



## การปฏิวัติโปรตีนจากแมลง: แหล่งโปรตีนทางเลือก

### Insect Protein Revolution: Edible Insects as Alternative Protein Sources

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Protein is a nutrient that plays an important role for humans. Protein adequacy can be used as an indicator to see the nutritional condition of society in general and also the government's success in developing food, agriculture, and health. For the human body, a lack of protein over a long period can result in increased susceptibility to illness. According to FAO, in 2050 the need for food will increase due to the world population which is estimated to reach 9.8 billion people [1]. Developed countries currently have food consumption patterns, especially animal protein that continue to increase [2]. Animal protein, including meat, eggs, milk, and fish, is considered to have high quality protein [3]. Meat and milk not only provide high-quality protein and energy but also provide micronutrients such as iron, calcium,

zinc, vitamins, and essential fatty acids [4]. However, it is important to remember that consuming meat, especially excessively processed meat, can result in various diseases, such as cancer, diabetes, and cardiovascular disease [5]. On the other hand, producing animal products requires quite a lot of natural resources, such as large areas of land, requiring a lot of water, and animal farming contributes 18% of greenhouse gas production [6]. It is clear that to meet future demands alternative protein sources are needed.

Insects are thought to be an alternative source of protein. From a nutritional point of view, insects contain a lot of protein and essential amino acids, even in some insects the protein content is better than conventional protein sources, such as beef

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and shrimp [7]. Insects are a resource that has a close relationship with humans, but insects are also known as detrimental pests, especially to crops, plantations, and forestry. Consuming insects, called entomophagy, has existed for thousands of years, especially in people living in tropical areas, including Latin America, Asia, and Africa [8]. The countries with the highest number of edible insect species are China, Mexico, Thailand, and India [9]. Nowadays, to produce alternative protein sources, the consumption of edible insects has received much attention throughout the world [10]. In the last 10 years, several edible insect companies have emerged in Europe, South Asia, and North America. There are around 130 edible insect companies with commercial brands worldwide [11].

There are approximately 1,900 species of edible insects including crickets, grasshoppers, bamboo worms, silkworms, wasps, ants, leafhoppers, dragonflies, termites, bees, beetles, and flies [12]. Currently, the most popular insects to consume in the Europe market are bees, crickets, silkworms, and bamboo worms, while in the North American market, the main edible insects consumed are crickets. In Thailand and China they generally consume grasshoppers, crickets, bamboo worms and beetles. Several types of edible insects can provide nutrients, such as protein, fiber, fat, vitamins, and minerals so that they are beneficial for the body [13]. The research results show that replacing casein with mealworm insects increases the metabolic health of hyperlipidemia mice [14]. Several studies have shown that insects contain good nutrients, and high levels of protein, fat, vitamins, fiber, and minerals, but the amounts vary for each species (Table 1).

**Table 1:** List of major edible insects and their nutritional content [15], [16].

Insect	Composition (%)		
	Protein	Fat	Fiber
Beetles, Grubs	40.7	33.4	10.7
Cockroaches, Termites	35.3	29.9	5.3
Flies	49.5	22.8	13.6
Bees, Wasps, Ants	46.5	25.1	5.7
Cicadas, Stink bugs	48.3	30.3	12.4
Butterflies, Moths	45.4	27.7	6.6
Dragonflies, Damselflies	55.2	19.8	11.8
Grasshoppers/locusts, Crickets	61.3	13.4	9.6

Consuming insects has received different views, including being considered poor primitive behavior and disgusting behavior, however, with advances in technology and research results that have proven the great potential and benefits of insects, the culture of insect consumption has succeeded in attracting public attention. The latest expert assessments are starting to convince the world that entomophagy has the potential to be an efficient alternative protein source because it uses fewer natural resources, has health benefits and helps in food security programs.

Even though insects can be a new alternative protein source, people's acceptance of consuming insects still needs more attention. To gain consumer acceptance, creativity is needed from business actors, including that insects can be processed into other, unrecognizable forms. For example, turning them into protein powder, analog meat, snack products, milk substitutes and into bakery products [9]. However, in some cases, certain countries are used to consuming insects traditionally or in whole



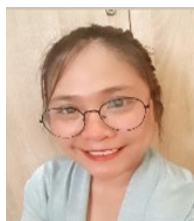
form, and in some cases, insects are given special treatment, namely by removing parts of the insect's body that do not taste good, for example, the wings, head, legs or stomach. Insect preparation processes are also vary depending on the sensory reception aspect, the health aspect and the operational steps including cleaning, heating, and drying processes [17].

Edible insects as an alternative protein source by looking at the various benefits obtained both in terms of health, economics, and utilization of natural resources. They are feasible and need to be studied and researched further, both for the diversity of food forms and the unexpected impacts on the body when consuming them for food safety sustainable.

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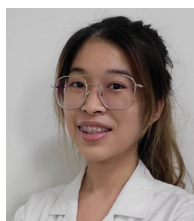
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