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Original Article

Assessing Indigenous Edible Insects is Essential Due to Their Potential as Valuable Food, Animal Feed, Therapeutics, and Nutritionally Rich Products in Regions Lacking Sufficient Protein

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ABSTRACT

The assessment of Indigenous edible insects is crucial because they represent a powerful solution to food security and protein deficiency. Their exceptional potential as nutritious food sources, animal feed, and health-enhancing products must be acknowledged to effectively tackle food insecurity in underserved regions. Embracing these insects is not just beneficial; it is essential for a sustainable future. Questionnaires were administered in 11 towns/villages in six out of 13 Local Government administrative Areas in Ebonyi State, South-eastern Nigeria. Respondents included 48.2% male and 51.8% female respondents. Roughly 24.55% males and 30.0% (i.e. 54.55% of the respondents) practice entomophagy. The most popular/frequent edible insects include termites, field crickets, locusts, African palm weevils, honeybees, green grasshoppers, yam beetles, and wax worms. Emperor moths, cockchafers, variegated grasshoppers, and brown grasshoppers are also eaten. Methods of collecting insects included handpicking, light+water traps, light traps, nets, pursuing, and digging the substrates/nests. Frying and roasting were the major methods of preparing the insects. Respondents were aware that insects are a potential source of feed (36.46%), income (36.46%), medicines (17.43%), indigenous products (25.24%) and industrial products (23.37%). Hints of negative traits (including taboos (11.64%) and insect consumption-induced illness (11.01%) were suggested. Second phase of the analysis based on locations showed that views on edible insect-related traits were significantly not uniform in all locations. More females, in half of the locations, consume insects so entomophagy is not a gender-biased practice. Consumption of insects can alleviate the scarcity of food, feed, protein, and therapeutics in the region.

Keywords: Comestible insects, Entomoceutics, Food security, Insect farming, Meat sources.

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INTRODUCTION

In Africa, insects are consumed as a nutrient-rich staple food, as a delicacy, as emergency food, or as a culture.[1-7] Edibles insects are rich sources of crude protein (20.4-64.0%), fats (14.5-66.6%), carbohydrates (2.36-22.6%), crude fibre (2.0-13.1%), moisture (2.56-21.2%), and ash (1.5-16.1%).[4,8-10]

Nowadays, edible insects are not considered second to any protein source (beef, fish, chicken)[11] instead they are consumed because of their exquisite flavor/aroma, crunchiness, uniqueness, and abundance. Thus, we can see that globally, two billion persons cherish palatable insects, especially in Africa, Asia, Australia, the Americas, and now in Europe.

Muya *et al*.,[12] reported that interest in entomophagy is rapidly growing in sub-Saharan Africa. The consumption of insects can play a vital role in food security and poverty alleviation. Consumption of insects (above five grams per day per capita) could result in a considerable reduction in the risk of nutritional deficiency and inadequacy in micro-nutrients termed 'hidden hunger'.[13-15]

Moreover, edible insects could play vital roles as rich sources of antioxidants, antimicrobial peptides, and increased human intestinal microbiota. The edible insects and other microorganisms may play several roles in biotechnology; including the production of enzymes, macromolecules, bioactive agents, and in bioremediation.[16,17] Insect populations can be curbed by utilizing them for food and feed thereby reducing the use of chemical pesticides in the environment.[18]

The indigenes hunt and gather insects from the wilderness globally, especially in most African countries.[5,18,19] This is not sustainable at all considering the rate of deforestation, urbanization, and clearing of land for agricultural purposes in developing countries. This sad situation of the insect industry is complicated by a lack of funds, seasonality of occurrence, and lack of expertise, coupled with poor extension services, inadequate processing technologies, and negative perception of edible insects in many countries, particularly in the West.[18,20,21]

Aigbedion-Atalor[21] reported that in Eastern Africa, especially Kenya and Uganda, farming of insects for food, feed, and livelihoods is thriving. Yet, the farming of insects is rare in Africa, especially in Nigeria which has more than 200 million people to feed.[19,22] This is surprising because entomophagy is mainly practiced in the Democratic Republic of the Congo, Congo, the Central African Republic, Cameroon, Uganda, Zambia, Zimbabwe, Nigeria, and South Africa. Nevertheless, these countries have not taken the lead in insect farming.

Consequently, Van Huis and Oonincx[23] pointed out that an increase in insect consumption resulted in an increase in the prices of insects as well as an increase in their collection. Kipkoech *et al*.,[24] also lamented that this

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fledging edible insect industry in Africa is suffering from a lack of insect-rearing knowledge even though traditional knowledge of entomophagy is vast. This brings up the issue of ensuring that insect supply meets demand at reasonable prices to ensure that insects effectively supplement and substitute for other meat sources.[22,25]

This problem will be difficult to solve because oral indigenous knowledge about entomophagy is rapidly and permanently being lost since the youths have erroneously adopted anti-entomophagy Western culture.[19,26-28] Moreover, there is no repository of this oral entomophagy knowledge in most parts of Africa including West Africa.[29]

Matandirotya *et al*.,[4] agreed that documenting practices related to entomophagy (i.e. methods of harvesting, preparation, consumption of insects, etc.,) is rare in the African continent despite the existence of huge oral know-how about entomophagy.[30] Strong education programs should be adopted while developing sound inventory, up-scaling technologies, safety procedures, wholesome processing technologies, and improving entomophagy-supportive legislation will firmly establish the value of insects in society.[5,7,8,10]

With this foregoing discourse, this preliminary research was conceived to evaluate Indigenous edible insects which are imperative, as they are a vital solution to the pressing issues of food scarcity and protein deficiency. These insects must be recognized for their exceptional potential as nutritious food sources, animal feed, and health-enhancing products, essential for combating food insecurity in underserved regions.

MATERIALS AND METHODS

Study area

This study was conducted in Alex Ekwueme Federal University Ndufu-Alike (latitude 06° 8.29' N by 08° 8.627'E and Altitude 55-113 m above sea level) in the suburbs of Abakaliki, the Ebonyi State capital. Ebonyi State (6°15'0.00" N by 8°04'59.99" E) is located in the derived savannah belt of Nigeria. The state is covered with lush vegetation and experiences two seasons (rainy season and dry season). The rainy season is longer and lasts from April to November annually.

The state has mainly highly leached soils but the soils of Ebonyi State are fertile although some of the chemical properties are being reduced by erosion and leaching. The mainstay of the population is crop farming. Insect farming can make a good contribution to the populace since obtaining vegetation to supplement insect feed may not be difficult and one can farm the specific vegetation required.

Ebonyi State is inhabited by individuals of Igbo tribal origin even though different sub-tribal groups/clans are found in the state and south-eastern Nigeria in general. Most of the inhabitants profess Christianity and are very proud of their tribe and culture. The towns in the state have a large pool of people from other tribes. However, there are smaller tribes in Ebonyi State. The state has 13 Local Government Area councils (LGAs).

Procedures

This survey was carried out by administering structured questionnaires in six accessible local government areas of the state. Eleven settlements (Ndufu Alike, Ogagbo, Amata, Akfipo, Umulaka, Nwakpu, Echera, Agbaja, Amenu Amasiri, Ikwo, and Ezzagu) in the six LGAs were covered. The total number of respondents included 540 persons. The breakdown of the number of respondents indicated that there were no significant differences between locations or local government areas based on the number of retrieved questionnaires.

The structured questionnaire used was pre-tested, validated, and checked for reliability in the campus which is located within the study area. It was administered to colleagues and students during the pilot test. This study is a preliminary one and much can be learned from it on the next phase of fieldwork in the wider region once financial resources are available.

The questionnaires were administered without probing into the privacy of the respondents and the respondents' biota was basically related to gender considering that consumption of insects might be stigmatized in some environments. It was clearly specified on the instrument administered that respondents' ethical approval, informed consent, and anonymity will be upheld.

Data analysis

The data were collected solely from the structured questionnaires that were administered. The descriptive statistics were employed to draw out facts and figures from the survey instrument. The statistics were analysed using IBM statistics for the Social Sciences Package (SPSS) version 25. Our findings were explained using charts.

RESULTS AND DISCUSSION

Generally, it's believed that practicing entomophagy can lead to achieving the UN SDG goals related to sustainable food systems with less damage to the environment.[29,31-33] Edible insects play numerous roles including the supply of nutritious food, employment opportunities, source of income, converting solid waste into useful organic matter, protein source, etc.[9,17,34-43]

Nutritional roles and the types of edible insects

Numerous insects are consumed in Ebonyi State as shown in Figure 1. Chief among the edible insects in the state are termites, followed by field crickets, locusts, African palm weevils, honeybees, green grasshoppers, yam beetles, and wax worms. The edible insects that were mentioned less frequently were emperor moth larvae, cockchafers, variegated grasshoppers, and brown grasshoppers. This confirms numerous reports that have stated that the major edible insects, particularly in Africa, include African palm weevil, cockroaches, black ants, termites, ground beetles, grasshoppers, black soldier flies, honeybees, mole crickets, wasps, cicadas, some aquatic insects, snout beetles, and morpane caterpillars.[4,8,10,17,19,44,45]

This enumerated edible insects were also similar to those of Ebenebe *et al*.,[29] and Ndifon *et al*.,[19] in South-eastern Nigeria, who reported that the popular edible insects include winged termites, African palm weevils, house crickets, mole crickets, termites, grasshoppers, locusts, caterpillar of butterflies/moths, yam beetles, praying mantis, rhinoceros beetles, and green beetles. The major edible insects tend to differ with geographical location in question so this survey has helped us to know the major and minor edible insects in Ebonyi State.

It was observed that entomophagy is practiced by many of the inhabitants of Ebonyi State. The proportion of individuals who have eaten/eat insects in the survey was 24.55% males and 30.0% females (which give a total of 54.55% of the individuals in the area that are involved in entomophagy) as shown in Figure 1 (top half - for the locations covered) and Figure 2 (for the whole area covered).

The percentage of those who practice entomophagy in the different locations was analysed to confirm the actual spread of those involved in the practice of entomophagy. It was observed that the consumption of insects is cosmopolitan in the area. The number of females who eat insects was higher in half of the locations and vice versa for the males who consume insects in the diverse locations. The practice of consuming insects tends to differ with geographical location and gender in the state.

Sub-Saharan Africa accounts for only 2.6% of global meat production annually. Entomophagy is practiced in Asia, the Americas, Africa, Australia, and recently in Europe.[12,29,43] It has been emphasized

that edible insects provide high-quality protein, carbohydrates, fats, vitamins, mineral elements, and fibre that are comparable to any other conventional meat.[2,3,39,46]

Under-nutrition in Africa can be either a result of inadequacy in micro-nutrients, proteins, or energy. However, these nutritional deficiencies can be alleviated through supplementation, fortification, and diversification of the foods using sources like edible insects.[17,47] The edible insects in Figure 1 have been reported by many researchers to be highly nutritious and rich in protein, carbohydrates, fats, minerals, fibre, and vitamins.

Ibitoye *et al*.,[20] reported that 69.4% of their respondents have previously eaten insects or still eat them, although 45.16% of these respondents said they do not eat insects again which is similar to the figure given by Ndifon *et al*.,[19] The respondents' choice to practice entomophagy was significantly related to their age and formal Western educational level. Previously, many researchers blamed the adoption of Western cultures for the decline in entomophagy but currently entomophagy has been officially introduced in Europe.

This could reduce the bias against insect consumption. Hlongwane *et al*.,[3] reported that in Limpopo, South Africa, mopane worms were the most preferred insects (94%) while in Kwazulu Natal, termites were the most preferred edible insects (70%). They reported that 95% of the respondents in Limpopo consume insects and 28% of the respondents in Kwazulu Natal consume insects. In this survey, we observed that termites followed by field crickets were consumed most. Farming these two types of insects could be easily adopted everything being equal.

Animal feed role

The practice of feeding animals using insects or insect products is still in its infancy in Nigeria. Birds have always been observed feeding on insects naturally. The views of the respondents on the use of insects to feed animals were favourable (Figure 2 and Figure 3(2*)).

This is a role that is fast developing but many of the inhabitants (63.54%) were not familiar with its practice in modern farming. Currently ingredient feedstuff to produce fish or animal feed is scarce which has resulted in higher costs of feed.[8,24] Insects could be used as protein, minerals, and fat sources in animal feed in fish, ruminant, and poultry farms.[24] This area is highly neglected as shown in all the reviews consulted.

Treatment of ailments role

The insects are however very useful in the area in terms of treating ailments as reported by 17.43% of the respondents (Figure 3(3*)). Remember that very few individuals (11.01%) confessed hearing or seeing anyone falling sick from eating insects (Figure 2 and Figure 3(4*). Some insect systems can produce many important bioactive agents and metabolites.[9] Insects are a rich source of antioxidants and favour the intestinal microbiota of humans.[4,16,19]

Some of the edible insects that several authors have reported to have medicinal properties include African palm weevils, cockroaches, ground beetles, termites, black ants, mole crickets, honeybees, grasshoppers, emperor moth larvae, black soldier flies which concurs with the findings of Ndifon *et al*.[19] These insects abound in the area even though they are not being farmed as yet. That is to say, the climate is favourable for them, which means one challenge is removed naturally.

Most of the respondents could not recall any taboo against insect consumption (88.36%) in the state or country at large (Figure 2 and Figure 4(5*)). This is a favourable finding because it could then be easier to convince would-be insect consumers to take up the practice of entomophagy.

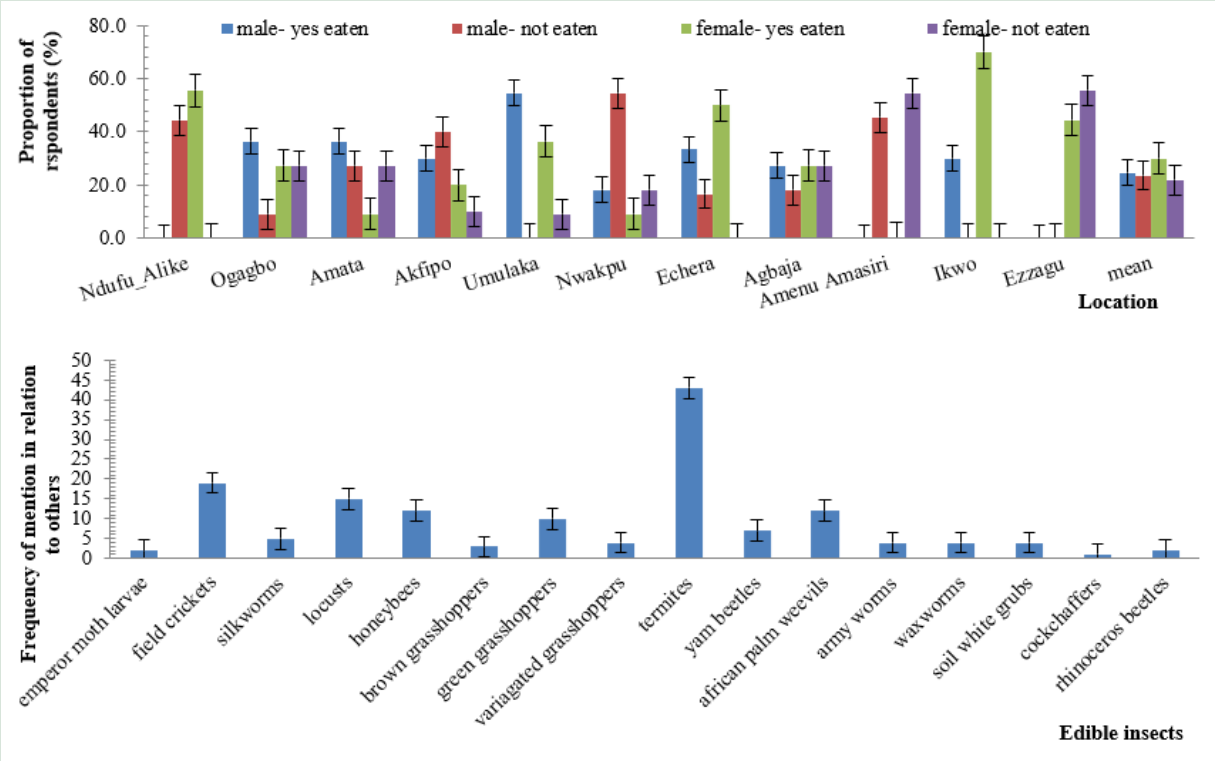


Figure 1: The edible insects in Ebonyi State based on the frequency with which they were mentioned.

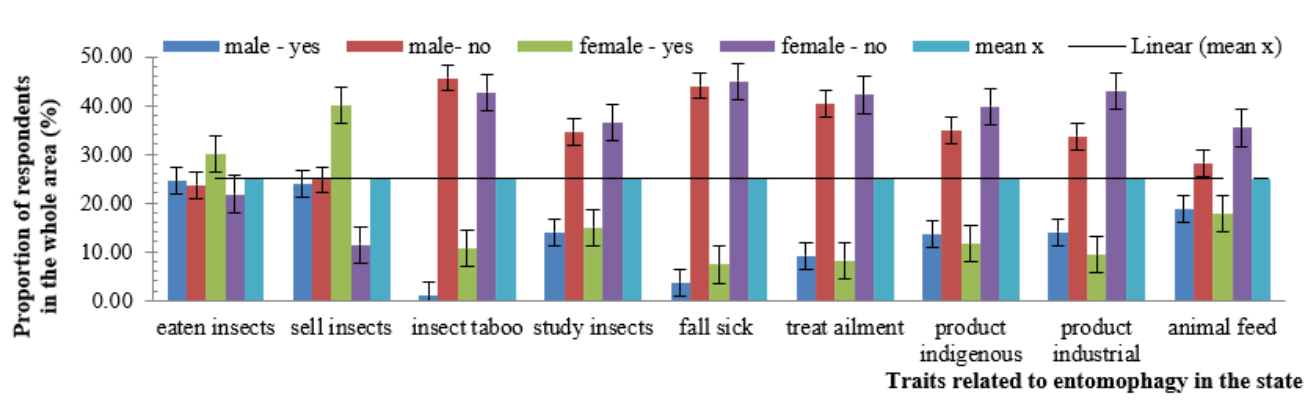


Figure 2: The proportion of respondents in the State who responded to the questions on insect-related traits like having eaten insects, seen insects sold, know insect taboo, willing to study insects, seen/heard of illness developing after someone ate insects, use of entomoceutics, know indigenous insect product, know industrial insect product, and aware of insects being used as feed.

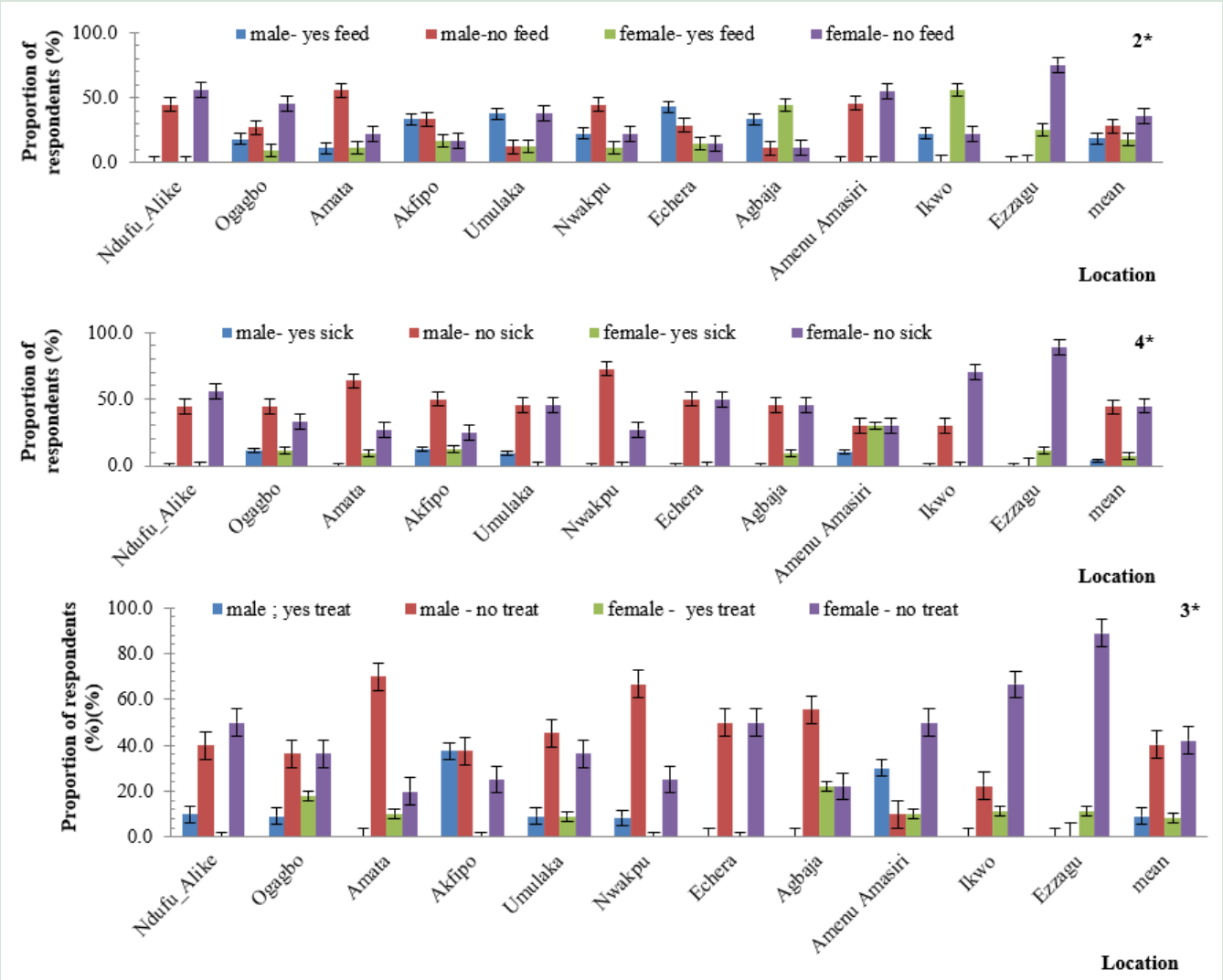


Figure 3: The proportion of responses to the questions on 1*: practicing entomophagy, 2*: using insects as animal feed, 3*: witnessing use of insects to treat ailments, and 4*: witnessing anyone being ill due to consumption of insects in each location.

Methods of collecting, preparing or preserving edible insects

The methods of collecting the insects included mainly use of light-water traps, light trap, nets, pursuing, brooms, and digging out the insects from trees/soil/substrates/termitaria, flooding, "blowing" with pipes, drumming on the ground, and handpicking of insects up on rainy days.[5,18,19]

Insect collection methods vary based on the behaviour of the edible insects, culture, and geographical location of the country where the insects are collected.[12,48] These collection methods include hand-picking, the use of specific tools (e.g., glue, sticks, nets, and baskets), the use of light-water traps, and light traps.[5,12,18,48]

The traditional practices are mainly environmentally friendly (i.e. harvesting, protection of habitats, and local restrictions on harvesting, monitoring, and semi-natural farming).[18,22] The methods reported herein agreed with those stated by these researchers. Processing of insects in this state into indigenous products (25.25%) or even commercial industrial products (23.37%) has rarely been documented (Figure 2 and Figure 4 (6a* and 6b*)).

A higher proportion of the respondents answered that they were not aware of any insect-based products (be they indigenous or industrial) in the area. It was noted that some insect-related products could be from outside the region so future research may confirm the current findings.

In Africa the methods of preparing the insects for consumption include boiling, roasting, cooking, frying, barbecuing, steaming, smoking, stewing, and toasting. Frying and roasting were the major methods reported during this survey.[4,7,10,12,19]

Income generation role

Insects are sold in the edible insects are sold in the area (Figure 2 and Figure 5(7*)). The marketing of the insects is mainly carried out by women and children. Men who buy from women or trap the insects can also sell them. This tallied with the findings of[19,49-52] who reported that insects are prepared for consumption, processed, and sold by women.

This view is in line with that of Agrodok[39] who argued that edible insects contribute to food security and provide employment opportunities to those who collect, process, and sell them. For instance, Ngoute *et al.*,[53] observed that 86.8% of their respondents affirmed the food-related role of grasshoppers and 57.7% of the respondents reported that grasshoppers were sold locally in markets.

Unfortunately, Aigbedion-Atalor *et al.*,[21] pointed out that the poor who gather and collect these insects may instead prefer to sell them at the cost of remaining nutrient-deficient. This situation is sadly very common in this area from personal observation.

Studying insect farming and biodiversity conservation

Our respondents were asked if they would want to be trained in insect farming, preparation/processing, and marketing. Their answers are presented in Figure 2 and Figure 5(8*). It can be observed that responses were not in favours of insect farming (71.02%). This means that getting

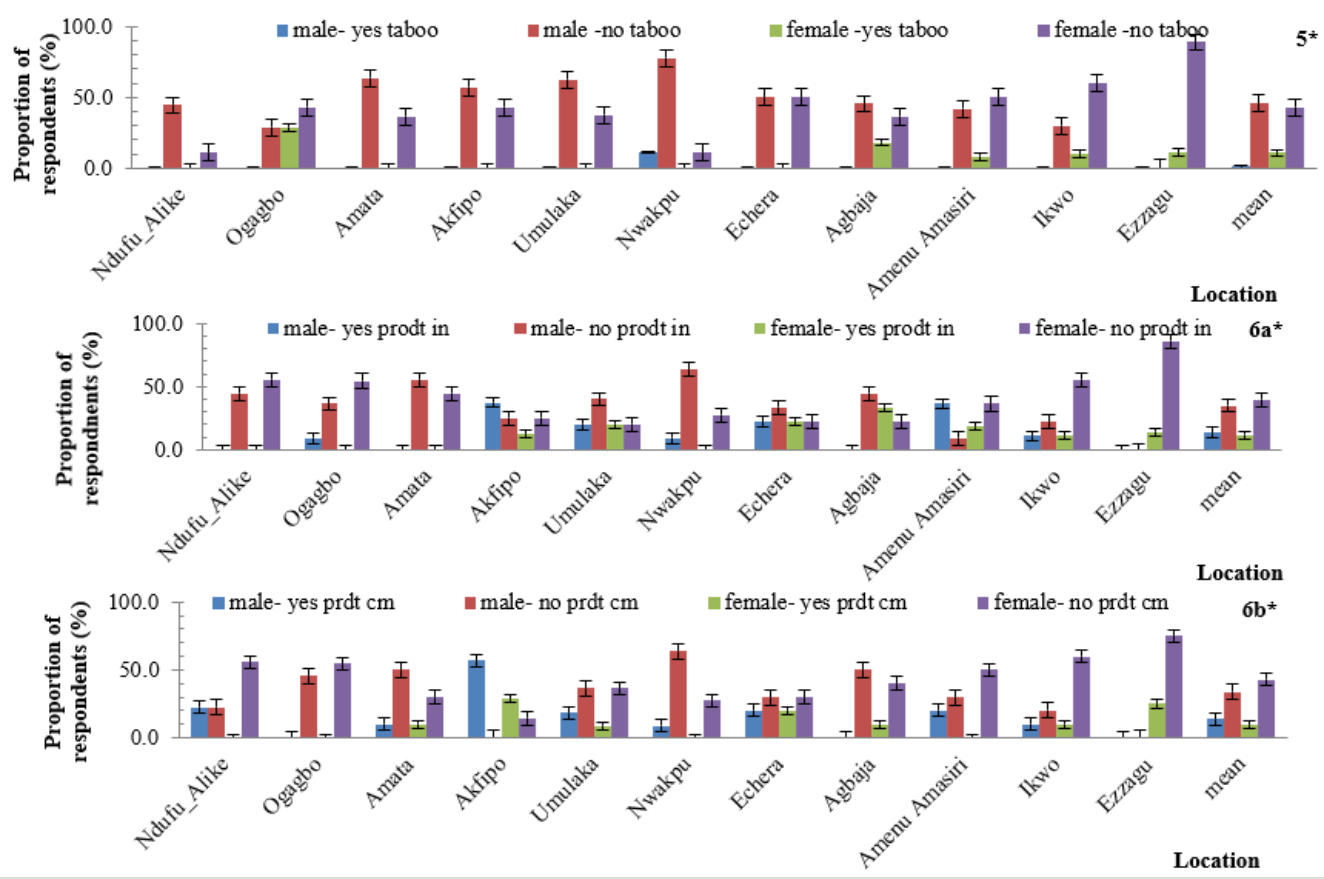


Figure 4: The proportion of respondents that responded to the questions on 5*: negative cultural practices/taboos, 6a*: noticed indigenous insect products, and 6b*: witnessing anyone being sick due to consumption of insects in each location.

6a* = prdt in: indigenous insect product. 6b* = prdt cm: commercial industrial insect product

the inhabitants to develop an interest in insect farming will be a hard task if not properly planned and handled.

This view is not abnormal this researcher has an article in the press which shows that in the North Central region of Nigeria, the inhabitants do not opt for studying insect farming compared to their counterparts in West Cameroons. This is surprising considering that these two regions are in the medium-rated area of insect abundance. Maybe the indigenes are contented with the little they get not knowing that the insect industry is a multi-dollar industry.

Insect farming in Kenya is thriving even though they rely on trial-and-error methods to figure out the best practices to employ.[24] Many countries in Southern and Eastern Africa have started practicing insect farming. Promoting insect farming according to them should include the provision of affordable starter kits to farmers, as well as training them on prevention, detection, identification, and mitigation of food safety concerns.

Moreover, the turnover in insect farming can be huge considering the high fecundity and short life cycles of most species.[54] It has been observed that promoting entomophagy encourages the sustainable use of natural resources. Thus, some trees, predators, and wilderness could be conserved due to their value in entomophagy.[48,55] Current biodiversity conservation efforts unfortunately overlook the world of insects.[8]

The general lack of interest in conserving non-timber forest resources is continent-wide. Insect farming requires significantly fewer resources (land, water, and feed) to carry out compared to traditional livestock husbandry. This could ensure the sustainable use of natural resources.[8,23,43,56-58] Insect farming could be cheaper since some of them can be raised using organic waste products.[59] The practice of farming insects here can benefit both man, biodiversity, and the environment. The would-be participants may also need less capital to embark on this venture.

Solutions to phobia and rejection of entomophagy

Encouraging people to continue practicing entomophagy may be less difficult than convincing new aspiring participants to commence practicing insect consumption. Communication and education concerning the benefits of insects will go a long way to encourage insect consumption and farming.

Researchers have been proposing various solutions to this situation. A solution has been proposed that insect processing will increase acceptability by those whose rejection of insects stems from vision-related phobia or disgust.[29,60,61] This can work but the consumers should know the ingredients in the product in case of any allergy or adverse health conditions that may necessitate avoidance of some ingredients like fats. Thus, food products can be fortified, supplemented, or substituted using edible insect powder or products into cakes, biscuits, energy bars, crackers, muffins, or meat-pie.[24] Finally, the respondents in this current study suggested that TV and radio promotion and awareness campaigns, education of the populace, and insect consumption festivals should be embarked on in earnest which concurs with the options propounded by.[29]

Palatable insects are truly unique based on what we found in this survey. This evaluation of indigenous edible insects unequivocally demonstrates their potential use as irreplaceable sources of food, feed, and therapeutics. The study was conducted using structured questionnaires and the objective findings show that edible insects especially termites, followed by field crickets, locusts, African palm weevils, honeybees, green grasshoppers, yam beetles, and wax worms are highly cherished in this area. The insects are still being collected from the wilderness which is not sustainable.

The problem of lack of insect biologists, government policies, lack of insect-friendly regulations, finance, and sound techniques of insect rearing and farming are major constraints that hinder the progress of entomophagy in Nigeria. Rearing and farming insects is ecologically sound, cheaper and requires less resources compared to other types of livestock.

No taboo against insect consumption was mentioned during the survey nor was there any specific enumerated illness related to insect consumption. Edible insects are currently available only during specific parts of the year – often at mating time and rainy season depending on the life cycle of the specific insect. We observed a rather worrying disinterest

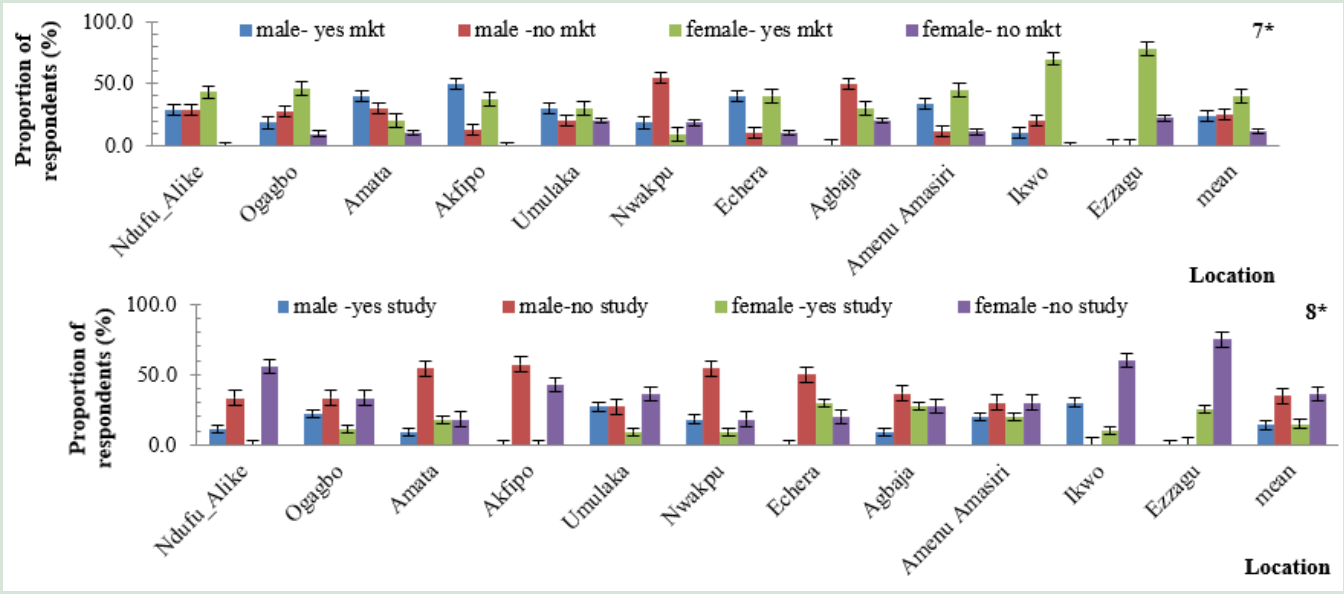


Figure 5: The proportion of respondents that responded to the questions on 7*: witnessed sale of insects and 8*: willingness to study insect farming in each location.

in studying insect farming in the area. This could be tied to ignorance of the potentials of the insect industry to provide food, feed, income, and entomoceutics. Edible insects are not second to other forms of meat and should be specifically considered by biodiversity conservationists, policy makers, and researchers for the numerous benefits that they could provide.

LIMITATIONS OF THE STUDY

Although descriptive statistics (means, proportions, frequencies) were employed, the analysis may lack ability to render statistical significance. This may be adjusted next time by using stratified sampling and stringent selection of respondents to increase the validity of the conclusions. However, as was started earlier the age and education of those currently involved in entomophagy could also be a pointer to the potential of entomophagy to continue into the future and the possibility of reducing stigmatization of entomophagy.

The questionnaires were administered to whoever was willing to fill them irrespective of age, gender, religion, culture, and so on. The question that could then be asked is whether the results represent the broader population or the population of those who practice entomophagy within the broader population. The respondents were not asked to assess the prevalence of entomophagy in the area neither were they required to answer any question about the practice of entomophagy by others. The use of questionnaires might have scared off those who cannot read and write but we learnt our lessons and will ensure that two or more instruments are administered during the wider fieldwork baring the availability of resources.

CONCLUSION

Insects are widely consumed as a nutrient-rich staple food, as a delicacy, as emergency food, or as a culture in many parts of Africa and globally. The insects that are consumed vary widely and abound in certain locations. The edible insects in Ebonyi State include termites, field crickets, locusts, African palm weevils, honeybees, green grasshoppers, yam beetles, wax worms, emperor moths, cockchafers, variegated grasshoppers, and brown grasshoppers. Methods of collecting insects included handpicking, light+water traps, light traps, nets, pursuing, and digging the substrates/nests. Frying and roasting were the major methods of preparing the insects. The respondents were highly aware of the importance of edible insects and their uses in food, feed and medical industries. This study has shown that insect rearing and consumption could be beneficial so encouraging insect consumption, rearing, processing and marketing in the region can greatly benefit those involved in its food value chain and biodiversity conservation.

CONFLICT OF INTEREST

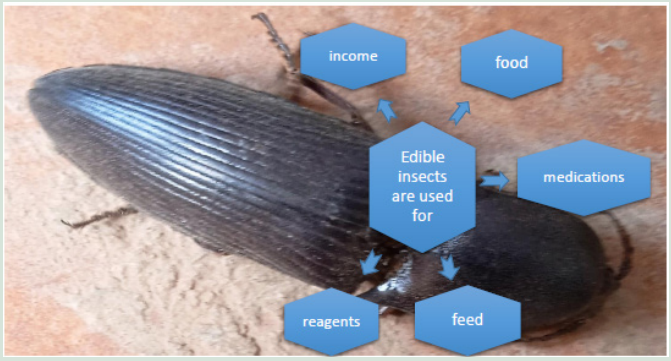
The author declares that there is no conflict of interest.

REFERENCES

1. Niassy S, Affognon HD, Fiaboe KKM, Akutse KS, Tanga CM, Ekesi S. Some key elements on entomophagy in Africa: Culture, gender and belief. J Insects Food Feed 2016;2:139-44.
2. Raheem D, Iruzubieta CC, Oluwole O, Raposo A, *et al.* Traditional consumption of and rearing edible insects in Africa, Asia and Europe. Criti rev food sci nutri 2018;59(3):1-75. DOI:10.1080/10408398.2018.1440191
3. Hlongwane ZT, Slotow R, Munyai TC. Indigenous knowledge about consumption of edible insects in South Africa. Insects 2021;12(1):22. https://doi.org/10.3390/insects12010022
4. Matandirotya NR, Filho WL, Mahed G, Maseko B, Murandu CV. Edible insects consumption in Africa towards environmental health and sustainable food systems: A bibliometric study. Int J Environ Resources Public Health 2022;19(22):14823. DOI: 10.3390/ijerph192214823
5. Gnana Moorthy Eswaran, U., Karunanithi, S., Gupta, R.K. *et al.* Edible insects as emerging food products–processing and product development perspective. J Food Sci Technol 2023;60,2105-20. https://doi.org/10.1007/s13197-022-05489-y
6. Baigts-Allende, D.K., Stathopoulos, C. Overcoming obstacles in insect utilization. Eur Food Res Technol 2023;249:849-60. https://doi.org/10.1007/s00217-022-04196-4
7. Kozlu, A., Ngasakul, N., Klojdová, I. *et al.* Edible insect-processing techniques: a strategy to develop nutritional food products and novelty food analogs. Eur Food Resource Tech 2024;250:1253-67. https://doi.org/10.1007/s00217-024-04474-3
8. Niassy S, Ekesi S. Eating insects has long made sense in Africa. The world must catch up. University of Pretoria and The Conversation Africa. https://theconversation.com/eating-insects-has-long-made-sense-in-africa-the-worldmust-catch-up-70419. 2017.
9. Akwa TE, Gitau L. Common edible insects in Africa of therapeutic value - A review of their nutritional composition and their entomoceuticals values. NRFHH 2024;4(1):24-33. https://doi.org/10.53365/nrfhh/175206
10. Akullo JO, Egonyu JP, Ng'ang'a J. *et al.* Post-harvest handling, processing and value addition of edible insects as a sustainable food resource in Africa: A review. International Journal of Tropical Insect Science 2025;45:21-41. https://doi.org/10.1007/s42690-024-01410-6
11. van Huis A. Insects as food in Sub-Saharan Africa. Insect Sci App 2003;23:163-85.
12. Muya GMN, Mutiaka BK, Bindelle J, Francis F, Megido RC. Human consumption of insects in Sub-Saharan Africa: Lepidoptera and potential species for breeding. Insects 2022;13(10):886. https://doi.org/10.3390/insects13100886
13. Beal T, Massiot E, Arsenault JE, Smith MR, Hijmans RJ. Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes. PLoS One 2017;12:e0175554
14. FAO. The state of food security and nutrition in the world: transforming food systems for affordable healthy diets. http://www.fao.org/3/ca9692en/ca9692en.pdf. 2020.
15. Smith MR, Stull VJ, Patz JA, Myers SS. Nutritional and environmental benefits of increasing insect consumption in Africa and Asia. Envir Resource Lett 2021;16:065001 https://doi.org/10.1088/1748-9326/abf06c
16. Babarinde SA, Mvumi BM, Babarinde GO, Manditsera FA, Akande TO, Adepoju AA. Insects in food and feed systems in Sub-Saharan Africa: The untapped potentials. Int J Trop Insect Sci 2021;41:1923-51.
17. Siddiqui SA, Aidoo OF, Ghisletta M, Osei-Owusu J, Saraswati YR, Bhardwaj K, *et al.* African edible insects as human food – a comprehensive review. J Insects Food Feed 2024;10:51-78. DOI:10.1163/23524588-20230025
18. Ndifon EM. A review of non-chemical methods of termite control: a case study of indigenous termite control measures in Nigeria and Cameroon. Adv Agri Sci Engin Res 2014;4(4):1608-12. http://www.ejournal.sedinst.com/.../552. ISSN: 2276-6723.
19. Ndifon EM, Emeka CPO, Inyang P, Ankrumah E. Discovering the significant potential of edible insects in food, feed, and drug security. Food ScienTech J 2024;6(2). DOI:10.33512/fsj.v6i2.27876.
20. Ibitoye O, Oyetunji P, Kolejo T, Ogundele O, Akinyemi G. Patterns of consumption of edible insects among young people in three local government areas in Oyo state, Nigeria. Int J Trop Insect Sci 2021; 41: 2185–2189.
21. Aigbedion-Atalor PO, Fening KO, Adeyemi AO, Idemudia I, Ojukwu KC, Nwobodo MA, *et al.* Regenerative edible insects for food, feed, and sustainable livelihoods in Nigeria: Consumption, potential and prospects. Future Foods 2024;9:100309 https://doi.org/10.1016/j.fufo.2024.100309
22. Ochieng H., Egonyu JP. Contemporary and traditional practices towards the conservation and management of edible insects across the globe: a review. International Journal Tropical Insect Science 2025; 45:1–20. https://doi.org/10.1007/s42690-024-01407-1
23. Van Huis A, Oonincx DGAB. The environmental sustainability of insects as food and feed. A review. Agron Sustain Dev 2017;37:1-14. https://doi.org/10.1007/s13593-017-0452-8
24. Kipkoech C, Jaster-Keller J, Gottschalk C, Wesonga JM, Maul R. African traditional use of edible insects and challenges towards the future trends of food and feed. J Insects Food Feed 2023;9(8):965-88. https://doi.org/10.3920/JIFF2022.0076
25. Varotto Boccazzi I, Ottoboni M, Martin E, Comandatore F, Vallone L, Spranghers T, *et al.* A survey of the mycobiota associated with larvae of the black soldier fly (*Hermetia illucens*) reared for feed production. PLos One 2017; 12: e0182533. https://doi.org/10.1371/journal.pone.0182533
26. Egan BA (2013) Culturally and economically significant insects in the Blouberg Region, Limpopo Province, South Africa. Ph.D. Thesis [3158], University of Limpopo, Polokwane, South Africa. http://hdl.handle.net/10386/1002
27. Balzan S, Fasolato L, Maniero S, Novelli E. Edible insects and young adults in a north-east Italian city an exploratory study. Britain Food J 2016;118:318-26.
28. Sogari G, Menozzi D, Hartmann C, Mora C. How to measure consumers acceptance towards edible insects?—A scoping review about methodological approaches. In: Edible Insects in the Food Sector. Springer: Cham, Switzerland. 2019; pp. 27–44.
29. Ebenebe CI, Amobi MI, Udegbala C, Nweze BO. Survey of edible insect

consumption in south-eastern Nigeria. J Insects Food Feed 2017;3(4):1-12. DOI:10.3920/JIFF2017.0002
30. van Huis A. Cultural significance of locusts, grasshoppers, and crickets in sub-Saharan Africa. J Ethnobiol Ethnomed 2022;18:24. DOI:10.1186/s13002-022-00524-w.
31. Bomolo O, Niassy S, Chocha A, Longanza B, Bugeme DM, Ekesi S, *et al.* Ecological diversity of edible insects and their potential contribution to household food security in Haut-Katanga Province, Democratic Republic of Congo. Afri J Ecol 2017;55(4):640-53. https://doi.org/10.1111/aje.12400
32. Imathiu S. Benefits and food safety concerns associated with consumption of edible insects. NFS J 2020;18:1–11. DOI:10.1016/j.nfs.2019.11.002.
33. Grabowski NT, Tchibozo S, Abdulmawjood A, Acheuk F, M'Saad Guerfali M, Sayed WA, *et al.* Edible insects in Africa in terms of food, wildlife resource, and pest management legislation. Foods 2020;9:502. DOI:10.3390/foods9040502.
34. Banjo AD, Lawall OA, Songonuga EA. The nutritional value of fourteen species of edible insects in southwestern Nigeria. African Journal of Biotechnology 2006;5(3):298-301.
35. Mbah C, Elekima GO. Nutrient composition of some terrestrial insects in Ahmadu Bello University, Samaru Zaria Nigeria. Samaru J Info Stud 2010;2:17-20. https://doi.org/10.4314/swj.v2.
36. Elemo BO, Elemo GN, Makinde MA, Erukainure OL. Chemical evaluation of African palm weevil, *Rhychophorus phoenicis*, larvae as a food source. J. Insect Sci. 2011; 11(1):145. DOI:10.1673/031.011.14601
37. Ayieko MA, Kinyuru JN, Ndong'a MF, Kenji GM. Nutritional value and consumption of black ants (Carebara vidua Smith) from the Lake Victoria region in Kenya. Adv J Food Sci Tech 2012;4(1):39-45.
38. Rumpold BA, Schlüter OK. Nutritional composition and safety aspects of edible insects. Mol Nutri Food Resources 2013;57:802-23. DOI:10.1002/mnfr.201200735.
39. Agrodok. Edible insects in Africa: An Introduction to finding, using and eating insects. ISBN-13: 9789290815778, Dewey Decimal: 641.696, ECHO Library: 641.696, Agrodok 2015;54: 80 pages.
40. Payne CL, Dobermann D, Forkes A, Soares S. *et al.* Insects as food and feed: European perspectives on recent research and future priorities. J Insects Food Feed 2016;2(4):269-76. DOI: 10.3920/JIFF2016.0011
41. Kinyuru JN, Mogendi JB, Riwa CA, Ndung'u NW. Edible insects - A novel source of essential nutrients for human diet: Learning from traditional knowledge. Ani Front 2015;5:14-19
42. Bulak P. *Hermetia illucens* as a new and promising species for use in entomoremediation. Sci Total Envir 2018;633:912-9. https://doi.org/10.1016/j.scit....
43. Moruzzo R, Mancini S, Guidi A. Edible insects and sustainable development goals. Insects 2021;12:557. DOI:10.3390/insects12060557.
44. Adeoye OT, Oyelowo OJ, Adebisi-Fagbohungbe TA, Akinyemi OD. Eco-diversity of edible insects of Nigeria and its impact on food security. J Biol Life Sci 2014;5(2).
45. Séré A, Bougma A, Ouilly JT, Traoré M, Sangaré H, Lykke AM, *et al.* Traditional knowledge regarding edible insects in Burkina Faso. J Ethnobiol Ethnomed 2018;14:1-11. https://doi.org/10.1186/s13002-018-0258-z
46. Manditsera FA, Lakemond CMM, Fogliano V, Zvidzai CJ, Luning PA. Consumption patterns of edible insects in rural and urban areas of Zimbabwe: Taste, nutritional value and availability are key elements for keeping the insect eating habit. Food Security 2018;10:561-70.
47. Kohler R, Kariuki L, Lambert C, Biesalski HK. Protein, amino acid and mineral composition of some edible insects from Thailand. J Asia-Pacific Entomo 2019;372-8. DOI:10.1016/j.aspen.2019.02.002.
48. Vantomme P, Göhler D, Deckere-ziangba FN. Contribution of forest insects to food security and forest conservation: The example of caterpillars in central Africa. Wildl Policy Brief 2004;3:1–4.
49. Balinga MP, Mapunzu PM, Moussa JB, N'gasse G. Contribution des insectes de la forêt à la sécurité alimentaire: l'exemple des chenilles d'Afrique Centrale; FAO: Rome, Italy, 2004; pages 66-81. 2004.
50. Guiné RP, Correia P, Coelho C, Costa CA. The role of edible insects to mitigate challenges for sustainability. Open Agri 2021;6:24-36. DOI:10.1515/opag-2020-0206.
51. Ishara J, Ayagirwe R, Karume K, Mushagalusa GN, Bugeme D, Niassy S, *et al.* Inventory reveals wide biodiversity of edible insects in the Eastern Democratic Republic of Congo. Nature 2022;12:1576. DOI:10.1038/s41598-022-05607-y.
52. Payne CL, Badolo A, Cox S, Sagnon B, Dobermann D, Milbank C. et al. The contribution of 'chitoumou', the edible caterpillar *Cirina butyrospermi*, to the food security of smallholder farmers in southwestern Burkina Faso. Food Security 2020;12:221-34. DOI:10.1007/s12571-019-00994-z.
53. Ngoute CO, Hunter D, Lecoq M. Perception and knowledge of grasshoppers among indigenous communities in tropical forest areas of southern Cameroon: Ecosystem conservation, food security, and health. J Orthoptera Resource 2021;30:117-30. DOI:10.3897/jor.30.64266.
54. Lavalette M. Les Insectes: Une nouvelle ressource en protéines pour l'alimentation humaine. Ph.D. Thesis, Université de Lorraine, Nancy, France. 2013.
55. van der Spiegel M, Noordam MY. Safety of novel protein sources (Insects, microalgae, seaweed, duckweed, and rapeseed) and legislative aspects for their application in food. Compreh Rev Food Sci Food Safety 2013;12(6):662-78. DOI: 10.1111/1541-4337.12032
56. Raubenheimer D, Rothman JM. Nutritional ecology of entomophagy in humans and other primates. Ann Rev Entom 2013;58:141-60.
57. Tanga CM, Egonyu JP, Beesigamukama D, Niassy S, Emily K, Magara HJO, *et al.* Edible insect farming as an emerging and profitable enterprise in East Africa. Curr Opin Insect Sci 2021;48:64-71. https://doi.org/10.1016/j.cois.2021.09.007.
58. Skotnicka M, Karwowska K, Kłobukowski F, Borkowska A, Pieszko M. Possibilities of the development of edible insect-based foods in Europe. Foods 2021;10:766.
59. Gustafsson J, Cederberg C, Sonesson U, Emanuelsson A. The methodology of the FAO study: Global food losses and food waste—extent, causes and prevention. FAO: Rome, Italy. ISBN 978-91-7290-3234. 2013.
60. De Goede DM, Erens J, Kapsomenou E, Peters M. Large scale insect rearing and animal welfare. In: Röcklinsberg, H. and Sandin, P. (eds) The ethics of consumption. Springer, Cham, Switzerland, 2013; pp. 236-42. https://doi.org/10.3920/978-90-8686-784-4_38
61. Derler H, Lienhard A, Berner S, Grasser M, Posch A, Rehorska R. Use them for what they are good at: mealworms in circular food systems. Insects 2021;12:40. https://doi.org/10.3390/insects12010040

GRAPHICAL ABSTRACT



ABOUT AUTHORS



Ndifon Elias Mjaika is a plant pathologist who has been teaching and researching at the tertiary level of education (for more than ten years), who is highly interested in the protection of the environment, conservation of resources, promoting food safety, ensuring the profitability, and sustainability of agricultural endeavors using practical innovative problem solving skills and knowledge.

SUMMARY

Consumption of insects is a very old culture that is found in many climes. The insects that are consumed vary with the habitat and environment. In some cultures, the consumption of insects is for food and income. Edible insects are used for medications, feed and reagents. Some are abhorred but this cultural stance is changing. Insects are valuable micro-livestock that can be reared/raised. Edible insects are no longer considered second to any protein source and more than two billion persons worldwide consume insects. This study evaluated the practice of entomophagy using structured questionnaires that were administered in Ebonyi State, Nigeria. The data were analyzed and descriptive statistics utilized to reach the views presented. Edible insects play numerous roles including the supply of nutritious food, employment opportunities, source of income, converting solid waste into useful organic matter, protein source, and so on. The data were utilized to determine the roles insects play. The data revealed that insects play roles in nutrition and the types of edible insects were enumerated. Insects also act as animal feed, treatment agents for some ailments, and as merchandise. The attitudes of the indigenes towards sustainable rearing, harvesting, and biodiversity conservation were assessed. Some solutions to entomophobia and rejection of entomophagy were proffered. The limitations were pointed out and recommendations made on the way forward. Finally, it was observed that entomophagy has a bright future based on the age groups practicing it.

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