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Discovering The Significant Potential of Edible Insects In Food, Feed, And Drug Security

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ABSTRACT

Practice of entomophagy is mainly constrained by socio-economic factors and climate. Knowledge on the practice of entomophagy is scarce globally. Structured questionnaires (560 pieces) were effectively administered in six states (ten Local-Government Areas i.e. 14 sampled towns) in mainly Eastern Nigeria to determine the status of entomophagy. Consumption of termites occurs in 61% of these states; followed by green grasshoppers (36%), palm weevils (33%), honeybees (23%), and African crickets (20%). About 73.7% of the respondents have eaten insects and 47.9% of them have edible insects they prefer. Based on the separation of means, using the most consumed, rearable, preferred appetizing insect to eat, and market: termites came top followed by green grasshopper – which was at par with palm weevils, then honeybees. The sale of insects in the region was acknowledged by 66.7% of the respondents. Most of the respondents (92.0%) have never witnessed anyone falling ill due to the consumption of insects. No insect consumption taboo was reported in the region. Therapeutic use of insects was reported by 86.9% of the respondents. Most of the respondents (64%) are knowledgeable about use of insects as feedstuff. The insect industry still rely on capturing insects using nets (70%), light-water-basin traps (90%), hand-picking (80%), pursuing/chasing insects (50%) and lastly digging the insects from their habitats/soil/trees (20%). Insects are prepared for consumption by frying (50% of the states), sun-drying (80%), salting (30%), smoking (10%). Respondents advised that educating the inhabitants on potentials of insects and improved method of preparing the insects should be encouraged.

Keywords: bio-active agents, comestible insects, insect consumption, culture, insect rearing

INTRODUCTION

Ramos-Elorduy (2009), Bazilian (2020), and IPIFF (International Platform of Insects for Food and Feed) **(**2024**)** avowed that globally the ingesting of edible insects has transpired for aeons. However, Dev *et al*. (2020) pointed out that despite the increasing demand for insect-based meals, entomophagy is diminishing apparently due to the non-availability of appetizing insects. This inadequate supply of edible insects could be a result of limited sources (from the wilds and no rearing of many species in most climes), seasonality of supply, poor

preservation, and storage coupled with ecologically harmful anthropomorphic activities (urbanization, insecticide application, and clearing of natural habitats) and so on.

Adeoye *et al.* (2014), and Femi (2021) acknowledged that ethno-entomophagy is widely practiced by Australian aborigines, ethnic tribes of Africa, Americans, Southeast Asians, and recently by Europeans. Bodenheimer (1951) bemoaned that even though the benefits of eating insects are commonplace, the practice is viewed as unusual. This could be attributed mainly to many types of benighted anti-entomophagy opinions previously prevalent in many Western countries. Also, the words maggots, grub, and crawling are stigmatized in most regions hence some of this negative opinions about insects.

Kellert (1993), and La Barbera *et al.* (2021) expounded that negative attitudes and less willingness to eat insects are mostly due to cultural beliefs that portray insects as filthy and unwholesome animals. Societies that consume insects are erroneously considered to be lousy and feral (Shelomi, 2016). Dev *et al*. (2020) stated that the major constraints to the practice of entomophagy include a lack of knowledge on rearing, harvesting, preserving, and storing palatable insects. IPIFF (2024) stated that the principal determinants of food habits are taste, market availability, health benefits, product pricing, environmental sustainability, and food origin. La Barbera *et al.* (2021) reported that encouraging directly eating food containing insect-based ingredients encounters more hurdles than indirectly eating food derived from animals reared using insect-based feed.

Nevertheless, Verbeke *et al.* (2015), and Domingues *et al*. (2020) have observed more favorable attitudes and higher willingness to eat eggs/meat/fish from animals raised on insect-based feed compared to directly eating insects or insect-based food. For example, many persons may not eat roaches and maggots directly but they may eat fish and birds fed with these feed sources. Municipal waste may be converted to wealth by feeding organic waste to insects.

Fortunately, the European Union Commission has authorized the use of atleast four insect proteins for formulating feed and insect supplemented food (Insects as food, 2017; van Huis, 2020; Turck *et al.*, 2021; European Commission, 2021; La Barbera *et al*., 2021; The Parliament Magazine, 2022). Bazilian (2020) reported that approximately two billion persons (across at least 140 countries) regularly consume insects as their source of protein, vitamins, minerals, and fat. Globally, there are more than 2000-2300 species of palatable insects (Van Huis *et al*., 2013; The Parliament Magazine, 2022).

Ethno-entomophagy is very popular in tropical and subtropical regions including Africa, where insects thrive due to the warm moist climate (Jongema, 2017). Gaston and Chown (1999) pointed out that tropical insects are generally larger and exhibit stable life cycles, which can facilitate the timing of harvesting. This could be a reason why many insects are a great resource in these regions. Bazilian (2020) reported that in most tropical regions the most preferred edible insects include bees, wasps, beetles, moths, caterpillars, crickets, and grasshoppers.

Femi (2021) and The Parliament (2022) accentuated that insects (micro-livestock) could be a sustainable source of protein and micronutrients for many regions where land is scarce or climate is unfavorable for keeping conventional livestock. The production of insects is less expensive in terms of their minimal resource requirements (feed, land, and water). Besides, they have a negligible carbon footprint compared to domesticated animals. Some comestible insects could be used as scavengers of organic waste. La Barbera *et al*. (2021) highlighted that to produce a kilogram of

eatable protein from mealworms one will require 10% of the land needed to produce a kilogram of beef.

Moreover, van Huis (2015) conveyed that insects are 20 times more efficient in converting feed to edible food/feedstuff compared to conventional livestock. Eating insects could reduce the amount of synthetic insecticides that are applied to control them. The insect production process is diverse thus offering many employment opportunities along its market chain.

Considering the foregoing dialogue we observed that ethno-entomophagy has scarcely been investigated in most of Africa especially in eastern Nigeria despite the rich history of entomophagy in Africa. This study was conceived to document the practices related to ethno-entomophagy in southern Nigeria region.

MATERIALS AND METHODS

The Study Area

This survey was carried out in old Eastern Nigeria (mainly in the current South East Region and one state from South South Region), explicitly from Ebonyi, Abia, Imo, Anambra, Enugu States, and Rivers State (Figure 1). South East region is one of the six geopolitical zones of Nigeria. Its vegetation types include transition forests and the Guinea forest–savannah mosaic

It is mainly inhabited by the Igbo people/tribe as well as the Igala people and the Idoma tribe. Rivers State is south of South East region. Rivers State is in southern Nigeria (but in the Old Eastern Region). Rivers state contains mangrove swamps, tropical rainforest, and many rivers. Rivers State is an agrarian area. Ijaw people/tribe are the main inhabitants of the region.

This geographical southeastern part of the country experiences tropical climatic conditions with heavy rainfall, high humidity, and high temperatures throughout its two seasons (i.e. rainy season and dry season) per annum. The countryside is covered with lush vegetation that harbors many types of insects and lots of wildlife. Agriculture is the mainstay of the inhabitants of this region.

Research Methods

Data Collection and statistical Analysis

The data were collected by trained personnel through distribution of questionnaires. The research included mostly quantitative assessment of the knowledge of the respondents. The respondents included inhabitants of the settlements irrespective of tribe, religion, gender or insect consumption status.

This study was carried out by randomly administering structured questionnaires with mostly closed-ended questions to inhabitants from all social classes in the region. Out of 630 administered questionnaires, 560 questionnaires were adjudged to be properly filled and utilized in this study.

The non-representative, incomplete, poorly filled questionnaires were rejected at coding stage. The balance of the number of questionnaires per settlement/town was maintained by randomly selecting the same number of questionnaires per settlement thus giving 560 questionnaires ultimately. Hence, the settlement with the lowest number of properly filled questionnaires indirectly determined how many questionnaires were utilized for the study.

Respondents answered questions about types of indigenous edible insects, ways of capturing the insects, rearing them, processing and storing insects, reasons for eating insects, how often they consumed insects, the benefits of eating insects, preferences for rearing, consuming, processing insects, and their attitude towards eating insects. Information was solicited on edible insect economy and value chains. The questionnaire dealt with the social bio-data of

respondents and practices related to ethno-entomophagy in the region.

Photographs of various edible insects mentioned in literature were employed **to** ensure uniform identity of mentioned insects. Suggestion of other species of insects by respondents was permitted. The respondents were free to ask questions but the person administering the questionnaire did not ask them questions on their responses. Those who opted to fill the questionnaire and submit later were permitted to do so (Agbidye *et al.*, 2009; Adeoye et al., 2014; Barbera *et al.*, 2021; Penedo *et al.* 2022; Ishara *et al.*, 2023).

Agbidye *et al.* (2009) in Nigeria during a survey identified the most abundant, most preferred and most consumed edible insect species in the study area. We incorporated these criteria into this study. Skotnicka *et al*. (2021) and Onwezen *et al.* (2021) also included the socio-demographic aspects considered relevant such as gender, age, country of origin, or linguistic region. We utilized only gender and age in this study, considering our milieu. The criteria utilized by Adeoye *et al*. (2014) were similar to those above and we took note of them.

Also, Penedo *et al.* (2022) in Switzerland investigated the effects of gender, age, linguistic affiliation based on area of origin, current education level, main field of study, and nationality. Findings from our pilot trial convinced us to drop some parameters especially those related to ethnic origin. Ethnicity is a highly divisive issue in West Africa.

Consequently, Ishara *et al*. (2023) in the Eastern Democratic Republic of Congo, carried out a field survey focused on documenting edible insects in the region, consumer preferences, preference factors, seasonal availability, host plants, harvesting techniques, processing and preservation methods. We documented the types of edible insects, consumer preferences, harvesting techniques, processing and preservation methods, education needs, improvement methods, marketing, medicinal applications, customs, and cultures related to insects.

The data mined from our questionnaire was converted into percentages using the IBM statistical package for social sciences (version 25) software. Descriptive statistics and Fisher's least significant difference (FLSD) ($p \leq 0.05$) were employed to evaluate the trends in the respondents' answers. Frequencies were generated from the questionnaires and employed to reach deductions presented herein (Agbidye *et al.*, 2009; Bednářová *et al.*, 2013; Adeoye *et al.*, 2014).

RESULTS AND DISCUSSION

Results

Results revealed that generally 50.5% and 49.5% of the respondents were female and male respectively. Interestingly most of the female respondents had no stigma against insect consumption. Only 3.2% of the respondents had no formal education, 8.4% held first school leaving certificates and 7.4% had secondary school certification. The majority of the respondents (81.1%) had attained tertiary school educational level.

The age distribution of the respondents indicated that 17.9%, 65.3%, 6.3%, 1.1%, and 9.5% were below 20 years old, 20-30 years, 31-40 years, 40-60 years and above 61 years old respectively. Based on their occupations, we had 12.5% farmers, 30.8% civil servants, 26.4% traders, 27.8% artisans/crafts-workers/artists, and 11.1% teachers or tertiary school students as respondents. This distribution was not planned but depended on the willingness to respond to the questions.

Table 1 shows nineteen major types of insects consumed in old Eastern Nigeria. These insects are still being sourced from the lush vegetation and trapped when they are in season. The quantity of each insect is usually too small or seasonal for industrial processing, thus they are consumed

immediately after processing. Inadequate or no storage facilities exist for off-season storage. Rearing of these insects is possible to augment the harvest from the wild. This can encourage industrial processing of the insects into products of commerce.

Figure 2 shows the proportion of the region having respondents who have consumed specific insects, prefer to rear a specific insect species, prefer to eat a specific insect species or have witnessed the sale of a particular insect species. The insects shown in the chart are those that are consumed most in the region.

Thus in South Eastern Nigeria/old Eastern Nigeria, termites (61%) followed by green grasshoppers (36%), palm weevils (33%), honey bees (23%), and African crickets (20%) are highly cherished and consumed. Most of these insects were selected to tally with those listed in published global literature and of tropical origin. Consumption of house cricket and mole crickets were not reported in the area.

A larger proportion (73.7%) of the respondents have eaten insects. Among those who have consumed insects, 47.9% have some insects they prefer to consume while 52.1% had no preferred insects in mind and can consume any edible insects. Probably, those who have no specific insect that they prefer could be early adopters of new insects introduced in the area, while those who prefer specific insects can be easily taught how to rear the insect they are already interested in. Among the respondents, 66.7% attested to the sale of insects but 33.3% were not aware of the marketing of insects in any form in the region.

Most of the respondents (92.0%) have never witnessed anyone falling ill due to the consumption of insects. Additionally, 100% of the respondents reported no taboo against insect consumption in the region. Moreover, 86.9% of the respondents reported that insects are used to treat some ailments (ants used against convulsion, fresh termites or locust against beriberi, African cricket against snake bite). Some repondents (13.1%) had no idea if insects are thus used to heal the sick.

Very few cases of insect consumption leading to sickness were reported; eating of yam beetle led to swollen stomach in one instance and excessive consumption of grasshoppers resulting in stomach upset and frequent stooling. No one reported the availability of any commercialized insect-based medicinal products. About 88.0% of the respondents claimed that they are familiar with products of insect origin (be it native or industrial) like candles, honey, wax, etc being processed and marketed in the region. Moreover, 74.4% of the respondents were aware that insects are used in animal feed in the region.

When quizzed about their willingness to study insect rearing and processing, 64.0% of the respondents indicated interest if the opportunity came. Unfortunately, 35.9% of the respondents were not interested in this opportunity although giving reasons ranging from entomo-phobia to no reason in particular.

The respondents offered many pieces of advice on how to increase the interest in ethno-entomophagy in the area as follows. The main advice was to increase the education of inhabitants (70%) and improve the method of preparing the edible insects (30%). While improving marketing strategies/chain, rearing and promoting entomophagy via media each scored 20%, improving the packaging of insect products and introducing insect eating festivals scored 10% each.

The techniques being employed to capture the insects included the use of nets (70%), light-water-basin traps (90%), handpicking (80%), physical chasing of insects (50%) and lastly digging out the insects from palm trees/trees or soil (20%).

The costs of insect products vary with location, type, season and demand from 0.067-0.4 US dollars (as of 2024) per glass cup based on the type of insect and pallatibility. The insects are prepared for consumption by frying (50% of the areas surveyed), drying (80%), salting (30%), smoking (10% of the areas surveyed) and a combination of these methods. In some areas, half of the respondents did not know how insects are prepared for consumption.

Based on the separation of the means, termites are significantly ($p \leq 0.05$) consumed most, followed by green grasshoppers and palm weevils, then honey bees and field crickets amongst the top eight insects in the region. Termites and palm weevils are significantly most preferred insects to consume in the area followed by green grasshoppers, which agrees with the findings on the insects consumed most in the area.

However, when it gets to which insects one prefers to rear, termites and honey bees were significantly most preferred ($p \leq 0.05$) followed by green grasshoppers and palm weevils. This preference reflected in the insects marketed in the area. Here termites are significantly ($p \leq 0.05$) encountered most in markets followed by palm weevils and honeybees then field crickets, variegated grasshoppers and so on. The responses in the chart had a better regional distribution compared to others so statistical analysis was easily employed to determine their statistical significance.

Discussion

Oonincx and de Boer (2012), Penedo *et al*. (2022), Niranjan (2023), and Fazi (2023) recounted that insect-based food products have been suggested as a more sustainable source of protein (e.g., less greenhouse gas emissions and less land/water required for production). The rearing of insects in Nigeria is still in its conception or pre-infancy stage. Dev *et al*. (2020) pointed out that insects are mainly collected from the natural habitat which results in seasonal scarcity of edible insects. This view concurs with the practice of harvesting insects mainly from the wild in Nigeria.

The use of media to promote entomophagy was recommended by the respondents. This corroborated the recommendation of Tang *et al*. (2019) who argued that workshops, radio, and Television shows should be employed to promote insect products and facilitate the adoption of insect production and consumption. IPIFF (2024) revealed that 60% of Europeans (especially those between 25-44 years old) who tasted insect-enriched products rated the taste as "very good". Sports supplements, pasta, burgers were the main groups of preferred insect enriched foods.

The major insects consumed in this Eastern region are characteristic of the edible insects in Nigeria (Adeoye *et al*., 2014). The sort of insects eaten in literature reviewed were the same with those eaten in southern Nigeria (Bazilian 2020). Meyer-Rochow (2005) and Tang et al. (2019) recounted that insects that are consumed sometimes differ distinctly between neighbouring regions. For instance, Dev *et al*. (2020) observed that the field cricket (*Brachytrupes* sp.), short-horned grasshopper (*Oxya* sp.) and giant water bug (*Lethocerus indicus*) were the most preferred insects (with percentage acceptance of 84%, 83%, and 79% by the respondents of all the ethnic groups they surveyed respectively).

Likewise, Dev *et al.* (2020) stated that the availability of edible insects depended on the season which could affect the use of insects in medicine and culture. These findings are typical of the plight of ethno-entomophagy in this region of Nigeria. They confirmed that nine insect species were used to treat coughs, fevers, nocturnal emissions, burning, and gastroenteritis. This concurs

with the instances cited above whereby insects are used to treat sicknesses.

Gora (2021) reported that insect farming is practiced and it is estimated to be about $1.5 billion by 2022. In the US about 30 companies rear insects for animal and human consumption. These insect production chains offer many of the benefits (food and employment) as traditional farms. Insect farming is easily scalable and efficient which results in a better environment compared to traditional feed production.

Bazilian (2020) reported that in Thailand (a prominent insect market) insects are imported at the rate of $10 per kilogram. This price is far above what is obtained in Nigeria and exporting insects could be a goldmine here where unemployment is very high. The stark lack of statistics on the insect farming sector in Nigeria is glaringly clear. It is difficult to estimate how much is made from selling insects and rearing them in the whole country. We could boost the economy using this insect-rearing avenue.

van Huis (2015) reported that food preferences are influenced by culture, experience, and adaptation. However, Tang et al. (2019) argued that these attitudes might closely relate to customs, although customs can be changed by open-minded people. Berger and Wyss (2020) mused that Europeans have always eaten food strongly associated with decay (e.g., mold-seasoned cheese or fungi) but they abhor insects.

Rozin and Haidt (2013), and Looy *et al.* (2014) earlier indicated that food-evoked disgust is primarily culturally learned. Jensen and Lieberoth (2019), and Berger and Wyss (2020) reported that subjective insect-eating norms significantly influence individuals' tasting behaviour of insect-food products.

Insect consumption can contribute to pest control thereby ensuring a healthy environment when fewer pesticides are used. The major insects consumed in southern Nigeria are potential pests of major crop species. Thus we can borrow a leaf from China where the stink bugs are largely captured for consumption which has contributed to the integrated management of litchi (Raksakantong *et al.*, 2010).

Tang *et al.* (2019) testified that the natural rearing of cicadas in the fields is feasible, profitable, and without safety concerns. The insects still live in the wild but the surrounding organisms are controlled. This practice can be improved on and introduced here as part of natural agriculture or nature farming. Moreover, some insect species are efficient in converting organic waste like rotten fruits into useful manure (Nguyen *et al.*, 2015).

Insect production is a huge opportunity that is waiting to be discovered in Africa especially in Nigeria that has an undiversified economy. Bazilian (2020) stated that cooked grasshoppers can have up to three times the amount of protein and one-third the amount of fat compared to a hamburger.

The cases of sickness developing that were mentioned above included cases of over-indulgence and possible under-cooking or some form of allergy. Luckly no report of death from eating insects was encountered. The consumption of uncooked insects is common worldwide. Funny enough even in this region no one reported that eating uncooked insects caused sickness. As we noted cultures that are disgusted with grubs or that have lots of animal proteins may have stigmatized insects without cause. The saying that ‘one man’s meat may be another man’s poison,’ may not even hold for insects until we come up with ample scientific proofs that eatable insects are deadly.

Silkworm larvae are eaten in this region besides being used to produce silk. Bazilian (2020) confirmed that silkworms are often used for silk production and food and that weaver ants are used to put off pests. The Chinese company ‘HaoCheng Mealworm Inc.’ has gone as far as producing flour,

candy, condiments, and instant noodles for human consumption from mealworms. The production of insect enriched/fortified bread and cookies is now common in some Western countries. Insects may be used as food supplements if proven to be healthy.

Termite consumption in Nigeria especially southern Nigeria is very common. Gora (2021) elucidated that in Southeast Asia and Africa, termites have been consumed for aeons. In Kenya, they are even eaten straight from their mound without any preparation. These insects keep very clean colonies and termitaria. They may thus be disease free. Moreover, termites can be roasted, fried, or mixed with flour for making wholesome bread. These practices extend to southern Nigeria as was reported herein.

Insect rearing/consumption can benefit both the economy and the environment (Halloran, *et al.,* 2016). The Parliament Magazine (2022) and Meticulous Research (2023) reported that insect-based products include **i**nsect powder, insect meal, insect oil from insects like crickets, black soldier fly, mealworms, ants, grasshoppers. These products are used for animal feed, pet food, protein bar/shakes, bakery**,** pasta, pizza, cakes and burgers, burger patties, falafels, sausages, and confectionery **(**Abdullahi *et al.*, 2022**).**

Moreover, the life cycles of insects are usually shorter than those of other protein sources (Wilkinson, 2011; Klunder *et al.*, 2012). Raubenheimer and Rothman (2013) confirmed that the nutritional compositions of insects are quite similar to those of traditional livestock. Furthermore, Tang *et al.* (2019) extolled the fact that insects are great sources of vitamins and micronutrients though some studies have pointed out that these nutrients can be affected by feedstuffs used to feed the insects.

The major limitations of the study include the use of a moderate sample size due to inadequate finance. The use of questionnaires allowed for easy analysis but interviews could have added more flesh to the study. The indigenes in this area may not be versed in English thus may be only those who are fluent in the language may have opted to fill the questionnaires.

Those who collected the questionnaires to fill them later were mostly suspected to be less fluent in English and required help later to go through the instrument. The research instrument gave room for written-volunteered suggestions for most of the questions so as to reduce the limitation. The questionnaires were also administered in a pilot trial in the campus and the instrument's validity and reliability were assessed.

Another limitation of this study included utilization of major settlements only. The rural dwellers constantly encounter insects and can give another view of the same area. The current insecurity (spree of kidnappings, banditry, armed robbers, insurgency, and so on) being experienced in the area restricted the workers from wandering too far from major settlements in the area.

The limitations in the research procedures mainly related to limited time given to the respondents to fill the questionnaires. This was mostly due to the necessity to get out of each town as soon as possible and cut down cost of transportation and accommodation for the field session.

The rural dwellers have fled to towns also. Thus, due diligence was employed to ensure that the 14 areas surveyed were properly assessed. Visiting remote hinterlands will be possible only when security and safety improves in the regions. This observation hindered analyzing the responses based on location since most inhabitants have moved/resettled in other locations.

Any instance of insect phobia and disgust can be reduced via increased educational awareness on the inherent

nutritional value of edible insect. Studies on insect food safety, toxicity, quality control, production and processing guidelines are necessary. Incentives and educational policies geared towards encouraging edible insect farming should be deployed.

In addition, more research should focus on the acceptability of food products fortified with edible insects. Our research team has conducted similar studies in some other regions of Nigeria and West Cameroon. More regions in West and Central Africa should be visited in order to gather more indigenous knowledge on usage of insects. Constrains identified in this study should be ameliorated to promote entomophagy and insect rearing.

CONCLUSION

The practice of insect consumption was investigated using questionnaires in the southeastern region of Nigeria. The practice of entomophagy is rampant in the region. The younger generation is also involved in the practice which can ensure the continuity of entomophagy. The edible insect especially termites (61%) followed by green grasshoppers (36%), palm weevils (33%), honey bees (23%), and African crickets (20%) are mainly consumed as food. Consumption of house cricket was not reported eventhough it is highly consumed elsewhere. Among the insects consumed in the area, emperor moth larvae, silkworm larvae, yam beetles, soil white grubs, armyworms, rhinoceros beetles and waxworms were less frequently mentioned as edible.

Entomophagy can be improved through the setting up of insect farms, research, media promotion activities, and educating the populace about it amongst other measures. Modern entomophagy should be encouraged in the area to avoid the situation whereby some insects may go extinct or become endangered species.

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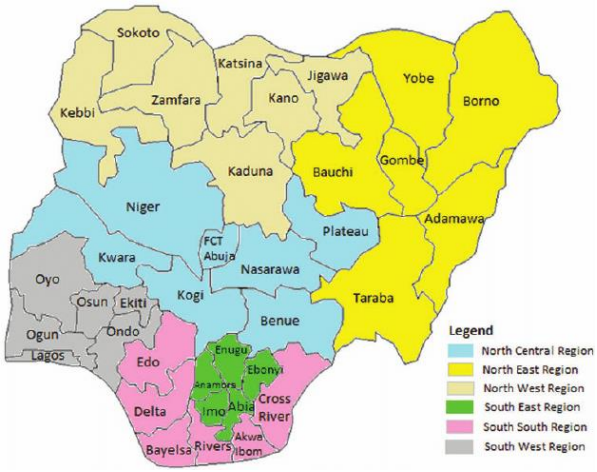
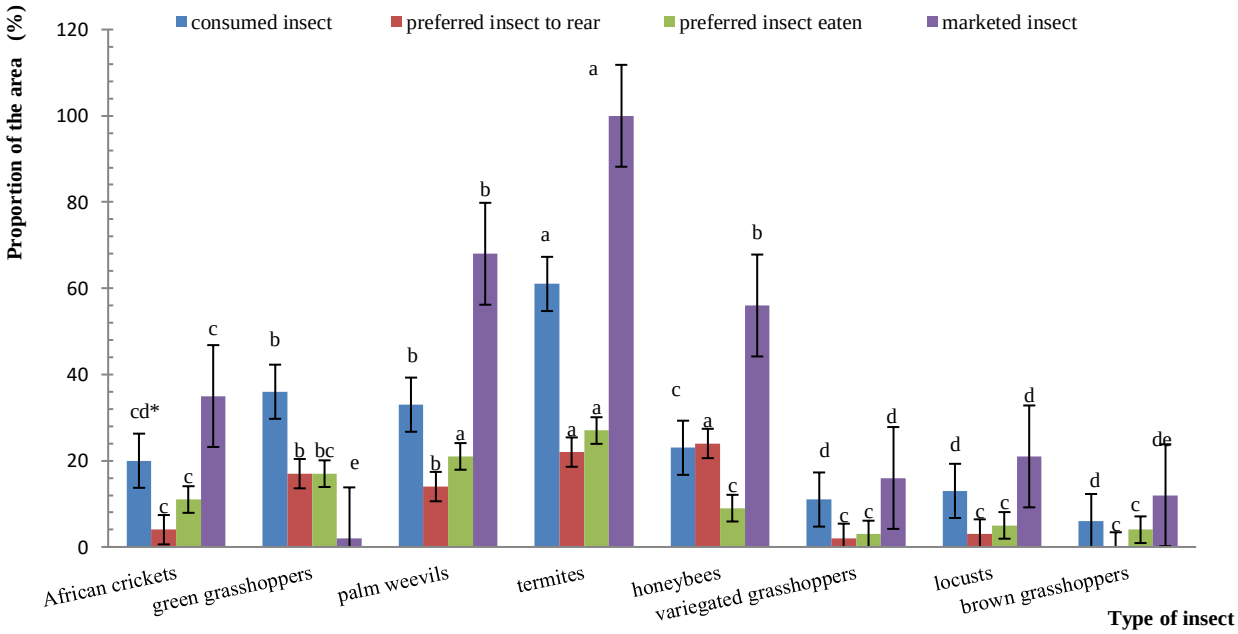
Table 1. Edible insects in Eastern Nigeria (old Eastern region)

Scientific name	Common name
Rhynchophorus phoenics	Palm weevil
Analeptes trifasciata	Rhinocerus beetle
Heteroligus meles	Yam beetle
Zonocerus variegatus	Variegated grasshopper
Macrotermes belliscosus	Termites
Macrotermes notalensis	Termites
Brachytrupes membranaceus	African cricket
Apis mellifera	Honeybee
Cirina forda	Pallid emperor moth
Bunaea alcinoe	Emperor Moth
Schistocerca gregaria	Desert locust
Locusta migratoria	Migratory locust
Omocestus viridulus	Green grasshopper
Gomphocerippus rufus	Brown grasshopper
Bombyx mori	Silkworm
Spodoptera exempta	African armyworm
Achroia grisella	Lesser waxmoth/ waxworms
Galleria mellonella	Greater wax moth/ waxworms
Cyclocephala, Heteronychus, Eulepida, and especially *Phyllophaga* species	Soil white grubs



Source: Sewa Mathews. History with buzz: how Nigeria became a 36 state country. https://www.boomplay.com/buzz/1040002#google_vignette

Figure 1. Map of Nigeria showing the states and geo-political zones/regions



*Means followed by the same letter(s) in a series are similar statistically using FLSD ($p \leq 0.05$)

Figure 2. The proportion of the region that reported the consumption, marketing, consumption preference, and rearing preference for specific highly consumed insect species