Continental J. Food Science and Technology 6 (2): 38 - 42, 2012 ISSN: 2141 – 422X
© Wilolud Journals, 2012 http://www.wiloludjournal.com
Printed in Nigeria doi:10.5707/cjfst.2012.6.2.38.42

PRELIMINARY DATA ON THE NUTRITIONAL POTENTIALS OF THE LARVAE OF EDIBLE DUNG BEETLE CONSUMED IN PAIKORO LOCAL GOVERNMENT AREA OF NIGER STATE, NIGERIA

Paiko, Y. B., Dauda, B. E. N., Salau R. B., and Jacob J. O.
Department of Chemistry, Federal University of Technology, P.M.B. 65, Minna,

ABSTRACT
In this study, the proximate composition of the larvae of dung beetle (*Aphodius rufipes*), a traditional delicacy of the Gbagyi people in Niger State was carried out. The larvae contained 3.25, 2.74, 22.42, 30.50 and 13.07 % moisture, ash, crude protein, crude lipid and carbohydrate respectively. Fourteen fatty acids were identified with saturated and unsaturated acids constituting 90.21 and 77.78 % respectively. The insect was found to be a good source of minerals such as Na, K, Ca, Mg and phosphorus. Results show that larva of dung beetle contain 20.41 % and 24.17 % of both essential and non-essential amino acids with Leu/Ile ratio of 1.14. The insect larva could serve as an alternative source of protein and other nutritional supplements in human and animal diet.

KEYWORDS: proximate composition, dung beetle, essential and non-essential amino acids, mineral composition.

INTRODUCTION

Insects have played important roles in the history of human nutrition in Africa and other parts of the world. There are over 1,400 recorded edible insects (FAO, 2008). Entomophagy (the habit of eating insects as food) is an old and well-established custom in many parts of the world (Sutton, 1988). In Nigeria, entomophagy has contributed significantly to the reduction of protein deficiencies[3]. Insects commonly consumed include termites, caterpillars, grasshoppers, crickets, larvae and pupae of beetles and the African silkworm (Fasoranti and Ajiboye, 1993).

The larva of dung beetle (*Aphodius rufipes)* is one of the commonly consumed insects in Paikoro Local Government Area of Niger State. Dung beetles have the affinity for the dung of cows, horses and sheep. The females lay eggs into the dung and develop into the larva which burrows into the ground before entering the pupa stage. It is this larval stage that is often consumed as a delicacy. It is commonly consumed boiled, smoked or fried and served as snacks or taken with carbohydrate foods. Although, the nutritional values of some species of dung beetles have been reported to contain high protein content (Hanboonsong, 2003), no sufficient data on their fatty acid and amino acid profiles have been reported. The present study aims at investigating the nutritional qualities of the larva of dung beetle by determining, proximate, mineral and fatty acid as well as the amino acid profile of this insect.

MATERIALS AND METHODS

Sample collection and analysis

The larvae of dung beetles were harvested under several cattle dungs at Tutungo village in Paikoro Local Government, Niger State, Nigeria. Their abdomen were pierced to remove the faeces and then washed in hot distilled water. They were sun-dried for 72 hours and finally milled into powder and stored in air tight containers prior analyses.

The moisture, ash, crude fat and crude fiber contents were determined using the methods of Official Analytical Chemist (AOAC, 2000). Crude protein was determined by Kjeldahl method as described by Pearson (Pearson, 1976). Carbohydrate content was obtained by difference and all determinations were done in triplicate. Sodium and potassium were determined using Gallenkamp flame analyzer, while calcium, magnesium, iron, manganese, zinc copper and lead were determined using Bach 211 atomic absorption spectrophotometer. Phosphorus level was determined using the phosphovanado molybdate colorimetric method and read on JENWAY 6100 Spectrophotometer (Pearson, 1976). The fatty acid analysis was carried out at the NARICT research laboratories, Zaria, Kaduna State, Nigeria. The oil in the sample was extracted using Folch's method (chloroform: methanol mixture). The extracted fat was hydrolyzed and the fatty acids converted to their fatty

acid methyl derivatives. The constituent fatty acids and their concentrations were determined using GC/MS. Amino acid analysis was carried out at the research laboratory of the Department of Food Science, University of Malasia using WATERS 1525 binary HPLC with multiwavelenght fluorescence detector.

RESULTS AND DISCUSSION

The result of the proximate chemical composition of the larva of dung beetle is presented in Table 1. The moisture content is low (3.25 ± 0.1 %) which may be advantageous in view of the sample's shell life. Moisture content as high as 8.6 ± 0.1 % and 10.85± 0.38 % have been reported in edible ants (Subhachai *et al*., 2009) and larva of *Cirina forda* (Omotoso, 2006), respectively.

The result shows that dung beetle is rich in crude protein (22.42 ± 0.1 %). Similar high crude protein content has been observed (35.18 ± 0.1, 33.41 ± 0.20 and 36.45 ± 0.2 %) in *I. belina, M. bellicosus* (Ekpo *et al*., 2009) and *O. monoceros* (Ife and Emeruwa, 2011). Thus dung beetle could contribute to the recommended daily protein requirement of 23 - 56 % stipulated by National Research Council (NRC, 1980). The ash content averaged 2.74 ± 0.1 % which is lower than values obtained from termites (Ajakaiye and Bawo, 1990). Similar value of 4.0% had been obtained (Ife and Emeruwa, 2011). Crude fat content (30.5 ± 1.2 %) recorded is higher than the value of 17.65 ± 3.24 % in *Z. variegatus.* The value is however similar to 34.0 % from the larva of *O. monoceros* obtained earlier (Ife and Emeruwa, 2011). Fats are vital in the structural and biological functioning of the cells and help in the transport of nutritionally essential fat soluble vitamins. Similar fat content of 31.46 ± 0.57 and 31.72 ± 0.33 % have been obtained for *M. bellicosus* (Ekpo *et al*., 2009) and *Z. variegatus* respectively (Adenire and Aiyesimi, 1999). The carbohydrate content (13.07 %) is higher than the values from *Z. variegatus* (9.68 %). Carbohydrate content of 12.4 ± 1.1 and 15.05 ± 0.1% have been documented for sun-dried edible ants (Subhachai *et al*., 2009) and the larva of *O. monoceros* (Ife and Emeruwa, 2011). The crude fibre content of the larva of dung beetle is high (28.12 ± 0.20 % which is very similar to values of 26.4 ± 1.4 % for edible black ants (Subhachai *et al*., 2009). Lower crude fibre content has (13.12 ± 0.15 and 14.13 ± 0.20 %) have been observed in *Periplaneta America* and *Componotus* sp (Aiyesimi and Oguntokun, 1996). The high crude fibre from this insect can be used to complement animal roughages. The calculated energy value is high although it is lower than the values of 2600 and 2172kJ/100g from the larva of edible stink-bug (Teffo et al., 2007). The mineral composition is shown in Table 2. The results show that phosphorus has the highest concentration (131.20 mg/100g), while zinc has the lowest value of 0.70mg/100g. Sodium and potassium have values of 129.0 and 92.5 mg/100g respectively. The average value of calcium is 42.16 mg/100g which is similar to the value of 47.8 mg/100g reported for the red ant *Atta cephalotes* (Mann, 1993). Magnesium and iron content were 11.72 ± 0.02 and 30.85 ± 0.31mg/100g respectively. The iron content is higher than the value of 1.8mg/100g of iron in Silk worm Bombyx mori (Dunkel, 1996). With this high iron content the larva is good for human consumption. It can be consumed along with other foods rich in essential minerals.

The amino acid profile is shown in Table 3. The results suggest that the larva is rich in essential amino acids, leucine, valine, lysine and phenylalanine.The total essential amino acid is 20.41 while the total non-essential amino acid is 24.17 g/100g representing 45.78 and54.42 % respectively. The larva is also rich in aspartic, glutamic, alanine, arginine and glycine. Cereal based diets common with low income earners could receive a boost with the inclusion of this insect in their diets.

Table 4 shows the fatty acid composition of the lipid fractions of the dung beetle larvae. The major saturated fatty acids are lauric, myristic, palmitic and stearic, while the major unsaturated fatty acids are elaidic, arachidonic and butanedioc acids accounting for 21.46, 14.14 and 20.98 % of the total unsaturated acids respectively. The ratio of total unsaturated fatty acids to total saturated fatty acids (TUFA/TSFA) is 0.86 which is in agreement with the findings that a TUFA/TSFA ratio as high as 0.8 is associated with desirable level of cholesterol and reduced coronary heart problems (Mann, 1993). The presence of both saturated and unsaturated fatty acids in the dung beetle larva could be an advantage since both may complement the function of one another.

CONCLUSION

The results obtained from this work reveals that the larva of dung beetle is a good source of protein and minerals. It contains high amount of fat, carbohydrate and crude fibre with reasonable levels of amino acids and fatty acids. It may be recommended for consumption by economically weaker low income earners.

Table 1. Proximate composition (%) of the larva of Dung beetle

Parameter	Concentration
Ash	2.74 ± 0.10
Moisture	3.25 ± 0.01
Crude protein	22.42 ± 0.10
Crude fat	30.50 ± 1.20
Crude fiber	28.12 ± 0.20
Carbohydrate (by difference)	13.07 ± 0.00
Energy (kJ/100g)	1731.83

*All given values are means ± SD of three determinate

Table 2. Mineral Composition (mg/100g) of Dung Beetle Larva

Mineral	Concentration
Sodium	129.00 ± 0.00
Potassium	92.50 ± 1.20
Calcium	42.16 ± 0.10
Magnesium	11.72 ± 0.02
Iron	30.85 ± 0.31
Manganese	3.70 ± 0.10
Zinc	0.70 ± 0.00
Lead	1.50 ± 0.20
Phosphorus	131.2 ± 0.01
K/Na ratio	0.72 ± 0.01
Ca/P ratio	0.32 ± 0.00

*All values are means ± SD of three determinations

Table 3. Amino acid Profile of the Larva of Dung Beetle

Amino acid	Composition (g/100g)
Valine	2.64
Tryptophan	2.75
Threonine	1.96
Histidine	1.21
Methionine	1.88
Lysine	2.61
Leucine	2.66
Isoleucine	2.33
Phenylalanine	2.38
Asparrtic acid	3.88
Serine	2.45
Glutamic acid	5.57
Glycine	3.35
Alanine	3.09
Arginine	2.46
Proline	2.81
Total essential amino acid (TEAA)	20.41
Total non-essential amino acid (TNEAA)	24.17
% TEAA	45.78
%TNEAA	54.42
TEAA / TNEAA	0.84
Leu / ile	1.14

Table 4. Fatty acid Composition of Dung Beetle Larva

Fatty acid	Trivial name	Composition (%)
Dodecanoic acid	Lauric	2.10
Mehyl tetradecanoate	Myristic	3.69
Pentadecanoic acid	-	3.52
Octacosanoic acid	-	4.84
Hexadecanoic acid	Palmitic	17.13
9- Octadecenoic acid	Elaidic	16.69
Octadecanoic acid	Stearic	2.98
13- Octadecenal	-	22.83
Arachidonic acid	-	11.0
Eicosanoic acid	-	18.49
Docosanoic acid	Behenic	5.45
Tetratetracontane	-	7.92
Butanedioc acid	-	16.32
Tetracosanoic acid	-	22.58

REFERENCES

Adenire, C. O and Aiyesimi, A. F. (1999). Proximate and mineral composition of the adult and immature forms of the variegated grasshopper. *Bioscience Research Communications*. 11, 121-126

Aiyesimi, A. F and Oguntokun, M. O (1996). Nutrient composition of *Dioclea reflexa* seeds- an underutilized edible legume. *Revista Italiana delle Sostanze Grasse*. 75, 521-523.

Ajakaiye, C. O. and Bawo, A, (1990). Comparison of the chemical composition of *Trinervitermas germinatus* with that of its feed, *Nigerian Journal of Entomology*. 2, 90-95.

AOAC (2000). Official methods of Analysis of the Association of Official Analytical Chemist ,17th edn. Edited by W. Hqrwitz. Association of Official Analytical Chemist, Arlington.

Dunkel, D. (1996). Nutritional values of various insects per 100 grams. *The Food Insect Newsletter.* 9.1-8.

Ekpo, K. E, Onigbinde, A. O and Asia, I. O (2009). Pharmaceutical potentials of the oils of some selected insects consumed in Southern Nigeria. *African Journal of Pharmacy and Pharmacology.* 3 (2), 51-56.

FAO (Food and Agricultural Organization) (2008). Forest insects as food: Humans bite back. *Forest News.* 22(1).

Fasoranti, J. O. and Ajiboye, D. O. (1993). Some edible insects of Kwara State, Nigeria. *American Entomologist.* 39 (2),113- 116.

Hanboonsong, Y. (2003). The dung beetle fauna (*Coleoptera scarabaeidae*) of Thailand. Reasearch Report from the National Institute for Environmental Studies, Japan. 175, 249 – 258

Ife, I. and Emeruwa, C. H (2011). Nutritional and anti-nutritional characteristics of the larva of *Oryctes monoceros. Agriculture and Biology Journal of North America.* 2 (1), 42-46.

Mann, J. (1993). Diseases of the heart and circulation: the role of dietary factors in aetiology and management: In: Human nutrition and Dietetics, eds J. S. Garrow and W.P.T. James Churchill, Livingstone, London. 619-622. NRC (National Research Council) (1980). Recommended Dietary Allowances. 9th edn. Nat. Acad. Sci. Washington DC.

Omotoso, O. T. (2006). Nutritional quality, functional properties and anti-nutrient compositions of the larva of *Cirina forda* (Westwood). *Journal of Zhejiang University Science B.* 7 (1), 51-55.

Pearson, D. (1976). Chemical Analysis of Foods. 7th Ed. Churchill, Livingstone, London. 7-11

Subhachai, B. Oranut, S. Lirong, S. and Duo, L. (2010). Nutritional and fatty acid profiles o sun-dried edible black ants (*Polyrhachis vicina* Roger). *Maejo International Journal of Science and Technology*. 4 (1), 101-112.

Sutton, M. O. (1988). Insects as food: Aboriginal Entomophagy in the great basin. Paper No. 3 Ballena Press, Menio Park, California, pp 1 – 11

Teffo, L. S., Toms, R. B. and Eloff, J. N (2007).Preliminary data on the nutritional composition of the edible stink-bug consumed in the Limpopo province, South Africa. *S. Afric J. Sci*. 103, 11-13.

Received for Publication: 24/07/2012
Accepted for Publication: 14/09/2012

Corresponding author
Jacob J. O.
Department of Chemistry, Federal University of Technology, P.M.B. 65, Minna,
Email: jacobasol@yahoo.com