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# The Benefits of Insects as a Nutrient

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**Abstract**

The global population is growing at an alarming rate, leading to a shortage of land and food resources. As a result, there is a need to find alternative sources of food. Edible insects have gained significant attention due to their economic and environmental benefits, as well as their potential in various industries. The consumption of edible insects is not limited to India but is prevalent worldwide. These insects are highly nutritious, containing high levels of fat, protein, and micronutrients that vary among different species. Therefore, they offer a valuable solution to address the food needs of future generations. The demand for alternative protein-rich foods is rapidly increasing globally, and insects present an innovative and sustainable option as a feed source. In addition to protein, insects also provide essential nutrients such as fats, minerals, and vitamins. This paper aims to explore the different types of edible insects and their nutritional value.

## Introduction

With the global population on the rise, there is a growing demand for space. However, limited access to land has resulted in limited food availability, prompting the search for alternative food sources. According to a study, it is projected that by 2050, the world's population will reach 8.2-10.5 billion [1]. The threat to global food security is further exacerbated by climate change and the depletion of natural resources. As a result, insects are now being considered as a sustainable alternative for human consumption. The consumption of insects is not limited to India alone; people all over the world consume insects, which are not only highly nutritious and rich in protein, but also contain fat and micronutrients that vary across species. Sources estimate that there are over 2300 insect species worldwide that are suitable for consumption, providing greater nutritional value and energy compared to traditional protein sources [2]. It is believed that there are approximately 6-10 million insect species globally, out of which more than 2300 species from 18 different orders have been confirmed as edible. Edible insects serve as an environmentally sustainable and healthy alternative source of protein. Around 2 billion people incorporate insects into their daily diet due to their protein richness, affordability, environmental friendliness, and palatability [3]. In the 21st century, with the increasing demand for food and animal protein, coupled with food scarcity, ecological pressures, population growth, and rising protein demand among different socioeconomic classes, insects as a feed and food alternative appear to be a significant industry.

Entomophagy, commonly referred to as the consumption of insects, is widely recognized in subtropical and tropical regions due to their warm and humid climate. This practice not only has a positive impact on the environment but also on human health. The concept of consuming insects and the commercial production of insect-based products is continuously improving and expanding. It is predicted that in the near future, the insect consumption industry will become a prominent sector within the food industry. This paper primarily emphasizes the nutritional advantages of insects, highlighting their potential as an alternative food source for future generations.

Insects have been present on Earth for approximately 400 million years, making them one of the oldest land animals [4]. Around 7000 years ago, indigenous populations began incorporating insects into their diets, as evidenced by paleontological studies [5]. In modern times, insects are commonly consumed and highly regarded for their availability and size. To facilitate catching and easy identification, insects should be of sufficient size and preferably abundant in quantity. Insects can be consumed at various stages of their life cycle and can be prepared

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in different ways, such as raw, fried, boiled, or roasted. Early gatherers and hunters relied on insects for survival due to their nutritional benefits, including high fat and protein content, as well as an adequate amount of micronutrients. Insects were commonly consumed and processed as a food source [6]. However, there were instances where insects were misidentified due to a lack of accurate information and knowledge. For instance, the term "locust" was incorrectly used to describe crickets, grasshoppers, cicadas, and other insects and caterpillars. Consequently, the insects mentioned in publications were not properly identified or classified, leading to ambiguity for ethnographers. Some insect archaeological records are questionable and can be misleading.

Edible insects are known to have significant nutritional value. Their composition and nutritional content are comparable to that of animal-based foods [7,8]. Insects not only provide nutrients and active substances for human consumption but also serve as a valuable food source for poultry. It is estimated that there are approximately 6-10 million insect species worldwide, with over 2,300 species belonging to 18 different orders identified as edible insects.

**Insects:** Nutritional Value.

With the global population on the rise, there is an increasing demand for food. Edible insects have emerged as a potential substitute and sustainable solution to meet the nutritional needs of the growing global population. These insects provide a sufficient source of various nutrients that are essential for the human body. In comparison to traditional high protein animals, insects offer a rich supply of nutrition and protein. Moreover, the human body can easily absorb and utilize these nutrients [9,10].

**Table 1:** Average nutrient composition and energy contents edible insect orders (on a dry matter basis). Adapted from Rumpold abd Schluter, 2013.

| Nutrients and energy* | Cockroaches (Blattodea) | Beetles (Coleoptera) | Flies (Diptera) | Beetles (Hemiptera) | Bees, wasps, ants (Hymenoptera) | Termites (Isoptera) | Caterpillars (Lepidoptera) | Dragonflies (Odonata) | Grashoppers, locusts, crickets (Orthoptera) |
|---|---|---|---|---|---|---|---|---|---|
| Data amount n | 3 | 45 | 6 | 27 | 45 | 7 | 50 | 2 | 51 |
| Protein, % | 57.30 | 40.69 | 49.48 | 48.33 | 46.47 | 35.34 | 45.38 | 55.23 | 61.32 |
| min | 43.90 | 8.85 | 35.87 | 27.00 | 4.90 | 20.40 | 13.17 | 54.24 | 6.25 |
| max | 65.60 | 71.10 | 63.99 | 72.00 | 66.00 | 65.62 | 74.35 | 56.22 | 77.13 |
| SD | 11.71 | 15.61 | 13.12 | 15.09 | 15.19 | 15.91 | 15.56 | 1.40 | 14.65 |
| Fat, % | 29.90 | 33.40 | 22.75 | 30.26 | 25.09 | 32.74 | 27.66 | 19.83 | 13.41 |
| min | 27.30 | 0.66 | 11.89 | 4.00 | 5.80 | 21.35 | 5.25 | 16.72 | 2.49 |
| max | 34.20 | 69.78 | 35.87 | 57.30 | 62.00 | 46.10 | 77.17 | 22.93 | 53.05 |
| SD | 3.75 | 18.91 | 9.35 | 18.74 | 11.96 | 9.05 | 17.89 | 4.39 | 10.90 |
| Fiber, % | 5.31 | 10.74 | 13.56 | 12.40 | 5.71 | 5.06 | 6.60 | 11.79 | 9.55 |
| min | 3.00 | 1.40 | 9.75 | 2.00 | 0.86 | 2.20 | 0.12 | 9.96 | 1.01 |
| max | 8.44 | 25.14 | 16.20 | 23.00 | 29.13 | 7.85 | 29.00 | 13.62 | 22.08 |
| SD | 2.81 | 6.50 | 2.81 | 5.74 | 6.32 | 2.47 | 5.15 | 2.59 | 4.23 |
| NFE, % | 4.53 | 13.20 | 6.01 | 6.08 | 20.25 | 22.84 | 18.76 | 4.63 | 12.98 |
| min | 0.78 | 0.01 | 1.25 | 0.01 | 0.00 | 1.13 | 1.00 | 3.02 | 0.00 |
| max | 10.09 | 48.60 | 8.21 | 18.07 | 77.73 | 43.30 | 66.60 | 6.23 | 85.30 |
| SD | 4.91 | 12.33 | 3.25 | 5.93 | 20.56 | 17.16 | 19.81 | 2.27 | 17.22 |
| Ash, % | 2.94 | 5.07 | 10.31 | 5.03 | 3.51 | 5.88 | 4.51 | 8.53 | 3.85 |
| min | 2.48 | 0.62 | 5.16 | 1.00 | 0.71 | 1.90 | 0.63 | 4.21 | 0.34 |
| max | 3.33 | 24.10 | 25.95 | 21.00 | 9.31 | 11.26 | 11.51 | 12.85 | 9.36 |
| SD | 0.43 | 4.83 | 8.14 | 5.44 | 1.56 | 3.98 | 2.65 | 6.11 | 1.65 |
| Energy, Kcal/100g | | 490.30 | 409.78 | 478.99 | 484.45 | | 508.89 | 431.33 | 426.25 |
| min | | 282.32 | 216.94 | 328.99 | 391.00 | | 293.00 | 431.33 | 361.46 |
| max | | 652.30 | 552.40 | 622.00 | 655.00 | | 776.85 | 431.33 | 566.00 |
| n (Energy) | 0 | 17 | 3 | 18 | 28 | 0 | 30 | 1 | 16 |
| > 400 kcal/100g | | 13 | 2 | 13 | 27 | | 25 | 1 | 9 |
| > 500 kcal/100g | | 10 | 1 | 8 | 7 | | 16 | 0 | 2 |
| SD | | 111.42 | 173.28 | 98.53 | 58.88 | | 114.10 | 0.00 | 63.70 |

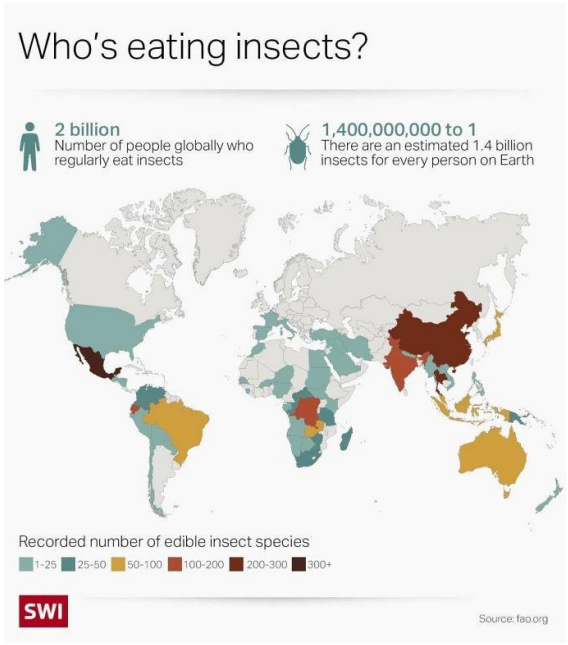


**Figure 1**

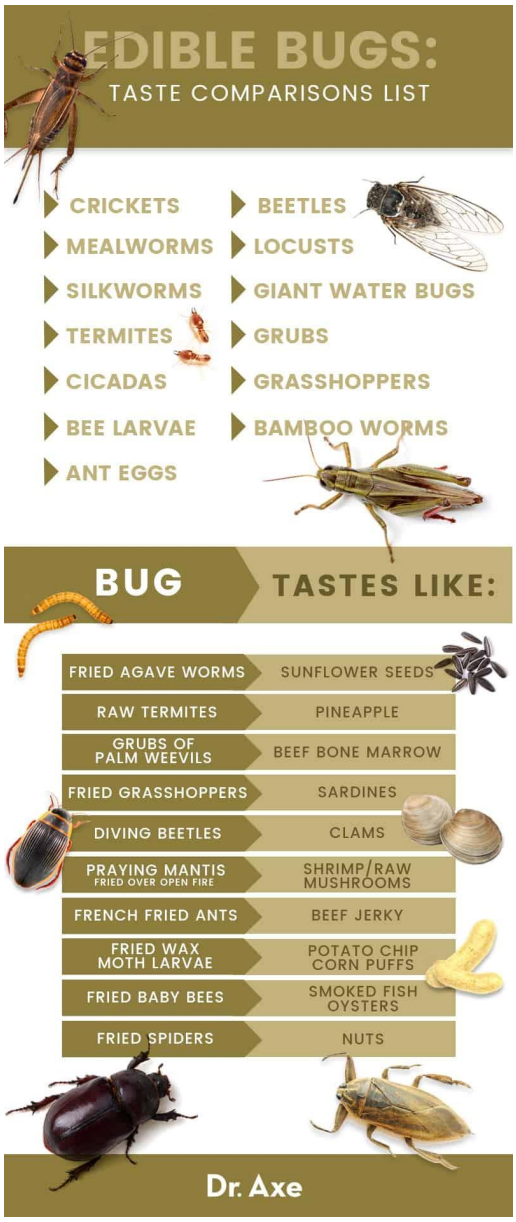


**Figure 2**

The dietary value of edible insects varies significantly, depending on factors such as their origin, metamorphosis, and diet [11]. However, overall, there are clear advantages to considering edible insects as a source of nutrition. In some cases, the nutritional value of edible insects is equal to or even superior to that of bird and mammal foods. Consumption of insects significantly improves and increases protein intake in the human body [12,13]. The protein content in insect dry matter ranges from 35% (termites) to 61% (crickets, grasshoppers, and locusts) and can even reach 77% in certain species [13]. Most edible insects also fulfill the recommended amino acid content for tyrosine, phenylalanine, threonine, lysine, and tryptophan.

Table 1 presents the nutritional value of some commonly consumed insect species worldwide, including their protein, carbohydrate, fat, mineral composition, and energy value per 100 grams of dry weight.

The adaptability of edible insects compared to other animals makes them potentially beneficial in terms of economics. As the global population continues to grow, there is a need for a significant increase in food production. However, this expansion will put a heavy burden on limited natural resources such as water, energy, oceans, and land. The current production cycles, especially in livestock farming, contribute to environmental issues and lead to deforestation, climate instability, and increased greenhouse gas emissions. Insects, on the other hand, have a chitin content of around 10% of their dried weight, which can vary depending on the species and developmental stage. Purified chitin, which makes up roughly 90% of dietary fiber, can be digested by humans. Both chitin and its deacylated form, chitosan, have the potential to improve cardiovascular and colonic health, enhance immune responses, reduce cholesterol levels, and aid in wound healing. Additionally, edible insects can be raised on natural byproducts such as manure, human waste, and compost, which helps reduce pollution in the environment. By replacing insect feed with organic byproducts, insect farming can become more profitable.

Insects in the mini livestock industry play a significant role in the global economy and livelihoods. While traditional livestock species like pigs, goats, and chickens dominate the sector, there is a growing demand for alternative options. Mini livestock, such as insects, offer a viable solution for economic diversification. Insect farming is a well-organized practice that can be carried out in various settings, including urban, periurban, and rural areas. Although some insects have been domesticated, many species, like tarantulas, still need to be collected from their natural habitats.

Mini livestock businesses have several advantages. Firstly, they require minimal space, making them suitable for areas with limited land availability. Additionally, they do not compete with food meant for human consumption, ensuring food security for communities. The demand for insect products often exceeds the supply, leading to quick cash inflows and high financial returns due to their high reproductive rates. Moreover, insects can efficiently convert feed into protein, making them a valuable source of nutrition for humans. Managing mini livestock is relatively simple, requiring less training and effort compared to traditional livestock. Furthermore, their portability adds to their convenience as they can be easily transported.

Considering the future challenges of food security, insects hold great potential. The Food and Agriculture Organization (FAO) of the United Nations predicts a global population of over

9 billion by 2050, necessitating a 100% increase in food production. However, the availability of cultivable land is expected to decline due to climate change, exacerbating food insecurity, particularly in low-income countries. Insects can address this issue by providing a sustainable source of food in areas where malnutrition and food insecurity prevail. They offer essential nutrients, including protein, vitamins, and minerals, crucial for human health and well-being. Therefore, sectors involved in insect production could potentially contribute to alleviating the food shortage and improving food security worldwide.

**Palatable characteristics of insects**

In certain regions of India, insects are consumed live immediately after being captured. If further processing is required, the most humane method of killing them is through scalding with hot water and subjecting them to starvation for a period of 1-3 days. Subsequent culinary processing methods include roasting, boiling, baking, frying, or drying.

Taste plays a crucial role in food selection as it is influenced by sensory attributes. It serves as the primary determinant of whether a food is allowed into the digestive system or not. While some evidence suggests that all humans possess the same types of taste receptors, this does not imply that all substances taste the same to everyone [14-21].

Odor, on the other hand, is of great importance in food perception. The olfactory nerve, being the first cranial nerve in humans, is far more sensitive than taste and other vertebrates. It enables the detection of food from a distance, even if it is not visible, and allows individuals to assess its acceptability as edible or not. Stinkbugs serve as a prime example of this, as their pungent and stinky odor makes them a favored food among many insectivorous individuals in Asia and Africa [22,23].

Visual appearance, particularly coloration, holds significance for animals and humans with color vision. It goes beyond indicating the potential hazards of a food and can provide valuable information about its developmental stage, as well as the presence of sugar or fat. This aids in determining whether the effort of collecting the food is worthwhile. Due to the varying developmental stages, shapes, and colors of insects, it becomes easier to differentiate highly valued stages or individuals from less desirable ones.

Lastly, the texture of an item also plays a crucial role in considering it as edible and acceptable as food. A closer inspection and assessment of texture are important factors. Items with a smoother and softer surface tend to attract more attention compared to those with a bristly and rough surface.

Spiky protrusions, for instance, are meticulously eliminated from insects prior to their further preparation for consumption. The future of edible insects is being shaped by the increasing global demand for meat and the scarcity of available land, which is driving the exploration of alternative protein sources. The utilization of edible insects is on the rise as people are becoming more engaged with this novel resource due to its abundant nutritional content. However, certain insects are still not readily accessible on a regular basis as they can only be harvested from the wild. Despite the successful large-scale rearing of some species, insect farming for food is still in its early stages [24]. The edible insect industry is projected to expand due to the introduction of new insect products, improved cultivation techniques, and production optimization. In countries like India and other developing nations where malnutrition is prevalent, consumers may incorporate insects into their regular diets. Additionally, insects could serve as a nutritional supplement in the formulation of specialized diets for athletes who are at risk of protein energy malnutrition. In terms of greenhouse gas emissions, water consumption, and land requirements, insect farming appears to be more environmentally friendly than livestock farming. Therefore, in order to meet the nutritional needs of the growing global population, edible insects seem to present a viable and sustainable option. However, several challenges need to be addressed before the potential of edible insects to enhance food security can be fully realized. Further research should be conducted on the nutritional value and health benefits of different insect species to establish a solid foundation for their promotion as a healthy food source. The long-term viability and environmental impacts of insect breeding, collection, and production must also be thoroughly examined and compared to traditional agriculture and livestock farming, which are believed to have greater environmental repercussions [25].

The potential socioeconomic benefits of collecting and rearing insects to enhance food security in low-income areas warrant further investigation. While insects may not exhibit concern for animal welfare, the extent of discomfort and pain they experience remains uncertain [26].

There are risks associated with consuming insect-based meals. The presence of a large number of insects in the wild can have a significant impact on the landscape ecosystem and agricultural production. Therefore, it is advisable to consume insects that have been raised on farms under controlled and defined conditions. The use of appropriate and safe feed is crucial to ensure the health of edible insects. It is also worth noting that allergies can be triggered by consuming insects, as some species have chitin-based external body coverings that are challenging for humans to digest.

In conclusion, as the global human population continues to grow, the demand for animal protein increases. However, due to food shortages in certain regions and mounting environmental pressures, the consumption of edible insects as a viable food source has become a global concern. Achieving ecologically sustainable food security is one of the most urgent challenges facing the world today. Evidence suggests that entomophagy, or the practice of consuming insects, plays a crucial role in addressing food insecurity. Edible insects offer high-quality protein, micronutrients, bioactive substances, and fiber. They are naturally abundant in protein, fat, and micronutrients, making them potentially capable of meeting the nutritional needs of the human body. Compared to other protein sources, edible insects have an estimated energy content of 400-500 kcal per 100 g of dry matter and also possess higher economic value. However, concerns regarding the potential risks to well-being and security associated with consuming edible insects persist. To enhance well-being and safety, efforts in food safety and development should collaborate. Appropriate rules and regulations need to be established to address food safety concerns. Edible insects have the potential to provide high-quality protein, micronutrients, bioactive substances, and fiber, but ensuring their safety is paramount.

## References

1. Ventura AK, Worobey J. Early influence on the development of food preferences. Curr Biol. 2013; 23(9): R401-R408.

2. Chufei Tang, Ding Yang, Huaijian Liao, Hongwu Sun, Chuanjing Liu, et al. Edible insects as a food source: A review. Food Produc-

tion, Processing and Nutrition. 2019; 2(1): 1-5.

3. LigayaMishan. Why aren't we eating more insects? The New York Time Style Magazine. 2018; 7.

4. Tiencheu Bernard, Hilaire Macaire Womeni. Entomophagy: Insects as Food. Insect Physiology and Ecology. 2017.

5. Arnold Van Huis. Edible insects are the future? Proceedings of The Nutrition Society. 2016.

6. Fenenga GL, Fisher EM. The Cahuilla use of piyatem, larvae of the white-lined sphinx moth (Hyles lineata) as food. J CA Anthropol. 1978; 5(1): 84-90.

7. Raubenheimer D, Rothman JM. Nutritional ecology of entomophagy in humans and other primates. Annual Review of Entomology. 2013; 58: 141-160.

8. Ayieko M, Kinyuru J, Ndonga M, Kenji G. Nutritional value and consumption of black ants (Carebaravidua Smith) from the Lake Victoria region in Kenya. Adv. J. Food Sci. Technol. 2012; 41: 39-45.

9. Van Huis A, Van Itterbeeck J, Klunder H, et al., Edible insects: Future prospects for food and feed security, FAO, Rome. 2013.

10. Finke MD, Oonincx DD. Insects as food for insectivores, in: J. Morales-Ramos, G Rojas, D.I. Shapiro-Ilan (Eds.), Mass Production of Beneficial Organisms: Invertebrates and Entomopathogens, Elsevier, New York. 2014; 583-616.

11. Bukkens SG. The nutritional value of edible insects, Ecol. Food Nutr. 1997; 36: 287-319.

12. Rumpold BA, Schlüter OK. Nutritional composition and safety aspects of edible insects, Mol. Nutr. Food Res. 2013; 57: 802-823.

13. Verkerk MC, Tramper J, Van Trijp JCM, Martens DE. Insect cells for human food. Biotechnology Advances. 2007; 25: 198-202.

14. Belluco S, Losasso C, Maggioletti M, et al. Edible insects in a food safety and nutritional perspective: A critical review, Compr. Rev. Food Sci. Food Saf. 2013; 12: 296313.

15. Finke MD. Estimate of chitin in raw whole insects, Zoo Biol. 2007; 26: 105-115.

16. Maezaki Y, Yamazaki A, Mizuochi K, et al. Measurement of dietary fiber in chitin and chitosan by the enzymatic gravimetric method, J. Agricult. Chem. Soc. 1993; 67: 677-684.

17. Paoletti MG, Norberto L, Damini R, et al. Human gastric juice contains chitinase that can degrade chitin, Ann. Nutr. Metab. 2007; 51: 244-251.

18. Steinfeld H, Gerber P, Wassenaar T, Castel V, Rosales M, et al. Livestock's long shadow: Environmental issues and options. Rome, FAO. 2006.

19. Oonincx DGAB, De Boer IJM. Environmental impact of the production of mealworms as a protein source for humans: a life cycle assessment. PLoS ONE. 2012; 7(12): e51145.

20. Tuorila H. Sensory perception as a basis for food acceptance and consumption. In: MacFie (ed) Consumer led food product development. Woodhead Press, Cambridge. 2007; 34-65.

21. Chakravorty J, Ghosh S, Meyer-Rochow VB. Practices of entomophagy and entomotherapy by members of the Nyishi and Galo tribes, two ethnic groups of the state of Arunachal Pradesh (north-East India). J Ethnobiol Ethnomed. 2011.

22. Teffo LS, Toms RB, Eloff JN. Preliminary data on the nutritional composition of the edible stinkbug, Encosternum delegorguei Spinola, consumed in Limpopo province, South Africa. S Afr J Sci. 2007; 103: 434-436.

23. Reineke K, Doehner I, Schlumbach K, Baier D, Mathys A, et al. The different pathways of spore germination and inactivation in dependence of pressure and temperature. Innovative Food Science & Emerging Technologies. 2012; 13: 31-41.

24. Sun-Waterhouse D, Waterhouse GIN, You L, et al. Transforming insect biomass into consumer wellness foods: a review, Food Res. Int. 2016; 89: 129-151.

25. Erens J, Van Es S, Haverkort F, et al. A bug's life: Largescale insect rearing in relation to animal welfare. Project 1052: Large-scale insect rearing in relation to animal welfare. 2012.

26. Elias S. The use of insect fossils in archaeology. Adv. Quaternary Entomol. 2010; 12: 89-121.