Sustaining Life with the Power of Insect Protein

Ensuring Feed Safety Using Insect-Based Ingredients

Protein is an essential component of nutrition for both humans and animals, continuously being formed inside the body and broken down again. In order to maintain this cycle, about 15% of the daily energy intake should be covered by protein, to build and repair the cells that sustain life. To feed today's global population, agriculture produces roughly 525 million tons of plant protein a year, found in corn, rice, wheat, or soybeans. Two third is fed to livestock to produce meat, while an estimated 15% is wasted from field to supermarket to consumer. If we consider future trends for meat consumption, it's not likely that these numbers will see much change. This means that in 2050, global protein production will need to increase by 50% in order to feed the growing world population. Experts agree, this cannot be achieved using current farming practices and resources. Therefore, new approaches are needed to provide protein for farmed animals, and insect protein promises to be a sustainable option. For the insect industry, innovation focused on nutrition, managing food waste and applying best practices in safe feed processing will be the way forward.

Using Insects to Feed Future Generations

The most promising insect for feed is the black soldier fly larvae because it feeds on organic residues from agriculture, the food industry and consumers. It can recover up to 70% of the nutrients from these streams. In fact, just two kilograms of feed can produce one kilogram of insect mass. More still, the black soldier fly requires little space to produce one kilogram of protein on a single square meter, achieving even higher yields in vertical farming systems. Since organic residues are available all over the world, insect farmers have plenty of access to local feed proteins.

Already, insects are being fed whole to animals in regions like Asia Pacific, albeit on a relatively small scale, and in Europe, eggs from live larvae fed chickens are generating market interest. But the real focus is on how to process insects into feed that can satisfy the largest protein consumers, namely livestock. Initial studies indicate the high lipid content of 35-40% (dry mass) can interfere with feed performance. That is why Larvae are generally separated into a protein meal and an insect fat. Since the meal has an amino acid similar to fishmeal, aquaculture could be a promising application that relieves pressure on natural fish populations. Meanwhile, the fat--similar to palm kernel or coconut oil--has a high percentage of lauric acid, known for its antimicrobial properties. Therefore, the fat is successfully applied in piglet feed, proven to prevent diarrhea and improve feed intake for a healthy transition from piglet to grower.

Scalable Technologies for a Food-Secure World

Although unchartered territory, scalable technologies are needed as the insect-for-animal-feed movement reaches a turning point. Bühler, the leading solutions provider for the food and feed industry, along with Protix, the leading insect production company, have formed the joint venture *Bühler Insect Technology Solutions*. This venture promises to provide scalable, industrial solutions that can process high-quality insect ingredients from organic residues. The solution is comprised of three major steps: f*eedstock preparation*, *larvae rearing* and *larvae processing*.

<u>Feedstock preparation</u>

Feedstock preparation is the first order of business for any farm. To provide insects with safe, nourishing food, farmers must have access to high quantities of organic residues such as fruit and vegetable waste, juice pulp, spent grains, or kitchen and catering remains. Many countries regulate which types of feedstock are allowed. In Europe, for example, insects can only be fed with pre-consumer organics that do not contain meat or fish, while kitchen or and catering remains are not allowed. To minimize operational costs, rearing should be established within close proximity to where waste is generated. For optimal feedstock preparation, processing steps like grinding, mixing and fermentation will be required. A feeding system provides the right diet at the right time to the larvae, in order to optimize growth and feed conversion.

Rearing Units

Black soldier fly seed larvae provided by specialized breeding companies are grown in stackable trays that are stored in ventilated rooms. Factors like temperature, humidity, oxygen concentration, larval density and nutrition dramatically impact productivity. Setting particular rearing conditions will achieve high productivity, optimize feedstock conversion and minimize development time.

In addition, accurate feed distribution and tray handling can be easily managed with automation, and each tray can be fed daily to optimize the availability of nutrients. A tray can also be closely tracked to monitor feed amount and larvae output. Since the tray system enables a modular design of the insect growth sector, the capacity of the plant can be easily adapted to the available feedstock capacity.

Processing units

Processing units transform the reared insect biomass into high value products. First, there's the separation of larvae from the residual material, which is typically dewatered and pelletized to produce a bio-fertilizer. Then, the clean larvae go through a patented process that includes a heat treatment step to ensure inactivation of all pathogenic microorganisms, along with an efficient separation of lipids to obtain a defatted protein meal. While insect rearing can be profitable on both a large or small scale, processors need access to a large enough volume of live larvae in order to reach an efficient scale.

Safe Feed Processing with Hygienically Designed Technologies

To ensure the healthiest relationship between animals and humans, insect farmers and feed processors must adhere to the highest standards of quality and safety. *Good Manufacturing Practices* (GMP) identify the key components as: sanitary building and equipment design, cleaning and disinfection procedures, and personnel hygiene. In addition, every plant must have a preventive system to mitigate biological, chemical and physical hazards. In fact, establishing hazard analysis critical control points can prevent feed safety problems before they occur.

Sanitary plant facilities must embrace the concept of barriers that prevent the entry of pests and other hazards from the external environment, along with hygienic zoning inside the building that prevents cross-contamination between raw and finished products. The ideal sanitary plant incorporates equipment designs that protect the consumer from foodborne hazards. Hygienically-designed machinery will not only reduce the risk of contamination, it will help to maintain product quality, increase productivity and contribute to sustainability by using a minimum amount of water, chemicals and labor for cleaning and changeover. Bühler's newest engineering designs offer full drain ability, with reduced crevices and microbial niches, constructed with hygienic surface finishes

and thorough accessibility for cleaning and disinfecting. The highest cleaning and disinfection standards can be achieved with sophisticated cleaning-in-place systems.

Finally, a processing plant dedicated to sanitation will recognize the importance of traceability through each stage of production, processing and distribution. As such, each batch of insects should be properly catalogued and trackable back to the raw materials used to feed that batch. Information that follows insects through each step of the production process, providing insight into history, location and path of a product or batch of products, along with the supply chain, will be sure to guarantee product quality and safety.

A Food Secure World for Tomorrow

No one solution can create a sustainable food future, but insects can offer a viable way to close the protein food gap, with health and environment benefits. Industrial scale production is the next step toward ensuring that the entire food chain has access to safe, efficient solutions. Integrated rearing and processing systems, combined with mechanization and automation, will make insect processing feasible. Meanwhile, safety will always be paramount and appropriate feed safety standards must be established to protect the consumer. Key elements of safe feed production include the following of HACCP guidelines, having a defined kill step that controls pathogenic organisms, and using traceability to offer trustworthy products. As a technology provider of industrial solutions for the farming and processing of insects, Bühler is considering every aspect, engineering processes that will bring a new protein source to the market and answer the world's growing need for protein.

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