



Bugs on the Menu: Embracing Entomophagy for Food Security

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Food security is defined as a situation where all people, regardless of their physical, social or economic circumstances, have access to enough, safe and healthy food that satisfies their needs and preferences for a healthy and active life. It encompasses both the availability and accessibility of food, as well as the utilization and stability of food supply for a given population. But the continuous growth of the human population poses a threat to food security as it creates a disparity between the production of food and meeting nutritional needs. It is estimated that the current population of 1.4 billion would reach 1.8 billion by 2050. Food security has become a significant issue in India. According to UN-India, the country has approximately 195 million undernourished individuals, constituting a quarter of the world's hunger-affected population. Moreover, about 43% of children in India suffer from chronic undernourishment. In the Food Security Index of 2022, India ranks 68 out of 113 major countries. Despite meeting 100% of the required nutritional standard, the country falls short in terms of quality protein intake, which stands at only 20%. Addressing this deficiency requires the availability of protein-rich food products in the market. Due to the growing scarcity of resources, various alternative food products have been suggested, with insects gaining significant attention. The escalating interest in edible insects forms part of a comprehensive approach towards attaining global food security. Insects, in general, are known for their elevated protein content and exceptional production efficiency when compared to traditional food sources. These attributes hold particular significance as the demand for protein is projected to rise in the future, while food supplies are anticipated to decrease.

The term entomophagy refers to the practice of consuming insects as food for humans. Entomophagy is a widespread practice globally, but it is particularly prevalent in tropical regions, where over 2,000 distinct insect species are known to be consumed. Most species of insects that are eaten by humans falls within the following taxonomic groups: Coleoptera (beetles), Lepidoptera (moths and butterflies), Hymenoptera (wasps, bees and ants), Orthoptera (crickets, grasshoppers and locusts), Hemiptera (true bugs), Isoptera (termites), Odonata (dragonflies) and Diptera (flies). The larval stages of the insects are preferred for consumption the most, for example, from Lepidoptera, majority of the species are consumed in the form of caterpillars rather than butterflies.

Entomophagy's prevalence is influenced by various factors such as insect palatability, taste, availability, nutritional value, local traditions, religious customs, and food taboos. While insects offer ecological benefits and a reliable source of nutritious food for resource-poor families, insect-based foods may not be universally embraced or deemed acceptable in all regions. It is mostly practiced by tribal communities in the states of Kerala, Orissa, Jharkhand, Karnataka, Tamil Nadu, Chhatisgarh, Madhya Pradesh and North East India.

Importance of Insects as a Source of Food

Edible insects hold significant importance as a food source for several reasons:

- **Nutritional Value:** Insects are rich in essential nutrients such as proteins, healthy fats, vitamins, and minerals. They often provide a more balanced and complete nutritional profile compared to conventional meat sources.
- **High Protein Content:** Many insect species contain a high percentage of protein, making them an excellent alternative protein source, which is especially crucial as the global demand for protein increases.
- **Environmental Sustainability:** Insects have a much lower environmental impact compared to traditional livestock. They require less water, land, and feed to produce the same amount of protein, and their farming generates fewer greenhouse gas emissions.
- **Resource Efficiency:** Insects can be raised on organic waste materials, contributing to waste reduction and resource recycling, which promotes a more circular and sustainable food system.
- **Biodiversity and Ecology:** Promoting the consumption of a wide range of insect species helps preserve biodiversity and ecological balance, as insects play vital roles in various ecosystems.
- **Food Security:** Incorporating edible insects into diets can enhance food security, especially in regions facing challenges of malnutrition and food shortages, as they offer a readily available and nutritious food source.
- **Livelihood Opportunities:** Insect farming and the edible insect industry can provide new economic opportunities, particularly for marginalized communities, potentially improving their livelihoods.
- **Climate Resilience:** Insects' ability to thrive in diverse environmental conditions makes them a more resilient food source in the face of climate change and its impacts on traditional agriculture.
- **Versatility:** Insects can be consumed in various forms, such as whole, powdered, or processed into food products, offering versatility and adaptability to different culinary preferences.
- **Innovation and Culinary Diversity:** Embracing entomophagy encourages culinary innovation, introducing new flavors and food experiences, which can enrich global gastronomy.

Edible Insect Fauna of India

Over 2000 insect species belonging to 18 orders are seen to be consumed worldwide. Chakravorty *et al.* documented a total of 298 edible insects from various orders, with the majority belonging to coleoptera (34%), followed by orthoptera (24%), hemiptera (17%), hymenoptera (10%), odonata (8%), lepidoptera (4%), isoptera (2%), and ephemeroptera (1%). In terms of insect diversity in different regions, Arunachal Pradesh had the highest number of species with 158, while Manipur and Nagaland each had 41 species. Assam had 38 species, Meghalaya had 16 species, Kerala had 5 species, and Karnataka, Tamil Nadu, Odisha, and Madhya Pradesh each had only 1 species. According to two separate surveys, indigenous communities in the North East region have a preference for coleopteran insects as a source of entomophagy. The first survey, conducted in Assam by Ronghang and Ahmed, involved the sampling of 30 insect species. Among these, 36.6% were coleoptera, 23.3% were hymenoptera, and the lowest proportion was found in isoptera at 3.3%.

In the second survey conducted by Chakravorty *et al.* in Arunachal Pradesh, they studied 81 insect species. In this area, Coleoptera had the most insects, with 29.6%, followed by Orthoptera with 20.9% and Hemiptera with 19.7%. The smallest number of species (11.1%) belonged to Odonata. It's worth noting that Chakravorty *et al.* did not include species

from Isoptera and Lepidoptera, which are two significant orders of edible insects. Additionally, the survey listed some unidentified insects in the overall inventory of species studied. Moreover, Chakravorty *et al.* observed that the Nyishi tribe in Arunachal Pradesh primarily consumed Coleoptera and Hemiptera insects, while the Galo tribe preferred insects from the Odonata and Orthoptera orders. In a survey conducted in Manipur state by Devi *et al.*, they discovered 31 edible aquatic insects, with the highest number (14 species) belonging to the Hemiptera order. In the Changlong district of Arunachal Pradesh, Chakravorty *et al.* collected 51 insect species from 9 different orders, which were consumed by the local population.

In both Arunachal Pradesh and Manipur, the Adi and Meitei tribes included insects from orders such as Hymenoptera, Hemiptera, Orthoptera, Odonata, and Coleoptera in their diet. Similarly, in another study conducted by Ranjit Singh and Padmalatha, they investigated ethno-entomological practices in the Tirunelveli district of Tamil Nadu and reported 11 edible insect species being consumed.

Some Common Edible Insect Species

- Crickets: Adult crickets can be a good source of iron, protein and vitamin B₁₂. They are generally ground into a powder that is added to protein shakes and flour. A brand of cricket chips flour is already available in America.
- Grasshoppers: These are high in protein and very popular in Mexico, Latin America and parts of Africa and Asia. They are in very high demand in Uganda that they cost more per kilogram than beef. In Mexico they are typically served toasted in oil with garlic, lemon and salt.
- Termites: They are rich in proteins, fatty acids and other micronutrients and also have iron and calcium. They are served smoked, fried or sun-dried.
- Ants: The larvae and pupae of weaver ant are in high demand in Asia. It is a good source of protein and have a lemony, citrusy flavour.
- Bees: The larvae is normally used as food. They are high in amino acids, B vitamins and other nutrients. They are generally said to have a buttery kind of fatty texture. Stingless bees are a traditional source of sugar in Thailand and are also used by Australian aborigines.
- Beetles: The adult *H. parallela* is rich in proteins, vitamins and minerals. They can be dry roasted, or used in recipes with the head, arms and legs removed.
- Mealworms: These insects have a lot of omega-3-fatty acids, proteins, vitamins and minerals like copper, sodium, potassium, iron, zinc and selenium. They can be eaten raw but are most often served dry-roasted or ground up and added to flour.
- Flies: Protein-rich flies are ground and used to enrich baked goods such as crackers, muffins, sausages, and meatloaf in African countries. They can also be roasted or dried in the sun.
- Caterpillars: In parts of Africa, nearly 9.5 billion of these are harvested each year. These are rich source of protein specially during rainy season. These are also popular in Asia and Mexico, and the most common way to serve them is fried or braised, seasoned with a spicy sauce, and wrapped in a tortilla. These are also found at the bottom of a bottle of mescal tequila.
- Stink Bugs: These are rich in fatty acids, flavonoids and amino acids. They are also rich in minerals like iron, potassium and phosphorus. In Southern Africa, they are soaked in lukewarm water to release their toxins, then sundried, washed and cooked in warm water and salt.

- Giant Water Bug: They are generally popular in Thailand. They can be eaten whole or crushed, ground and added to chili paste. This mixture is known as *jaew maeng da* in Laos and *nam phik* in Thailand.

Some Methods of Consuming Edible Insects

- Raw: In some cultures, certain types of edible insects are consumed raw, particularly small insects like ants, termites, or some beetle larvae. They might be eaten as they are or mixed with other foods.
- Roasted: Roasting is one of the most popular methods of preparing edible insects. Insects are often roasted over an open flame, on a grill, or in an oven until they become crispy and crunchy. This method enhances the flavor and texture, making them more appetizing.
- Fried: Edible insects can be deep-fried or pan-fried in oil, giving them a crispy and savory taste. Fried insects are commonly seasoned with spices, salt, or other flavorings to enhance their taste.
- Boiled or steamed: Larger insects or larvae can be boiled or steamed until they are fully cooked and tender. This method is commonly used for larger insects like grasshoppers or mealworms.
- Ground into powder or paste: In some cases, edible insects are ground into a fine powder or paste and used as an ingredient in various dishes or added to flour to make insect-based products like bread or pasta.
- Incorporated into dishes: Edible insects can be used as an ingredient in various recipes, such as soups, stews, salads, or even mixed with other foods like rice or vegetables.
- Flavored or seasoned: To make them more appealing, edible insects are often flavored or seasoned with herbs, spices, or sauces, just like any other food.

Nutritional Benefits from Entomophagy

- Protein: Insects are excellent sources of protein. Their protein content can range from 30% to over 80% of their dry weight, making them comparable or even superior to traditional sources of protein like meat, fish, and legumes. The protein in insects is also considered of high biological value, containing all the essential amino acids required by the human body.
- Fats: Insects contain varying amounts of fats, which can include both saturated and unsaturated fats. Some insects, such as mealworms and waxworms, are particularly rich in fats and can provide essential fatty acids like omega-3 and omega-6.
- Micronutrients: Edible insects are good sources of essential vitamins and minerals. They can contain significant amounts of B-vitamins (e.g., B₁, B₂, B₃, B₅, B₆, and B₁₂), iron, calcium, zinc, magnesium, phosphorus, and potassium.
- Fiber: Insects can provide dietary fiber, which is beneficial for gut health and digestion.
- Chitin: It is a structural polysaccharide that is found in exoskeleton of insects. While it is not a nutrient, it has potential health benefits, such as aiding in cholesterol management and promoting gut health.
- Antioxidants: Some edible insects contain antioxidants, such as carotenoids and polyphenols, which help protect cells from oxidative stress.
- Mineral Content: Edible insects can contain essential minerals like selenium, copper, manganese, and others that are crucial for various biological functions.

Why Promote Entomophagy?

Entomophagy can be promoted for three reasons:

- Health:
 - Insects are healthy alternatives to chicken, pork, beef and even fish
 - Nutritious
 - They are already a part of many regional and national diets

- Environmental:
 - Emit few greenhouse gases when promoted as food
 - Rearing of insects is not a land based activity
 - Ammonia emission from rearing insects is less as compared to conventional livestock such as pigs
 - Insects are efficient at converting feed into proteins as they are cold-blooded
 - One can feed insects with organic waste streams
- Livelihoods(economic and social factor):
 - Insect rearing is low capital investment option,hence economical for the poorer section of the society
 - Minilivestock provides livelihood opportunities for both urban and rural people.

Food Safety and Preservation

The processing and storage of insects and their products should adhere to the same health and sanitation standards applied to other conventional food or feed items. This is crucial to guarantee food safety. Due to their unique biological composition, several factors must be taken into account, including microbial safety, toxicity, palatability, and the presence of inorganic compounds.

In addition, when feed insects are bred on waste materials such as manure or abattoir waste, there are additional health factors that come into play. While there is limited evidence of allergies resulting from the consumption of insects, cases of allergic reactions to arthropods have been reported. Although conclusive evidence of allergies caused specifically by insect consumption is currently lacking, it remains an area of concern that merits attention.

Conclusion

In conclusion, embracing entomophagy, the practice of consuming insects as food, presents a promising solution to address food security challenges. Bugs on the menu can play a crucial role in providing a sustainable and nutritious food source for a growing global population. Edible insects offer high-quality protein, essential nutrients, and a low environmental impact, making them an attractive alternative to traditional livestock and plant-based proteins.

To fully harness the potential of edible insects for food security, it is essential to overcome cultural barriers and regulatory challenges. Public awareness and education campaigns can help change perceptions and promote the inclusion of insects in mainstream diets. Moreover, establishing proper processing and storage practices following health and sanitation regulations is imperative to ensure food safety.

By leveraging the nutritional and environmental benefits of edible insects, we can create income-generating opportunities, promote biodiversity, and improve resilience against climate-related food crises. Integrating entomophagy into our culinary traditions can not only enhance our cultural heritage but also contribute to building a more sustainable and secure food future for all. Embracing bugs on the menu is a step towards ensuring food security and fostering a more resilient, healthier, and equitable global food system.

References

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