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Nutritional Potential of *Oryctes rhinoceros* larva

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Abstract: The proximate and mineral profiles of the larva of *Oryctes rhinoceros* were investigated. The fatty acid profile of the larval oil and the amino acid profile of the larval protein were also determined and from the latter, the protein score was evaluated. A high protein content (42.29% wet weight) rich in the essential amino acids (with histidine, methionine and phenylalanine being predominant) with a protein score of 72.97% and valine as the limiting amino acid was observed. The larval oil had a high proportion (60.34%) of unsaturated fatty acids, including the essential fatty acid linoleic acid. A high ash content (12.70% wet weight) containing a high proportion of manganese and iron (3.80 mg 100 g^{-1} and 10.70 mg 100 g^{-1}, respectively) was observed. The other mineral elements, calcium, magnesium, potassium, sodium, copper and phosphorus were only present in small concentrations (0.20-0.99 mg 100 g^{-1}). The larva could form a base for new food/feed products of considerable nutritive value, especially in view of its high protein content.

Key words: *Oryctes rhinoceros* larva, larval protein and oil, nutritive value

Introduction

Oryctes rhinoceros, so called because of its resemblance to the rhino is primarily a pest of coconut in most part of the world, especially in Southern Asia, but in Africa, Nigeria in particular; it lives and feeds mostly on oil and raphia palms. While the adults attacks the palm tree, the larvae are harmless, feeding only on decaying organic matter such as decaying palm logs, manure, rubbish dumps etc. Usually, when left to decay, old stems of coconut, raphia and oil palms, provide excellent breeding sites or grounds for *Oryctes rhinoceros*. The larva, also called grub, is called osori by the Ijaws, tam by the Ogonis and utukuru by the Ibos, all of Southern Nigeria. It is either eaten raw, boiled, smoked or fried. It may be consumed as part of a meal or as a complete meal. The present study was aimed at evaluating the nutritional components of the larva, with a view to revealing any possibility of its use as a base for the formulation of new food/feed products.

Materials and Methods

Live larvae of *Oryctes rhinoceros* were collected from coconut palms in Oyigbo town in Rivers State, Nigeria. They were transported to the laboratory together with their wet/moist feed of coconut palm pit in a well ventilated container and were used within 24 h of collection.

Proximate analysis of the samples was carried out in triplicate, according to standard methods (AOAC, 1984) in order to determine the moisture, crude protein, ash, crude fat and total carbohydrate while the energy value was calculated using the factors 4, 9 and 4 for protein, fat and carbohydrate respectively (Chaney, 2006a). The mineral composition was determined as described by AOAC (1984). The method described by Ige *et al.* (1984) was modified for the preparation of protein concentrate. Sample powder was defatted by the Soxhlet method using petroleum ether (60-80°C). 600g of the defatted flour was suspended in distilled water at room temperature (29±1°C) and at a powder-solvent ratio of 1:10. The slurry was stirred for 1h. After adjusting the pH of the slurry, the extraction was then allowed to continue with occasional shaking for 12 h while maintaining the pH. The slurry was then centrifuged at 8000 rpm for 30 min. The extraction was repeated on the residue and supernatant was precipitated by drop-wise addition of 0.1 MHCl. The precipitate formed in each case was centrifuged at 8000 rpm for 30 min. The curd obtained was reslurried in distilled water and spray dried. The spray dried sample was used as protein concentrate. Samples were hydrolyzed in consistent boiling hydrochloric acid for 22 h under nitrogen flush. The amino acid profile of the protein concentrate was determined using a Technicon Sequential Mutlisample Amino Acid Analyzer. Then the chemical score of the protein was determined by comparison with WHO reference protein pattern (WHO, 1975). Oil was extracted from the larva, according to the method described by Aremu *et al.* (2007). Oven dried sample was extracted in Soxhlet apparatus with chloroform-methanol mixture (2:1) for 20h under nitrogen atmosphere. Solvent was removed under reduced pressure in a rotary evaporator. Toluene was added to ensure removal of any water through azeotropic distillation with toluene. The fatty acid profile of the oil was determined by gas liquid chromatography, using a Pye Unican Series 104 GCD equipped with flame ionization detector and connected to a Hitachi model 056 recorder (Hitachi Ltd., Tokyo, Japan), at PZ Nigeria limited, Aba, Nigeria.

Statistical analysis: Data obtained were presented as mean ± SD (where possible) and analyzed by simple percentages.

Results and Discussion

The proximate profile of *Oryctes rhinoceros* larva is given in Table 1. The moisture content is higher than that reported for caterpillar, but lower than those for termite, cow milk, egg (FAO, 1972; Singh, 2004) and *Rhynchophorus phoenicis* (Ekpo and Onigbinde, 2005). This high moisture content portends a short shelf life for the *Oryctes rhinoceros* meal. Moisture content of food is usually used as a measure of the stability and susceptibility to microbial contamination (Frazier and Westoff, 1978; Scott, 1980). Therefore, dehydration would generally improve the shelf life/preservation of the larva and, in addition increase the relative concentrations of the other food components. Relatively high ash content was observed for the larva, when compared with reported values for meats, meat products, poultry (Watt and Merril, 1963) and egg (Singh, 2004). Insects are known to be rich sources of various macro and trace elements. These elements are probably accumulated for future use in adult exoskeletal and connective tissue formation. The crude protein content observed here for *Oryctes rhinoceros* larva is higher than those reported for cow milk, egg, termite, *Rhynchophorus phoenicis* and beef (FAO, 1992; Pyke, 1979; Mayhew and Penny, 1988; Singh, 2004; Ekpo and Onigbinde, 2005), but lower than those of caterpillar and locust (FAO, 1972; Mayhew and Penny, 1988). The implication of this high protein content is that the larval meal can contribute significantly to the daily protein requirements of humans, which is about 23-56 g (NRC, 1974; Chaney, 2006a). The larva has higher total carbohydrate content, compared to the reported values for *Rhynchophorus phoenicis*, caterpillar, termite, cow milk and egg (FAO, 1972; Singh, 2004; Ekpo and Onigbinde, 2005).

The mineral profile of *Oryctes rhinoceros* larva is given in Table 2. It is rich in manganese and iron. The former is a component of arginase and pyruvate carboxylase, while the latter is a component of hemoglobin, myoglobin, cytochromes, non-heme proteins, myeloperoxidase, etc. (Chaney, 2006b). The iron content of the larva can augment the daily requirements for iron and manganese. The larva has a low content of calcium, magnesium, potassium, sodium, copper and phosphorus. This implies that diets based on this larva will be inadequate for growing children, older women and individuals prone to osteoporosis and colon cancer (Nelson, 1987), unless supplemented with these mineral elements or foods rich in them. Furthermore, the low calcium to phosphorus ratio (0.133) portend danger, since according to Shils and Young (1988), phosphorus rich-calcium low diets are associated with increased loss of calcium in the bones. The amino acid profile and chemical scores of the protein are given in Table 3-4 respectively. It is rich in the essential amino acids, especially histidine, methionine and phenylalanine and may well meet the minimum daily requirements (WHO, 1975; McGilvery and Goldstein, 1983). In comparison to the WHO reference protein pattern (WHO, 1975), the limiting amino acid of the protein is valine, giving it a protein score of 72.97%. This implies that while diets formulated from this protein may need to be fortified with valine, it could serve as a rich source of arginine, especially for growing children, for whom, according to Voet *et al*. (2006), arginine is essential. This proteins chemical score is higher than that of caterpillar (FAO,

Table 1: Proximate composition of *Oryctes rhinoceros* larva

	Composition		
Parameter	Wet weight	Dry weight	Lean weight
Moisture (%)	16.73±0.49	-	-
Crude fat (%)	0.55±0.10	0.66±0.12	-
Ash (%)	12.70±0.81	15.25±0.97	15.35±0.98
Crude protein (%)	42.29±0.84	50.79±1.01	51.13±1.02
Total carbohydrate (%)	27.73±0.50	33.30±0.60	33.52±0.60
Total metabolizable energy (kcal 100 g^{-1})	285.03	342.30	338.60

Values are means ± SD of triplicate determinations

Table 2: Mineral profile of *Oryctes rhinoceros* larva

Mineral	Composition, mg 100 g^{-1}
Calcium	0.01
Magnesium	0.04
Potassium	0.15
Sodium	20.29
Manganese	2.31
Iron	4.50
Copper	2.61
Phosphorus	0.10

Values are means of duplicate determinations

Table 3: Amino acid profile of *Oryctes rhinoceros* larva's protein

Amino acid	Composition, g 100 g^{-1} protein
Lysine*	4.42
Histidine*	3.82
Arginine	8.16
Aspartate	7.73
Threonine*	3.34
Serine	3.70
Glutamate	15.60
Praline	5.00
Glycine	4.72
Alanine	5.25
Cysteine	2.02
Valine*	3.51
Methionine*	1.93
Isoleucine*	3.99
Leucine*	5.30
Tyrosine	3.09
Phenylalanine	4.60

*Essential amino acids

Table 4: Comparison of *Oryctes rhinoceros* larva protein with WHO reference protein pattern (WHO, 1975)

Amino acid	Reference Pattern, g 100 g^{-1} protein	Chemical score (%)
Lysine	5.17	85.49
Histidine	1.77	215.82
Threonine	3.47	96.25
Valine	4.81	72.97
Methionine	1.53	126.14
Isoleucine	4.19	95.23
Leucine	7.03	75.39
Phenylalanine	3.01	152.83

Table 5: Fatty acid profile of *Oryctes rhinoceros* larval oil

Fatty acid	Composition (%)
Palmitic acid	36.86
Stearic acid	2.80
Myristoleic acid	N.D.
Palmitoleic acid	9.30
Oleic acid	48.84
Linoleic acid*	2.20
Linolenic acid*	N.D.

Values are means ± SD of duplicate determinations. *Essential fatty acids. N.D. = Not detected

Table 6: Degree saturation of *Oryctes rhinoceros* larva oil

Component	Composition (%)
Total saturated fatty acid	39.66
Total unsaturated fatty acid	60.34
Monounsaturated fatty acid	58.14
Polyunsaturated fatty acid	2.20

1972), comparable to that of soy bean (WHO, 1975) and lower than those of human milk, egg, cow milk and beef (FAO, 1972; WHO, 1975). The fatty acid profile of the larval oil is given in Table 5. The proportion of unsaturated fatty acid in the oil (Table 6), is higher than the reported values for lard, cocoa butter, palm oil and coconut oil, but less than those of castor oil, almond oil, olive oil, groundnut oil, cotton oil, cod liver oil and amaranth oil (Evans, 2005; Martirosyan *et al*., 2007). The high content of unsaturated fatty acids has two implications:

Firstly, it means that the oil is safe for consumption by individuals predisposed to dyslipidemia, diabetes mellitus and cardiovascular diseases. Reduction in the consumption of saturated and an increase in unsaturated fatty acids prevents and/or reduces the severity of lipid metabolism (Holub and Holub, 2004; Martirosyan *et al*., 2007), since unsaturated fatty acids lower serum cholesterol and triglyceride levels (Holub and Holub, 2004; Chaney, 2006a) this is more so, when a part of the unsaturated fatty acids in question is the essential fatty acid, linoleic acid (Maimanee *et al*., 1999). Secondly, it portends a high propensity for spoilage. The higher the degree of unsaturation of any oil, the higher its tendency to develop rancidity on keeping, due to peroxidation.

Finally, our results show that *Oryctes rhinoceros* larva is a rich source of good protein, energy, iron and relatively rich and safe oil; especially in view of the fact that insect oils have very low cholesterol contents.

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