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Research Article

Biochemical Constituents of Larvae of the Rhinoceros Beetle *Oryctes Owariensis* Beauvois (Coleoptera: Scarabaeidae) In Bayelsa State

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Abstract: Biochemical constituents of fresh and processed (dried) forms of *Oryctes owariensis* larvae were investigated in the laboratory using standard procedures stipulated by the Association of Official Analytical Chemists (AOAC). The values for the nutrient composition were higher for the fresh sample except for carbohydrates which was higher in the dried sample. Mean percentage values for moisture content was 9.34% and 3.74%; ash content: 4.73% and 2.44%; Crude protein: 41.75% and 36.86%; crude fat: 15.57% and 12.46%; crude fibre: 2.80% and 1.75%; carbohydrate: 35.15% and 46.52% respectively for fresh and dried *O. owariensis* larvae. Mineral salts and their compositions in the larvae were: calcium (48.57mg/100g and 46.39mg/100g); magnesium (270.91 mg/100g and 266.47mg/100g); sodium (97.57mg/100g and 88.68mg/100g); potassium (84.37mg/100g and 72.78mg/100g); iron (18.68mg/100g and 15.85mg/100g); manganese (5.92mg/100g and 6.67mg/100g); zinc (6.95mg/100g and 4.87mg/100g), phosphorus (93.86mg/100g and 76.94mg/100g) and copper (0.85mg/100g and 0.76mg/100g) in both the fresh and dried larval samples. The mineral content of the fresh form of the larvae were more than those of the dried larvae. The phytochemical analysis of the samples revealed the presence of alkaloids (2.35mg/100g), flavonoids (2.51mg/100g), saponin (1.49mg/100g), phenols (3.65mg/100g), oxalate (1.28mg/100g) and tannins (5.39mg/100g) respectively in the dried larval sample. The nutritional properties and the mineral composition of the larva calls for its complete utilization whether in fresh, dried or processed forms as food supplement for both livestock and humans.
Keywords: *Oryctes owariensis, owariensis.*

1. INTRODUCTION

The palm beetle (*Oryctes owariensis)* is a member of the Rhinoceros beetle family which is a major pest of palm trees such as the raphia and oil palms Ukoroije & Bawo, (2019a), occurring in many tropical regions of the world. It is an edible insect consumed in so many regions around the world because it contains high protein content, minerals and vitamins (Defoliart, 1991). The adult form of *O. owariensis* can cause extensive damage to economically important wide and palm plantation, they eat the leaves and burrow into the crown of palms where thy mate and lay their eggs thus stunting plant development (Bedford, 1980). The eggs hatch into larvae which bore into the palms and are voracious eaters, feeding adlibitumly thereby reducing the palm pith into dark brown frass and killing the palm in the process Giblin-Davis, (2001), Ukoroije & Bawo, (2019b).

O. owariensis and their larvae are widespread and often recognized as pests of the palm species they feed on all over tropical Africa, especially where palm species are cultivated on commercial basis. However in the South South States of Nigeria and particularly in the Niger Delta and many parts of Africa, the larvae of *O. owariensis* are cherished delicacy with high nutritional value (Defoliart, 1992; Allotey and Mpuchane, 2003). In and within the Niger Delta region mostly within Yenagoa metropolis, *O. owariensis* larva is one of the most prized and eaten insects. It can be found hawked along major roads, streets and markets on sticks (Ukoroije & Bobmanuel, 2019). Some tribes in the

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Niger Delta States (Urhobo's and Isoko's, both in Delta) strongly recommend it to their pregnant women, probably as a source of nutrients (Ekpo, 2005).

O. owariensis grubs are commonly called and known as Bayelsa suya and are accepted as special treat and delicacy among the people of Bayelsa State. All the life stages of *O. owariensis* are eaten as food but the larvae from the second instar stage are widely accepted by all and sundry: men, women, youths and children alike. The grubs are processed by frying them in their own fat and used in garri drinking, eating of farina (kpokpo garri) drinking of beer, palm wine and other softs. Grubs are widely used in jellof rice preparation, pepper soup and even for cooking stew (Ukoroije and Bobmanuel, 2019). The grubs are believed to rid the chest of hangovers due excessive intake of alcohol. Most people prefer eating the grub raw, with the claim that it contains relatively high content of water and low in oil thus does not aggravate malaria symptoms in sufferers. It is also a belief amongst the people that expectant mothers are liable to give birth to healthy and chubby looking babies when they eat these grubs (Ukoroije and Bobmanuel, 2019). Its importance as real protein supplement cannot be over emphasized

O. owariensis specie is widely accepted as food in Bayelsa State and beyond, yet there are little or no literature as to its biochemical constituents as references are always made to other related scarabeid species such as *Oryctes rhinoceros*, *Oryctes monoceros*, *Oryctes boas* and even *Rhynchophorus phoenicis* which are all confirmed as rich sources of various macro and trace elements/ minerals such as sodium, potassium, calcium, magnesium, iron, manganese, phosphorus, zinc, copper and chromium Banjo *et al*., (2006), Olowu *et al*., (2012), Omotoso, (2007); (2018), hence the significance of this study.

Plate 1: *Oryctes owariensis* third larval instar, source: Ukoroije & Bobmanuel, 2019

2. MATERIAL AND METHOD

2.1 Collection and Preparation Of Larvae

The fresh palm beetle (O. *Owariensis*) larvae were bought from a local farmer in Amassoma, Southern Ijaw Local Government Area of Bayelsa State on the 30th September, 2019. After collection, the larvae were placed in a cooler with ice to keep their freshness and then transported to the laboratory for analysis. Adopting the procedure of Omotoso, (2018), all the larvae were washed in distilled water and separated into two halves for processing either as fresh form or as dried form. The first half then, dried at 65°C in an oven for 5 hours. The dried larvae were ground using a porcelain mortar to obtain the crude flour and kept in air tight cans for use in the bioassay. The second half were the fresh larvae which were asphyxiated in the freezer at -10^{o}C for 3 hours, blended afterwards using electric blender. The crude extracts were stored in air tight cans in the refrigerator for later use in the biochemical analysis.

2.2 Nutrient Composition of Larvae

Employing the standard procedures spelt out by the Association of Official Analytical Chemists AOAC (1999), (2005), proximate analysis of the nutrient composition and minerals present in both the fresh and dried larvae samples were determined. Moisture content, ash content, crude protein, crude fat, crude fibre and carbohydrates were investigated. Mineral salts present in the sample such as calcium, magnesium, sodium, potassium, iron, manganese, copper, zinc and phosphorus were also determined. Experiments were in three replicates.

2.3 Anti Nutrient Composition Of Larvae

Qualitative and quantitative analysis of the larvae samples were carried out using standard gravimetric and spectrophotometric procedures by Harborne, (1973), (1998), Obadoni and Ochuko, (2001), Okwu, (2001), Trease and Evans, (2002), Ejikeme *et al*., (2014), Ezeonu & Ejikeme, (2016), Gupta *et al*., (2017) to determine the availability of phytochemicals such as alkaloids, saponins, phenols, flavonoids, tannins and oxalate respectively and their composition. Experiments were in three replicates.

2.4 Statistical Analysis

The result for nutrient composition was expressed in mean and standard deviation of percentages of the three experimental evaluations.

Mineral salts were expressed in mg/100g while phytochemicals were presented as mean and standard deviation expressed in mg/l00g. All results were presented on tables.

3. RESULTS

3.1 Nutrient Composition of both Fresh and Dried *O. Owariensis* Larval Samples

The result for proximate composition of the nutrient content of both fresh and dried or processed *O. owariensis* larvae is shown on table 1 below. The values for all the parameters tested were higher for the fresh sample except for carbohydrates (tested using both difference and Nitrogen free extract methods) which was higher in the dried sample. Mean percentage values for moisture content was 9.34% and 3.74%; ash content: 4.73% and 2.44%; Crude protein: 41.75% and 36.86%; crude fat: 15.57% and 12.46%; crude fibre: 2.80% and 1.75%; carbohydrate: 35.15% and 46.52% respectively for fresh and dried *O. owariensis* larvae.

Table 1: Nutrient composition of *O. owariensis* fresh and dried larvae samples

Nutrients	Fresh *O. owariensis* larvae (%)	Dried *O. owariensis* larvae (%)
Moisture content	9.34±0.51	3.74±0.30
Ash content	4.73±0.35	2.44±0.12
Crude protein	41.75±0.84	36.86±0.62
Crude fat (lipids)	15.57±0.97	12.46±0.82
Crude fibre	2.80±0.14	1.75±0.05
Carbohydrate(using difference method)	90.66±1.63	96.26±1.82
Carbohydrate (using Nitrogen free extract method)	35.15±0.64	46.52±1.00

Values are presented as mean ± SD of three experimental evaluations

3.2 Mineral Composition of *O. Owariensis* Fresh and Dried Larval Samples

The result for the composition of mineral salts contained in *O. owariensis* fresh and dried larvae are presented on table 2 below. The minerals calcium, magnesium, sodium, potassium, iron, manganese, copper, zinc and phosphorus were found present varying amounts in both the fresh and dried forms of the larvae. The mineral content of the fresh form of the larvae was more than those of the dried form with respect to all the above minerals. The values represented in mg/100g are as follows: calcium (48.57mg/100g and 46.39mg/100g); magnesium (270.91 mg/100g and 266.47mg/100g); sodium (97.57mg/100g and 88.68mg/100g); potassium (84.37mg/100g and 72.78mg/100g); iron (18.68mg/100g and 15.85mg/100g); manganese (5.92mg/100g and 6.67mg/100g); zinc (6.95mg/100g and 4.87mg/100g) and phosphorus (93.86mg/100g and 76.94mg/100g) respectively for fresh and dried *O. owariensis* larval forms.

Table 2: Mineral composition of *O. owariensis* fresh and dried larvae

Mineral	Fresh *O. owariensis* larvae (mg/100g)	Dried *O. owariensis* larvae (mg/100g)
Calcium	48.57	46.39
Magnesium	270.91	266.47
Sodium	47.57	88.68
Potassium	84.37	72.78
Iron	18.68	15.85
Manganese	5.92	5.67
Copper	0.85	0.76
Phosphorus	93.86	76.94
Zinc	6.95	4.87

Values are presented as means of three experimental evaluations

3.3 Anti Nutrient Composition of *O. Owariensis* Fresh and Dried Larval Samples

Qualitative and quantitative screening of phytochemicals contained in the fresh and dried larval samples revealed the presence of the secondary metabolites in various quantities: saponins (1.72 and 1.49mg/100g), tannin (5.78 and 5.39mg/100g), flavonoids (2.85 and 2.51mg/100g), alkaloids (2.43 and 2.35mg/100g), phenols (3.71 and 3.65mg/100g) and oxalate (1.56 and 1.28mg/100g) (table 3).

Table 3: Anti nutrient composition of *O. owariensis* fresh and dried larval samples

Phytochemicals	Composition (mg/100g) Fresh larva sample	Dried larva sample
Flavonoids	2.85±0.12	2.51±0.12
Saponin	1.72±0.05	1.49±0.05
Alkaloids	2.43±0.12	2.35±0.12
Tannin	5.78±0.35	5.39±0.35
oxalate	1.56±0.05	1.28±0.05
Phenol	3.71±0.30	3.65±0.30

Values are presented as means and Standard deviation of three experimental evaluations

4. DISCUSSION

The larvae of *O. owariensis* specie are highly nutritional and most prized with high content of protein. The values obtained for moisture, ash, fat and fibre contents are similar to those reported by Omotoso, (2018) but higher than those of Banjo *et al*., (2006), Ekpo, *et al*., (2009) for *O. rhinoceros* species. Also, the values for carbohydrate were higher than those of the previous authors but lower for protein. This could be attributed to the difference in the method of biochemical analysis employed in the study. However the reduced moisture content indicates that the larvae have longer shelf life and can be stored for a long time without spoilage as stated by Omotoso, (2018). The nutritional composition of the fresh sample were higher than those of the dried sample except for carbohydrates (tested using both difference and Nitrogen free extract methods). Mean percentage values for moisture content was 9.34% and 3.74%; ash content: 4.73% and 2.44%; Crude protein: 41.75% and 36.86%; crude fat: 15.57% and 12.46%; crude fibre: 2.80% and 1.75%; carbohydrate: 35.15% and 46.52% respectively for fresh and dried *O. owariensis* larvae.

Traditionally, many claimed that the larva content of Oryctes species extend beyond nutritional to medicinal properties hence, its acceptability. This is in conformity with the statement of Mignon, (2016), which stated emphatically that *O. owariensis* larvae are highly prized and widely consumed as alternative protein source. This is further buttressed by the report of Solomon *et al*., (2008), who stated that as long as protein-energy malnutrition prevails in developing countries, the search for low cost, nutritious and easy to prepare locally available complementary foods will continue. The fresh sample had higher percentage of protein (41.75%) as against the dried with (36.86%) which could be as a result of the drying or processing process since proteins are usually denatured by heat or high temperature (Ekpo, 2011, Omotoso, 2018). The protein content of oryctes species larva compares with those from most conventional protein sources (Omotoso, 2018). 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. A relatively high cash value is observed for the larva, when compared with the reported values for meats, meat products and poultry. These grubs have been proven by researchers to be good source of protein and other nutrient supplements Omotoso, (2018). These values are higher than the values obtained by Banjo *et al*., (2006), Ekpo, *et al*., (2009).

The ash content was higher for the fresh sample (4.73%) than the dried (2.44%). These values are in agreement with those of Omotoso, (2018) but different from those of Onyeike *et al*., 2005, Olowu *et al*., (2012), Oparaocha *et al*., (2012).

Regarding fat content, the fresh sample has 15.57% while the dried was 12.46%. These values are in conformity with those of Banjo *et al.*, (2006), Ekpo *et al*., (2009) and Omotoso, (2018) for Oryctes species. The larvae Oryctes are reported as containing unsaturated fatty acids since high in iodine, have low saponification values and remains at room temperature in liquid form (Omotoso, 2018). According to Defoliart, (1991), insect fatty acids are similar to those of poultry and fish in their degree of unsaturation but higher in the unpolysaturates.

Crude fibre content for the fresh sample was 2.80% and 1.75% for the dried. This is as a result of the gluttonous and voracious feeding habit of the larvae which is an indication for their free bowel movement.

Both *O. owariensis* larval samples showed high percentages of carbohydrate using both the difference method of analysis and the Nitrogen free extract method. The values were higher than the values obtained by previous authors.

Insects are known to be rich sources of various macro and trace elements/ minerals Omotoso, (2007). The following minerals: sodium, potassium, calcium, magnesium, iron, manganese, phosphorus, zinc and copper were found present in both the fresh and dried samples though higher in the fresh sample. Magnesium was highest, followed by sodium, then phosphorus and potassium which also were highly present. Calcium was moderately present in composition while iron, magnesium and zinc were slightly present. Copper was present negligibly. These results are in agreement with those of other authors who worked independently on other scarabeid larvae such as Banjo, (2006), Olowu *et al*., (2012), Ekpo *et al*., (2009), Omotoso, (2018). According to Soetan *et al.*, (2010), Omotoso, (2018), the presence of these mineral salts in the bodies of the

larvae are for promoting the normal functioning of the systems of the insect such as respiration and carriage of oxygen and as co-factors in the structure of enzymes for biochemical pathway. Saris *et al*., (2000), AbdelMoniem *et al*., (2017) disclosed that iron deficiency has been a major problem in women's diet in the developing world particularly among pregnant women and most especially in Africa but that these grubs are rich source of iron. They stated that the iron content of palm beetle larvae is a good source of minerals for young, pregnant and lactating mothers and for the proper development and functioning of the body system.

Qualitative and quantitative analysis of the larvae revealed the presence of phytochemicals such as flavonoids, saponin, tannin, alkaloids, oxalate and phenols in low amounts indicating the safety of these larvae for both human and livestock consumption. According to Omotoso, (2007), these plant secondary constituents or metabolites are beneficial to human as they protect against platelets aggregation, dental caries, cancer, lower blood sugar response and promote the human immune system. The results obtained quantitatively are similar to those observed by Omotoso, (2018).

5. CONCLUSION

The larval stage of *O. owariensis* beetle has successfully proven its richness in nutrients both micro and macro, hence confirming its acceptability and consumption by the people of Bayelsa State specifically and Niger Delta region generally. The protein and carbohydrate contents can supplement for the daily requirements by man and livestock thus making up for the achievement of the sustainable development goals of Agriculture whether incorporated in fresh or dried forms in the diets of man and livestock.

RECOMMENDATION

The authors do recommend that *O. owariensis* larvae be recognized as sustainable alternatives to meat, milk and other proteinous food and generally incorporated directly or indirectly whether in fresh or dried form as food for man and feed for livestock.

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