Chapter 9

Future Crops: Edible Insects and Alternative Protein Sources

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Abstract

Considering its high nutritional value, protein content, and vitamin content, insects can help end world hunger in a sustainable way. However, consumer resistance is a barrier to broad acceptance in Western countries. In discussing the benefits and drawbacks of insects as well as regulatory structures and marketing tactics, the paper highlights the significance of addressing psychological and emotional hurdles. With an emphasis on their potential as a nutrient-dense food source, this article explores the nutritional value, practical characteristics, and bioactive components of several insect species. Examining insect eating from prehistoric times to the present, the article looks at worldwide insect species, their usage as a substitute source of protein, and both conventional and novel techniques for digesting insects and obtaining their nutritious components. In light of consumers' reluctance to develop the industry despite edible insects' ethical status as a dietary alternative, this article examines the possible advantages of ingesting edible insects, including their nutritional worth and environmental effect as a substitute protein source, as well as the regulatory obstacles encountered by the sector. Examining their extraction methods, characteristics, applications and nutritional worth, this article explores alternative protein sources as viable alternatives for proteins obtained from vertebrates. Furthermore, it attracts attention to the positive aspects and limitations of incorporating these proteins into methods of food produce and processing. In this article, the nutritional profiles and processing techniques of edible insects are highlighted as a viable and sustainable food source. By rectifying protein deficits and even acting as a substitute protein source in food formulations, it implies that insects might improve food and nutritional security.

Keywords

Entomophagy, Fiber, Iron, Omega-3, Vitamin B12, Zinc

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1. Introduction

Entomophagy, or eating insects, has advantages for the environment, economy, and health. In addition to reducing pollution and supplying food security, edible insects also produce biomass from feed and flourish on organic waste. In addition, their nutritional content frequently equals or exceeds that of birds and animals, and they consume less water and land than conventional livestock production [1]. Edible insects have a digestibility of 76% to 98% and provide nutrients such protein, minerals, vitamins, and unsaturated fatty acids. Their immune-stimulating, blood-sugar-regulating, antioxidant, and anti-genotoxic qualities may help maintain the health of the cardiovascular and neurological systems [2]. As essential sources of protein for humans as well as livestock, edible insects have the potential to improve food security globally. To achieve their full potential, they need greater care in the production and processing stages [3]. Highlighting the sustainable and environmentally favorable opportunities of fermentation in the large-scale production of edible insects. It indicates the requirement for further research for increased efficiency and sustainability by demonstrating that fermentation may feed adapted insects [4]. By tackling climate change and biodiversity loss, improving food security, minimizing nutrient and energy cycles, and enhancing sustainable circular agriculture, the insect industry could lead the way for stronger insect-related regulations [5]. By minimizing reliance on external sources, insects could help in fighting against the world's food shortages. Academic, industrial, and government partnerships are emphasizing the health benefits, enticing processing methods, and reducing dependency on other food sources [6]. For farmers, insect farming may emerge as a new agricultural industry that boosts the supply of food and feed while also creating opportunities for employment and innovative entrepreneurial alternatives. Though controversial, the idea has potential to meet the requirements of the world's growing population [7]. By recycling food waste, invertebrate insects such as black army flies, grasshoppers, mealworms, housefly larvae, and crickets can be used in aquaculture, farming for human beings, and feed for livestock [8]. The possible advantages of legume products, fungi, insects, and aquatic weeds as sources of protein; their pharmacological, nutritional, and phytochemical characteristics; and health concerns had been discussed [9].

Figure 1 : Various types of Edible Insects

2. Edible Insects and Alternative Protein Sources

Insects as a food source have been the subject of a great deal of research since the Food and Agriculture Organization of the United Nations (FAO) 2013 report, however insufficient has been established about their nutritional composition [10]. On Earth, there are more than 2,000 edible insects, currently only a limited number are often eaten. Insect eating is a traditional habit in many cultures and provides a more environmentally friendly and sustainable meal choice than meat-based proteins [11]. For more than 25 years, the European Union has enforced the safe consumption of meals derived from insects in developing countries with the objective of minimizing allergic responses and creating revenue for this sector [12]. Over the past decade, the EU has been promoting the consumption of edible insects as novel foods, modifying policies, and supplying them to livestock to boost agricultural production [13]. Forecasts indicate that edible insects may provide a substantial source of sustainable protein, with a projected $8 billion worldwide market for them by 2030. As a possible alternative source of protein to meet the global food deficit, insects are high in nutrients and bioactive peptides it may have therapeutic properties [14]. Organic resources such as agricultural and culinary by-products may be converted into useful proteins with needed amino acids by using edible insects. The Lauric acid, oleic acid, omega-3, and omega-6, among other healthy fatty acids, are found in their oil. Edible insects can add up to 100% more protein to diets that are deficient in minerals [15]. Rich in nutrients, edible insects offer health benefits including vitamin B12, iron, zinc, fiber, amino acids, omega-3 and omega-6 fatty acids, antioxidants, and a reduction in greenhouse gas emissions [16]. Worldwide, people consume over 2,100 different types of insects, mostly in tropical areas. Since edible insects are nutritious, Western civilizations are interested in them; yet, industrialization and processing are essential for adoption [17]. Plant-based proteins, reared meat, fermentation, and precision agriculture are some examples of sustainable food production techniques and alternative proteins. It measures the viability of insect farming, as well as the nutrition and protein isolation methods, meeting various dietary requirements in a sustainable manner [18]. Concerns regarding the environment, food security, and animal welfare have made animal-based proteins like fish and meat popular. With their high protein content and effective manufacturing, insects are an appealing alternative that may be utilized for producing novel food products in a variety of ways [19]. While stem cell technology is being investigated for cultured meat, anti-nutritional factors, digestibility, allergic reactions, and biosecurity remain as constraints to the exploration of alternative protein sources such as plants, insects, and single-cell organisms [20]. Technological, sensory, and nutritional constraints continue to be problematic even with an abundance of research on substitute protein sources. The influence of processing on the structural and functional characteristics of these proteins requires additional research [21]. Uncertainties surrounding climate change create challenges for the world's population in terms of food production sustainability. Considering greenhouse gas emissions and crops suitable for human consumption are necessities for livestock, insect farming has emerged as an acceptable replacement [22]. Fifure 1 below shows various types of edible insects.

3. Recommendations

We propose following recommendations on basis of the literature review of potential in using alternative protein sources, such as insects as dietery suppliments.

- Future research should examine the possible advantages of consuming all insects or insect extracts over conventional food sources, particularly in relation to the health and ecological benefits that insects contribute.

- Encouraging edible insects as a wholesome and sustainable food source is essential for regions dealing with food security and resisting the impact of Western feeding customs, particularly in locations where consuming insects is already common.
- Utilizing food waste as substrates or nutritional components in large-scale processes involving human consumption and animal feed, edible insects could enhance food industry sustainability and fulfill future demands for animal protein.
- Considering the need for global food systems to adapt in order to meet problems, governments play a crucial role in supporting sustainable food solutions. In order to achieve sustainability, the Farm to Fork concept emphasizes the significance it is for all parties involved in the food chain.
- In order to overcome customers' discomfort and revulsion with eating insects, future entomophagy research should concentrate on developing marketing techniques that will make insects and products derived from them look more appealing.
- A comprehensive approach is required to compete with overexploited and dangerous protein sources while preserving quantity, quality, and cost-effectiveness through expanding insect production.
- In the future, multidisciplinary research, sustainable legislation, and knowledge-sharing networks may all contribute to the advantages of edible insects.
- The current state of edible insects is insufficient to completely replace traditional livestock nutrition, despite efforts to broaden the market and eliminate Western prejudice.
- Subsequent investigations have to concentrate on ascertaining the most favorable processing parameters that provide insect protein extracts suitable for food formulation, guaranteeing functional characteristics, economic viability, and ecological sustainability.

Conclusion

The food industry has showed potential in using alternative protein sources, such as insects, microalgae, and mycoprotein, in place of animal-based protein. They may be a better option as they have a similar or even higher protein content, but in other situations, their nutritional profile may be impoverished. The need for animal protein, population increase, food instability, and environmental concerns have led to the usage of edible insects as a source of food for humans. Entomophagy is the practice of consuming insects. It contributes to global food security by providing high-quality protein, fiber, bioactive substances, and important micronutrients. The distribution of protein in the world is not even, with a large portion going toward animal feed. Population increase and environmental changes need a reevaluation of the global protein balance sheet, with high-income countries benefiting from a reduction in animal products. Rich in protein, edible insects provide a sustainable and environmentally beneficial substitute for conventional protein sources. They supply the vital amino acids needed for a balanced diet as the world's population increases. Certain insect orders share protein compositions with plant- and animal-based foods including fish, chicken, and soy.

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