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Insect as Food Resource: Utilization, Challenges and Prospects in the Niger Delta Region of Nigeria

Zakka U.* and Godwin-Egein, M.I.

Department of Crop and Soil Science, Faculty of Agriculture,
University of Port Harcourt

*Corresponding author (Email: uzakka@yahoo.com; Phone: +234-8065703350)

ABSTRACT

The utilization, challenges and future prospects of insects as food resource in the Niger Delta region of Nigeria was evaluated using a structured questionnaire covering the type of insects consumed, harvesting techniques, preference for insects as protein source over other protein sources and the perceptions and phobia attached to their consumption. The factors responsible for the decline in the art and science of entomophagy in the region, industrial potential of entomophagy and other roles insects play in culture, religion and tradition, were also assessed. The results showed that the African palm weevil (*Rhynchophorus phoenicis*) larvae was the most consumed insect in the region and that felling down of the host tree was the common method of harvesting the African palm weevil larvae. Factors responsible for the decline in the availability of edible insects in the region were tied to oil exploration and exploitation activities. The respondents showed eagerness to have industries and restaurants to process and sell edible insects as food resource; to conserve the practice of entomophagy as a value addition chain and not as an aberration.

Key words: *Rhynchophorus phoenicis*, entomophagy, Niger Delta, African palm weevil, food resource.

INTRODUCTION

The Niger Delta vegetation consists of extensive mangrove forests, brackish swamp forests, and rainforests. It is richly endowed with abundant natural resources and enabling weather condition which supports all year round agricultural production. Federal Office of Statistics (FOS) (1995), reported about 50% of the active labour force of this region is engaged in one form of agricultural activity or another with commodities like yam, cassava, plantain, maize, cocoyam and vegetables as the most important food crops in the area. Fishery is a major industry of the region. The fishing industry is an essential component that provides sustainability of both the Niger Delta and Nigeria's economy at large because it provides the much needed protein and nutrients for the people, but with the higher demand on fishing, and declining fish population due to depressed ecosystem, aquaculture and fish farming has led to the demand for other protein sources because as the ecosystems are being drastically changed, marine and terrestrial habitats for most marine and terrestrial species are being lost.

Entomophagy in Africa is an age long tradition and insects as food resource has been practiced for centuries all over the world. Rojas-Briales and van den Ende (2013) are of the view that edible insects have always been part of human diet though this assertion is not without reservation to the Western world. van Huis

(2003b) opined that insects are eaten as delicacy particularly in the tropics but the practice is seen as an aberration in the western world where most people are skeptical about it and they consider it as primitive and barbaric. Razin and Vollmecke (1986) added that disgust is the major factor contributing to it which is often than not triggered by questions like: What is it? Where has it been? Where is it from? This judgment generally plays greater role in people's rejection of certain foods (Fessler and Navarette, 2003) but Hertz (2012) opined that it is rather an innate reaction and human emotions and culture (FAO, 2013). By 2050 the world population will rise to nine (9) billion people which means the current food production will need to be doubled even in the face of scarce land with limited room for expansion made for farming, water bodies being over fished, climate change posing threat to food security (FAO, 2013) which makes it expedient for insects' farm as an addition to the food value chain. Currently there are over one billion people hungry yet food wastage is high with no alternative ways of producing food (Rojas-Briales and van den Ende, 2013). Reduced food production has led to reduction in average caloric intake and increased malnutrition estimated to affect 300 million people. Hunger is one of the major constraints to Africa's development; the use of insects to substitute other food sources to ameliorate hunger is yet to receive full attention as reiterated by FAO (2013).Currently there is a rising cost of animal protein and alternative sources of protein is needed.

Boulidam (2010) primarily categorized edible insects as Non-Wood Forest Products (NWFPs) and they are capable of alleviating hunger and have high potential of being a major food resource (Vantomme *et al.*, 2004). Edible insects in tropical Africa are found all year round and in large numbers that do not require seasonal outbreak before gathering/harvesting and processing requires no sophisticated equipments or gear. van Huis (2003b) reported that nearly one million years ago the early hominids either *Homo* or *Australopithecus robustus* in South Africa used bones to harvest termites from their nests as food resource. Accurate records on entomophagy in Africa are grossly lacking which could be attributed to poor research in this area coupled with poor data collection, processing and storage as common in many developing nations. However, available data show that insect species eaten all over the world range from 1000 (van de Foliart, 1997) to 1391 (Ramos-Elorduy, 1997) with about 524 species eaten in 34 African countries which represent 38% of all species consumed (van Huis, 2003b). Insects are a traditional diet of at least two billion people (Rojas-Briales and van den Ende, 2013). Insects contribute significantly to the food security and livelihoods in both rural and urban areas as major source of protein, carbohydrates and vitamins, traditional medicine and pollen dissemination (Stack *et al.*, 2003; Vantomme *et al.*, 2004). Edible insect species belong to nine orders comprising Coleopteran, Hymenoptera, Orthoptera and Lepidoptera, others include Heteroptera, Homoptera, Isoptera, Diptera and Odonota (van Huis, 2013; Rojas-Briales and van den Ende, 2013)

Insects have proven to be one asset man will cherish even though their acceptability or otherwise are contentious (Adedire, 2008). Protein, fat, oil and mineral of insects compare very favourably with other sources like meat and fish (Nkouka, 1987). Bukkens (1997) and van Huis (2003) reported that 1g/100g dry weight caterpillar contains 50-60, Palm weevil larvae 23-26, Orthoptera 41-91, ants 7-25 and termites 35-65.

Most edible insects are harvested from the wild, some have long history of artificial

rearing such as bee and silkworm and others are reared for biocontrol, maggot therapy and pollination. The concept of farming insects for food and feed is relatively new (FAO, 2013). Boulidam (2010) reported that in a village of Dong Makkhai in the Lao Peoples Democratic Republic, an average of 23% of the combined household income of the village is derived from the production and sales of insects. The current health risk associated with consumption of red meat and other sources of protein requires alternative protein source that is cheap, available and can be easily processed by the body without harm. The aim of the study was to evaluate the utilization, challenges and prospects of entomophagy in the Niger Delta region and specific objectives included to determine the insect type, harvesting technique and threats to biodiversity, factors responsible for the decline and attitudinal changes in entomophagy and the role of insects in culture and tradition in the Niger Delta Region.

METHODOLOGY

Study Area

The study was conducted in the Niger Delta region of Nigeria. The area is located between longitude 5^{o} and 8^{o}E and latitudes 4^{o} and 6^{o}N on the West African coast (Agumagu *et al.*, 2008). The region is classified into four ecological zones; coastal inland zone, freshwater zone, lowland rainforest zone, mangrove swamp zone. The study was carried out in the first three zones represented by Abia, Akwa Ibom, Bayelsa, Delta and Rivers States.

Niger Delta is located in Southern Nigeria with a coastline of about ± 450km; it is the world's third largest delta (Awosika, 1995). The delta covers about 20,000sq/km within wetlands of about 70,000 sq./km making it the largest wetland in Africa and among the third largest in the world (Powell *et al*., 1985; CLO, 2002; Anifowose, 2008; Chinweze and Abiola-Oloke, 2009). This floodplain is about 7.5% of Nigeria's total land mass. About 2,370sq/km of the Niger Delta area consists of rivers, creeks, estuaries, and stagnant swamps covering approximately 8600sq/km, the Delta mangrove swamp spans about 1900sq/km as the largest mangrove swamp in Africa (Awosika, 1995). The Niger Delta region is diverse with several ethnic groups including the Urhobo, Ibo, Isoko, Itsekiri, Ijaw, Ukwani group in Delta and the Yoruba (IIaje) in Ondo in the western part of Nigeria. The Niger Delta is classified as a tropical rainforest with ecosystems comprising of diverse species of flora and fauna both aquatic and terrestrial species. The region is considered one of the ten most important wetlands and marine ecosystems in the world (FME, *et al*., 2006; ANEEJ, 2004). The Niger Delta is made up of the following Nigerian States Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Ondo, Imo and Rivers respectively (Figure 1).

The Niger Delta is highly susceptible to adverse environmental changes, occasioned by climate change because it is located in the coastal region. Human activities and those of oil exploration and exploitation raise a number of issues such as depletion of biodiversity, coastal and riverbank erosion, flooding, oil spillage, gas flaring, noise pollution, sewage and wastewater pollution, land degradation and soil fertility loss, deforestation and water hyacinth invasion, which are all major environmental issues.

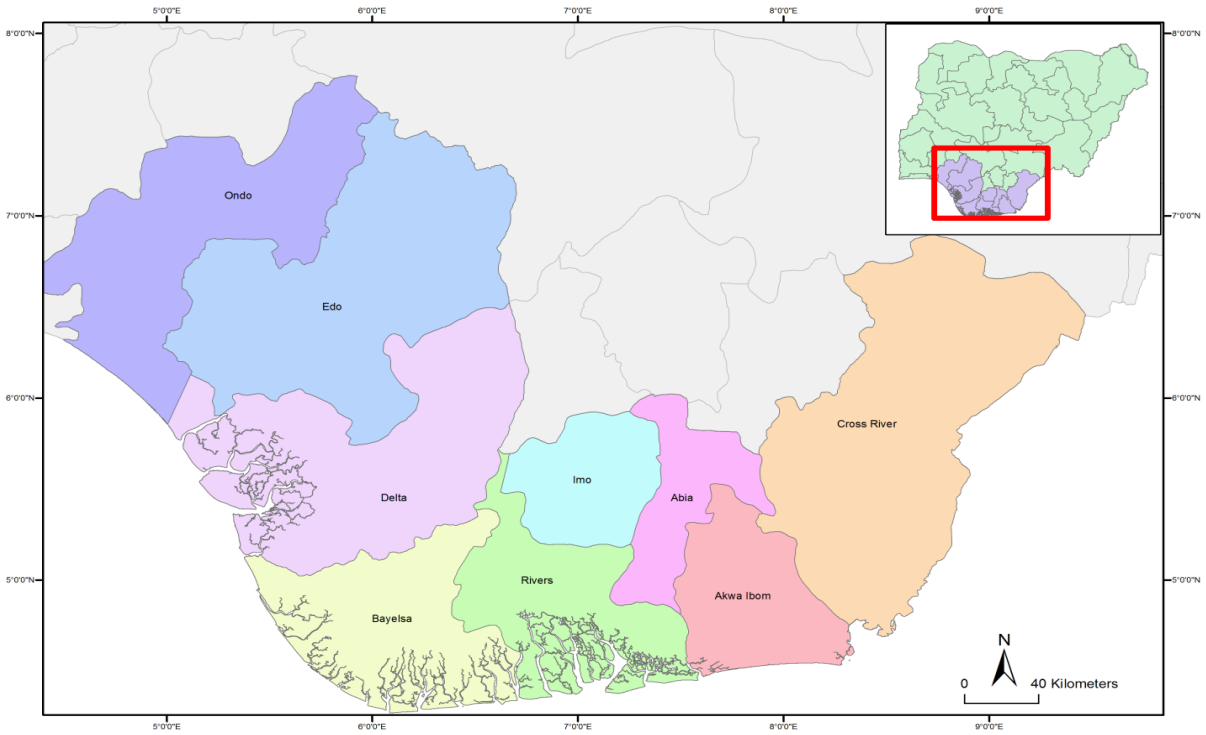

Figure 1. Map of Nigeria numerically showing states typically considered part of the Niger Delta region: (Okonkwo *et al*., 2015)

Research Questions

A structured questionnaire was designed with seven major headings covering insect type, quantity consumed and period of collection, harvesting techniques, method of detecting the presence of edible insects and the possible threat to biodiversity and its practical conservation methods, perception and reasons of entomophagy in the Niger Delta. Others included insect preference over other sources of protein, the most desired form for consumption, factors responsible for decline in availability and other attitudinal changes in entomophagy in the region, packaging, processing and industrialization and some elements of insect in culture, art and tradition.

The questionnaire was distributed with no prejudice to sex, educational background and other demographic parameters. Seventy five respondents were randomly selected with at least fifteen respondents from five Niger Delta States (Abia, Akwa Ibom, Bayelsa, Delta and Rivers States). Seventy five questionnaires were distributed equally among the states and fifty questionnaires were retrieved and processed using SPSS Frequency and percentile tables were constructed and standard error of the mean were analysed and presented. Relevant literatures were reviewed and acknowledged.

RESULTS

Table 1 shows the result of insect type commonly consumed, quantity eaten per day and time of collection in Niger Delta region of Nigeria. African palm weevil larvae (*Rhynchophorus phoenicis*) popularly called edible warm is the most commonly consumed insect followed by cricket while grasshopper was the least. An average of 1-2 sticks or pan was consumed daily with 12% of the respondents unable to estimate the approximate quantity they eat.

Harvesting technique and its attendant effects on forest resources in the Niger Delta is shown in Table 2. Cutting down or felling and splitting of the host tree was the major practice (54%) followed by handpicking from decayed host plants and 4% indicated shaking the host tree which was more common when harvesting matured adults rather than the larvae. Means of detecting the presence of palm weevil was by sound where experienced harvesters placed their ears to the host plants and listened to the feeding activity of the developing larvae and 16% indicated by sight where physical sign probably of damage on the host plant associated with the insect was used. When asked what could be the adverse effects of the harvesting method employed to forest conservation, 52% indicated depletion of the host species followed by 36% that indicated probable extinction of the host species and the edible worm in the region and 2% showed that it might lead to over exploitation of the ecosystem. Thirty two per cent (32%) of respondents opined that closed season, otherwise restriction of the harvest time, followed by improved sericulture and diversifying the current method of harvesting can practically conserve the environment and the crop.

Table 3 shows the perception and other reasons why people in the Niger Delta practice entomophagy. Eighty two per cent (82%) of respondents ate insects because they see other people eating it and 12% ate insects out of curiosity. As to how they perceived the art and science of entomophagy, 44% believed it was born out of peasantry and 34% perceived it as a highly priced food especially in this region where other sources of protein like fish was an alternative.

Table 4 shows that 52% of respondents preferred beef as source of protein and 4% fish which was the commonest source of protein in the region and 30% of the respondents could not place it over any of the sources of protein they consume. The same table showed that only 4% of the respondents indicated insects and chicken as their sources of protein and majority 66 % indicated fish and only 16% indicated beef which is a priced protein source in the region. Respondents also indicated that processed larvae (56%) were the most desired form, followed by processed adult weevil (22%). Three per cent (3%) of respondents preferred live larvae. On phobia associated with entomophagy, 56% of respondents indicated fear, followed by vomiting (16 %) while 4% indicated body itching.

Table 5 shows factors responsible for the decline in the availability of edible insects in the region. Oil exploration and exploitation (major cause), modernization and adoption of the western culture especially among the youth, in order of magnitude, were indicated as factors responsible for the decline of edible insects availability. When attitudinal change towards entomophagy was evaluated, results showed that processing and handling techniques (poor value addition), non-availability especially during off season and lack of awareness of nutritional value, in that order were responsible for the decline in consumption rate.

Table 1: Responses on type of insect and quantity consumed/day and period of harvesting in Niger Delta Region of Nigeria.

Type of Edible Insect	Frequency	Percentage
Cricket	8	16.0
Grasshopper	2	4.0
Edible warm	30	60.0
Termites	6	12.0
No response	4	8.0
Mean	2.92	
SE	0.151	
Quantity eaten/day		
1-2 stick or pan	23	46.0
3-4 stick or pan	10	20.0
5-6 stick or pan	5	10.0
7 and above	6	12.0
No response	6	12.0
Mean	1.78	
SE	0.059	
Period of harvest		
Jan-March	5	10.0
April-June	10	20.0
July-Sept	18	36.0
Oct-Dec	17	34.0
Mean	2.94	
SE	0.192	

Table 2: Responses on Harvesting technique and its effects on forest resources in the Niger Delta Region of Nigeria.

Harvesting Technique	Frequency	Percentage
Shaking the host tree	2	4.0
Cutting or felling the host tree	27	54.0
Bush fire and Light trap	4	8.0
Hand picking from decayed host plant	17	34.0
Mean	2.73	
SE	0.140	
Means of detecting the presence of the edible worm		
Sound	30	60.0
Feeding point	6	12.0
Insect droppings	6	12.0
Sight	8	16.0
Mean	1.84	
SE	0.165	
Harvesting technique and threat to biodiversity and ecosystem		
Depletion of the host species	26	52.0
Unsustainable NWFPs	4	8.0
Over exploitation of ecosystem	2	4.0
Extinction of the host species and edible worm	18	36.0
Mean	2.97	
SE	1.228	
Practical conservation method		
Diversification	11	22.0
Ration burning	5	10.0
Improved sericulture	13	26.0
Restriction of harvesting edible insects at certain time and area	16	32.0
No response	5	10.0
Mean	2.98	
SE	0.186	

Table 3: Responses on perception and reason for eating insects among the Niger Delta populace

Reasons why people eat insects	**Frequency**	**Percentage**
Curiosity	6	12.0
Out of hunger	1	2.0
Inadequate protein	2	4.0
My people eat it	41	82.0
Mean	2.18	
SE	0.136	
Perception about eating insects		
Highly prized food	17	34.0
Mere warding off hunger	9	18.0
Peasantry	22	44.0
No response	2	4.0
Mean	3.56	
SE	0.143	

Table 4: Most preferred protein, sources of protein other than insects and most desired form of insect protein among Niger delta populace.

Preference of insect over other sources of protein	**Frequency**	**Percentage**
Fish	2	4.0
Cow meat	26	52.0
Both	6	12.0
No response	15	30.0
Mean	1.63	
SE	0.079	
Source of protein other than insects		
Insect	2	4.0
Chicken	2	4.0
Beef	8	16.0
Fish	33	66.0
Response	5	10.0
Mean	4.20	
SE	0.134	
Most desired form		
Processed larvae	28	56.0
Live larvae	3	6.0
Processed adult	11	22.0
Live adult	6	12.0
No response	2	4.0
Mean	2.02	
SE	0.182	
Common source of phobia with practice of entomophagy		
Itching	2	4.0
Vomiting	8	16.0
Fear	28	56.0
No response	12	24.0
Mean	1.94	
SE	0.086	

Table 5: Decline in the availability of insect in the region

Responses	Frequency	Percentage
Agents responsible for decline of insect population		
Gas flaring	7	14.0
Oil exploration and pollution	18	36.0
Deforestation	8	16.0
Modernization	10	20.0
Culture	5	10.0
Entomophobia	2	4.0
Mean	2.98	
SE	0.122	
Attitudinal change to entomophagy in the region		
Westernization/Urbanization	1	2.0
Non-Availability	15	30.0
Processing and handling techniques	19	38.0
Lack of awareness of Nutritional value of insects	14	28.0
None of the above	1	2.0
Mean	1.94	
SE	0.108	

Seventy per cent (70%) of respondents wished to continue with the old method of packaging and processing techniques, 16% indicated keeping in baskets and only 4% desired to have it canned. Current processing techniques showed that roasting was still the preferred processing technique followed by drying and 6% was not decided on what to use. Fifty six per cent (56%) of the respondents indicated industrializing insect processing, and establishing standard restaurants for selling edible insects in the region (Table 6).

Table 7 shows that insects had a role in culture and tradition, traditional medicine, children's game, religion and art; 58% do not know if there exist any law forbidding any sex or age grade and foreigners from eating insects followed by 20 and 6% that indicated foreigners and children respectively are likely forbidden from eating insects in the deltaic region.

Table 6: Traditional and most desired modern processing techniques in entomophagy industry in the Niger Delta

Desired packaging of edible insects		
	Frequency	**Percentage**
Sealing in polyethene bags	4	8.0
Kept in basket	8	16.0
Canned	2	4.0
Sticking	35	70.0
No response	1	2.0
Mean	3.28	
SE	0.111	
Current processing techniques		
Freezing	2	4.0
Salting	1	2.0
Roasting	31	62.0
Drying	13	26.0
No response	3	6.0
Mean	3.15	
SE	0.881	
Industrializing entomophagy		
Cottage industry for processing insects	28	56.0
Insect restaurant	9	18.0
Insect market	4	8.0
No response	9	18.0
Mean	2.16	
SE	0.169	

Table 7: Entomophagy in the Niger Delta's culture and other folk tales

Role of insects in culture and tradition	**Frequency**	**Percentage**
Literature	3	6.0
Art	4	8.0
Religion	1	2.0
Medicine	17	34.0
Music/song	2	4.0
Children's games	11	22.0
No response	11	22.0
Mean	**2.18**	
SE	**0.136**	
Class or group forbidden from entomophagy in the deltaic region		
Women	4	8.0
Men	3	6.0
Foreigners	10	20.0
Children	3	6.0
Youth	1	2.0
No response	29	58.0
Mean	**1.83**	
SE	**0.895**	

DISCUSSION

African palm weevil (*Rynchophorus phoenicis*) larvae are widely eaten in the region as seen hawked on major streets and road sides. This agrees with an earlier report by Ramos-Elorduy (1990) which placed insects in a dietary schedule of the poor regions of the world and called for scientists to recognize the fact and to begin to build on rather than discouraging or ignoring it. FAO (2013) reporting Linneus 1758, says *"larvae assate in deliciis habentur"* (meaning fried larvae are delicious). This points to the fact that entomophagy is an age long practice. Larvae of *Rynchophorus* spp are consumed in Asia, (*R. ferrugineus*), Africa (*R. phoenicis*) and Latin America (*R. palmarum*) (Cerda *et al.*, 2001). This practice might be attributed to their rich nutritional content, especially fats, as expressed by those who relish it (Fasoranti and Ajiboye, 1993). The low consumption quantity of 1-2 sticks or pan may be due to high cost of purchase, the existence of an off-season and lack of awareness. Ramos-Elorduy (1990) reported such low consumption rate and observed that, although there is much increase in the awareness of Non-Wood Forest Products (NWFPs) role in food security less recognition has been placed on insects as one of the NWFPs.

Harvesting techniques employed by the indigent people of Niger Delta by felling of the host tree with only few collecting from decayed palm in the study may suggest the mind of collectors that insects are seemingly inexhaustible resources obtained by harvesting them from nature with no respect or concern to the forest. This trend was reported by Ferreira (1995) that, challenges like over exploitation in time of glut, direct competition with predators and/or parasitoids, undermining population of viability especially collection of mature individuals exceeding regeneration capacity (Cerritos, 2009) and collection of immature before they are able to moult (Illgner and Nel, 2000; Latham, 2003; Cerritos, 2009) and timing of bush fires and regulations in the area of cutting down trees to harvest insects (Leleup and Daems, 1969) pose a great threat to its sustainability or total extinction of such species. Other challenges include the local natural resource management strategies like pesticide usage and tree conservation decision (Vantomme *et al.*, 2004; Morris, 2004; Schabel, 2006), disregard of indigenous knowledge on sustainability of edible insects (Kenis *et al.*, 2006), inexperienced collectors resulting in faulty collection methods (Ramos-Elorduy, 2006; Choo *et al.*, 2001), and direct and indirect damage to host plants population (Morris, 2004; Schabel, 2006). Ramos-Elorduy (2006) identified 14 species of edible insects under threat and FAO (2013) documented 34 insect species as endangered; the practical way of combating this menace, could among others, be by enforcing closed season where harvesters will be restricted for a given period and improved sericulture and the adoption of an eco-friendly collection method. FAO (2013) reported that palm weevil occur all year round where the hosts abound. Other favourable hosts are coconut palm (*Cocus nucifera*), date palm (*Phoenix dactylifera*), Sago palm (*Metroxylon sago*), Oil palm (*Elaeise guineensis*), Rhaphia palm (*Raphia* spp) (FAO, 2013) which can be used to 'stem the tide'

Entomophagy is a science and an art. The high percentage of respondents that eat insects because they see their peers or parents eating it is not out of place. Probably those that eat insects out of curiosity might be none Niger Deltans and others that see it as peasantry might be influenced by western culture especially, among urban dwellers, since entomophagy is a practice amongst rural dwellers. van Huis (2003b) tried to correct a misconception that eating of insects in the developing world is prompted by starvation; that it is a survival tactics. He

argued that such is a fallacy, rather it is a common practice in sub-Saharan Africa and it deserves more attention, though Vantomme *et al*. (2004) suggested the potential of insects being seriously considered in the food security and poverty alleviation strategy in sub Saharan Africa. The perception of insect as a highly priced snack contradicts report by FAO (1995) as insects are gathered as food resource in many cultures of the world either as an occasional delicacy or as a replacement food at times of food shortage, drought, flood or war.

Preference of insects over other sources of protein such as beef and fish that are common especially the latter in the region might be due to awareness among consumers, cheaper and probably being a subsidiary means of protein source in the region where peasants are known to harvest the palm weevil and either eat it live or processed. Nutritional importance of insects in human diet is not in doubt Santos Oliveira *et al*. (1976). van Huis (2003b) observed that *Macrotermes bellicosus* collected in Nigeria are probably as valuable in complimenting maize protein. Bukkens (1997) stated that insects are good sources of iron and vitamins A and B and insects contain more bio-efficacious micro nutrients than vegetables (van Huis, 2003b). In this study, the most preferred is the processed grub which contains less nutrients than the live larvae, this agrees with earlier reports by Vantomme *et al.* (2004) that fresh caterpillar had higher protein and fat content and provided more energy per units than meat and fish.

Recent findings have shown that many edible insects are now in peril of extinction (Schabel, 2006). There is a decline in the availability of harvestable crop. This may be due to over harvesting, land and water pollution, wild fire, habitat degradation, especially those due to anthropogenic activities and climate change (Rojas-Briales and van den Ende, 2013, FAO 2013). Many edible insects are only seasonally available creating a gap in supply. To ensure availability, development of rearing methods rather than relying on natural harvesting would allow continuous supply (Fasoranti and Ajiboye, 1993; van de Foliart, 1995).

Proper packaging and handling is one of the best ways to sell any agricultural product and where such is lacking, potential consumers may be put off easily. The traditional technique of roasting and mere staking reported in the study may be the reason for the want of an improved entomophagy. Insects are often consumed whole but can also be processed into granular or paste forms (FAO, 2013).

Some insects sequester toxic chemicals from their food plants Duffey (1980) or some produce the toxins themselves so edible insects require special preparation before consumption. van Huis (2003b) reported *Zonocerus variegatus* in Cameroun and Nigeria requiring repeated cooking before eating and *Natalicola delagorguei* in Zimbabwe and South Africa excretes a pungent fluid which is capable of causing severe pains and sometimes temporary blindness. To consume such insects therefore the fluid is removed by squeezing the thorax and thereafter diluting the poison by putting the insects in hot water (Scholtz, 1984; van Huis, 2003b). Johnson (2010) opined that insects are generally considered food more for their novelty than their nutrients (FAO, 2013). Harvesting and trading caterpillar provides important income for many rural families (Stack *et al.*, 2003) such income is comparable to with and much often higher than that generated by conventional agricultural crop and livestock (Munthali and Mughogho, 1992; Chidumayo and Mbata, 2002).

Insects in the region are not only seen as pests or to same extent as food resource as

in the case of African palm weevil but are widely used in trado-medicine, children's game, sports and other form of art (van Huis, 2003a; Elvin *et al*., 2005; FAO, 2013). Other roles of insects as reported by Lewis (1992) included production of biomaterials and other promising materials for clinical functions (Vepari and Kaplan, 2007), biobased polymer for food packaging and chitosan (antimicrobial agent) (Cutter, 2006; Portes *et al*., 2009). FAO (2013) reported insects in literature such as children's book, movies, visual art and ornamental. Weidner (1952) reported that insects cited in an epigram dating to 600BCE in Ancient Greece of a young girl and her dying cricket also Xing-Boa and Kai-Ling (1994) reported cricket- fighting as a popular sport in China under the Dynasty (960-1278CE) which has now become a flourishing game in cities across Asia, New York and Philadelphia.

CONCLUSION

Entomophagy holds great potential in the region but the method of harvesting needs to be reviewed in order not to destroy the fragile forest ecosystem that is been threatened due to oil exploration and exploitation activities in the region. The development of insect industry as mini livestock and its processing into acceptable form by value addition is imperative in the region. The nutritional components of insects over other sources of protein needs to be aggressively explored in the region by inculcating it into our syllabus at secondary or tertiary levels in related fields such as home science and nutrition classes.

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