PROXIMATE COMPOSITION AND CONSUMPTION CONSTRAINTS OF EDIBLE FOREST INSECTS IN THREE LOCAL GOVERNMENT AREAS OF CROSS RIVER STATE, NIGERIA

Abstract

Proximate composition and consumption constraints of edible forest insects was studied within ten months. Data on protein, lipid, carbohydrate, crude fibre and moisture contents was obtained by collecting insect's samples from forest and households in Akamkpa, Obubra and Ogoja in Cross River State and taken to the laboratory and analyzed. The data generated was subjected to different vigorous processes in the laboratory using approved methods. Data on constraints to insect's consumption was obtained through administration of questionnaire to respondents. Results reveal that protein content (19.8%) was highest in termites and lowest in yam beetles (16.5%). The carbohydrates content (17.6%) was highest in ground cricket and lowest in oil palm grub (6.3%). Lipid content (18.6%) was highest in oil palm grub and lowest in grasshopper (15.1%). Ash and moisture contents were highest (16.8 and 18.6%) in grasshopper and termites, respectively, and lowest in yam beetles (14.1%) and grasshopper (13.4%). Fibre content (17.6%) was highest in locust and lowest in termites (13.4%). Therefore, due to their high protein and lipid content, termites, oil palm grubs and ground cricket should be considered as important delicacies for man's basic nutritional challenges and encourage food sufficiency. Different cultures and traditions should encourage their subjects to consume these delicacies for healthier society.

Keywords: Consumption, Forest insects, Composition, Edible, Constraints.

Introduction

The most diverse and well known animal group on earth are the insects and this is because they are found in almost all habitats and environments (Oibiokpa*et al*., 2017). The roles insects play to the environment and man cannot be overemphasized including the creation of valuable products for man and livestock (Ojianwuna and Enwemiwe, 2020). Even though insects are known to be distructive and cause harm to many other resources, its advantages outweighs its demerits. It has been confirmed that five hundred and twenty-four species of edible insects are found in Africa, making it a hotspot (Benard and Womeni, 2017). The majority of the insects that are highly valued and consumed in Nigeria are those belonging to the orders coleoptera, isopteran, orthoptera, Lepidoptera and hymenoptera. There is growing agitation for the inclusion of processed form of insects in diets of humans and also as alternative sources of feed for animals (Caparros*et al*, 2016). The continued dependence on meat and fish for protein by people especially those in rural areas has resulted to increased prices offered and paid for the products (Durst and Shono, 2010). This situation is causing untold hardship and making life unbearable for the people, especially with the present economic challenges facing the nation. The only alternative to the consumption of meat and fish is insects which have been proven to be essential in protein quality when compared to meat and fish (Muafor*et al*, 2015). Also edible insects have proven to be reach sources of mineral and vitamins, thereby reducing malnutrition amongst households in rural areas to the barest minimum. Major assessment of crude fibre, nitrogen and lipid content of consumable insects have revealed considerable values that are acceptable standards for consumption (Achu*et al*., 2017). This study aims therefore to determine the proximate composition and consumption constraints of edible forest insects in the study area, with a view to unraveling the insect's species requirements that are consumption friendly.

2. Materials and Methods

2.1 Collection and preparation of samples

The samples for the study were collected from small markets and farms in three locations of Akamkpa, Obubra and Ogoja. The samples were placed in labelled specimen bottles and taken to the microbiology laboratory, and were identified with the assistance of an entomologist. The samples were subjected to a temperature of 28^{0}C and relative humidity of 77.7%. The experiment was carried out in separate air tight containers and in triplicate and analysis was carried out immediately to reduce deterioration of the samples (Adeyeye and Olayeye, 2016).

2.2 Proximate composition

The proximate composition of the raw and fermented samples was determined using standard methods by Association of Official Analytical Chemists (AOAC, 2000).

Moisture Content

Two (2) grams of each of the samples were weighed into a dried crucible. The samples were then put into a moisture extraction oven at a temperature of 105^{0}C and heated for three hours. The dried samples were put into desicators and allowed to cool and reviewed. The difference in weight was calculated as a percentage of the original sample

$$\%\text{ moisture } = \frac{\text{weight of original sample} - \text{weight of dry sample}}{\text{Weight of original sample}} X\,100$$

Ash Content

Two (2) grams of the samples was weighed into a crucible and heated in a moisture extraction oven for three hours at a temperature of 100^0C before it was transferred into a muffle furnace for 550^0C. This continued until the samples turned white and were free from carbon. The samples were then removed from the furnace, allowed to cool in the desiccators to a room temperature and was reweighed immediately. The weight of the residual ash was calculated as ash content.

$$\% \text{ Ash } = \frac{weight\ of\ ash}{\text{Weight of original sample}}\ X\ 100$$

Fat Content

Two grains of the samples were wrapped with a filter paper and was put into a thimble which was fitted to a clean round bottom flask. The sample was heated with a heated mantle and allowed to reflux for five hours. The heating was then stopped and the thimbles with the spent samples reweighed. The difference in weight was taken as a mass of the fat and was expressed as a percentage of the samples.

$$\% \text{ Fat } = \frac{\text{weight of lask and oil extracted} - \text{ weight of empty extraction lask}}{\text{Weight of original sample}}\ X\ 100$$

Crude Protein

Two grams each of the samples was mixed with 10ml of concentrated H_2SO_4 in a heating tube. One table of selenium catalyst was added to the test tube and the mixture was heated inside a fume cupboard. The digest was transferred into distilled water. Ten (10ml) protein of the digest was mixed with equal volume of 45% NaOH solution and was poured into kieldahl distillation apparatus. The mixture was then distilled and the distillate collected into 4% boric acid solution containing three drops of methyl red indicator. A total of 50ml distillate was collected and titrated. The samples were duplicated and mean values of the samples taken. The Nitrogen content was calculated and multiplied by 6.25 to obtain crude protein content.

$$\% \text{ Nitrogen } = \frac{100xNx14xVF}{100\text{xVa}}$$

N = Normality of the titrate (0.1N), VF = total volume of the digest = 100ml, Va = Aliquot volume distilled

Crude Fibre

Two grains of the samples with one gram abestos was put into 200ml of 1.25% of H_2SO_4 and allowed to boil for 30 minutes. The solution and the content poured into a Buchner funnel equipped with muslin cloth and secured with elastic band. This was allowed to filter and the residue put into 200ml boiled NaOH and the boiling was allowed to continue for 30 minutes after which it was transferred to Buchner funnel and filtered. It was then washed twice with alcohol and the material obtained washed three times with petroleum ether. The residue obtained was placed in a clean dry crucible and dried in the moisture extraction oven to a constant weight. The dried crucible was removed, cooled and weighed. The difference in weight was calculated as the percentage of the original sample.

$$\text{Crude ibre} = \frac{\text{weight of sample before inceneration} - \text{weight of after inceneration}}{\text{Weight of original sample}} X\ 100$$

Carbohydrate content

The carbohydrate content was calculated as the difference between 100 and the summation of the proximate parameters as Nitrogen free extract (NFE) percentage carbohydrate.

NFE = 100 – (moisture + protein + fat + ash + crude fibre)

3.0. Results and Discussion

The study presents the proximate composition and consumption constraints of edible forest insects in selected local governments area in Cross River State (Table 1). Ash content was highest in grasshoppers (16.80+0.54) followed by oil palm grub (16.75+2.20), with the lowest ash content recorded in yam beetle (14.13+1.64). The ash contents recorded in this study is far above that observed for Africa palm, weevil, termites and crickets in a study conducted by Ojianwuna*et al* (2021). This marked differences observed may not be unconnected with location. The protein content was highest in termites (19.76+0.24) followed by ground cricket (18.65+0.42), with the lowest protein content recorded in yam beetles (16.53+0.64). These protein content is in disagreement with the work of Agbidye*et al*., (2009).

Table 1: Proximate analysis of some selected insects in the study area (100% composition - dry weight)

Insects	Nutrients					
	Ash content	Carbohydrate Content	Fibre content	Lipid content	Moisture content	Protein content

Grasshoppers	16.80±0.54	16.12±0.01	16.74±0.05	15.12±0.01	13.44±4.14	16.75±0.50
Ground crickets	14.25±0.24	17.55±0.40	16.22±1.67	17.05±5.22	14.67±5.00	18.65±0.42
Termites	16.40±0.50	14.33±0.03	13.40±1.45	17.21±1.20	18.60±2.61	19.76±0.04
Oil palm grub	16.75±2.20	6.34±0.00	15.26±2.26	18.63±2.40	16.12±0.13	18.15±0.03
Yam beetle	14.13±1.64	12.67±0.00	14.22±0.21	16.03±0.40	14.40±2.20	16.53±0.64
Locust	14.39±0.25	14.42±0.25	17.62±0.25	15.42±0.62	14.36±0.22	17.61±0.02

Values presented mean standard deviation of triple determination. Values presented are percentage means of triplicate determination ± standard deviation (SD).

The study recorded highest lipid content in oil palm grub (18.63+2.40) and was closely followed by termites (17.21+1.20). The lowest lipid content was however observed in grasshopper (15.12+0.01). The lipid content observed in this study was far below that recorded for five species of edible insects consumed in South West Nigeria as stated by Adeyeye and Olaleye (2016).

The highest carbohydrates content was recorded in ground cricket (17.55+0.40), followed by grasshopper (16.12+00.01). Oil palm grub recorded the least carbohydrate content (6.34+0.00). These values were not in agreement with those recorded by Ojianwuna*et al.*, 2021. Fibre contents were higher in locust (17.62+0.02), grasshopper (16.74+0.05) and ground cricket (16.22+1.67), and this can be due to the nature of the chitin of their external skeleton when compared to beetle with its chitin in the anterior body part. High fibre contents recorded in some insects is as a result of the presence of chitin in the external anatomy of such insects (Omotoso and Adesola, 2018).

Termites (18.60+2.61) and oil palm grub (16.12+0.13) had the highest moisture content with grass hopper recording the least moisture content (13.44+4.14). Differences in geographical location may be the reason for the variation in moisture content as opined by Bernard and Womeni (2017).

There were variations in the constraints militating against the consumption of insects in the study area (Table 2). These variations which were location specific contribution to the consumption habits of the people in the study area. In Akamkpa, bad taste and seasonality were the major constraints to insect’s consumption, while seasonality was the major constraints to insect'sconsumption in Ogoja. In Obubra, the respondents agreed that all except bad taste were constraints to insect consumption. These variations may be due to the fact that the culture and traditions of the people differ in these locations. (Durst and Hanboonsong, 2015).

Table 2: Rating on consumptionconstraints to edible forest insects in the study area

PARAMETER	SA	A	D	SD	Tot.	Mean	REMARK
Akamkpa							
Religious beliefs	2	5	35	8	93	1.9	Disagree
Difficulty in harvesting	3	10	31	6	104	2.1	Disagree
Poor processing methods	7	4	36	3	112	2.2	Disagree
Attack by the insects	5	14	26	5	114	2.3	Disagree
Bad taste	12	16	20	2	136	2.7	Agree
Seasonality	4	25	18	3	127	2.5	Agree
Poor preservation methods	4	13	27	6	109	2.2	Disagree
Obubra							
Religious beliefs	4	23	22	1	129	2.6	Agree
Difficulty in harvesting	40	9	1	0	189	3.8	Agree
Poor processing methods	11	31	7	1	151	3.0	Agree
Attack by the insects	38	11	1	0	187	3.7	Agree
Bad taste	0	8	32	10	88	1.8	Disagree
Seasonality	15	34	1	0	164	3.3	Agree
Poor preservation methods	18	32	0	0	168	3.4	Agree
Ogoja							
Religious beliefs	5	7	29	9	99	2.0	Disagree
Difficulty in harvesting	2	9	30	9	95	1.9	Disagree
Poor processing methods	10	8	27	5	118	2.4	Disagree
Attack by the insects	10	6	27	7	112	2.2	Disagree
Bad taste	8	12	24	6	116	2.3	Disagree
Seasonality	10	21	11	8	125	2.5	Agree
Poor preservation methods	7	14	24	5	118	2.4	Disagree

SA=Strongly Agree, A=Agree, D=Disagree, SD= Strongly Disagree, Agree if item mean score is 2.5 and above,

Conclusions and recommendation

This research has shown that termites and oil palm grubs contained the highest nutritional components compared to grasshopper, ground cricket, yam beetles and locust. In comparisonwith other insects, those under review have shown to be beneficial sources of carbohydrates, proteins, lipids and fibre. Considering their nutritional capabilities, the consumption of these insects would serve as alternative protein sources in Cross River State while at the same time serving as a remedy for food security as well as contributing to other environmental challenges. It is therefore recommended that people irrespective of location should consume insects as alternative to other meat sources.

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