

Edible Insects: The Future of Food for Humans and Domestic Animals

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In a world grappling with climate change, shrinking agricultural resources, and an ever-growing population, the humble insect is finding its way from the wild and farm fields onto dinner plates and into animal feed troughs. While the idea may seem novel—if not unsettling—to some, for many cultures, eating insects is a tradition as old as humanity itself and now, more than ever, entomophagy (the practice of eating insects) is gaining ground as a sustainable solution for food and feed worldwide (Ordoñez et al., 2021)

Why Are Insects Becoming Popular As Food?

Global protein demands are soaring. Livestock farming—while vital—demands vast tracts of land, copious water, and generates significant greenhouse gases. Insects, by contrast, require far less space, reproduce rapidly, and can be farmed on organic wastes, converting them into high-value proteins and nutrients (Bessa, et al., 2018). This eco-friendly model is especially appealing in developing regions where food security is precarious, but it also attracts the attention of sustainability-minded consumers and policymakers in developed economies.

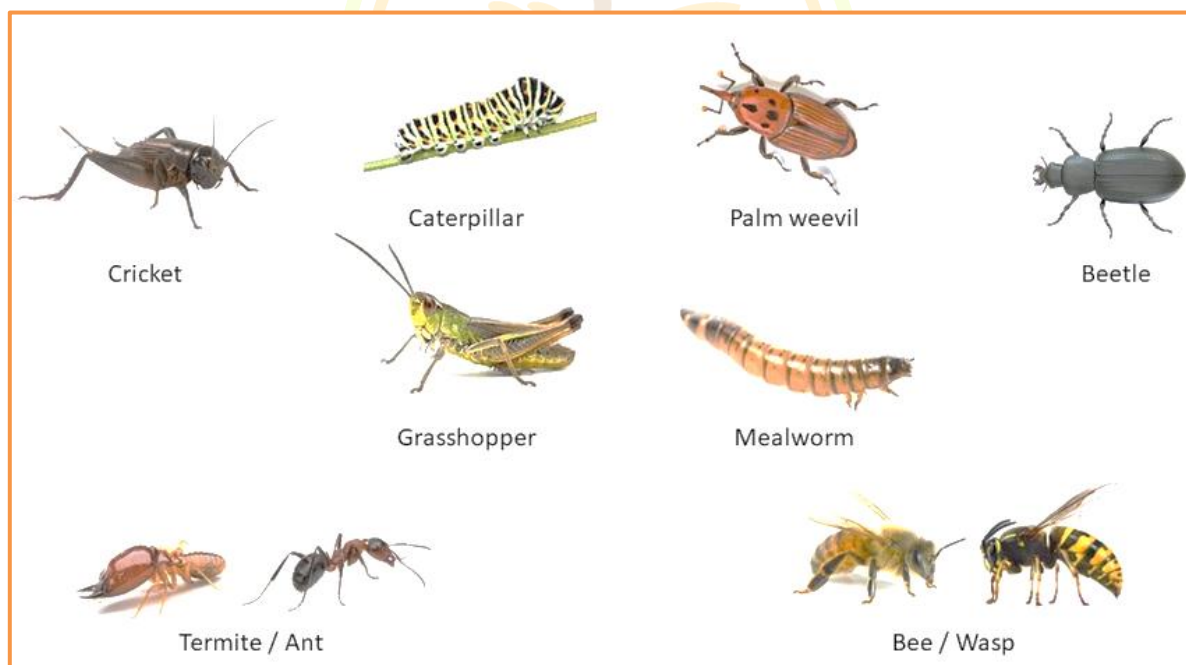


Fig1: Commonly used insects as edible food.

Why Insects? Unpacking the Nutritional Powerhouse

Nutrient Profile: Edible insects are nutritional all-stars. Their content includes:

- **Proteins:** Typically, between 20–70% by dry weight, with a high proportion of essential amino acids that are digestible and often exceed those found in milk casein or plant sources.

- **Fats:** Ranging from 10–50%, including heart-healthy mono- and polyunsaturated fats, and essential omega-3 and omega-6 fatty acids.
- **Minerals:** High concentrations of iron, zinc, calcium, copper, manganese, and B-complex vitamins make insects valuable as micronutrient sources.
- **Fiber:** Unlike other animal-based proteins, insects contain chitin, an indigestible fiber with antimicrobial and cholesterol-lowering properties.
- **Bioactive Compounds:** Phenolic compounds, flavonoids, and functional peptides, which may enhance immune function and protect against chronic diseases, are also present.

This nutrient richness suggests that, for both humans and animals, integrating insects into the diet could fill critical gaps—especially in regions struggling with protein and micronutrient deficiencies (Van Huis *et al.* 2013 & Aidoo *et al.* 2023)

Environmental Boon: How Insects Outperform Conventional Livestock

- **Feed Efficiency:** Insects convert feed into body mass much more efficiently than most traditional livestock, needing less land, water, and energy.
- **Lower Emissions:** Compared to cattle, pigs, and chickens, insect farming produces negligible greenhouse gas emissions and less environmental contamination.
- **Waste Conversion:** Insects can thrive on organic waste or agricultural by-products, turning low-value matter into high-quality protein and reducing pressure on landfills and resources.
- **Resource Utilization:** Edible insects require a fraction of the land and water needed for conventional animal farming, contributing to a reduced environmental footprint.

Human Nutrition: A Closer Look

Meeting Protein Needs

Crickets, grasshoppers, mealworms, and beetle larvae often provide all essential amino acids. The protein efficiency ratios and biological value of insect proteins not only match but sometimes surpass that of dairy and conventional meat.

Enhancing Diets

This is especially true for populations relying heavily on plant staples, who may lack sufficient lysine, methionine, or tryptophan. For example, termites and palm weevil larvae, common in parts of Africa and Asia, can significantly upgrade the protein quality and diversity of regional diets.

Disease Prevention & Health Benefits

Emerging research shows edible insects may provide: Immune enhancement, Gut health support, Antioxidant and anti-inflammatory properties and Potential protection against cardiovascular diseases, diabetes, and cancer. Traditional medicine has, for centuries, also utilized insects therapeutically for wound healing and treatment of respiratory and digestive disorders.

Changing the Menu: From Ancient Practice to Modern Plates

Deep-Rooted Traditions: Over 2 billion people already consume insects regularly, with traditions especially strong in Africa, Asia, and Latin America. Locusts, grasshoppers, mopane worms, and silkworm pupae remain staples from Mexico to Thailand, and are considered culinary delicacies in many settings.

Western Adoption

While Western cultures historically shunned insect foods due to aesthetics or cultural inertia, attitudes are shifting as gourmet chefs and health-oriented consumers experiment with cricket flour, protein bars, snacks, and even high-end gourmet dishes.

Disguised and Gourmet Applications

- **Powdered or ground insects** are easy to incorporate into baked goods, snacks, and protein supplements, offering a familiar texture or flavor profile.
- **Whole insects** may appear in traditional or fusion cuisine, often roasted or fried to a satisfying crunch.

Feeding Domestic Animals: Protein Boost for Pets and Livestock

- **Chickens and Poultry:** Black soldier fly larvae, mealworms, and grasshoppers can substitute for fishmeal or soy in poultry diets, maintaining or improving growth, feed efficiency, and product quality.
- **Egg Production:** Chickens fed with mealworm meal rather than fishmeal showed increased egg laying.
- **Fish Farming:** For aquaculture, especially in Asia and Africa, black soldier fly meal and mealworms can fully or partially replace fish or soybean meal, sustaining healthy and productive livestock.
- **Pigs and Other Livestock:** Black soldier fly larvae and cricket meal are viable alternatives to traditional feeds, proving palatable and nutritionally adequate for piglets and other livestock.

Advantages for Animal Agriculture

- **Lower Cost:** Insect-based feeds can be produced economically, enabling producers to reduce reliance on expensive feed sources.
- **No Adverse Effects:** Numerous studies confirm no detriment to animal health, taste, odor, texture, or nutritional quality in meat, eggs, or fish.
- **Consumer Preference:** Some trials even suggest that chickens fed diets including grasshoppers yield meat with improved flavor.

Functional and Medicinal Benefits

The consumption of insects doesn't just sustain; it also supports health in unique ways. Peptides and other bioactive compounds derived from insect proteins exert several functional effects:

- Cholesterol-lowering effects via chitin and its derivatives.
- Antioxidant activity thanks to the presence of flavonoids and phenolics.
- Immune modulation shown in experimental studies.
- Promotion of gut health through dietary fiber (chitin) and effects on the microbiome.

Safety, Acceptance, and Current Challenges:

Food Safety and Risks

- **Allergens:** Insects can trigger allergic reactions, particularly in individuals with shellfish allergies, since both groups share similar proteins.
- **Pathogens:** As with all animal foods, proper farming and processing are paramount to minimize disease risks.
- **Bioaccumulation:** Insects raised on contaminated substrates may accumulate toxins, highlighting the need for regulation and food safety protocols.

Social and Cultural Acceptance

- **Overcoming the “yuck” factor:** In cultures unaccustomed to eating insects, acceptance remains a challenge. Strategies include marketing, product innovation, education, and integrating insects into familiar foods (pastas, breads, protein powders).
- **Policy and Regulation:** Many countries are developing or adapting food safety and labeling regulations specific to edible insect products, building consumer trust and industry standards.

The Sustainability Equation: Are Insects the Ultimate Green Protein?

When it comes to efficiency, versatility, and environmental impact, insects outshine almost every other protein source:

Criteria	Insects	Conventional Livestock
Protein content	20–70%	15–30%
Essential amino acids	All, highly bioavailable	All, variable
Land/water use	Minimal	High
Feed conversion efficiency	Excellent (high)	Moderate to low

Greenhouse gas emissions	Very low	High
Waste reduction	Feed on organic waste	Require high-quality feed
Edible fraction	Up to 80–100%	40–55%(meat, fish yield)

Future opportunities

Insects in the Global Food System given their proven nutritional benefits and unmatched sustainability profile, **insects are poised to play a crucial role as both food and feed** in the coming decades:

- **Food Security:** Insect farming offers a productive solution to address hunger and nutrient deficiencies, particularly where resources are limited or climate poses challenges to conventional agriculture.
- **Economic Opportunity:** From smallholder insect farms in Africa to state-of-the-art insect protein factories in Europe and Asia, the sector creates livelihoods and can empower communities.
- **Research and Innovation:** Advances continue in breeding, processing, and formulating insect-based products that appeal to mainstream consumers and optimize nutritional value.

Conclusion

Edible insects are much more than a novelty—they are a critical resource for human and animal nutrition, environmental conservation, and food security. With substantial protein, healthy fats, vitamins, minerals, and unique functional compounds, they can diversify diets and fortify existing foods. Moreover, their high feed conversion, minimal resource needs, and capacity to recycle waste make them a linchpin in building a more sustainable agricultural system. As science, tradition, and technology come together, eating insects isn't just a nod to the dietary wisdom of our ancestors—it's a smart strategy for feeding the future while protecting the planet. For both humans and animals, the age of the edible insect has truly arrived.

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