

# Alternative Proteins

INTERNATIONAL MAGAZINE FOR  
ALTERNATIVE PROTEINS TO ANIMAL FEED

by **Feed**  Additive Magazine

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October 2024 - Issue 4

**NOVEL PROTEIN SOURCES:**  
Impact of insect protein meals  
on pet food palatability

**ACCELERATING ADOPTION OF  
INSECT-BASED INGREDIENTS  
FOR PET FOOD**



**Andrea Lopez, Selko**  
Alternative source of proteins  
for animal feed



**Tomáš Kubeš, Bene Meat**  
An innovative ingredient  
for pet food: Cultivated meat



**Tran Thi Chau, Entobel**  
Antimicrobial peptides in black soldier  
fly larvae: Opportunities and challenges

Dear Readers,

Over the last year, there have been a number of remarkable developments in the alternative proteins industry, which have been closely followed by the animal nutrition industry. Particularly in insect farming, we see that scale-up investments have accelerated considerably and serious steps are being taken for industrial scale production. Investors' interest in this industry is increasing day by day. On the other hand, governments continue to revise legislations to support the growth of the insect industry, especially due to environmental impact and sustainability concerns, while maintaining a distant approach. Research and trials conducted by industry members in partnership with independent organizations are expected to accelerate the acceptance of insect ingredients.

Another alternative protein branch, cell-based meat, is also experiencing interesting developments (although not as fast as the insect industry). One of the biggest global players in the animal nutrition industry has opened its first cell feed production facility. In its new facility, the company has started producing cell feed specially developed for the cultured meat industry. Although small batches are being produced for now, this is a very important step for the development of

the cultured meat industry.

The use of cultured meat in animal nutrition seems to be limited to pet food for now. Pet food manufacturers are taking steps to experiment with this new protein source and continue to introduce new cultured meat-based pet food types to pet parents. In this issue, you will find news and articles on the potential use of cultured meat in pet food and developments in the industry.

However, there are some obstacles to the widespread use of cultured meat. In particular, there are regulatory restrictions on the production and consumption of cultured meat in some regions. This slows the development of the technology and limits the growth of the industry. There is also insufficient scientific data on the use of cultured meat in animal feed. Therefore, more research is needed on the effects and safety of cultured meat in animal nutrition.

In conclusion, we see that scientific data and research are key to the growth of all segments of the alternative protein market. In this long-range run, we will continue to share news, new scientific data and research studies on the development of the industry.

Hope to see you in the next issue...

Enjoy your reading...

# Alternative Proteins

by Feed Additive Magazine

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# Sustainable alternatives that make a little go a long way



Sustainability goals and raw material scarcity mean by-products from the food and beverage industry is now seen as a viable, nutritious source of energy for animals. Trouw Nutrition offers solutions to help the industry use resources more efficiently and move towards a circular, more sustainable economy.

## THE BENEFITS



Reduce landfill



Upcycle by-products



Maintain nutritional value

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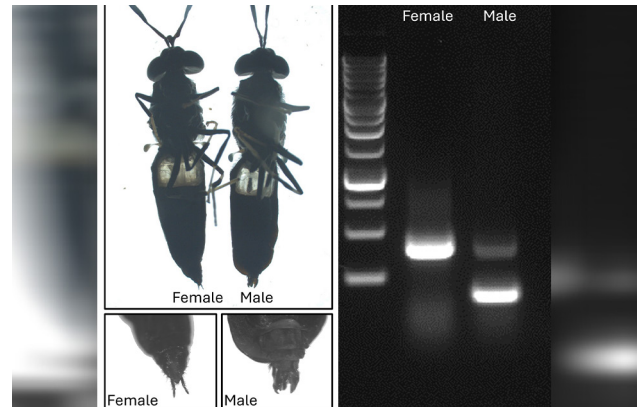
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## FreezeM unveils new method in sex identification of BSF larvae

One of the leaders in black soldier fly (BSF) breeding, FreezeM's R&D team developed a groundbreaking method for identifying male and female BSF larvae using Polymerase Chain Reaction (PCR), revolutionizing breeding and rearing practices. Previously, sex differentiation was only possible in adults through a manual, one-by-one process under a microscope, according to the company. Early identification during the larval stage, especially in a high-throughput manner, presents significant opportunities to optimize breeding, rearing, and production efficiency by enabling targeted management of each sex.

The company explains the key findings as:

- **Innovative Sex Differentiation:** Our R&D team discovered a unique genetic sequence distinguishing male and female BSF. By amplifying this sequence with PCR, we can now accurately determine the sex of larvae.
- **Non-Invasive and Sustainable:** This non-destructive method allows larvae to be tested through a harmless biopsy. The larvae continue developing into adults capable of reproduction, making it practical and sustainable for ongoing breeding programs.



- **Impact on Breeding and Rearing:** Early sex differentiation enables more precise breeding and rearing strategies. Producers can optimize male/female population balances for specific objectives, improving resource management, product consistency, and economic outcomes.

- **High-Throughput Application:** This PCR-based approach supports large-scale operations by enabling high-throughput screening. Early sex identification streamlines selective breeding programs and promotes the development of genetically superior lines for targeted traits.

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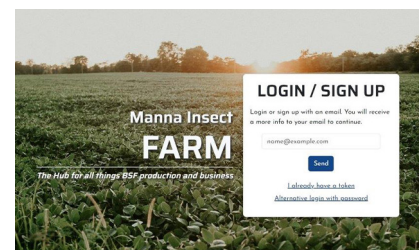
## Manna Insect launches insect farming hub

Finnish company that offers knowledge, tools and solutions to profitably upcycle organic waste into high-protein animal feed, Manna Insect unveiled that its FARM Hub launched after going through a testing period. The FARM Hub includes lots of new content, such as Black Soldier Fly (BSF) farming training materials, webinar recordings, and a full BSF training course, together with a whole new learning center, a BSF business calculator, an insect

farm management tool (Manna Insect Farming App), and an AI-assisted BSF knowledge base, and more, all for free.

There's paid premium content as well, such as advanced training materials, a visual dashboard to Manna MIND customers, premium Farming App features and more. The company explains that all necessary content to getting started is there for free to watch, read, and to run BSF farms accordingly.

Manna Insect announced that



it is also building there a marketplace for all kinds of Black Soldier Fly and more widely insect farming related tools, technology, services, eggs, larvae, BSF products and what not - to be launched this autumn.

[Read more>>](#)

## DeepBranch continues its alternative proteins journey as Aerbio

Aiming to usher in a new era of sustainable biotechnology, Aerbio officially launched. The newly formed company comes as part of a buy-out of UK-headquartered DeepBranch Biotechnology Ltd, with the core management team of Kaspar Kristiansen (CEO), Rob Mansfield (CTO) and Peter Rowe (CXO), and Chairperson Lars Topholm retained to forge a new path for the business. Several announcements related to Aerbio's technology development, board composition and other topics are set to follow in the coming weeks and months.

Aerbio CEO, Kaspar Kristiansen states: "At Aerbio, we don't just follow the rules for fermentation—we rewrite them. With the acquisition of Deep Branch's groundbreaking (R)evolve™ platform, we're able to harness a technology to convert simple molecules into sustainable, high-value products and use it at the centre of a new, bolder direction built in close collaboration with our shareholders and management team."



As one of the pioneers of aerobic gas fermentation, Aerbio is positioned at the forefront of a revolution in the field of industrial biotechnology where the traditional reliance on sugar as source of carbon and energy is addressed. The company explains its primary focus for their technology that uses carbon dioxide and hydrogen in the same way most fermentation processes use sugar as to scale production of Proton™, a protein-rich ingredient poised to revolutionize food and animal nutrition.

[Read more>>](#)

## Goterra and Skretting partner for aquafeed

Skretting Australia, the Australian arm of Nutreco's aquaculture division, and Goterra, a multi-award-winning Australian climate tech startup, announced a new partnership to include Australian insect meal in aquaculture feeds. This collaboration will drive the upscaling of key technologies required to mitigate food waste impacts, while contributing to the sustainable production of Australian farmed seafood. According to the companies, this is a win-win for the country's food system.

With a mission to mitigate food waste by transforming it into alternative proteins and sustainable fertilisers, Goterra is helping to combat climate change along the way.

A key part of the Australian aquaculture industry since the 1990s, Skretting Australia has been at the forefront of driving feed innovation and sustainability in the Australian market across these 30 plus years. The company has shown considerable com-



mitment to the development and validation of new novel ingredients in recent years.

Both the global and local aquaculture industries are large and growing; it is essential for the global industry to support the development of novel ingredients, such as insect meals, to commercial scale. According to the companies, the local validation of insect meals marks the beginning of a new chapter of circularity for Australian aquaculture. Because, without the development and validation of new raw materials, aquaculture simply cannot grow in line with forecast demand.

[Read more>>](#)

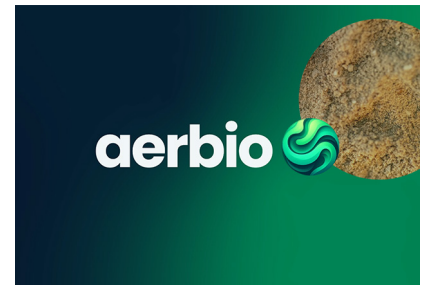
## Aerbio announces €50 million Series A fundraising plan for sustainability

One of the pioneers in sustainable biotechnology, Aerbio announced its plans to raise up to €50 million in a Series A funding round, with the target close set for Q4 2024. This bold step forward will reportedly fund the construction of Aerbio's cutting-edge demonstration-scale facility and expand the company's revolutionary (R)evolve™ platform, setting the stage for full-scale commercial operations.

Aerbio is at the forefront of biotechnology innovation, transforming simple molecules into valuable

products without the need for arable land or fossil fuels. With its groundbreaking (R)evolve™ platform, the company points out it has unlocked the potential of microbiology to convert carbon dioxide and hydrogen into valuable products. Aerbio's launching product is Proton™, a protein-rich ingredient poised to revolutionise food and animal nutrition industries.

"Our ambition knows no bounds," says Kaspar Kristiansen, CEO of Aerbio. "Our Series A round is a bold statement in our conviction in our plan and our



relentless pursuit of breaking new ground in biotechnology. We're not just building a company—we're turning biotechnology on its head, paving the way for a sustainable future where sugar-free fermentation is a reality."

[Read more>>](#)

## Bühler and NRGene inaugurate insect center

Bühler, the Swiss technology group, and NRGene Canada, a subsidiary of NRGene Technologies Ltd., an Israeli genomics company, celebrated the successful launch of the North American Insect Center (NAIC). The inauguration event, held at NRGene Canada's facility in Saskatoon, marks a significant leap forward in the production and optimization of insect protein in North America, the companies stated.

The NAIC is designed as a research and demonstration center where customers can evaluate the performance of Black Soldier Fly (BSF) varieties tailored to their specific by-product streams. The cutting-edge facility is also dedicated to supporting investors in evaluating the economic viability of larger plants before committing to full-scale investment. According to the companies' explanation, this innovative approach empowers businesses to make informed decisions, ensuring optimal efficiency and sustainability in protein production.

The launch event featured a tour of the cutting-edge lab, showcasing the advanced capabilities of the NAIC. Attendees included Dr. Gil Ronen, CEO and Co-Founder of NRGene, Andreas Bau-



mann, Head of Market Segment Insect Technology at Bühler, and Jeremy Harrison, Minister of Trade and Export Development. "Saskatchewan is continuing to attract innovative companies who are choosing to invest and grow their business in our province," Jeremy Harrison notes. "Our reputation as global leaders in agricultural and biotechnology is attracting record capital investment into the province. We're very proud to see the North American Insect Center join a growing list of cutting-edge institutions here in the province. This facility will create new skilled jobs and further position Saskatchewan as a center for alternative protein production research and a leader in global food security."

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# LEADING THE WAY WITH NATURAL SHELF-LIFE STABILITY



VERDILOX antioxidants are the solution for natural pet food diets with its distinct well balanced of blend of mixed tocopherols and vertically-integrated supply chain of botanically-sourced ingredients.

The VERDILOX line of products gives pet food manufacturers an innovative, more sustainable option for achieving their **shelf-life goals**. The unique antioxidant combinations of VERDILOX provide the ability for pet food manufacturers and ingredient suppliers to stabilize their novel ingredients and formulations with **natural antioxidants**.

A study on *dried black soldier fly larvae meal*, recently approved for adult dog food, assessed its oxidative stability and suitable antioxidant treatments. Oxidation in this meal can decrease palatability and nutrient quality. The study tested untreated and antioxidant-treated samples, measuring peroxide values and residual antioxidants over six months. VERDILOX GT Liquid, containing mixed-tocopherols and botanical extracts, was found to be the **most effective in preventing oxidation**. The larvae meal's fatty acid profile was similar to other animal-based meals, like chicken and pork, with comparable iodine and fatty acid levels.

#### VERDILOX enhancing *pet food stability*:

- Well balanced blend of mixed tocopherols and botanically sourced ingredients
- Assists in preventing the formation of free radicals that start the autoxidation process
- Improved chelation
- Improved sustainability
- Enhanced pet food and ingredient shelf-life performance
- Suitable for vegetarian-vegan diets



Sources: INF-22-20267

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## Nutreco opens world's first cell feed production facility

Nutreco completed construction on the world's first dedicated food-grade powder production facility for cell feed in Boxmeer, the Netherlands, and brought it up to commercial operation. According to Nutreco's statement, this facility produces the first cell feed product developed specifically for the cell-cultured meat industry.

This development is one way in which Nutreco is working towards its purpose of Feeding the Future, the company pointed out. To feed the global population in 2050, we need to produce more food than we do today – a momentous challenge for the industry and the world.

"The cell-cultured protein industry is in its development stage and one of its biggest challenges is how to feed protein cells cost-efficiently, sustainably and at scale. We see potential for this industry to be one solution to the challenge of feeding the rising global population and are committed to helping the industry grow by becoming a supplier and a solutions provider," expressed Susanne Wiegel, Head of Alternative Protein Program.

"We must continue to drive productivity and reduce the environmental footprints in the animal protein value chain, and produce protein from more and



more varied sources – animals as well as alternative sources of protein such as plant-based protein, meat or seafood developed from animal cells and protein produced through fermentation. Our investments and innovation in the cell-cultured protein industry are just one way we're tackling the challenge," pointed out David Blakemore, CEO of Nutreco.

[Read more>>](#)

## Innovafeed partners with pet food companies for Hilucia label

Innovafeed, one of the global leaders in insect production, announced two strategic partnerships with the US pet food companies Jiminy's and Arch for the rollout of its Powered by Hilucia™ co-branding on Jiminy's Good Grub Dog Food and Arch's Insect and Plant Recipe Dog Food. According to Innovafeed's statement, these new collaborations, launched at Superzoo, one of North America's premier pet retail events, mark a significant milestone in the company's journey.

Products featuring the Powered by Hilucia™ label will be available on Jiminy's and Arch's websites, Amazon, and throughout major pet food retailers.

Hilucia™, a portmanteau of *Hermetia illucens*, the scientific name of the Black Soldier Fly, is Innovafeed's brand for sustainable and performant ingredients for animal and plant nutrition that was soft-launched earlier this year. According to the Innovafeed, Hilucia™ represents the convergence of the company's pioneering industrial technology combined with the natural properties of an incredi-



ble insect that bring high-qualitative nutrition.

The Powered by Hilucia™ label is therefore becoming a seal of performance, sustainability, and precision, the company claims. The front-of-pack label is designed to raise awareness about the benefits of Innovafeed's model, including the lower environmental impact—requiring at least 50% less greenhouse gas emissions compared to traditional protein and oil sources—and the superior nutritional profile of the Hilucia™ Protein and Oil for Pets products, which contain 60% protein and essential fatty acids for optimal pet health, respectively.

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## Nasekomo improves insect protein production efficiency with new suspension technology

Nasekomo, one of the leading biotech innovators dedicated to advancing the insect industry, announced an upgrade to its neonate delivery service for *Hermetia illucens* (black soldier fly, BSF) newborn larvae. The company points out that this enhancement introduces a groundbreaking suspension technology, significantly improving the efficiency and reliability of insect-based protein production.

“The extended suspension of the newborn larvae was a testament to the innovative efforts of Nasekomo's R&D department,” says Bartosz Grodzki, Head of the Nasekomo Multiplication Center, underlining that the company is deeply committed to scientific research. “We've always prioritized a deep understanding of the biology of our insects, which is fundamental in creating solutions that meet the needs of the growing insect industry. The more we explore the biological intricacies of *Hermetia illucens*' life cycle, the more complexity we uncover, but we also see a wealth of new opportunities,” adds Grodzki.



Nasekomo states that as the insect bioconversion industry evolves, with companies specializing in different stages of the process, it has consistently provided high-quality neonate delivery services, thereby supporting the growth of the insect industry. “The complexity and specialized knowledge required for each stage are driving the industry towards a more specialized and segmented approach” explains the Co-founder of Nasekomo Marc Bolard. According to him, outsourcing the breeding stage reduces operational costs and allows producers to focus on rearing and processing.

[Read more>>](#)

## Calysta's pet protein now available in Europe

One of the world-leading protein pioneers, Calysta is targeting significant growth in Europe as the first major shipment of FeedKind® Pet protein arrived at its warehouse in Poland. The shipment builds upon its launch of FeedKind Aqua earlier this year. FeedKind Pet, a non-GMO protein with no animal or plant ingredients used in its production, is now available to pet food manufacturers across Europe, where it can be used in dry kibble, tinned food, or treats.

Made by fermentation, the protein was shipped by Calysseo, Ca-

lysta's joint venture with Adisseo to produce FeedKind at commercial scale. Earlier this year, Calysseo received MARA approval from China for use in aquaculture feeds. An export permit granted this spring enabled Calysseo to commence shipping internationally. Calysseo explains it hosts two of the largest fermenters in the world, each with a 10,000-tonne nameplate capacity.

Herman Sloot, Vice President of Commercial Development at Calysta says: “For the first time, Europe's pet food sector has the option to choose a fermented pro-



tein that is nutritious and kind to the environment. Starting today, FeedKind Pet will be available globally at commercial scale.

FeedKind Pet is already approved for use in both the EU, the UK, Canada, and many other countries.

[Read more>>](#)

## Insect protein producer secures investment of \$58 million

Idealist Capital, Sanimax and Fondaction announced their \$58 million strategic investment in Entosystem, one of the key players in the production of insect proteins and organic fertilizers for agriculture and animal nutrition. This decisive investment aims to accelerate Entosystem's growth by increasing existing production capacity and constructing a second commercial plant.

Using its cutting-edge technology, Entosystem reportedly diverts tonnes of organic materials from landfills and transforms them into high-quality ingredients, reducing the environmental footprint of food production.

"This agreement is the result of a rich collaboration with strategic business partners and, above all, the dedication of an outstanding team without whom Entosystem would not have been able to position itself so quickly as a world leader in its sector. We have all the keys in hand to achieve our ambitions and grow," says Cédric Provost, President and Co-Founder, Entosystem.

The Drummondville carbon-negative plant can process 90,000 tonnes of organic matter each year into 5,000 tonnes of high-quality protein meal, as well as 15,000 tonnes of fertilizer approved for organic farming.



According to an independent study, this innovative project reduces GHG emissions by 85% compared to the current scenario and generates carbon credits. According to the hierarchy of solutions to prevent food loss and waste, Entosystem's solution is preferred as it enables the re-introduction of organic matter into the food chain through an ecological process.

[Read more>>](#)

## Industry experts gather to discuss insect feed and food sector

The 5th edition of the "Insects to Feed the World" (IFW 2024) conference, organised by the Asian Food and Feed Insect Association (AF-FIA), concluded at the Singapore EXPO on 22 June 2024. The event served as a pivotal platform for advancing dialogue and collaboration in the insect feed and food sector.

Over 600 participants attended IFW 2024, underscoring its significance as a global gathering of industry leaders, researchers, policymakers, and entrepreneurs committed to exploring innovative solutions for food and feed security. Key highlights included significant talks by the Singapore Food Agency (SFA), Herman Teo, on "Developing a Comprehensive Insect Regulatory Framework for Singapore" and by MUIS (Majlis Ugama Islam Singapura) representative, Nur Sharalyn Abdullah, on "Assessing Halal Certification of Insects". Notably, Singapore achieved a milestone with its first halal certification



for insects by MUIS, reflecting its commitment to diverse dietary needs and food security.

The conference featured five parallel sessions covering a wide range of topics, including insect regulatory frameworks, engineering, biology, and Lunch and Learn sessions on market outlooks, BSF developments in China, and breeding strategies. These sessions facilitated robust discussions and knowledge exchange among participants, ensuring a comprehensive and engaging experience throughout the event.

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## Dr. Clauder's and Calysta unveil fermented protein dog treat

Germany-based pet food brand Dr. Clauder's joined forces with protein pioneer Calysta to launch the world's first dog treats made with FeedKind® Pet protein, a revolutionary new pet food ingredient.

The air-dried treats from Dr. Clauder's were presented at the world's leading pet trade fair, Interzoo. The product contains Calysta's nutritionally rich protein produced by natural fermentation. According to the companies, its production by natural fermentation makes this protein an excellent non-GMO ingredient that meets market demands for nutritional quality, taste and health for pets.

After its debut at Interzoo, the Dr. Clauder Trainee snack cultivated protein treat featuring FeedKind Pet, will be made available for sale in Europe. Calysta explains that FeedKind Pet protein is a fermented ingredient that is nutrient dense, has a complete amino acid profile for dogs, and has postbiotic properties that help maintain a healthy gut in animals. Additionally, FeedKind Pet is a vegan protein source.

"Dog owners have high expectations for their pet's food and are increasingly conscious about the



source, quality, and safety of the ingredients used," said Herman Sloot, vice president commercial development at Calysta.

"For the first time, Europe's pet food sector has the option to choose a high-quality source of protein that is nutritious and kind to the environment. Calysta is now producing at significant scale, and FeedKind Pet is approved for use in pet foods in the EU. We are excited Dr. Clauder's is introducing a snack featuring FeedKind Pet protein as we set a new standard for dog treats – one that prioritises both taste and health, while looking after our planet," Sloot added.

[Read more>>](#)

## Czech start-up unveils cell bank for cultivated meat

Bene Meat Technologies (BMT), a company that focuses on the development and commercialization of cultivated meat in the food and feed industry, unveiled its cutting-edge cell bank, an essential part of ethical and sustainable cultivated meat production.

More than 5,000 samples have reportedly already been stored in the cell bank of the biotech company. This bank, allowing the cultivation of meat without the need for animal slaughter, is the result of several years of research by the startup. Its existence en-

sures access to a sufficient quantity and variety of cells that can be cultivated for both research and production purposes, the company states.

"The cell bank is a crucial element in our effort to produce meat in an ethical and sustainable way. From the very outset, we knew that it would be essential to our success. Advanced cell preservation technology is critical to the smooth progress of both our research and cultivated meat production. With its use, we can meet the demand for meat without a negative impact on animals



and the environment. In our research and production, we mainly use primary cells directly sourced from small tissue samples, ensuring both high quality and an ethical approach," explains Ing. Zuzana Šaturová, Manager of the Cell Bank.

[Read more>>](#)

## Enifer secures €36M in funding for its PEKILO® mycoprotein

Finnish mycoprotein company Enifer announced the completion of a €36M funding package that enables it to start constructing a unique food-grade mycoprotein factory in Kirkkonummi, Finland. The factory, which is set for completion by the end of 2025 and projected to cost €33M, will convert food industry side streams into Enifer's sustainable PEKILO® fungi-based protein ingredients. The plant will be the world's first commercial plant to produce such a mycoprotein ingredient from sidestream raw materials.

“At Enifer, we're extremely excited to announce the kick-off of our first factory investment project. For over half a century, Kantvik has been at the heart of Finnish bioindustries, and I could not think of a better location to bring PEKILO® fermentation back to life. I would like to thank our new investors, in particular Taaleri Bioindustry and the Finnish Climate Fund, for joining us in our mission. Mycoprotein is the missing ingredient for a more sustainable food chain – the facility in Kantvik serves as a key steppingstone on our path to



making mycoprotein a cornerstone of protein supply, with several future factories already being planned,” says Simo Ellilä, CEO and co-founder of Enifer.

The new funding package comprises a new €15M Series B equity funding round led by the Finnish private equity fund Taaleri Bioindustry Fund I, with follow-on investments from existing shareholders Nordic Foodtech VC, Voima Ventures, Valio, and Laine Holding.

[Read more>>](#)

## GEA builds technology center for alternative proteins

GEA began the construction of its technology center for alternative proteins in Janesville, Wisconsin, USA. Scheduled to open in 2025, the center will scale up the production of novel plant-based, microbial, and cell-based foods. Here, GEA aims to support manufacturers in meeting the demand for complementary proteins and ingredients to traditional animal-based products.

“This investment underscores our commitment to innovation and sustainability in the food industry,” said Arpad Csay, who leads GEA's new food activities in North America, at the groundbreaking ceremony on May 8, 2024. The center will house pilot lines for cell cultivation and precision fermentation, bridging the gap between benchtop and commercial production of alternative proteins. “The technology center will offer foodtech businesses a platform to



develop and derisk their processes to ensure technological and commercial viability. It helps startups in the sector implement a business strategy that requires little upfront investment. This way, we help accelerate the development of market-ready products,” adds Csay.

[Read more>>](#)

## NAIC to serve as innovation hub for insect protein industry

**N**RGene Canada, NRGene's Canadian subsidiary, announced the opening of the North American Insect Center (NAIC). This research center for collaborative innovation was established together with the Swiss technology group Bühler marking a significant milestone in the advancement of insect protein production in North America.

The North American Insect Center (NAIC) is located at NRGene Canada's facility in Saskatchewan. This cutting-edge center will serve as a testing and demonstration facility for both companies' customers, offering them the opportunity to evaluate the performance of chosen Black Soldier Fly (BSF) varieties on the by-product streams available to the customers.

The NAIC will allow customers to assess BSF varieties, operational parameters, and practices for efficient industrial-scale production. NRGene Canadian emphasizes that this collaborative ap-



proach enables informed decisions and maximizes BSF's potential as a sustainable protein source. The center will serve as a hub for innovation, supporting the growth of the insect protein industry in North America. Additionally, the center will offer workshops, training sessions, and seminars to educate the industry stakeholders on the benefits and best practices of insect protein production.

[Read more>>](#)

## BSF startup receives £3 million in funding

**U**K-based startup Flybox® launched the FeedFlow project, which was awarded £3 million in funding by Innovate UK as part of Defra's Farming Innovation Programme. This initiative brings together a consortium of industry leaders and academic institutions to address significant health and welfare issues in poultry production, utilising advanced technologies and Black Soldier Fly (BSF) larvae, the company points out.

Despite significant advancements in production efficiency through genetic selection, the poultry industry reportedly fac-

es persistent issues, including poor leg health, high mortality rates, and variable feed conversion ratios (FCRs). Additionally, poultry production contributes notably to ammonia emissions in the UK. To address these issues and stay competitive against low-cost imports, UK production systems must evolve continuously.

Flybox® points out that Black Soldier Fly farming and Artificial Intelligence (AI) are emerging as revolutionary solutions for improving poultry welfare and performance while supporting sustainability. BSF larvae are renowned for their ability to pro-



mote natural poultry behaviour and provide a nutrient-rich, high-quality protein source enhanced with antimicrobial peptides. AI systems propel precision agriculture by delivering real-time data on flock welfare and early warnings of potential issues.

[Read more>>](#)



## Portuguese companies introduce new petfood with insect protein

The official launch of the new adult dog food product, happyOne Premium Insect Protein, developed in collaboration with pet food manufacturer petMaxi and the insect producer EntoGreen, was held at an event in Lisbon.

EntoGreen's Founder and CEO, Daniel Murta, opened the session reflecting on the importance of developing innovative products for the national and international markets and announcing the characteristics of insect proteins that make it a unique and high-quality product to include in petfood.

Dr Rui Fortunato, petMaxi's Technical Director, presented

the advantages of this new petfood, namely the fact that it is hypoallergenic, with a single protein source, insects, being a high-quality product that is part of petMaxi's Premium range. The companies emphasize that this product incorporates 25% insect protein and is characterised by being suitable for animals with sensitivities (itching, hair loss, among others) and allergic symptoms.

This launch session was also special as it presents one of the first products resulting from the work carried out by the InsectERA Mobilising Agenda, funded under the Portuguese Recovery and Resilience Plan (PRR), a project that is



expected to launch more than 100 new products, processes, and services by 2026. Although having a launch session in May, this product reached the Portuguese market in February, and can currently be found in more than 50 physical and online points of sale, including veterinary clinics and pet shops.

[Read more>>](#)

## Agroloop builds BSFL factory for animal feed

Hungarian insect producer Agroloop agreed with Germany-based WEDA Dammann & Westerkamp on the feeding technologies of its new black soldier fly larva (BSFL) rearing facility to be established for animal feed. The plant for the industrial production of the feed insect is currently being built near Budapest Airport, and will go into operation in Autumn 2024.

Agroloop Hungary is significantly increasing its existing larvae breeding capacities for the European market with the plant investment of more than 20 million euros. By the end of this year, the agrotech company is expected to receive 120 tonnes of raw material per day, of which 6,000 tonnes of soil improver granules, nearly 3,000 tonnes of feed protein and more than 600 tonnes of feed fat will be produced annually – producing around 10,000 tons of end product in its 13,000 square metre plant.

High-quality insect-based feed proteins are in-



creasingly being used as a health-promoting source of protein for the pet food and livestock feed segment. In view of a rapidly growing world population, the global demand for animal proteins is expected to increase by around 100% by 2050. It is estimated that the insect feed market will reach a total annual turnover of €2 billion by the end of the decade, producing 1 million tonnes of insect meal per year.

[Read more>>](#)

## EXPLORING ALTERNATIVE PROTEINS FOR ANIMAL NUTRITION IN THE EU: WHAT YOU NEED TO KNOW



In the EU there are different alternative/non-traditional sources of proteins allowed for use in animal nutrition that companies and consumers are not necessarily familiar with. In this short article, we will cover some of them, including the characteristics the ingredients must have to comply with European regulations.

### By Argenta

Alternative sources of protein for use in animal nutrition are classified in the EU as feed materials. As per Regulation (EC) No 767/2009, 'feed materials' are *products of vegetable or animal origin, whose principal purpose is to meet animals' nutritional needs, in their natural state, fresh or preserved, and products derived from the industrial processing thereof, and organic or inorganic substances, whether or not containing feed additives, which are intended for use in oral animal-feeding either directly as such, or after processing, or in the preparation of compound feed, or as carrier of premixtures.* In Commission Regulation (EU) 2022/1104 of 1 July 2022 amending Regulation (EU) No 68/2013 on the Catalogue of feed materials both, industry and consumers, can find the list of these proteins that can legally enter the market for use in feeding stuffs. On Table 1, you will find some of the most interesting examples authorised to date.

The first two entries of the table cover insects already authorised for use in the EU, which is a source that can be tricky to understand from the farming/manufacturing point of view since the diet of these animals is also subject to regulatory requirements, further details are provided.

#### FEED FOR INSECTS

Companies interested in harvesting insects for use in animal feeds should notice that their feed is also subject to legal requirements that guarantee the safety of the entire food chain. In particular, farmers must pay attention to the following (as per Commission Regulation (EU) 2017/893):

- Feed for insects cannot contain ruminant proteins, catering waste, meat-and-bone meal, manure, or faeces.
- The substrate used for feeding insects may only

Table 1. Examples of alternative protein sources currently authorised for use in animal feeds in the EU.

Name of the ingredient	Description	N° assigned in the EU catalogue	Examples
<b>Terrestrial invertebrates, live</b>	Live terrestrial invertebrates, in all their life stages, other than species having adverse effects on plant, animals and human health.	9.16.1	Black Soldier Fly ( <i>Hermetia illucens</i> ), Common Housefly ( <i>Musca domestica</i> ), Yellow Mealworm ( <i>Tenebrio molitor</i> ), Lesser Mealworm ( <i>Alphitobius diaperinus</i> ), House cricket ( <i>Acheta domesticus</i> ), Banded cricket ( <i>Gryllobates sigillatus</i> ), and Field Cricket ( <i>Gryllus assimilis</i> ) – currently authorized.
<b>Terrestrial invertebrates, dead</b>	Dead terrestrial invertebrates, other than species having adverse effects on plant, animals and human health, in all their life stages, with or without treatment but not processed as referred to in Regulation (EC) No 1069/2009.	9.16.2	Black Soldier Fly ( <i>Hermetia illucens</i> ), Common Housefly ( <i>Musca domestica</i> ), Yellow Mealworm ( <i>Tenebrio molitor</i> ), Lesser Mealworm ( <i>Alphitobius diaperinus</i> ), House cricket ( <i>Acheta domesticus</i> ), Banded cricket ( <i>Gryllobates sigillatus</i> ), and Field Cricket ( <i>Gryllus assimilis</i> ) - currently authorized.
<b>Aquatic invertebrates (includes both, live and dead)</b>	Whole or parts of marine or freshwater invertebrates, in all their life stages, other than species pathogenic to humans and animals.	10.1.1	Mayfly, Odonata species – potential for future use.
<b>Single cell proteins from fungi</b>	Fermentation product obtained from culture of <i>Aspergillus oryzae</i> , <i>Paecilomyces varioti</i> or <i>Trichoderma viride</i> on substrates mostly of vegetable origin such as molasses, sugar syrup, alcohol, distillery residues, cereals and products containing starch, fruit juice, whey, lactic acid, sugar, hydrolysed vegetable fibres and fermentation nutrients such as ammonia or mineral salts.	12.1.9	-
<b>Product from <i>Bacillus subtilis</i> rich in protein</b>	Fermentation product obtained from culture of <i>Bacillus subtilis</i> on substrates mostly of vegetable origin such as molasses, sugar syrup, alcohol, distillery residues, cereals and products containing starch, fruit juice, whey, lactic acid, sugar, hydrolysed vegetable fibres and fermentation nutrients such as ammonia or mineral salts.	12.1.10	-
<b>Single cell proteins from bacteria</b>	Protein products obtained by fermentation with bacteria on a substrate/culture medium consisting of methanol (fermented with <i>Methylophilus methylotrophus</i> ) or natural gas (fermented with <i>Methylococcus capsulatus</i> , <i>Alcaligenes acidovorans</i> , <i>Aneurinibacillus danicus</i> (previously known as <i>Bacillus brevis</i> ) and/or <i>Bacillus firmus</i> ) as carbon source, a nitrogen source of vegetal or chemical origin, vitamins and minerals.	12.1.13	-
<b>Bacterial biomass rich in protein</b>	Protein rich co-products obtained from the production of amino acids, vitamins, organic acids, enzymes and/or their salts obtained by fermentation with <i>Bacillus coagulans</i> , <i>Bacillus subtilis</i> , <i>Bacillus velezensis</i> , <i>Bacillus licheniformis</i> , <i>Bacillus smithii</i> , <i>Corynebacterium casei</i> , <i>Corynebacterium glutamicum</i> , <i>Corynebacterium melassecola</i> , <i>Ensifer adhaerens</i> , <i>Enterococcus faecium</i> , <i>Escherichia coli</i> K12 or <i>Lactobacillaceae</i> on substrate/culture medium consisting of a carbon source mostly of vegetal origin, a nitrogen source of vegetal or chemical origin, vitamins and minerals. The product may be hydrolysed.	12.2.8	-
<b>Fungal biomass</b>	Protein rich co-products obtained from the production of products such as enzymes, vitamins and/or organic acids obtained by fermentation with <i>Ashbya gossypii</i> , <i>Aspergillus niger</i> , <i>Aspergillus tubingensis</i> , <i>Aspergillus sojae</i> , <i>Neurospora intermedia</i> , <i>Neurospora tetrasperma</i> , <i>Trichoderma viride</i> , <i>Trichoderma longibrachiatum</i> or <i>Trichoderma reesei</i> on substrate/culture medium consisting of a carbon source mostly of vegetal origin, a nitrogen source of vegetal or chemical origin, vitamins and minerals.	12.2.9	-



contain products of non-animal origin or the following products of animal origin of Category 3 material: fishmeal, blood products from non-ruminants, di- and tricalcium phosphate of animal origin, hydrolysed proteins from non-ruminants, hydrolysed proteins from hides and skins of ruminants, gelatine and collagen from non-ruminants, eggs and egg products, milk, milk based-products, milk-derived products and colostrum, honey, and rendered fats.

How about the potential for new ingredients to be authorised for use in insect feeds, such as feed additives? To date, there is no feed additive authorised specifically for use in insects in the EU. However, European authorities are already contemplating the possibility of receiving a request for authorising such products since, as it can be seen in the recently updated Guidance on the assessment of the efficacy of feed additives published by the European Food Safety Authority (EFSA), there are now requirements for experimental design when the target species are insects. For example, a) an application dossier aimed at authorising a feed additive for all insects must contain a total of 4 efficacy studies: 2 in honeybees + 2 in other insect species (1 in each), b) applications for all terrestrial species must now include studies with insects or they will be excluded from the authorisation, c) the duration of the efficacy studies must cover the whole production cycle.

### **NEW ALTERNATIVE PROTEINS ON THE HORIZON?**

From the regulatory point of view, companies in-

terested in placing a new feed material on the market must first make a registration in the Online Feed Material Registers. The register is periodically reviewed and updated by the EU Feed Chain Task Force composed of representatives of the EU feed business sectors. As part of this process, the Task Force could authorize the incorporation of new protein sources into the Catalogue of feed materials in the next update of this regulation. To date, there are some interesting ingredients in the Online Register that could make it into the Catalogue in the future, such as onion protein, pineapple concentrate (protein-rich), lemna protein, and guar protein concentrate.\*

### **PARTNER FOR SUCCESS: NAVIGATING REGULATORY CHALLENGES TOGETHER**

Securing market authorisation for your product requires navigating a complex regulatory landscape. This can be challenging, but the rewards—healthier, happier, and safer animals—are significant.

Taking a proactive and strategic approach is key to overcoming these regulatory hurdles. At Argenta, we understand the importance of tailored support for your unique needs. Our collaborative and knowledgeable team is dedicated to providing the regulatory expertise needed to guide your product to approval.

Whether you're developing feed materials or other animal health/nutritional products, our experienced teams in Germany, Spain, and the USA are

here to support you. We have a proven track record with the European Food Safety Authority (EFSA), the EMA, and national competent authorities in the EU, as well as with the FDA Center for Veterinary Medicine (CVM), the Environmental Protection Agency (EPA), and the USDA in the USA. Let's work together to ensure your product reaches the market successfully.

### References

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2. Commission Regulation (EU) 2017/893 of 24 May 2017 amending Annexes I and IV to Regulation (EC) No 999/2001 of the European Parliament and of the Council and Annexes X, XIV and XV to Commission Regulation (EU) No 142/2011 as regards the provisions on processed animal protein: <https://eur-lex.europa.eu/eli/reg/2017/893/oj>

3. Feed materials register: <https://feedmaterialsregister.eu/>

4. Guidance on the assessment of the efficacy of feed additives: <https://www.efsa.europa.eu/en/efsajournal/pub/8856>

5. Regulation (EC) No 767/2009 of the European Parliament and of the Council of 13 July 2009 on the placing on the market and use of feed, amending European Parliament and Council Regulation (EC) No 1831/2003 and repealing Council Directive 79/373/EEC, Commission Directive 80/511/EEC, Council Directives 82/471/EEC, 83/228/EEC, 93/74/EEC, 93/113/EC and 96/25/EC and Commission Decision 2004/217/EC: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:%3A02009R0767-20181226>

\*As per Regulation (EC) No 767/2009, ingredients in the online register can be placed on the market but its regulatory status can be revoked at any given time and the consequences will be immediate.



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## ALTERNATIVE SOURCE OF PROTEINS FOR ANIMAL FEED: A byproducts preservation and circular economy approach

**Andrea Lopez**  
Global Product Manager  
Selko

"Throughout the world, animal protein producers are seeking alternatives to support their efforts towards a more sustainable feed-to-food chain. For animal feed production, by-products can provide a cost-effective and reliable source of valuable nutrients. However, high moisture content makes these materials sensitive to decomposition and nutrient spoilage by microbes. Treating by-products with Selko Yeast Inhibition solutions for protein extraction is an innovative approach that supports a more circular economy..."

By-products from the food and beverage industry are increasingly popular and inexpensive sources of protein, sugars, and fibre compared to the conventional raw materials used in animal feed. Conventional ingredients can fluctuate in price and availability due to weather conditions affecting crop quality and yield. As global demand for animal feed continues to grow, reliance on crops like soybeans, corn and other conventional feed sources leads to environmental challenges, including deforestation, and water and land depletion.

Throughout the world, animal protein producers are seeking alternatives to support their efforts towards a more sustainable feed-to-food chain. For animal feed production, by-products can provide a cost-effective and reliable source of valuable nutrients. However, high moisture content makes these materials sensitive to decomposition and nutrient spoilage by microbes. Within hours of production, by-products can significantly deteriorate. To protect that nutritional content, they require a combina-

tion of effective on-site treatments that inhibit microbial proliferation, such as drying, ensiling or fermentation. Though effective, these treatments can add expense and increase energy consumption and processing. Since these by-products can be considered waste streams by food and beverage producers the objective is to remove these materials at a low cost. Offering a solution that is more cost-effective and easier to apply – while significantly increasing the shelf-life and maintaining dry matter and nutritional value – provides a key to overcome these challenges.

Both brewers' spent grain (BSG) and dried distillers' grains with solubles (DDGS) – which provide a protein concentration of 16%–22% – are commonly used for animal feed. But they also contain high levels of moisture, which allows for the fast proliferation of mould and yeast when the feed ingredients have not been properly managed or stored. Specific organic acid blends, including Revalet, Selko-SVG, Selko-BE+, and Selko-RSD decreases the pH of

by-products. This acidification inhibits microbial growth, specifically yeasts, moulds and spoilage bacteria, thereby preventing protein degradation and helping retain amino acid profiles, crucial for the nutritional quality of animal feed.

Animal feed producers may incorporate the complete byproduct or extract the protein component depending on their nutritional needs or by-product quality. Regardless of intended use, BSG and DDGS are treated at the production site or at trader facilities. If only the protein component is desired, then the protein extraction process begins. That process may include drying the BSG for efficacy before particle size reduction using mechanical grinders, like hammer or roller mills, occurs. The BSG is mixed with water to adjust the pH to a base level of 9-11, at which point proteins become soluble. As moulds and yeasts can survive in a basic environment, the initial acidification step before processing is vital to prevent the degradation of the extracted proteins.

Once the pH is raised using mild alkali, the mixture is stirred for 1-2 hours to allow protein solubilization. Then the slurry is centrifuged or filtered to separate the solid or residual fibre from the liquid containing the solubilized protein. The solubilized

protein is then dried to a powder that can be easily stored and incorporated into animal feed.

The protein extract can be mixed with other nutritional components like vitamins or minerals depending on the feed requirements of the specific target species. The protein concentrate is typically pelletized into animal feed to ensure uniform distribution and ease of consumption.

Other high moisture by-product streams rich in protein are whey (a by-product of cheese making), brewer's spent yeast (a by-product of beer brewing) and wet corn gluten feed. These by-products are also prone to microbial spoilage and protein degradation if not properly preserved. In unpreserved whey and spent yeast, microbial activity can lead to protein hydrolysis, resulting in the breakdown of proteins into smaller peptides and amino acids, which could reduce their nutritional value and digestibility for animals. Whey typically has a pH around 6.0-6., while brewer's yeast may have neutral pH at around 7. Acidification to a pH of 3.5-4.5 creates unsuitable conditions for microbial growth while still being safe for proteins. To optimise the extraction of protein for animal feed, Selko Yeast Inhibition organic acids blends are often used to stabilise and preserve these by-products prior to extraction.



## BREWER'S SPENT YEAST PROTEIN EXTRACTION

Live yeast cells that are used for alcohol production have a thick cell wall, so physical, mechanical, or enzymatic disruption is often required to break the cells and release proteins. These steps may include heating, centrifuging or treatment with specialised enzymes, but some extraction methods are more expensive than others. The industry's preferred method is direct steam application or heating live yeast to 80°C, which can produce protein degradation. Selko Revalet offers a cheaper solution for yeast inactivation and protein preservation and avoids damaging heat treatments and additional energy consumption. In a research trial comparing the protein content found in brewery spent yeast that was untreated, heat treated or treated with a blend of organic acids, the acidified content maintained 6.48% protein content - almost the initial 6.6% content - for 7 days, while the heat-treated product fell to 3.8% during that period (Figure 1). However, Selko Revalet not only inactivates live yeast cells, once the cell is destroyed, proteins are released in yeast extract and will remain in the same concentration. Additionally, adding the organic acid blend prevents microbial proliferation during transportation and storage of the yeast extract.

When an enzymatic treatment is added to create cell disruption and provide proper preservation of the yeast extract, it also helps maintain the proteins for solubilization using the process as described earlier in this article. Since the yeast has been preserved with Revalet the proteins are more likely to remain intact, which improves the efficiency of the extraction process.

## IN CONCLUSION

The treatment of high-moisture by-products with Selko Yeast Inhibition solutions plays a crucial role in preventing microbial proliferation and preserving the integrity of proteins for subsequent extraction. Lowering the pH of these by-products creates an environment that inhibits the growth of bacteria, moulds and yeasts. By controlling microbial spoilage, these solutions prevent the breakdown of proteins by microbial enzymes, ensuring that the proteins remain intact for efficient extraction and use in animal feed. Once stabilised, the protein extraction process can proceed with minimal degradation, leading to higher protein yields and improved quality. These proteins can then be incorporated into animal feed formulations, providing a nutritionally rich, affordable,

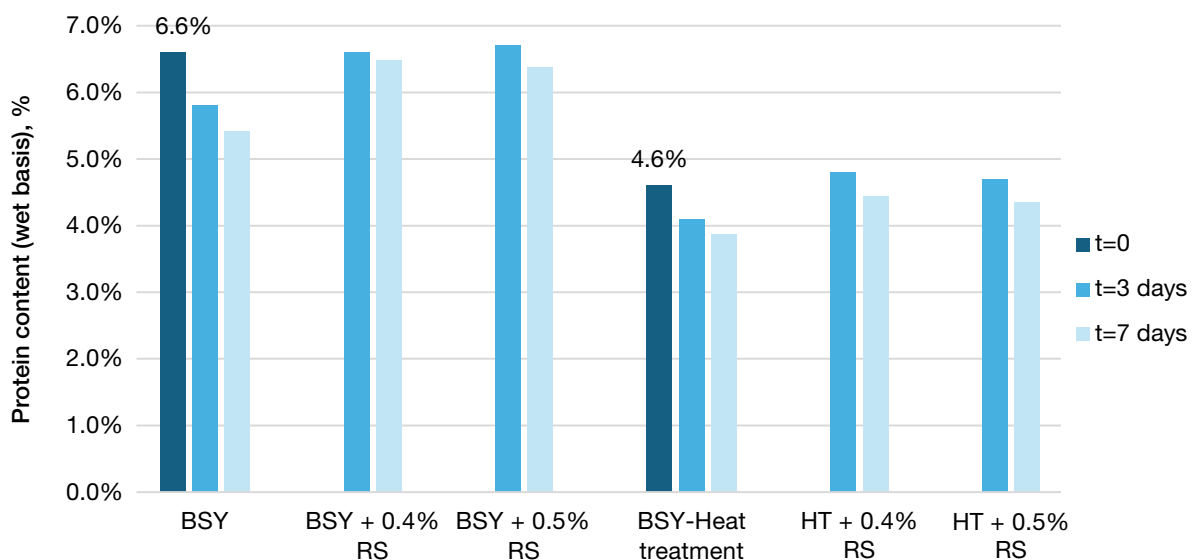


Figure 1. Brewery spent yeast treated with Revalet Super (RS) and Heat (HT). A decreased protein content is noticed when yeast is treated with heat from 6.0% to 4.60% with moisture content of 80%. Revalet reduce protein losses vs heat treatment.



and sustainable alternative to conventional feed ingredients.

Treating by-products with Selko Yeast Inhibition solutions for protein extraction is an innovative approach that supports a more circular economy by making waste products valuable in their own right and preserves natural resources. It transforms what was once considered waste into a valuable feed ingredient, contributing to more sustainable, efficient, and eco-friendly animal production systems.



### How organic acids attack: Mode of action explained

Specific blends of buffered and non-buffered organic acids prevent spoilage by inhibiting microbial growth. By lowering the pH and creating a hostile environment for spoilage organisms, these acids help to preserve the proteins present in liquid byproducts. Organic acids have been found to attack unwanted microbial organisms, like bacteria, in several ways including by damaging the cellular walls of these organisms, creating energy competition, increasing the permeability of cell walls, raising intracellular osmotic pressure, and inhibiting biomolecule synthesis. For example, these acids can enter the cell of an unwanted microbe and dissociate to generate acid ions and protons (H<sup>+</sup>), which alters the internal pH. The cell becomes more acidic, causing it to waste its energy actively expelling protons. Similarly, the collection of acid ions increases intracellular osmotic pressure and dealing with that pressure interrupts

normal cell growth and the function of its metabolism. Direct antimicrobial action of organic acids in their undissociated form can penetrate microbial cell membrane and disrupt metabolic processes, leading to microorganism death. Ultimately these effects lead to increased cell death for the unwanted microbes.

As the harmful microbes perish, they can no longer break down proteins and cause formation of unwanted metabolites, like toxins or ammonia, which reduce protein quality. Furthermore, organic acids ensure the proteins stay intact by preventing microbial proteases – enzymes that break down proteins – from being produced by bacteria or moulds. This collection of modes of action helps prevent the decomposition of proteins, preserves amino acid profiles, and maintains nutrient suitability for extraction and use in animal feed.

#### **About Andrea Lopez**

*Andrea Lopez is Selko's Global Product Manager for Yeast Control and Food2Feed program. She is a dynamic professional with a background in biotechnology and a wealth of experience in sustainable practices within the food and feed industry. Her work experience has been dedicated to implementing sustainable solutions that optimize the utilization of by-products as alternative protein and nutrients sources, replacing common raw materials used in animal feed.*

*Currently, Lopez serves in a pivotal role focusing on the application of organic acids for nutritional preservation and microbial control in high moist by-products. As an integral member of the team, she spearheads initiatives aimed at harnessing the potential of organic acids to enhance the nutritional quality and safety of these by-products when used on animals. Her dedication to addressing environmental concerns while promoting nutritional preservation underscores her commitment to shaping a more sustainable future for the feed and food industry.*



## PRELIMINARY TRIALS: MEALWORM PULP SHOWS POSITIVE PALATABILITY IN PETS

**Dr. Bénédicte Lorrette**

*Animal Nutrition & Health R&D Director  
Ynsect*

Ynsect’s new mealworm-based wet pet food ingredient, WetPro15, is nutritionally excellent, environmentally sound, and functionally transparent for pet food manufacturers. These attributes will appeal to pet owners who are seeking quality alternatives to conventional ingredients — but the bottom line is, how will our cats and dogs respond to it? Here, we report the results of two new studies that reveal that including WetPro15 in the diet has no negative effect on palatability for pets, and no detrimental effects on faecal consistency in dogs.

Insect protein is one of several novel protein sources that are raising interest among pet-owners who are seeking alternatives to conventional meat-based pet foods. This interest in alternatives is in part motivated by their perceived nutritional and environmental benefits. As recently reported in our previous article<sup>1</sup>, our ingredient, WetPro15, certainly meets these criteria: the mealworm pulp has a higher protein-to-fat ratio than proximate products such as MDMs; it is a natural source of linoleic and oleic acids; and its ileal and peptic digestibility are greater than 90%. From an environmental standpoint, its climate change contribution is equivalent to chicken MDM, and significantly lower than other meat-based protein sources.

However, while pet-owners are increasingly evaluating products based on their nutritional and environmental profile, there are other factors that contribute to their choice of their pets’ diet. One of these is how much enjoyment the pet derives from its food: a recent study has reported that palatability

is the fourth-most important aspect of a pet food (out of fourteen attributes surveyed) that pet-owners consider when choosing their companions’ diet<sup>2</sup> and it is moreover considered an aspect of animal welfare, coming under Provision 5 which mandates for “positive mental experiences”<sup>3</sup>. Palatability, which encompasses visual, olfactory and textural cues in addition to taste *per se*, appears to be particularly important for cats, which show greater selectivity than dogs<sup>4</sup>. It is therefore important that any novel ingredient should undergo palatability trials. Here, we report on a preliminary trial conducted by an external partner that reveals that incorporating WetPro15 into a poultry-based pâté does not diminish the palatability of the food.

Another factor that is of particular concern to dog-owners is the digestibility of the food —specifically regarding how it affects dogs’ faecal characteristics. We have previously reported results of a safety trial of our dry pet food ingredient, Protein70, which showed that dogs’ stool quality scored an ide-

al score of 3 – “moist and formed”<sup>5</sup>. Here, we report on a new trial in which we confirm similar results for WetPro15.

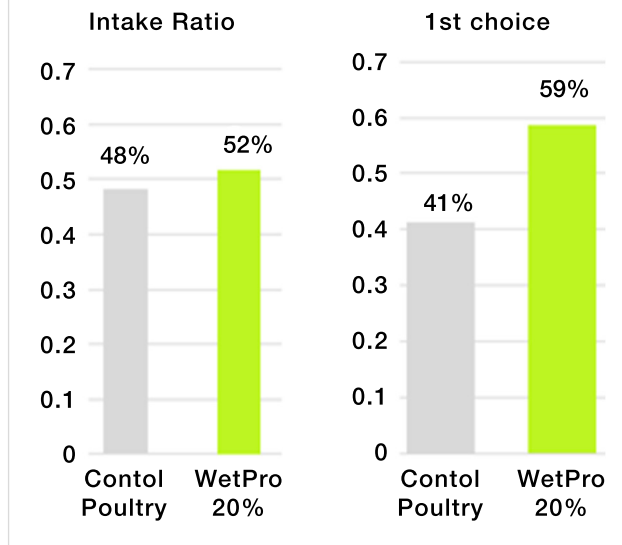
### PALATABILITY TRIAL ON CATS

To evaluate the palatability of WetPro15, we carried out a two-bowl test in which 33 cats were offered a choice between a control pâté, whose animal protein source was poultry MDM, and a test pâté, in which 40% of the animal protein source was replaced with WetPro15. As shown in Figure 1, there was no significant difference in intake ratio (one-tailed t-test at 95% confidence), meaning the cats were as eager to consume the test diet as the control diet. Moreover, cats chose the test pâté first 59% of the time, which indicates that visual and olfactory cues were positive.

### PALATABILITY AND FAECAL CONSISTENCY IN DOGS

Our dog trial was performed via a 10-day monadic test in which 32 adult dogs were either fed a control pâté (poultry MDM 50%) for five days followed by a test pâté (20% WetPro15 & 30% poultry MDM) for five days, or vice versa. As shown in Figure 2a, there was no significant difference in intake quantity – a total of 309g of test pâté (blue)

Figure 1



was consumed, compared to 288 g of control pâté — indicating that the insect protein was no deterrent to consumption.

The dog owners were asked to report on aspects related to the digestibility of the diet, including the firmness and quantity of the dogs' faeces (Figure 2b). The diet including WetPro15 was associated with “just right” faecal consistency by 81% of owners, compared to only 63% for the control diet. Moreover, 22% of owners reported increased flatu-



Figure 2

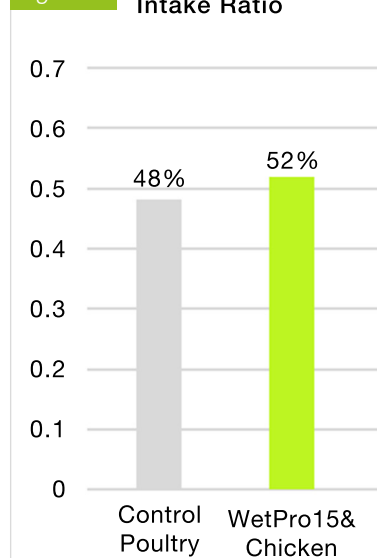


Figure 2a. Intake ratio on adult dogs

Figure 2

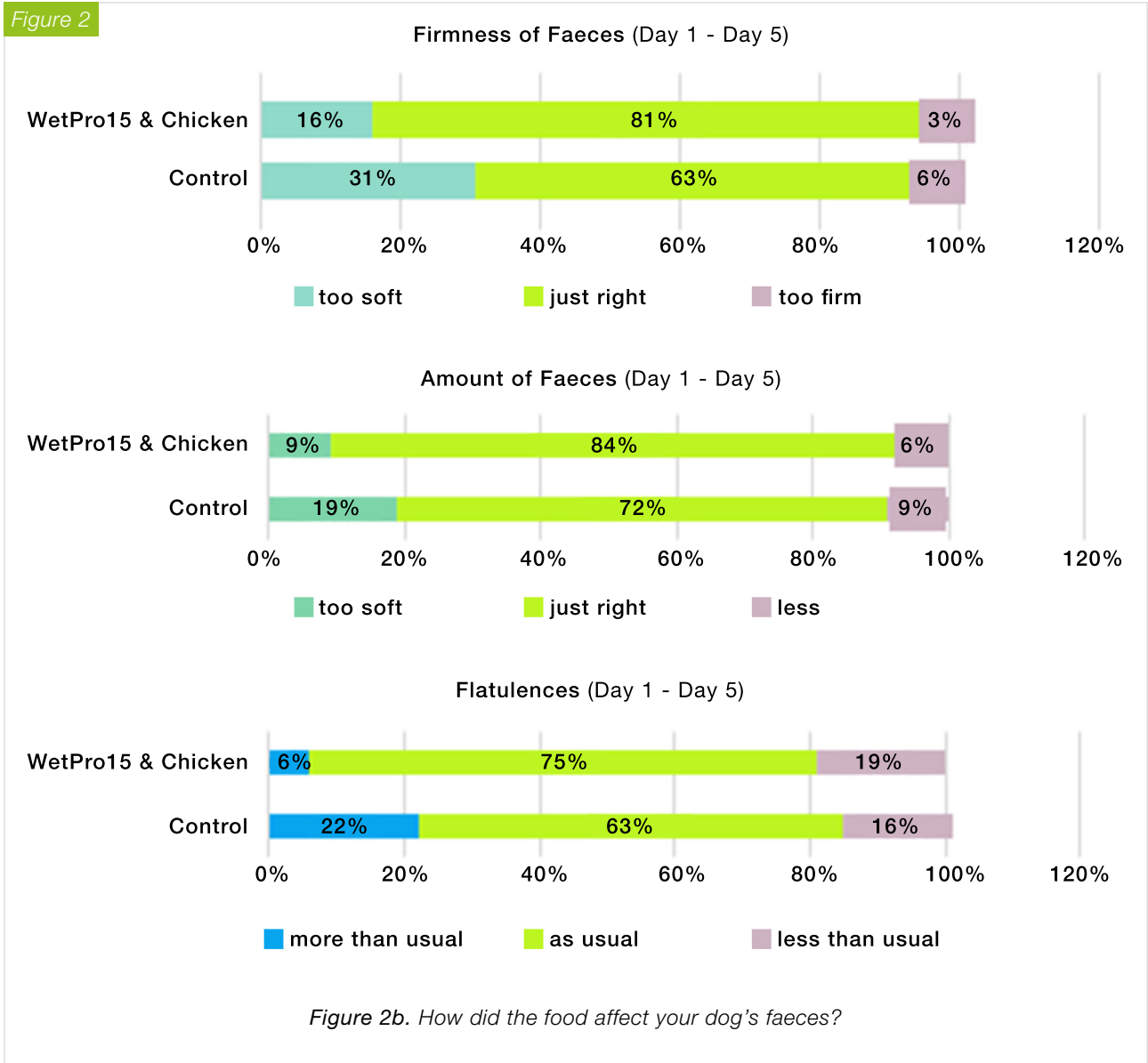
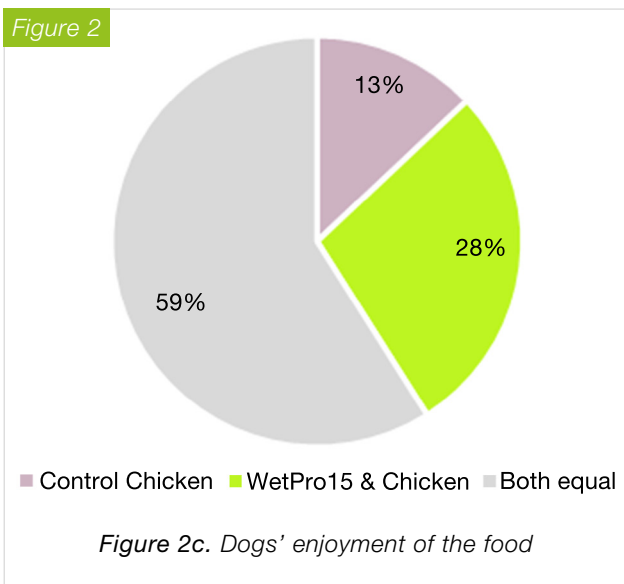


Figure 2



lence after the control diet, compared to only 6% after the test diet.

When owners were also asked to judge their pets' enjoyment of the food, 75% reported a high level of enjoyment from the test paté, compared to only 63% from the control paté. Overall, 28% of dogs were reported to prefer the test paté compared to only 13% preferring the control (Figure 2c); nearly 60% showed no preference.

**MOVING FORWARD**

While further studies are required to determine the significance of these observations, they certainly suggest that at the very least, the presence of

WetPro15 was no deterrent to either cats or dogs, in terms of the palatability of the food and to dogs' enjoyment of their food.

Besides, the canine trial suggests further that a diet including mealworm protein has digestive benefits for dogs. This is probably related to the presence of chitin in the mealworm pulp, which is known to be a good source of natural fiber.

The palatability of insect-based pet foods is perhaps unsurprising, in principle, considering that catching and consuming insects (among other prey) is a natural behaviour for both dogs and cats. In comparison to conventional wet pet food products, our WetPro15 has no obvious visual or olfactory deterrents: the mealworm pulp's light brown colour makes it visually similar to traditional products, and it is not associated with any strong odour. Moreover, as previously reported in

our article<sup>1</sup>, it is texturally similar to patés made from chicken MDM. Hence, from the perspective of the animal, including WetPro15 in the diet appears to be largely transparent: mealtime for them is “business as usual”.

These initial results are an encouraging indication for pet-owners that they can offer their companions a diet that is both nutritionally and environmentally superior, without sacrificing their tastebuds.

### References

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## NOVEL PROTEIN SOURCES: IMPACT OF INSECT PROTEIN MEALS ON PET FOOD PALATABILITY

**Dr. Cristina Murcia García**

*Technical Service Manager*

*Kemin Nutrisurance EMEA*

“Insects have unique flavor profiles that can vary significantly between species. For instance, crickets have a nutty taste, while mealworms can be more neutral.

These flavors can be both an advantage and a challenge when formulating palatable pet foods. The impact of insect protein on pet food palatability is a critical factor that manufacturers are actively addressing through research, innovation, and consumer feedback.”

The increasing population of humans and animals is pushing the boundaries of our planets’ resources and requiring the production of higher quantities and more sustainable food and feed.<sup>1</sup>

Novel ingredients such as insects, algae, yeasts and vegetable by-products are being investigated as potential new protein sources for pet food.

This article will focus on the incorporation of insect protein meals into pet food and the evaluation of its impact to palatability in dogs and cats’ diets by analyzing the latest public research available on this topic.

### INSECT MATERIALS AS PET FOOD INGREDIENTS

Last decade, the use of insect ingredients as balanced sources of proteins and fats has become a global reality. In each continent, we can find research centers and universities with projects focused on insect materials and their use in humans, livestock and pet food diets.

Big scale production has also improved, so big hurdles to becoming profitable for producers and affordable for customers are about to be overcome. This positions insect meals and oils as relevant sources of proteins and lipids for the pet food industry.<sup>2</sup>

Insect ingredients not only meet the nutritional requirements for pets but are also a great tool for claiming sustainability, lower carbon footprint and innovative ingredients, just to name a few.<sup>3</sup>

While insect proteins can have a lower environmental footprint than most animal proteins, this is not as significant for the pet food industry, since pet foods mainly incorporate low environmental impact animal by-products from the rendering industry.<sup>4</sup>

Currently, the main sources of insect oils and meals are black soldier fly, mealworm and cricket. They are considered as good alternative protein sources and mostly have adequate amino acid levels, meeting the standard requirements for dogs and cats.<sup>5</sup>

**Table 1.** Average nutrient composition of selected form of insects on a dry matter basis.

Edible insect	Life stage	Protein (%)	Fat (%)	Fiber (%)	Ash (%)
Black soldier fly <sup>7</sup>	Larvae	42.35	24.29	7.00	21.50
Meal worm <sup>8</sup>	Larvae	53.75	37.10	-	2.75
Banded cricket <sup>9</sup>	Imago	70.00	18.23	3.65	4.74
Field cricket <sup>10</sup>	Imago	56.40	28.80	7.00	6.40
Commercial BSF <sup>11</sup>	Final meal	56.27	14.12	7.87	8.61



In insect materials, protein is the nutrient composing the largest fraction, with values ranging from 40% to more than 60% on a dry matter basis.

Fat makes up the second largest fraction, and generally, insect materials contain lower levels of ash compared to other animal protein sources (see **Table 1**). Insects are also packed with micronutrients, including iron, zinc, calcium, and B-vitamins, which are vital for various bodily functions.<sup>6</sup>

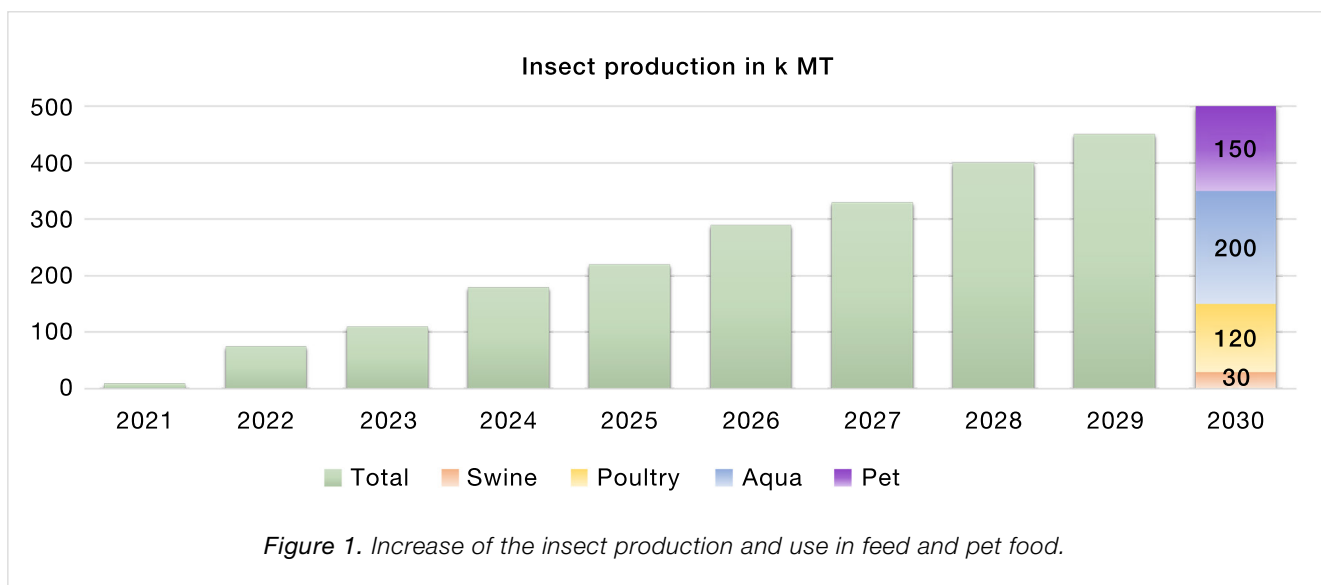
One key property of insect ingredients is that it is possible to modulate their nutritional composition by changing the feeding during the insect rearing. Several studies confirmed this by investigating the impact of different diets on the content and amino acid profile, lipids and other nutrients in insect protein meals and oils. Consequently, we could find insect meals and oils from the same species but with

a different amino acid profile or fatty acid profile<sup>12</sup>. Therefore, insects represent versatile raw materials for the pet food industry with fast growing expectations in the market.

As per Rabobank's research of 2021, see **Figure 1**, the global volume of insect ingredients incorporated in feed and pet food is expected to grow up to 500K MT by 2030, predicting pet food to be the second largest market.<sup>13</sup>

According to a review done in 2023, there are 43 insect-based pet food brands active around the globe, 35 of which are operating in Europe. Black soldier fly and mealworm are the most used species in pet foods.<sup>14</sup>

Despite the various advantages of using insect ingredients there are other aspects that must be evalu-





ated when applying them in pet food. This includes potential allergic reactions, contamination risks during production, stability and shelf-life concerns and the ability to meet the nutritional needs of cats and dogs in a specific recipe.

### INSECT INGREDIENTS' EFFECT ON PALATABILITY

Another important factor and key to the success of a diet is “palatability”. Palatability is a critical factor in pet food acceptance. Cats are notoriously picky eaters, and their willingness to consume food is influenced by its taste, aroma, and texture. Therefore, understanding how insect protein affects these sensory attributes is essential.

Insects have unique flavor profiles that can vary significantly between species. For instance, crickets have a nutty taste, while mealworms can be more neutral. These flavors can be both an advantage and a challenge when formulating palatable pet foods.

Edible insects were first promoted as a sustainable method for food waste bioconversion, and it seems this practice is already implemented in Asia. However, how the heterogeneity of food waste sources affect fat oxidation, flavor and palatability of the final insect meal for pets is not well understood.

To maintain or improve palatability, manufacturers use flavor enhancers, fats, and other ingredients to

mask or complement the natural taste of insect protein. For example, adding chicken fat or liver flavor can make insect-based pet food more appealing.

Currently there is limited reliable research on palatability of insects in pet foods, but we expect more long-term research to be done in the coming years to allow a standard and better evaluation of this factor. However, we could find in the literature some interesting palatability studies thanks to a review done by Bosch and Swanson.<sup>15</sup>

Some studies found that regarding palatability of insects, dogs and cats showed different preferences depending on the insect species and the inclusion rate of the insect ingredients.

In 2018, Beynen reported that dogs showed a preference for dry foods containing black soldier fly larvae meal over those with yellow mealworm meal (intake ratio of 60:40; n=10), whereas cats preferred the yellow mealworm-based food (40:60; n=10). Both insect meals represented 30% of the total crude protein in these diets.<sup>16</sup>

In 2020 Kilburn et al. showed that a banded cricket meal inclusion rate of 8, 16 or 24% in extruded pet foods did not affect the intake in dogs (n=8).<sup>17</sup>

Regarding cats’ palatability, Paßlack and Zentek published in 2018 that 3 out of 10 cats had refused a food



containing 35% black soldier fly meal and 3 cats had an intake between 78 and 87% of the food offered.<sup>18</sup>

For a food containing 22% black soldier fly meal, one cat vomited and then refused the food completely and two cats had lower food intakes (83 and 88%).<sup>17</sup>

In cats fed a diet containing 5 or 20% of black soldier fly meal for 2 days (n=20 per diet), 38 and 54% of food was consumed. None of the cats rejected the 5% black soldier fly diet, whereas one cat rejected the 20% black soldier fly meal diet.

## CONCLUSION

Insect protein represents a promising frontier in pet nutrition, offering a nutritious alternative to traditional proteins. The impact of insect protein on pet food palatability is a critical factor that manufacturers are actively addressing through research, innovation, and consumer feedback.

While insect protein holds great promise, there are challenges that need to be addressed to ensure its widespread adoption in the pet food industry.

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### About Dr. Cristina Murcia García

Dr. Cristina Murcia García gained her PhD in Chemistry with focus on red-ox reactions from the University of Bonn (Germany). Since then, she has specialized in managing oxidation in rendering and pet food products. She works as Technical Service Manager for Kemin Nutrisurance Europe where she provides solutions to improve raw materials and pet food safety and shelf-life. Besides, she develops tailor-made trials and protocols for customers and holds customer specific trainings on topics like oxidation, freshness, and food safety.



## ANTIMICROBIAL PEPTIDES IN BLACK SOLDIER FLY LARVAE: OPPORTUNITIES AND CHALLENGES

**Tran Thi Chau**  
*R&D Product Development Team Leader*  
 Entobel

“Although ongoing research on AMPs shows promising *in vitro* antimicrobial properties, its applications in the insect industry and commercial products face several key challenges. First, the understanding of insect immune systems and the mechanisms involved in AMPs production, particularly in *Hermetia illucens*, remains limited. This lack of knowledge hampers treatments to efficiently enhance AMPs levels in the BSFL stage, posing challenges in both trial-scale and large-scale production.”

In recent years, the Black Soldier Fly Larvae (BSFL) and its derived products have seen significant market growth. This expansion is particularly significant in the Animal Feed sector, where BSFL meal is becoming a key alternative protein source, offering both nutritional value and additional functional benefits. BSFL-derived products, such as those produced by Entobel, are closely aligned with Sustainable Development Goals (SDGs) providing an eco-friendly alternative by utilizing food industry by-products and helping to reduce carbon emissions of the feed industry. Entobel’s BSFL meal is notable for its high protein content – with an average of 55% crude protein – and its well-balanced amino acid profile, including Methionine (2.11%), Cystine (1.36%), Proline (5.87%), and Tyrosine (6.68%). These amino acids not only support immune function but also acts as natural attractants for animals. In addition to its protein content, BSFL meal naturally contains antimicrobial peptides (AMPs), which gained interest in both research and the feed industry for their potential ability to enhance animal health. As a result, BSFL-derived

proteins future innovations while addressing environmental concerns and promoting more sustainable practices in the feed industry.

Antimicrobial peptides (AMPs) are small peptides that contain about 10–100 amino acids, known for their broad-spectrum activity against bacteria, fungi, viruses and parasites. Recent research has identified key AMPs families in the BSF genome. Jian Peng *et al* (2023) discovered 33 cecropin genes, while Vogel Heiko *et al* (2018) reported 26 genes coding for defensin AMPs and 6 genes coding for attacin<sup>1,2</sup>. These AMPs families play a crucial role in the fly’s immune defense system and exhibit significant potential for antimicrobial applications.

The cecropin family in BSFL consists of four types of peptides, each containing approximately 69 amino acids and having a molecular mass of 7 kDa. Cecropins are particularly effective against a range of bacteria, including Gram-negative species such as *Escherichia coli*, *Pseudomonas aeruginosa*, and *Vibrio parahaemolyticus*, as well as Gram-positive

bacteria like *Bacillus subtilis* (2). Besides that, the defensin family, comprises six mature peptides, each with a molecular weight of around 4 kDa. These defensins are potent against *E. coli*, *Staphylococcus aureus*, and *Salmonella* species, as noted by Jingjing Zhang *et al* (2021)<sup>3</sup>.

The antimicrobial effects of AMPs operate through diverse mechanisms, with the most well-studied being membrane disruption. These peptides interact with bacterial cell membranes, causing structural destabilization and increased permeability, which leads to cell lysis and death. Also, the interaction and binding with intracellular targets as well as immune modulation has been reported as antibacterial mode of actions of AMPs. Due to this broad spectrum potential antibacterial effect, it is challenging for bacteria to develop resistance to AMPs, unlike traditional antibiotics that target specific bacterial processes.

AMPs offer several advantages, including their rapid action against bacteria and a low risk of inducing bacterial resistance, as it is difficult for bacteria to alter their membranes to resist AMP-induced disruption. Furthermore, AMPs have a short half-life, reducing their environmental persistence. These properties make AMPs promising candidates for use in animal feed applications to support pathogenic bacteria control, enhance animal health, and improve productivity in the livestock and aquaculture industries.

With a mission to develop functional insect-based ingredients for animal feed and health, Entobel started with an in-house research project to investigate the AMPs properties found in its BSFL products. By exploring alternatives to antibiotics, Entobel aims to promote healthier fish and shrimp farming practices. One key area of research involves assessing the antimicrobial activity of extracts from fresh BSFL against bacterial infections in aquaculture, including *Vibrio parahaemolyticus*, a pathogen responsible for Acute Hepatopancreatic Necrosis Disease (AHPND) in shrimp and *Streptococcus agalactiae*, known to cause infections in freshwater fish. In a recent study, Entobel carried out preliminary research to assess the antimicrobial activity of whole, fresh BSFL which were reared on a diet

of brewer's spent grain, with no additional treatments applied. The crude AMPs were extracted, followed by purification and fractionation based on molecular mass. To confirm the antimicrobial activity of each fraction, the Agar Inhibition Zone method was used. Additionally, SDS-PAGE, a technique for separating proteins based on their molecular mass, was used to determine the size of the peptides in each fraction.

Two key fractions from the study demonstrated promising results. Fraction F3, which contained peptides ranging from 4 kDa to 7 kDa, showed antimicrobial activity against *S. agalactiae*, with a zone of inhibition measuring 13.5 mm at a 10.8 mg/mL concentration. Meanwhile, Fraction F4, accounting for the highest content in the crude extract and containing peptides smaller than 14 kDa, displayed antimicrobial activity against *V. parahaemolyticus*, and *S. agalactiae*. This fraction produced a zone of inhibition measuring 10.3 mm at a concentration of 21.5 mg/mL. (Figure 1 & 2)

These initial findings suggest that the BSFL-derived AMPs possess an antimicrobial potential, particularly against some pathogenic bacteria in aquaculture.

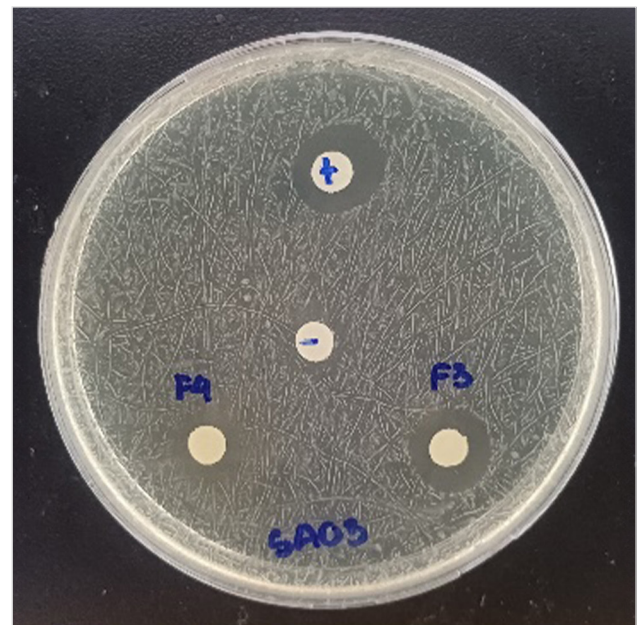


Figure 1. Diffusion inhibition zone of F3 and F4 against *S. agalactiae*

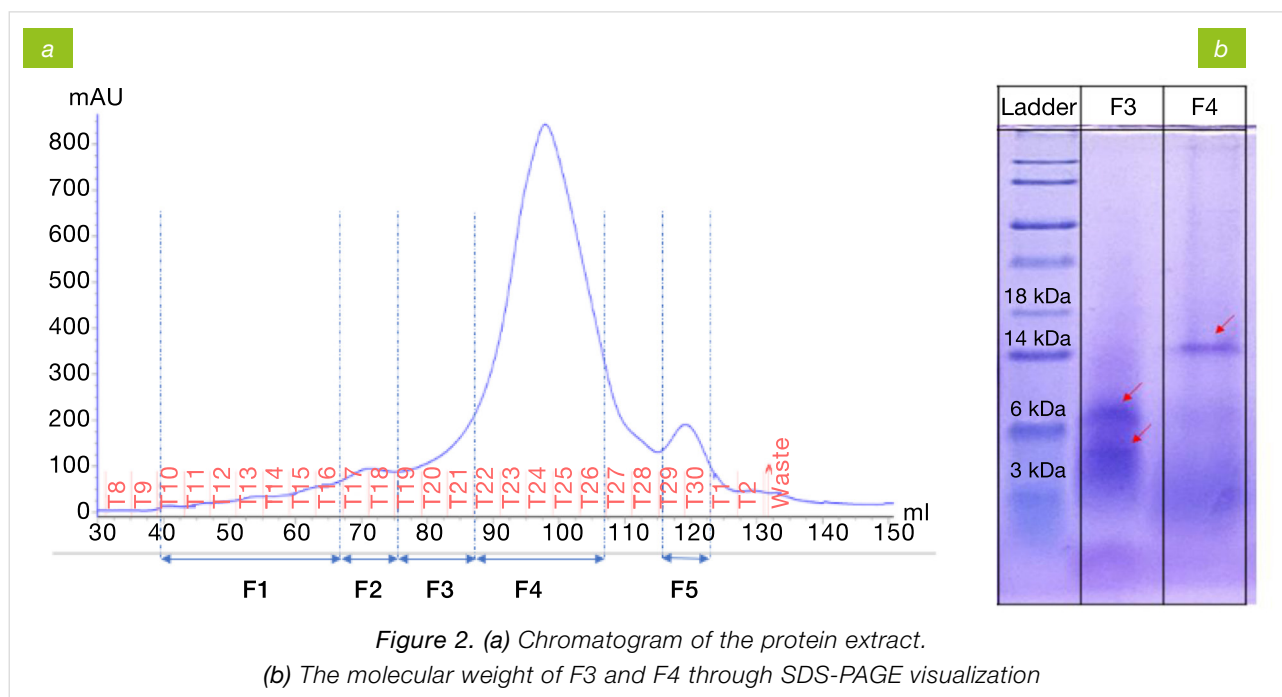


Figure 2. (a) Chromatogram of the protein extract.  
(b) The molecular weight of F3 and F4 through SDS-PAGE visualization

Although ongoing research on AMPs shows promising *in vitro* antimicrobial properties, its applications in the insect industry and commercial products face several key challenges. First, the understanding of insect immune systems and the mechanisms involved in AMPs production, particularly in *Hermetia illucens*, remains limited. This lack of knowledge hampers treatments to efficiently enhance AMPs levels in the BSFL stage, posing challenges in both trial-scale and large-scale production. Additionally, AMPs share the same characteristics of a protein, such as thermal sensitivity, active pH, and enzyme digestion. These put special requirements on scale-up processing and storage methods which need to be carefully optimized to preserve the antimicrobial activity of these peptides, as improper extraction and purification can degrade their effectiveness. Another challenge is ensuring the stability of AMPs in digestive tract systems. As proteins, AMPs can be broken down during digestion, potentially losing their bioactivity before they can act against pathogens, making it difficult to maintain their effectiveness when used as feed additives.

The potential of BSFL meal, combined with the antimicrobial properties of its peptides, offers a promising solution for sustainable protein sources and natural disease management in livestock and aquaculture.

However, understanding is needed, such as enriching the amount of AMPs, improving their bioactivity, and overcoming limitations in processing and digestion. To drive sustainable development, collaboration between researchers, the BSF industry, and the feed industry is essential. By working together, they can unlock the full potential of BSFL products, improve efficiency, and address the growing need for alternatives to antibiotics in animal farming.

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## ACCELERATING ADOPTION OF INSECT-BASED INGREDIENTS FOR PET FOOD

**Dr. Jennifer Adolphe**  
*Pet Technical Services Manager*  
 ADM

“The top ‘must haves’ for insect-based pet food are their pet must like the flavor, the food must offer nutritional benefits, labels must clearly state the food contains insect-based ingredients and these ingredients must be backed by science. Notably, 63% of surveyed pet owners said having their top priorities met would increase their likelihood of serving pet food made with insect protein.”

Global demand for high-quality protein and sustainably sourced ingredients continues to rise, driven by consumer preferences, corporate initiatives and public policy. Insect-derived ingredients – like dried black soldier fly larvae (BSFL) – are increasingly being used in pet food formulations to satisfy pets’ dietary needs while contributing to the circular economy. Black soldier flies (*Hermetia illucens*) are powerful upcyclers with the ability to efficiently turn low-quality feedstock into premium-quality alternative sources of amino acids, fatty acids and other key nutritional components.

Agtech company Innovafeed is a leading producer of *Hermetia illucens* with a unique “industrial symbiosis” production model. Its indoor insect farms are strategically located alongside grain processing facilities to upcycle grain byproducts as feedstock for black soldier flies. In Decatur, Illinois, USA, Innovafeed has joined forces with ADM, a global leader in innovative solutions from nature, to leverage its corn processing plant. This co-location will eliminate the need to dry the feedstock and the trucks required for transport, reducing energy and

fuel needs. Additionally, Innovafeed plans to use reclaimed heat and water from ADM’s facility as circular energy sources.

ADM also serves as Innovafeed’s exclusive North American distributor of Hilucia™ Protein and Oil ingredients for the pet food industry. Hilucia™ products deliver highly digestible essential amino acids; lauric acid, a medium chain triglyceride that is prevalent in coconut oil; over 50 unique bioactive peptides, small proteins with unique properties; and chitin, which acts as a dietary fiber.

### DETERMINING SUITABILITY FOR PET DIETS

Dr. Maria R. C. de Godoy is a prominent researcher in the field of companion animal nutrition at the University of Illinois, with a specific focus on BSFL as an ingredient for dog and cat foods. Her trailblazing research, in collaboration with ADM and Innovafeed, recently investigated the protein quality of BSFL to determine if it is a nutritious substitution for other commonly used protein ingredients in pet food.

The first feeding trial measured the digestible indispensable amino acid score (DIAAS), which evaluates amino acid digestibility to assess protein quality. DIAAS values for Hilucia™ Protein were compared to scores for chicken meal, a high-quality, very common ingredient in pet food, and whole powdered egg, which is considered the gold standard for protein quality. Results demonstrated that Hilucia™ Protein is a suitable substitute for chicken meal in pet foods<sup>1</sup>.

In the second trial, dog diets were specially formulated to evaluate macronutrient digestibility of Hilucia™ Protein. The control diet was made with chicken meal, and two test diets included either 15% or 30% Hilucia™ Protein as a partial or complete substitution for chicken meal, respectively. Findings indicate that all three diets were well accepted by the dogs<sup>1</sup>. In addition, all of the diets had average fecal scores between 2 and 3, which is considered ideal. Notably, the 30% Hilucia™ diet resulted in the firmest stool, which is a highly desirable trait for pet parents<sup>1</sup>. Researchers also noted that macronutrient digestibility values were very similar between the three diets, again suggesting that Hilucia™ Protein performs very similarly to chicken meal in dog diets<sup>1</sup>.

### INFLUENCING CONSUMER ACCEPTANCE

ADM and Innovafeed have also collaborated on a consumer study to understand pet parent percep-

tions of insect ingredients in pet food. This survey of U.S. dog and cat owners identified barriers and drivers to purchasing insect-based pet food, as well as the impact of consumer education on willingness to feed insect protein to their pets.

A key finding from the survey shows consumers can be educated to enhance their likelihood of serving pet food made with insect protein. Initially, only 12% reported being “completely likely,” while 43% expressed being “not likely at all” to feed their pets insect-based food<sup>2</sup>. When asked the question again after receiving educational statements about insects, covering nutrition, safety, ethics and environmental benefits, 42% of pet owners became more willing<sup>2</sup>.

Additionally, pet parents emphasized that nutrition remains their top priority when selecting pet food, though ethical production is also a significant concern. The top “must haves” for insect-based pet food are their pet must like the flavor, the food must offer nutritional benefits, labels must clearly state the food contains insect-based ingredients and these ingredients must be backed by science<sup>2</sup>. Notably, 63% of surveyed pet owners said having their top priorities met would increase their likelihood of serving pet food made with insect protein<sup>2</sup>. The most important product claims for pet parents considering an insect-based pet food are its high protein content and support for digestive health and healthy aging<sup>2</sup>.





## ADVANCING INNOVATION THROUGH COLLABORATION

As the industry forges ahead with alternative ingredients like insect proteins, it is important that knowledge and discoveries are shared to collectively take the next step forward. For example, ADM's new Pet Nutrition Institute is a free, online resource for scientific research and consumer trend reports. Currently featuring insights on plant-based proteins for pet products, this library will be continuously updated to spotlight groundbreaking innovations and key insights advancing the pet nutrition industry. Through partnerships with universities and researchers across the globe, ADM seeks to develop and promote investment in research that improves the lives of pets and their owners.

The Pet Sustainability Coalition is another useful resource. This nonprofit organization is dedicated to creating a more sustainable pet industry by providing assessment tools, strategic support, accreditation and events. Members of the coalition include consumer brands, suppliers, pet trade media, retail stores, packaging companies and more.

Serving as a bridge between industry and academia is the Center for Environmental Sustainability through Insect Farming (CEIF). CEIF strives to expand the production of insect ingredients for animal feed, pet and human food, with support from the National Science Foundation, three research universities, major ingredient suppliers like ADM, leading pet food companies, insect farming pioneers such as Innovafeed, and many others.

Cooperative efforts led by CEIF, the Pet Sustainability Coalition, ADM and other like-minded organizations will help accelerate widescale adoption of emerging and alternative ingredients, and aid progress towards a circular economy.

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### About Dr. Jennifer Adolphe

Dr. Jennifer Adolphe is responsible for providing technical support, nutrition training, formulation services and new product development for ADM's customers in the pet food industry. She graduated with her Ph.D. in companion animal nutrition from the Western College of Veterinary Medicine at the University of Saskatchewan. She has a Master of Science degree in human nutrition and previously worked as a registered dietitian. Dr. Adolphe has more than 20 years of experience in both human and companion animal nutrition and previously held positions at two leading pet food companies in Canada. In addition to her role at ADM, she is an adjunct professor at the University of Saskatchewan and is pursuing a Master of Business Administration through Penn State University.

**Tomáš Kubeš, Head of Strategic Projects at Bene Meat Technologies:**

“Our company’s pet food ingredient has achieved a significant milestone in the alternative proteins space. On November 8, 2023, it was officially registered under the Feed Materials Register as 'Cultivated Cells of Mammalian Origin'. Prior to this, on October 27, 2023, our production line was approved by the Czech Central Institute for Supervising and Testing in Agriculture. These two milestones allow us to produce and commercialize this innovative ingredient for pet food across the EU market.”



## AN INNOVATIVE INGREDIENT FOR PET FOOD: CULTIVATED MEAT

**B**ene Meat Technologies, a cultivated meat company with a mission to develop meat that is not only sustainable and ethical, but also affordable and accessible to everyone, is strengthening its presence in the alternative protein market with its ingredients for pet food. Thanks to two approvals from authorities, the company has been able to produce and commercialize this innovative ingredient for pet food in the European market. Tomáš Kubeš, Head of Strategic Projects at the company, shares the following information: “We have already begun supplying our cultivated meat ingredient to several pet food manufacturers, working with them to develop the final products.”

Kubeš provides details about Bene Meat Technologies' innovative ingredient and the use of cultivated meat in pet food for the readers of our magazine.

**Dear Mr. Kubeš, first of all, can you introduce Bene Meat Technologies to our readers who may not know about your company? What is your expertise and how long have you been in the business for?**

At Bene Meat Technologies, we are dedicated to reshaping the future of meat production—creating cultivated meat that does not rely on animal slaughter or harm to the environment. Our mission is to develop meat that is both sustainable and ethical, while being affordable and accessible to all.

Cultivated meat offers numerous advantages over conventional meat. It is produced without antibiotics and under highly controlled conditions, eliminating the risk of harmful residues commonly associated with traditional slaughterhouse meat. Additionally, it represents a far more sustainable and responsible approach to meeting global protein demands.



I joined Bene Meat Technologies in the summer of 2021, bringing my experience in commercializing revolutionary technologies. I am responsible for listening to customers and ensuring that the nascent technology in the hands of our scientists turns into a product that solves a specific problem customers are already having. Officially, my title is “Head of Strategic Projects,” though in the context of a U.S. startup, my role would likely align with a “Chief Product Officer” position.

**Is it true that Bene Meat Technologies is the first entity to produce and sell cultured meat for the purpose of making pet food? Can you tell us about the reason why you chose to go into this specific field?**

Our company’s pet food ingredient has achieved a significant milestone in the alternative proteins space. On November 8, 2023, it was officially registered under the Feed Materials Register as “Cultivated Cells of Mammalian Origin” with ID number 009569. Prior to this, on October 27, 2023, our production line was approved by the Czech Central Institute for Supervising and Testing in Agriculture (No.: CZ 802529-01). These two milestones allow us to produce and commercialize this innovative ingredient for pet food across the EU market.

We are proud to be the first company globally to gain market access for cultivated meat as a pet food ingredient, paving the way for future advancements in this field.

Our team of 100 dedicated professionals is working relentlessly to scale production, and we have already begun supplying our cultivated meat ingredient to several pet food manufacturers, working with them to develop the final products.

The demand we’re addressing is clear. Pet owners recognize the importance of meat in their pets’ diets but often feel a moral disconnect between the care they provide to their companions and the conditions under which farmed animals are raised and slaughtered. Affordable cultivated meat offers a compelling solution, providing the authentic

high-quality, nutritious animal protein—without the need for animal suffering or slaughter. It represents an ethical alternative that resonates with today’s conscientious consumers.

**Why should cultured meat be used in the production of pet food? What are your reasonings for the usage?**

There are several compelling reasons to use cultivated meat in pet food. First, it provides a premium, high-quality protein source with over 77% protein content in dry mass, making it a great choice for pets with specific dietary needs.

As a monoprotein derived from a single species and cell type, it significantly lowers the risk of allergic reactions, making it ideal for specialized veterinary diets, especially for sensitive animals.

The sterile, controlled environment in which cultivated meat is produced, eliminates the risks like contamination from pathogens, parasites, hormones, or antibiotics, which is a constant concern for almost all pet food manufacturers.

For pet food manufacturers, it might also represent increased security in sourcing. In future, meat could be cultivated directly on site, reducing the logistical risks, again a common headache for most pet food supply managers, and would also contribute to an overall reduction in the carbon footprint.





Finally, as mentioned, cultivated meat addresses the ethical concerns of some pet owners who struggle with the moral dilemma of killing one animal to feed another, to fulfill the need for meat in pet diets.

**Recently, there has been a lot of talk regarding the ban of cultured meat, with Italy and some US states being the most recent ones to implement the ban. What are your thoughts on the bans? Why should the production of cultured meat be supported/approved?**

We are actively monitoring the regulatory landscape regarding potential bans on cultivated meat both in Europe and in the USA. Whenever possible, we engage in constructive dialogue to address concerns and provide accurate, science-based information. We recognize that many of the fears driving these bans stem from misconceptions or a lack of knowledge about the technology.

We are convinced that if people better understood the technology, the cleanliness, the monitoring and the care cultivation requires, they would not be worried.

Some people are also worried about the future of farming. Our aim is not to replace traditional farm animals or their products, but to offer consumers

an additional option—an alternative for those who seek one. We believe cultivated meat can complement existing choices and broaden the menu. Cultivated meat might also be an interesting choice for those who currently avoid meat altogether.

We do not want to prescribe to anyone what they should eat and we are very sad that someone wants to ban something we would like to eat. We strongly believe that anyone should be free to enjoy bolognese spaghetti, salads or burgers with the protein source their heart desires.

**Do you have any trials about the usage of cultured meat in pet food? What can you say about its effects on animal health and welfare in particular?**

At Bene Meat Technologies, safety is our foremost priority. To ensure this, we conduct tests that far exceed regulatory standards. We have performed a comprehensive review of all potential risks associated with meat cultivation, and this thorough assessment will be published in a scientific journal. We believe it could set a new industry standard for cultivated meat safety.

Our rigorous process begins with screening cell samples for contaminants, including viruses, bacteria, parasites, and other possible hazards. Only

when the cells pass this stringent screening are they approved for further development.

Throughout cultivation, we maintain a completely sterile environment, as the cells are grown outside an organism without the natural immune defenses that would typically protect them. Even the presence of a single bacterium is enough to spoil an entire batch. Our cultivators are thus held to absolute 100% sterility, levels that exceed even those of operating rooms.

We have a robust system in place to monitor every input, output, and potential vulnerability in the process. Once the cultivated meat is ready, we conduct an extensive laboratory analysis, testing for bacteria, heavy metals, pesticides, chemicals, molds, toxins, and other harmful substances. Our final lab test currently screens for over 50 different elements, ensuring the highest possible quality and cleanliness of the product.

No conventionally produced meat undergoes the level of scrutiny, screening, and cleanliness control that cultivated meat does.

Furthermore, we are collaborating with several independent research institutions and universities to conduct a series of feeding trials on the final product. We have already completed in-vitro studies, and multiple feeding trials, including digestion and long-term feeding tests, are either in progress or about to begin.

**What is the current price difference between cultured meat and real meat? When can cultured meat become a real affordable and accessible alternative for pet food manufacturers?**

From the outset, our goal has been to make cultivated meat accessible to the broader public. We believe it should not be a luxury available only to the wealthiest consumers. In the near term, we are pricing our ingredient to be compatible with current premium pet food formulations. Over time, our aim is to further reduce costs, making our cultivated meat affordable even for the mass pet food market.

**What are your expectations for the future of the cultured meat industry?**

Meat cultivation is still an emerging industry. The first cultivated burger was introduced in 2013, and by 2020, small quantities of cultivated meat became available to consumers in few restaurants in Singapore, followed by few restaurants in the U.S. in 2023. In 2024, the first cultivated meat product appeared on retail shelves in a single store in Singapore.

At Bene Meat Technologies, we are working diligently to bring cultivated meat to our four-legged European consumers. Our initial cultivation facility will have an annual production capacity of around 200 tonnes. For context, 42 million tonnes of meat were slaughtered in Europe alone in 2022, and globally, that number reached approximately 330 million tonnes.

Even scaling our current facility 10,000 times would only account for less than 5% of the European market. This reality underscores the challenge and the scale of work ahead. Therefore I can confidently predict that over the next decade, our industry will be focused on scaling production, optimizing processes, and meeting the demand of early adopters.

Looking forward, I am confident that cultivated meat will become a viable, ethical, and sustainable protein source, offering consumers—and their pets—a meaningful alternative.





## REPLOID: REVOLUTIONIZING INSECT PROTEIN PRODUCTION

**Vincent Reda**  
*Leading Performance Management*  
 REPLOID Group AG

“By feeding the larvae EU-approved materials that border on organic waste, Reploid taps into the remarkable sustainability of BSF larvae. These larvae thrive on low-value, waste-like but approved feed streams, transforming them into high-quality, eco-friendly products.”

REPLOID, born from the merger of three top European BSF producers (madebymade, Nutrifly, Insektianer), is revolutionizing sustainable agriculture with its innovative decentralized *ReFarmUnit* technology, empowering partners to efficiently produce insect-derived raw materials. For industrial (food-) suppliers, REPLOID offers a much-needed solution to fulfill the requirements of the Corporate Sustainability Reporting Directive (CSRD).

### A SUPPORTIVE BUSINESS MODEL FOR SUCCESS

REPLOID’s business model is designed to integrate decentralized BSF larvae production seamlessly into the agricultural value chain, while absorbing much of the potential risk that producers typically face—such as market access challenges. This approach ensures that farmers and producers can focus on what they do best, while REPLOID provides vital support and infrastructure. Beforehand, REPLOID ensures the site is viable as a production facility and assists in obtaining the necessary building permits.

“We carefully select our partners, supporting them from the very beginning and ensuring the busi-

ness case remains viable in the long run,” explains **REPLOID’s CEO Philip Pauer**. As a shareholder in the *ReFarmUnits*, which are operated in partnership, REPLOID also guarantees market access while supplying optimized feed and juvenile larvae as inputs.

### HIGH POTENTIAL APPROACH TO REDUCING THE CCF

Since January 2024, companies in the (food-) industry are required to determine their corporate carbon footprint (CCF) and disclose it publicly. Under the Corporate Sustainability Reporting Directive (CSRD), they are required to evaluate their environmental impacts along the value chain and to develop appropriate measures to make their production processes and products more sustainable. This includes upstream and downstream emissions, known as Scope 3 emissions, which account for a relevant portion of a company’s environmental impacts (60-80% of the CCF).

REPLOID offers companies solutions in several ways to meet the EU’s sustainability requirements: With the help of decentralized insect rearing, REPLOID takes a large part of their “excess load” off their hands by returning residual materials from production back

to the raw materials cycle. With a high-quality organic fertilizer based on insect frass, it is also possible to encourage contract farmers to fertilize their agricultural land in a CO<sub>2</sub>-neutral way. This way, the farmers can also help their products to have a lower ecological footprint, which in turn has a positive effect on the CCF balance of the processing company.

**PLUG-AND-PLAY TECHNOLOGY FOR FAST IMPLEMENTATION**

REPLOID’s decentralized rearing system, housed in modular containers, includes advanced ventilation and climate control, allowing for quick and easy implementation. This plug-and-play design empowers producers to start operations swiftly, without the need for complex setup.

“When designing the system, we aimed to stay as close to the agricultural context as possible; there’s no need for costly and over-engineered equipment to grow BSF larvae,” says **Dr. Jonas Finck, Chief Biological Officer of REPLOID**. Each *ReFarmUnit* can convert 40 tons of wet agri-food byproducts into approximately 8 tons of fresh larvae per day on a footprint of roughly 1,500 square meters. The entire process can be managed by a single operator working an eight-hour shift, five days a week.

**REPLOID AS A BSF KNOWLEDGE HUB**

What sets REPLOID apart from competitors is their ability to utilize a wide variety of organic side-streams as feed substrates. By feeding the larvae EU-approved materials that border on organic waste, Reploid taps into the remarkable sustainability of BSF larvae. These larvae thrive on low-value, waste-like but approved feed streams, transforming them into high-quality, eco-friendly products.

“Being part of an enterprise which mimics the nature-based process of organic matter decomposition motivates us to get better every day. New insights in feed recipe development, like micronutrient levels, are directly implemented into our *ReFarmUnits*, ensuring the efficiency of the process is always our highest priority,” says **Dr. Moritz Gold, Head of Innovation at REPLOID**.

**A FULLY INTEGRATED VALUE CHAIN FOR A SUSTAINABLE FUTURE**

REPLOID’s involvement doesn’t end at production. Further along the value chain, the company collaborates with key partners to process the larvae, creating a range of refined products that can be utilized in animal feed, additives, and other applications. By focusing on both upstream and downstream activities, REPLOID ensures that the entire process, from larvae growth to product refinement, operates with maximum efficiency and sustainability.

This comprehensive approach gives REPLOID significant control over the quality and scalability of its insect protein products, which, in turn, benefits their agricultural partners and the broader food production ecosystem. Through these strategic partnerships, REPLOID is not only producing sustainable, high-quality feed but also contributing to a circular economy where organic by-products are repurposed into valuable resources.

By rethinking insect protein production from start to finish, REPLOID is setting a new standard in sustainable agriculture and driving a future where environmentally friendly practices are at the heart of food and feed industries.



**About Vincent Reda**

*Vincent Reda brings over 7 years of expertise in Black Soldier Fly (BSF) production to his role as Head of Performance Management at REPLOID Group AG. Having worked with industry leaders such as Hermetia Baruth and Better Insect Solutions, Vincent joined Reploid in January 2024, where his extensive experience continues to drive innovation and operational excellence.*



## Norwegian Mycelium (NoMy): PIONEERING MYCELIUM INNOVATION IN SUSTAINABLE ANIMAL FEED

**Erik Tveteraas**  
*Chief Financial Officer*  
NoMy

As the world's food supply faces increasing threats from political and climate instabilities, a secure supply of proteins as feed for animal production is no different. NoMy is leading the charge to address critical supply chain resilience for the animal feed industry with sustainable, mycelium-based protein alternatives.

By tapping into the incredible potential of fungi, the company is offering an environmentally friendly solution to traditional feed ingredients that meet the industry's requirements for competitive price, nutritional performance and volume.

### **H**ARNESSING NATURE'S POWER: THE SCIENCE BEHIND MYCELIUM

Mycelium, the intricate root-like network of fungi, is being recognized for its vast potential across multiple industries, including animal nutrition. NoMy's approach has three distinct advantages as a source for cost-competitive, high quality and large-scale supply of proteins for the future.

First, mycelium is the body form of many fungi such as molds and mushroom strains involved in breaking down organic matter and converting it into essential nutrients. NoMy leverages the natural ability of its fungal strains as recyclers and upcyclers of nutrients to develop sustainable feed solutions that help reduce the burden on traditional protein resources. By combining fermentation technologies, advanced sensors, and AI/ML, NoMy transforms food residues and sidestreams (before they become waste) into a growth medium used to cultivate high-protein fungal strains as a biomass into nutritious feed ingredients. This is a tried-and-true technology used and scaled

in other areas of food production, called biomass fermentation. NoMy's innovative approach enables feed producers to supplement conventional vegetable and marine proteins, which can be associated with land use change or unsustainable fishery practices. By focusing on raw materials that are underutilized today instead of commodity inputs, the company aims to offer a greener alternative (as the raw materials inputs are essentially "waste") meanwhile delivering a consistent product at scale without compromising on nutritional quality. Further, mycelium's rapid growth cycle allows for more efficient production compared to traditional feed crops, ensuring that NoMy can quickly scale up to meet the demands of its partners in the animal nutrition sector.

### **SUSTAINABLE FEED SOLUTIONS FOR A GREENER FUTURE**

The second advantage lies in NoMy's fermentation technology's ability to deliver ingredients at a lower carbon footprint compared to peers. The environmental impact of the animal feed industry is signif-

icant, with the industry’s carbon emissions coming under greater and greater scrutiny from consumers and regulators. As an example, nearly 80% of the carbon footprint from Norwegian salmon production comes from feed ingredients alone. NoMy provides an alternative by producing its feed ingredients with significantly lower environmental impact.

The production of mycelium-based feed requires fewer natural resources, such as land and water, compared to conventional commodity crops. Additionally, the controlled, local production of mycelium ensures a stable supply chain, reducing the dependence on imported feed components. This innovative approach helps mitigate the risks associated with fluctuating crop yields, climate change, seasonality and trade disruptions, providing a reliable, sustainable solution to feed manufacturers that improves the resiliency of feed producers’ supply chains.

**ENHANCING ANIMAL HEALTH AND NUTRITION**

Lastly, NoMy’s products are not just sustainable—they are also highly nutritious. Mycelium-based feed ingredients are rich in proteins, fibers, and bioactive compounds, which have shown to support gut health, enhance immune system function, and promote the overall well-being of animal health.

One key benefit of mycelium is its ability to enhance the digestibility and bioavailability of feed. Studies have shown that mycoproteins have a higher digestibility score than incumbent proteins, particularly soy. Functional impacts from B-glucans in fungal cell wall biomass in the mycoproteins may also enable an immunostimulatory response, leading to healthier animals and better productivity. NoMy continues to explore the health-promoting properties of mycelium and is committed to ongoing research that aims to enhance the nutritional profile of their products.

**FUTURE PROSPECTS: EXPANDING MYCELIUM’S POTENTIAL**

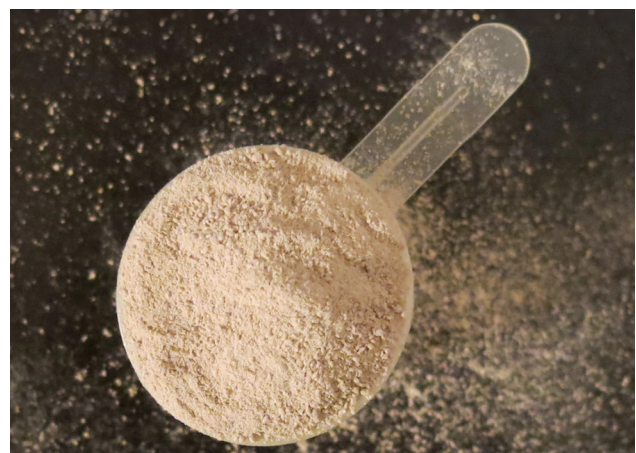
Looking ahead, NoMy is poised to expand the applications of mycelium far beyond feed ingredients.

As the global industry increasingly shifts toward sustainable supply chains favoring environmentally friendly raw materials, the versatility of NoMy’s technology platform offers a multitude of opportunities for growth and innovation.

The company’s long-term vision includes collaborating with global feed manufacturers to integrate mycelium-based ingredients into a wider array of feed formulations. By partnering with forward-thinking companies and research institutions, NoMy aims to push the boundaries of what mycelium can achieve in both animal and human nutrition.

Furthermore, the development of sustainable feedstocks from food industry residues opens the door to new business opportunities for cost effective biomanufacturing in industries such as biotechnology, pharmaceuticals, and materials science. NoMy’s holistic approach to sustainability and innovation positions them as a leader in the ongoing transformation towards a bio-based, circular economy.

NoMy’s innovations in fungal technologies represent just the beginning of what can be possible for a whole new world of sustainable solutions. However, it will not be possible without sustained investment by private and public stakeholders towards the emergence of a new bio-based green industry for food, feed and beyond. And it cannot be built overnight. The time is now to invest in the industrial development of tried-and-true technologies, like biomass fermentation, that can deliver a brighter and greener future for tomorrow.





**Dr. Yehonatan Alcalay**  
*CTO*  
*BugEra*

**Dr. Noam Chehanovsky**  
*VP Business Development and Product*  
*BugEra*

## UNVEILING M-BSF PLATFORM

### The most advanced platform for rapid development of BSF strains

“As the M-BSF platform enables the development of tailor-made strains with novel traits, it presents new opportunities for the BSF industry. For instance, through the utilization of the M-BSF platform, BugEra can improve the overall efficiency of BSF, resulting in increased yields, elevated protein content, enhanced nutritional values for animal feed, generate novel molecules for diverse industries, and much more.”

**B**ugEra, a pioneering BSF-genetics company based in Israel and the United States, stands at the forefront of BSF genetics and strain development. With its headquarters in the shiny city of Beer-Sheva, Israel, and an additional location in Iowa, USA, the company utilizes state-of-the-art molecular techniques and has developed a distinctive gene-editing technology based on the Crispr/Cas system. This technology, named Molecular – BSF (M-BSF) Platform, has emerged after several years of extensive R&D, and enables the development of novel BSF strains in the most efficient way. In addition to the internal R&D, BugEra is taking a significant part in the Israeli BSF consortium, which is supported by the Israeli Innovation Authority. In collaboration with other Israeli BSF companies and

academic institutions, the company is contributing to the establishment of the most advanced and comprehensive scientific database on BSF globally.

#### **BUGERA’S M-BSF PLATFORM**

Following three years of extensive R&D, BugEra is pleased to announce the successful completion of its M-BSF platform, which is now fully operational. This innovative technology for strain development offers a cost-effective, precise, and significantly rapid system for creating customized BSF strains. While numerous BSF companies engage in selective breeding to improve BSF performance, the M-BSF platform presents an alternative approach that complements and enhances selective breeding and provides substantial additional advantages.





BugEra's R&D site and insectaries

The primary advantage of the M-BSF platform over selective breeding lies in its exceptional precision and the capability to rapidly modify a specific trait while leaving all other genes untouched. To demonstrate the effectiveness of the M-BSF technology, BugEra initially modified several phenotypic traits that can be easily observed. Following the successful demonstration of the technology's capabilities, BugEra is now positioned to alter nearly any gene of interest for various BSF markets.

As the M-BSF platform enables the development of tailor-made strains with novel traits, it presents new opportunities for the BSF industry. For instance, through the utilization of the M-BSF platform, BugEra can improve the overall efficiency of BSF, resulting in increased yields, elevated protein content, enhanced nutritional values for animal feed, generate novel molecules for diverse industries, and much more.



Screening for genetically edited larvae under the microscope

**BUGERA'S FIRST PRODUCT: BSFx2**

Positioned as an innovative company, BugEra's disruptive technology and novel strategy redefine the BSF industry borders. While the majority of BSF companies focus on protein and considers the oil as a by-product, BugEra's is expanding the BSF industry into new value chains, following its motto "BSF is more than just protein". Accordingly, BugEra's first commercial product is a high-oil strain, named BSFx2, is specifically designed for the biofuel industry. Developed through BugEra's advanced gene-editing technology, BSFx2 yields a significantly higher volume of oil, and an increased concentration of fatty acids compared to native strains, thereby addressing the economic barriers associated with BSF oil, and producing premium oil for biofuel production.

Fossil fuels rank among the most significant pollutants globally, and there are huge efforts to develop bio-fuels as alternatives to fossil fuels. Currently, the primary sources of oil for biofuel production include crops, particularly soy and palm, and used cooking oil. While oil derived from crops is of superior quality compared to used cooking oil, it presents considerable environmental drawbacks, such as the use of huge agricultural land, soil contamination, excess use of water and fertilizers, resulting in a significant CO<sub>2</sub> footprint. BugEra's approach to producing BSF oil addresses these critical issues by providing the biofuel industry a sustainable oil source with lower CO<sub>2</sub> footprint by up to 80% in comparison to crop oil used, while ensuring high quality.

"BSF oil is perfect for biofuel production, particularly for sustainable aviation fuel. By focusing on

the biofuel sector, we are tackling two of the most urgent climate and environmental challenges: energy for heavy transportation and organic waste management” says **Yoav Etgar, BugEra’s CEO.**

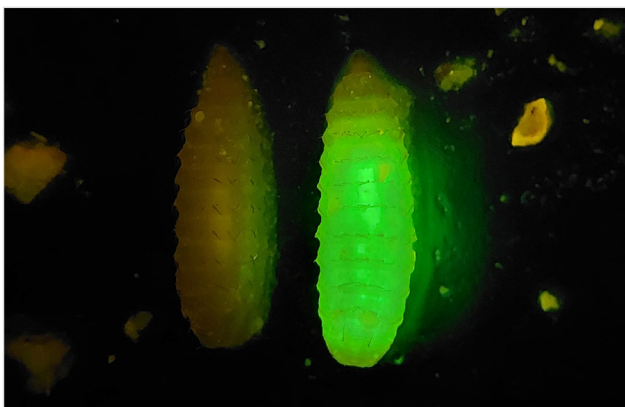
Moreover, as biofuel is not food or feed, BSF<sub>x</sub>2 can be cultivated on non-feed grade waste, offering a solution for new sources of organic waste streams that are currently untapped in the BSF industry today. Additionally, utilizing non-feed grade waste as a cultivation medium contributes to a reduction in cost of goods sold (COGS).



*BugEra’s BSF<sub>x</sub>2 oil*

## GENETIC EDITING AND CRISPR/CAS TECHNOLOGY

For the readers who may not be familiar with Crispr/Cas technology, a brief overview is provided. Crispr/Cas is a relatively new technology for gene-editing (GE), enabling the modification of specific traits by altering precise nucleotides within an organism’s ge-



*A genetically modified larva expressing GFP protein (right) and a Native larva (left).*

nome, without the incorporation of foreign DNA. This contrasts with the more widely recognized method of genetic modification (GM or GMO), which involves the insertion of foreign DNA into the organism’s genome and can result in unpredictable and potentially detrimental outcomes. Indeed, many Western nations classify GE organisms as non-GMO, thereby establishing a regulatory framework that facilitates the application of Crispr/Cas technology for the development of new strains in a highly accurate and efficient manner<sup>1</sup>. As Crispr/Cas gains traction in agriculture for enhancing plant traits and receiving acceptance in medicine for treatment of various diseases, BugEra is elevating the BSF industry to a similar level, positioning it alongside other leading sectors.

## StaaS (STRAIN AS A SERVICE) AND FUTURE PROSPECTIVES

A primary objective of BugEra is to facilitate the growth and advancement of the BSF industry. Utilizing the M-BSF platform, along with its cutting-edge molecular tools and innovative genetic technologies, BugEra is equipped with unparalleled expertise in BSF genetics and strain development. Thus, almost any trait can be altered to provide added value for BSF growers, and for the expansion of BSF industry into novel value chains such as the example of BSF<sub>x</sub>2 for biofuel.

Following the successful development of BSF<sub>x</sub>2 and unlocking the BSF oil production economical barriers, we are ready for new challenges and look for new products and novel value chains, such as ingredients for cosmetics, specialized oil for lubricants, bio-stimulants for agriculture, high-value protein for feed and food, and even pharma.

Therefore, BugEra offers new service of development customized BSF strains, named StaaS (Strain as a Service), and invites BSF companies and research institutions to collaborate and leverage the M-BSF platform, whether for research purposes or for development of customized strains to meet specific needs.

### References

1. <https://crispr-gene-editing-regs-tracker.geneticliteracyproject.org/>



## THE USE OF SILKWORM BASED INGREDIENTS IN LIVESTOCK FEED AND PET FOOD

**Ankit Alok Bagaria**  
*Co-Founder and CEO*  
*Loopworm Private Limited*

“Silkworm pupae are packed with protein, healthy fats, vitamins, and minerals essential for pets' overall health and well-being. They are particularly rich in amino acids, crucial for muscle development and maintenance, making them an ideal option for promoting lean muscle mass in pets.”

As sustainability and nutritional innovation take center stage in animal nutrition, silkworm-based ingredients emerge as a revolutionary option for livestock feed and pet food. Rich in protein, essential amino acids, and healthy fats, these ingredients boost animal health and promote eco-friendly practices, making them a promising alternative to conventional ingredients.

Silkworm farming, or sericulture, has ancient roots dating back over 5,000 years to China, primarily for silk production. Traditionally, silkworms are cultivated for their silk fibers, vital to the textile industry. Over time, the nutritional value of silkworm pupae was recognized, leading to their use in animal feed and pet food due to their high protein and essential nutrient content. Recently, silkworms have gained attention in the nutraceutical industry for their bioactive compounds, which offer health benefits such as boosting immunity and providing hypoallergenic protein sources. This evolution highlights their versatile applications beyond textile production.

Silkworms provide a nutritionally consistent, safe, and pure protein source compared to other insects.

Fed exclusively on fresh mulberry leaves, they offer stable protein and essential nutrient levels. This controlled diet ensures they are free from pesticides and antibiotics, unlike insects bred on variable food waste, which can introduce contaminants and pathogens. This makes silkworms a safer, more reliable choice for animal feed and pet food, guaranteeing high-quality nutrition without the risks associated with waste-fed insects.

Silkworm farming benefits from millennia of refinement, ensuring optimized breeding and cultivation processes. Unlike newer insect farming methods still evolving, silkworm cultivation is well-established globally, notably accepted in North East India, China, and across Asia for both animal feed and human consumption. This extensive cultural acceptance minimizes adoption hurdles. Moreover, silkworm pupae are EU-approved for animal diets, underscoring their safety and nutritional value. These factors position silkworms as a reliable and accepted choice, leveraging historical expertise and widespread approval for sustainable nutrition solutions in today's global market.

Here is a brief on the applications of Silkworm derived ingredients in animal feeds & pet foods:

**Applications in Livestock Feed:**

1. **Poultry Feed:** Silkworm pupae meal can be used as a protein supplement in poultry diets, improving growth performance and feed efficiency.

2. **Aquaculture:** It is also suitable for fish feed, enhancing growth rates and overall health of fish.

3. **Swine and Ruminant Feed:** Inclusion of silkworm pupae meal in swine and cattle diets can improve protein intake and promote better growth. It is also proven that in vitro rumen methane production goes down by 15-30% with an inclusion of 2-4% of Silkworm Pupae Oil, a promising way to not only provide necessary lipids in the diet but also solve for GHG emissions.

**Applications in Pet Food:**

1. **Dog and Cat Food:** Silkworms can be processed into pet food, providing a novel protein source that is hypoallergenic and highly digestible.

2. **Exotic Pets:** For reptiles, birds, and other exotic pets, silkworms are a natural and nutritious food option.

*Table 1-2-3 are comparative analyses of the typical proximate compositions, Amino Acid profiles, Phospholipids & Sterols of Silkworm Pupae products in comparison to other conventional sources.*

**APPLICATIONS OF SILKWORM PUPAE OIL IN AQUA FEED FORMULATIONS**

Silkworm Pupae Oil emits a distinctive and potent aroma, making it an effective chemoattractant to enhance feed palatability and attractability.

The emergence of **white spot syndrome (WSS)** poses a significant challenge to crustacean aquaculture, resulting in substantial economic losses. Beta-sitosterol, identified as a potent inhibitor of white spot syndrome virus (WSSV), shows promise as an effective agent against WSS outbreaks in crustacean aquaculture<sup>1</sup>.

For **optimal growth of fish** and crustacean larvae, diets typically require 1–3% phosphatidylcholine + phosphatidylinositol (PC + PI) of the diet's dry weight<sup>2</sup>.

**Alpha Linolenic Acid (ALA)**, constituting over 35% of Omega-3 fatty acids in Silkworm Pupae Oil, significantly influences the growth performance of fish like Coho Salmon (*Oncorhynchus kisutch*), impacting hepatic lipid metabolism enzymes and muscle fatty acid composition<sup>3</sup>.

Research on **White Legged Shrimps** indicates that dietary supplementation with Linolenic Acid upregulates immune genes (peritrophin-44-like protein, lysozyme, and cathepsin C) and enhances antioxidant enzyme activity (superoxide dismutase

Table 1	Unit	Silkworm Pupae – Full Fat powder	Silkworm Pupae – Defatted Meal	Fish Meal 60%	Fish Meal 65%	Squid Liver Powder	Soya Bean Meal	Shrimp Head Meal
Source		Loopworm Pvt Ltd	Loopworm Pvt Ltd	Indian Fishmeal producer	Indian Fishmeal producer	Indian Squidmeal producer	Indian Soymeal producer	Indian Jawla meal producer
Moisture	g/100g	5.6	5.3	7.7	7.9	5.6	9.9	6.9
Fat	g/100g	33.6	13.2	9.2	5.0	7.7	0.9	3.5
Protein	g/100g	50.1	70.3	62.0	66.7	49.9	54.5	55.6
Ash	g/100g	4.9	5.7	20.2	20	6.9	7.2	28.7
Fibre	g/100g	4.1	4.3	1.3	0.5	4.6	6.3	3.0
Carbohydrate	g/100g	1.7	1.3	0	0	25.3	21.2	2.3
Energy	kcal/100g	525.8	419.3	331.5	312	369.6	310.5	263.6

Table 2	Unit	Silkworm Pupae – Full Fat powder	Silkworm Pupae – Defatted Meal	Fish Meal 60%	Fish Meal 65%	Squid Liver Powder	Soya Bean Meal	Shrimp Head Meal
Amino Acids		Loopworm Pvt Ltd	Loopworm Pvt Ltd	Indian Fishmeal producer	Indian Fishmeal producer	Indian Squid meal producer	Indian Soymeal producer	Indian Jawla meal producer
Asp	g/100g	6.8	7.1	5.6	6.8	5.4	6.7	5.9
Thr	g/100g	1.6	4.7	2.0	2.6	2.1	2.3	2.1
Tyr	g/100g	2.2	4.5	1.8	2.6	2.2	2.2	2.2
Val	g/100g	3.1	4.1	2.9	3.4	2.5	2.7	3.4
Met	g/100g	0.5	1.7	1.6	1.6	0.6	0.6	1.4
Lys	g/100g	3.7	4.7	4.2	4.4	2.4	3.6	4.0

Table 3	Units	Cholesterol	Beta-sitosterol	Phospholipids
Product				
SoyaMeal 50%	ppm	6	60	370
Squid liver powder	ppm	2154	398	600
LoopMeal Pro (Silkworm Pupae Defatted powder)	ppm	1825	377	610
LoopMeal Omega (Silkworm Pupae Full fat powder)	ppm	3574	732	1030
Fish meal 60%	ppm	4344	22	780
Fish meal 65%	ppm	4412	23	740
LoopOil (Silkworm Pupae Oil)	ppm	6102	1356	1230
Shrimp Head Meal	ppm	7260	64	-
Krill Meal	ppm	3400	20	-

and catalase) in the hepatopancreas of *P. vannamei*. This supplementation improves the growth and non-specific immunity of *P. vannamei*<sup>4</sup>.

### APPLICATION OF SILKWORM PUPAE IN PET FOOD

Silkworm pupae are packed with protein, healthy fats, vitamins, and minerals essential for pets' overall health and well-being. They are particularly rich in amino acids, crucial for muscle development and maintenance, making them an ideal option for promoting lean muscle mass in pets. Moreover, silkworm pupae are highly digestible, which is beneficial for pets with sensitive stomachs or food allergies, ensuring efficient nutrient absorption without gastrointestinal discomfort.

Recent studies have highlighted the potential of silkworm pupae in pet diets. For instance, research conducted by scientists at Kasetsart University in Bangkok, Thailand, demonstrated that silkworms can substitute poultry meal in canine diets without adverse effects on health or nutrient digestibility. The study found that inclusion levels of up to 14% of silkworms in dog food were well-tolerated and supported healthy digestion in dogs.

Similarly, in Taiwan, researchers at the Miaoli Agricultural Research and Extension Station developed silkworm pupae-based cat food. This innovative approach was tested at a cat cafe, where feline residents showed increased energy levels and improvements in

stool odor, indicating potential health benefits associated with the consumption of silkworm-based diets.

Silkworms also offer a range of bioactive compounds beyond high-quality proteins and fats. Phospholipids play crucial roles in cell membrane structure and function, promoting cellular health in fish and shrimp, enhancing growth and immune response. Sterols contribute to hormonal balance and vitality in poultry, aiding in egg production and overall health. Chitin, known for its antimicrobial properties, supports gut health in dogs and cats, reducing digestive issues.

1-DNJ (1-deoxynojirimycin) helps regulate blood sugar levels in pets, particularly beneficial for diabetic management. Omega-3 fatty acids from silkworms enhance skin and coat health in dogs and cats, reducing inflammation and allergies. Palatability enhancers ensure silkworm-based diets are appealing to ornamental fish and birds, encouraging adequate intake and growth.

By harnessing these bioactive compounds, silkworm-based diets can optimize health outcomes across various species, from improved growth and

**Table 4.** Application of Silkworm Pupae Meals in Aquatic Species Diet with benefits observed

Name	Observation and Benefits	Reference
Shrimp	<ul style="list-style-type: none"> <li>• 75% silkworm pupae replace fish meal</li> <li>• Increased survival rate</li> <li>• No significant growth difference vs. control.</li> </ul>	<a href="#">Replacement of fish meal with defatted silkworm (<i>Bombyx mori</i> L.) pupae meal in diets for Pacific white shrimp (<i>Litopenaeus vannamei</i>) - ScienceDirect</a>
Giant River Prawn	<ul style="list-style-type: none"> <li>• Best survival rate</li> <li>• Highest % body mass increase Silkworm Pupae Meal (45% protein) superior</li> </ul>	<a href="https://ojs.library.okstate.edu/osu/index.php/OAS/article/view/8240">https://ojs.library.okstate.edu/osu/index.php/OAS/article/view/8240</a>
Trout	<ul style="list-style-type: none"> <li>• 10% fish meal replaced with silkworm pupae</li> <li>• No adverse effects on FCR, SGR, WG, CF, SR, protein/lipid content, NPU</li> <li>• Lowest FCR (1.32-1.33) with silkworm pupae - Inferior FCR (10.14) with synthetic amino acids</li> </ul>	<a href="https://intapi.sciendo.com/pdf/10.1515/aopf-2016-0006">https://intapi.sciendo.com/pdf/10.1515/aopf-2016-0006</a> (9th-National-Proceedings-of-Livestock-and-Fisheries-Research-Nepal.pdf (researchgate.net))
Abalone	<ul style="list-style-type: none"> <li>• 16% inclusion with soymeal</li> <li>• Weight gain = 74% Survival = 99% - Shell length = 51.9 Shell width = 33.8</li> </ul>	<a href="#">(Effect of fishmeal substitution with various animal and/or plant protein sources in the diet of the abalone <i>Haliotis discus hannai</i> Ino - Cho - 2010 - Aquaculture Research - Wiley Online Library)</a>
Pompano	<ul style="list-style-type: none"> <li>• Improved blood profile up to 50% FM protein replacement</li> <li>• Beyond 50% affects intestines (necrotic lesions, cell detachment)</li> <li>• Safe replacement: 30.5% FM protein (9.5% SWP)</li> </ul>	<a href="https://doi.org/10.21203/rs.3.rs-2740866/v1">https://doi.org/10.21203/rs.3.rs-2740866/v1</a>
Rainbow shark	<ul style="list-style-type: none"> <li>• 30% fish meal replaced with silkworm pupae (protein = 55.63%, Fat = 27.41%)</li> <li>• Higher weight gain (5.18±0.28 g)</li> <li>• Higher specific growth rate, SGR (2.54±0.07% day<sup>-1</sup>)</li> <li>• Improved protein efficiency ratio, PER (1.50±0.04) - Better feed conversion ratio, FCR (1.91±0.06) compared to control (weight gain - 2.76 ± 0.02, SGR - 1.79, PER - 0.96, FCR - 2.85±0.02)</li> </ul>	<a href="#">(View of Effect of silkworm (<i>Bombyx mori</i>) pupae on the growth and maturation of Rainbow shark <i>Epalzeorhynchus frenatum</i> (Fowler, 1934) under captive rearing (icar.org.in))</a>
Koi	<ul style="list-style-type: none"> <li>• Full fat Silkworm pupae meal enhances color and growth rate when fed up to 30% of total food volume above 15°C</li> <li>• Including 20% full fat silkworm pupae meal promotes excellent growth, color, and reduces waste</li> <li>• Natural source of lipids and proteins for superior Koi growth, used daily or as a seasonal treat to enhance weight, sheen, and lustre</li> </ul>	<a href="#">(Evolution Aqua Silkworm Pupae - Absolute Koi (absolute-koi.com))</a>  <a href="#">(Supersilk-20 - Kusuri Products)</a>  <a href="#">(Koi Food for Sale   Silkworm Koi Treats   The Pond Guy)</a>



reproduction in aquaculture to enhanced vitality and longevity in pets. Their natural composition aligns with the nutritional needs of animals, making silkworms a versatile and beneficial choice in modern animal nutrition strategies.

Ongoing research focuses on optimizing the processing methods, improving the nutritional profile, and assessing the long-term impacts of silkworm-based diets on animal health and productivity. Studies are also being conducted to understand the palatability and acceptance of these ingredients among different animal species.

In conclusion, silkworm-based ingredients offer a promising alternative to conventional feed

ingredients, with potential benefits for animal health, environmental sustainability, and economic efficiency. However, further research and development, along with regulatory and consumer acceptance, are essential for their widespread adoption.

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### About Ankit Alok Bagaria

*Ankit Alok Bagaria is the Co-Founder & CEO of Loopworm Private Limited, a pioneering company that develops products from industrially farmed insects for animal, plant, and human nutrition. Loopworm utilizes insects, often dismissed as pests, to harness their potential as a sustainable bioresource. Insects offer a scalable, eco-friendly solution, requiring far less land and water than traditional protein sources like soy and fish.*

*Loopworm Private Limited caters to the US\$ 200 billion animal feed protein and fats market, with a factory capacity of 100 tonnes per month. Bagaria's innovative approach earned him spots on Forbes India and Asia 30 Under 30.*

## Aerbio unveils fully operational alternative protein facility

One of the pioneers in sustainable biotechnology, Aerbio announced its plans to raise up to €50 million in a Series A funding round, with the target close set for Q4 2024. This bold step forward will reportedly fund the construction of Aerbio's cutting-edge demonstration-scale facility and expand the company's revolutionary (R)evolve™ platform, setting the stage for full-scale commercial operations.

Aerbio is at the forefront of biotechnology innovation, transforming simple molecules into valuable products without the need for arable land or fossil fuels. With its groundbreaking (R)evolve™ platform, the company points out it has unlocked the potential of microbiology to convert carbon dioxide and hydrogen into valuable products. Aerbio's launching product is Proton™, a protein-rich ingredient poised to revolutionise food and animal nutrition industries.



“Our ambition knows no bounds,” says Kaspar Kristiansen, CEO of Aerbio. “Our Series A round is a bold statement in our conviction in our plan and our relentless pursuit of breaking new ground in biotechnology. We’re not just building a company—we’re turning biotechnology on its head, paving the way for a sustainable future where sugar-free fermentation is a reality.”

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## Fonterra and Superbrewed Food team up to meet rising protein demands

Global dairy co-operative Fonterra and natural ingredient manufacturer Superbrewed Food teamed up to boost sustainable food production. The partnership combines Superbrewed's biomass protein platform with Fonterra's dairy processing, ingredients, and applications expertise to develop additional nutrient-rich, functional biomass protein. The collaboration aims to address the rising global demand for protein, reflecting both companies' commitment to delivering sustainably sourced, functional proteins that meet customer and consumer needs worldwide.

The collaboration builds upon Superbrewed's commercial

launch of their patented biomass protein, called Postbiotic Cultured Protein. According to the statement from Superbrewed Foods, Postbiotic Cultured Protein is a non-GMO, allergen-free, nutrient-dense bacteria biomass protein that recently received US market green light from the FDA. In ingredient evaluations, Fonterra determined that the excellent function and nutrition of Postbiotic Cultured Protein complement dairy ingredients in food applications with growing consumer demand.

Additionally, Superbrewed demonstrated that its non-GMO, fermentation platform could be adapted to ferment other inputs. Thus, the multi-year joint effort



seeks to develop new biomass protein solutions based on the fermentation of multi-feedstocks, including Fonterra's lactose permeate, which is produced during dairy processing. According to the companies, the objective is to add value to Fonterra's lactose by converting it into high-quality, sustainable protein with Superbrewed's technology.

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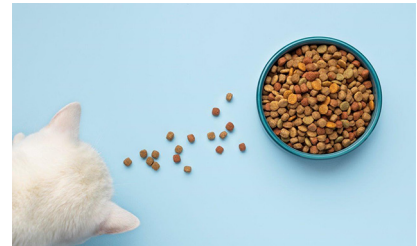
## Further Foods designs FDA trial for cultivated meat in pet food

**C**ULT Food Science Corp., a food technology platform pioneering the commercialization of lab grown meat and cellular agriculture to reshape the global food industry, announced that its subsidiary, Further Foods Inc., expects to complete the design of the feeding trials necessary for regulatory approval of dog food products containing cell-cultivated chicken later this month. Cell-cultivated chicken is a new ingredient without prior approval for animal consumption and Further Foods is, in partnership with Dr. Sarah Dodd, designing a target animal safety (TAS) study to establish the inclusion of cell-cultivated chicken in future Noochies! formulations is safe and effective.

Dr. Sarah Dodd commented,

"I'm thrilled to be collaborating with Further Foods and Noochies! on this very exciting feeding trial. Cultivated meat is an area I am personally exceptionally excited about, for both its nutritional potential for animals and for its positive impact on the environment. I look forward to navigating the regulatory pathways and feeding trial requirements with the FDA and advancing this first of its kind trial forward."

"This is a transformative moment for CULT Food Science as a company. We believe this FDA feeding trial will position us on the leading edge of cellular agriculture and cultivated meat innovation. But even more importantly, we believe that the implications of a successful trial could change the



landscape of pet food as a whole. Cultivated meat has nutritional benefits, environmental benefits and ethical benefits for pet owners. But the regulatory pathways have yet to be successfully navigated and as a result, this is not currently an option in North America. We are seeking to be a first mover in changing that and look forward to advancing this trial in collaboration with Dr. Sarah Dodd and the FDA," said Mitchell Scott, CEO of CULT Food Science.

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## Innovafeed completes third expansion phase of industrial site

**I**nnovafeed, one of the leading insect producers for animal and plant nutrition, announced the completion of the third phase of expansion at its production site in Nesle, France. According to the company, this is a crucial step that marks the scaling up of its production capacities, as announced in September 2022, following its record-breaking €250M Series D funding round. This new expansion brings the total floor area to 55,000m<sup>2</sup>. As a result, it increases the larval production capacity fivefold and enhances rearing conditions

through automated and optimized production flow management. Innovafeed claims that with this expansion, Nesle will become the largest insect production site in the world.

According to Innovafeed, this achievement not only demonstrates the viability of its breakthrough technology but also its ability to scale up to large-scale, profitable, and sustainable production. "Innovafeed thus proves the robustness of its innovative industrial model," the company adds.

The construction of this latest



expansion in Nesle is the result of an industrial development designed in phases to manage and mitigate the risks of its model. The first two phases, inaugurated in 2020 and 2023 respectively, addressed the technological risks inherent in creating a new innovative industrial sector based on living organisms.

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## Indian insect company certifies safety, quality and industry compliance

**A** bioscience and biomanufacturing company that transforms farmed insects into sustainable value-added products, Loopworm secured ISO 22000, GMP+, and HACCP certifications for LoopFactory, a 6k tonnes/annum insect protein production unit in Bangalore, India. According to Loopworm, these prestigious certifications underscore the company's dedication towards ensuring safety, quality, and industry compliance in providing insect-derived protein for pet foods as well as animal feed.

Obtaining the ISO 22000 certificate demonstrates that all products manufactured by Loopworm adhere to rigorous food safety standards. It ensures

that Loopworm's insect-derived products are produced in a controlled and hygienic environment to eliminate any possibility of contamination. It also guarantees that Loopworm products are safe for animal consumption and won't introduce harmful pathogens into the supply chain avoiding disease outbreaks.

The GMP+ (Good Manufacturing Practices for Feed) certification proves the consistent production and quality control of Loopworm's feed products. This ensures that its insect protein and fat ingredients meet high standards across every batch. GMP+ certification is also important to demonstrate compliance with international quality and safety requirements for feed. Since obtaining GMP+ is a



necessity for several international locations, especially in Europe, it reportedly allows Loopworm to penetrate those markets. HACCP (Hazard Analysis and Critical Control Points) certification also highlights Loopworm's preventive measures for risk management. By observing and controlling hazards in the production process, HACCP guarantees that Loopworm's products do not contain biological, chemical, or physical contamination.

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## Salmon produced under Label Rouge standard to be fed insects

**T**hanks to the cooperation between value chain partners in the Scottish aquaculture industry, salmon sold with the prestigious 'Label Rouge' (Red Label) can now be fed diets containing insect-derived ingredients during the juvenile stages. Label Rouge production represents 12% (8,900T) of Scotland's salmon exports, a significant and growing segment of the industry. It is thus the ideal breeding ground to support premium responsibly sourced ingredients. This endorsement was achieved in an initiative that brought together INAO, the French Label Rouge regulatory authority; Landcatch, the Hendrix Genetics' genetics brand for salmon breeding; Scottish Quality Salmon which acts as the management organisa-

tion (ODG) for Scotland's salmon producers and companies; and the leading company in insect ingredients worldwide, Protix.

The internationally recognised Label Rouge requires compliance with stringent standards to ensure the best quality products for consumers. This includes specifications for feed that limit the types and amounts of ingredients that farmers can use across the lifecycle of the salmon. In a recently approved update to these specifications, insects can now be included in the diets of juvenile (freshwater) salmon – marking a significant shift for the Scottish industry towards a feed and food system with a lower footprint. This important watershed comes at a time when the industry is also increasingly putting

larger smolt to sea.

Novel ingredients broaden the ingredients basket and are an important instrument in the sector's toolkit as they push towards carbon neutrality by 2045. Protix points out that its insect meals have a carbon impact almost 89% lower than a similar soy alternative (soy protein concentrate) per kg, while being a closer analogue to the salmonids' natural diets. Feed represents up to 80% of the carbon impact of the salmon sector, and innovation in this space drives demonstrable impact.

Landcatch supplies customers worldwide with high-quality salmon ova, fry, parr and smolts (juvenile fish) and is the first Label Rouge certified company to have signed an agreement to use insect-derived feed in its operations. General Manager



Jarl van den Berg says: "Our salmon are bred with balance in mind, in line with our vision to set the standard in responsible animal breeding. This success underpins our mission of delivering premium quality, healthy and high-performing fish sustainably and profitably."

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## Hotel in Australia manages food waste using insects

In an industry-leading move, Hyatt Regency Sydney, one of Australia's largest hotels, became the first hotel in the world to implement Goterra's compact sustainable food waste management system onsite. Championed by owners M&L Hospitality, this initiative marks a significant step towards managing the hotel's food waste and reducing its carbon footprint and environmental impact.

Goterra's system, created and led by CEO Olympia Yarger, employs innovative technology to manage food waste using insects. The system utilises Black Soldier Fly larvae to break down food waste onsite rapidly and at a large scale. Housed in high-tech, containerised units dubbed 'Maggot Robots,' the larvae can devour vast amounts of food waste, reducing it by 95% in just 24 hours. This transformational innovation will help the industry tackle climate change, aligning Hyatt Regency Sydney with global sustainability goals, Goterra points out.

"When you manage food waste with insects, you radically reduce the impact it has on the world. Using insects in tandem with industrial robotics means we manage waste efficiently, producing a sustainable protein



that can be used in agricultural supply chains, creating a truly circular system," Goterra CEO Yarger explains.

According to the statement from Goterra, Hyatt Regency Sydney is Australia's largest premium hotel. Boasting 878 rooms, award-winning dining experiences and 4,000 square metres of flexible meeting and event spaces that can house up to 1,000 guests, the hotel actively manages thousands of tonnes of food waste every year. In a huge win for bettering sustainable supply chains, the new system closes the loop with a 'circular egg'; whereby Goterra processes the hotel's food waste with insects and technology, then provides the hotel's key egg supplier, Hilltops Free Range, with the insect protein as a feed mix alternative.

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## Piotr Postepski joins Protix as new CCO

Protix, one of the leading companies in insect-based ingredients for feed and food, appointed Piotr Postepski as Chief Commercial Officer (CCO) as of August 2024. Piotr Postepski will further drive the company's ambitious international expansion path.

Piotr Postepski brings almost 2 decades of international experience at global companies to the Protix team. His career spans various leadership roles in the pharmaceutical sector, across different geographies where he has consistently driven growth and innovation. Postepski is a seasoned professional with an impressive track record in developing new business. Before joining

Protix, Postepski was instrumental in the development and scaling of a global, innovative animal health business. Trained as a veterinarian, he holds a master's degree in Veterinary Medicine from the Agricultural University of Lublin, Poland. He has further honed his management, leadership and financial skills at Warsaw School of Economics and London Business School.

As CCO of Protix, Piotr Postepski will help drive international expansion and, taking a measured approach to growth, will steer Protix towards profitable expansion in the next stage of its journey. He will be responsible for the overall commercial strat-



Piotr Postepski

egy, leading the sales team, marketing and business development activities as well as product development. Piotr will work with the Protix teams to accelerate growth based on collaboration, innovation, a customer centric culture and a clear sense of purpose.

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## IFC invests \$2 million in Costa-Rican insect protein producer

In a move to spur the circular economy in Latin America and the Caribbean, the International Finance Corporation (IFC), a global development institution focused on the private sector in emerging markets, announced an initial investment of US\$2 million in ProNuvo, a Costa Rica-based company specialized in the sustainable production of insect-based animal feed.

The IFC financing, part of the institution's Upstream activities, will allow ProNuvo to complete the construction of a 4,000 MT/year industrial insect feed plant in the district of Guápiles. Additionally, IFC will provide support to accelerate the global expansion of the nascent insect protein industry, a rapidly emerging field driven by a market opportunity of US\$11 billion for aquaculture feed and the pet food market.

Formed in 2018, ProNuvo harvests black soldier fly larvae, a species native to Costa Rica and other tropical countries. The company uses organic waste material to feed the larvae, which are converted into high-quality fats and proteins. Furthermore, the feed



residue from this process, known as frass, is transformed into organic fertilizer rich in microorganisms.

"At ProNuvo we transform waste into high-quality products to generate a positive environmental and social impact," said Miguel Carmona, Co-founder and Chairman of the Board of ProNuvo. "We are proud to operate in a country that is committed to the environment and to have the support of collaborators like IFC that are perfectly aligned with our mission of creating a more sustainable food chain for future generations."

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## Mycoprotein producer welcomes Erik Tveteraas as CFO

Norwegian Mycelium (NoMy) announced the appointment of Erik Tveteraas as Chief Financial Officer (CFO). Tveteraas joins NoMy from Nutreco, where he led its strategic investment and innovation arm, NuFrontiers. There he managed Nutreco's investment portfolio across animal health, nutrition (incl. sustainable ingredients), precision farming, alternative aquaculture farming tech and alternative protein. According to NoMy, Tveteraas will leverage significant industry experience to support and de-risk NoMy's growth journey as it embarks on its next chapter of development. Tveteraas has an MSc degree in International Business from the University of Edinburgh.

NoMy is a fermentation technology company transforming food industry side and waste streams into low-carbon, circular ingredients, using the power of fungi. Founded in 2020 and based in Oslo, Norway, NoMy currently collaborates with industry players and science powerhouses such as Skretting, SINTEF and the Norwegian Research Council to commercialize mycoprotein for feed applications. By deploying an asset-efficient scaling strategy and clear focus on product market-fit, NoMy plans to grow into pilot scale and initial commercial scale over the next 6-12 months. Ingrid Dynna, CEO and co-founder of NoMy said: "I'm delighted that Erik is joining the company at a pivotal moment. As



Erik Tveteraas

a strategic CFO, he enhances our investor readiness and strengthens our ongoing development of symbiotic industry partnerships. His extensive knowledge of the feed industry, coupled with his vast experience in investments, impactful innovations, and partnerships, makes him the ideal choice to support NoMy in our long-term go-to-market strategy."

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## Nasekomo and RVS Ruse complete project on insect bio-valorization

The joint project of Nasekomo, Bulgaria-based Black Soldier Fly breeder, and Regional Veterinary Station Ruse (RVS Ruse) "Innovative services for emerging bio-based industries: parametrization of key industrial indicators for insect bio-valorization of low-value organic streams" ended in June 2024. The project was supported by the National Innovation Fund through the Executive Agency for Small and Medium Enterprises and lasted 18 months starting in December 2022. The project is unique for Bulgaria and Europe, as it is the first time that scientific data on key indicators in the production cycle of bio-valorization by black soldier fly have been derived and validated both in the laboratory and in a near-production environment. The project partners point out that the data will frame the optimal parameters for the startup and cost-effective management of insect bio-valorization factories.

The project was implemented in partnership be-



tween Nasekomo EAD and Regional Veterinary Station Ruse EOOD – a laboratory for testing food, feed, and biological materials with over 87 years of experience in food and feed testing. Both partners recognized the need for reliable, scientifically proven indicators that would enable the definition of the quality of products resulting from the industrial production of insects for the feed industry. Furthermore, the project enabled both partners to expand their capacities and offer entirely new services to their clients.

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## Meatly unveils new protein-free culture medium

**A**gronomics, a company with a focus on the field of cellular agriculture, announced that its portfolio company Good Dog Food Limited trading as Meatly has achieved a significant milestone in developing a protein-free culture medium, costing only one pound per litre.

Culture medium is an essential element in the production of cultivated meat, providing cells with the nutrients required for in vitro viability and proliferation. Although animal cell culture is routinely performed in academic labs, creating the amount of biomass required for commercial scale and price points demands significant cost reductions and innovations for the replacement of certain medium components such as fetal bovine serum and albumin. Medium costs account for a significant portion of the costs of producing cultivated meat and reducing them is a well-known hurdle the industry faces as it looks to scale up and achieve price parity with conventional meat products, Agronomics unveiled.

Agronomics' team observed that medium prices vary substantially between companies and in some cases are still at levels exceeding hundreds of pounds



per litre, making industrial production economically unviable. However, Agronomics explained that Meatly's new medium contains no serum, animal-derived components, steroids, hormones, growth factors, or antibiotics, and is used in their suspension culture bioreactors without micro-carriers. The absence of these expensive proteins, such as transferrin and insulin, as well as growth factors and micro-carriers, means the production of Meatly's protein-free culture medium at an industrial scale is economically viable - at the price of one pound a litre. Meatly believes further cost reduction will be possible when higher volumes of the medium are purchased.

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## New study: Shrimp fed with fungi protein grow faster and healthier

**G**lobal shrimp farmers face challenges with soaring costs and rampaging diseases that diminish their profits. Finnish biotech startup Enifer published a new study conducted by independent study partner AquaBioTech Group, at its aquaculture R&D facility, Innovia, about the health benefits of using Enifer's PEKILO®Aqua mycoprotein in shrimp feed. The company unveiled that the results were excellent, with shrimp living longer and healthier when fed with PEKILO®Aqua.

Currently, shrimp get roughly 10% of their protein from a fishmeal diet. Fishmeal, derived from marine fish, has been a staple in shrimp diets due to its rich protein content. Additionally, fishmeal

contributes to the overall palatability of the diet. However, almost 90 percent of global marine fish stocks are now fully exploited or overfished, and the shrimp feed industry is the largest single user of fishmeal.

According to the statement of Enifer, the study found that the overall mortality rate was notably reduced in shrimp fed the PEKILO®Aqua diet. The survival rate increased from 74% to 85% among shrimp consuming the 30% PEKILO®Aqua diet. Additionally, following carcass analysis, it was observed that the crude protein content was significantly higher (2.5%) in the PEKILO®Aqua-fed group compared to those fed diets containing higher levels of fishmeal.

Shrimp have an innate immune system but no adaptive immune system, meaning they cannot be vaccinated. To make shrimp more resistant to diseases, their immune systems must be stimulated periodically or constantly with separately added compounds. Enifer points out that PEKILO®Aqua already includes immune-enhancing compounds like beta-glucan and nucleotides, which makes it a great feed for disease-prone shrimp as they can build immune cells faster without damaging the shrimp's energy reserves. The results also showed that PEKILO®Aqua contributes to improved shrimp



growth without an increase in feed intake. Additionally, in addition to nucleotides, PEKILO®Aqua contains another shrimp growth-enhancing compound, spermine.

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## Nofima: Consumers distrust use of insects and microalgae in salmon feed

Nofima, a leading food research institute that conducts research and development for the aquaculture industry, the fishing industry and the food industry, examined consumers' beliefs and thoughts regarding salmon. Katerina Kousoulaki, a senior scientist at Nofima, is currently leading a project aimed at creating sustainable salmon feed from algae and insect meal. In the future, the salmon industry will require a greater diversity in sustainable raw materials which are beneficial to both salmon and the environment than current options, and microalgae and insects are promising raw materials. This is why Kousoulaki has been listening in on focus groups where French consumers of salmon have discussed their beliefs and thoughts.

“The respondents loved eating salmon, but did not know much about the fish,” says Kousoulaki.

“My impression is that we need to educate the consumers.”

It turns out that consumers know very little about Norwegian salmon. What's more, they think they “know” several things that are in fact wrong. “Everyone was sure that farmed salmon contains lots of antibiotics – which is not correct. They like to eat salmon, but they don't know much about how it is produced,” she states.

According to Kousoulaki, when the existing knowledge is lacking, it makes it even more challenging to talk about feed with new raw materials. “If you ask people what salmon eat in the wild, many will answer ‘algae’ and ‘shrimp’. However, salmon don't eat algae, and they don't eat much shrimp, either. They mainly feed on fish, and upriver they feed on insects,” Katerina Kousoulaki explains. “Many of the surveyed consumers had a



positive attitude towards using algae in fish feed, but did not think that insects were a natural food for the salmon.”

François Saulais in the multinational retail group Auchan is tasked with selling Norwegian salmon to French consumers. “Our customers' knowledge about the products they buy is not as good as we would like. This does not come as a surprise to us; the only surprise is that more people than we thought believe that fish farmers use antibiotics and growth hormones, a misconception we need to address,” concludes Saulais.

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## Biotech company achieves GRAS status for its microbial protein

String Bio, an India-based biotech company, announced the Generally Recognized as Safe (GRAS) status of its innovative microbial protein, PRO-DG™, for use in crustacean feed in the U.S. This landmark achievement was affirmed by an independent panel of experts who rigorously evaluated the body of published data supporting the safety of PRO-DG™ for its intended use, the company explained.

The GRAS status, governed by the US Food and Drug Administration (FDA), sets a high standard for ingredients to be approved for use in both feed and food. String Bio's PRO-DG™ stands out as it contains approximately 70% protein derived from methanotrophic bacteria, manufactured through the company's patented String Integrated Methane Platform (SIMP®). According to the company's statement, this advanced platform ensures an ideal amino acid profile, resulting in high digestibility and performance, as validated in various aqua trials. Notably, the protein's tolerability by shrimp was evidenced through peer-reviewed publications (Felix



et al., 2023; Nederlof et al., 2023).

Speaking on the announcement, Dr. Ezhil Subbian, CEO of String Bio said, “The FDA-regulated GRAS status will enable the commercialization of PRO-DG™ in the United States, opening new markets and opportunities for growth. Many countries look to GRAS status as a strong indication that a feed ingredient has been rigorously tested to meet the highest standard. GRAS status of PRO-DG™ is an important milestone in String's journey and will boost String Bio's market presence in the feed sector.”

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## UK approves cultivated meat for pet food

Focused on producing sustainable cultivated meat for pets, Meatly received regulatory clearance to sell cultivated meat for pet food in the UK, making it the first in the world to get authorization for cultivated pet food. A huge leap forward for the cultivated meat industry, gaining regulatory approval also makes Meatly the first-ever cultivated meat company approved for sale in any European country, according to the announcement.

Commenting on the announcement, Owen Ensor, Meatly CEO said: “Today marks a significant

milestone for the European cultivated meat industry. I'm incredibly proud that Meatly is the first company in Europe to get the green light to sell cultivated meat. We are proving that there is a safe and low-capital way to rapidly bring cultivated meat to market.”

“We're delighted to have worked proactively alongside the UK's regulators to showcase that Meatly chicken is safe and healthy for pets. Pet parents are crying out for a better way to feed their cats and dogs meat – we're so excited to meet this demand. We



can now continue our mission to give consumers an easy choice – ensuring we can feed our beloved pets the real meat they need and crave, in a way that is kinder to our planet and other animals,” continued Ensor.

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## Bernd Meerpohl assigned as interim CEO of Big Dutchman

A company providing high-tech farming solutions for protein and plants for farmers, Big Dutchman announced that Dr. Frank Hiller, CEO of the company, asked the Supervisory Board to release him from his duties with effect from 30 September 2024 for personal reasons, and the Supervisory Board has agreed to this request. Dr. Hiller will continue to support the management team and Supervisory Board in an advisory capacity in the coming months.

Bernd Meerpohl, Chairman of the Supervisory Board of Big Dutchman: “We respect and regret Dr Hiller’s decision. On behalf of the shareholders and the supervisory Board, I would like to thank him for the impetus he contributed during his time as CEO to help us achieve further sustainable growth. We wish Dr Hiller and his family all the best for the future.”

Dr. Frank Hiller says: “My thanks to the Supervisory Board for accepting and respecting my decision to prioritise personal



Bernd Meerpohl

matters. With its dedicated management team and highly motivated employees, I am certain that Big Dutchman will overcome the challenges of the future.”

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## German companies team up for insect farming

FarmInsect and AGRAVIS Raiffeisen AG will be working together in the field of insect farming in the future. The agricultural and service company AGRAVIS is already active in this market with its start-up Flyvis Farming. Thanks to the cooperation with FarmInsect, interested farmers can now also enter the insect fattening sector in smaller fattening systems with a lower investment volume, the companies stated.

FarmInsect offers a complete modular solution for the regional on-site production of black soldier fly larvae. The systems can be integrated into existing buildings and can be scaled to any size. Farmers fatten the insects for seven days using approved feed from residual streams. They then feed the insects to their own animals or sell them to FarmInsect, which processes them into protein meal.

AGRAVIS Raiffeisen AG is a modern agricultural trading company in the agricultural products, an-



imal nutrition, crop production and agricultural technology segments. Since 2021, the company has been active in the insect industry through a strategic partnership with Illucens GmbH. While the latter manages larger fattening systems, AGRAVIS explained that it would like to offer interested farmers more options in terms of system size through its cooperation with FarmInsect.

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