# Proximate Composition and Public Perception of Variegated Grasshoppers (*Zonocerus variegatus*) as a Source of Animal-Based Protein

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## ABSTRACT

This paper examined the proximate composition of variegated grasshoppers *Zonocerus variegatus* and public perception of its consumption in Alabata Village, Ogun State, Nigeria. Proximate composition was determined through standard lab procedures, while social information was collected using a questionnaire. Five households were selected randomly on each street in the village, except when there were less than that number. The questionnaire covered demographics, knowledge about consuming *Zonocerus variegatus,* and willingness to accept insects as a food source under various conditions. Descriptive statistics and regression analysis were used for data analysis. Nearly half (40.6%) of the respondents ate insects and all them said that insect consumption is a common practice in the community. However, 50.4% claimed their diet had to contain more than insects. Number of years spent in the community ($r=0.022$, $p<0.05$) and income ($r=0.03$, $p<0.01$) were significant predictors of insect consumption, at least in this study area. Proximate analysis of *Zonocerus variegatus* showed mean values of 34.45 %, 9.47%, 7.03%, 2.63%, and 86.61% for crude protein, ash, ether extract, crude fiber and dry matter respectively, while micro nutrients showed mean value of 11.23mg/kg,30.056mg/kg, 60.300mg/kg, 0.424mg/kg, 20.067mg/kg, 0,114mg/kg, 1.477mg/kg, 0.253mg/kg, 0.423mg/kg and 0.504mg/kg for Iron, Manganese, Zinc, Cobalt, Copper, Magnesium, Calcium, Phosphorus, Potassium, and Sodium, respectively.

Comparing the proximate composition of grasshoppers with some other animals showed relative advantages in crude protein, ash content, ether extract, crude fibre, and dry matter. Despite the nutritional advantage of insects, majority of the villagers preferred other sources of animal protein. Some possible solutions include using other forms of grasshoppers and labelling it as protein powder.

(Keywords: entomophagy, grasshoppers, wildlife consumption, nutrition, utilization)

## INTRODUCTION

Recent changes in the direction and magnitude of global food demand have been observed in developing countries due to rapid urbanization and rising economies. As the world's population increases, agricultural utilization will probably shrink (Hanafi, 2012). One of the greatest challenges facing humanity will be to produce sufficient feed grain to sustain meat production (Fiala, 2008).

Increasingly, insects are being viewed as alternative sources of animal-based protein. Edible insects have played a vital and historic role in satisfying human nutritional requirements in many regions around the globe, especially for individuals in developing countries (Banjo et al., 2006). For example, more than 2,000 insect species are consumed worldwide in at least one stage of their life cycle.

The variegated grasshopper, *Zonocerus variegatus (*Linnaeus, 1758) is found across Western and Central Africa that can be eaten. It is associated primarily with forest regions, but this species has extended its range into the savanna but restricted to riverine habitats. Its presence in northern Nigeria has become a serious problem since it feeds on over 300 economic plant species such as coffee,

pineapple, and banana, as well as wide range of subsistence crops, notably cassava (Chapman et al., 1986).

The rate and scale of insect outbreaks have increased during the past few years, leading to a renewed interest in developing some appropriate control strategies. *Zonocerus variegatus* belongs to the family Pyrgomorphidae and like some other members of this family, it is aposematically colored and lives in dense clusters (Chapman et al., 1986). Group behavior and its polyphagous habits contribute to its status as an insect pest.

One solution for the controlling the population is by entomophagy (i.e., consuming it like other edible insects) (Iduwu and Modder, 1996). This approach would be ideal since grasshoppers have a high nutritional value and are a cheap source of protein. Thus, consuming this species provides several benefits; population reduction, increased crop yields, and improved nutrition. This study investigated proximate composition of variegated grasshopper *Zonocerus variegatus* and public perception of its consumption as a source of animal protein in Alabata Village of Ogun State, Nigeria.

## MATERIALS AND METHODS

### Study Area

The study was conducted at Alabata Village situated in Odeda Local Government, Ogun State, Nigeria. Its geographical coordinates are 7° 19' 0" North, 3° 30' 0" East. Odeda, the local government, lies within Latitude 7° and 7° 5' and Longitude 3°3'E AND 3°37'W. It shares boundaries with Oyo State and Ewekoro, Obafemi Owode Local Government to the South, Yewa North, Odeda Imeko Afon Local Government Areas to the West, East, and North, respectively.

Though predominantly occupied by the Yoruba ethnic group, Odeda Local Government is generally inhabited by people from all sub-ethnic groups in Nigeria and neighboring West African states. The Local Government hosts the Federal University of Agriculture, Abeokuta, Federal College of Education, Osiele, Ogun Oshun River Basin Development Authority, and State Headquarters of Nigeria Police, Eleweran.

### Methodology

**Proximate Analysis:** Proximate composition was determined using AOAC methods (1990). Moisture content was measured by weighing the samples before and after oven-drying at $100^0$C-$105^0$C for 16 hours. Protein content (%N X 65) was determined by the Kjeldahl Methods. Ash content was determined using dry ash procedure. Fat content was measured by drying the samples in $100^0$C oven and then extracting the crude fat with petroleum ether in a Soxhlet extractor for 4 hours. Mineral content including calcium, magnesium, iron, and potassium were determined by digesting each of the samples with 4ml of perchloric acid, 25ml of nitric acid, and 2ml of sulfuric acid. All samples were done in triplicate

**Collection of Social Data:** Social data was collected using a questionnaire administered to five households that were selected at random from each street of the village. A total of 125 household heads were interviewed in all. The survey covered information on socio-demographics, knowledge about consumption of variegated grasshoppers, and willingness to consume this insect under various conditions.

### Method of Data Analysis

Descriptive statistics such as frequencies, percentages, means, standard deviations, and standard errors were calculated. Data summaries were presented in tables. Regression analysis was used in determining which socio-economic factors (age, occupation, marital status, academic background, family size, gender, religion and income) contributed to grasshopper consumption.

## RESULTS AND DISCUSSION

### Proximate Analysis of *Zonocerus variegatus*

Proximate analysis of *Zonocerus variegatus* showed mean values of 34.85 %, 9.47%, 7.03%, 2.63%, and 86.61% for crude protein, ash content, ether extract, crude fiber, and dry matter respectively (Table 1). Grasshoppers had a relative advantage in proximate and mineral composition in comparison to some domestic and wild animals.

**Table 1:** Proximate Analysis of *Zonocerus variegatus.*

| Sample | % Crude Protein | % Ash Content | % Ether Extract | % Crude Fiber | % Dry Matter |
|---|---|---|---|---|---|
| 1 | 34.65 | 9.70 | 7.10 | 2.80 | 86.60 |
| 2 | 35.01 | 9.20 | 6.80 | 2.50 | 86.20 |
| 3 | 34.90 | 9.50 | 7.20 | 2.60 | 87.02 |
| Mean | 34.85 | 9.47 | 7.03 | 2.63 | 86.61 |

**Table 2a:** Proximate Analysis of Micro-Nutrients.

| Sample | Fe (mg/kg) | Mn (mg/kg) | Zn (mg/kg) | Co (mg/kg) | Cu (mg/kg) |
|---|---|---|---|---|---|
| 1 | 11.200 | 30.100 | 60.400 | 0.425 | 20.070 |
| 2 | 11.400 | 30.080 | 60.300 | 0.419 | 20.040 |
| 3 | 11.100 | 29.989 | 60.200 | 0.427 | 20.090 |
| Mean | 11.23 | 30.056 | 60.300 | 0.424 | 20.067 |

**Table 2b:** Proximate Analysis of Micro-Nutrients.

| Sample | %Mg | %Ca | %P | %K | %Na |
|---|---|---|---|---|---|
| 1 | 0.110 | 1.490 | 0.240 | 0.440 | 0.510 |
| 2 | 0.120 | 1.460 | 0.270 | 0.420 | 0.495 |
| 3 | 0.111 | 1.480 | 0.250 | 0.410 | 0.507 |
| Mean | 0.114 | 1.477 | 0.253 | 0.423 | 0.504 |

This result is consistent with the findings of Jokthan *et al.* (2007) who reported that grasshoppers have higher crude protein content than some other animals. The high protein content is an indication that variegated grasshoppers are good sources of nutrition that can replace other animal protein that is not usually found in the diet of rural people in most developing or under-developed countries.

## Mineral Composition

Proximate analysis of micro-nutrients showed mean values of 11.23 mg/kg, 30.056 mg/kg, 60.300 mg/kg, 0.424 mg/kg, 20.067 mg/kg, 0,114 mg/kg, 1.477 mg/kg, 0.253 mg/kg, 0.423 mg/kg and 0.504 mg/kg for Iron, Manganese, Zinc, Cobalt, Copper, Magnesium, Calcium, Phosphorus, Potassium and Sodium, respectively (Tables 2a and 2b). This finding suggests that variegated grasshoppers have numerous micro-nutrients, including high quantities of zinc.

## Perception of Respondents Based on Eating of Insect

All of the respondents (100%) said that they knew people in the community who ate insects, mainly "Esunsun" (termites). Slightly less than half of the respondents (49.6%) reported that they ate insects, but a majority of them (82.3%) have eaten Esunsun. Yet, only 14.5% indicated that grasshopper and Esunsun were preferred. Over half of the respondents (50.4%) said that they needed to eat something else at mealtime, in addition to insects (Table 3).

## Perception and Demographic Characteristics

Number of years spent in the community ($r=0.022$; $p<0.05$) and income ($r=0.03$; $p<0.01$) contributed significantly to the perception of eating insects (Table 4). These findings were consistent with studies conducted by Akinyemi and Oduntan (2014) which found that wildlife harvesting in Nigeria was associated with certain demographic characteristics, such as income and standard of living.

## Perception and Implication

Based on information presented in Table 5, the average respondent does not like eating grasshoppers, even if they are free (2.744±0.06). Instead, people prefer eating other insects (2.880±0.13).

**Table 3**: Distribution of Respondents Based on Insect Consumption.

| Variables | Frequency | Percentages |
|---|---|---|
| Do you know insects that people eat in this community? | | |
| Yes<br>No | 125<br>0 | 100<br>0 |
| What type of insect do they eat? | | |
| Esunsun (Termites) | 125 | 100 |
| Do you eat insects? | | |
| Yes | 62 | 49.6 |
| No | 63 | 50.4 |
| If yes, which insects have you eaten? | | |
| Esunsun (Termites) | 51 | 40.8 |
| Grasshopper | 2 | 1.6 |
| Both | 9 | 7.2 |
| If no, why will you not eat insects? | | |
| Just cannot | 63 | 50.4 |

**Table 4:** Relationship Between Perception and Socio-Economic Characteristics.

| Model | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|
| | Beta | Standard. Error | Beta | | |
| (Constant) | .509 | .206 | | 2.477 | .015 |
| Years spent in community | -.009 | .004 | -.249 | -2.325 | .022* |
| Age | .005 | .005 | .140 | .983 | .328 |
| Gender | -.079 | .091 | -.078 | -.876 | .383 |
| Marital status | .071 | .094 | .080 | .760 | .449 |
| Education level | .082 | .053 | .144 | 1.553 | .123 |
| Size of family | .013 | .017 | .083 | .733 | .465 |
| Ethnic group | -.079 | .089 | -.082 | -.892 | .374 |
| Religion | .043 | .084 | .048 | .512 | .610 |
| Occupation | -.040 | .027 | -.136 | -1.489 | .139 |
| Income | .220 | .073 | .189 | 2.970 | .003** |

*Coefficients significance at 5%
**Coefficients significance at 1%

**Table 5:** Perception on Consumption of *Zonocerus variegatus.*

| Variables | SD (1) | D (2) | IND (3) | A (4) | SA (5) | Mean | SD | SE |
|---|---|---|---|---|---|---|---|---|
| I like eating Grasshopper | 37 (29.6) | 64 (51.2) | 2 (1.6) | 20 (16) | 2 (1.6) | 2.0880 | 1.04739 | 0.05 |
| I like eating other insects, not Grasshoppers | 38 (30.4) | 21 (16.8) | 0 (0) | 50 (40) | 16 (12.8) | 2.8800 | 1.51658 | 0.13 |
| I can eat grasshoppers if free of charge | 33 (26.4) | 38 (30.4) | 4 (3.2) | 28 (22.4) | 22 (17.6) | 2.7440 | 1.49679 | 0.06 |
| I can buy grasshoppers in the market for consumption | 36 (28.8) | 39 (31.2) | 12 (9.6) | 25 (20) | 13 (10.4) | 2.5200 | 1.36547 | 0.10 |
| I know grasshoppers can replace fish and meat in the food | 26 (20.8) | 47 (37.6) | 42 (33.6) | 10 (8) | 0 (0) | 2.2880 | 1.88733 | 0.04 |
| I cannot eat any insect even if it is delicious | 29 (23.2) | 38 (30.4) | 3 (2.4) | 9 (7.2) | 46 (36.8) | 3.5600 | 1.67236 | 0.13 |
| I cannot eat insects even if it is cheap | 26 (20.8) | 41 (32.8) | 4 (3.2) | 12 (9.6) | 42 (33.6) | 3.7240 | 1.61876 | 0.06 |
| I cannot eat insect even if it is more nutritious than fish and meat | 24 (19.2) | 44 (35.2) | 3 (2.4) | 26 (20.8) | 28 (22.4) | 3.9200 | 1.49515 | 0.21 |
| I will eat insects if it is not poisonous | 34 (27.2) | 24 (19.2) | 3 (2.4) | 29 (23.2) | 35 (28) | 3.0560 | 1.62790 | 0.19 |
| I will eat grasshoppers if they are cheap | 46 (36.8) | 27 (21.6) | 1 (0.8) | 35 (28) | 16 (12.8) | 2.5840 | 1.52497 | 0.03 |

Interestingly, respondents disagreed with the item, "I know that grasshoppers can replace fish and meat in the food" (2.288±0.04), which is a true statement. Disagreeing with this information is one explanation for not eating grasshoppers, even if they are free. Another possible concern is the amount of poison found in insects, particularly grasshoppers, which often feed on cash crops. If present, insecticides might be ingested by grasshoppers.

## CONCLUSIONS AND RECOMMENDATIONS

Although variegated grasshoppers are relatively high in crude protein, ash content, ether extract, and crude fiber when compared with many other sources of animal protein, the majority of respondents disliked eating them. This finding represents an interesting management challenge since these insects have a high nutritional quality which is much needed by local people. Income and number of years spent in the village contributed to preference for consumption, suggesting some that some people might be more prone to eat them than others.

One solution could be a massive education program to promote the nutritional quality and health benefits of eating grasshoppers, while counteracting any misinformation about this insect. Yet, persuasion seems unlikely due to a number of other factors associated with consuming insects, such as taste and cost. For example, respondents said that they did not want to eat insects even if their nutritional quality was higher than fish or meat. Since insects, especially grasshoppers, are a cheap replacement for conventional sources of animal protein, another possible strategy is creating a powdered form of the product. It could be labeled as protein powder, seasoned to taste, and sprinkled on food that is already eaten. Alternatively, it could be encapsulated and taken as a pill.

There is need for a comparative study on economic evaluation of variegated grasshopper relative to other sources of animal protein.

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