THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
Popular Article
July, 2023; 3(07), 1619-1621

Role of Insects as An Alternative Animal Protein Source in Poultry Feed

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https://doi.org/10.5281/zenodo.8190050

Introduction

In developing countries, animal and plant proteins typically supply the amino acids (e.g. lysine, methionine and cysteine) in poultry feed. But, increase in the global demand for animal protein source due to population growth and economic development has become a challenge. And in this context, demand for poultry meat and eggs is expected to increase, as poultry industry is the major source of animal protein. In poultry diets majorly used components are energy and protein source. Commonly used protein source is soyabean meal (SBM) followed by fishmeal (FM). However, due to increased demand and reduced production the price of soyabean meal has been increasing. In the poultry sector cost of the feed itself accounts for 75 to 80% of the total cost of production and which is why there is a due need to find the best alternate source for protein. Using insect meal as an alternate source of protein in poultry feed is one best option.

Insects as an alternative animal protein

Insects are suggested as a high quality, efficient and sustainable alternative protein source in poultry feed, due to similar fat (30–40% DM) and protein content (40–60% DM) to that of SBM or FM (Makkar *et al*. 2014). Chickens with access to outdoor areas pick up insects at all life stages and eat them voluntarily, which indicates that they are evolutionarily adapted to insects as a natural part of their diet (Bovera *et al*., 2015). Approximately 50% of the food consumption of wild birds consists of insects. There are various advantages of insect meal: not only they are the cheapest source of animal protein but also insects can reproduce and grow fast, and, because they are cold blooded, their

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*Published:*25.07.2023

FCR is generally high, plus they can be reared on bio-waste materials, giving environmental benefits. On average 1 kg of insect biomass can be produced from 2 kg of feed biomass (Collavo *et al*., 2005). Insects can convert waste biomass into a high value food and feed resource. Lower feed-to-protein conversion ratio and produce fewer greenhouse gases and lower ammonia emissions than any conventional livestock (Van Huis *et al*., 2013). And mostly insect rearing can be operated in developing countries that need low-tech and low-capital investment.

In health and nutritional point of view, insect's exoskeleton is rich in chitin, a polysaccharide which is considered to have a positive effect on the functioning of the immune system. It's a nitrogen containing carbohydrate (N- acetylated glucosamine polysaccharide) and contains about 7% nitrogen (equivalent to 43.75% crude protein) which is nutritionally unavailable to most animals. Insects at all life stages are rich sources of animal protein (Bovera *et al*., 2015). Reduced blood cholesterol levels and albumin to globulin ratio is another positive effect of chitin that has been observed in poultry (Marono *et al*., 2017).

The protein content of insect meals varies considerably from around 41% - 70% even when the meals are based on the same insect species. The nutrient concentration of insects depends on their life stage as well as the rearing conditions and the composition of the growth media used for insect production (Makkar *et al*., 2014). Insects are a rich source of antimicrobial peptides (AMPs). Most insect AMPs are small, cationic proteins which exhibit activity against bacteria and/or fungi, as well as certain parasites and viruses. The largest group of insect AMPs are defensins. Defensins have been identified in numerous insect species belonging to the orders Diptera, Hymenoptera, Coleoptera, Lepidoptera, Hemiptera, Isoptera, Odonata (Yi *et al*., 2014). These peptides are produced by body fat cells, as well as blood cells – thrombocytes, from where they can be easily diffused and act throughout the whole body.

Insects such as the black soldier fly, common house fly, silkworm and yellow meal worm are the most promising insects in animal feed. Grasshoppers and termites are also viable, but to a lesser extent. And larvae like black soldier fly larva, common house fly (maggots), yellow meal worm etc are more environmentally friendly source of protein with rich essential amino acid profile, as they can be raised on various organic waste materials and require less water. Similarly, the spent pupae of silkworm are a major by-product of silk production which are produced in large quantities (Datta, 2007). The larvae's waste can be further used as an organic fertilizer.

Studies on insect meal supplementation in poultry feed

Bovera *et al*. (2015) observed positive effects on feed conversion ratio and European Efficiency Factor due to the use of yellow mealworm larvae (*Tenebrio molitor* L.) (TML) diet as a replacement to soyabean meal in broiler diets. Also, lowered albumin to globulin ratio suggesting a better disease resistance and immune response of birds, which might be due to the prebiotic effects of chitin.

Elangovan *et al*. (2021) included black soldier fly (BSF) prepupae meal at 5% level in broiler diet and observed similar ($P > 0.05$) body weight gain, feed intake or feed conversion ratio in chicks fed either insect meal or control diet during the experimental period and concluded that BSF at 5% is safe and can play a significant role in converting waste into feed and add to the feed basket in future.

Thus, it can be concluded that utilization of insect meal from different sources can effectively reduce poultry feed costs, if produced on a large commercial scale to replace fish and soybean meal.

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Published:**25.07.2023**