EDIBLE INSECTS AS VALUABLE SOURCE OF NUTRITION: AN OVERVIEW

Abstract

Insects are vital components of the environment, they provide a variety of ecological services to both agriculture and the natural world. They view as being crucial to human survival. As a food source, insects have not yet been fully utilised and developed. The nutritional content of edible insects was reviewed based on analysis and research. The findings revealed that insects had high levels of protein (20–70%), amino acids (30–60%), fat (10–50%), fatty acids and carbohydrates (between 2 and 10 percent), minerals, vitamins, and other active substances that support human health. In terms of protein sources, edible insects are just as nutritious as other animals or plants. As nutritive resources, edible insects can be used widely and have significant development potential because insects are known for their wide range of species and large populations. This review mainly deals with the nutritional excellencies of edible insects.

Keywords : carbohydrate; fat; **i**nsects; nutritional content; protein

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I. INTRODUCTION

Within the arthropod phylum, insects are the most diverse group of animals and are present in almost all settings. The majority of them live in freshwater and on land, making up around three-fourths of all the species on Earth. However, very few are known to survive beyond the ocean's tidal range (Stork, 2018).There are an estimated 6–10 million species of animals in the world, of which 4–8 million are known to be insect species.The actual estimates of the total number of bug species or those belonging to particular orders, however, frequently differ greatly, and a thorough documentation has not yet been made. According to the average of their estimations, there are approximately 1.5. There are 1 million recognized species of beetle and 5.5 million insect species in existence (Grimaldi and Engel, 2005; Stork, 2018). Since they are vital components of the environment, insects provide a variety of ecological services to both agriculture and the natural world. They view this as being crucial to the continued existence of humanity. However, because insects are typically viewed as pests or possible carriers of pathogens, their ecological significance is sometimes overlooked and goes unrecognized. Due to their high diversity and abundance, insects serve as the biological underpinning for all terrestrial ecosystems.They are crucial in the bio-degradation of trash, which increases soil fertility (Bornemissza, 1976), the natural bio-control of pest infestations (Godfray, 1994), and the facilitation of plant reproduction . A significant biological resource that is still underutilized globally is insects. Most common insects used in Asia as food are presented in Table 1.

II. IMPORTANCE OF EDIBLE INSECTS AS VALUABLE SOURCE OF NUTRITION

Insects come in a huge variety of species. Proteins, amino acids, fat, carbohydrates, a variety of vitamins, and trace elements are all abundant in insect bodies. Therefore insects offer an important nutritional resource for humans and are worthy of development (DeFoliart 1992; Mitsuhashi (2005); Ramos-Elorduy and Pino 1990). Since they are vital components of the environment, insects provide a variety of ecological services to both agriculture and the natural world. They view this as being crucial to human survival. As a food source, insects have not yet been fully utilised and developed. According to research and analysis, eating insects was a common practise in many nations and locations during the period of human evolution. Insect use as food was quite popular in ancient China. In addition, many ancient writings describe the eating of insects; some insects were even brought to the king and top officials as tribute. Various entomologists discusses the nutritional value and eating habits of edible insects. An analysis of the nutritional content of commercially available edible insects showed that they are not only excellent suppliers of all required elements, but also have a number of medical benefits for preserving good health. Insect consumption as food has a long history, mostly among ethnic groups from many areas of the world. Raising silkworms for the purpose of producing silk has a long history in India and is closely related to the socioeconomic circumstances of the rural population.

III. NUTRITIONAL CONTENTS OF EDIBLE INSECTS

Many countries and ethnic groups consider insects to be an essential component of their diet. In terms of nutrition, insects have a substantial amount of protein. Depending on the type and stage of the insect's development, it ranges from 20 to 76% dry matter. Large (2–

50% of dry matter) diversity in fat content results from a variety of variables. Up to 70% of all fatty acids may be total polyunsaturated fatty acids. Chitin, whose composition ranges from 2.7 mg to 49.8 mg per kg of fresh matter, is the principal source of carbohydrates. A considerable number of minerals (K, Na, Ca, Cu, Fe, Zn, Mn, and P), as well as vitamins like those in the B group, vitamins A, D, and E, are present in some species of edible insects.

IV. PROTEIN AND AMINO ACIDS

The building blocks of all biological function, including enzymes, hormones, and haemoglobin, are proteins. Protein is a crucial component of antibodies since it supports the body's immune system. It is the sole substance that can create nitrogen, which is essential for converting genetic information, preserving acid-alkaline equilibrium, and moving essential substances within the human body. It can give off heat and act as a nutritional ingredient that produces energy. Earlier studies proved that edible insects are a good source of Proteins as well as amino acids. Protein and amino acid contents in different insect orders are presented in Fig.1.

V. ANTIOXIDANTS

A natural resource of great significance to the food business is insects that can be eaten. Not just because of their superior nutritional value and technological production advantages, but also because they contain entomochemicals, which are bioactive substances. These include derivatives of amino acids as well as phenolic, alkaloid, and terpenoid chemicals, among others. Due to their function in the formation of food and their bioactive qualities, phenolic compounds have been the best characterised and are the subject of this study. Orthoptera, Coleoptera, and Lepidoptera are the main taxonomic orders investigated in this area; the phenolic chemicals in their edible specimens act as antioxidants.

VI. FATTY ACIDS

An essential part of the human body, fat supports and protects several organs in addition to storing and delivering energy. Fat can assist with vitamin absorption as well. Many tissues and cells include phosphorus, carbohydrates, and cholesterol; when coupled with protein, these substances can create fatty proteins and cell membranes. Phosphatide is beneficial for the brain and liver, lowers blood fat, creates clean cholesterol, promotes cell growth and skin growth, and delays senility. Saturated and unsaturated fatty acids are two categories of fatty acids. Unsaturated fatty acids can promote human growth, safeguard the skin, and lessen the development of thrombi and blood platelet coagulation. Fat content of edible insects is graphically presented in Fig. 2.

VII. CARBOHYDRATES

The body needs carbohydrates as one of its primary nutritional components. They serve as the primary heat source, can lower protein intake, and promote detoxification. They are also significant components of the human body. Insects that can be eaten are high in protein and fat but low in carbohydrates. Different edible bug species have different carbohydrate levels that range from 1 to 10%. Insect tea, which is made from their faeces and has a greater carbohydrate content (16.27%), is a unique source. Insects contain significant

levels of polysaccharide, which has been found in recent studies to improve the immune system in humans. Carbohydrate content of some insect order is presented in Fig.3.

VIII. VITAMINS

One class of chemical molecules required for human metabolism is the vitamin family. Vitamins must continually be given by diet because the human body is unable to synthesise them. There are not enough studies on the vitamins in eatable insects. However, the results of analyses by DeFoliart 1992) showed that edible insects contain vitamins A, carotene, B1, B2, B6, D, E, K, and C among other nutrients.

IX. CONCLUSION

Insects that can be eaten are abundant in protein and amino acids, particularly those that are necessary for human health. They are a good protein source. They can provide abundant fat, fatty acids, nutrients, vitamins, and carbs, particularly large levels of unsaturated fatty acids, which have significant nutritional value. Insects also include other components that are beneficial to human health, such as antimicrobial protein and peptides, enzymes, and hormones. Some insects are excellent sources of nutrition. Future research for human health and nutrition should concentrate on edible insects as a dietary resource and their industrialization.

Table 1: Most consumed insects as food resources traditionally in Asia

Order	Scientific name	Common name	Consumed stage	Type of preparation	References
Hemiptera	Coccidea	Scale insect	Adult	Fried	DeFoliart (1999)
	Cicadoidea	Cicarales	Adult	Fried	
	Aspongopus chinensis	Stinkbugs	Adult	Fried	
	Corizushyosyami	Cinnamon bugs	Adult	Fried	
	Udongamontana	Pentatomid bug	Adult	Fried	
	Meimuna	Walker's cicada	Adult	Fried	
Hymenoptera	Corizushyosyami	Cinnamon bug	Adult	Fried	Defoliart (1999); Joanna et. al. (2018)
	Polyrachis dives	Weaver ats	Adult	Fried	
	Apiscerena	Honey bee	Larvae, pupae	Fried	
	Apis mellifera	Honey bee	Larvae, pupae	Fried	
	Vespula lewisii	Bee	Larvae, pupae	Fried	
	Oecaphyllasmaragdina	Weaver ant	Adult	Fried	
Orthoptera	Isoptera	Termites	Adult	Fried	Singh & Chakraborty (2008); Oonincx et. Al (2011)
	Locusta migratoria	Locust	Adult	Fried	
	Oxyayezo	Grasshopper	Adult	Fried	
	Oxya japonica	Grasshopper	Adult	Fried	
	Oxyavelox	Grasshopper	Adult	Fried	
	Oxyayezoensis	Grasshopper	Adult	Fried	
	Allonemobius fasciatus	Ground cricket	Adult	Fried	

Lepidoptera	Samiaricini	Eri silkworm	Larvae, pupae, adult	Fried, boiled, whole fresh	Ghosh & Gangopadhyay (2020); Ray & Gangopadhyay (2021)
	Bombyx mori	Mulberry	Larvae, pupae,adult	Fried, boiled, whole fresh	
	Antheraea mylitta	Tasar	Larvae, Pupae, adult	Fried, boiled, whole fresh	
	Antheraea mylitta	Muga	Larvae, Pupae, adult	Fried, boiled, whole fresh	

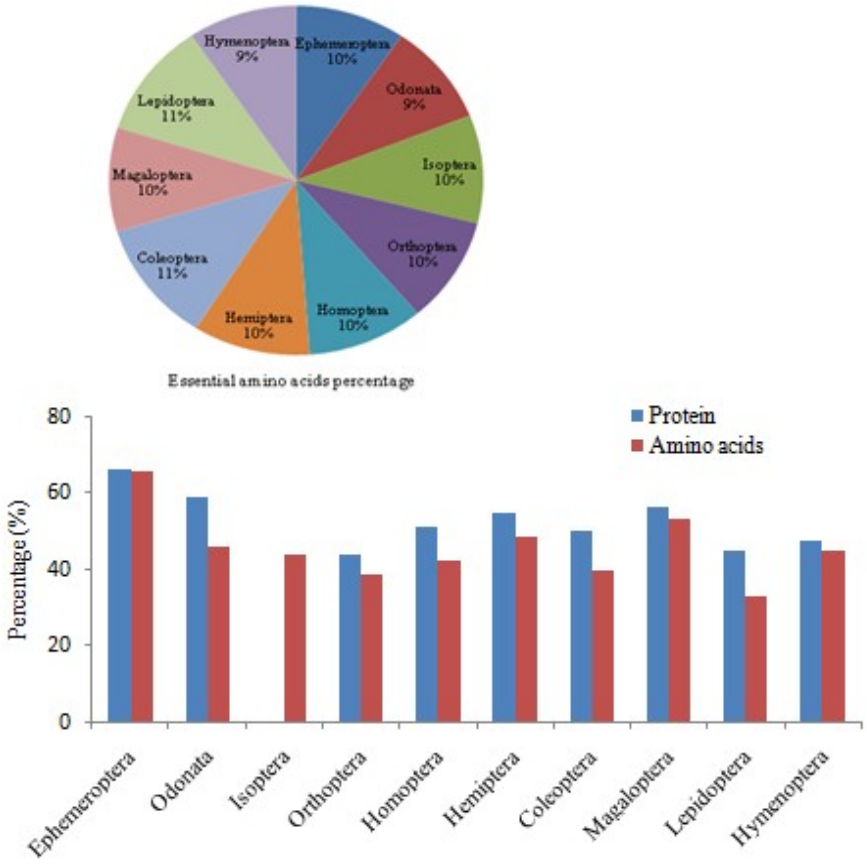

Figure 1: Protein and amino acid contents in different insect orders; Inset pie chart indicates percentage of essential amino acids to total amino acids content

Source: Protein- and amino acids-(Ramos-Elorduy and Pino 1990)

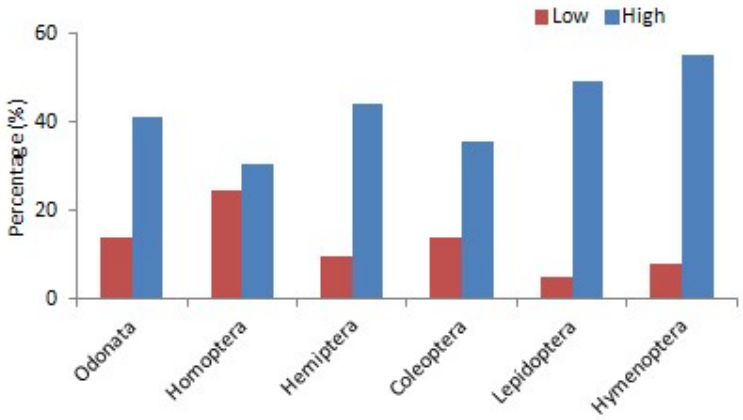

Figure 2: Fat content of some edible insects (% dry weight)
Sources: DeFoliart (1992)

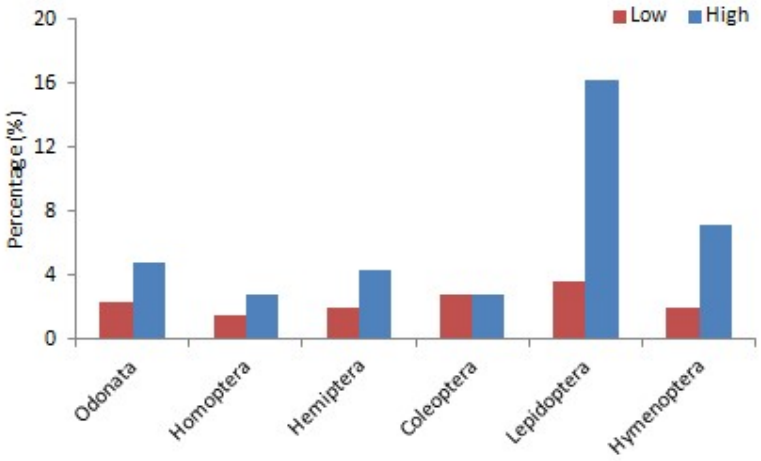

Figure 3: Carbohydrate content in some insect orders (% dry weight)
Sources: Genç, H. (2006)

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