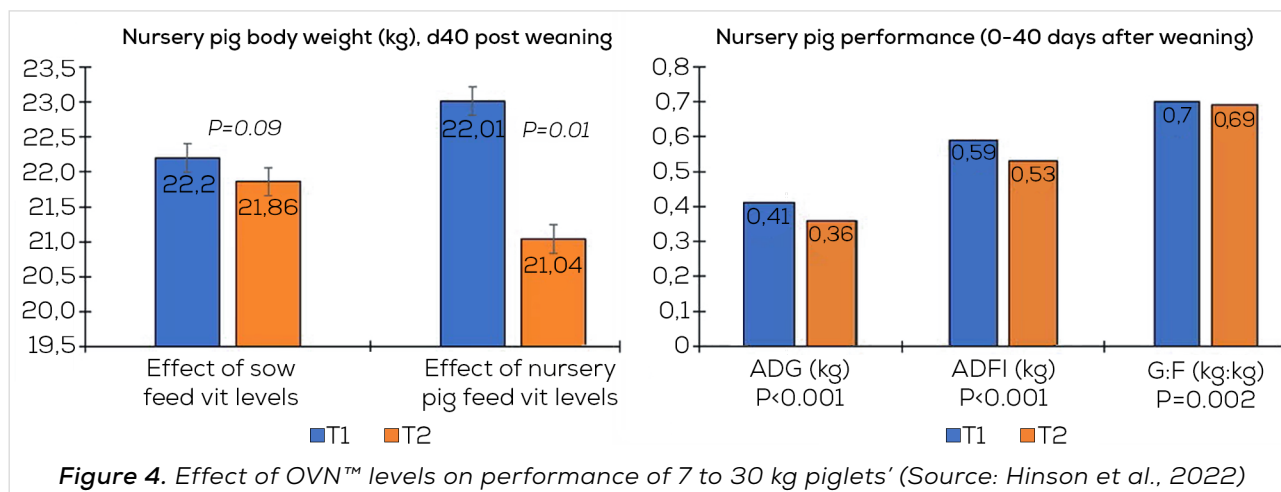


Table 4. Vitamin A stability in pelleted feed
(Source: EU Premixer data, 2020, unpublished)

70-80-90 °C temperature and 30-60-120 seconds holding time					
	70 °C (% vs target in feed)	80 °C (% vs target in feed)	90 °C (% vs target in feed)	Average (% vs target in feed)	Efficiency vs Rx A1000
DSM A1000	88%	106%	101%	98%	100%
Prod. A	49%	61%	52%	54%	55%
Prod. C	65%	57%	54%	59%	60%

- Premixes produced with 3 different vitamin A products
- Target vit A in feed = 10,000 IU vit A/kg feed
- Feed corn/wheat/soy produced by Kolding Technological Institute, Denmark
- Tests with 70-80-90 °C pelleting temperature and 30-60-120 seconds holding time
- Vitamin analyses carried out by LUFA Kiel lab, Germany (method REG(EC) 152/2009, IV, A)

In an independent trial under practical 70 °C - 80 °C - 90 °C pelleted feed industry conditions, ROVIMIX A1000 proved to be much more stable than other vitamin A products

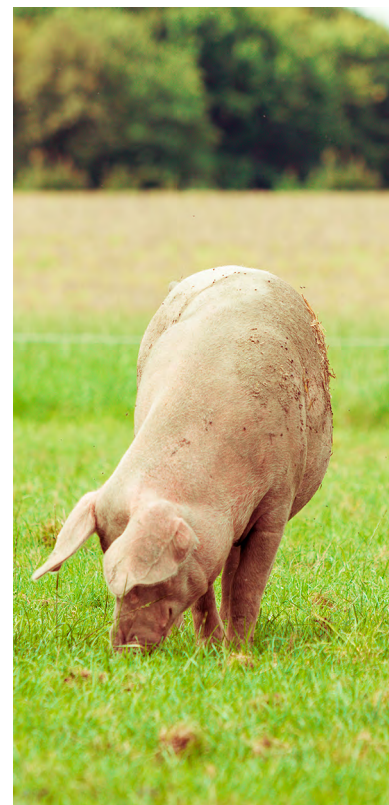
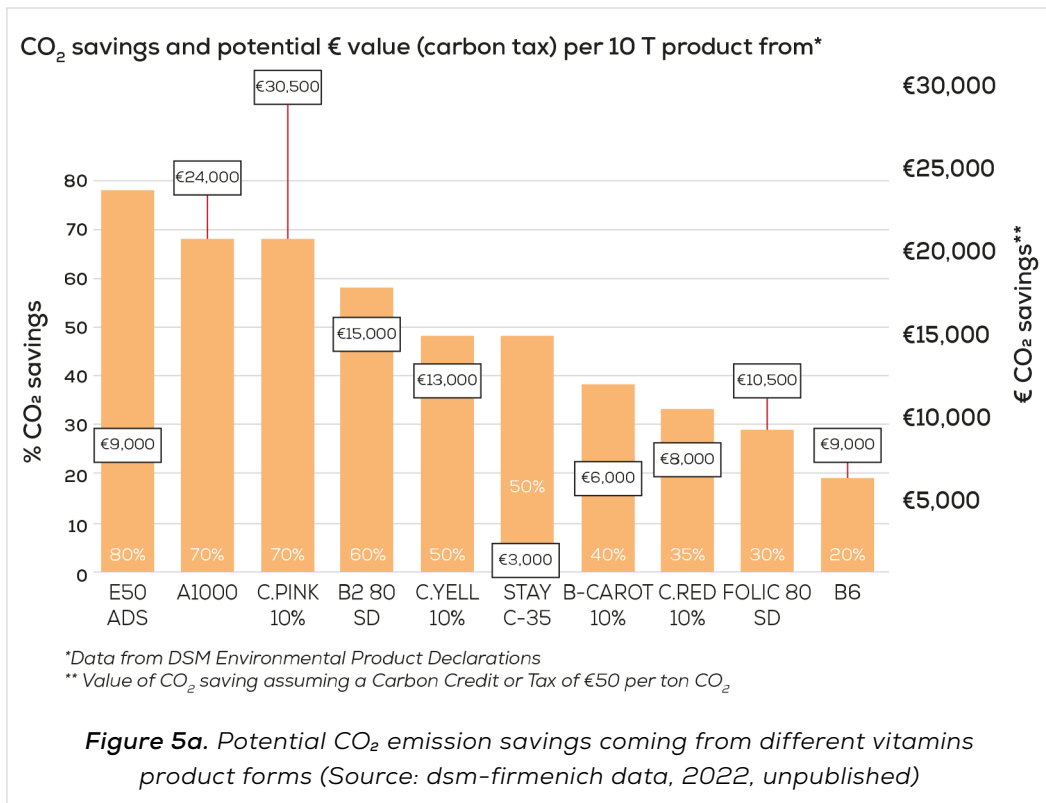
These environmental product reports may be soon part of the industry specifications according to their individual needs and commitment to sustainability in the feed and food chain.

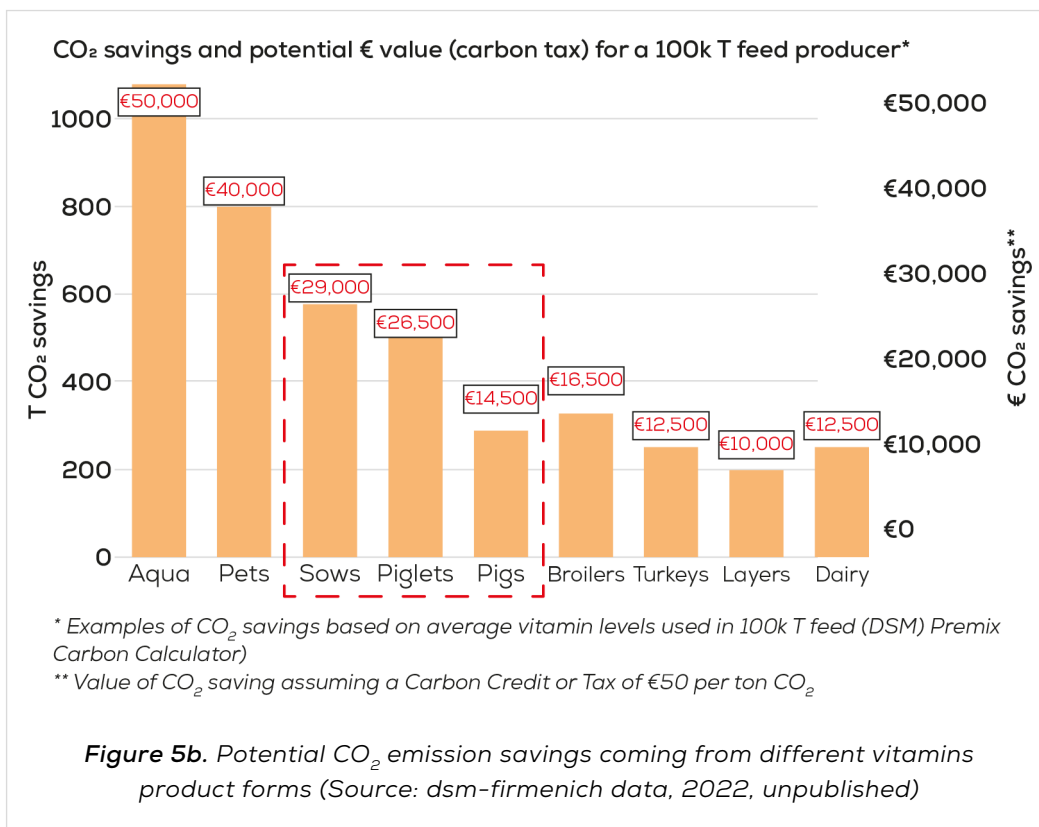
Reducing the carbon footprint of vitamin and other feed additive operations, enable feed millers, integrators, and farmers to become more sustainable, reduce their risk profile and to potentially benefit from value created from future carbon tax savings (Figure 5a and 5b).

CONCLUSION

dsm-firmenich, as part of our sustainability commitment, has developed Environmental Vitamin Product Declarations (EPD) which transparently provides environmental footprint information to support purchasing decisions and to support feed millers, integrators, and farmers to better assess product sustainability.

Supporting swine diets with appropriate vitamins help make farming more sustainable. Optimum Vitamin Nutrition® (OVN™) is about feeding animals high quality vitamins, produced with the lowest environmental footprint, in the right amounts, appropriate to their life stage and growing conditions, to





optimize animal health and welfare, animal performance and food quality and waste.

Nutrition programmes for farm animals, including vitamin supplements, need to be adjusted in a manner consistent with improved animal management techniques, new health challenges and genetic development which have supported the feed industry to achieve annual productivity improvements of +1-2%.

Testing different levels of individual vitamins as well as combination of all vitamins versus current vitamin blends used by the industry seem to be a

consistent strategy to review and adjust optimal use of vitamins in feed.

Once vitamin levels are defined, maximum attention must be paid to the use of the right vitamin product forms. This would avoid jeopardizing decisions taken by nutritionists to optimize animal health and production cost of foods of animal origin (meat/egg/milk/fish) with products which might not be stable enough or mixed properly in premix or feed. It is more essential than ever that nutritionists and purchasers engage in an ongoing dialogue to advance more sustainable farming and improve farmer profitability.

About Gilberto Litta

Gilberto Litta, an Italian national, holds a degree in Agronomy and Animal Science from the Catholic University in Piacenza, bringing almost 40 years of experience in the field of animal nutrition. He started working at the University as scientist and then moved to industry, joining Roche-dsm-firmenich in 1996, holding various roles in sales, technical support and marketing.

About José-María Hernández

José-María Hernández is a Spanish national holding a Degree in Veterinary Medicine and Masters in Exec-MBA and Marketing and Commercial Management. Close to 35 years in the feed industry, he joined Roche-dsm-firmenich in 1989 and had different technical, commercial and marketing positions in EMEA and Global (Poultry) Business and Category (Vitamins, Carotenoids) management in Spain, Switzerland as well as GM in Argentina, Uruguay and Paraguay.



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CHOLINE: A REQUIRED NUTRIENT FOR TRANSITION DAIRY COWS

“Substantial progress has been made on our understanding of choline as a nutrient for dairy cows. The introduction of rumen-protected products containing choline chloride has facilitated research into various aspects of choline's mode of action within intermediary lipid metabolism in dairy cows. This advancement has also enabled the exploration of crucial questions regarding choline's role in maintaining hepatic health and enhancing productive performance during the critical transition period for cows.”

Dairy cows are truly remarkable creatures. Consider the rapid transformation of a modern Holstein cow, going from zero to producing as many as 50 kilograms of energy-corrected milk per day in just 3 to 4 weeks of lactation. Such incredible production demands dynamic and integrated adaptations in multiple tissues to cope with the nutrient shifts during lactation onset.

Research conducted by Chris Reynolds at the University of Reading in the United Kingdom revealed that during the initial 3 weeks of lactation, there is a notable augmentation in hepatic blood flow. This flow rate rises from around 1.100 liters per hour to 2.220 liters per hour. Remarkably, this shift occurs in conjunction

with a twofold elevation in oxygen consumption by the splanchnic tissues over the same period¹. These alterations mirror the escalation in both dry matter intake and nutrient absorption within the gastrointestinal tract. This transformation parallels the heightened demand for essential components like glucose, amino acids, and fatty acids. These elements are crucial for the synthesis of milk by the mammary gland.

During the first 4 to 8 weeks of lactation, dairy cows experience negative nutrient balance, concurrent with increased susceptibility to diseases. Approximately 30 to 35% of the dairy cows are anticipated to experience a clinical disease event in the first month or two postpartum, and success during

the transition period greatly influences the success of the remainder of the lactation of a cow.

An obstacle frequently encountered by dairy cows during the initial stages of lactation is the excessive mobilization of fat tissue, which can lead to an amplified deposition of triacylglycerol within the liver. This condition is commonly referred to as hepatic lipidosis or fatty liver. While minor increments in hepatic triacylglycerol may not necessarily yield detrimental effects on subsequent performance, cows displaying a more pronounced lipidosis, ranging from moderate to excessive levels, experience compromised productivity and well-being. This situation also heightens the likelihood of premature culling. Approximately 40 to 45% of dairy cows develop moderate to severe hepatic lipidosis in the first 3 weeks of lactation.

Recent research from the University of Florida published in the *Journal of Dairy Science* sheds new light on hepatic lipidosis and its impact on dairy cow performance². In that specific cohort study, the authors examined a group of 329 cows to establish a connection between the concentration of hepatic triacylglycerol within the first week postpartum and its subsequent impact on health, production, and survival outcomes. The study's results demonstrated that once concentrations of hepatic triacylglycerol surpassed the range of 4 to 7%, the risk of disease occurrence escalated while productive performance

declined. Though not establishing causality, these associations suggest that identification of strategies to reduce the accumulation of triacylglycerol in hepatic tissue may benefit dairy cows.

One potential solution to alleviate fatty liver is to increase the export of triacylglycerols from the liver, requiring increased synthesis and assembly of very-low-density lipoproteins (VLDL). Choline, a nutrient identified in the 1850s, has subsequently been recognized as a required dietary component for mammals due to its pivotal role in facilitating the synthesis of various compounds. These include phospholipids, sphingolipids, and neurotransmitters. As it turns out, the synthesis and secretion of VLDL by the liver necessitates the presence of phospholipids, many of which fall under the category of phosphatidylcholines. Coincidentally, during the early 1920s when Canadian scientist Frederick Banting was in the process of discovering insulin, his experimental model involved dogs that had their pancreases removed. Remarkably, these dogs developed hepatic lipidosis, a phenomenon observed by one of Banting's students named Charles Best. Best, who later gained international recognition as a scientist, conducted further research and demonstrated that adding phosphatidylcholine to the diets of these depancreatized dogs mitigated the severity of lipidosis in their livers. These groundbreaking findings prompted an exploration of choline as an essential nutrient within the human diet.



Dairy cows affected by fatty liver exhibit lower plasma phosphatidylcholine concentrations. Although phosphatidylcholine can be endogenously synthesized by tissues, it is likely that the demands of choline during the transition period are greater than the supply from dietary sources and from endogenous synthesis, particularly because endogenous synthesis requires methyl groups originated by compounds such as methionine, which can be in short supply at the onset of lactation.

Ruminants, unlike nonruminants, face limitations in choline availability from dietary sources because of rumen microbial degradation. Therefore, supplementing rumen-protected choline (RPC) becomes essential. Despite widespread recognition of choline as a required nutrient for most mammals, established feeding guidelines for lactating or dry dairy cows remain absent.

CHOLINE PLAYS IMPORTANT ROLES ON HEPATIC LIPID METABOLISM

Numerous experiments at the University of Florida studied the role of choline in hepatic lipid metabolism. The experiments used a feed-restriction model to simulate the negative nutrient balance that dairy cows typically experience in the first weeks of lactation³⁻⁶. The initial utilization of this model can be credited to Ric Grummer from Wisconsin. Grummer demonstrated that the application of RPC led to a reduction in the extent of triacylglycerol accumulation within the livers of dry cows. In subsequent experiments carried out in Florida, a total of 187 pregnant dry cows in the late stages of gestation were intentionally provided with less than 40% of the energy required for both cow maintenance and sustaining the pregnancy. This restricted feeding regimen lasted for a span of 9 days and was designed to induce fatty liver in the cows. The diets administered to the cows contained varying amounts of choline ions, ranging from 0 to 25,8 g/day, in the form of the ReaShure brand of RPC. To ensure consistency, the cows were also given rumen-protected methionine supplementation during the period of restricted feeding, thus replicating the exact metabolizable methionine in-

take that would occur when the cows consumed 11 kg of dry matter on a daily basis.

Administering choline as part of the diet resulted in a substantial 31,7% reduction in hepatic triacylglycerol concentration, while concurrently increasing glycogen concentration by 54,2%. Importantly, these effects were directly proportional to the quantity of choline ion introduced through the diet. Notably, a noteworthy outcome emerged from one of the experiments: cows that received a supplementation of 25,8 g/day of choline ion via RPC exhibited an elevated hepatic secretion of triacylglycerol-rich lipoproteins⁵. This finding aligns with observations from research involving non-ruminant species and underscores the significance of choline in supporting the synthesis and subsequent export of lipids from the liver through the production of VLDL.

The introduction of RPC into the diet during the period of feed restriction induced modifications in the expression of multiple genes within the hepatic tissue, specifically those associated with lipid metabolism. These alterations in gene expression patterns indicate a decrease in hepatic lipogenesis and a simultaneous improvement in the export of lipids⁴⁻⁶. This phenomenon sheds light on the mechanism behind the reduction in hepatic lipidosis observed in cows that were supplemented with RPC.

SUPPLEMENTING RPC ENHANCES FAT DIGESTIBILITY

Choline serves as a constituent of phosphatidylcholines, a subset of phospholipids that constitute crucial components of both cell membranes and lipoproteins. These phospholipids play a pivotal role in facilitating the absorption and transportation of lipids. As cows approach the period of parturition, their dry matter intake typically decreases, followed by a gradual increase after giving birth. Research conducted by Lance Baumgard at Iowa State University has demonstrated that sudden shifts in dry matter intake can disrupt the structure of the gastrointestinal tract lining, leading to alterations in the integrity of the intestinal epithelium. This, in turn, affects the absorption of nutrients⁷.



Indeed, models involving feed restriction have been utilized to replicate disturbances within the intestinal tract that mirror the naturally occurring decline in dry matter intake during the transitional phase. In a recent study conducted at the University of Florida, the impact of RPC supplementation on the digestibility of fat in dairy cows was investigated⁶. For this experiment, 33 prepartum Holstein cows were subjected to a feed restriction regimen aimed at disrupting intestinal integrity. These cows were divided into two groups, with one group receiving 0 g/day of choline ion and the other group receiving 25,8 g/day of choline ion supplementation for a duration of 9 days during the feed restriction period.

On the ninth day, the cows were deprived of feed and were instead given a mixture of saturated fatty acids to assess the apparent digestibility of fat. Supra-mammary lymph samples were collected 6 hours after the cows consumed the fatty acids. The results indicated that providing RPC led to an increase in fat digestibility and the concentrations of triacylglycerol in both blood and lymph. This suggests that supplementing choline to cows experiencing a negative nutrient balance could potentially enhance the transport and absorption of fatty acids within the intestines.

SUPPLEMENTING RPC BENEFITS PRODUCTIVE PERFORMANCE AND HEALTH

While a wealth of literature exists detailing the various cellular mechanisms influenced by choline, a recurring question arises: Can its impact on phospholipid synthesis, liver function, or nutrient transport translate into improved health and productivity outcomes? However, experiments where interventions are applied to individual cows via diet and require careful feeding often face the challenge of limited sample sizes, which can restrict the ability to thoroughly investigate the effects of dietary changes on health and reproduction.

To circumvent this limitation and ensure the broader applicability of interventions, researchers employ meta-analytical techniques that integrate findings from multiple published studies. In 2020, a systematic review of the available literature was conducted, followed by a comprehensive meta-analysis examining the effects of supplemental RPC during the transition period⁸. This analysis encompassed 20 publications, incorporating 21 experiments involving a total of 1,313 transition cows. These cows were randomly assigned to receive either 0 g/day of choline ion or varying amounts of choline ion via RPC starting before calving.

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Results from the meta-analysis indicated that supplementing RPC during the transition phase led to a notable increase in energy-corrected milk yield by an average of 2,2 kg/day. Furthermore, there was a tendency for a reduction in the incidence of retained placenta and mastitis among the supplemented cows compared to their non-supplemented counterparts. Interestingly, the changes in energy-corrected milk yield and milk component yields exhibited a linear relationship with the amount of choline ion supplementation, up to a threshold of 25,2 g/day. The exact optimal dosage of choline ion supplementation remained uncertain due to this linear response.

The meta-analysis also unveiled that the response to choline was influenced by the supply of metabolizable methionine in the postpartum diet. This connection was expected due to the biochemical interactions between choline and methionine within the body, influencing 1-carbon metabolism and phosphatidylcholine synthesis. Even when the lactating diet provided metabolizable methionine at a level of 2,60% of metabolizable protein, supplementing RPC still increased energy-corrected milk yield.

A noteworthy observation stemming from the meta-analysis was the dearth of literature investigating the role of supplemental choline in nulliparous cows

– those that haven't given birth yet. These nulliparous cows typically comprise around 30 to 35% of the prepartum cow population on dairy farms. While it's anticipated that these cows could also benefit from choline supplementation during the transition period, this remains a relatively unexplored area in research.

THE EFFECTS OF RPC ARE OBSERVED REGARDLESS OF THE BODY CONDITION OF COWS

Given choline's role in hepatic lipid metabolism and its potential to reduce the risk of fatty liver, it's not uncommon for nutritionists and veterinarians to propose supplementing RPC primarily to over conditioned prepartum cows, which are at an increased risk of developing hepatic steatosis. To investigate this notion, we revisited data from two randomized experiments. In these studies, prepartum cows were divided into groups, with one group receiving 0 g/day of choline ion and the other group receiving 12,9 g/day of choline ion from ReaShure RPC. This supplementation began around 255 days of gestation and continued until 21 days postpartum⁹. The objective was to ascertain whether the response to RPC was influenced by the body condition of cows upon entering the prepartum group.

A total of 215 pregnant parous Holstein cows were enrolled in both experiments, with each cow's body condition score assessed twice before the treatments commenced. The cows' mean body condition was 3,51, ranging from 2,69 to 4,25. The results of this analysis revealed that irrespective of the cows' body condition scores prepartum, supplementing transition diets with 12,9 g/day of choline as RPC yielded consistent positive effects. This supplementation led to increased milk yields by 1,8 kg/day, fat yields by 0,08 kg/day, true protein yields by 0,04 kg/day, energy-corrected milk by 1,9 kg/day, and 3,5% fat-corrected milk by 2,1 kg/day. Additionally, cows that received RPC exhibited enhanced feed efficiency in converting feed into energy-corrected milk, regardless of whether they were under or over conditioned before calving. This study demonstrates that the response to RPC is observed in cows regardless of their degree of fatness at the initiation of prepartum supplementation.

RESPONSES TO RPC EXTEND BEYOND THE PERIOD OF SUPPLEMENTATION

Research conducted at the University of Florida, along with a recent study conducted by Barry Bradford at Michigan State University, has demonstrated that cows supplemented with RPC during the transition period exhibit heightened milk production during the supplementation phase, and this effect persists for several weeks after the supplementation period concludes¹⁰⁻¹².

In one experiment, cows were provided RPC from the close-up period until 21 days postpartum, resulting in a milk yield increase of 2,1 kg/day that continued for up to 40 weeks into lactation. In another separate experiment, an increase in milk yield of 2,0 kg/day was observed due to RPC supplementation, and this enhancement extended for 25 weeks into lactation.

This phenomenon is consistent with observations from various dietary interventions introduced during the transition period, which tend to positively impact animal health and metabolism and subsequently extend their effects on production beyond the intervention period. However, the precise mechanism underlying this carry-over effect remains to be fully understood.

Substantial progress has been made on our understanding of choline as a nutrient for dairy cows. The introduction of rumen-protected products containing choline chloride has facilitated research into various aspects of choline's mode of action within intermediary lipid metabolism in dairy cows. This advancement has also enabled the exploration of crucial questions regarding choline's role in maintaining hepatic health and enhancing productive performance during the critical transition period for cows.

While the precise optimal dosage of choline to optimize both production and health in dairy cows is not yet definitively established, the existing data unequivocally demonstrate the positive impact of feeding choline ion through RPC, up to 25 g/day, during the transition period. This supplementation not only triggers lipotropic effects within the hepatic tissue but also exhibits tangible improvements in productive performance and health outcomes. These findings collectively provide compelling evidence that choline should be considered a required nutrient in the diet of transition dairy cows.

References are available upon request.

About José Eduardo P. Santos

Dr. José E.P. Santos is a Professor in the Department of Animal Sciences at the University of Florida where he conducts research and extension in dairy cattle nutrition and reproduction. He earned his DVM degree from São Paulo State University in Brazil in 1992, completed the M.Sc. and Ph.D. degrees in 1995 and 1997 at the University of Arizona, and a clinical residency in Dairy Production Medicine in 2000 in the School of Veterinary Medicine at the University of California Davis. Before joining the University of Florida, José spent 8 years as a faculty member in the Department of Population Health and Reproduction in the School of Veterinary Medicine at the University of California Davis.

About Usman Arshad

Usman Arshad is from Pakistan and received his Doctor of Veterinary Medicine degree (2010-2015) from University of Veterinary and Animal Sciences (UVAS), Lahore. Usman completed his masters (M. Phil Theriogenology; 2015-2017) from UVAS and Ph.D. (Animal Molecular and Cell Biology; 2018-2023) from University of Florida with a major concentration in Dairy Cattle Nutrition and Reproduction. He has recently joined Dr. Heather White's Lab at University of Wisconsin-Madison as a Post-Doctoral Research Associate.

Usman is passionate about transition cow management and exploring molecular and cellular pathways related to hepatic tissue metabolism and feed efficiency in dairy cows. Usman has a longstanding interest in data analysis, especially conducting meta-analysis that benefits the dairy industry and facilitates dairy farmers in decision-making. During his post-doctoral training, Usman intends to gain additional experience in analysis of fatty acid composition, Western blots, flow cytometry, and use of cell culture models to elucidate intermediary metabolism in dairy cows.



North America Animal Feed Market

It is seen that the North America has the high share in the world compound feed production with a production of approximately 261 million tons and a share of 20.6%. According to Alltech's data, the feed production of the North America, which was 259 million tons in 2021, increased to 261 million tons in 2022. Growth expectations in the market vary between 1% and 5%. According to a report, the total value of the animal feed market of the region will reach USD 237.15 billion by 2029.

By Derya Yildiz

North America (US and Canada) is the third largest compound feed producer in the world after the Europe region. According to the Agri-Food Outlook 2023 report by Alltech, 261 million tons (20.6%) of world compound feed production, which was 1.266 billion tons in 2022, was realized by North America countries. The total feed production of the region, which was 259.3 million tons in 2021, reached 261.69 million tons in 2022 with an increase of 0.88%.

North America animal feed market is flourishing due to increasing demand for meat and dairy products, expansion of livestock production, adoption of advanced animal nutrition technologies, and rising awareness about the benefits of using compound feed for livestock.



FEED PRODUCTION BY COUNTRY

According to the report of Mordor Intelligence, United States dominates the North America animal feed market. The country is one of the major compound feed markets in North America. The domestic animal food manufacturing industry largely relies on the free-trade agreement with Canada and Mexico (North American Free Trade Agreement's (NAFTA) implementation), which has allowed exports of feed ingredients, feed and pet food. This trade agreement coupled with increasing livestock industry is driving the market for animal feed. The country remains the one of the world's largest animal feed producers and exporter as well as home of many world's leading animal feed producers.

According to data from The American Feed Industry Association (AFIA), there are more than 5,800 animal feed manufacturing facilities in the U.S. producing more than 284 million tons of fin-

ished feed and pet food each year. The mill sizes vary tremendously from a small on-farm mixer to a modern, computerized system with few human operators making more than 1 million tons of feed each year for swine or poultry operations.

In Canada, the other major player in the region, according to the 2021 data of The Animal Nutrition Association of Canada (ANAC), 470 commercial mills across the country supply roughly 19.3 million tonnes of feed. In the country, approximately 28.9 million tonnes of feed were consumed by livestock (not including forages) in 2021. It is estimated that 96.5% of total feed is consumed by swine, beef cattle, dairy cattle and poultry.

FEED PRODUCTION BY SPECIES

Beef feeds are in the first place in compound feed production in North America on a species basis. North America, which is also the world's largest beef feed producer, alone accounts for 57% of the world's beef feed production, which is approximately 118.2 million tons. The region's total beef feed production, which was 66.7 million tons in 2021, increased by 0.6% to 67.3 million tons in 2022. According to the Alltech report, the region is in its fourth straight year of declining herd population caused by drought and economic issues, but it has not affected feed production. Experts anticipate 2023 to be the tipping point, with a predicted decline of 2-3%. Additional economic pressure will be put on the American producer; the American dollar is expected to remain strong and exports are likely to decrease.

Pig feeds rank second in North America's feed production. The pig feed production of North America, which was 63.6 million tons in 2021, decreased by 0.97% in 2022 to 62.9 million tons. According to the Alltech report, in North America, the pig feed production decreased by nearly 1% because of a reduction in pork supply, aggressive outbreaks of porcine reproductive and respiratory syndrome (PRRS), high feed and trucking costs, disruptions in trade due to shipping costs, labor shortages and input cost volatility aggravated by the invasion of Ukraine.

North America* Compound Feed Production

	2021	2022	Growth (MMT)	Growth (%)
Beef	66.772	67.355	0.429	0.64%
Pig	63.600	62.984	(0.616)	-0.97%
Broiler	58.200	60.132	1.932	3.32%
Dairy	28.700	28.500	(0.200)	-0.70%
Layer	15.120	15.530	0.410	2.71%
Pets	10.600	11.200	0.600	5.66%
Equine	3.778	3.800	0.022	0.58%
Aqua	1.730	1.750	0.020	1.16%
TOTAL	259.367	261.639	2.272	0.88%

Source: 2023 Alltech Agri-Food Outlook

*North America includes Canada and the U.S.

Broiler feeds rank third in feed production in North America. The region's broiler feed production, which was 58.2 million tons in 2021, increased by 3.3% in 2022 to 60.1 million tons. Broiler exports were flat in 2022 but broiler production is growing slowly each year and will most likely continue at this pace, according to the Alltech report.

In the region, another important item on the basis of species is dairy feeds. The dairy feed production of the region, which was 28.7 million tons in 2021, decreased by 0.7% in 2022 to 28.5 million tons. A reduction in dairy cows slowed feed production in the U.S., where high building costs and feed costs have limited expansion, according to the Alltech report.

The total layer feed production in North America, which was 15.1 million tons in 2021, increased by 2.7% in 2022 to 15.5 million tons. According to the Alltech report, layers were more affected by avian influenza than any other poultry species in the U.S in 2022. More than 57 million commercial birds in the U.S. were affected, mostly layers and turkeys.

North America, which is the world's second largest pet food producer after Europe, alone produces about 31.8% of the world's pet food production of 35.3 million tons. The pet food production of the

region, which was 10.6 million tons in 2021, increased by 5.6% in 2022 to 11.2 million tons.

North America is the world's largest producer of equine feed. The region alone produces 46.6% of the world's equine feed production. The region's equine feed production, which was 3.7 million tons in 2021, increased by 0.5% in 2022 to 3.8 million tons.

In the region, aqua feed tonnage was up 2% (0.02 MMT) due to increases in fish prices, favourable weather conditions and the lifting of size restrictions, according to Alltech's report.

COMMERCIAL VALUE OF THE MARKET AND EXPECTATIONS

There are different estimates about the size of the market and growth prospects. For example; Blue-Weave Consulting, one of the leading strategic consulting and market research firms, in its recent study, estimated North America compound feed market size at USD 168.29 billion in 2022. During the forecast period between 2023 and 2029, North America compound feed market size is to grow at a robust CAGR of 5.88% reaching a value of USD 237.15 billion by 2029.

The report by Market Data Forecast states that the market was worth USD 119.77 billion in 2021 and estimated to be growing at a CAGR of 1.30%, to reach USD 127.76 billion by 2026.

Research And Markets, one of the leading research companies, estimates the market value of the North American animal feed market at USD 74.862 billion in 2020 in its report. The research company forecasts that the market will reach USD 93.534 billion in 2027 with a 3.23% CAGR.

MARKET DRIVERS & RESTRICTIONS

Consumer demands are the main trend-setting factor in North America, as in many other regions. According to the report of Mordor Intelligence, especially growing demand for animal-based products is driving the market. The research company report includes the following information:

Some of the major players:

- ADM Animal Nutrition
- Alltech
- Cal-Maine Foods
- Cargill Inc
- Hueber Feed
- ForFarmers B.V
- Hillandale Farms
- Hi-Pro Feeds
- J.D. Heiskell & CO
- Kent Nutrition Group
- Koch Foods
- Land o' lakes, Inc
- Mountaire Farms
- Nutreco
- OSI Group
- Peco Foods
- Perdue Farms
- Prestage Farms
- Purina Animal Nutrition
- Rose Acre Farms
- Sanderson Farms
- Smithfield Foods
- Tyson Foods
- Versova Holdings
- Wayne-Sanderson Farms

The demand for higher-value and quality foods, such as meat, eggs, and milk is increasing in the region. The increase in demand for these products and other non-food items, has led to the growth in the usage of feed additives, thereby, boosting the compound feed in the growth of the animal feed market. In Canada, the commercial chicken and turkey meat production totalled 1.43 billion kilograms in 2018. The demand for poultry and egg products is growing. Over the last five years, food availability increased annually on average by 2.3% for chicken, 1.4% for turkey, and 2.5% for eggs.

According to the report of BlueWeave Consulting, growing emphasis on sustainable and organic feed components, fuelled by customer demand for ecologically friendly and healthier goods, is a major factor behind the expansion of the North America compound feed market. To improve efficiency and quality, there was a noticeable increase in the use of technology in feed production and management. Also, the market witnessed a rise in the amount of money spent on R&D to create novel feed formulations that enhance animal performance and health. To fulfil the changing needs of the agricultural and animal industries, the North America compound feed market is generally observing a shift towards more sustainable, technologically sophisticated, and nutritionally optimized products.

Pointing out in its report that the market is developing at a significant rate due to the increase in the livestock population, Market Data Forecast, like many other research companies, remarks that con-

sumer demands are the driving force of the market. However, the report also mentions that increasing costs of raw materials and operations are the major restraining factors for this market.

NORTH AMERICA FEED INDUSTRY

North America is one of the largest regions in the world in terms of the presence of feed mills. According to 2022 data, 6,300 of the 28,156 feed mills in the world are located in this region. This number was announced as 6,280 for the previous year. In other words, between 2021 and 2022, it is seen that 20 new factories started operating.

However, as consolidation continues, the number of feed mills continues to decrease and output by large feed mills continues to rise, according to the Alltech's report.

On the other hand, North American compound feed market is highly competitive with the presence of many local and international players who are operating in this region. According to the report of Mordor Intelligence, some of the players have been expanding their geographical presence by acquiring or merging with the manufacturers in the foreign market. The leading companies focuses on the expansion of the business across regions and setting up a new plant for increasing production capacity as well as a product line. The companies are also increasing production capacities of their existing plants.

References are available upon request.

PwC names Skretting, Lerøy, Mowi, and SalMar as Climate Leaders

Among Norway's 100 largest companies, nine are successfully reducing emissions as mandated, with four hailing from the aquaculture sector. The Climate Index, an annual overview of the climate impact of Norway's 100 largest companies, is compiled by audit firm PwC, drawing from the companies' annual and sustainability reports. The 2023 Climate Index, unveiled during Arendal Week, positions Skretting among Norway's top nine performers.

"The progress is too slow," says Hanne Løvstad, Partner and Head of Sustainability and Climate Services at PwC during her presentation at Arendal Week. "While 22 out of 100 companies exhibit emission cuts in their operations and value chains, only nine of these align with the Paris Agreement."

Løvstad's presentation spotlighted the aquaculture industry, wherein three major aquaculture producers showcase emissions reductions of at least seven percent. Løvstad pointed to Skretting as assisting the industry in achieving its climate objectives, given that feed significantly contributes to the salmon's carbon footprint.

"This underscores our recent successes, and it's impressive to witness the aquaculture sector leading



Norway's climate efforts," states Leif Kjetil Skjæveland, Sustainability Manager and Community Liaison at Skretting Norway.

PwC defines climate champions by their transparent, consistent climate reporting over the years. The top-ranked entities must also meet the Paris Agreement's baseline emission cut requirements, averaging at least seven percent annually over the past three years. Skretting Norway's climate footprint last year stood at 1.77 CO₂ equivalents per kilogram of fish feed produced, a remarkable 46 percent decrease from the 2018 baseline.

[Read more>>](#)

FeedProfessionals distributes AO-Biotics in Brazil

BioZyme[®] Inc. announced that FeedProfessionals now distributes AO-Biotics[®] products. The distribution agreement allows FeedProfessionals to deliver AO-Biotics[®] Amaferm[®] and AO-Biotics[®] EQE in the largest country of South America, Brazil.

FeedProfessionals was founded in 2016 by a team with more than 20 years of experience in the Latin American animal nutrition market. Their goal is to leverage

their knowledge and experience to improve animal health and nutrition. They work to find international partners who supply feed safety additives that they can distribute through Latin America.

"We are very happy to include FeedProfessionals as our distribution partner. Their team shares the same passion to provide care that comes full circle to food animals. They can achieve that with our AO-Biotics products," said



Fernando Bargo, Ph.D., BioZyme Business Development and Innovation Manager.

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SalMar uses a flexible oxygen system in northern Norway

Salmon farmer SalMar has strong links to the Troms and Senja region in northern Norway through its subsidiary SalMar Nord. The latter has investments in sea sites, a processing plant, and an RAS smolt farm, which was commissioned by Billund Aquaculture.

This land-based facility, which is located about two hours from the city of Tromsø, consists of two projects that were built within five years of each other. The facilities are designed to produce around 29 million Atlantic salmon smolt per year, enough fish to secure self-sufficiency in the north of the country.

The site's performance has been enhanced by several innovations, including one of the most advanced oxygen-booster systems in the market. According to Billund Aquaculture's Group CEO & Founder, Christian Sørensen, one of the things the company learned from its experience with its first project, Senja 1, which was built in 2017, was the



need to have a scalable oxygen system. "At times, they wanted to produce more biomass in individual tanks. Therefore, we designed a flexible system that was able to run at a greater fish density in any given tank by keeping oxygen levels very high compared to other tanks," he said.

This tailor-made feature allows greater adaptability to production requirements from the company's sea sites, while also being a shining example of the good cooperation between Billund Aquaculture and SalMar.

[Read more>>](#)

AFIA's Gina Tumbarello to serve on U.S. Agricultural Trade Advisory Committee

The American Feed Industry Association (AFIA) announced that Gina Tumbarello, AFIA's senior director of global strategies, policy, and trade, has been reappointed to serve on the U.S. Foreign Agricultural Service's Agricultural Technical Advisory Committee (ATAC) for Trade in Grains, Feed, Oilseeds and Planting Seeds.

Tumbarello has represented AFIA members on the ATAC since 2014 and provides valuable technical advice and information about U.S. animal food products and the industry to the secretary

of agriculture and U.S. Trade Representative (USTR). Tumbarello joins Constance Cullman, AFIA's president and CEO, who has been serving on the Agricultural Policy Advisory Committee (APAC) since 2020.

"Last year, the U.S. animal food industry exported over \$11 billion worth of feed and pet food products," said AFIA President and CEO Constance Cullman. "The AFIA's ability to provide ongoing industry representation to the U.S. trade negotiators is paramount to ensuring continued and further global market access



Gina Tumbarello

for the U.S. animal food industry and our vision for a healthier world through advanced animal nutrition. We are thrilled to continue being a voice for the country's nearly 5,650 animal food manufacturers."

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Novus to highlight egg and meat challenges

Novus International will share poultry research that can lead to positive outcomes for both egg and meat production in September. Mireille Huard, senior poultry technical services manager for Europe, will present the findings during two presentations at the 19th European Symposium on the Quality of Eggs and Egg Products and the 25th European Symposium on the Quality of Poultry Meat (together known as the Egg & Meat Symposium), 7-9 September in Krakow, Poland.

“With fluctuations in feed costs and demand, it’s critical to offer a variety of ways to support the profitability of our customers’ poultry operations,” said Huard. “The information I’m presenting is valuable; based on a sound understanding of the biological mechanisms underlying the production of quality meat and eggs.”

Symposium attendees can hear the first presentation from Huard on September 7 during her presentation titled, Review on Eggshell Translucency: Description, Causes and Consequences for Egg Production.



“Eggshell translucency is a quality issue that affects the appearance of the egg but can also impact the egg’s resistance to breakage and even bacterial infection. This challenge is a concern for both table eggs and hatching eggs,” Huard said. “My presentation is a review of the literature available on the topic and recommendations on intelligent nutrition interventions that can strengthen eggshells.”

Huard’s second presentation is on September 8 where she’ll offer insights on the topic, Microminerals to Reduce Meat and Carcass Quality Issues.

[Read more>>](#)

CAT appoints Simon Hill as Chief Business Development Officer

The Center for Aquaculture Technologies (CAT), a leading provider of contract research services to the aquaculture industry, announced Simon Hill as its new Chief Business Development Officer. In this role, Simon will spearhead strategic growth initiatives, expanding market reach, driving global expansion, and forging long-term partnerships, with a special focus on the rapidly advancing genome editing space.

Simon brings over 20 years of business development experience

to the table. His expertise spans strategy development, dynamic financial modeling, and project management. He has led multiple key market entries and service offerings within the scope of aquaculture genetics and research.

Dr. John Buchanan, CAT's Chief Executive Officer, commented on Simon's appointment: "With his extensive experience in long-term strategic planning and structural development, Simon Hill is the perfect fit for this new position. I am very pleased to welcome him



Simon Hill

to the team. His inclusion will enhance value to our clients and create new opportunities for boosting efficiency and sustainability in the aquaculture sector.”

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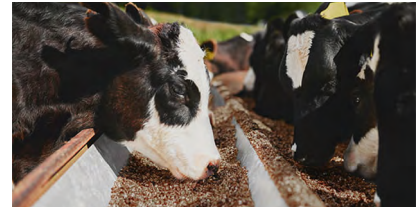
CropEnergies invests more than EUR 100 million in UK production site

CropEnergies AG, Mannheim, will invest more than EUR 100 million into various projects in the production site of its subsidiary Ensus UK Ltd. in Wilton, UK, over the next years. The investments will enhance the overall profitability of the site as well as its competitiveness, reduce CO₂ emissions, and strengthen its position in the European ethanol and protein markets.

The major part of the investment will be the construction of

a new unit for the production of high-protein animal feed. The new product which will be marketed under the brand name EnPro is a high-protein product aimed at UK and European aquafeed and pet food markets. The total investment will be approximately EUR 75 million with commissioning being scheduled for 2025.

Additional investments are mainly aimed at improving plant reliability and reducing emissions. Some of the installed feed driers will be replaced or upgraded. An-



other project is the installation of a mechanical vapor recompression unit which will also bring about significant reductions of CO₂ emissions.

In total, CropEnergies will invest more than EUR 100 million at the Wilton site by 2025.

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Devenish expands international aquaculture team

Headquartered in the UK and trading in over 40 countries, Devenish is recognized as a leading provider of animal nutrition solutions including premix and feed additives that are designed to improve both animal and human health. With over 70 years of experience in the pig, poultry, ruminant, and companion sectors, the company has recently expanded into the aquaculture market.

Dr Antonios Chalaris joins Devenish from a global aquaculture business where he was a Product Manager. He has over 13 years of commercial and R&D aquaculture experience in fish hatchery production and development of fish feeds across the UK and internationally.

A key part of Devenish's growing aqua division, Antonios will be responsible for spearheading sales growth and fostering relationships with new and existing customers in the aqua division. He will be supported by the wider Devenish international and technical teams.

"Aquaculture is the fastest-growing food system in the world, and with the global population rapidly increasing, the need for nutritious and sustainably produced food is greater than ever. It represents a huge opportunity for Devenish as we have a number of core technologies and products that can be adapted for the aquaculture market," said Ian Atterbury, Managing Director of Devenish International. "As a



Antonios Chalaris

research-led business, Devenish has a portfolio of exciting innovations for aqua application, proven in trials completed with some of Europe's most respected aquaculture research facilities. I am very pleased to welcome Antonios to the team, with his technical expertise and commercial experience, he will be well placed to grow our business in the aqua sector."

[Read more>>](#)

ADM earns 2023 Independent Pet Innovation Award with DermalEase

ADM, a global leader in human, animal, and pet nutrition, earned the 2023 Independent Pet Innovation Award for Cat Skin & Coat Care Product of the Year. DermalEase® is a topical skin-care solution from Protexin® Veterinary, a trusted ADM brand featuring an extensive line of natural products and probiotic supplements based on years of research.

“Receiving this award underscores ADM’s commitment to innovative and science-based products and solutions that meet the needs of today’s pet owners,” said Mark Lotsch, ADM’s president of global health and wellness. “As human trends increasingly inspire pet nutrition offerings, innovative ways to proactively support pets’ overall well-being will continue to emerge. Most pet owners are seeking out foods, treats, and supplements to help improve their pets’ physical and behavioral health.”

Skin health is essential to maintain a pet’s overall well-being. Aside from skin constituting 10-15% of a cat’s body weight, the organ also plays a vital role in regulating bodily processes, including immunity, hydration, sensory, and temperature regulation. DermalEase supports healthy, hydrated, and nourished skin in two versatile and con-



venient formats. The drop formulation allows targeted application for smaller, discrete areas, while the mousse formulation is ideal for larger, more diffuse areas.

DermalEase products leverage Biosfeen®, a unique profile of sphingomyelins and ceramides, and Dermial®, a source of glycosaminoglycans with a high concentration of hyaluronic acid, both developed by Bioiberica. These active ingredients provide dual levels of support, including a healthy skin barrier of the epidermis, and aid for the structure, elasticity, and hydration levels of the inner-layer dermis. With no known contraindications to its use alongside other medications or for pets with allergies, DermalEase has shown to be very safe for companion animals.

[Read more>>](#)

EW Nutrition welcomes Jan Vanbrabant as new CEO

EW Nutrition, a leading global provider of functional animal nutrition solutions, welcomes Jan Vanbrabant as its new Chief Executive Officer. Jan has a PhD degree in microbiology and is an experienced manager in animal health and nutrition, having held leadership roles at DSM, Erber Group, Biomin and Kemin.

“We are very pleased that we have found a strong management lead in Jan, who embodies the philosophy of EW Nutrition,”

says Jan Wesjohann, Managing Director of parent company EW Group. “EW Nutrition is an innovation-driven company, with intensive investment in R&D. Together with Jan we are looking to enter the next growth phase of EW Nutrition.”

“I am very excited to be joining the EW Nutrition team,” said Jan Vanbrabant. “EW Nutrition’s long-term focus has created an extremely competitive portfolio. EW Nutrition is uniquely posi-



Jan Vanbrabant

tioned to support its customers in mastering the challenges of the changing animal health and nutrition environment.”

[Read more>>](#)

CULT Food Science partners with Everything But for cell-cultivated chicken

CULT Food Science Corp., a pioneer in the investment, development, and commercialization of cellular agriculture technologies and products, announced a partnership with Korean pet foods startup Everything But to supply cell-cultivated chicken for the company's stable sustainable pet food brands. In collaboration with Everything But, the Company will be including cell-cultivated chicken in its dog and cat food brands, which currently include Noochies! Cultivated Pet Food, Marina Cat, and Indiana Pet Foods.

"Our collaboration with Everything But is illustrative of our commitment to shaping the future of food at a truly global scale. These ingredients will allow us to reach even more customers with innovative products," said Lejyy Gafour, CEO of CULT.

The cell-cultivated chicken was recently approved for sale in the United States for human consumption. The regulatory pathway in pet food requires approval from the Center For Veterinary Medicine, a branch of the U.S. Food and Drug Administration. According to the company's statement, chicken is the leading animal protein consumed by cats and dogs in the United States.

"Chicken is the most sought-after farmed animal meat in pet food, globally. By bringing cell-cultivated chicken-based pet products to the United States, we are able to fill existing market demand but at the same time create a whole new category of sustainable pet products," said Joshua Errett, VP of Product Development at CULT.

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Katharina Haydn joins Perstorp as Product Manager Gut Health

Perstorp announced that Katharina Haydn joined the Animal Nutrition team as Product Manager Gut Health, with effect from 1 August 2023. Haydn will focus on running strategic projects as a part of the company's Gut Health Product Management team and report to Dr. Antonia Tacconi.

"I am delighted to welcome a new member to our dynamic product management team. This holds immense significance as it solidifies our ability to offer unparalleled support and expert guidance for future advancements. With the addition of Katharina, we are well-equipped to propel our endeavors towards

providing exceptional assistance and shaping innovations that will undoubtedly contribute to our continued success with our ProPhorce™ and Gastrivix™ gut health portfolios," commented Dr. Tacconi, Global Product Manager Gut Health – Perstorp Animal Nutrition.

Katharina is already an experienced product manager, with 5 years as a product manager for mineral feeds and combinations of feed additives in her previous role under her belt. Haydn graduated from the University of Natural Resources and Life Sciences in Vienna, Austria in 2017.

"This is a very exciting opportunity for me. I have always seen



Katharina Haydn

Perstorp as a reliable and innovative company, that not only innovates in animal nutrition but for example also in the field of sustainability. Now I get to use my knowledge and experience to help drive the gut health portfolio forward and together with this motivated team take it to new levels," commented Haydn.

[Read more>>](#)

IFF - Danisco Animal Nutrition appoints Brandon Raddatz as Key Account Manager

Danisco Animal Nutrition & Health, a business unit of the Health & Biosciences Division of IFF (International Flavors & Fragrances Inc.), announced the appointment of Brandon Raddatz as its newest Key Account Manager.

Raddatz brings with him a wealth of experience in the field of production agriculture and animal nutrition. Born and raised on a family farm in western Nebraska, Raddatz's passion for agriculture and animal health began at an early age. After completing his studies in agribusiness at the University of Nebraska, Lincoln, he embarked on his career with the Archer Daniels Midland Co (ADM). At ADM, Raddatz gained extensive knowledge in commodity trading, specifically dealing

with sunflowers, canola, flax, and soybeans. Additionally, he excelled in selling meal co-products to diverse feed markets. His journey at ADM also included selling refined cooking oils in the human food market, which provided him with invaluable insights into various aspects of the industry.

Throughout his impressive 23+ year career, Raddatz has held leadership positions in oilseed processing, amino acids, and specialty feed additives. His commitment to building strong customer relationships remains a constant driving force behind his success. Prior to joining IFF - Danisco Animal Nutrition & Health, Brandon further honed his skills in the yeast and probiotic animal feed space during his tenure at Phileo by Lesaffre.



Brandon Raddatz

Currently residing in Bentonville, Arkansas with his wife and two sons, Raddatz is thrilled to be joining the IFF - Danisco Animal Nutrition & Health team. His role as Key Account Manager will allow him to leverage his vast experience and passion for customer satisfaction in serving clients not only in his local "backyard" of Northwest Arkansas but also across North America.

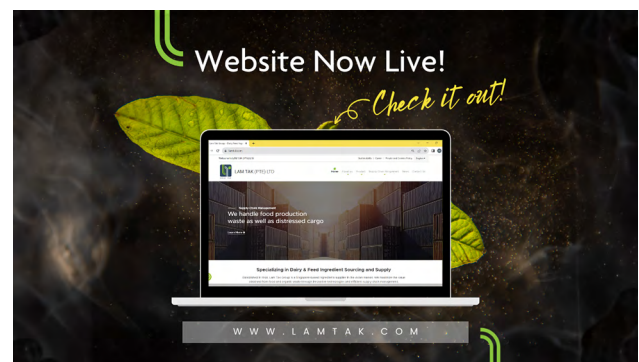
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Lam Tak Group launches its new website

Lam Tak Group, a trailblazer in the domain of dairy and feed ingredient sourcing and supply, unveiled its newly revamped website. The revamped online platform offers a comprehensive window into Lam Tak's core values, diverse product offerings, and unwavering dedication to sustainability through innovative solutions, according to the company's statement.

Lam Tak Group, established in 1968, continues its journey of innovation with the launch of its revamped website. As a Singapore-based dairy and feed ingredients supplier catering to the Asian market, this digital transformation mirrors the company's commitment to adaptability and staying at the forefront of the industry.

The new website provides visitors with a window



into Lam Tak Group's identity, from its beginnings to its present-day achievements. Delve into a treasure trove of historical insights that chronicle the transformation of waste into valuable feed ingredients through pioneering technologies.

[Read more>>](#)

Anchor acquires grain handling facility in North Dakota

Anchor Ingredients, one of the leading providers of high-quality ingredients for the pet food industry, is excited to announce its latest strategic move to expand its operations. The company has successfully acquired a grain handling facility in Hatton, North Dakota. The facility will allow the company to expand its ingredient portfolio and processing capabilities.

The facility is strategically positioned to cater to the needs of both Anchor's customers and growers. Its location will provide Anchor's farm-level partners with an efficient, year-round delivery site for their raw materials, ensuring a continuous supply for ingredient processing across Anchor's network of facilities. This strategic move underlines Anchor Ingredients' dedication to enhancing and guaranteeing its supply chain capabilities to the premium pet food market.

"We are thrilled to welcome the Hatton facility into the Anchor Ingredients network," said Everett Jordan, Director of Operations at Anchor Ingredients. "This acquisition represents a critical step for-



ward for our company, enabling us to better serve our customers and growers, and further strengthen our presence in the pet food industry."

As the Hatton facility commences its operations, Anchor Ingredients reiterates its commitment to providing high-quality ingredients to pet food manufacturers. The company's dedication to sustainability, innovative technology platforms, and a comprehensive range of product and service offerings solidify its position as a preferred supply chain partner for the pet food industry.

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Dr Alejandro Gutierrez spearheads CAT's breeding leadership

The Center for Aquaculture Technologies (CAT) has a proven track record of assisting clients in attaining their production and efficiency goals through the utilization of cutting-edge breeding technologies. To meet the escalating demand for genetic services while maintaining its client-focused approach, CAT announced the appointment of Dr. Alejandro Gutierrez as the Director of Breeding. Alejandro will lead the breeding and genetic services team, guiding CAT in expanding its portfolio of clients and breeding services.

Dr. Gutierrez has spent more than a decade conducting research and leading teams in the fields of genomics, genotyping, and selective breeding. His experience spans numerous species, and his research has left a positive mark on the scientific community.

In response to Dr. Gutierrez's new position, Dr. Klara Verbyla, Vice President of Genetic Improvement, said, "We are delighted with the appointment of Alejandro as the Director of Breeding. His role underscores the continuous rapid growth of the CAT breeding team



Dr Alejandro Gutierrez

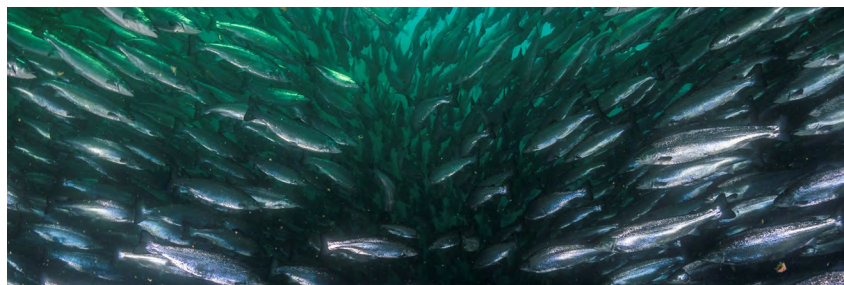
in response to industry requests and the need for a dedicated leader to guide and drive the team forward. Alejandro has exceptional technical expertise in both applied breeding and genomics with demonstrated experience in people leadership."

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Veramaris and Manolin partnership reveals benefits of optimum omega nutrition

Scientific understanding of the benefits of essential fatty acids in fish nutrition is developing fast, but the implications for commercial salmon farming proved hard to define, until now. A new partnership between Veramaris and Manolin enabled the use of big data in commercial aquaculture conditions for the first time, with the aim of gaining insights into Omega-3 (EPA & DHA) levels in commercial aquafeed and the effects upon fish performance, quality, health and welfare.

Earlier this year, Veramaris recruited Manolin's experts to conduct research and analyze anonymously provided feed and farm data. Through its innovative 'Harpoon' aquaculture research data intelligence platform, Manolin conducted a focused



study analyzing data from most Norwegian production zones to provide insights into the impact of dietary EPA & DHA levels on farmed salmon performance.

"Our platform has collected data from more than 900 generations of farm salmon, producing insights for the aquaculture industry and demonstrating the immense potential of leveraging data intelligence in aquaculture research. In addition, our anonymous and unbiased data is well-placed for industry collaborations such as this one with Ve-

ramaris," said Tony Chen, CEO of Manolin.

Veramaris has been assisting farmers make the most of its new algal oil Omega-3 product by resetting omega nutrition specifications in feed to improve farm productivity. "We started by studying performance in research conditions before progressing to individual commercial farm sites, but the study allows us to go so much deeper than this," said Ian Carr, Senior Director for Global Business Development at Veramaris.

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Ginkgo and ILRI collaborate on pathogen surveillance among livestock

Ginkgo Bioworks, which is building the leading horizontal platform for cell programming and biosecurity, and the International Livestock Research Institute (ILRI), a leading organization on One Health approaches, announced that they entered into a Memorandum of Understanding with the intent to collaborate on pandemic surveillance work.

The Consultative Group on International Agricultural Research (CGIAR) is a global research partnership for a food-secure future dedicated to transforming food, land, and water systems in the climate crisis. Through its ILRI research institute, CGIAR works to improve food and nutritional security and reduce poverty in developing countries while ensuring better lives through

livestock cultivation. ILRI plans to work closely with Ginkgo's biosecurity and public health unit, Concentric by Ginkgo, to identify and mitigate pathogens and diseases that originate in animals and livestock.

As part of this agreement, Concentric and ILRI/CGIAR aim to develop a joint biosurveillance and pathogen testing program. They will begin with a pilot phase designed to utilize wastewater testing focused on key pathogens and antimicrobial-resistant genes through passive monitoring systems beginning in Nairobi, Kenya.

"Zoonotic spillover events have been responsible for over half of novel epidemic diseases in recent decades," said Matt McKnight, General Manager, of Biosecu-

urity at Ginkgo Bioworks. "As we lay the foundation for global biosecurity infrastructure, we are thrilled to partner with ILRI/CGIAR to implement programs to detect and respond to future biological threats."

Additionally, Concentric and ILRI/CGIAR plan to establish sequencing-based activities for pathogen identification and characterization, and bioinformatics support. As Concentric and ILRI/CGIAR continue their partnership, data from these programs could be shared with national and international stakeholders to continue critical advancements toward global biosecurity.

"ILRI plays a pivotal role in pathogen surveillance, employing a One Health approach in collaboration with a wide range of partners. As part of the CGIAR network, partnerships with private sector groups en-



hance pandemic preparedness to detect, respond, and blunt emerging infectious disease promptly," said Appolinaire Djikeng, director general of ILRI and senior director for CGIAR Livestock-Based Systems.

[Read more>>](#)

SFR clients can now request methane emission measurements

Schothorst Feed Research (SFR) announced that it is now able to offer methane emission measurements with the Greenfeed system as a part of dairy nutrition trials.

The Greenfeed system consists of a cubicle where small portions of concentrates are offered to attract the cows. From now on, SFR clients can request methane emission measurements as a part of dairy nutrition trials: "This offers new insights," said Marije van Tol, a researcher at SFR. She explained: "At our research farm, we study the impact of feeding strategies, ration composition, and additives. Not only on production and health parameters but from now on also on environmental aspects."

Concerns about greenhouse gas emissions from livestock and dairy farms, as well as their connection to global warming and climate



change, have grown among the general public worldwide in recent years. To evaluate these emissions, there is a need to use reliable methods. The 'golden standard' for assessing greenhouse gas emissions is measuring all incoming and outgoing gases from animals kept in climate respiration chambers. This is a very complicated and expensive method, and it does not reflect practical farm circumstances.

Enteric methane and other greenhouse gas emissions from ruminants can be mitigated in numerous ways including management of the animals, the diets, and the manure. Dairy farmers,

together with the feed sector, are encouraged to further look for strategies to lower methane emissions without affecting the performance and welfare of the animals. With the addition of Greenfeed to the research facilities, SFR can also contribute to achieving this goal.

"While the animal is in the Greenfeed, the exhaled air of the cow enters the equipment," said Van Tol. "The apparatus registers the pipe air flow rate and methane and carbon dioxide concentration in the air sample. From these data, the amount of methane exhaled per cow per day is calculated."

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Scoular announces its new sustainability team

Scoular announced its new team that will both drive the company's corporate sustainability strategy and provide expertise to help customers meet their sustainability goals. The five-member sustainability team partners with the company's businesses to provide sustainability solutions for Scoular's global grain, feed, and food customers, as well as its producers.

"Scoular's team possesses expertise and experience in creating innovative sustainability solutions," said Jennifer Deitloff, Scoular Vice President, Senior Associate General Counsel and Chief Diversity Officer and leader of the company's sustainability efforts.

Kate Pitschka, Corporate Sustainability Manager: Kate brings over 10 years of experience with sustainability strategy and programs, most recently as the Director, Supply Chain Sustainabil-



ity at ConAgra Brands.

Beth Stebbins, Customer Sustainability Manager: Beth was most recently the Sustainability Manager for Grain Millers where she led their sustainability program, working with customers on multiple initiatives.

Dan Harr, Diversity, Equity, & Inclusion (DEI) Manager: Dan has deep DEI experience, including implementing strategic initiatives and scalable ERG programs.

Lauren Rogers, Sustainability Analyst: Lauren most recently worked as a Sustainability Spe-

cialist at the Minnesota Chamber of Commerce, focusing on business waste diversion programs.

Amy Wiechmann, Community Engagement Manager: Amy brings over 10 years of experience in marketing for international consumer-focused companies and is a community volunteer and leader.

In addition, Brian Ellis, who has extensive experience working in regenerative ag with producers, partners closely with the sustainability team as a member of Scoular's producer strategy team.

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TECHNA restructures with new corporate logo and product range

As a specialist in precision nutrition, husbandry techniques and natural health, TECHNA redesigned its corporate logo and restructured its product range into 3 brands dedicated.

The company, which has been supporting the animal and plant production sectors since 1964, included the following in its statement: "Today, the agricultural industry as a whole is faced with a number of challenges to ensure that the growing population is fed in both a rational and sustainable way. We, at TECHNA, are convinced that science and technology are the only effective levers that will drive improvement and progress. As we approach our 60th anniversary, we are more than ever committed to

helping the animal production secure the performance of their production, according to their goals:

- Technical and economic performance through expert advice, combined with reliable, effective products and powerful decision-making tools.

- Environmental and societal performance through innovative, efficient solutions designed to improve animal welfare, preserve natural resources and help combat climate change and antibiotic resistance.

In order to deliver on this collective commitment, we have redesigned our corporate logo and restructured our product range into 3 brands dedicated to our 3 categories of customers."

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Methane-fighting start-up CH4 Global raises total investment to US\$47 million

CH4 Global, Inc., a climate tech company on the path to radically reducing GHG emissions in animal agriculture, announced it raised US\$29 million in Series B funding. The company will use the funds to build and validate the CH4 Global EcoPark™, an aquaculture and production facility that will make CH4 Global's signature product, Methane Tamer™, at scale.

This round, led by DCVC, DCVC Bio, and Cleveland Avenue – with participation from other investors with a strong interest in climate change – brings the total raised to date to nearly US\$47 million. It also underscores market demand for safe, viable solutions to vastly reduce enteric methane from ruminant livestock.

When added to cattle feed, Methane Tamer—which uses red seaweed (*Asparagopsis*)—reduces the animal's methane emissions by up to 90% while also reducing the feed energy lost to methane emissions. With the development of its CH4 Global EcoPark, the company is poised for expansion in key markets and with key



partners throughout all six inhabitable continents.

"We are receiving massive interest from governments, food producers, and farmers of all sizes, fueling our sense of urgency that we must act now to avoid a climate tipping point. The pressure is on with new regulations and the desire to produce at a measurably lower impact. What we've developed at CH4 Global is what we call a CH4 Global EcoPark, which enables low-cost growth and processing of *Asparagopsis*," said Steve Meller, Ph.D, co-founder and CEO, CH4 Global.

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Novus adds Michaela Braun to its methionine team

Intelligent nutrition company Novus International, Inc. added feed mill expert Michaela Braun to its methionine team serving customers in North America. Braun joined the company as a senior liquid systems and sales specialist. In this role is responsible for the Automated Inventory Management System (AIMS) located on the sites of customers using Novus' liquid source of methionine, ALIMET® feed supplement. She also provides feed mill technical support for the company's sales teams in the United States and Canada.

Hands-on experience while earning her bachelor's and master's degrees in feed science and

management at Kansas State University (KSU) cemented Braun's career in animal agriculture.

"I was at the O.H. Kruse feed mill as an undergraduate mill operator and enjoyed every part of the feed manufacturing process," she said. "I also worked as a research assistant with animal trials, which led me into the graduate program a K-State where my passion for the animal agriculture industry grew."

Before joining Novus Braun served as a feed manufacturing consultant with NutriQuest Manufacturing Services where she provided customers with insight on all aspects of the feed



Dr Alejandro Gutierrez

manufacturing process from drafting regulatory plans to overseeing process improvement projects. She also managed the Feed Technology Center at the University of Illinois (U of I) where she coordinated the new center's initial startup, including training all employees and student workers.

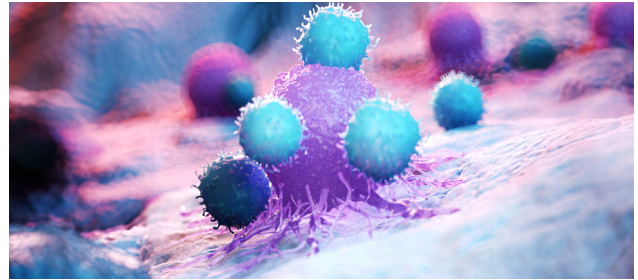
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Hill's Global Symposium returns with focus on veterinary oncology

Hill's Pet Nutrition, a global leader in science-led nutrition, will host its annual Hill's Global Symposium, one of the largest, free global education events available for veterinary professionals.

Titled "Feeding the Fight Against Cancer," this year's Hill's Global Symposium will bring together the world's leading experts in canine and feline cancer and nutrition. The event will be hosted in Lisbon, Portugal from September 25-26, 2023 and offered online, both live and on-demand, for free via Hill's global education platform, Hill's Veterinary Academy.

"For the past 75 years, supporting the veterinary profession has been a top priority for Hill's Pet Nutrition. The Hill's Global Symposium allows us to support the veterinary community and build practical knowledge related to one of the leading causes of mortality in pets," said Dr. Jolle Kirpensteijn, Global Chief Veterinary Officer for Hill's Pet Nutrition and specialist in veterinary surgical oncology. "We are grateful to each of the speakers for dedicating their time and expertise as we tackle some of the most pressing topics related to oncology in cats and dogs."



More than 15 sessions spanning topics such as: early detection and diagnosis, supportive care for the cancer patient and how to build a partnership with pet parents to deliver the best outcomes will be offered from renowned industry experts such as Sue Ettinger, DVM, DACVIM (Oncology), Susan Little, DVM, DABVP (Feline) and Walter L. Brown, Jr., RVTg, VTS (ECC). The full panel of speakers can be found on Hill's Veterinary Academy.

"The veterinary industry is continuously evolving. Hill's Pet Nutrition helps veterinary professionals stay up to date on the latest data, trends, and treatments so they can be at their best," said Chief Veterinary Officer, Dr. Karen Shenoy of Hill's Pet Nutrition US.

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New trial: Mileutis reduces antibiotic use in dairy cows

Mileutis, an Israeli-based biopharmaceutical company that is leading the dairy industry and animal health into a sustainable future, completed a rigorous, randomized, case-controlled, multi-center, clinical field trial. The trial was conducted at seven different commercial dairy farms and involved over 500 dairy cows. The results of this trial provide further conclusive evidence of the ability of Imilac™,

therapy to completely substitute the routine use of antibiotics at dry-off in the dairy industry.

In addition, the study revealed that Imilac™ is further impacting milk nutritional characteristics – a breakthrough that was patented by Mileutis. The trial was carried out in dairy farms providing milk to Israel's two largest dairy product providers – Yotvata Dairy, part of the Strauss Health Group, partially owned by Da-

none, and Tnuva, Israel's largest dairy company.

Antibiotics have traditionally been used to treat and manage udder inflammation in dairy cows (mastitis), the primary issue faced by the dairy industry at the beginning of the dry-off period. However, this approach, applied for too long, presents farming challenges and human health risks related to antimicrobial resistance (AMR). Mileutis has de-

veloped a revolutionary, safe, and residue-free biological therapy named Imilac™, which helps to address this critical health issue without using antibiotics.

Designed to replace the routine use of antibiotics administered at dry-off once a year, Imilac™ has exhibited game-changing results in clinical trials, paving the way for a transformation in the dairy sector and leading the dairy industry into a sustainable future.

Mileutis conducted a comprehensive trial, including a follow-up period of one full year, to



analyze the quantity and quality of milk from cows undergoing the Imilac™ therapy compared to the traditional treatment of antibiotics. The trial was conducted at seven prominent dairy farms across Israel, spanning from Yotvata and Yahel in the south to

the Hama'ayanot Valley in the northeast and Kfar Vitkin on the coastal plain. The trial produced significant findings that support the company's goal of reducing antibiotic use and enhancing the welfare of dairy cows.

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GSA announces two senior management team promotions

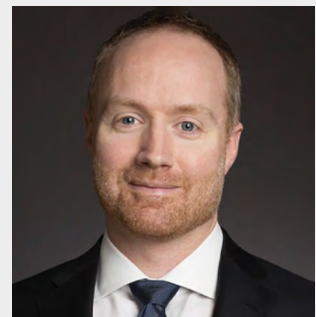
The Global Seafood Alliance (GSA) announced two promotions on its senior management team. Steven Hart has been promoted to Senior Vice President of Market Development and Mike Kocsis has been promoted to Chief Strategy Officer.

As SVP of Market Development, Hart oversees GSA's market development team, which engages with retailers, food service operators, and suppliers to drive the growth of GSA's Best Aquaculture Practices (BAP) and Best Seafood Practices (BSP) certification programs.

Hart joined GSA, then the Global Aquaculture Alliance, in 2015, and has spent most of his career at GSA as the Vice President of Market Development, overseeing teams in Europe, the United Kingdom, and Asia. Previously, Hart was the Executive Director of the Soy Aquaculture Alliance, which develops new, domestic markets for U.S. soybeans through the development of aquaculture production. He also holds a Ph.D. in aquaculture nutrition from Purdue University.



Steve Hart



Mike Kocsis

Kocsis joined GSA in 2022 as Chief Systems Officer, overseeing information technology and certification operations departments. He has more than 20 years of supply chain and operations experience in the seafood industry, holding leadership roles with some of the leading U.S. seafood brands including High Liner Foods, King & Prince Seafood, and Gorton's Seafood. In his new role as Chief Strategy Officer, Kocsis oversees information technology, certification operations as well as the marketing and communications team.

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