

Evaluating the nutritional composition of edible insects: an alternative source of food supplements in Nagaland

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Edible insects are rich sources of macronutrients such as protein, lipid and carbohydrate, and they are considered a promising alternative source of nutrients to alleviate food security. However, the nutritional profiling of edible insects is very limited, highlighting the need to evaluate their potential as a promising source of nutrients. Therefore, the present study was conducted to assess the nutrient composition of nine commonly consumed edible insects in their fresh, fried and roasted forms, as well as to examine the variations across development stages (larva, pupa and adult) of *Provespa barthelemyi*. The results showed that protein concentrations varied significantly ($F_{(2)} = 293.8$, $p < 0.05$) among fresh, fried and roasted forms. Lipid content ranged from 0.01 ± 0.00 (*Laccotrephes ruber*) to 0.5 ± 0.06 (*Samia cynthia ricini*) in fresh, 1.09 ± 0.08 (*Tarbinskiellus portentosus*) to 1.27 ± 0.08 (*Cossus* spp.) in fried, and 0.4 ± 0.0 (*Mecapoda nipponensis*) to 1.3 ± 0.0 (*Oecophylla smaragdina*) in roasted form. While carbohydrate content ranged from 0.2 ± 0.0 (*L. ruber*) to 5.8 ± 0.5 (*O. smaragdina*) in fresh, 0.6 ± 0.0 (*Lethocerus indicus*) to 12.17 ± 3.78 (*Cossus* spp.) in fried, and 0.5 ± 0.3 (*L. indicus*) to 13.1 ± 3.8 (*Cossus* spp.) in roasted form. Across the developmental stages of *P. barthelemyi*, the highest amount of protein, lipid and carbohydrate was present in the larval stage. Further, eight essential and nine non-essential amino acids were also present in edible insects. Insects such as *O. smaragdina* and *P. barthelemyi* have moderate to high levels of both essential and non-essential amino acids, such as leucine, phenylalanine, alanine, glycine and proline, suggesting they can serve as a well-rounded protein source for humans. The present study highlighted that edible insects are compelling food supplements that can serve as a promising alternative source of nutrients.

Keywords: Amino acid, entomophagy, foods, nutrients, protein.

DRIVEN by the growing interest in exploring sustainable and nutritional food, entomophagy, the practice of eating edible insects, is evolving rapidly worldwide. Approximately 2,000 species of insects are considered food and feed¹. Many studies on edible insects have been reported worldwide, considering them as a regular traditional diet and as alternative nutrient sources to alleviate food security²⁻⁶. Edible insects are a good source of high-quality protein, essential amino acids, unsaturated fatty acids, vitamins, fibre and minerals. They are considered a sustainable alternative to conventional animal protein sources⁷. Studies also showed that edible insects contain a variety of health benefits, including antioxidant, antimicrobial, anti-inflammatory, anti-tumour, anti-ageing and hypolipidemic activity, which may be attributed to the presence of bioactive compounds such as fatty acids, phenolic compounds, peptides and chitin⁸⁻¹¹. With a low environmental impact, insects are one of the best sources of nutrients, and many of the world's indigenous populations rely heavily on edible insects as a food source¹². While edible insects often bridge the affordability of conventional meat and lack of nutrients in several marginalised societies, studies on the nutritional and economic potential of edible insects are lacking¹³, for which dietary reference with nutritional profiling of edible insects is very important.

In India, diverse forms of edible insects have been documented, and entomophagy practices have been predominantly observed among the tribal populace^{14,15}. The availability of these insects depends substantially on the geographical distributions of host plants, seasons, and harvesting period¹⁶. The indigenous communities of Nagaland maintain a close association with nature, which is reflected in their dietary practices, where edible insects constitute an important component. These insects are gathered from the wild or sourced from local markets¹⁷⁻¹⁹. Various edible insects, such as grasshoppers, cicadas, crickets, water beetles and giant water bugs, are primarily collected from natural environments and consumed more frequently, particularly

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