

**FULL LENGTH RESEARCH ARTICLE**

**NUTRIENT COMPOSITION OF SOME TERRESTRIAL INSECTS IN AHMADU BELLO UNIVERSITY, SAMARU ZARIA NIGERIA.**

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**ABSTRACT**

Terrestrial insects belonging to 8 species groups were collected from 5 sites in A.B.U. main campus and analysed for nutritional constituents using standard biochemical methods. The highest level of crude protein was found in *Catantopsilus taeniolatus* (40.57%) and the lowest in *Microtermes* sp (24.85%). Crude protein and lipid contents varied significantly ( $P < 0.05$ ) between the species groups. Differences between the crude protein content of *Zonocerus variegatus* specimens was not significant ( $P > 0.05$ ) and decreased in the order nymph > winged adult > de-winged adult. Carbohydrate ( $LSD_{(0.05)} = 1.09$ ) and crude fibre ( $LSD_{(0.05)} = 0.79$ ) also varied significantly between the groups. The ash content of *Microtermes* sp was about 4 times higher than the level in any other species group. The significance of these nutrients and their role as suitable substitutes and supplements in human and livestock diets are discussed.

**Keywords:** Terrestrial insects, nutrients composition, Samaru, Nigeria

**INTRODUCTION**

From pre-historic times to the era of the cave-man, human beings utilized insects as ready source of food and an important source of edible protein. In all human cultures, insects have been utilized as food from ancestral records. In Europe, Asia, Australia, the Americas and Africa, people feed on different stages of various insects. Early records (Ene 1963) showed that the ancient Greek-Parthians and Nasamines ate locusts and grasshoppers as food; the Epicureans of ancient Rome ate cossus caterpillars while the North American Indians fed on rocky mountain locust, ants, grasshoppers, crickets and warble fly grub (Sandel 1745, cited by Ene 1963); the French feed on the abdomen of the beetle *Rhizotrogus assimilis*. It is believed that the 'manna' God provided for the children of Israel in the wilderness were the sugary secretions of *Gossyparia mannifera*. (Exodus 16:14-15)

There are about 2000 edible insects around the world (Menzel & D'Aluisio, 2004). They have been a staple of almost every indigenous culture, not only because of their delicious flavour but for providing high protein nutrients than soyabean or fish and have been found to be concentrated sources of calcium, magnesium, vitamins, niacin and several other nutrients (Menzel & D'Aluisio 1998).

Edible insects may be consumed either in the larval (e.g. grubs and caterpillars, silkworms) or the adult form (e.g. grasshoppers, termites, crickets). In Thailand, it is estimated that over 50 species of insects are consumed throughout the year (Ramos-Elorduy 1998), and in Ecuador greater number of species have been recorded by Vantomme (2004) as important complement to other sources of animal protein. Grasshoppers constitute a common dietary component of the North American Indians for many centuries (Defoliart 1989): they are also sold as novelty dish in the United States.

Caterpillars are important food for many Central African countries (Menzel & D'Aluisio 2004). More than 80% of the people in Central African Republic consume caterpillars, 70% in the Democratic Republic of the Congo (D.R.C) and more than 90% in Botswana. Currently, hundreds of tons of 'Mopanie' are exported annually from Botswana and South Africa to Zambia and Zimbabwe.

Several insect species or their products are utilized as food by the people of West Africa. Among the favourite insects eaten in Nigeria are termites, grasshoppers, caterpillars, locust, palm tree larvae (grub), dung larvae (scarabeids) crickets and composite beetle larvae. Many of these contain high quality fats and essential nutrients (William 1991). Of the several insects eaten in different parts of the world, only few have been analysed for their nutritional contents, with the majority remaining unexplored. This paper sets out to examine nutrient contents of 8 insect species (edible and non-edible) and their contribution to man's food needs.

**MATERIALS AND METHODS**

Eight insect species, namely *Periplaneta americana*, *Microtermes* sp., *Macrotermes nigeriensis*, *Zonocerus variegatus* (winged adults, de-winged adults and nymphs), *Comptonotus* sp., *Oecophylla longinoda*, *Catantopsilus taeniolatus* and *Zulua cyanoptera* were collected from 5 sites within Ahmadu Bello University campus, Samaru Nigeria using sweep nets, handpicking and forceps. The insects were killed in killing bottles containing 75% chloroform soaked in cotton wool and air-dried at room temperature.

A beaker containing the air dried samples was transferred to an oven (Thelco, GCA/Precision Scientific) set at 105 °C for 24 hr, and removed the following day. The percentage dry matter was determined as follows:

$$\% \text{ dry matter} = \frac{\text{Wt. of beaker} + \text{dried sample} - \text{Wt. of beaker} \times 100}{\text{Wt. of sample before drying}}$$

Ash contents and crude fibre were determined from 2 g and 1 g of the powdered samples respectively, according to methods outlined by AOAC (1975).

Oil (lipid %) was determined from 2 g of the powdered sample by Soxhlet extraction (AOAC 1975). Percentage Nitrogen Free Extract (Carbohydrate) was obtained by computation (AOAC 1975) applying the formula:

$$100\% - (\% \text{ protein} + \% \text{ lipid} + \% \text{ ash} + \% \text{ fibre}).$$

The dried insect samples were also analysed for crude protein using block digester machine by placing 1 g of dried sample into the block digestion flask to which was added sodium sulphate and cuprisulphate at 1:5 ratio to serve as catalyst.

Total nitrogen (%N) was determined in 1000 ml of the powdered sample by the micro Kjeldahl method (AOAC 1975) and crude protein obtained by using a Nitrogen: Protein Conversion factor of 6.25.

The moisture content was obtained from the relationship: 100%-percentage dry matter

The results were subjected to analysis of variance (ANOVA) according to Parker (1980) to determine the level of significance between different insect samples.

**RESULTS**

Analysis of ten insect samples belonging to eight species was carried out in duplicate, except for *M. nigeriensis*, de-winged adult *Z. variagatus* and *Zulua cyanoptera*. The results were averaged and the following nutrient composition obtained (Table 1).

**TABLE 1: MEAN VALUES OF NUTRIENT COMPOSITION OF INSECT SAMPLES (VALUES) FOR DRY MATTER ARE RAW SCORES).**

Insect Samples	D.M%	C.P% ± S.E	C.F.% ± S.E.	OIL% ± S.E.	ASH%± S.E.	N.F.E.% ± S.E.
A	76.62	24.85±0.500	12.22±0.155	17.04±0.390	27.74±0.315	18.17±0.055
B	89.06	35.88±0.000	5.54±0.000	28.37±0.000	5.78±0.000	18.73±0.000
C	85.63	38.72±0.030	8.74±0.305	28.64±0.265	5.77±0.010	18.14±0.590
D	62.16	37.88±0.275	8.91±0.000	28.29±0.000	5.16±0.000	20.01±0.000
E	81.73	39.22±0.095	11.62±0.390	31.72±0.325	6.94±0.135	10..51±0.265
F	75.55	37.79±0.215	12..34±0.070	41.34±0.345	7.34±0.095	7.24±0.155
G	86.71	39.60±0.035	13.12±0.150	21.50±0.195	6.17±0.426	19.63±0.045
H	83..53	40.10±0.065	14.13±0.200	15.95±0.150	9.56±0.025	20.28±0.010
I	83.88	40.57±0.030	13.25±0.000	23.37±0.000	6.89±0.000	15.94±0.000
J	65.44	33.72±0.030	13.27±0.245	28.52±0.140	6.59±0.185	17.84±0.540

D.M.= Dry matter, C.P = Crude protein, C.F = Crude fibre, N.F.E = Nitrogen free extract, ± S.E. = Standard Error, A = *Microtermes* sp, B = *Macrotermes nigeriensis*, C = *Zonocerus variegatus* (Fab) Winged Adult, D = *Zonocerus variegatus* (Fab) De-winged Adult, E = *Zonocerus variegatus* (Fab) Nymph, F= *Oecophylla longinoda*, G= *Periplaneta americana* (L), H = *Componotus* sp, I = *Catantopsilus taeniolatus* (Karsah), J = *Zulua cyanoptera* (Stal.).

**TABLE 2: MAIN RESULTS OF ANOVA FOR NUTRIENT CONTENT OF EIGHT INSECT SPECIES GROUPS.**

Nutrients	Source of Variation Species groups	LSD <sub>(0.05)</sub>
Crude Protein	S(F = 639.024)	0.66
Crude fibre	S(F = 86.079)	0.79
Oil (fat)	S(F = 726.383)	0.92
Ash	S(F = 975.824)	0.74
Carbohydrate (N.F.E)	S(F = 257.113)	1.09

S = Significant at 0.05% probability level; F = Variance ratio. N.F.E= Nitrogen Free Extract

Crude protein constituents varied significantly ( $LSD_{(0.05)}=0.66$  (Table 2) between the eight insect species groups. The highest level of crude protein was found in *C. taeniolatus* (40.57%), closely followed by *Componotus sp.* (40.10%) and the least in *Microtermes sp.* (24.85%). Differences between crude protein content of the three stages of *Z. variegatus* was not significant ( $P>0.05$ ) and decreased in the order Nymph > winged adult > de-winged adult. *P. americana* had higher crude protein (39.60%) than the nymph of *Z. variegatus* (39.22%).

The crude fibre content was highest in *Componotus sp.* (14.13%) and lowest (5.54%) in *M. nigeriensis*. Crude fibre contents of all the insect species varied significantly ( $LSD_{(0.05)} = 0.79$ ) with *Z. variegatus* (nymph) recording the highest fibre content than the adults (Table 1).

Lipid (fat) content between the insect species groups was significant ( $LSD_{(0.05)} = 0.92$ ) with *O. longinoda* having the highest (41.34%) and *Componotus sp.* the lowest (15.95%). The nymph of *Z. variegatus* contained more lipid than the adults (Table 1).

The ash content of *Microtermes sp.* (27.74%) was about four times higher than every other species group except *Componotus sp* which contained 9.56%. Significant difference in ash content was obtained between all the 8 insect species groups ( $LSD_{(0.05)} = 0.74$ ).

The carbohydrate (Nitrogen Free Extract) contents of all 8 species of insects varied significantly ( $LSD_{(0.05)} = 1.09$ ) between groups. It was highest in *Componotus sp.* (20.28%) and least in *O. longinoda* (7.24%). De-winged adult of *Z. variegatus* contained more carbohydrates (20.01%) than winged adults (18.14%) and nymph (10.5%) of the same species.

## DISCUSSION

Insects are the most abundant invertebrates that have successfully colonized the terrestrial and aquatic habitats of the world. Because they are found almost everywhere, they serve as important link in the food web in any ecosystem where they live. Among the insect specimens investigated, five species are edible by man, namely *Microtermes sp.*, *M. nigeriensis*, *C. taeniolatus*, *Zulua cyanoptera* and *Zonocerus variegatus* ( nymph, winged and de-winged adults ) while three are not edible (*O. longinoda*, *Periplaneta americana* and *Componotus sp.*) but are consumed by predators in their environments.

Grasshoppers form a delicacy and a veritable source of protein in many cultures (Ene 1963), and indeed are used as substitute for meat (Defoliart 1989; Vantomme 2004). The crude protein content of the grasshoppers analysed showed that *C. taeniolatus* (40.57%), *Zulua cyanoptera* (33.72%) and the three specimens of *Z. variegatus* averaged 38.61%, indicative of a high protein content and confirming their importance as a good source of protein in cultures where they are consumed as delicacies (Ramos-Elorduy 1998) or used as feed supplements.

The crude protein extract from *C. taeniolatus* is comparable to the crude protein in *Componotus sp.* which is not edible by man but served as food for other animals. Since *Componotus sp.* has a high yield of crude protein, it could be used as livestock feed supplements because they are abundant and readily available.

*M. nigeriensis* is a favourite delicacy in many African countries. The winged adults on nuptial flight are usually collected 'at light', salted, fried and sold in open markets. The crude protein content of 35.88 % obtained from the species was higher than the 14.2 % recorded for *Macrotermes subhyalinus* (Defoliart 1989), indicating that *M. nigeriensis* is a good source of protein for man and animals.

The American cockroach *P. americana* is a serious pest in homes as well as a mechanical vector of numerous parasites. A lot of money and man hour is spent in attempts to control it. The presence of high crude protein of 39.60 % in this insect strengthens the belief that it supplies a lot of protein to animals that feed on them. Because of the danger of direct transmission of the pathogens inhabiting its intestine, it is suggested that this insect may be collected, killed, oven-dried, ground into powder and processed as feed supplement for livestock. *O. longinoda* with equally high crude protein content of more than 30.0 % can also be processed in similar way for animal feeds.

The high lipid (oil) extract from *O. longinoda* makes it a better candidate for the supply of cheap and readily available animal fat. The nymph of *Z. variegatus* contains more oil than winged and de-winged adults probably because they are younger and could be used to prepare insect oil-based products.

The high crude fibre content found in the grasshopper *Zulua cyanoptera* and *Componotus sp.* indicated that they can be used to complement animal roughages in addition to other uses mentioned earlier.

Nitrogen free extract or carbohydrate is an essential food passed on to the consumer from the producer. Significant quantity of carbohydrates was found in all the species groups except *O. longinoda*. Carbohydrate is a source of stored energy in the body of insects, therefore when consumed by man or animals, the carbohydrates is converted into food molecules and stored or utilized as ATP to do work. The insects analysed in the present study can serve as a energy to man or animals (Ruddle 1973).

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