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Original article

CHEMICAL COMPOSITION AND FATTY ACID PROFILE OF EDIBLE LARVA OF *CIRINA FORDA* (WESTWOOD)

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SUMMARY

The nutrient composition of the larva of Cirina forda (Westwood) was determined. It contained 33.12 (0.87 g/100g crude protein, 9.40 (0.16 g/100g crude fibre, 12.24 (18 g/ 100g fat, 7.12 (0.32 gl 100g ash, 38.12 (0.65 g/ 100g carbohydrate and gross energy value of 359 (2.83 Kcal/ 100g. The larva is an excellent source of minerals and a 100-g dry sample contained phosphorus (1090mg), zinc (8.6mg) iron (64.0mg) potassium (2130mg) and sodium (210mg). The fatty acid profile of Cirina forda larva is characterized by a very high proportion of the polyunsaturated fatty acids, linoleic acid and (-linolenic acid (53.8%) which is higher than the percentages found in poultry (23.7%) and fish (30.8%) Mono unsaturated fatty acids content was 14.6% while saturated fatty acid constituted 31.6%. The dietetic significance of the polyunsaturated saturated fatty acid ratio of 1.7:1 and the high potassium and low sodium content of Cirina forda larva is discussed.

Key words: Insect larva, nutrient composition, fatty acid profile

Edible insects are important dietary components in many developing countries. Insects commonly consumed include locusts, termites, grasshoppers, weevils and various caterpillars (Ene, 1963). Many studies have shown that edible insects contain appreciable amounts of proteins of good quality and high digestibility (Ashiru, 1988; De Foliart 1989; Ramos - Elorduy et al 1997). They have also been found to be rich sources of fat, vitamins and minerals, especially iron and zinc (Oliveira et al 1976; Malaisse and Parent 1980; Kokondi 1987). Phytophagous insects such as lepidopterous larvae have been reported to contain appreciable amounts of the polyunsaturated fatty acids (Fast, 1970).

Cirina forda (Westwood) is an insect pest of *Butyrospernum paradoxum*, the sheabutter tree. The larvae of this insect are processed into the dried form which is widely marketed and consummed as an essential ingredient in vegetable soups (Fasoranti and Ajiboye, 1993). There is little information on the nutrient composition, especially the fatty acid profile of this larva. Such composition data would be very useful for food consumption studies, in updating food composition tables and in diet therapy. The purpose of this study was to determine the proximate and mineral composition and the fatty acid profile of *Cirina forda* edible larva.

MATERIALS AND METHODS

Sample Collection

Larvae of *Cirina forda* were handpicked from sheabutter trees in Bida, Niger, State of Nigeria. The live samples were transported to the laboratory for confirmation of identity at the Department of Crop Protection and Environmental Biology, University of Ibadan, Ibadan.

Analysis

The insect larvae were killed by freezing (Finke *et al*, 1989). The frozen samples were then allowed to thaw at room temperature and dried in an oven at 60^0C for 72 hrs to remove the body hairs. They were milled and stored in air tight containers for subsequent analysis.. the moisture, crude fat and crude fibre (structural carbohydrate) contents were determined using the methods the Association of Official Analytical Chemists (AOAC, 1995). The carbohydrate value was obtained by difference and all determinations were done in triplicate. The spectrophotometric method of Garcia et al (1998) was used for mineral estimation. Sodium and potassium were determined by flame photometry while phosphorus level was determined using the phosphovanado molybdate method (AOAC, 1995). The fatty acid analysis was carried out at the Shiiiker laboratories, Illinois, United States of America using AOAC method (AOAC, 1995). The oil in the sample was extracted using chloroform: methanol mixture. The extracted fat was hydrolysed and the fatty acids converted to their methyl ester derivatives. The constituent fatty acids and their concentrations were determined by gas chromatography.

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RESULTS AND DISCUSSION

The proximate chemical composition of the larva of *Cirina forda* (Westwood) is presented in Table 1. The result shows that the larva is a good source of protein, fat and ash. The crude protein content of 33.12% falls within the protein range of 15-60% previously reported for various forms of lepidopterous edible insects from the State of Oaxaca, Mexico (Ramos Elorduy et al., 1997). Work is in progress to evaluate other protein quality indices and elucidate the composition of the carbohydrate by difference.

Table 1:
Chemical Composition of *Cirina forda* larva (g/100g dry matter).

Protein	33.12 ± 0.87
Fat	12.24 ± 0.18
Ash	7.12 ± 0.32
Crude fibre	9.40 ± 0.16
Carbohydrates (by difference)	38.12 ± 0.65
Energy (Kcal/100g)	359.00± 2.83

Values are means ± SD of triplicate determinations.

The gross energy value of 359 ± 2.83 Kcal/100g is much lower than 611 Kcal/100g obtained for the larva of *Anaphe venata* in Nigeria (Ashiru, 1988) and the average of 457 Kcal/100g dry matters for twenty three species of saturniidae larva in Zaire (Malaisse and Parent, 1980). The difference in energy values between *Cirina forda* larva and those cited in literature could be attributed to differences in composition of the larvae, especially the fat content and other calorigenic components of the larvae.

The crude fibre (9.40 ± 0.16g/100g) in the larva of *Cirina forda* could be due to chitin found normally in insects. The crude fibre content of 9.40 ± 0.16/100g and the ash content of 7.12 ± 0.32g/100g were similar to data in the literature (Ramos – Elorduy 1997, Bergeron *et al.*, 1988). The mineral composition of the larva of *Cirina forda* is shown in Table 2.

The larva is a good source of mineral elements with a 100-g dry sample containing magnesium (32.4mg) zinc (8.6mg) iron (64.0mg) and phosphorus (1090mg). The consumption of 100g dry larva would provide 100%, 355%, and 57% of the Recommended Dietary Allowances of phosphorus, iron and zinc respectively (food and Nutrition Board, 1980). The sodium and potassium levels in the larva are 210mg/100g and 2130mg/100g, respectively, resulting in potassium to sodium ratio of approximately 10:1. This favourable potassium/sodium ratio renders the larva of *Cirina forda* a potential component of diets for the management of hypertension. Potassium intake has been found to lower blood pressure by antagonizing the biological effect of sodium (Einhorn and Landsberg, 1988).

Table 2.
Mineral Composition of larva of *Cirina forda* (mg/100g dry matter)

Element	***Composition***
Calcium	7.0
Potassium	2130
Magnesium	32.4
Phosphorus	1090
Sodium	210
Iron	64
Zinc	8.6
Manganese	7.0

Table 3 shows the fatty acid profile of the larva of Cirina forda. The major fatty acids present are palmitic, stearic, oleic, linoleic and (-linolenic. Saturated fatty acids account for 31.6% of the fat. This figure is comparable to 35.5% and 29.6% reported for poultry and fish respectively but lower than 52.0% and 44.1% reported for beef and pork respectively (De Foliart, 1991). Saturated fatty acids found in the larva included palmitic acid (13.0%), stearic acid (16.0%) and myristic acid (0.7%). Palmitic acid as well as myristic acid have been demonstrated to raise low density lipoprotein (LDL) cholesterol and are therefore considered atherogenic (Willett and Sacks, 1991). However, stearic acid which constitutes nearly 50% of the saturated fatty acid in the larva has been shown not to raise plasma LDL cholesterol (NRC, 1988); Bonamone and Grundy, 1987).

Unsaturated fatty acids constitute 68.6% of the total larva fattty acid and 14.6% of this are monounsaturates. Oleic acid accounts for 95% of the monounsatureates and has been shown to be hypocholesterolemic (Mensink and Katan, 1989). The larva contains a high amount of polyunsaturates,(-linolenic acid (45.3%) and linoleic acid (8.1%). Ratio of polyunsaturated to saturated fatty acids (P/S) has been used widely to indicate the cholesterol lowering potential of a food. A P/S ratio of 0.2 has been associated with high cholesterol level with high risk of coronary heart disorders while a ratio as high as 0.8 is associated with desirable levels of cholesterol and reduced coronary heart diseases (Mann, 1993). The P/S ratio of 1.7 in *Cirina forda* larva tends to suggest that the larva has the potential of being used in the dietetic management of certain coronary heart diseases.

The results of this study show that the larva of *Cirina forda* (Westwood) has the potential to provide substantial amounts of proteins, minerals and polyunsaturated fatty acids to the diet of low income people whose diets are usually deficient in animal protein. Also, the larva has a high potassium-sodium ratio (10:1)" and a high polyunsaturated to saturated fatty acid ratio (P/S 1.70). Further studies are needed to establish the nutritional and health benefits of these nutrient ratios found in the larva of *Cirina forda* (Westwood).

Table 3
Fatty acid composition of the larva of *Cirina forda*

Fatty acid	% Composition
Butyric	< 0.1
Caproic	< 0.1
Caprylic	< 0.1
Capric	< 0.1
Undecanoic	< 0.1
Lauric	< 0.1
Tridecanoic	< 0.1
Myristic	0.7
Pendadecanoic	0.3
Palmitic	13.0
Margaric	1.1
Stearic	16.0
Nonadecanoic	< 0.1
Eicosanoic	< 0.1
Behenic	< 0.4
Tricosanoic	< 0.1
Trignoceric	< 0.1
Myristoleic	< 0.1
Pentadenoic	< 0.1
Palmitoleic	0.2
Margaroleic	0.4
Oleic	13.9
Elaidic	< 0.1
Gadoleic	0.1
Erucic	< 0.1
Nervonic	< 0.1
Linoleic	8.1
(-Linolenic	45.3
Gamma linolenic	0.2
Eicosadienoic	0.2
Ecosatrienoic	< 0.1
Homogamma linolenic	< 0.1
Arachidonic	< 0.1
Eicosapentanoic	< 0.1
Docosadienoic	< 0.1
Docosahexanoic	< 0.1
Total Saturated Fatty Acid (SFA)	31.60
Total Monounsaturated Fatty Acid (MUFA)	14.60
Total Polyunsaturated Fatty acid (PUFA)	53.80

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