Bio Vet Innovator Magazine

Volume 2 (Issue 1) JANUARY 2025

OPEN ACCESS

Popular Article

Insect Meal As An Alternative Source For Poultry Protein

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DOI: https://doi.org/10.5281/zenodo.14835170

Received: January 18, 2025

Published: January 22, 2025

Abstract:

Insect meal is a sustainable, cost-effective alternative to traditional poultry protein sources like soybean meal (SBM), which are expensive and environmentally taxing. Rich in protein (40–60%), amino acids, essential fatty acids, vitamins, and minerals, insect meal supports poultry growth and health. Its bioactive compounds, such as antimicrobial peptides, lauric acid, and chitin, enhance immunity, feed efficiency, and meat quality. Studies show improved growth rates, egg production, and meat characteristics in poultry fed insect-based diets. With lower resource requirements and reduced environmental impact, insect meal addresses the rising demand for animal protein while offering a sustainable solution for poultry production.

Keywords: Insect meal; Poultry; Alternative protein; Antimicrobial peptides

Introduction:

The global demand for animal protein is rising, leading to increased livestock production costs, with feed accounting for up to 70% of total expenses. Soybean meal (SBM), a primary protein source in livestock feed, is widely used in poultry diets due to its high protein content and amino acid profile. However, SBM's environmental impact—including deforestation, greenhouse gas emissions, and water pollution—combined with price fluctuations, necessitates the search for alternative protein sources. While meat and bone meal has been explored as an option, it offers lower digestibility, thereby reducing nutrient utilization. Recent research highlights insect-based meal as a sustainable alternative, aligning with poultry's natural foraging behavior. Insect-based protein provides a cost-effective, eco-friendly feed solution, addressing the growing need for sustainable poultry production while reducing dependence on traditional protein sources like SBM. This innovative approach could balance production efficiency, environmental sustainability, and cost-effectiveness in the livestock industry.

Benefits of Insect-Based Meal:

- Rich in vitamins, minerals, essential amino acids, fat, MUFA, PUFA
- Produce Antimicrobial pepides (AMPs) and Bioacive substances (fatty acids, chitin and chitosan) - Deals Anibiotic resistance
- Reduction of carbon footprint
- Organic waste material to valuable insect protein
- Small scale farmers- alternate source of income
- Ability to grow in low oxygen, higher stocking density and no light and resistant to temperature fluctuations
- Eco-friendly production methods

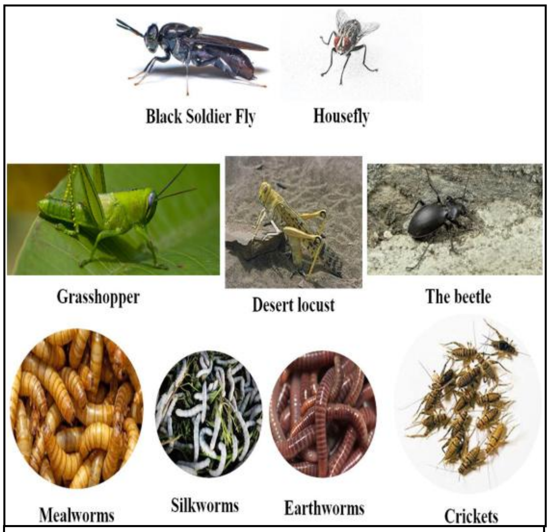


Fig.1 Recognized species commonly included in poultry feed

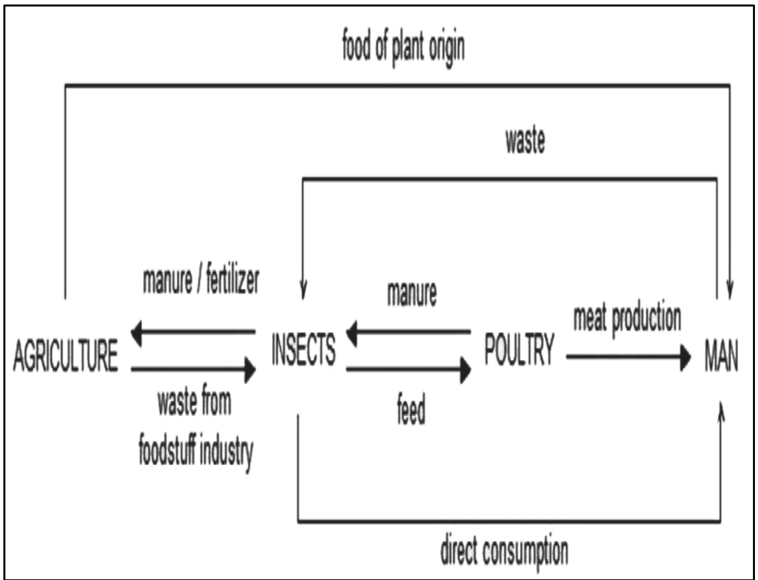


Fig. 2 Proposed food chain among insects, poultry, man and agriculture

Production Of Insect Meal:

Dehydration → Grounded to powder → Processing by steaming, boiling, frying, smoking, drying & toasting

- Optimal temperature for growth: 27^0 to 30^0 C
- Humidity < 70 %
- These heat treatments decreased the crude fat content and increased the crude protein content up to 14.3–28.2 g/Kg DM, 37–41.3 g/Kg DM respectively

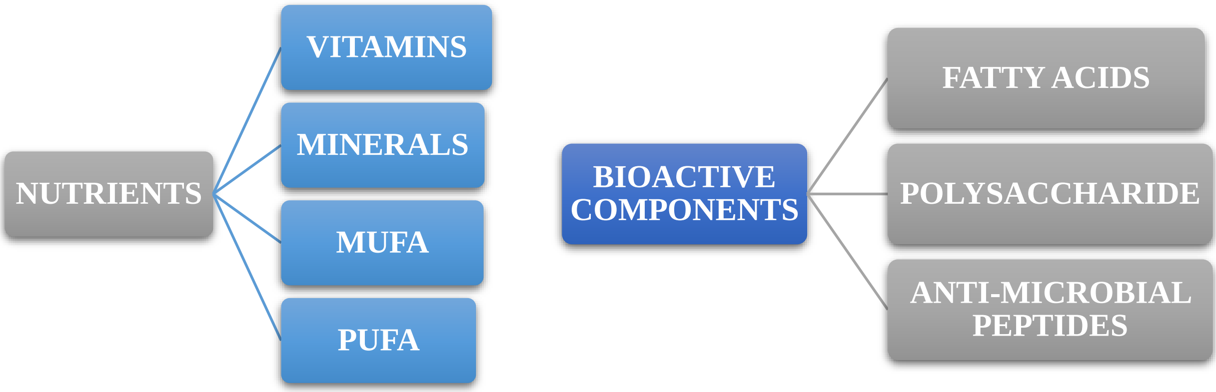
Citation: Prabhakaran T, K. Devadharshini, Pavithra P. (2025). Insect Meal As An Alternative Source For Poultry Protein. In Bio vet innovator magazine (Vol. 2, Issue 1, pp. 12–16). Bio vet innovator magazine. https://doi.org/10.5281/zenodo.14835170

Nutritional Profile of Insect Meal in Poultry:

The nutritive value of insect meal is broadly classified into nutrients and bioactive substances. In addition to vitamins (riboflavin, folic acid, cyanocobalamin, thiamine, retinol) and essential minerals (zinc, iron), nutrients include protein, energy, digestible essential and non-essential amino acids, and saturated (SFA), monounsaturated (MUFA), and polyunsaturated fatty acids (PUFA). The bioactive components of insects include fatty acids (e.g., lauric acid), polysaccharides (chitin and chitosan), and antimicrobial peptides (glycine, proline, and cysteine-rich peptides, as well as α-helical peptides).

1. **Protein:** The protein content of insect meals varies significantly, ranging from 40–60%. Factors such as the insect's diet, developmental stage, and environmental conditions influence the nutrient profile, leading to differences among related insect species. The protein content of dried insect matter ranges from 35% in termites to as high as 61% in crickets, grasshoppers, and locusts, with some species exhibiting protein levels up to 77%.
2. **Carbohydrates:** Insects primarily store carbohydrates in two forms: chitin and glycogen. Chitin constitutes the main component of their exoskeleton and is a polymer of N-acetyl-D-glucosamine. Conversely, the muscle cells of insects' store glycogen as an energy source. Edible insects contain varying amounts of carbohydrates (mealworms: 14–18%; crickets: 10–20%; grasshoppers: 11–21%; silkworm pupae: 10–20%; ants: 2–15%).
3. **Antinutritional Compounds:** Findings from Khalifah et al. suggest caution when including insects with notable antinutritional factors such as protease inhibitors, phytic acids, oxalates, tannins, lectins, and alkaloids in poultry diets. Typically, their inclusion is limited to 2–5% or below to avoid adverse effects on nutrient absorption and overall feed efficiency.
4. **Antimicrobial Peptides (Amps):** AMPs target bacterial cell membranes, disrupting their structure and killing the cells by forming ion channels or transmembrane pores. Studies on maggot-based medical treatments have demonstrated their antibacterial properties. For instance, maggot secretions contain a defensin called lucifensin, which is active against *Staphylococcus aureus*, *Staphylococcus carnosus*, *Streptococcus pyogenes*, and *Streptococcus pneumoniae*. These AMPs could be beneficial in poultry production by enhancing overall health and resistance to infections.
5. **Lauric Acid:** Lauric acid, a medium-chain fatty acid with potent antimicrobial properties, improves feed conversion rates and breast meat yield in broiler chickens. Studies in Cobb 500 broilers demonstrated that supplementation with 22.8 g of free lauric acid per 100 g of total fatty acids improved feed: gain ratio and breast meat yield. In male Ross 308 broilers, lauric acid supplementation significantly enhanced body weight (BW) and average daily growth (ADG). Lauric acid is present in high levels in Black Soldier Fly (BSF) prepupae, especially when reared on organic waste streams rich in starch. Feeding whole larvae or prepupae to poultry is recommended to maximize the antimicrobial benefits of lauric acid.
6. **Chitin and Chitosan:** These polysaccharides are known for their antimicrobial and antiparasitic properties. Chitin supports immune activity and has hypolipidemic and hypocholesterolaemia effects. In broiler chickens, chitin supplementation has been linked to decreased body fat and leaner meat production. Similarly, chitosan exhibits antimicrobial activity against bacteria, yeasts, and fungi, promoting overall poultry health. A study on

laying hens fed BSF larvae meal-based diets with 1 g of chitin daily showed improved immune activity, demonstrating the potential of insect-derived ingredients in enhancing poultry health.



Case Study:

- **Case study 1:** Cullere *et al.*, (2016), reported that, in broilers fed BSF (Black Soldier Fly) meal, showed superior digestibility of ether extract (EE) proving the high digestibility of crude protein and amino acids and hence insect meal can be a viable and efficient protein source for poultry.
- **Case study 2:** Hwangbo *et al.*, (2009) described enhanced contents of lysine and tryptophan in the breast muscle, despite the unchanged content of CP. This may be due to the greater AA profile and the high protein digestibility (98.5%) of House fly larvae meal (HF). HF larval meal supplementation has been shown to significantly enhance broiler live weights, overall dietary feed intake, and daily average growth.
- **Case study 3:** The antioxidant capacity of the meat was improved using a diet containing 5% Earthworm (EW) meal. An inclusion rate of 7% EW meal allowed for obtaining greater aroma, juiciness, residues, and flavor in Cobb 500 broiler meat. Gholami *et al.*, (2016) reported that feeding EW meal to Ross 308 broiler chickens increased yield of breast meat.
- **Case study 4:** 15% BSF meal resulted in an increased abdominal fat percentage, meat redness, meat protein percentage, MUFAs percentage in breast meat, and reduced breast meat PUFAs percentage. Kawasaki *et al.*, (2019) investigated the effect of BSF larvae and pupae meals on the egg quality of laying hens and reported that the highest weights of egg albumen and egg shell thickness in the poultry group fed with BSF pupae.

Conclusion:

Insect meal offers a sustainable and efficient alternative to conventional protein sources like soybean meal for poultry production. Its high protein content, bioactive compounds, and nutritional benefits enhance poultry growth, health, and product quality. Additionally, insect meal has a lower environmental footprint, making it a viable option in the face of growing global demand for animal protein. While factors such as antinutritional components and optimal inclusion rates require consideration, the evidence from various studies underscores its potential to revolutionize poultry nutrition. Integrating insect meal into poultry diets can contribute to sustainable, cost-effective, and eco-friendly livestock production systems.

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