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Nutritional Composition of Edible Insects in Lagos State

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Abstract
The nutritional values of edible insects are highly variable because of the wide variety of species. Even within the same group of edible insect species, values may differ depending on the metamorphic stage of the insect (particularly holometabolous species), their habitat and diet. This study was assessed to determine the nutritional composition of the three prominent edible insects consumed in Lagos State. The choice of the University of Lagos as a study site for administering of questionnaire was based on the fact that the university is open to large population of people. Majority of the University of Lagos community are aware that the insects are edible (87%) while 55% have actually consumed it. The edible insects African palm weevil, red palm weevil and pallid emperor moth caterpillar analyzed for their nutritional content indicate they are high in protein with 40.55%, 54.57% and 58.54% while the fat content were 22.3%, 18.13% and 10.33%, respectively. Red palm weevil larvae has the highest protein composition (58.54%) and African palm weevil larvae has the least (40.55%) whereas the African palm weevil has the highest fat content of 22.30% while the red palm weevil larvae has the least fat content of 10.33%. This study shows that these edible insect species though tree pests are highly nutritive and can serve as alternate protein source for the growing population of Lagos State.

Keywords: Edible insects, oral interview, protein, fat and species.

1. Introduction

Insects are invertebrate animals and are cosmopolitan. They can be found in the house, farms, roads, air, and so on(Van Huis, 2013). All insects have three body parts; the head, thorax and abdomen. They are the only group of invertebrates that fly. Insect cause a lot of damage to stored grains leading to huge agricultural loss to farmers and merchants of agricultural produce. A review of insect damage gives the entire group a sinister approach. That is why insects are considered as pests. However, there are some insects that are beneficial. An example of a beneficial insect is the honey bee, *Apismellifera*. It produces honey as well as pollinates flowers. Many insects such as ants, bugs, beetles and moths pollinate plants and flowers too. Parasitic insects such as Ichneumon flies, wasp, flies, ladybird beetles, serve as biological control of other insect groups. Maggots and honey from bee are used in medicine to treat and dress wounds. Silk, used in textile, is gotten from the silkworm. Insects such as beetles and bugs help to aerate the soil. Black soldier fly, the biological vector of *Onchocercavulvarus,* known to cause river blindness, is a great decomposer, and breaks both animal and human faeces down to humus(Veldkamp *et. al.*, 2012). The environmental benefits of rearing insects for food and feed are founded on the high feed conversion efficiency of insects. For example, the production of 1 kg of live animal weight of crickets requires as little as 1.7 kg of feed (Dele *et. al.*, 2012).In addition, insects can be reared on organic matter such as human and animal waste and this can help reduce environmental contamination. Insects are reported to emit fewer greenhouse gases and less ammonia than intensive cattle or pigs farming, and they require significantly less land and water than cattle rearing (Van Huis, 2013). The nutritional value of edible insects is highly variable because of the wide range of edible insect species. Even within the same group of species, nutritional value may differ depending on the metamorphic stage of the insect, the habitat in which it lives, and its diet (FAO, 2013). Usually, it is the larva and adult stage of insects that is mostly consumed. Nigeria has its own share of edible insects and caterpillars which are gathered from bushes and farmlands by women and children, processed or sold in school premises or the open market. There are 22 species of edible insects in Nigeria belonging to six Orders which include Lepidoptera, Coleoptera, Orthoptera, Isoptera, Hemiptera and Hymenoptera

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(Alamu *et. al.*, 2012). Insect availability is usually during the rainy season, between March and October.

2. Materials And Methods

Experimental site: Lagos State with the Atlantic seaboard as the southern boundaries lies between longitudes 2042'E and 30 22'E of the Greenwich Meridian and latitudes 6 o 22N and 6 o 42'N of the Equator. The metropolitan area comprises of seventeen out of the twenty Local government Councils which make up the state. These include: Lagos Island, Eti-Osa, Lagos Mainland, Surulere, Ikeja, AjeromiIfelodun, Amuwo- Odofin, Alimosho, Apapa, Ojo, Somolu, Kosofe, Mushin, Oshodi-Isolo, Agege and Ikorodu. Littoral climatic variables prevail throughout the year with average daily maximum temperature of about 30oC and 29 mils bar of vapour pressure in the air at critical sunny dry season days. Metropolitan Lagos is within the Sandy Barrier- Lagoon Complex of Western Nigerian coastline. Morphologically, this bioregion is framed by interconnecting creeks. The University of Lagos is situated in the western part of Lagos State at approximately 20˚ 50'N and 30˚ 50'E. It is largely surrounded by the scenic view of the Lagos Lagoon on 802 acres of land in Akoka, North Eastern part of Yaba, Lagos. It is bounded on the North by IlajeEse-Odo, South West by Iwaya and South East by the Lagos Lagoon. The total area spans approximately 8194.93m2 consisting of both wet and dry land out of which a conservative 21.5% is estimated to be wet lands (Ramo, 1997).

Source of Information: The information was gathered by oral interview of market traders, buyers, motorists, edible insect consumers and traders on where edible insects can be obtained in Lagos metropolis. Information was also gathered by reviewing the work done by other scientists on edible insects. A total of 600 questionnaires were distributed out of which 470 were filled and returned in a sampling technique. The choice of the University of Lagos as a study site for administering of questionnaire was based on the fact that the university is open to large population of people. In order to cut across the entire community, people in the University of Lagos were categorized into 6 groups, which are academic staffs, non-academic staff, post graduate students, undergraduate students, traders and visitors. Some of the information captured from respondents include the following; age group, the categories people belong to in the University of Lagos, the awareness they have of insects being edible, if they have ever eaten insects, the insects encountered here in Lagos, the kind of insects eaten, how often they consume edible insects, whether they know any place or places where insects can be bought, their level of acceptance of edible insect consumption and so on. The African palm weevil, *Rhynchophorusphoenicis*and the Red palm weevil, *Rhynchophorusferrugineus*were obtained from Itookin, Epe Local Govt. and Pallid emperor moth caterpillar *Cirinaforda*at Gate bus stop, Ipaja-Ayobo Road, Alimosho Local Government area of Lagos State. These processed insects were then identified based on oral interview from traders, past literatures on local names and host species (Alamu*et. al.,* 2012, Banjo *et. al.,* 2006).

Statistical Analysis: Descriptive analysis such as frequency counts, percentages and tables was used to summarize the data obtained.

3. Results And Discussion

Table 1: Nutritional composition of some of the edible insects found in Lagos

PARAMETERS	APC	EMC	RPW
% Moisture	8.10	8.20	8.70
% Crude Protein	40.55	54.57	58.54
% Crude Fat	22.30	18.13	10.33
% Crude Fiber	9.47	7.76	8.32
% Ash	5.30	6.12	3.42
% NFE	13.60	22.22	10.69

APC= African Palm Weevil
EMC= Pallid Emperor Moth Caterpillar
RPW= Red Palm Weevil
NFE= Nitrogen Free Extract

The edible insects found in Lagos include the African Palm weevil *Rhynchoporusphoenecis.(Ogongo)*, Red palm weevil,*Rhynchoporusferruginus (itun)* and the Pallid emperor moth *Cirinaforda (Monimoni),* Termites*, Macrotermes spp*. Itookin was found to be the main market for edible insect from this study. This is in agreement with the findings of Adeoye *et al.*, (2014) who reported that the African palm weevil*Rhynchophorusphoenicis, (*Fabr) Curcilionidae, is sold alongside the red palm weevil*Rhynchoporusferruginus (itun)* in a small town called Itookin as collaborated by Adeoye*et.al*, 2014. This is a town along Ikorodu Epe expressway about 15 minutes drive from Agbowa, Ikorodu. The town is a transit town for people travelling to Ijebu Ode and Epe. It is sold by the roadside by young females to mostly motorists and travelers. Upon interviewing the traders, they get their raw or fresh insects from boatmen and claim the boatmen were from Lekki, Ajah axis. Another trader said they get their supplies from Orisha under Epe local government. The palm grubs are usually processed by boiling and frying and then fixed on bamboo sticks. It is sold with freshly fried pepper. A stick of our palm grubs is sold for 100naira as at February, 2015. The palm grubs are also sold alongside fried snails and shrimps. When asked why they don't sell beyond this area, a trader explained she grew up seeing their family members involved in the trade so she grew up, learning the trade, showing the social nature of edible insect trade. The traders hawk as far as Ojota and Berger. Both are major car parks where people travelling out of Lagos board buses or cabs, which indicates that people who lived in the rural area are more aware and consume insects more than city dwellers (Finke, 2007). The traders complained that the trade is not profitable because of the cost of purchasing raw insects and it is sometimes difficult to obtain especially during rainy season due to flooding in

Table 2: Different Categories of the University of Lagos Community

Categories	Frequency	%	Valid %	Cumulative %
Valid Non-response	3	0.6	0.6	0.6
Academic staff	30	6.4	6.4	7.0
Non-Academic staff	54	11.5	11.5	18.5
Undergraduate	151	32.1	32.1	50.6
Postgraduate	101	21.5	21.5	72.1
Trader	46	9.8	9.8	81.9
Visitor	85	18.1	18.1	100.0
Total	470	100.0	100.0	

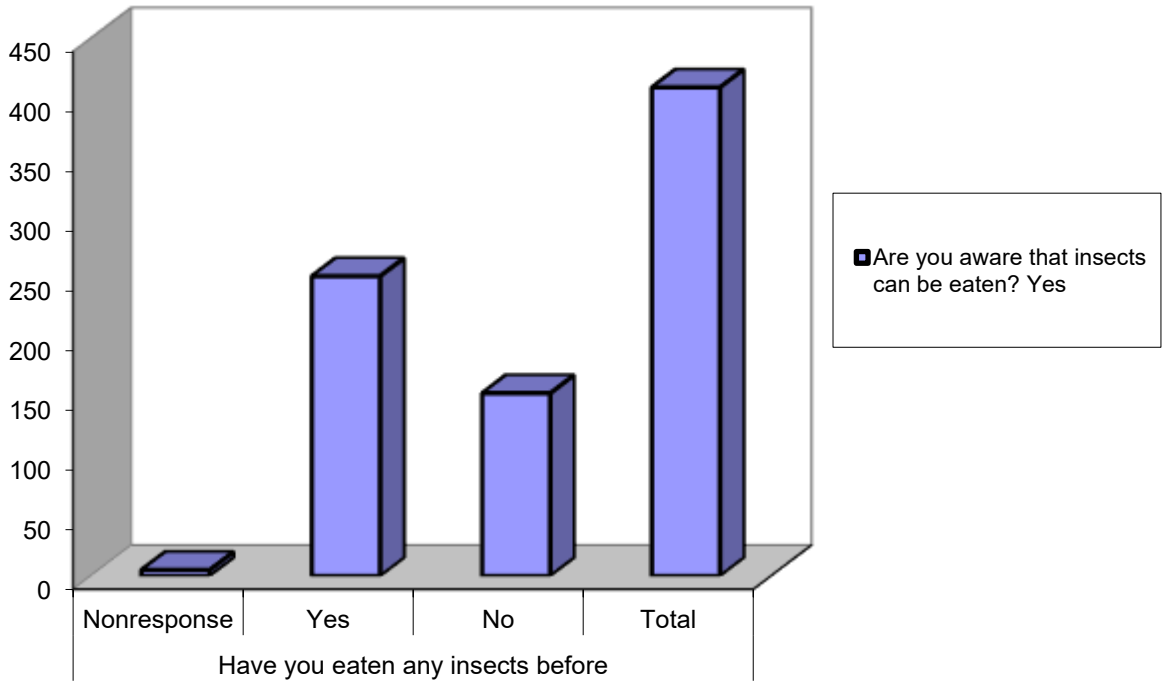


Figure 1: Proportion of respondents awareness to the practice of insect consumption. 87% of my respondents are aware that insects can be eaten while 55% have actually eaten insects

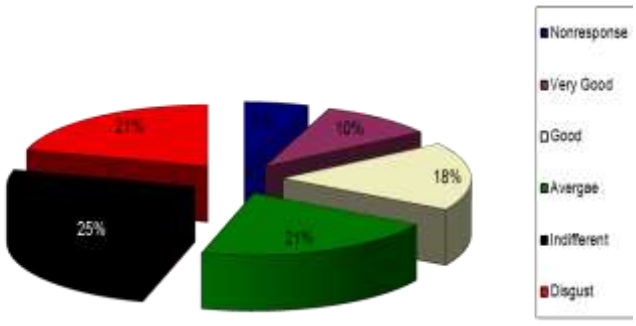


Figure 2: Proportions of Respondents that are Aware and have eaten Edible Insects

forests and fear of getting trapped in the swampy area.
The moisture content of the African Palm Weevil, Pallid Emperor moth and red palm weevil is12.10%, 8.20% and 8.70% respectively the moisture content of the African Palm Weevil was similar in findings with (Boulidam, 2007) and Elemo*et.al*.,2011, while their crude protein contents are 45.55%, 54.57% and 58.54% respectively with red palm weevil having the highest protein content of 58.54%. The protein content of pallid emperor moth is less than that reported by Agbidye *et. al.,* 2009, but higher than Banjo *et.al*., 2005. The crude fat, crude fibre, nitrogen free extract and ash content level obtained generally agree with those reported by other authors.The proximate analysis reveals that these edible insects which are regarded as pest of the tree palms and shea butter tree *Butyrospernumparadoxum* have high nutritive value as compared with some conventional meat sources such as beef.

Categories Respondent Belong to in the University of Lagos Community

The six categories of University of Lagos were well represented in the (table 2) with the number of post graduate and undergraduate students having the highest frequency of 101 and 151 frequency respectively. There are 87 % of my respondents are aware that insects are edible while only 54% have actually consumed insects.

The larvae of Cirina.forda"Monimoni" are consumed among the Yoruba and Nupe tribes of Kwara and Niger State respectively (Fasoranti *et. al.,*1993). It is a defoliator of the Shea butter tree. So they occur in areas such as Oyo, Kwara state, etc. It is believed to have a very high Vitamin A content. The only point where the palid emperor moth larva was obtained during the period of this research was at Gate bus stop along Ipaja Ayobo road, an outskirt town of Lagos. The caterpillar was available at that point of sale from August to December. It is not a naturally occurring insect in Lagos. It is brought in from Shaki, a town in Oyo State, as posited by Adeoye *et. al.*,2014. It is sold in modules and dericas. A tin of evaporated milk is sold for 100 naira while a derica is sold for 200 naira. The caterpillars are gathered from base of Shea butter tree when larva stop feeding and drop from trees in order to pupate. They are then smoked in hot ash to remove the hairs, rinsed and then sundried oven dried before transporting to point of sale or packed for travelling. The moisture content of the African Palm Weevil, Pallid Emperor moth and Red palm weevil is 12.10%, 8.20% and 8.70% respectively the moisture content of the African Palm Weevil was similar in findings with Omotosho *et. al.*, (2007) and Okaraonye 2008, while their crude protein contents are 45.55%, 54.57% and 58.54% respectively with Red palm weevil having the highest protein content of 58.54%. The protein content of pallid emperor moth is less than that reported by Agbidye *et. al.,* 2009, but higher than Banjo *et. al.,* 2005. The crude fat, crude fibre, nitrogen free extract and ash content level obtained generally agree with those reported by other authors. The proximate analysis reveals that these edible insects which are regarded as pest of th e tree palms and shea butter tree Butyrospernumparadoxum have high nutritive value as compared with some conventional meat sources such as beef. Being a university community, most of the respondents fall within the age range of 20 – 59 years. The highest percentage is 67.4% of age group 20-39years, with age group 40- 59years having 16.2%, below 20 years 12.3% and above 60years having least percentage of 1.3%. Most of the respondents has had education up to tertiary level with 67.2% and 19.1% have up to secondary education while 9.6% have had primary education. Only 10% of my respondents view edible insects as being very good, while 20% of the respondents view the practice of entomophagy with disgust with the remaining respondents scattered in between. 57% of the respondents do not accept insects should form a staple part of our diet as against 34% that accept insects as a staple part of our diet. Many of the respondents are undecided and fall within the proportion of non-response.

4. Conclusion

The practice of consuming insects amongst the university community is quite low as most of those who have eaten edible insects before did so a long time ago. Government needs to review insect farming as a means of livelihood or extra income to farmers. Therefore, they need to provide funds and grants so as to develop ways of cultivation of edible insects to make them available all year round. This would in turn bring more commerce in the area of edible insects both within and outside the country.

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Contribution of the Authors

This work was carried out in collaboration with all authors. Authors Ajao, Noah, lmade and Anuoluwatelemi, designed and wrote the study protocol. Authors Kusamotu, Adeyilola, Osokolo, Oladunmoye, Adetoboye, and Abel conducted the documentary research, conducted the laboratory analyses, the statistical analysis and the first draft and revised the manuscript. Authors Sarumi and Familola took part in the interpretation of the results and provided a major contribution in the elaboration of the final document.

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