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Edible Insects for a Healthier Future: Nutritional Value and Their Potential in Human and Animal Health

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As global population growth, climate alteration, resource scarcity threaten food security, malnutrition, and sustainable dietary solutions are becoming essential. In this context, consumable insects are gaining attention as an alternative source of high-quality protein, essential amino acids, healthy lipids, vitamins, minerals, and bioactive compounds for both human consumption and livestock feed. Globally, more than 2,000 insect species are known to be consumed as food. The practice of eating insects, known as entomophagy, has a long history and remains an integral part of conventional food culture of many communities, particularly in the North-Eastern region of India. In addition to their nutritional value, insects have potential to contribute to more sustainable food and feed systems through efficient resource utilization and development of innovative, value-added food products. Despite these prospective benefits, the use of edible insects on a larger scale faces several challenges, including limited consumer acceptance, food safety concerns, allergenicity, variation in nutritional values, the need for appropriate processing techniques, regulatory constraints, and difficulties associated with efficient large-scale production systems. Future research and innovation should emphasize the development of reliable safety protocols, improved processing techniques, enhanced digestibility, targeted breeding of suitable insect species, mechanized production, and affordable technologies for large-scale farming. As scientific research advances and consumer awareness increases, edible insects could play a crucial role in expanding food and feed resources, supporting nutritional security, generating new livelihood opportunities, and promoting food systems that are both ecologically sustainable and climate-resilient.

Keywords: Entomophagy, Nutritional security, Insect-based foods, Sustainable nutrition

Introduction

Accelerating population growth, climate instability, and pervasive malnutrition are placing unprecedented stress on worldwide food production network. With nearly 10 billion people expected by 2050, sustainable and nutritious food sources are essential for food security (Habib et al., 2025). Traditional livestock farming requires substantial amounts of land, freshwater, feed inputs, and other natural resources, while also contributing to greenhouse gas emissions. These environmental and resource-related constraints have encouraged researchers

to seek sustainable, nutrient-rich and resource-efficient alternatives for future agro-food production (Behera et al., 2026). In this context, edible insects are gaining recognition as a viable option because of their high nutritional content, efficient use of natural resources, and wide-ranging utility in both human and farm animal nutrition.Across the world, more than 2,000 insect species are recognized as edible and are traditionally consumed in several regions such as Africa, Asia, Latin America, and Oceania. The traditional consumption of insects, known as entomophagy, has deep-rooted cultural significan ce and continues to be an important traditional practice among several communities across North-East India (Jiménez-Pichardo et al. (2025). Edible insects such as beetle larvae, caterpillars, ants, bees, wasps, crickets, grasshoppers, and locusts are highly nutritious and contain health-promoting bioactive constituents (Nachtigall et al., 2025; Figure 1). The nutritional value of edible insects varies significantly across species and developmental phases, although many species provide substantial level of protein similar to those found in conventional livestock sources (Gogoi et al., 2022). Insect-based ingredients are also gaining attention as feed components for poultry, farm livestock, aquaculture, and pets, creating new pathways toward sustainable nutrition and more resilient food systems.

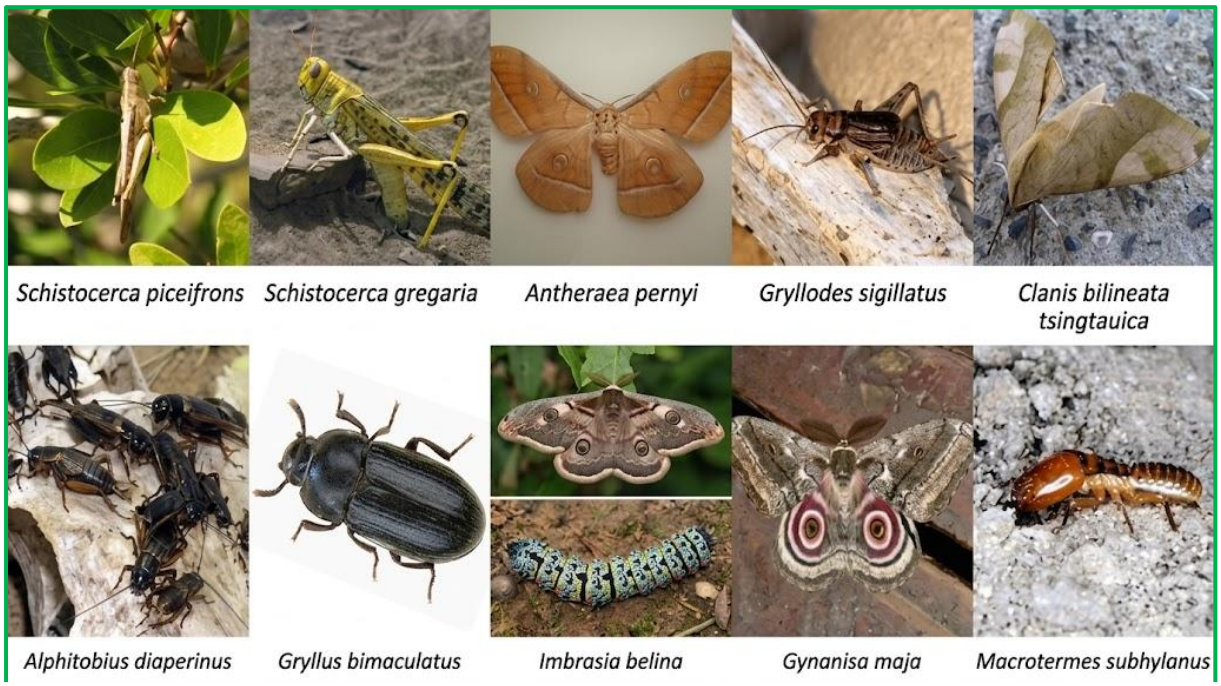

Figure 1: Diversity of Edible Insects Consumed as Food and feed. Image generated using artificial intelligence (AI) for illustrative purposes.

Nutritional Values of Edible Insects

Consumable insects are emerging as a promising alternative source of nutrients for both human and animal diets, offering high-quality proteins, essential amino acids, beneficial lipids, vitamins, minerals, and several bioactive compounds (Pérez-Ramírez et al., 2019; Table 1). In the context of human nutrition, insect-derived foods can contribute to greater dietary diversity by supplying important micronutrients nutrients including iron, zinc, vitamin B12, along with beneficial unsaturated fatty acids (Bbosa et al., 2025). In animal feeding systems, insect-based meals are being explored as partial alternative protein ingredients that can relatively replace conventional sources such as soybean-based food and fishmeal in poultry and aquaculture diets. The relatively high protein content of several edible insect species, compared with conventional meat sources (Jiménez-Pichardo et al., 2025; Table 2). Nevertheless, the nutritional composition and feed efficacy of insects are affected by several factors such as insect species, life stage, processing techniques, dietary inclusion rate, and the nutritional needs of the target animal. Consequently, careful feed formulation, suitable processing practices, and comprehensive safety assessment are necessary to ensure their efficient and sustainable use in food and feed systems.

Table 1 Nutritional Composition of 10 important consumable Insect Species

Scientific Name	Protein (%)	Fat (%)	Ash (%)	Fiber (%)	Refrences
Schistocerca piceifrons	80.26	6.21	3.25	12.56	Pérez-Ramírez et al. (2019)
Schidtocerca gregaria	71.90	20.10	4.00	NA	Zielińska et al. (2015)
Antheraea pernyi	70.00	18.23	4.74	3.65	Zhou eta l. (2006)
Gryllodes sigillatus	65.50	23.68	2.17	3.77	Zielińska et al. (2015)
Clanis bilineata tsingtauica	58.32	11.88	9.69	9.53	Gao et al. (2021)
Alphitobius diaperinus	58.76	25.90	3.50	6.08	Turck et al. (2022)
Gryllus bimaculatus	56.80	12.90	10.40	NA	Ghosh et al. (2017)
Imbrasia belina	55.92	12.10	7.40	NA	Siulapwa et al. (2014)
Gynanisa maja	52.74	6.36	6.41	NA	Vanqa et al. (2022)
Macrotermes subhylanus	48.70	38.10	2.30	8.80	Turck et al. (2022)

Table 2: Protein Content of Selected Edible Insects and Conventional Meat Sources

Insect/Meat Type	Protein Content (%)	Reference
Cockroaches	57.30–76.00	Rumpold & Schlüter (2013); Jiménez-Pichardo et al. (2025)
Cicadas	53.00–64.00	Jiménez-Pichardo et al. (2025)
Ants	40.83–66.00	Jiménez-Pichardo et al. (2025)
Wasps	38.24–70.00	Jiménez-Pichardo et al. (2025)
Moths	30.88–76.00	Jiménez-Pichardo et al. (2025)
Grasshoppers	26.80–77.95	Jiménez-Pichardo et al. (2025)
Chicken	22.2 (fresh), 54.70 (dry basis)	Rumpold & Schlüter (2013); Jiménez-Pichardo et al. (2025)
Beef	22.50 (fresh), 40.50 (dry basis)	Rumpold & Schlüter (2013); Jiménez-Pichardo et al. (2025)
Pork	21.00 (fresh), 27.70 (dry basis)	Rumpold & Schlüter (2013); Jiménez-Pichardo et al. (2025)

Role of Edible insects in Human and Animal health

Ingestible insects may contribute to animal health by providing needful nutrients and bioactive compounds that can influence growth, feed utilization, gut health, intestinal integrity, immune responses, and overall performance, along with potential antioxidant and antimicrobial activities (**Choudhury et al., 2025).** These compounds may also exhibit various beneficial biological activities, including antioxidant, antibacterial, antiviral, anti-inflammatory, and anticancer effects, as well as potential roles in regulating blood glucose and lipid levels, reducing blood pressure, and promoting hair growth (Zhou et al., 2022; Table 3).

Table 3. Major nutritional components of edible insects and their potential importance in human and animal health

Nutritional component	Key benefits
Carbohydrates	Provide energy and may support gut health through fibre-like properties.
Protein	Supplies amino acids that support growth, tissue repair, enzymes and vital physiological functions
Essential amino acids	Elevates protein synthesis and healthy body development.
Healthy lipids	Provides energy and beneficial unsaturated fatty acids.
Iron	Essential for haemoglobin synthesis and oxygen transport
Zinc	Supports immune function, growth and metabolism
Vitamin B12	Essential for blood formation and neurological function
Minerals	Calcium, magnesium, phosphorus, potassium and other minerals may contribute to dietary requirements
Bioactive compounds	Possess antioxidant, antimicrobial, and other bioactive properties.

Edible insects in Food Safety and Sustainability

Insect-based foods offer valuable nutritional and environmental benefits when produced safely and sustainable conditions. Ensuring reliable species identification, hygienic rearing practices, proper cooking, control of contaminants, safe storage, and appropriate allergen marking are important to ensure their safety for consumption (Habib et al., 2025). The sustainability of insect production is influenced by feed sources, efficient energy use, processing, transportation, and waste management (Behera et al., 2026). Although insects can be produced with relatively efficient use of resources, their overall environmental advantages vary depending on the production system and management practices used.

Edible Insects in the Indian Context

India has a long history of entomophagy, especially in North-Eastern states of India, including Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, several insect species are consumed as seasonal delicacies and are closely associated with local food culture and customs **(Gogoi et al., 2022).** Scientific research can play an important role in documenting this traditional knowledge, assessing the nutritional potential of edible insects with advance technology, ensuring their safety through improved processing methods and promoting the development of innovative insect-based food products (Rumpold & Schlüter (2013). Such efforts could also bring opportunities for sustainable income and livelihood generation in local communities. However, allergenicity, nutritional variability, and food safety require careful attention for wider acceptance.

Challenges and Future Prospects

Recognizing their nutritional and environmental potential, edible insects face numerous challenges such as consumer acceptance, food safety, allergenicity, nutritional variation, processing, regulatory requirements, and large-scale production. Future research should emphasize standardized safety measures, better digestibility, selective breeding, automation, and affordable processing technologies. Developing products such as protein powders, insect flours, functional foods, and animal feeds through multidisciplinary research could help establish safe, efficient, and sustainable insect-derived food systems.

Conclusion

Eatable insects have considerable potential to improve nutritional security while supporting more sustainable food and feed systems. Their high-quality nutrients, efficient resource utilization, and associated health benefits make them valuable alternatives to conventional protein sources. In India, particularly across North-Eastern region, traditional insect consumption provides a strong foundation for further development. Research and technological innovation can help address concerns related to food safety, allergenicity, consumer acceptance, processing, and regulation, thereby supporting the safe and sustainable use of **insect-based foods.**

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