



Entomophagy: exploring the health advantages of edible insects - a review

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Summary

More and more people are becoming aware of edible insects as a wholesome and sustainable food source. This article explores the health-promoting aspects associated with their consumption. Edible insects offer a rich source of macronutrients, including proteins, healthy fats, dietary fibers, and essential micronutrients such as vitamins and minerals. These nutritional elements support improved cardiovascular health, satiety, muscle growth, and cognitive function, among other health benefits. In addition, compared to conventional cattle, edible insects have a far smaller environmental impact, which makes them a desirable option for sustainable food production. For broader adoption, overcoming obstacles related to societal acceptance and the regulatory environment will be essential. More research is required to comprehend the long-term consequences completely and optimise the potential health advantages of edible insects.

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Introduction

Insects as food, often known as edible insects, are insect species that are consumed by humans. According to estimates, around 2 billion people frequently eat insects (Huis et al. 2018). Approximately 2,000 insect species are considered edible worldwide, but much fewer are being investigated for mass production in industry and have local approval for use as food. Despite species-specific variations in nutritional value as well as other parameters like food and age, many insects are very nutrient-dense. Diverse culinary goods, including pasta, burger patties, and snacks, frequently include whole or ground insects, which possess a diverse array of flavours (Lange & Nakamura 2023).

Eating insects as an option in the human diet is hesitantly accepted in many societies across the globe, however insects have played significant roles in the history of human nutrition throughout Africa, Asia, and Latin America. According to (Pal & Roy 2014), at least 2 billion people frequently consume insects worldwide. These include ants, beetle larvae, which are consumed by tribes in Africa and Australia as part of their subsistence meals, and crispy-fried locusts and beetles that are popular in Thailand. The literature has identified about 1900 species of bugs as edible, most of which are located in tropical regions. The most often consumed insects are termites, dragonflies, flies, caterpillars, bees, wasps, ants, grasshoppers, locusts, crickets, cicadas,

leaf and planthoppers, scale insects, and true bugs (Pal & Roy 2014; Haldhar et al. 2020).

Entomophagy, or eating insects for food, is gaining popularity as a nutrient-dense and sustainable alternative to traditional protein sources. People have consumed edible insects for centuries in a range of global civilisations, and they are now being recognised for their possible health benefits. There is an abundance of literature substantiating the use of insects as food. Ethnographic studies reveal that insects have traditionally played an important role in the diets of various indigenous tribes around the world. Although some cultures are reluctant to eat insects, there has recently been a resurgence of interest in edible insects. This may be in part, a reaction to the detrimental consequences of globalisation, which lower living standards for rural populations worldwide and hurt biodiversity. Insects are now considered a form of mini-livestock due to the increased recognition of their value as a commodity over the past 20 years. In impoverished rural communities, insects can serve as a decent supply of protein, minerals, vitamins, and energy with few inputs, outperforming animal meat in comparison. This review article aims to explore the nutritional composition and bioactive compounds found in edible insects, as well as their potential benefits for human health. We can gain a better understanding of edible insects' significance in tackling global food security issues and advancing a sustainable and healthy future by looking at the scientific facts about the families of insects. (Kim et al. 2019; Haldhar et al. 2021).

Reasons why entomophagy should be promoted Health

- ✓ A wholesome, nutrient-dense substitute for common foods like chicken, hog, beef, and even fish (from ocean catch) are insects.

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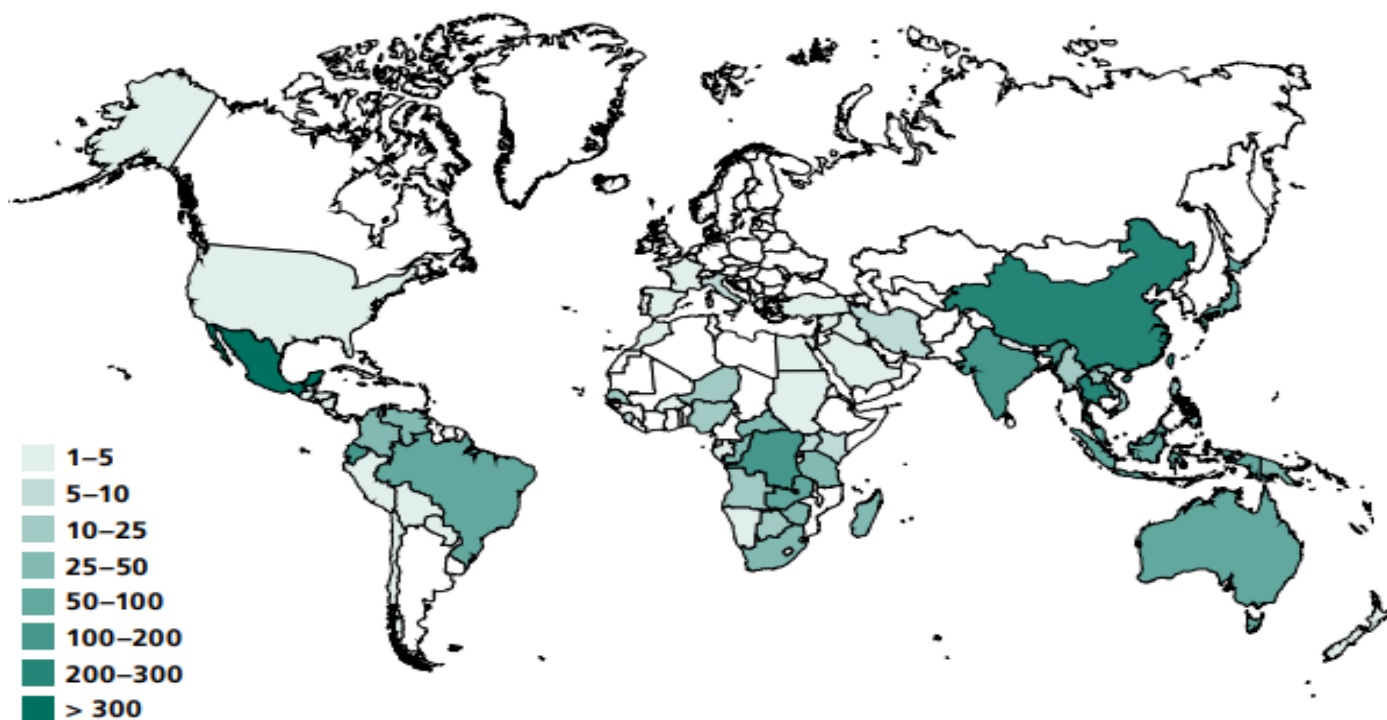
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- ✓ Many insects are abundant in calcium, iron, and zinc.
- ✓ Compared to most animals, insects marketed for food create a significantly lower amount of greenhouse gases (GHGs); for instance, only a small number of bug species, such as termites and cockroaches, produce methane.
- ✓ Raising insects doesn't necessarily require the removal of land in order to boost productivity. The most essential requirement for land is feed, and many local and national cuisines already include insects. (Huis 2013)

Environmental

- Ammonia emissions from insect rearing are likewise far lower than those from conventional animals such as pigs.
- Insects are particularly effective at converting feed into protein because they are cold-blooded (crickets, for example, require 12 times less feed than cattle, four times less feed than sheep, and half the feed as pigs and broiler chickens to generate the same amount of protein).
- Organic waste streams can be given to insects. (Halloran et al. 2016)



Source: Centre for Geo Information, Wageningen University, based on data compiled by Jongema, 2012.

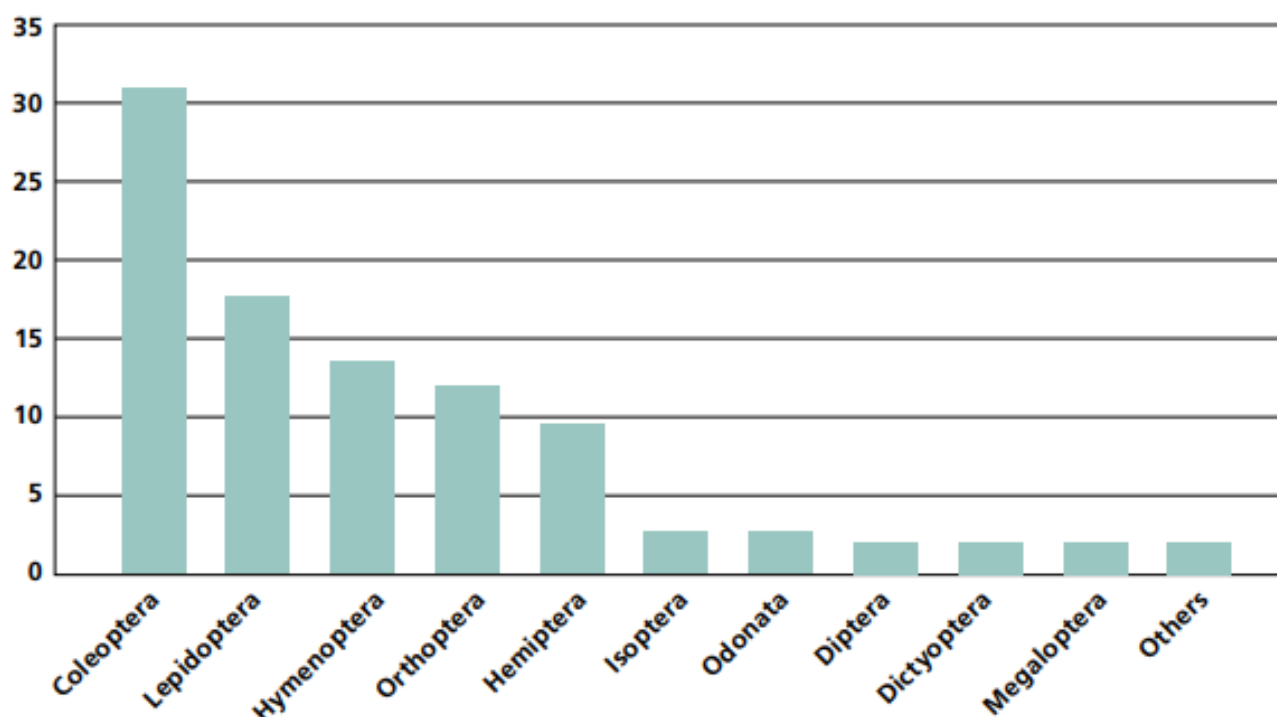
Earnings (economic and social factors): Harvesting and rearing insects is a low-tech, low-capital investment option that even the most impoverished segments of society, including women and the landless, can engage in. Mini livestock provide options for both urban and rural residents. Depending on the level of sophistication, insect rearing can be low-tech or high-tech.

Global markets are expanding

It is projected that by 2032, the value of the edible insect market worldwide will have increased from 3.2 billion US dollars in 2022 to over 17.6 billion US dollars. East Asia's market is predicted to rise by around 25% during that period, more than any other global area. Between 2021 and 2022, the edible insect market in the United States increased by more than 40%, rising from 264 million dollars to around 371 million dollars.

Insect fascination

Beetles and caterpillars are the most commonly consumed insects worldwide. Consumers worldwide are becoming more interested in eating insects. In fact, many French consumers prefer eating insects over consuming laboratory-cultured beef. Having said that, only about 19% of French customers would be willing to eat insects intact. Despite East Asia's fast-developing edible insect sector, according to a 2021 poll, less than 7% of Japanese consumers across all age categories have tasted insects as food. There is still a lot of opportunity for growth in the worldwide edible insect industry, but the growing demand for environmentally friendly products and new protein sources is anticipated to drive expansion.



Note: total number = 1 909.

Source: Jongema, 2012.

Nutritive value of insects

Insects as edible protein

Due to their high energy content and high-quality protein, edible insects are highly appreciated because their amino acid profile can meet the nutritional needs of humans. In certain species, the protein content may exceed 20 g per 100 g serving, matching or surpassing that of chicken breast. Insects present a fascinating and sustainable source of protein, boasting a diverse array of species with varying nutritional profiles. Among these, crickets, grasshoppers, and locusts stand out with their remarkable protein content, ranging from 35% to an impressive 61%, as reported by Rumpold & Schluter 2013. In contrast, termites offer a slightly lower protein content of around 34.35%, according to the same study. However, it's important to consider that these figures may vary based on factors such as diet and metamorphosis stage, as elucidated by Fidanza & Versiglione 1982.

Moreover, the protein content of insects compares favourably to traditional livestock, with studies indicating protein levels comparable to beef and pig, typically falling within the range of 40-75 g/100 g dry weight (Lupo 1997). Despite differences in composition, insect proteins are found to be highly digestible, with digestibility rates ranging from 76% to 98%, as noted by (Gorbunova & Zakharov 2021; Sheileja et al. 2022; Loganathan & Haldhar 2020). This digestibility places insect proteins in a favourable position compared to plant-based proteins like peanuts and lentils, which typically exhibit lower digestibility rates.

Furthermore, the nutritional richness of certain insect products, such as White wax scale (*Ericerus pela*)

eggs, cannot be overlooked. These eggs boast an impressive protein content of 44.6%, with the shells containing even higher levels at 53.57%, as highlighted by Ying et al. (2001). Sheileja et al. (2023) reported that the Asian giant hornet (*Vespa magnifica*) fondly consumed as a delicacy among the ethnic communities of Manipur the North Eastern State of India has a high protein content ranging from 31.1 to 38.4 per cent. Additionally, they are abundant in amino acids, minerals, and vitamins, further enhancing their nutritional value.

Insects as a source of vitamins

Insects, long overlooked in Western diets, are increasingly recognized as valuable sources of essential vitamins. Among them, mealworm larvae and house crickets stand out for their significant content of vitamin B12, crucial for metabolic processes and immune function. While B12 is predominantly found in animal-derived foods, these insects offer viable alternatives, with mealworms containing 0.47 µg per 100 g and house crickets providing 5.4 µg per 100 g in adults and 8.7 µg per 100 g in nymphs (Bukkens 2005; Finke 2002).

It is projected that by 2032, the value of the edible insect market worldwide will have increased from 3.2 billion US dollars in 2022 to over 17.6 billion US dollars. In contrast, bee pupae are a major source of vitamins A and D, and caterpillars are rich in B1, B2, and B6. (Schluter & Rumpold 2013). Vitamin E is abundant in red palm weevil larvae, which contain 35 mg of α-tocopherol and 9 mg of β+γ tocopherol per 100 g, more than the daily requirement of 15 mg (Bukkens 2005). In a similar vein, 9.65 mg of vitamin E per 100 g of silkworm powder is high (Tong, Yiu, and Liu. 2011). Mealworms have a higher total vitamin content than beef, except vitamin B12. Bee

brood (pupae) is rich in vitamins A and D, and caterpillars stand out for having an abundance of B1, B2, and B6 (Rumpold & Schluter 2013). One noteworthy source of vitamin E is the red palm weevil (Bukkens & Paoletti 2005). Last but not least, eating escamoles and eggs from the Formicidae family provides significant levels of vitamins A, D, and E; 505 µg of retinol, 3.31 µg of cholecalciferol, and 2.22 mg of alpha-tocopherol have been observed per 100 g (Kourimska & Adamkova 2016).

Mineral content

Insects are a rich source of various micronutrients beyond just vitamins, including iron, manganese, magnesium, potassium, phosphorus, selenium, sodium, and zinc (Rumpold & Schluter 2013). Certain insect species, particularly those in the Orthoptera and Coleoptera orders, are known to have substantial amounts of folic acid (Kourimska & Adamkova 2016). Insects like *Imbrasia oyemensis*, *Nudaurelia oyemensis*, *Ichthyodes truncata*, and *Imbrasia epimethea* contain significant levels of retinol, with concentrations ranging from 32 to 48 µg per 100 g of dry matter.

The mineral composition varies significantly among different insect species. Most insects have low calcium content (less than 100 mg/g on a dry matter basis), but horse fly larvae and adult melon bugs are exceptions, containing higher levels. The pupae of *Polybia occidentalis* offer just 54 mg of potassium per 100 g, whereas *Apis mellifera*, another Hymenoptera species, provides a high potassium content at all developmental stages, with mature individuals containing 1500 mg of potassium per 100 g. *Macrotermes nigeriensis* has only 6.1 mg of magnesium per 100 g, whereas *Euschistus egglestoni* has a notably higher magnesium content of 1910 mg per 100 g (Gorbunova et al. 2021).

Maximum calcium contents have been reported for adult house crickets, palm weevil grubs, and dung beetle grubs (*Oryctes* sp.), respectively, at 61.3, 72.4, and 76 g/100 g dry weight (Banjo et al. 2006; Onzikou et al. 2010; Vogel 2010). Termites and caterpillars have been reported to have maximum iron levels of 27–29 and 35.5 g/100 g dry weight, respectively (Banjo et al. 2006). High phosphorus levels, ranging from 226–238 g/100 g, are seen in grasshoppers and the gigantic water insect *Lethocerus indicus* (Feng et al. 2000). Furthermore, it has been discovered that the magnesium concentration of grasshoppers and weevils ranges from 7.54 to 8.21 g/100 g (Banjo et al. 2006).

Insects are Super High in Antioxidants

Insects have amazing anti-oxidant qualities. African caterpillars, grasshoppers, silkworms, crickets, and evening cicadas have antioxidant capacities that are two to three times higher than those of olive oil or orange juice, according to studies comparing the antioxidant potential of fresh orange juice and olive oil with water-soluble and liposoluble insect extracts (Di Mattia et al. 2019).

The antioxidant properties of phenolic compounds in insect tea (*Hydrillodes repugnalis*) and vegetal tea were shown in an in vivo investigation conducted on mice. In comparison to the control group, mice given insect tea had reduced levels of nitric oxide and malonaldehyde activities and increased levels of superoxide dismutase,

glutathione peroxidase, and glutathione activities (Aiello et al. 2023).

Four distinct in vitro tests were used to assess the antioxidant activity of the adult *Holotrichia parallela* ethanolic extract (EE) and water extract (WE). While WE demonstrated outstanding antioxidant activity in scavenging 2,2-diphenyl-1-picrylhydrazyl (DPPH) radicals and metal-chelating activity, EE demonstrated substantial metal-chelating activity and prevention of lipid peroxidation (Liu et al. 2012).

Insect phenolic compounds are recognised for their wide range of bioactivities, including anti-inflammatory, anti-cancer, and antioxidant properties. While the primary focus of research on insect phenolics has been on their antioxidant bioactivity, protein and peptide fractions from insects such as mealworms (*Tenebrio molitor*), desert locusts (*Schistocerca gregaria*), and tropical banded crickets (*Gryllodes sigillatus*) are generally considered to be responsible for the overall bioactivity related to oxidation, inflammation, hypertension, and glycaemic inhibition (Zielinska et al. 2017, 2018; Hall & Liceaga 2020; Hall et al. 2018).

Beneficial Fats of Edible Insects

Edible insects are rich in beneficial unsaturated fats, which are essential since the human body cannot synthesize fatty acids and must obtain them through diet. Insects serve as an excellent source of these important lipids. For instance, crickets possess an optimal Omega 3:6 ratio. Unlike other sources of Omega 3 and Omega 6, such as salmon and other seafood that may contain high levels of heavy metals, insects present a substantially lower risk (Lupo 1997; Zhou et al. 2022).

The nutritional and anti-nutritional properties of *O. fuscidentalis* larvae indicate a high protein content of 30.5% and a lipid content of 43.1%. These larvae provide a total energy value of approximately 526.6 kcal/100 g from available carbohydrates, protein, and fat. Among the micronutrients, potassium and calcium are the most abundant minerals, making the larvae a valuable supplement to human diets.

Insects as Bioactive compounds

Bioactive chemicals, which are extra nutritional components typically found in trace amounts in foods, are extensively researched for their health impacts (Kris-Etherton et al. 2002). Numerous studies have identified bioactive chemicals in insects that may enhance immune function and reduce health risks (Roos & Huis. 2017). To protect against microbial infections and environmental changes, various organisms, including insects, mammals, reptiles, and plants, have developed antimicrobial peptides (AMPs) (Soares & Mello 2004). Preliminary studies on the edible stink insect (*Encosternum delegorguei*) have identified the presence of alkaloids, flavonoids, anthraquinones, tannins, steroids, triterpenoids, and cyanogenic glycosides (Yen 2015). *Bombyx mori* L., commonly known as the mulberry silkworm, is one of the most widely domesticated silkworms for commercial silk production. Besides producing high-quality silk, the silkworm is also valued for its various bioactive properties (Islam et al. 2016).

Antimicrobial peptides

The current problem of multidrug resistance is being addressed by a major focus on insect antimicrobial peptides (AMPs), which are a class of antibiotics that are both biologically active and less harmful. An important source of AMPs is insects. More than 150 insect AMPs have been purified or identified since the first insect AMP (cecropin) from the pupae of *Hyalophora cecropia* and *Samia cynthia* giant silk moths was purified in 1980. This purification occurred after antimicrobial activity was discovered in the hemolymph of the pupae in 1974 (Hui-Yu et al. 2014). The gigantic silk moth *H. cecropia*'s immunised hemolymph yielded the first cecropins, cationic antimicrobial peptides (Hultmark 1982; Steiner 1981). Cecropins were also identified as part of the immune response in two silkworms, *Bombyx mori* and *Antheraea pernyi*. Many cecropin families have been isolated in lepidopteran and dipteran insects (Hui-Yu et al. 2014). Insect species provide the greatest unexplored store of antimicrobial peptides. To counter the threat posed by multidrug-resistant infections, these peptides may be utilised in place of conventional antibiotics.

Angiotensin-converting enzyme inhibitors

ACE inhibitors, used to treat cardiovascular disorders by preventing blood vessel constriction, have been found in several insect species. According to Cito et al. (2017), the ACE inhibitory action of the yellow mealworm *Tenebrio molitor*, the silkworm *Bombyx mori*, and the wax moth *Galleria mellonella* is equivalent to that of other food sources. Seo et al. (2017) discovered that obese mice fed yellow mealworm larvae powder on a regular basis gained less body weight because their adipocytes' triglyceride content and lipid accumulation were decreased, indicating that insect bioactive chemicals

may help with weight loss. Additionally, these studies indicate potential benefits for managing type II diabetes, as an ethanol extract of beetle administered to obese mice reduced endoplasmic reticulum (ER) stress, a factor in diabetes pathophysiology. Eating edible insects may also help lower high blood pressure, as ACE causes blood vessels to constrict. Insects like wax moths, yellow mealworms, and silkworms have shown ACE inhibitory activity, though this needs confirmation through human in vivo studies (Micek et al. 2014).

Chitinase and chitin

Arthropod exoskeletons include chitin, a long-chain polymer of N-acetylglucosamine that is the second most common natural polymer after cellulose. For commercial use, chitin is deacetylated to create chitosan. Studies have shown that chitin can reduce fat, as evidenced by leaner grill hens fed crickets, which also consumed less feed and had the best feed conversion ratio. Additionally, chitin has been effective in controlling rumen fermentation and reducing methane emissions in ruminant feed.

In aquaculture, dietary chitosan is suggested for water treatment due to its antibacterial, growth-promoting, antioxidant, and immune-stimulating properties. In humans, chitosan also has a variety of pharmacological properties, such as blood coagulant, anti-cancer, anti-ulcer, antibacterial, antiviral, hypolipidemic, and hypocholesterolemic effects. It also promotes wound healing. Cricket powder contains chitin, which boosted the levels of the probiotic *Bifidobacterium animalis* in humans by a factor of 5.7. By triggering plant defence systems including phytoalexins and pathogenesis-related proteins, chitosan also enhances the health of plants (Lopez-Santamarina et al. 2020).

Potential health benefits of edible insects in the literature

Angiotensin converting enzyme inhibitory activity relevant to hypertension treatment	Peptides from different insect species have angiotensin converting enzyme inhibitory action that is comparable to that of bioactive substances from other animals (Cito et al. 2017). increased hydrolysates' inhibitory action of the angiotensin converting enzyme after different insects' gastrointestinal digesting (Vercruysse et al. 2005; Vercruysse et al. 2008; Wu et al. 2011)
Antioxidant activity	Di Mattia et al. (2019) found that the antioxidant capabilities of water and liposoluble extracts from multiple insect species were 2-3 times greater than those of orange juice and olive oil.
Anticarcinogenic activity	Potential anticancer properties of crude extracts derived from insects (Ahn et al., 2000) and of different proteins, peptides, and alkaloids found in insects (Slocinska et al. 2008; Petit et al. 2005).
Hypolipidemic activity	Omega-3 α -linolenic acid-rich silkworm chrysalis oil influences the lipid metabolism of rats, potentially improving hyperlipidaemia and hyperglycemia (Mentang et al. 2011). Rats given chitooligosaccharides derived from chitosan of larvae skin (<i>Clanis bilineata</i>) showed reductions in body weight growth, total cholesterol, plasma low-density lipoprotein cholesterol, and plasma triacylglycerol (Xia et al. 2013).
Anti-obesity effect	Reduced body weight gain in obese mice given a high-fat diet after receiving powdered yellow mealworm larvae (Seo et al., 2017). Dose-dependent decrease in mice's organ weight, fat tissue volume, and body weight growth when Korean horn beetle larvae were administered (Yoon et al. 2015). house cricket and yellow mealworm extracts administered along with lipase activity associated to the digestion of dietary fats inhibited (Del Navarro Hierro et al. 2020)
Anti-hepatic	The powdered silkworm larvae have been shown to have preventive effects on hepatic steatosis

steatosis activity	and damage in rats treated with ethanol by increasing fatty acid β -oxidation, decreasing de novo fatty acid production, and suppressing oxidative stress and inflammatory response (Hong et al. 2018).
Gut microbiota effect	Human ingestion of whole cricket powder has been shown to support the growth of the probiotic bacterium <i>Bifidobacterium animalis</i> and reduce plasma TNF- α , indicating improved gut health and decreased systemic inflammation (Stull et al. 2018).
Health-span and lifespan	<i>Drosophila</i> fed powdered mature silkworm larvae had longer lifespans and improved health (Nguyen et al. 2016).

Recent scientific literature related to the health benefits of different edible insect species

Mealworms (<i>Tenebrio molitor</i>), buffalo worms (<i>Alphitobius diaperinus</i>), Palm worm larvae (<i>Rhynchophorus ferrugineus</i>)	Water and liposoluble extracts	In vitro	Antioxidant	Di Mattia et al. 2019
Crickets (<i>Grylloides sigillatus</i>)	Bioactive peptides	In vitro	Antioxidant, antihypertensive, antidiabetic, antiglycemic, anti-inflammatory	Hall et al. 2020
Weaver ants (<i>Polyrhachis dives</i>)	Thirteen non-peptide nitrogen compounds (most were identified as alkaloids)	In vitro	Anti-inflammatory, immunosuppressive, renoprotective	Tang et al. 2015
House cricket (<i>Acheta domesticus</i>) and tropical banded cricket (<i>Grylloides sigillatus</i>)	Chitin and chitosan	In vitro	Hypolipidemic, antimicrobial	Malm et al. 2015
Mealworms (<i>Tenebrio molitor</i>) and Chinese beetle (<i>Ulomoides dermestoides</i>)	Extract with main components of saponins, carbohydrates, and proteins	In vitro	Antioxidant and antimicrobial	Flores et al. 2015
Silkworm (<i>Bombyx mori</i>)	Powder	In vivo	Anti-Parkinson activity	
Bee pupae	Polypeptide components	In vitro and in vivo	Immunomodulatory	Chen et al. 2022
Mealworms (<i>Tenebrio molitor</i>)	Supercritical fluid CO ₂ extract	In vivo	Immunomodulatory	Tang et al. 2016
Green beetle (<i>Mimela sp.</i>)	Aqueous extract	In vivo	Antioxidant and immunomodulatory	Tukshipa et al. 2022
Crickets (<i>Grylloides sigillatus</i>)	Bioactive peptides	In vivo	Antioxidant	Mudd et al. 2022
House cricket (<i>Acheta domesticus</i>) and mealworms (<i>Tenebrio molitor</i>)	Polyphenolic ethanol and ethanol: water extracts	In vitro	Antioxidant and antiobesity	Navarro et al. 2020
House cricket (<i>Acheta domesticus</i>)	Polyphenolic methanolic extracts	In vitro	Antioxidant	Nino et al. 2021
Mealworm (<i>Tenebrio molitor</i>) and grasshopper (<i>Sphenarium purpurascens</i>)	Flour fermented with <i>Lactococcus lactis</i> strains	In vitro	Antioxidant and antihypertensive	Mendoza et al. 2021

Future directions

The future directions of edible insects encompass a wide range of areas that require further exploration and development. As the field of entomophagy continues to evolve, the following aspects present promising avenues for future research and innovation:

Nutritional profiling and optimization: Conducting comprehensive studies to determine the precise

nutritional composition of different insect species and their life stages. This includes identifying variations in nutrient content based on factors such as diet, rearing conditions, and processing techniques. Additionally, optimizing insect diets to enhance their nutritional value and addressing any potential anti-nutritional factors will be crucial.

Safety assessment: Conduct extensive research on the safety aspects of consuming edible insects, including evaluating potential allergenicity, assessing the presence of contaminants (e.g., heavy metals, pesticides), and establishing standardized protocols for quality control and food safety throughout the insect farming and processing chain.

Scaling up production: Developing efficient and sustainable insect farming methods that can be implemented on a larger scale to meet the increasing demand for edible insects. This involves optimizing production systems, exploring automated rearing technologies, and addressing environmental factors such as energy consumption, waste management, and minimizing greenhouse gas emissions.

Sensory acceptance and consumer perception: Conducting sensory studies to assess the acceptability and palatability of different insect species and products across diverse cultures and consumer groups. Understanding consumer attitudes, beliefs, and barriers towards edible insects is essential for developing marketing strategies and promoting wider acceptance and adoption.

Culinary innovation and product development: Exploring new culinary techniques and product formulations that incorporate edible insects into familiar food products, making them more appealing and accessible to a broader consumer base. Developing novel processing methods that preserve the nutritional integrity and sensory qualities of insects will be key to expanding the range of edible insect-based food products.

Health benefits and functional properties: Investigating the specific health benefits and functional properties of edible insects in greater depth, including their impact on gut health, immune modulation, and disease prevention. This research may uncover potential applications in specialized diets, nutraceuticals, and functional foods.

Environmental impact assessment: Comparing the environmental effects of conventional cattle production with insect farming systems by carrying out thorough life cycle studies. Analysing resource use, land use, water consumption, and greenhouse gas emissions are all included in this. Insect farming systems can become even more circular by investigating the possibility of employing insect waste as a sustainable source of animal feed or fertiliser.

Policy and regulatory frameworks: Establishing standardised, unambiguous rules and guidelines for the raising, preparing, and labelling of edible insects. Strong regulations will safeguard consumer safety, ease trade, and encourage the edible insect sector to expand. The field of edible insects can develop further by addressing these future areas, realising their full potential as a wholesome, culturally acceptable, and sustainable food source that will improve environmental sustainability and global food security.

Conclusion

To sum up, this review paper has illuminated the several health benefits associated with eating insects. In light of the growing worldwide need for sustainable food supplies, edible insects have become a feasible and eco-

friendly choice. They are abundant in vital elements including protein, good fats, vitamins, and minerals; in addition, they have special benefits like a high feed conversion rate and little environmental impact. There are a number of health advantages associated with eating edible insects. They're a great alternative protein source because of their high protein concentration, especially for people on a restricted diet or looking for a more sustainable protein supply. Furthermore, lysine and methionine—two necessary amino acids that are frequently lacking in plant-based protein sources—can be found in edible insects. Despite the numerous health benefits associated with edible insects, challenges remain in terms of acceptance and consumer perception. Overcoming cultural barriers and enhancing the palatability and processing techniques of edible insects are crucial to increasing their acceptance in mainstream diets.

Summary

In summary, this review article highlights the remarkable health-promoting aspects of edible insects. Their nutrient profile, bioactive compounds, and sustainability make them a promising solution to global food security and nutrition challenges. By embracing these tiny yet powerful creatures as a part of our dietary choices, we can contribute to a healthier future for both ourselves and the planet. Further research and awareness are essential to fully unlock the potential of edible insects and incorporate them into our daily lives.

Declaration of Interests

The authors have no conflict of interest to declare.

Data Sharing

All relevant data are within the manuscript.

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