DOI:36108/NJE/4002/22.0170

NIGERIAN JOURNAL OF ENTOMOLOGY (2004) 21:65-70

Nutrient Composition and Processing of the Variegated Grasshopper *Zonocerus variegatus* (L.)(Orthoptera: Pyrgomorphidae) for Human Consumption

IDOWU, M. A.,[1] IDOWU, A. B.[2] and M. F. FASEKI[1]

[1] Department of Food Science and Technology, University of Agriculture, Abeokuta, Nigeria.

[2] Department of Biological Sciences, University of Agriculture, Abeokuta, Nigeria. E-mail: idowuab@unaab.edu.ng or tomiwo2@yahoo.com

(Accepted 08 January, 2004)

ABSTRACT

Grasshopper, *Zonocerus variegatus* (L), was processed using five different methods and evaluated for sensory quality, nutrient and mineral composition. Boiling, removal of wings, decapitation, washing, draining, frying or roasting gave acceptable product to tasters. The raw insect, which contains 64.28±0.70% moisture, when processed, had values of 61.65±0.20%, 20.73±0.54%, 4.25±0.70%, 1.45±0.02%, 1.25±0.40%, 150ppm, 75.6ppm, 70.3ppm and 33ppm for its crude protein, ether extract, carbohydrate, crude fibre, ash, potassium, magnesium, copper and sodium contents respectively. The insect was however, found to be poor in its iron and calcium contents. *Z. variegatus* may serve as a non-conventional protein source for human consumption if properly processed.

INTRODUCTION

In Nigeria, vertebrate protein contributes only a small proportion of the total protein intake of a large percentage of the population because of inadequate production. Hence the use of vegetables and insects as protein sources is not uncommon and well documented (FAO, 1970, Asibey, 1974; Ajayi, and Tewe, 1985; Oluyemi, 1985; Tobor, 1985; Idowu and Modder, 1996). Consumption of insects such as locusts, crickets, termite and grasshoppers therefore, may serve not only as a means of biological control, but also as a source of nutrient for man (Idowu and Modder, 1996 ; Adamolekun, 1993; Ashiru, 1988).

Zonocerus variegatus (L) has been reported to occur in large number twice a year in various parts of Nigeria (Taylor, 1972). Although Chapman *et al.* (1986), reported that *Z. variegatus* has an unpleasant smell, Idowu and Modder (1996), showed that it is an item of diet in some areas of Ondo State of Nigeria being eaten by 68.4 to 83.8% of the sampled population. Despite the consumption of *Z. variegatus* in some parts of Nigeria, literature is however, scanty on the nutritional quality of this insect

particularly in its ready to eat form. This paper reports the method, sensory quality, nutrient composition and mineral composition of the West African grasshopper *Z. variegatus* when processed for human consumption.

MATERIALS AND METHODS

Collection of Samples

Adult *Z. variegatus* were collected within the campus of the University of Agriculture, Abeokuta, Nigeria. They were kept inside a cage covered with mosquito net and fed fresh excised cassava leaves until processed.

Processing of *Z. variegatus* for human consumption

Five different laboratory-processing methods were applied to prepare *Z. variegatus* for human consumption (Fig. 1) based on work by Idowu and Modder (1996). The major unit operations involved are boiling, removal of wings, decapitation, and roasting or frying. Roasting was on hot charcoal while deep fat frying was inside groundnut oil.

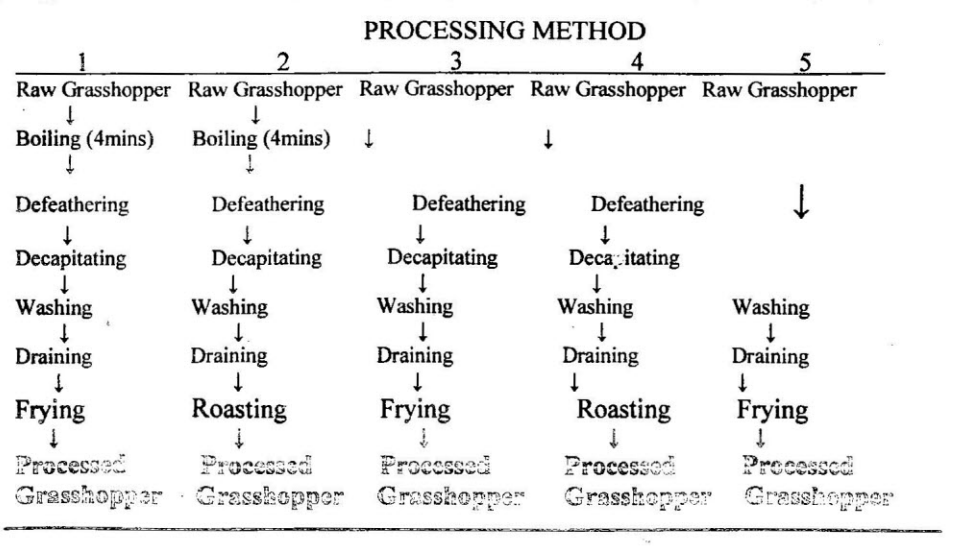

Figure. 1 Five different methods for processing *Z variegatus* .

Sensory evaluation

Samples of *Z. variegatus* obtained from each of the five different processing methods were evaluated for difference and preference using 12 judges. For the different tests, ranking method was used to assess the appearance, aroma, texture and taste of processed *Z. variegatus, w*ith 1 and 5 representing maximum and minimum appeal of attributes respectively. Responses obtained from the panellist were subjected to statistical analysis of variance and means were separated using New Duncan's multiple range test as described by Larmond (1977).

For the preference test, a 9 – point Hedonic scale (Larmond 1977) was used to assess the appearance, aroma, texture, taste and overall acceptability. 9 and 1 were used to represent like extremely and dislike extremely respectively. Responses obtained from the panelists were also subjected to statistical analysis of variance and means were separated by New Duncan's multiple range test. The most acceptable sample was then evaluated for its nutrient composition and mineral composition.

Chemical analysis

Raw and the most accepted processed samples of *Z. variegatus* were analysed for moisture, crude protein, ether extract, ash and fibre contents according to the methods of AOAC (1980), while carbohydrate content was obtained by difference. Mineral analysis of the ash was done to determine the concentrations of potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), iron (Fe), copper (Cu), manganese (Mn) and chromium (Cr) using an Atomic Absorption Spectrophotometer (AAS) (Model: Buck VGP 210) and flame photometer (Model: Corning 410).

RESULTS AND DISCUSSION

Processing and sensory evaluation of Z. variegatus

Zonocerus variegatus processed by methods 1 and 2 (Fig.1) were significantly different ($P<0.05$) from those obtained from methods 3, 4, and 5 in all the attributes tested (Table 1). The lower scores of samples 1 and 2 reflect higher appeal of attributes in them. Although samples 1 and 2 were similar in aroma and appearance, they differed in taste and texture. Improved products with better appearance and texture found in samples 1 and 2, may be due to boiling for 4 minutes that distinguish both methods and which must have helped to detoxify and remove the unpleasant taste and odours associated with the live insect (Idowu, 1994). *Z. variegatus* obtained from method 1 (boiled and fried form) had the lowest scores or the highest intensities of all the attributes tested, in agreement with earlier report of Idowu and Modder (1996).

The result of the preference test (Table 2) for processed *Z. variegatus* followed a similar pattern to the difference test with samples 1 and 2 had higher scores for preference than other samples (3, 4 and 5). The taste, texture, appearance and overall acceptability of samples 3, 4 and 5 were not significantly different ($P\geq0.05$) and were less preferred to samples 1 and 2 (Table 2). The above results, suggest that boiling, removal of wings, decapitation, frying or roasting are the necessary processing operations needed to make *Z. variegatus* acceptable for human consumption.

Table 1: Mean Scores* for sensory evaluation of processed *Zonocerus variegatus* (Difference Test)

Product	Aroma	Taste	Texture	Appearance
1	1.5±0.65a	1.3±0.47a	1.3±0.47a	1.4±0.47a
2	1.7±0.62a	1.7±0.47a	1.8±0.80b	1.7±0.47a
3	3.1±0.85b	3.5±0.77b	3.3±0.50c	3.3±0.43b
4	4.1±0.60c	3.9±0.64c	3.9±0.76d	3.9±0.64c
5	4.4±0.64c	4.9±0.64d	4.6±0.76e	4.8±0.28d

*Mean Scores with same letters in a column are not significantly different ($P>0.05$) using the Duncan Multiple Range Test (DMRT).

Table 2: **Mean Scores* for Sensory evaluation of processed *Zonocerus variegatus* (Preference Test).**

Product	Aroma	Taste	Texture	Appearance	Overall Acceptability
1	7.0±1.68a	7.0±1.29a	6.9±0.95a	7.5±1.12a	7.7±0.94a
2	7.0±1.78a	6.8±1.48a	6.7±1.31a	7.0±1.08a	7.2±1.21a
3	5.5±1.12a	4.3±1.93b	4.5±1.38b	4.4±1.04b	5.0±1.73b
4	4.3±1.89b	4.5±1.61b	4.3±1.83b	3.6±1.85b	4.3±2.2b
5	4.1±2.23b	3.5±1.66b	3.4±1.61b	3.2±1.95b	3.8±1.68b

*Mean Scores with same letters in a column are not significantly different (P>O.05) using the Duncan Multiple Range Test (DMRT)

Proximate and Mineral content of *Z. variegatus*.

The moisture, crude protein, ether extract, fibre and ash contents of raw *Z. variegatus* were found to be 64.28%, 27.05%, 8.64%, 0.19% and 0.94% respectively, while the corresponding values for processed sample were 10.67%, 61.65%, 20.73%, 1.45% and 1.25% respectively (Table 3). Processing was found to effect removal of quite a large amount of moisture (Table 3) and thus increased the nutrients content of the insect. Crude protein figures (Table 3) obtained for the raw and processed insect respectively showed that the insect is a rich source of protein. These values were higher and compare favourably with some conventional and unconventional protein sources, such as beef (22.2%), pork (21.6%), elephant (30.9%), and African giant snail (18.28%) (Pearson, 1982; Ajayi and Tewe, 1985). The insect therefore could serve as a supplementary protein source for human consumption. However, there is the need to further determine the amino acid composition and true digestibility of the proteins in a nutritional study. The insect was found to contain a considerable amount of ether extract (Table 3) and this may contribute to the instability of the stored sample of the processed insect through oxidation. The insect is however, a poor source of carbohydrate but this can always be supplemented by sources such as roots, tubers or cereals which are commonly used as staples in Africa and other developing countries of the world where such insects are consumed (UNFEM, 1989, Idowu and Akindele, 1994). The crude fibre of the insect is about 1.25% and it could be useful in regulating colonic function in man (Cadden, 1988).

The ash of processed *Z. variegatus* was found to be rich in potassium, magnesium, copper and sodium (Table 3). Its calcium and iron contents were low, otherwise it could have been very useful for tooth and bone formation in children. It is also poor in manganese and chromium but these minerals are only required in trace amounts by man (Fox and Cameron, 1987).

Table 3. Nutrient composition and mineral content of raw and processed Zonocerus *variegatus* (n=10)

	Raw	Processed
Moisture (%)	64.28±0.08	10.67±0.28
Crude Protein (%)	27.05±0.10	61.65±0.20
Ether Extract (%)	8.64±0.05	20.73±0.54
Ash (%)	0.49±0.11	1.25±0.40
Fibre (%)	0.19±0.02	1.45 ±0.02
Carbohydrate by Difference (%)	ND	4.25±0.70
Potassium (ppm)	82.0	150.0
Sodium (ppm)	6.0	33
Calcium (ppm)	3.7	9.1
Magnessium (ppm)	3.4	75.6
Iron (ppm)	0.9	10.7
Manganese (ppm)	ND	2.7
Copper (ppm)	ND	70.3
Chromium (ppm)	ND	0.03

ND Not determined

CONCLUSION

Zonocerus variegatus can be processed for human consumption by boiling, removal of wings, decapitating, washing, draining followed by either frying or roasting. The insect was found to be rich in protein, ether extract and some mineral elements.

REFERENCES

ADAMOLEKUN B. 1993. *Anaphae venata* Entomophagy and seasonal ataxic syndrome in Southwest Nigeria. *Lancet 341:629*

AJAYI, S.S. AND TEWE, O. O. 1985. Potentials of wildlife production and processing in Nigeria. *Nigerian Food Journal 2 & 3*: 57 – 61.

AOAC. 1980. *Official methods of analysis*, 13th ed. Association of Official Analytical Chemists, Washington, D.C. 46pp

ASIBEY, E.O.A. 1974. Wildlife as a source of protein in Africa south of the Sahara *Journal of Biological Conservation 6*: 32 – 39

ASHIRU M.O. 1988. The food value of the larvae of *Anaphae venata* Butler. *Ecol. Food Nutrition* 22:313-320

CADDEN, A. M. 1988. Moisture Sorption Characteristics of Several Food Fibres. *Journal of Food Sciences 53(4)*: 1150 - 1155.

CHAPMAN, R. F.; PAGE, W.W. and MCCAFFERY, A. R. 1986. Bionomic of the variegated grasshopper *(Zonocerus variegatus)* in West Africa and Central Africa. *Annual Review of Entomology 31*: 479 – 505.

FAO 1970. *Provisional indicative plan for agricultural development* Vols. I and II. Food and Agriculture Organization, Rome. 52pp

FOX, B. A. and CAMERON, A. G. 1987. "*Food science, a chemical. Approach.*". Hodder and Stoughton. London 234pp

IDOWU, A. B. 1994. Structural and Physiological studies on the repellent gland of the African pest grasshopper, *Zonocerus variegatus* (Orthoptera: Pyrgomorphidae). *Ph.D Thesis.* University of Ibadan, Nigeria 212pp.

IDOWU, A. B. and MODDER, W.W.D. 1996. Possible control of the stinking grasshopper, *Zonocerus variegatus* (L) (Orthoptera. Pyrgomophidae) in Ondo State, through human consumption. *The Nigerian Field. 61*: 7 – 14.

IDOWU, M. A. and AKINDELE, S. A. 1994. Effect of storage of cassava roots. on the chemical composition and sensory qualities of gari and fufu. *Food Chemistry 51:* 421 – 424

LARMOND, E. 1977. *Methods for sensory evaluation of food.* Food Research Central Experimental Farm, Canada Department of Agriculture Ottawa.51pp

OLUYEMI, J. A. 1985. Meat and Poultry Production in Nigeria – an overview. *Nigerian Food Journal 2 & 3:* 55 – 57.

OKAFOR, L.C. 1992. *Biometry: Basic principles and approaches.* Geelink Publishers. Onitsha, Nigeria. 171pp

PEARSON, D. 1982. *The chemical analysis of foods* (8th ed.). Churchill-Livingstone, London.575pp

TAYLOR, T. A. 1972. On the origin of the wet-season form of *Zonocerus variegatus*(L) (Orthoptera: Pyrgomorphidae) in Nsukka, Plateau, Nigeria. *Entomologia Experementalis et Applicata 16:* 64 – 76.

TOBOR, J. G. 1985. Fish production and processing in Nigeria. *Nigerian Food Journal 2 & 3* :51 – 56.

UNIFEM 1989. *The United Nations Development Fund for Women,* New York Food Cycle Technology Source Book No. 577pp