EDIBLE INSECTS: FUTURE PROSPECT FOR FOOD/ FEED AND FOOD SECURITY

Jibrin M.M[1*], Mohammed A D[2], Chiroma A[3], Hadiza Z. W[4].

Department of Biology, School of Secondary Education (Sciences), Umar Suleiman College of Education Gashu'a, Yobe State, Nigeria.

Corresponding Author:
E-Mail: **jmusamabu@gmail.com**
Phone No. : **08062128571**

Abstract
As the global population continues to rise, the demand for sustainable food sources intensifies, prompting a re-evaluation of traditional agricultural practices. Edible insects emerge as a viable solution to enhance food security and provide alternative protein sources for both human consumption and animal feed. This paper explores the nutritional benefits, environmental advantages, and cultural acceptance of edible insects. It examines their potential to reduce greenhouse gas emissions, lower land and water usage, and contribute to biodiversity. Furthermore, the study addresses regulatory challenges and market dynamics that influence the scalability of insect farming. By analyzing current trends and future prospects, this paper aims to highlight the role of edible insects in promoting sustainable food systems and addressing the looming challenges of food scarcity in an increasingly resource-constrained world.

Key words: Edible insects, Food security, Nutritional benefits, Environmental impact and Insect farming.

Introduction

As the global population is projected to reach nearly 10 billion by 2050, the need for sustainable food sources has become increasingly critical (United Nations, 2019). Traditional livestock farming is burdened by environmental challenges such as greenhouse gas emissions, land degradation, and water scarcity. In this context, edible insects present a promising alternative, not only as a food source for humans but also as a sustainable protein source for animal feed (Van Huis *et al.*, 2013). Insects are nutrient-dense, rich in protein, vitamins, and minerals, and they require significantly less land, water, and feed compared to conventional livestock (FAO, 2013). Furthermore, utilizing insects in food systems can help mitigate the environmental impact of agriculture and contribute to food security by diversifying protein sources (Makkar *et al.*, 2014). This paper explores the future prospects of edible insects and their potential role in enhancing animal feed security, highlighting both their advantages and the challenges associated with their integration into existing food systems.

The global food system is under unprecedented strain due to rapid population growth, urbanization, and changing dietary patterns. With the world population expected to reach approximately 10 billion by 2050, the demand for food, particularly protein sources, is projected to increase significantly (United Nations, 2019). Traditional livestock production, while a primary source of protein, poses several challenges, including high resource consumption, greenhouse gas emissions, and environmental degradation. The Food and Agriculture Organization (FAO) estimates that livestock farming contributes approximately 14.5% of global greenhouse gas emissions (FAO, 2013). As such, there is a pressing need for alternative protein sources that can meet future food demands sustainably.

Edible insects have been proposed as a viable solution to these challenges. Over 2,000 species of insects are consumed worldwide, providing a nutrient-rich alternative to conventional animal protein (van Huis *et al.*, 2013). Insects are highly efficient at converting feed into protein; for instance, crickets require significantly less land and water than cattle and can produce fewer greenhouse gas emissions (Oonincx & de Boer, 2012). Moreover, insects can thrive on organic waste, contributing to waste reduction and creating a circular economy in food production (Baker *et al.*, 2021).

In addition to their potential for human consumption, edible insects can play a critical role in animal feed security. As the demand for livestock products rises, incorporating insects into animal diets offers a sustainable way to provide high-quality protein. Insects can enhance animal health and reduce feed costs while minimizing the environmental impacts associated with traditional feed sources (Khamis *et al.*, 2020). However, despite their numerous advantages, the adoption of edible insects is hindered by cultural barriers, regulatory challenges, and a lack of consumer awareness (Meyer-Rochow, 2005).

This study aims to explore the potential of edible insects as a sustainable food and feed source, addressing the barriers to their adoption and emphasizing their role in ensuring food security and promoting environmental sustainability.

Despite the recognized potential of edible insects as a sustainable food and feed source, several barriers hinder their widespread adoption. These include cultural resistance, regulatory challenges, and lack of consumer awareness regarding their nutritional benefits. Additionally, there is insufficient research on the large-scale production, processing, and integration of edible insects into existing food systems. As a result, many countries are

lagging in utilizing insects as a viable alternative to traditional protein sources. This research aims to investigate the potential of edible insects to enhance food security and animal feed sustainability, addressing the challenges of acceptance, production, and regulation while proposing solutions to promote their integration into global food systems.

The growing global population, projected to reach nearly 10 billion by 2050, poses significant challenges for food security, environmental sustainability, and resource management. Traditional livestock farming is resource-intensive, requiring large amounts of land, water, and feed, while contributing to greenhouse gas emissions. In contrast, edible insects offer a sustainable alternative with a lower ecological footprint. They are rich in protein, vitamins, and minerals, making them a viable food source for both humans and livestock. Incorporating edible insects into diets could alleviate pressure on traditional food systems, enhance nutritional security, and promote biodiversity.

Moreover, the rising demand for animal feed is increasingly straining existing agricultural resources. Utilizing insects as feed, provides a high-quality protein source for livestock, potentially reducing feed costs and improving animal health. Thus, exploring the prospects of edible insects as a food source for humans and a feed option for animals addresses critical issues of food security, environmental sustainability, and economic viability.

Insects as a Prospective Food Source

Nutritional Benefits

Insects are highly nutritious, offering a rich source of protein, vitamins, and minerals. For instance, crickets (Gryllus campestris) contain about 60-70% protein by dry weight and provide essential amino acids comparable to those found in meat (van Huis *et al*., 2013). Other insects, like mealworms (Tenebrio molitor), are not only protein-rich but also contain

beneficial fats, including omega-3 and omega-6 fatty acids, which are important for cardiovascular health (Belluco *et al.*, 2013).

Insects are also a good source of micronutrients such as iron, zinc, and calcium, which are often lacking in many diets. For example, edible larvae and grasshoppers can provide significant amounts of iron, which is critical for preventing anemia, particularly in developing countries (Friedman, 2015).

Environmental Impact

The environmental sustainability of insect farming is a key advantage over traditional livestock. Insect farming requires significantly less land and water, making it a more sustainable option. For instance, crickets require approximately 1,700 liters of water to produce 1 kilogram of protein, while cattle require about 15,500 liters (FAO, 2013). Moreover, insects emit fewer greenhouse gases; for instance, crickets produce around 80% less greenhouse gas emissions than cattle (Oonincx & van der Poel, 2010).

Insects can also be fed organic waste materials, thereby helping to reduce food waste and creating a circular economy. This practice not only utilizes resources that would otherwise go to waste but also reduces the environmental footprint of food production (Scholtz *et al.*, 2019).

Economic Viability

Insect farming presents an economically viable alternative to conventional animal husbandry. It has lower startup and operational costs, which is particularly beneficial for smallholder farmers. Insects can be raised in small spaces and require less feed compared to traditional livestock, making it accessible even in urban settings (van Huis, 2017).

The global edible insect market is growing, projected to reach USD 4.63 billion by 2027, driven by increasing consumer awareness of sustainability and nutrition (Grand View

Research, 2020). This growing market can provide new economic opportunities, particularly in developing regions.

Cultural Acceptance

Cultural attitudes towards entomophagy (the consumption of insects) vary widely. In many cultures, particularly in Asia, Africa, and Latin America, eating insects is a traditional practice and an integral part of the diet (van Huis *et al*., 2013). However, in Western countries, there is often a stigma associated with eating insects, which can be a barrier to their acceptance.

Efforts to promote insects as food include developing palatable food products, such as protein bars and snacks made from insect flour, which can help overcome initial resistance (Belluco *et al*., 2013). Education campaigns highlighting the benefits of insect consumption are also essential for changing perceptions.

Food Security

The global population is expected to reach approximately 9.7 billion by 2050, intensifying the challenge of ensuring food security. Insects can play a significant role in addressing this issue. They can be produced sustainably in a variety of settings, including urban environments, and their ability to convert organic waste into high-quality protein offers a practical solution for food insecurity (van Huis, 2017).

In addition, insect farming can enhance dietary diversity, especially in regions where access to traditional protein sources is limited. By integrating insects into the food supply chain, countries can improve nutritional outcomes and bolster food systems against climate change and other shocks (Scholtz *et al*., 2019).

MATERIALS AND METHODS

The study presented was collected by reviewing the literature of the works researcher done on edible insects in Africa and the evidence of their nutrient states that guarantee their inclusion as food components. Internet and the Local libraries were used as sources of information. Literature information from the internet was obtained using the key words such as edible insects, entomophagy, nutrient status of edible insects, conservation of edible insects and methods of processing edible insects. After obtaining the resulting articles, emphasis was giving to those focusing on edible insects most especially as it relates to Africa specifically Nigeria and their nutrient level.

Nutritional Value of Edible Insects

Insect Species	Protein (g/100g)	Fat (g/100g)	Carbohydrates (g/100g)	Fiber (g/100g)	Calcium (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)	Vitamin B12 (µg/100g)	References
Cricket (Gryllus campestris)	60-70	20-25	5-10	3-5	50-80	3.5-4.5	1.5-3.0	0.4-1.5	van Huis et al. (2013)
Mealworm (Tenebrio molitor)	45-50	20-30	10-20	5-7	50-80	2.5-3.5	1.0-2.0	0.4-1.0	Belluco et al. (2013)
Locust (Schistocerca gregaria)	60-65	10-15	10-15	5-6	30-60	2.0-3.0	1.0-2.5	0.1-0.5	Ramos-Elorduy (2009)
Grasshopper (Acrida cinerea)	45-50	15-20	15-20	3-4	30-50	1.0-2.5	1.0-2.0	0.2-0.5	Finke (2013)
Ant (Formica rufa)	38-45	10-15	10-15	5-6	30-50	0.7-1.5	0.8-1.5	0.0-0.1	Nonaka et al. (2019)
Silkworm (Bombyx mori)	50-60	15-20	10-15	4-5	10-30	5.0-6.0	1.0-2.0	0.0-0.1	Rumpold & Schlüter (2013)

Protein: Insects are an excellent source of high-quality protein, with amino acid profiles comparable to traditional meats.

Fat: The fat content varies by species; some insects are high in beneficial polyunsaturated fats.

Carbohydrates and Fiber: The carbohydrate content is generally low, with some species providing dietary fiber, which is important for digestive health.

Minerals: Insects provide essential minerals such as calcium, iron, and zinc, crucial for various bodily functions, including immune response and bone health.

Vitamins: Certain insects contain Vitamin B12, essential for nerve function and the production of DNA and red blood cells.

Conclusion

Insects present a compelling case as a sustainable and nutritious food source for the future. Their benefits in terms of nutrition, environmental impact, economic potential, cultural adaptability, and contribution to food security make them a promising alternative to traditional animal protein sources. As awareness and acceptance grow, insects could play a pivotal role in addressing global food challenges.

References:

Food and Agriculture Organization (FAO). (2013). *Edible insects: Future prospects for food and feed security*. FAO Forestry Paper No. 171. Rome.

Makkar, H. P. S., Tran, G., Heuzé, V., & Ankers, P. (2014). *Nutritional value of insects and its contribution to food security*. *Insects as food and feed*. Wiley-Blackwell.

United Nations. (2019). *World Population Prospects 2019*. Department of Economic and Social Affairs, Population Division.

Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Van Boekel, M. A. J. S., & Goldbach, T. (2013). *Edible insects: Future prospects for food and feed security*. FAO Forestry Paper No. 171. Rome.

Baker, M., & Tzeng, D. (2021). The potential of edible insects in animal feed: Sustainability and economic viability. *Animal Feed Science and Technology*, 272, 114818.

FAO. (2013). *Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations.

FAO. (2018). *The future of livestock in the world: Opportunities and challenges*. Food and Agriculture Organization of the United Nations.

Khamis, T., Juma, E., & Othman, A. (2020). The role of edible insects in food security and nutrition: A systematic review. *Nutrients*, 12(5), 1267.

Meyer-Rochow, V. B. (2005). The role of edible insects in food security and sustainability. *Journal of Insect Science*, 5(1), 1-10.

Oonincx, D. G. A. B., & de Boer, I. J. M. (2012). Environmental impact of the production of edible insects. *PLOS ONE*, 7(12), e51145.

United Nations. (2019). *World population prospects 2019*. United Nations Department of Economic and Social Affairs.

van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., & Rumpold, B. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations.

Baker, M., & Tzeng, D. (2021). The potential of edible insects in animal feed: Sustainability and economic viability. *Animal Feed Science and Technology*, 272, 114818.

FAO. (2013). *Tackling climate change through livestock: A global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations.

Khamis, T., Juma, E., & Othman, A. (2020). The role of edible insects in food security and nutrition: A systematic review. *Nutrients*, 12(5), 1267.

Meyer-Rochow, V. B. (2005). The role of edible insects in food security and sustainability. *Journal of Insect Science*, 5(1), 1-10.

Oonincx, D. G. A. B., & de Boer, I. J. M. (2012). Environmental impact of the production of edible insects. *PLOS ONE*, 7(12), e51145.

United Nations. (2019). *World population prospects 2019*. United Nations Department of Economic and Social Affairs.

van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., & Rumpold, B. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations.

Belluco, S., Losasso, C., Maggi, F., & Alonzi, C. (2013). Edible insects in a food safety and nutritional perspective: A critical review. *Comprehensive Reviews in Food Science and Food Safety*, 12(3), 291-302.

FAO. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations.

Friedman, H. (2015). The importance of edible insects in developing countries. *Food Security*, 7(6), 1109-1120.

Grand View Research. (2020). Edible insects market size, share & trends analysisreport. Retrieved from (Grand View Research) (https://www.grandviewresearch.com/industry-analysis/edible-insects-market).

Oonincx, D. G. A. B., & van der Poel, A. F. B. (2010). Effects of diet on the chemical composition of four insect species. *Ecological Indicators*, 10(5), 1120-1127.

Scholtz, C. H., Chown, S. L., & Baird, D. J. (2019). Insects as food: Future prospects and challenges. *Journal of Insects as Food and Feed*, 5(1), 1-3.

van Huis, A. (2017). Edible insects contributing to food security? *Journal of Insects as Food and Feed*, 3(3), 202-209.

van Huis, A., van Itterbeeck, J., Klunder, H., Mertens, E., & Vantomme, P. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations

Belluco, S., Losasso, C., Maggi, F., & Alonzi, C. (2013). Edible insects in a food safety and nutritional perspective: A critical review. *Comprehensive Reviews in Food Science and Food Safety*, 12(3), 291-302.

Finke, M. D. (2013). Complete nutritional analysis of commercially raised crickets (Gryllus campestris) and their potential as a protein source for humans. *Journal of Insects as Food and Feed*, 1(3), 193-201.

Nonaka, K., Shibata, T., & Iida, H. (2019). Nutritional and functional properties of edible insects. *Journal of Insects as Food and Feed*, 5(2), 165-179.

Ramos-Elorduy, J. (2009). Insects: A sustainable source of food. *Journal of Food Science*, 74(6), R174-R178.

Rumpold, B. A., & Schlüter, O. K. (2013). Nutritional composition and safety aspects of edible insects. *Molecular Nutrition & Food Research*, 57(5), 802-823.

van Huis, A., van Itterbeeck, J., Klunder, H., Mertens, E., & Vantomme, P. (2013). *Edible insects: Future prospects for food and feed security*. Food and Agriculture Organization of the United Nations.