Journal of Experimental Research

December 2017, Vol 5 No 2
www.er-journal.com
Email: editor-in-chief@er-journal.com

Received: June, 2017
Accepted for Publication: August, 2017

DETERMINATION OF NUTRIENTS, ANTINUTRIENTS, MACRO ELEMENTS, AND HEAVY METALS IN WINGED TERMITE (*Macrotermes bellicosus*) FROM EKE VILLAGE.

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Abstract

Winged reproductive termite (*Macrotermes bellicosus*) was collected from Eke Village in Udi Local Government Area during their nuptial flight on March 15, 2013. Nutritional, antinutritional , and heavy metal analysis was carried out using conventional analytical methods. Comparing the results obtained from the chemical analysis of the samples with the Recommended Dietary Allowance (RDA) for each of them showed that the moisture content (53.9%), crude protein (42%), and lipid content (52.3%) were relatively high when compared with other edible insects. The ash content (4.1%), crude fiber content (0.28%), and carbohydrate content (1.32%) were low. Result of the antinutrient revealed that oxalate (79.2mg/100g) was the most abundant while phytate (0.33mg/100g) was the least abundant. Elemental analysis showed that iron (Fe) content of the sample was relatively high while calcium (Ca), potassium (K), and phosphorous (P) content were low. Heavy metals like lead (Pb) and cadmium (Cd) analyzed for were very low in the sample. The result shows that the winged termite may be used as an alternative source of food supplement.

Keywords: Antinutrient, Edible, Elemental, Heavy metals, Termite.

INTRODUCTION

Insects have played an important part in the history of human nutrition in Africa, Asia, and Latin America (Bodenheimer, 1951).Different cultures around the world have made insects a main ingredient in their diet, providing an excellent source of protein. Hundreds of insects species have been used as human food, some of the most important groups include; grasshoppers, caterpillars, beetle grubs, winged termite, bee wasps and a variety of aquatic insects (Ite, 2006). Insects and meat play the same role in the human body i.e. they provide almost the same nutritional value and protein to the body (Banjo et al., 2006). People are not aware of the fact that some edible insects and other locally available fruits can meet their deficient nutrient needs if consumed locally (Bodenheimer, 1951), available fruits and vegetables for vitamin needs, insects for protein, fat and some essential minerals, nuts and seeds for fiber needs, hence most people living in the rural communities are vulnerable to malnutrition and lack some basic body nutrient due to ignorance (Okaka et al., 1992).Termites are small medium sized insects that live in social groups or colonies, they have soft bodies and are pale in colour. Termites live in caste in millions working together for the benefit of the whole colony (Okaka et al., 1992). The chemical composition of any insect is dependent of the geographical location, climate, food source and time of sampling (Banjo et al., 2006). Basic knowledge of foods and their nutrient content is very essential for healthy growth and development in human beings. The body needs six nutrient classes to ensure adequate nutritional body requirement and maintain good health (Enders and Rockwell, 1994). Prolonged deficiency in any of these nutrients present in foods could result in some irreversible and life threatening health challenges (Okaka et al., 1992).There exist some substance present alongside nutrients in food substance which could hamper/deter the efficient use of the food for proper functioning of the body system. These substances are called antinutrients, they include: hydrocyanide, oxalate, hydrate, tannin, lectin, glucosinolates, saponins, etc (Banjo et al., 2006). The effectiveness and activities of antinutrients in the system depends on the amount present and quantity consumed over a given period. Some of these antinutrients like oxalate, lectin, and hydrocyanide can be deactivated by cooking (Onigbinde, 2005) .The knowledge of type and amount of antinutrients present in edible food substances becomes imperative. Minerals are inorganic elements occurring in living tissues, they are required in small quantities, which constitute three to four percent of the total body weight (Joshi, 2004). These minerals have a simple structure which makes them stable to heat and harsh environmental condition during cooking and processing. Minerals are subdivided into two classes, the macro minerals and the trace minerals. The macro mineral are those that are required in large quantities (at least 100mg/day) which include calcium, potassium, magnesium, sodium , phosphorus etc, while the trace minerals are required in minute quantities (less than 20mg/day), they include copper, chromium, zinc, sulphur, molybdenum, iodine, fluorine etc (Sutnick, 1984).Heavy metals are metallic elements that have relative density of at least $5g/cm^3$ (Whitney and Rolfes, 1991).These metals include mercury, lead, cadmium, arsenic, lead etc. These metals enter the body via food, water or air, they build up in the body and cannot be decomposed easily thereby causing harm to the body. 10% increase in the world's supply of animal protein through insect and other locally available rich sources can largely eliminate the problem of malnutrition and also decrease the over dependency on other protein sources in developing countries (Robert, 1989). Therefore, the objectives of this study are to determine nutrients, antinutrients, macro elements, and heavy metals in winged termite (macrotermes bellicosus) from Eke village in Udi local government area of Enugu State, Nigeria, and to ascertain its suitability for use as an alternative source of food supplement.

MATERIALS AND METHODS

Sample Collection

The sample (winged reproductive termite) was collected on 15th March, 2013 during their nuptial flight between 10:30am and 1:30pm, two days after the second rain from residential buildings in Eke village in Udi Local Government Area of Enugu State, Nigeria.

Sample Preservation and Treatment

The sample collected were washed to remove sand and unwanted materials, dewinged, and then preserved in a refrigerator before getting to the laboratory. Moisture content was determined instantly while the rest of the sample was dried at 50°C and stored in an airtight container before other analysis was done.

Proximate Analysis of Winged Reproductive Termite (*Macrotermes bellicosus*)

The proximate analysis was carried out using the methods and recommendations of the Association of Official Analytical Chemists as described in its *Official Methods of Analysis,* (AOAC, 1975 and 1984).

Determination of Macro Elements and Heavy Metals

The ash obtained was leached with 5ml of 6M HCl solutions and made up to mark in a 50ml volumetric flask. The digest was used to analyze for calcium (Ca), potassium (K), phosphorus (P), cadmium (Cd), lead (Pb), and iron (Fe) using UNICAM 969 Atomic Absorption spectrophotometer.

Antinutrient Analysis of Winged Reproductive Termite (*Macrotermes bellicosus*)

Oxalate determination was carried out using method of Dye (1956), while tannin determination was carried out using method of Burns (1971). Also, alkaline titration method of the Association of Official Analytical Chemists as described in its *Official Methods of Analysis,* (AOAC, 1984) was adopted for hydrocyanide determination and phytate determination.

Analysis of Vitamins in Winged Reproductive Termite (*Macrotermes bellicosus*)

This was carried out using the methods and recommendations of the Association of Official Analytical Chemists as described in its *Official Methods of Analysis*, (A.O.A.C, 1984) for the determination of Vitamins A and C.

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RESULTS AND DISCUSSION

Table 1: Proximate analysis of winged termite from Eke

Parameters	Amount (%)
Moisture	53.92
Crude fat	52.30
Crude protein	42.00
Crude fiber	0.28
Ash	4.10
Carbohydrate	1.32

Table 1 consists of the result of proximate analysis on winged termites from Eke village in Udi Local Government Area of Enugu. It revealed that moisture content, crude fat, crude protein were the major nutrients present in the sample with percentage by compositions; 53.92, 52.30 and 42.0% respectively. The high moisture content of the sample implies that most of the essential nutrient will be in solution and concentration by frying or sun drying would help to increase the concentration of other nutrients. The insect is commonly eaten fried. The fat content of the sample is quite high when compared to other edible insects. Calvert et al., (1969) reported a lipid value of 15.5% in pupae housefly, while 7.45% was reported for adult honey bee (Ryan et al, 1983).The fat content of the insect could have contributed to its palatable flavor when fried or roasted. The crude protein content obtained for the sample was lower than (50.75%) obtained by Ite (2006) in worker termite (*Macroterms bellicosus*) obtained in Akwa Ibom state. The protein content of the insect is suggestive of the potential of it being used in combating protein deficiency in Eke , Enugu state and Nigeria .The crude fiber content (0.28%) of the sample was lower than (2.20%) obtained in *Macrotermes notalensis* (Bango et al., 2002).This may be due to differences in species, feed consumed by the insect , climate, and geographical location. The ash content of the winged termite (4.1%) is similar to that (4.0%) reported by Oyarzun et al., (1996) in *Nasutitermes spp*. The carbohydrate content of the winged termite (1.32%) is low when compared to other edible termites.

Table 2: Vitamin A and C composition of winged termite from Eke

Vitamin	Concentration(mg/g)
A	0.720
C	0.001

Table 2 above shows the concentration of vitamins A and C in winged termite to be 0.720mg/g and 0.001mg/g respectively. The concentration of vitamin A in the sample is higher than (0.65mg/g) obtained by Oyarzun et al., (1996) in *Nasutitermes spp*. The concentration of vitamin C in the sample is lower than (0.1mg/g) obtained in *Apis mellifera* by Banjo et al., (2002).

Table 3: Elemental composition of winged termite from Eke

Elements	Concentration (mg/100g)
Calcium (Ca)	16.410
Potassium (K)	15.840
Phosphorous (P)	2.120
Iron (Fe)	16.810
Cadmium (Cd)	0.230
Lead (Pb)	0.003

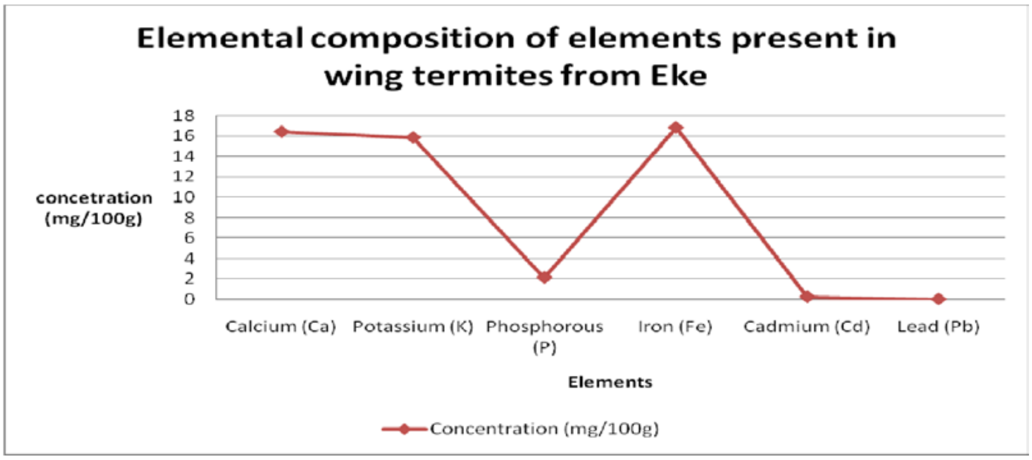

Figure 1: Elemental composition of winged termite from Eke village

The concentration of calcium in winged termite (16.41mg/100g) was found to be lower than (60.81mg/100g) obtained in the larva of *Rhynchophorus phoenicis* (Ekpo and Onigbinde , 2005).Potassium concentration in the sample (15.84mg/100g) is lower than 1875mg recommended by RDA (1980).Phosphorous concentration in the sample (2.12mg/100g) is lower than (122.2mg/100g) reported by Banjo et al., (2002) in caterpillar (*Anaphe spp*.).The concentration of iron (Fe) in winged termite (16.8mg/100g) is higher than (0.75mg/100g) reported by Defoliart, (1992) in *macrotermes subhyanlinus*. Lead (Pb) concentration in the winged was 0.003mg/100g. Ekop and Onigbinde (2005) reports lead (Pb) concentration in the larva of *Rhychophorus phoenics* to be 0.21%, which is higher than that obtained in winged termite. The concentration of lead (Pb) in winged termite is lower than 4.38mg, this implies that winged termite from Eke can be consumed without fear of lead poisoning. Cadmium (Cd) concentration in winged termite (0.23mg/100g) was higher than (0.039mg/100g) reported by Ekpo and Onigbinde (2005) in *Rhychophorus phonenicis*. The concentration of the heavy metals tested for are within the allowable limit in food substances.

Table 4: Antinutritional composition of the winged termite from Eke

Antinutrients	Concentration (mg/100g)
Hydrocyanide	8.64
Tannin	1.15
Phytate	0.33
Oxalate	79.20

Table 4 above shows the antinutritional composition of winged termite from Eke, oxalate concentration was highest while phytate was the least .Hydrocyanide concentration concentration in the sample (8.64mg/100g) was lower than (910.80mg/100g) reported by Ite, (2006) in solider termite. Hydrocyanide concentration obtained was lower than the lethal dose of 35mg (oke, 1969).Tannin content in the sample (1.15mg/100g) is low when compared with the lethal dose in food which is between 2.5-5.0mg.The amount of tannin in the sample must have contributed to the high level of iron and protein in the sample. Phytate concentration in the sample (0.33mg/1000g) is low when compared with the allowed level of phytate in food (i.e.between 1and 10mg/kg of the body weight).Oxalate content in the sample (79.2mg/100g) was lower than (140mg/100g) obtained by Ite, (2006) in honey bee. Oxalate concentration between 200mg to 500mg prevents the absorption of calcium and iron in the body (Pearson,1973).The concentration of oxalate in the sample implies that allow for absorption of calcium and iron in the body (Omuluche et al., 2015).

CONCLUSION

Winged termite can serve as an alternative source of food and vitamins to most synthetic food substances which have some negative health effect on the body. The data obtained from the analysis of the winged reproductive termite from Eke shows that the moisture content, fat, and protein were high in the sample. The low concentration of vitamins A and C implies that winged termite could not be used as a major source of these vitamins in food as the values are well below the daily requirement. Antinutrients analyzed (i.e. hydrocyanide, phytate, oxalate and tannin) show that the sample is at safe level for consumption. Analysis of elements shows that the sample is rich in iron (Fe) but poor in calcium (Ca), potassium (K) and phosphorus (P). Heavy metal analysis show that the winged termites from Eke can be consumed without fear of cadmium (Cd) and lead (Pb) poisoning. Winged termite from Eke can be used as an alternative source of protein, fat and iron by the inhabitants of the area.

REFERENCES

AOAC. (1975). Official methods of analysis of the Association of Official Analytical Chemists. 12th ed., Washington, DC. Pp: 251-292.

AOAC. (1984). Official methods of analysis of the Association of Official Analytical Chemists. 12th ed., Washington, DC. Pp: 152-252.

Banjo AD, Lawal OA, Songonugu EA. (2006). The Nutritional Values of Fourteen Species of Edible Insects in South-western Nigeria. African Journal of Biotechnology. 5: 298-301.

An Official Publication of Enugu State University of Science & Technology ISSN: (Print) 2315-9650 ISSN: (Online) 2502-0524

Bodenheimer FS. (1951). Insects as Human food. International Conference on Environmental Hazards Mitigation, Cairo University, Egypt. pp. 542-556.

Burns RE. (1971). Methods of Estimation of Tannins. Grain Sorghum Agronomy Journals.163: 511-519.

Calvert CL, Matins RD, Morgan NO. (1969). Housefly Pupae as Food for Poultry. Journal of Econ. Entomologist. 62: 938-939.

Defoliart GR. (1992). Insect as human food in the near time, Elsevier Science publishers, Sweden. Pp: 55-57.

Dye WB. (1956). Studies on Halogenated Glomeratus Weed. A Global Concern. 8th Ed., McGraw-Hill, New York. Pp: 130-246.

Ekpo KE, Onigbinde AO. (2007). Characterization of lipids in winged Reproductive Termite (*Macrotermes bellicosus*). Pakistan Journal of Nutrition. 6:247-251.

Endres BJ, Rockwell RE. (1994). Food Nutrition and the young child. 4th Ed, Macmillan Publishing Company, Canada. Pp: 14-26.

Ite KE. (2006). Chemical Composition of Termites (*Macrotermes bellicosus*) obtained in Akwa Ibom State. PhD Thesis, University of Maiduguri, Nigeria. Pp: 88-96.

Joshi SA. (2004). Nutrition and Dietetics. 2nd Ed., Tata McGraw-Hill Publishing Company Ltd, New Delhi. Pp:130-131.

Okaka, JC, Akobundu EN, Okaka AN. (1992). An Integrated Approach to research. Enugu State University of Science and Technology, Enugu. Pp: 51-249.

Onigbinde, AO, (2005). Food and Human Nutrition. 2nd Ed., Aiva Corporate Organization, Benin. Pp: 287-301.

Oyarzun SE, Crawhaw GJ and Valdes EV. (1996). Nutrient Composition of termite (*Tamandua tetradactyla*). Zoo Biology. 5: 500-524.

Pearson D. (1973). Laboratory Techniques in food Analysis. Butterworths, London. Pp: 33-52.

Robert K. (1989). The Application of Industrial Technology for production of insects as food. The Food Insect News letter. 3:32-43.

Ryan JK, Jelen P, and Sauer WC. (1983). Alkaline Extraction of protein from Spent Honey bees. Journal of Food Science. 48:886-896.

Sutnick MR. (1984). Nutrition and Children's Health. George Tickley Company, Washington. Pp: 25-29.

Whitney EN and Rolfes SR. (1999). Understanding Nutrition. 8th ed., Wadsworth Publishing Company, U.S.A. pp: 432-479.

An Official Publication of Enugu State University of Science & Technology ISSN: (Print) 2315-9650 ISSN: (Online) 2502-0524