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Characteristics and Uses of Black Soldier Fly (BSF)

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The Black Soldier Fly (*Hermetia illucens*) has emerged as one of the most promising insect species for sustainable protein production. Its larvae are rich in high-quality protein, lipids, minerals, vitamins, and functional compounds that can replace conventional feed ingredients such as fishmeal and soybean meal. *Hermetia illucens* is a widespread fly of the family Stratiomyidae. In recent years, *H.illucens* has increasingly been gaining attention because of its hyper accumulation of protein and fats via consumption of renewable substrates. Black Soldier Fly larvae can efficiently convert organic waste into valuable biomass, contributing to environmental protection and circular economy systems. This article describes the biological characteristics, nutritional composition, production aspects, and practical applications of Black Soldier Fly in feed and agriculture. Special emphasis is given to nutrient values of Black Soldier Fly larvae and their inclusion ratios in poultry, aquaculture, livestock, and pet feeds, highlighting their role in reducing feed cost while improving animal performance and sustainability.

Biological and functional characteristics of BSF

The Black Soldier Fly is a beneficial insect that differs significantly from common houseflies. Adult Black Soldier Flies do not consume human food and are not vectors of diseases, making them safe for large-scale farming. The most important stage is the larval stage, which shows rapid growth and strong ability to convert organic materials into nutrient-rich biomass. Under suitable temperature and moisture conditions, BSF larvae reach harvestable size within about 12 to 15 days, allowing continuous production cycles. The larvae can utilize a wide range of substrates such as vegetable waste, fruit residues, agro-industrial by-products, and food scraps, thereby transforming low-value waste into high-value protein and fat. This biological efficiency supports waste management and environmental sustainability. In addition, BSF larvae are highly adaptable and require less land and water compared to conventional livestock, while producing fewer greenhouse gas emissions. Their physical structure also allows easy processing into meal, powder, or oil, increasing their commercial usefulness across multiple industries.

Nutritional Composition and Nutrient Values of BSF Larvae

Black Soldier Fly larvae possess a highly balanced nutritional profile suitable for animal and human nutrition. On a dry matter basis, BSF larvae typically contain about 35-45 percent crude protein, making them comparable to fishmeal and superior to many plant protein sources. The protein fraction includes essential amino acids such as lysine, methionine, leucine, valine, and threonine, which are required for muscle growth, enzyme activity, and immune function. The lipid content generally ranges from 20 to 35 percent and includes beneficial fatty acids like lauric acid, oleic acid, and linoleic acid. Lauric acid is particularly

important because it has antimicrobial properties that improve gut health and reduce pathogenic bacteria. In addition, BSF larvae contain around 8 to 12 percent ash, indicating a rich mineral composition. Calcium levels may range between about 500 and 800 mg per 100 g, phosphorus around 300 to 500 mg, iron 10 to 20 mg, zinc 8 to 15 mg, and magnesium 50 to 100 mg. These minerals support bone development, blood formation, metabolic processes, and enzyme systems. BSF larvae also supply B-complex vitamins that support energy metabolism and nervous system function. Because of this complete nutrient package, BSF meal shows high digestibility and efficient nutrient utilization when incorporated into feed formulations.

Processing techniques and Product Characteristics of Black Soldier Fly

For practical use, Black Soldier Fly larvae are processed into stable and safe products. After rearing on organic substrates, larvae are harvested at the optimum growth stage and cleaned to remove impurities. They are then dried using sun drying, hot-air drying, or mechanical dryers to reduce moisture content and prevent microbial spoilage. The dried larvae are ground into fine meal or powder, which can be directly incorporated into feed formulations. In some processing systems, oil is extracted from the larvae, producing defatted BSF protein meal with higher protein concentration and separate BSF oil rich in lauric acid. These processing steps improve shelf life, handling, and nutritional consistency of BSF products. The resulting BSF protein powder has good functional properties such as water-binding and emulsifying capacity, which are useful in feed and food manufacturing. Hygienic processing and proper packaging are essential to maintain quality and safety, especially when BSF products are intended for commercial distribution and potential human consumption.

Use of Black Soldier Fly in Poultry and Livestock Feeding

Black Soldier Fly protein meal is increasingly used in poultry and livestock nutrition as a replacement for conventional protein sources. In poultry diets, BSF meal improves growth performance, feed conversion ratio, immune response, and egg quality because of its high-quality protein and antimicrobial fatty acids. Practical feeding trials indicate that BSF meal can be included at about 5 to 10 percent in starter diets, 10 to 15 percent in grower diets, and around 5 to 12 percent in layer diets without negative effects on performance. In pig feeding, BSF meal contributes to muscle development and better feed efficiency, and inclusion levels of about 5 to 15 percent are commonly recommended depending on age and production stage. For cattle and other ruminants, BSF is mainly used as a protein supplement rather than a complete replacement, and inclusion levels of around 3 to 8 percent in concentrate mixtures help improve protein supply and overall productivity. By partially replacing fishmeal and soybean meal, BSF reduces feed cost while maintaining or improving animal health and performance.

Use of Black Soldier Fly in Aquaculture and Pet Nutrition

Aquaculture is one of the most promising sectors for Black Soldier Fly utilization. Fish and shrimp require high-quality protein for rapid growth, and BSF meal provides an excellent alternative to fishmeal. Because of its balanced amino acid profile and good digestibility, BSF can replace about 10 to 30 percent of fishmeal in fish diets and around 10 to 25 percent in shrimp feeds without affecting growth, survival, or flesh quality. In many cases, lauric acid in BSF oil also helps improve disease resistance in aquatic animals. Beyond aquaculture, BSF protein is widely used in pet food production. Dog, cat, bird, and reptile feeds incorporate BSF meal because it is nutritious, highly digestible, and less likely to cause allergic reactions compared to some traditional animal proteins. In pet diets, BSF protein can generally be included at levels of about 5 to 20 percent, depending on formulation goals and species requirements. These applications highlight the versatility of BSF across different animal nutrition sectors.

Agricultural, Environmental and Future Scope of BSF

Apart from feed uses, Black Soldier Fly also contributes significantly to agriculture and environmental management. The residue produced during larval rearing, known as frass, is

rich in organic matter and nutrients and is used as an organic fertilizer and soil conditioner. It improves soil structure, microbial activity, and nutrient availability, leading to better crop growth and yield. Environmentally, BSF farming supports waste recycling by converting food and agricultural waste into valuable protein and fertilizer, reducing landfill use and pollution. From a future perspective, BSF has strong potential in human nutrition, functional foods, and biotechnology due to its protein quality and bioactive compounds such as antimicrobial peptides and chitin derivatives. With increasing research, technology development, and regulatory support, Black Soldier Fly is expected to become a key component of sustainable food and feed systems worldwide.

References

1. Makkar, H. P. S., Tran, G., Heuzé, V., & Ankers, P. (2014). State-of-the-art on use of insects as animal feed. *Animal Feed Science and Technology*, 197, 1–33.
2. Van Huis, A., Van Isterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G., & Vantomme, P. (2013). *Edible insects: Future prospects for food and feed security*. FAO Forestry Paper No.171, Rome.
3. Diener, S., Zurbrugg, C., & Tockner, K. (2009). Conversion of organic material by Black Soldier Fly larvae. *Waste Management & Research*, 27(6), 603–610.
4. Barragan-Fonseca, K. B., Dicke, M., & Van Loon, J. J. A. (2017). Nutritional value of the Black Soldier Fly (*Hermetia illucens* L.) and its suitability as animal feed. *Journal of Insects as Food and Feed*, 3(2), 105–120.
5. Sprangers, T., Ottoboni, M., Klootwijk, C., Owyn, A., Deboosere, S., De Meulenaer, B., et al. (2017). Nutritional composition of Black Soldier Fly larvae for feed and food applications. *Journal of the Science of Food and Agriculture*, 97, 2594–2600.
6. Henry, M., Gasco, L., Piccolo, G., & Fountoulaki, E. (2015). Review on the use of insects in aquaculture feeds. *Aquaculture*, 438, 1–10.
7. Schiavone, A., De Marco, M., Martínez, S., Dabbou, S., Renna, M., Madrid, J., et al. (2017). Nutritional value of a partially defatted Black Soldier Fly meal for poultry. *Poultry Science*, 96(9), 3373–3380.
8. Surendra, K. C., Olivier, R., Tomberlin, J. K., Jha, R., & Khanal, S. K. (2016). Bioconversion of organic wastes into biodiesel and animal feed using Black Soldier Fly. *Waste Management*, 47, 80–90.