



Proximate and Elemental Composition of some Edible Insects in the Humid Tropics Caterpillar (*Cirina butyrospermi*) and Cricket (*Brachytrupes membranaceus*)

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ABSTRACT

The objective of this study is to increase the value of these edible unconventional insects' resources to ensure food security. The study was also to ascertain the collection, cooking/processing and conservation techniques, financial income and distribution channels. The period of availability and the nutritional value of these edible insects. The proximate composition and minerals of these insects were evaluated. The results 16.60% CP, 6.00% EE, 5.00% CF, Ash 7.00%, moisture 6.00% and NFE 59.40% respectively while phosphorus was 76.35, Mg 42.57, K 315.16, Ca 125.34, Fe 2.36 and Zn 0.26mg/100g respectively for caterpillar-Cricket recorded values of 21.50CP, 8.60EE, CF 6.00, Ash 7.95, Moisture 6.20 and NFE 49.70. According to the proximate and elemental evaluation these insects could be a potential source of protein, fats and minerals for humans and animal feeding if properly exploited.

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INTRODUCTION

Entomophagy, the eating of insects is not a new phenomenon for humans with archaeological evidence demonstrating that humans have evolved as an entomophagous species (Rothman, 2011). The majority of hungry people live in developing countries; Africa remains the region with the highest prevalence of undernourished (van Huis *et al.*, 2013). Lately insects have received wide attention as a potential alternate major source of protein (Makker *et al.*, 2014), due to their nutritional content comparable to conventional livestock and fish. The crude protein content of insects range from 40-75% on dry matter basis with beneficial amino acid profile and a variable fat content (Verkerk *et al.*, 2007). Insects are also variable sources of minerals and vitamins (Finke, 2013). They have a high biodiversity with higher feed conversion efficiency than cattle (Labandeira and Sepkoski, 1993), (Verkerk *et al.*, 2007). Among the insects order Lepidoptera (caterpillars)

represent 80% of edible species (Ramos-Elorduy *et al.*, 2005) in the order of Lepidoptera, the family saturniidae takes the first with 109 different species eaten by human (Malaisse and Lathem, 2014)

MATERIALS AND METHODS

Experimental site

The research was conducted in Taraba state, Taraba state is located in the North eastern Nigeria. The state is located on latitude 8° 53' N and longitude 11° 23' E. The area has an annual rainfall ranging from 1000 – 1500mm and temperature of 30 – 38°C (Encarta, 2009).

Collection and Preparation of Sample

The insects were collected from the study area which is Taraba state of Nigeria. West Africa. Crickets were dugged from their holes in the ground. Caterpillars were collected from shea butter trees (*Butyrospermi parki*), caterpillars of *Cirina butyrospermi* were

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handpicked from shea butter trees (*butyrospermi parki*) directly from the trunk, from or under soil and were transported to the laboratory for identification and confirmation. They were washed, precooked at 100°C, sundried and then oven dried in an oven at 60°C for 72 hours. Dried larva were grounded and stored for proximate and elemental analysis.

The samples were analysed for proximate and elemental composition according to the procedure described by AOAC (1995). Percentage of nitrogen free extract was obtained by difference applying the formula 100 – other proximate components. Energy was calculated using the formula of Pauszenga (1985)

RESULTS

The proximate composition of caterpillar is given in Table:1, this composition expressed on dry matter basis, revealed 16.00% crude protein, 6.00% EE, 5.00% CF, 7.00% Ash, moisture 6.00% and NFE 56.55%. grasshopper gave the values of 17% CP, 7.00% EE, 5.65% CF, Ash 7.80%, moisture 6.00% NFE 56.55%, palm weevil 19.55% CP, 7.85% EE, 6.00% CF, &.85% Ash, moisture 6.00% and 52.72% NFE, cricket 21.50% CP, 8.60%EE, 6.00% CF, 7.95Ash, moisture 6.20% and NFE 49.70% and Grub worms (manure worm) revealed 23.70%CP, 8.90% EE, 6.95% CF, 8.00Ash, moisture 6.35% and 46.10% NFE, total of six minerals were estimated. Table 1 shows that caterpillar has (76.35mg/100g) of phosphorus, Mg 42.57, potassium 315.16, calcium 125.34, Fe 2.36 and Zn 0.25, (grasshopper P 91.24, Mg 47.72, K 365.40, Ca 132.03, Fe 4.57 and Zn 0.38, palm weevil showed P 98.13, Mg 53.28, K 375.87, Ca 135.22, Fe 4.68 and Zn 0.53) cricket revealed 143.57 phosphorus, K 425.63, Ca 141.22, Fe 6.65 and Zn 0.86 (Grub worm P 171.13, Mg 68.12, K 511.36, Ca 184.63, Fe 6.93 and Zn 0.89).

DISCUSSION

The crude protein of 16.60% obtained in this study was lower than that obtained by Anvo *et al.* (2016) and (Ouedraogo, 1993), but the result was within the range of 15-60%

reported for various forms of edible insects of Lepidoptera order from the state of Oaxaca Mexico (Ramos-Elorduy *et al.*, 1997). Furthermore, protein, lipid and Ash content were within the range established for tropical Africa caterpillar (Malaisse and Lathem, 2003).

The variations in the biochemical composition of insects may be due to the host tress, because the amount of protein, fats, carbohydrates vary by species of the insects and within the same species according to the nutritional qualities of the host tress leaves (Banjo *et al.*, 2006), since insects have high feed conversion efficiency (Verkerk *et al.*, 2007). Chitin is a major crude fiber in insects (Lindsay, *et al.*, 1984) the percentage of crude fiber obtained in this study was lower than the values of 9.4% and 9.35% respectively obtaine for carina forda (Ramos-Elorduy *et al.*, 1997) and for zonocerus variegatus (Alegbeleye *et al.*, 2012). The crude fiber of insects varies among species and development phases (Sanchez-Muros *et al.*, 2014), the amount of energy of food depends on its lipid, protein and carbohydrate contents. The energy calculated for this caterpillar is 2654 kcal/kg, this value was higher than the energy value of 1728kcal/kg obtained for *C. forda* (Paiko, *et al.*, 2014).

Ash content is indicative of the mineral content (Verkerk *et al.*, 2007). Caterpillar was rich in essential minerals such as potassium, calcium, phosphorus and iron. The results obtained in this study were higher than those of *C. forda* which were respectively 65.04, 32.24 and 111.0mg/100g (Paiko, *et al.*, 2014). The values of iron obtained in this study was inferior to 31mg/100g observed for *Imbrasia belina* and beef meat 6mg/100g (Bukkens, 1997). The variation may be due to differences in geographical locations and in dietary habits of insects because the mineral content is a reflection of the animals feed sources.

Edible crickets are excellent sources of protein, lipids, carbohydrates, mineral salts and vitamins. However, the nutritional composition of these crickets varies across the different species (Malaisse and Lathem, 2003). The nutritional content can also vary within the same species of

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cricket influenced by the stages of development, habitat, climate, sex and the food substrate fed on by the cricket (Bukkens, 1997), the nutritional value may also be influenced by the method in which the crickets are processed (i.e cooking, drying, smoking, deep-frying, roasting and toasting), before consumption (Bugsolutely, 2016) most of the edible crickets supply adequate energy and proteins to the consumer diet at the same time meeting the amino acid requirements. Besides these insects are rich in elements such as calcium, potassium, magnesium, phosphorus, sodium, iron etc as well as vitamins like folic acid, panthothenic acid, riboflavin and biotin which are the most deficient nutrients in humans (Verkerk *et al.*, 2007; Malaisse and Lathem, 2003; van Huis., 2013). The values of protein reported in the present study agrees with that reported by Magara *et al.* (2021) with the range of 18.6 – 71.1% crude protein in dry weight. Edible crickets possess a significant amount of ash, ranging from 2.96 – 20.50mg/100g dry weight. The value in this study falls within this range. Crickets have a higher content of Ash when compared to goat, broiler and pork meat (van Huis., 2013).

The carbohydrate content of edible crickets reported in the previous studies ranged from 2.50 – 47.20mg/100g of dry weight. The carbohydrate content in crickets is greatly influenced by the diet they consume (Rothman, 2011). Crickets store their carbohydrates in the

fat body, mainly in the form of glycogen, which can be later rapidly hydrolysed into a readily useable form of energy.

Different studies have reported the caloric energy content of 12 cricket species which ranges from 18 – 536kcal/100g of dry weight. The energy value obtained in the presence study is within this range. In another vein, a food company Bugsolutely has launched an innovative product for fast growing market of food products based on edible insects. The company says the pasta benefits from an exceptional amount of nutritional value, including high protein, calcium, iron, vitamin B₁₂ and omega 3. All of these benefits are due to the characteristics of cricket flour. Protein is the key to the flour, as 70% of crickets are made of protein. (Bugsolutely, 2016).

CONCLUSION

Results obtained from the present study showed higher and sufficient proximate and elemental composition of caterpillar and cricket. It is therefore evident that caterpillar and cricket can serve as a potential source of protein, fat and minerals for humans and animals.

Further researchers should evaluate variations in the nutritional qualities based on ecology (habitats) and location of the host tree, the harvesting and processing methods. Amino acids and anti-nutritional factors in these insects should be of concern.

Table 1: Proximate composition of samples (%)

Samples	CP	EE	CF	Ash	Moisture	NFE	Energy
A	16.60	6.00	5.00	7.00	6.00	59.40	
B	21.50	8.60	6.00	7.95	6.20	49.70	

Minerals content of samples, (mg/100g)						
Samples	P	Mg	K	Ca	Fe	
A	76.35	42.57	315.16	125.34	2.36	0.26
B	143.57	65.35	425.63	141.22	6.65	0.86

Key: A- caterpillar, B- crickets, CP- crude protein, EE- ether extract, CF- crude fibre, NFE- nitrogen free extract



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