# Role of Insects as a Potential Source of Nutrients in Human Diet

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**ABSTRACT**

Insects have emerged as a promising source of nutrition for humans, offering a sustainable and nutrient-rich alternative to traditional protein sources. Rich in protein, healthy fats, vitamins (such as B vitamins), minerals (like iron and zinc), and dietary fiber, they provide a well-rounded nutritional profile. Beyond their nutritional benefits, insects require significantly fewer resources—land, water, and feed—compared to conventional livestock, making them environmentally sustainable. Consuming insects has been a longstanding human practice, yet remains stigmatized or taboo in certain cultures. Compared to conventional livestock, insect farming requires minimal land, water, and feed inputs, thereby reducing environmental footprint. Their cultivation emits significantly fewer greenhouse gases and contributes less to deforestation, aligning with sustainability goals. This efficiency makes insects particularly attractive in regions where agricultural resources are limited or climate challenges threaten food security.

## INTRODUCTION

The world's population is predicted to approach or surpass 9 billion people by 2050, and this will result in a 70% increase in the demand for food, feed, and fibre worldwide. This problem is made worse by the way that industrial and urban development are encroaching on some of the most productive arable land, and by the growing rivalry between urban settlements and food production systems for fresh water resources. The dual assaults by urbanisation and food production on natural habitats and

the biodiversity they support represent another source of conflict. And finally, even if greenhouse gas production mitigation is successful in the near future, food production systems will still need to adjust to the effects of global climate change. In summary, in order to preserve valuable freshwater resources, food producers will have to raise their output per unit of land. Therefore, it is imperative to develop alternatives to conventional livestock and feed sources. Because of this, insects have a lot of potential as food and feed in the future food systems, and they're also good for the environment. Increasing the use of insects as a sustainable source of animal protein has several advantages. Protein, vitamins, and minerals are often abundant in insects. In comparison to their vertebrate counterparts in traditional husbandry, they are incredibly efficient at converting ingested matter into biomass, emitting fewer greenhouse gases, requiring less water, and having a lower impact on resources and the environment. For this reason, eating insects is good for both the environment and human health.

Over two billion people worldwide have historically engaged in the practice of entomophagy, or the consumption of insects. Of these, an estimated 524 insect species are consumed in Africa, 349 in Asia, 679 in the Americas, 152 in Australia, and just 41 in Europe (Jongema 2015). The most widely consumed insects worldwide are those that are easily obtained, such as termites (Isoptera: 3%), dragonflies (Odonata: 3%), flies (Diptera: 2%), cicadas, leafhoppers, planthoppers, scale insects, and true bugs (Hemiptera: 10%), beetles (Coleoptera: 31%), caterpillars (Lepidoptera: 18%), bees, wasps, and ants (Hymenoptera: 14%), grasshoppers, locusts, and crickets (Orthoptera: 13%), cicadas, leafhoppers, and planthoppers, scale insects, and true bugs (Hemiptera: 10%), flies (Diptera: 2%), and others (5%)(Van Huis *et al*., 2013).In various regions globally, insects are consumed either raw or incorporated into diverse products, ranging from salads to cookies. There has been a significant rise in tourist interest in consuming insect-based foods like moths and larvae, although certain delicacies like rice field grasshoppers, known as "*inago*" in Japan, are considered luxurious. They are also consumed in salads and used for production of protein powders. In Mexico, insects have been a part of rural diets since ancient times, but there is now increasing demand in urban areas and upscale restaurants, where they are served in spreads, soups, fillings, and a variety of stews. However, it's crucial to consider that their nutritional content can vary due to factors such as temperature during preparation. The large-scale cultivation of insects for their high protein content, intended initially for animal consumption, ultimately contributes to protein production for human consumption.

**Nutritional value of insects**

Most insect species contain abundant proteins, fatty acids, vitamins, fibres, and minerals. They serve as a valuable alternative source of high-quality proteins and nutrients, benefiting not only developing nations but also populations in developed countries. The nutritional profile of insects can vary depending on how they are prepared (boiled, fried, baked, dried) before consumption. Despite these variations, insects remain a critically important food source for human consumption across many regions worldwide. Insects are not just nutritious and delicious; they also offer an environmentally sustainable protein source. Some of the essential nutrients found in insects are as follows:

1. **Protein:** Proteins are key nutrients that supply both essential and nonessential amino acids. Essential amino acids (EAAs) must be obtained through diet because the human body cannot produce

them on its own. Certain insects like termites, grasshoppers, caterpillars, weevils, and houseflies provide higher amounts of protein per unit weight compared to beef, pork, chicken, and lamb (Srivastava *et al*., 2009). The protein content of insects plays a crucial role in assessing their significance in entomophagy. Worldwide, edible insects, particularly those belonging to the Orthoptera order such as grasshoppers, crickets, and locusts, are highly protein-rich and offer a valuable alternative source of protein. When compared to casein and soy, the availability and digestibility of insect protein is promising; however, the quality varies and can be enhanced through chitin removal. More investigation into the quality of insect proteins is necessary before considering them as a substitute source of protein. This covers the edible insects' amino acid profiles and their suitability for human consumption.

2. **Amino acids:** Similar to proteins, the amino acid composition of edible insects varies significantly across different species and orders. A study analyzing nearly a hundred edible insect species found that essential amino acids (EAAs) make up between 46% and 96% of the total amino acid content (Xiaoming *et al*., 2010). In various insect species such as *Tenebrio molitor*, *Glyptotendipes testaceus*, and orthopterans, significant levels of amino acids like isoleucine, leucine, phenylalanine, tyrosine, and glycine are present. Tryptophan and lysine deficiencies are common in some African nations (Angola, Kenya, Nigeria, and Zimbabwe), where maize is a staple crop. These people occasionally add termite species, like *Macrotermes bellicosus* (Angola), to their diets to help with these deficiencies. The significant potential of insects as an alternative protein source is evident when compared to plant-based protein sources.

3. **Fats:** When compared to meat, certain insects have higher concentrations of important fatty acids, such as linoleic and/or linolenic acids. Larvae generally have higher fat content compared to adults. Caterpillars and termites are particularly noted for their higher fat content. The amount of palmitic acid is likewise comparatively high. The combined percentage of oleic, linoleic, and linolenic acid in the field cricket (*G. testaceus*) was 77.5% (Wang *et al*., 2004). As an instance, the ideal Omega 3:6 balance is found in crickets. Termites have a 49% dry matter fat content and are high in oleic acid (48%) and palmitic acid (30%). Insects often contain essential linoleic and α-linolenic acids and are rich in polyunsaturated fatty acids. The fat content of edible grasshoppers (*R. differens*) is 67% dry matter and comprises 46% oleic acid, 28% palmitoleic acid, and 16% α-linoleic acid. *R. phoenicis,* the African palm weevil, has a 54% fat content and 38% palmitoleic acid and 45% linoleic acid. 24% dry matter and 38% α-linoleic acid are present in saturniid caterpillars (Womeni *et al*., 2009)

4. **Micronutrients, fiber, and vitamins:** Edible insects are rich sources of minerals, fibers, and vitamins. They are excellent sources of minerals like copper, iron, magnesium, manganese, phosphorous, selenium, and zinc, as well as vitamins like riboflavin, thiamine, pantothenic acid, biotin, and folic acid. The most significant fibre present in insects is called chitin. It is the primary constituent of an insect's exoskeleton and is insoluble. In insect species farmed

commercially for insectivores, the amount of chitin varies from 2.7 to 49.8 mg per kg (fresh weight) and 11.6 to 137.2 mg per kg (dry matter). Compared to commercial chitin made from prawn and crab shells, it is of higher quality. Chitin has been linked to protection against certain allergic disorders and parasitic infections.

**Advantages of adding insect to human diet**

1. **High Protein Content:** Insects are rich in protein, with some species containing up to 60% protein by dry weight, making them a valuable source of protein for those looking to increase their intake.
2. **Low Environmental Impact:** Insect farming requires significantly less land, water, and feed compared to traditional livestock, making it a more sustainable option for food production.
3. **Nutrient-Rich:** Insects are a good source of essential minerals like iron, zinc, calcium, and magnesium, as well as healthy unsaturated fats.
4. **Diverse Species:** Over 2,000 species of insects are consumed worldwide, offering a wide range of flavours and textures to incorporate into diets.
5. **Cultural Significance:** Insect consumption is a long-standing practice in many cultures, particularly in Asia, Africa, and Latin America, and can be a way to connect with cultural heritage.
6. **Food Security**: Insect farming can help address food security issues, particularly in areas where traditional livestock farming is challenging due to climate change, water shortages, or limited land.
7. **Therapeutic Uses:** Insects have been used in traditional medicine for centuries, and some species have antimicrobial properties that can be beneficial for human health.
8. **Food Variety:** Insects can be prepared in various ways, such as boiling, drying, toasting, or frying, and can be used in a range of dishes, from snacks to main courses**.**
9. **Future Prospects:** The edible insect industry is expected to grow significantly, with projected values of over $3 billion by 2030, making it a promising area for innovation and investment
10. **Allergen-Friendly:** Many people with allergies to common protein sources, such as nuts or shellfish, can tolerate insects without issue, making them a viable alternative.
11. **Versatility in Cooking:** Insects can be incorporated into a wide variety of dishes, from savory to sweet, and can be used as a substitute for traditional protein sources in recipes.
12. **Reduced Greenhouse Gas Emissions:** Insect farming has a significantly lower carbon footprint compared to traditional livestock, contributing to a more sustainable food system.
13. **Potential for Waste Reduction**: Insects can be fed on organic waste, such as agricultural byproducts or food waste, reducing the amount of waste sent to landfills or incinerators.
14. **Potential for Improved Gut Health:** Some studies suggest that consuming insects may have a positive impact on gut microbiome composition and overall gut health.
15. **Potential for Improved Immune Function:** Certain insect species contain

compounds that may have immunomodulatory effects, potentially enhancing the body's immune response.

16. **Potential for Weight Management:** Insects are generally low in calories and high in protein, making them a potentially useful food for weight management and weight loss.

17. **Potential for Improved Cognitive Function:** Some research indicates that certain insect-derived compounds may have neuroprotective properties and could potentially benefit cognitive function.

18. **Potential for Improved Skin Health**: Insects contain antioxidants and other compounds that may have beneficial effects on skin health, such as reducing inflammation and improving skin barrier function.

**Points to be considered before adding insects to the human diet**

Consuming insects presents several challenges that must be carefully managed to ensure safety and nutritional benefit. Allergic reactions to insect proteins or specific species can occur, necessitating awareness and caution among individuals prone to allergies. Cross-reactivity with other allergens further complicates dietary choices. Hygiene is critical during insect handling and preparation to prevent bacterial and viral contamination, which can pose health risks if not properly managed. The method of processing insects, such as cooking or drying, significantly impacts their safety, nutritional content, and palatability. Additionally, concerns about pesticide residues and the potential presence of toxic substances in insects harvested from the wild or farmed environments require careful consideration. Some of these are discussed below:

1. **Identification and Safety:** Proper identification of the insect species is crucial to avoid consuming potentially harmful or toxic species. Insects vary widely in appearance and can be mistaken for similar-looking species that may pose health risks if ingested. Knowledge of local entomophagy (insect-eating) traditions and guidance from experienced individuals can help ensure safe consumption practices.

2. **Allergies:** Like any food source, some individuals may have allergies to insect proteins or specific insect species. It's important to be aware of personal allergic reactions or sensitivities. Allergies to insects can manifest similarly to allergies to other foods, including itching, swelling, respiratory issues, or gastrointestinal discomfort.

3. **Preparation**: Proper preparation of insects is essential to ensure they are safe for consumption. This typically involves cooking or processing to eliminate potential pathogens such as bacteria or parasites. Common methods include boiling, frying, baking, or drying, depending on the insect species and local culinary traditions. Adequate cooking also enhances flavour and texture, making insects more palatable**.**

4. **Nutritional Content:** The nutritional composition of insects can vary widely between species. Some insects are rich in protein, healthy fats, vitamins (such as B vitamins), minerals (like iron and zinc), and dietary fibre. Understanding the nutritional benefits of different insect species can help individuals choose insects that best supplement their dietary needs.

5. **Sustainability:** Consider the environmental impact and sustainability of insect harvesting or farming practices. Compared to traditional livestock farming, insects generally require less land, water, and feed to produce the same amount of protein. Sustainable practices include farming insects on organic waste or by-products, minimizing resource use, and reducing greenhouse gas emissions.

6. **Cultural Acceptance:** Insect consumption is culturally accepted and even celebrated in many regions worldwide. However, cultural beliefs and attitudes toward insect consumption can vary significantly. Respect for cultural traditions and local customs regarding insect preparation and consumption is important. Understanding the cultural significance of insects as food can enhance appreciation for their nutritional and ecological value.

7. **Regulations:** Be aware of local regulations and guidelines governing the harvesting, sale, and consumption of insects as food. In some regions, insects may be classified as novel foods, requiring specific approvals or certifications for commercial distribution.

Addressing these challenges involves implementing stringent food safety practices, adhering to regulatory guidelines, and ensuring thorough inspection and testing to mitigate risks associated with insect consumption.

## CONCLUSION

Insects represent a promising solution to address pressing global challenges related to food security and environmental sustainability. They offer a nutrient-dense source of protein, healthy fats, vitamins, minerals, and fiber, while requiring significantly fewer resources such as land, water, and feed compared to traditional livestock. However, integrating insects into diets requires careful consideration of factors like allergies, safety measures to mitigate contamination risks, and respect for cultural attitudes towards entomophagy. By promoting education and awareness about the nutritional benefits and ecological advantages of insect consumption, societies can foster broader acceptance and adoption of insects as a viable and beneficial food source. This shift has the potential not only to diversify dietary options but also to contribute positively to the resilience and sustainability of global food systems**.**

### Future prospects

Looking ahead, ongoing research and development in insect farming techniques and culinary applications are poised to broaden their acceptance and integration into global diets. Innovations in processing technologies and product development are expected to enhance the palatability and versatility of insect-based foods, potentially mainstreaming their consumption as a nutritious and sustainable dietary option worldwide.

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