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Nutritional Potentials of the Larva of *Rhynchophorus phoenicis* (F)

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Abstract: Proximate and chemical analyses was carried out on the larva of *Rhynchophorus phoenicis* (F) and the observed results used to assess it nutritionally. A high fat content (25.30±0.20% wet weight) rich in the essential fatty acids was observed, while all the essential amino acids were detected in varying amounts in the protein component. Macro-elements like sodium (773.49±1.02 mg/100g), calcium (60.81±0.32 mg/100g) and potassium (26.65±0.24 mg/100g) as well as micro-elements like copper (1.26±0.04 mg/100g), cadmium (0.039±0.022 mg/100g) and zinc (10.57±0.89 mg/100g) were present in significant amounts in the insect larva. The insect larva could form a base for new food /feed products of considerable nutritive value, especially if some level of defatting is done to further increase the relative proportion of the protein component.

Key words: Nutritional potentials, *Rhynchophorus pheonicis* (F) Larva

Introduction

The larva of the beetle *Rhynchophorus phoenicis* (F) popularly known as "Edible worm" is a delicacy in many parts of Nigeria and other countries in Africa where it is found. The larva is known by various names by the different ethnic groups in Nigeria (Table 1) who strongly believe it to have high nutritive as well as certain pharmaceutical potentials. The mode of preparing it for eating differs from one geographical locality to another. In some places, it is boiled (Ilesha) while others smoke, fry or simply eat it raw (Ibibio's in Akwa Ibom State, and Ibos in Anambra state). It may be consumed as part of a meal or as a complete meal with Tapioca or bread (Urhobo's in Delta state,). Some tribes (Urhobo's and Isoko's, both in Delta state) strongly recommend it to their pregnant women, probably as a source of essential nutrients (Ekpo, 2003). The use of the larva of *Rhynchophorus phoenicis* is believed to extend beyond the nutritional value. Traditionally, many claim that the larva has medicinal properties. For example, the Itsekiri's in Delta state believe that the live larva could cure a certain ailment in infants which presents such symptoms as the twitching of the hands and feet, restlessness and other such movements. To effect a cure for these conditions, the larvae are left in water which is then used to wash the child for several days at the end of which the larvae are crushed together with alligator pepper and administered orally to the child. The biochemical basis for this treatment is not known.

Evaluation of the nutritive value of this larva becomes important as the insect larva could form a base for new food/feed product of considerable nutritive value.

Table 1: The common names of *Rhynchophorus phoenicis* (F) larva as known to the various ethnic groups in Nigeria

Ethnic group (tribe and / or state	Name
Ibibio (Akwa Ibom)	Nten
Bini (Edo)	Orhu
Itsekiri (Delta)	Ikolo
Esan (Edo)	Okhin
Yoruba, Ibadan (Oyo)	Awon
Yoruba, Ilesha (Oyo)	Ekuku
Urhobo (Delta)	Edon
Isoko (Delta)	Odo
Ibo, Idemili (Imo)	Elughulu /Akpangwo
Ibo Ukwa (Anambra)	Eruru
Ibo, Ihiala (Imo)	Nza
Ibo, Aniocha (Delta)	Nzaolubu
Idomas (Benue)	Eko - Ali

Materials and Methods

Live larva of *Rhynchophorus phoenicis* (F) was collected at Illushi, a fishing terminal at the bank of River Niger in Edo State. The species were specifically identified in the Entomology Department, Nigerian Institute for Oil Palm Research (NIFOR), Benin City, Nigeria. The larvae were transported to the laboratory together with their wet/moist feed of raphia palm pith in a well ventilated plastic container and were used within twelve hours of collection.

Lipid from the larva was extracted by the method of Bligh and Dyer (1959). Moisture and ash were estimated using the method of AOAC (1999). Crude protein value was quantified using the modified Kjeldahl method of William (1964). The amino acid profile of the larval sample was determined using the method of Spackman *et al.* (1958) in a Technicon Sequential Multisample Amino Acid Analyzer (TSM). Fatty acid methyl ester (FAME) was prepared using the method of Gunstone (1969) while the GLC equipment used was a Pye

Unicam Series 104 GCD equipped with flame ionization detector (F.I.D) and connected to a Hitachi model 056 recorder (Hitachi Ltd, Tokyo, Japan). The stationary phase comprised of 10% polyethylene glycol adipate (PEGA) on acid washed and silanized chromosorb W(100-120 mesh) packed in a 1.5x4mm (I.D) glass column of length 5ft. The carrier gas (nitrogen) flowed at 35 ml/min while injection, oven and column temperature was 185^{o}C. The fatty acid peaks were identified by reference to co-chromatographed authentic fame standards (Sigma chemicals). The mineral elements in the larva were determined using an atomic absorption spectrophotometer. Carbohydrate values were determined by difference.

Results

Table 2 shows the proximate composition of *Rhynchophorus pheonicis* (F) larva. The moisture value of the larva is quite high (61.85%) while the lipid value 25.30% (wet weight) increases to 66.61% on dry weight basis. Dehydration and defatting is seen to increase the relative concentration of the other nutrients encompassed in the proximate composition.

Table 2: Proximate composition of *Rhynchophorus phoenicis* larva (% wet weight)

Nutrient	Wet weight	Dry weight	Lean weight
Moisture	61.85±0.18	-	-
Lipid	25.30±0.20	66.61±0.35	-
Protein	8.38±0.31	22.06±0.26	66.09±0.28
Carbohydrate	2.10±0.10	5.53±0.17	16.56±0.11
Ash	2.20±0.08	5.79±0.13	17.35±0.08

Results represent the mean ± SEM of three estimations.

Table 3 shows the fatty acid composition of *Rhynchophorus phoenicis* larva. Palmitic, Oleic and Linoleic acids are the major fatty acids in the larval oil which is highly unsaturated as shown in Table 4. The total unsaturated fatty acids in the larval oil is 61.10%. This value when compared to oils from most conventional sources is quite high.

Table 3: Fatty acid composition *of Rhynchophorus phoenicis* Larva (% fatty acid)

Fatty acid	% composition
Lauric (C12:0)	0.20 ± 0.03
Myristic (C14:0)	3.20 ± 0.12
Palmitic (C16:0)	32.40 ± 0.58
Palmitoleic (16:1)	3.30 ± 0.20
Stearic (18:0)	3.10 ± 0.13
Oleic (C18:1)	40.10 ± 0.72
Linoleic (C18:2)	13.00 ± 0.20
Linolenic (18:3)	3.50 ± 0.10
Arachidonic (C20:4)	1.20 ± 0.04

Results represent the mean ± SEM of three estimations

Table 5 shows the amino acid composition of *Rhynchophorus phoenicis* larva. All the essential amino acids were present in the protein portion of the larva with leucine, lysine and phenylalanine constituting the main essential amino acids.

Table 4: Degree of saturation of *Rhynchophorus pheonicis* larva oil

TUFA	61.10
TSFA	38.90
MUFA	43.40
PUFA	17.70

TUFA = Total unsaturated fatty acid
TSFA = Total saturated fatty acid
MUFA = Monounsaturated fatty acid
PUFA = Polyunsaturated fatty acid

Table 5: Amino acid composition of *Rhynchophorus phoenicis* (F) larva (g/100g protein)

Lysine	3.99
Histidine	3.44
Arginine	5.06
Aspartic acid	7.02
Threonine	3.10
Serine	3.27
Glutamic acid	12.91
Proline	2.11
Glycine	2.95
Alanine	3.05
Cysteine	2.20
Valine	2.80
Methionine	2.05
Isoleucine	3.45
Leucine	6.22
Tyrosine	2.02
Phenylalanine	4.13
Tryptophan	2.51

The mineral composition of the larva of *Rhynchophorus phoenicis* larva is shown in Table 6. Sodium, magnesium and iron were the major elements in the larva.

Table 6: Mineral composition of *Rhynchophorus phoenicis* (f) larva (mg/100g)

Fe	65.23 ± 0.15
Zn	10.57 ± 0.89
Mn	1.16 ± 0.09
Pb	0.21 ± 0.08
Cd	0.039 ± 0.022
Mg	127.16 ± 5.13
Ca	60.81 ± 0.32
Cu	1.26 ± 0.04
Na	773.49 ± 1.02
K	26.65 ± 0.24

Results represent the mean ± SEM of three estimations

Discussion

The larva of *Rhynchophorus phoenicis* is a “delicacy” and is usually used as a food supplement by those who feed on it. It is usually consumed as part of a meal or as a complete meal with bread or tapioca. When compared with conventional animal food supplements such as beef, chicken, pork and fish, which have a moisture content within the range of 40 - 70% (Watt and Merril, 1963), the larva is seen as a high moisture food supplement. The high moisture content may imply that most of the essential nutrients in the larva will be in solution and in forms that are easily available to the body when the larva is consumed as food. Dehydration would generally help to increase the relative concentrations of the other food components and in addition would improve the shelf life/preservation of the larva.

The fat content of the larva is quite high. On a dry weight basis, the lipid content of the larva (66.61 ± 0.35) is higher than the amount found in most conventional foods like beef, chicken, egg, Herring, Mackerel and milk (Pyke, 1979). This high lipid content of the larva is seen to contribute to its highly acceptable flavour when roasted or fried. Malnutrition in developing countries is as much or more, a problem of caloric deficiency as of protein deficiency (DeFoliart, 1992). The fat level implies that a 100g sample of the larva will meet the caloric needs in most developing countries (Davidson *et al,* 1973). The protein content of *Rynchophorus phoenicis* larva shown in Table 2 compares with those from most conventional protein sources (Pyke, 1979). The high protein content of the larva is suggestive of the potential of the larva being used in combating protein deficiency. If the larva is dehydrated and defatted, it can be regarded as a good source of protein (66.09 ± 0.28). A relatively high ash value is observed (Table 2) for the larva, when compared with the reported values for meats, meat products and poultry (Watt and Merril, 1963). 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 synthesis. Results of the mineral composition of *Rhynchophorus phoenicis* (F) shows that 100g sample of the insect will meet the RDA values for iron, zinc, copper, manganese, and magnesium, in most third world countries. Iron deficiency is a major problem in women diets in the developing world, particularly among pregnant women, and especially in Africa (Orr, 1986; UNACC-SN, 1993). Zinc deficiency has been known to cause poor growth and impairment of sexual development (Chaney, 1997). Vegetarians any where are at risk of zinc deficiency. The cereal based diets observed in most third world countries could receive a boost with the addition of the larva to the diets.

The level of unsaturation observed in *Rhynchophorus phoenicis* larval oil (Table 3 and 4) is higher than what is obtainable in most animal lipids, as well as for palm oil and coconut oil which are common household oils. Insect fatty acids are similar to those of poultry and fish in their degree of unsaturation (DeFoliart, 1991). Nutritionally, a high level of saturated fatty acids in foods might be undesirable because of the linkage between saturated fatty acids and atherosclerotic disorders (Rahman *et a*l.,1995). The presence of the essential fatty acids such as linoleic, linolenic and arachidonic acids in substantial amounts further points to the nutritional value of the larval oil. One implication of the high fat content in the insect larva is that it may increase susceptibility of the undefatted larva to storage deterioration via lipid oxidation (Greene and Cumuze, 1982). This may then be accompanied by increased browning reactions concurrent with reduced lysine availability (Pokorny, 1981). Another implication of the high fat content is that defatting the larva will markedly increase the relative proportions of the other nutrients encompassed in the proximate composition. This means that greatly increased protein contents can be achieved by defatting the larva, as can be seen in the protein value of the defatted larva (Table 2).

The quality of protein in food is determined by its content of the essential amino acids. All the essential amino acids were present in the protein portion of the larva (Table 5). Of particular interest is the high level of leucine, lysine and threonine observed in the insect larva. Lysine and threonine are limiting amino acids in wheat, rice, cassava and maize based diets that are prevalent in the developing world (Hill, 1970; Ozimek *et al.,* 1985),while leucine and histidine have been reported to enhance the growth of infants and young children (Cameron and Hofvander, 1980). The values of the sulphur amino acids, though not so high ,yet meet the RDA values for these amino acids. Comparing the amino acid composition of this larva with conventional animal foods indicate that the supply of some of the essential amino acids were superior to those found in these conventional foods (FAO, 1970). This insect larva may constitute a cheaper source of essential nutrients that is easily available and affordable to the natives within the localities where the insect larva are found.

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