



Insects as Future Food and Feed

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The increasing global population and the rising demand for protein have intensified the search for sustainable alternatives to traditional livestock production. Insects are emerging as a promising source of food and feed due to their high nutritional value, efficient feed conversion, and low environmental footprint. Several insect species, such as the Black soldier fly larvae, crickets, silkworm pupae and mealworms are being explored for human consumption and animal feed. Insect farming is a nutrient-rich protein source but also helps in recycling waste and circular bioeconomy. This article highlights the nutritional importance, applications, benefits, challenges and future prospects of insects as food and feed.

Keywords: Edible insects, Insect protein, Black soldier fly, Sustainable agriculture, Animal feed, Food security.

Introduction

Meeting the food requirements of a growing world population is one of the greatest challenges of the twenty-first century. Traditional livestock production requires large amounts of land, water and feed, and it contributes significantly to greenhouse gas emissions. Therefore, the search for alternate and sustainable protein sources has gained increasing attention. Insects are a promising alternative due to their high nutritional value, fast growth and lower environmental footprint. Insects have long been a food source in many parts of the world, and now being acknowledged as the “food of the future” and a significant component of sustainable agriculture.

Why insects?

Insects possess several advantages over conventional livestock. They have excellent feed conversion efficiency, require less water and land, and emit significantly lower greenhouse gases. In addition, many insects can be reared on organic by-products, thereby contributing to waste management and recycling of resources.

Nutritional value of edible insects

Edible insects are good sources of proteins, lipids, essential amino acids, vitamins and minerals. Depending on the species, protein content ranges from 35 to 70 percent, making insects comparable to traditional sources of animal protein.

Table 1. Nutritional composition and major applications of selected edible insects.

Insect Species	Protein (%)	Fat (%)	Major Uses
Black Soldier Fly larvae (<i>Hermetia illucens</i>)	35–45	20–35	Poultry and fish feed
Mealworm (<i>Tenebrio molitor</i>)	45–60	25–35	Human food and animal feed
House Cricket (<i>Acheta domesticus</i>)	55–70	10–20	Protein powder and snacks
Silkworm Pupae (<i>Bombyx mori</i>)	50–60	20–30	Poultry feed, aquaculture feed, and human consumption

Major insects used as food and feed

Black soldier fly

Black Soldier Fly larvae are efficient converters of organic waste into protein-rich biomass. Their larvae are increasingly used in poultry, fish, and livestock feed industries.

Mealworms

Mealworms are very nutritious and are used in food products, snacks and feed formulations.

Crickets

Crickets are among the most widely consumed edible insects worldwide. Cricket flour is rich in protein and is used in health foods and nutritional supplements.

Silkworm pupae

Silkworm pupae, a by-product of the silk industry, contain valuable proteins and lipids and are used both as food and feed.

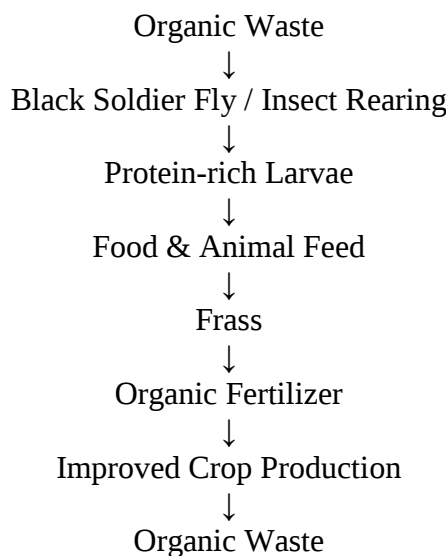


Figure: Circular bioeconomy based on insects



Figure: Common insects used as future food and feed

Table 2. Applications of insect products

Insect Product	Source Insect	Application
Black soldier fly meal	<i>Hermetia illucens</i>	Poultry, fish and livestock feed
Cricket powder	<i>Acheta domesticus</i>	Protein supplements, bakery products and health foods
Mealworm meal	<i>Tenebrio molitor</i>	Aquaculture, poultry and pet food
Silkworm pupae	<i>Bombyx mori</i>	Poultry feed, aquaculture feed and human consumption
Insect oil	Black Soldier Fly larvae	Animal nutrition and industrial applications
Insect frass	Various insects	Organic fertilizer and soil amendment
Whole dried insects	Crickets, mealworms	Snacks and human food products
Live larvae	Black Soldier Fly larvae	Feed for poultry, fish, reptiles, and pets

Environmental benefits

Insect farming offers several environmental advantages. It requires less water and land compared to conventional livestock production and generates fewer greenhouse gases. Insects can also convert agricultural wastes into valuable protein, thereby promoting circular bioeconomy and sustainable waste management.

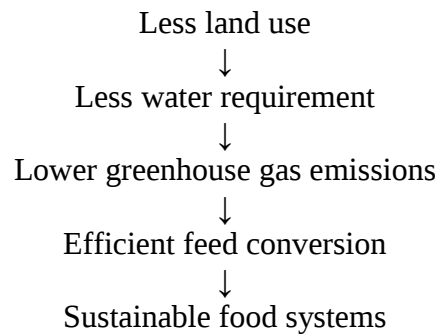


Figure: Environmental benefits of insect farming

Insects and global food security

By 2050, the world population is expected to exceed 9 billion and sustainable sources of protein will be in even greater demand. Insects can help fill the widening protein gap by providing nutritious food and feed, while using fewer natural resources. Their inclusion in agriculture can contribute to achieving the Sustainable Development Goals (SDGs), especially those related to food security, sustainable consumption and climate action.

Insects in animal feed

Insects are increasingly replacing conventional feed ingredients such as fishmeal and soybean meal. Black soldier fly larvae and mealworms are used extensively in poultry, aquaculture, pig and pet feed industries. Their inclusion improves feed efficiency and reduces dependence on expensive feed resources.

Global and Indian scenario

The edible insect industry is growing rapidly in Europe, North America and Asia. In India, insect consumption has traditionally been practiced in several North-eastern states such as Arunachal Pradesh, Nagaland, Manipur, Assam and Meghalaya have a long tradition of consuming edible insects. Research institutions and start-ups are exploring Black soldier fly technology and insect-based feed production. The growing interest in sustainable agriculture offers enormous opportunities for insect farming and entrepreneurship.

Challenges

Despite their potential, there are several challenges which hinder the widespread adoption of insects as food and feed. Constraints such as consumer acceptance, food safety concerns, lack of regulations and technologies for large-scale production are still important. Further research and policy support is needed to develop a sustainable insect based industry.

Future prospects

As the demand for sustainable protein sources increases, insects are expected to play a crucial role in the future of food systems. This emerging sector is expected to grow faster with improvements in insect farming technologies, processing and commercialisation. Insects can make a major contribution to food security, environmental sustainability and circular bioeconomy.

Conclusion

Insects offer a promising solution to the food and feed security challenges of the twenty-first century. Their high nutritional value, efficient resource utilization and lower environmental footprint make them attractive alternatives to conventional protein sources. With appropriate research, awareness and policy support, insects are poised to become an integral component of sustainable food systems and animal nutrition in the future.

References

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