ENTOMOPHAGY AND THE PRESERVATION OF HUMAN FOOD SECURITY

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ABSTRACT

Food security is a concern in many developing and less developed nations, owing to the rise in human population, as well as the decline in agricultural production and availability of food resources. Edible insects are a naturally occurring, renewable source of food that provides carbohydrates, proteins, lipids, minerals, and vitamins in addition to other nutrients. The practice of eating insects is widespread among ethnic groups in South America, Mexico, Africa, and Asia where indigenous insects are readily accessible and may be eaten in a variety of ways (raw/processed), as well as utilized as an ingredient or supplement in contemporary cuisine. Entomophagy, as a result, provides a chance to close the protein gap in human diets, notwithstanding a few limitations that have been addressed. In terms of food security, greater attention should be paid to evaluating and revalidating entomophagy in the context of contemporary living. Further study would be required to fully utilize insect biodiversity and ethno-entomophagy, to prevent overexploitation of these insects, and to start conservation efforts aimed at protecting insects.

KEYWORDS: *Agriculture, Entomophagy, Food Security, Insects, Production.*

1. INTRODUCTION

Food security is rapidly becoming a concern for human beings as a result of rapidly growing populations, rising consumption levels, and the potential for food supply to decrease. The production of agricultural products has almost reached a standstill, and chronic hunger is rampant in many developing countries. Global food insecurity appears to be caused by a combination of natural factors such as climate change, the energy crisis (depleting soil fertility), the occurrence of pests and plant diseases, and man-made factors such as increased food prices, non-availability of foods, a lack of purchasing power among consumers, unequal distribution of foods, and so on. Global food demand is expected to increase for at least another 40 years[1].

The demand for food will rise by 50% by 2030, with the human population increasing by six million people per month and existing food stocks at their lowest level in 50 years. Searching for new and readily accessible sources of nutrition to supplement or replace meals may be a realistic and necessary step. It will take time for efforts to improve food supply through new technologies to be implemented on a large scale in order to become feasible/practical, cost-effective, and environmentally friendly (for example, genetically modified crops, geo-engineering, crop genotypes with resistance to pests, diseases, and drought, plants with the ability to reflect

sunlight (albedo effect), new chemical molecules, integrated plant nutrient and pest management techniques, and so on)[2].

The Food and Agriculture Organization of the United Nations (FAO) took the initiative to develop a policy and suggested a programme to feed people with alternative sources, including insects, as part of its global duty, at the very least for member nations. The organization emphasizes the need of both physical and economic access to food that satisfies people's nutritional requirements as well as their preferences, despite the fact that globalization of the world economy has the potential to undermine food security, particularly in Africa.

Entomophagy is a word used to describe the practice of consuming insects as a source of nutrition. Although the terms 'micro-livestock' and ‘mini-livestock' are not synonymous with the term entomophagy, they are frequently used to classify insects that may be consumed by humans. The consumption of palatable insects is now a natural food resource for many ethnic groups in Asia, Africa, Mexico, and South America, where entomophagy is a sustainable practice that provides economic, nutritional, and environmental advantages to rural communities[3].

However, entomophagy is becoming less prevalent in certain areas as a result of the growing consumption of contemporary foods, the transformation of social structures, and demographic shifts. Tasting, nutritional content, cultural traditions, local prohibitions, familial history, and accessibility are all factors that influence which edible bug species are preferred by consumers. According to researchers, there are 1391 bug species consumed across the globe.

This author later reported 1681 species in 14 insect orders, and more recently 2086 insect species that are eaten by 3071 ethnic groups in 130 countries, all reported by the same author. Eating edible insects varies depending on the area and country within a region, with 348 species in Mexico, 250 in Sub-Saharan Africa, 187 in China, 96 in the Central African Republic, 83 in Ecuador and 60 in India and Borneo, 55 in Japan, 50 in Thailand, and 40 in Nigeria being the most abundant. Despite the fact that various statistics are available for different insect orders, the Lepidoptera, Orthoptera, Coleoptera, and Hymenoptera are the insect orders that produce the bulk of edible insects. The Isoptera, Homoptera, Heteroptera, Diptera, and Odonata are some of the other common insect orders[4].

Worldwide, entomophagy plays a significant role in human food security, and academics have already conducted a thorough study of the topic. Similarly, the results of the FAO workshop and 'The Food Insects Newsletter,' which is no longer published but is available as a collection of 13 volumes in a book, are the finest sources of information on edible insects. Improvements in nutrition and food security will be required in the future.

In order to feed people, this review considers entomophagy as one of the practical and viable solutions to food security. It presents recent developments to supplement earlier reports, discusses major challenges, and envisions future steps in order to feed people by suggesting that entomophagy be included in future food security plans and initiatives.

1.1 Entomophagy:

For the following reasons, entomophagy is widely practiced across the world:

a. Insects are readily discovered in forestland and water resources, and they may be gathered in large numbers in a short period of time when their populations are high.

b. The brief life cycle of insects, as well as their rapid intrinsic growth rate, allow them to be raised and duplicated quickly in tiny places and over a short period of time. Because edible insects do not need grain feeding, their upbringing is more ecologically friendly than that of conventional cattle. When compared to conventional cattle, insects reproduce at a higher rate. For example, the female house cricket Achetadomesticus L. (Orthoptera: Gryllidae) can lay from 1200 to 1500 eggs in 3 – 4 weeks and has a very low water requirement, whereas the beef industry has a ratio of four breeding animals for every marketed animal. For example, the female house cricket Achetadomesticus L. (Orthoptera: Gryllidae) can lay from 1200 to 1500 eggs in 3 – 4 weeks and has a very low water. Furthermore, the efficiency of conversion of ingested food (ECI) is greater in insects (up to 44 percent in certain insects) than it is in conventional meats (up to 20 percent in some insects). Take, for example, the house cricket, which has an ECI that is twice as efficient as pigs and broiler chickens, four times more than that of sheep, and six times larger than that of a steer when losses in carcass trim and dressing % are taken into consideration.

c. Low-income areas are unable to feed their families during a food shortage because only insects are available. This is especially true at the beginning of the rainy season, when livestock is starving, new crops have only recently been planted, and the stocks of stored produce from the previous crop season are running low. The result is that local markets are overrun with insects that have been packaged in plastic bags and marketed as food items throughout the planting season. Packages of insects may be readily disseminated as an emergency food security strategy in the event of a natural catastrophe (such as floods, droughts, or human disease outbreaks), ethnic conflict, or a war, for the same reasons as above[5].

d. Insects are usually combined with, or often eaten as a complement to, main diets based on maize, cassava, sorghum, millet, beans, and rice, and they are also used as a component in the production of other food products such as flour. 'Tortillas' (thin flat bread prepared from finely ground maize) are supplemented with mealworm larvae in Mexico, while the termite MicrotermesbellicosusSmeathman supplements maize protein alone in Nigeria, both of which are native to Africa.

e. The following methods of preparing insects are available: frying, braising, stewing, stewing after frying, boiling, and roasting. All stages of the life cycle are consumed, although larvae and pupae are frequently offered in restaurants and at local and retail markets in metropolitan areas. Fried grasshoppers in cans and chocolate-covered ants are popular in Mexico, while chocolate chirpy chips or popcorn with roasted crickets and grasshoppers are popular in the United States, ants with popcorn are popular in Colombia, and maggot cheese is a delicacy in Italy, among other places. In the United States, several restaurants are integrating insects into their recipe books and menus, such as stir-fried mealworms and caterpillar crunch, among other dishes[6].

f. Food businesses in industrialized nations have taken the initiative to export insects in the form of beetle juice, canned silkworm pupae, caterpillars of hesperid butterflies, and juvenile stages of ants, in addition to supplying local markets with these products. In comparison to traditional cattle, insects generate much lower levels of greenhouse gases (GHG), especially methane and nitrous oxide, per kilogram of meat consumed. When compared to mealworms, a pig emits up to 100 times the amount of greenhouse gases. Also seeming to be considerably reduced is the emission of ammonia, which is responsible for the acidification and

eutrophication of ground water. A pig generates 8–12 times the amount of ammonia produced by crickets, and up to 50 times the amount produced by locusts.

1.2 Insects Nutritional Value:

A loaf of bread made from the grubs of the African palm weevil Rhynchophorusphoenicis (F.) contains all of the main and minor nutrients required for proper body development. In a recent research conducted in Kenya, wheat buns enriched (5 percent mix) with the termite MacrotermessubhyalinusRambur outperformed conventional breads in terms of certain characteristics (e.g., size, color, texture, fragrance, and consumer preference) and customer choice, as well as overall quality. Furthermore, the researchers discovered that the enriched bread contained higher levels of riboflavin (0.17 mg versus 0.26 mg), niacin (0.90 mg versus 1.11 mg), folic acid (0.30 mg versus 0.33 mg), calcium (10 mg versus 10.83 mg), iron (1.20 mg versus 1.80 mg), and zinc (2.78 mg versus 3.23 mg) than regular bread. The oil produced from R. phoenicis grubs has a high concentration of unsaturated components and possesses favorable physiological characteristics, which allow it to be utilized as an edible oil in many cultures[7].

In the case of silkworm caterpillars, eating them may provide adequate amounts of copper, zinc, iron, thiamin, and riboflavin to meet daily needs, and the shortage of riboflavin can be remedied by consuming insects that contain this amino acid. In addition, protein synthesis from insects is more environmentally friendly and uses less resources than animal protein production (Gordon, 1998). It is necessary to do further study to determine if the production of a kilogram of insect protein is likewise more ecologically friendly than the production of a kilogram of traditional animal protein when the whole production chain is taken into consideration.

2. DISCUSSION

Entomophagy is the practice of consuming insects as a food source. Humans have been harvesting insects as sustenance for thousands of years, and insects are still being collected today. Previously, this practice was seen as 'old' and 'barbaric,' and there was a strong opposition to the inclusion of insects in meals on the part of many people. However, it is now receiving global interest since insects are being touted as the future food source for the globe. Over the last few years, the Food and Agriculture Organization of the United Nations (UN) has made consistent efforts to promote entomophagy as a healthy, sustainable, and environmentally beneficial activity. This has resulted in increased worldwide awareness of this technique, with individuals daring to experiment with insect dishes in ways they have never done before[8].

As it happens, it is necessary to address some fundamental questions about entomophagy, such as the types of insects that are edible, where they can be found, how they are supposed to be consumed, at what stage of their lives they are suitable for consumption, and whether they can be commercially bred are all addressed. Researchers addressed the different ways of collecting and capturing edible insects, including traps and nets. Insect harvesting is typically carried out by women, and in certain areas, by children, for whom insect farming may be a low-input, long-term type of agriculture with a minimal environmental impact. The manner in which the insects are collected is determined by their behaviour.

If the temperature is low enough in the morning, insects will be relatively inactive and easy to catch; nocturnal insects (such as termites and grasshoppers) can be caught in light traps because they are attracted to light; artificial breeding sites can be used to attract palm weevils; and the sound of crickets and cicadas can be used to locate them[9].

Obtaining a significant number of insects in the field is frequently difficult owing to the unpredictable nature of their whereabouts and density of populations. According to researchers in the Democratic Republic of the Congo (DRC), research on the management potential of wild edible insects will increase harvests, ensure nature's sustainability, and create the potential and economic feasibility of mass collection of promising species by local people, who will eventually contribute to rural food stocks and earn their livelihood, as demonstrated by researchers studying the brown silkworm AnapheinfractaWalsingham in the DRC. Caterpillar output in northern Zambia may be increased by shifting agricultural farming, which is another option.

Because most insects are only accessible in nature during certain seasons, the development of commercially viable methods of mass rearing in confined settings is essential. The raising of insects in captivity (cages, potted plants, and rooted food plants) at the village level, rather than depending on wild collection, may provide a more consistent supply of insects. It is possible to raise the hepialid caterpillar Wiseanacopularis Meyrick (Lepidoptera: Hepilidae) and the South American palm weevil Rhynchophoruspalmarum L. on alternate host plants or artificial diets (semi-synthetic/synthetic) in a laboratory setting.

Farmers in India have had great success raising the eri silkworm and mulberry silkworm in their homes, while in Japan they have raised giant hornets (Vespula spp.) in wooden hive boxes and in Thailand they have raised the eri silkworm on cassava leaves. Indoor rearing of these insects has become a routine commercial activity. For cricket farming, farmers in Thailand utilize cement tanks or wooden containers covered with a plastic sheet to store the crickets. For the crickets' benefit, a layer of sandy loam soil is added, which is then covered with dried grasses, bamboo shoots, or empty egg cartons to give shade. The introduction of egg masses is followed by the covering of containers with nylon netting. Water and an artificial diet consisting of chickfeed mixed with grasses or weeds are given for the chickens. Adult crickets are ready to be collected after 4 to 6 weeks of growth[10].

It is possible that the sale of insects generates more revenue for farmers in the Sahel than the sale of millet in areas where small-scale production units using simple techniques of mass rearing can be established. In these areas, small-scale production units with simple techniques of mass rearing can be established. If insects are raised or gathered in excess, preservation by drying may help to develop cottage businesses by providing a profitable commercial opportunity.

The transition from small units to an industrial phase, accompanied by the adoption of cost-effective mass manufacturing on a huge scale, is thus necessary. Of fact, taxonomic ambiguity and a paucity of knowledge on the biology of some insects make commercialization difficult in some cases. Accordingly, new research should focus on the identification of insect species, their ecology, and the nutritional content of insect species with short life cycles, which are the most suited for mass raising. In recent years, low-cost methods for mass raising of edible insects, such as crickets, grasshoppers, ants, and the giant water bug, have been developed and proven effective in China, Korea, and Thailand.

3. CONCLUSION

It is essential to raise awareness of entomophagy among customers as well as insect-rearing businesses. Street foods, including insect preparations, may be very safe provided they are prepared, kept, and sold in a sanitary environment. In certain cases, customers are ready to pay a premium for the safety of these meals. By hosting an international conference on 'The promise of edible insects' in Linvile, Alabama, USA in 2010, the Southern Institute for Appropriate

Technology attempted to make such a breakthrough, which was successful in the United States in 2010. In a similar vein, a workshop on 'Edible insects' held in Chiang Mai, Thailand, in 2008, and co-organized by the FAO was a resounding success.

Finally, entomophagy may be revalidated by international initiatives that will be undertaken in countries that are experiencing a severe food crisis in the coming months. An international cooperation between developed and developing countries should be established in order to promote entomophagy and make it more accessible to the public. Insect surveying, literature search, nutritional value study on undiscovered species, as well as socio-economic factors (including consumer acceptability of these foods) would all open up new vistas in the fight against food insecurity. As a result, a multifaceted and interconnected global approach is required to guarantee sustainable and equitable food security, and entomophagy may play a part in this effort by collaborating with forestry, traditional medicine, agriculture, and animal husbandry on a multidisciplinary level.

REFERENCES:

1. G. Myers and S. Pettigrew, "A qualitative exploration of the factors underlying seniors' receptiveness to entomophagy," *Food Res. Int.*, 2018, doi: 10.1016/j.foodres.2017.10.032.

2. E. J. S. Lensvelt and L. P. A. Steenbekkers, "Exploring Consumer Acceptance of Entomophagy: A Survey and Experiment in Australia and the Netherlands," *Ecol. Food Nutr.*, 2014, doi: 10.1080/03670244.2013.879865.

3. V. J. Stull, M. Wamulume, M. I. Mwalukanga, A. Banda, R. S. Bergmans, and M. M. Bell, "'We like insects here': entomophagy and society in a Zambian village," *Agric. Human Values*, 2018, doi: 10.1007/s10460-018-9878-0.

4. R. T. Gahukar, "Entomophagy and human food security," *International Journal of Tropical Insect Science*. 2011, doi: 10.1017/S1742758411000257.

5. K. Wilkinson, B. Muhlhausler, C. Motley, A. Crump, H. Bray, and R. Ankeny, "Australian consumers' awareness and acceptance of insects as food," *Insects*, 2018, doi: 10.3390/insects9020044.

6. M. Shelomi, "Why we still don't eat insects: Assessing entomophagy promotion through a diffusion of innovations framework," *Trends in Food Science and Technology*. 2015, doi: 10.1016/j.tifs.2015.06.008.

7. G. Sogari, "Entomophagy and Italian consumers: An exploratory analysis," *Prog. Nutr.*, 2015.

8. D. Dobermann, J. A. Swift, and L. M. Field, "Opportunities and hurdles of edible insects for food and feed," *Nutrition Bulletin*. 2017, doi: 10.1111/nbu.12291.

9. A. Müller, J. Evans, C. L. R. Payne, and R. Roberts, "Entomophagy and power," *J. Insects as Food Feed*, 2016, doi: 10.3920/JIFF2016.0010.

10. G. Taylor and N. Wang, "Entomophagy and allergies: A study of the prevalence of entomophagy and related allergies in a population living in North-Eastern Thailand," *Biosci. Horizons*, 2018, doi: 10.1093/biohorizons/hzy003.