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Proximate Composition of Okpokuru *(Oryctes Rhinoceros)* and Red Palm Weevil Larva *(Rhynchophorus Ferrugineus)*

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Abstract | **Original Research Article**

There is need to know the nutritional composition information on any edible agricultural product known to man. This is a required information serves as a guide to consumers. In this work, the proximate composition and mineral content of Red palm weevil, (*Rhynchophorus ferrugineus*) and *Orycytes rhinoceros (Izon Okpokuru)* were studied This was done in line with AOAC standards in order to acquire insight into the samples' health advantages. These samples had acceptable concentrations of crude lipids, crude protein, fibre, nitrogen free extract, calcium, magnesium, iron, and zinc, implying that Red palm weevil (Rhynchophorus ferrugineus) and Orycytes rhinoceros (Izon Okpokuru) could be used as good sources of nutrients and minerals for human diet and animal feed production. Furthermore, the drying rates for both samples as a function of drying temperatures (50, 60, 70, 80, 90, and 100°C) reveal that they all dried quicker when the temperature was increased.

Keywords: Mineral content, proximate composition, Red palm weevil, *Orycytes rhinoceros*, temperature.

INTRODUCTION

Orycytes Rhinoceros and Red palm weevil are phytophagous insects that lives and feeds on decaying tissues of Raphia palm trees. The larvae of Red palm weevil are popularly called ''Bayelsa suya'' in south-south parts of Nigeria because it is predominately harvested in high quantities and consuming population see Plate 1. The Orycytes Rhinoceros is a weevil that has red-headed and its larvae is milky white in colour, its physical body structure is C-shape see Plate 2. The both samples are sold in market places in its raw state, cooked or semi-dried forms. Since they are highly perishable, microbial deterioration starts rapidly beyond its generalized Organoleptic requirement and can be freeze-store or dried to increase its shelf life. In this state microbial and biochemical deterioration will be reduced to a safer level. The both samples are edible and comparable to meet from convectional animal sources as they washed and spiced and cooked fried in a dry pot or roasted to give a creamy colour that appeals to organoleptic sense of taste and flavor. Its usually dried to a rather low moisture content, packaged and traded by table-top retailers.

There is need to know the nutritional composition information on any edible agricultural product known to man. This is a required information serves as a guide to consumers. Agricultural materials and food products have different chemical composition such as fat, protein, ash, carbohydrate, moisture content, fibre, vitamins and minerals. The quality, acceptability or fitness for consumption is been determined by the chemical composition or analysis in the food products.

Upon drying, Zibokere and Egbe (2020a) investigated the drying behavior of Red palm weevil which shows that the temperature dependent effective moisture diffusivity tends to increase from $6.42x10^{-8}$ – $4.08x10^{-6}$ as the temperature increased from 50-100°C and its relative activation energy was 18.5kJ/mol also Zibokere and Egbe (2020b) investigated the thin layer drying kinetics of spiced Okpokuru and the report shows the its effective moisture diffusivity ranged from $3.943x10^{-7}$-$1.349x10^{-6}$ as the temperature increased from 50-100°C with an activation energy of 28.5kJ/mol.

Nevertheless, several researcher's food products have investigated the nutritional analysis of various bio-materials and food products, this informs its wide application in technical literature as in the report of Burubai and Amber (2014) for Ipoli fruits; Akindaunsi and salawu (2005) for tropical green leafy

vegetables; Sadiku and Oladimegi (1991) for Catfish and Adewole and Omotosho (1997) for selected fresh water fishes.

In Nigeria, the two biomaterials are not generally accepted due to lack of information on the nutritional values of the food products. The objective of this research work is to study the proximate composition of Orycytes Rhinoceros and Red palm weevil for the purposes of improving their acceptability for immediate consumption and storage.

Plate 1: A red palm weevil larvae (Izon doon)

Plate 2: *Orycytes rhinoceros (Izon Okpokuru)*

MATERIALS AND METHODS

Heathy and good quality of Red palm weevil *(Rhynchophorus ferrugineus)* and Orycytes rehinoceros *(Izon Okpokuru*) were harvested from deteriorated palm species in Ondewari community forest located at Southern Ijaw Local government area of Bayelsa state Nigeria. The experimental samples were packaged into a sterilized thermocol containers containing dried ice and transported to the laboratory, Department of chemistry, Federal University of Technology Owerri (FUTO) for processing and analysis. The both samples were oven dried until constant weight was attained. After drying, it was grinded into a power form and used for the analysis. The weight of the products was taken before drying and after drying to determine the moisture content in the products and proximate analysis conducted according to AOAC standard (2000).

Proximate Composition

Proximate composition was conducted on both Red palm weevil *(Rhynchophorus ferrugineus)* and Orycytes rehinoceros *(Izon Okpokuru*) samples such as moisture content, ash content, crude fibre, nitrogen free extract, crude protein, crude fibre and lipid extract.

Determination of Moisture Content

The moisture content was determined using oven drying method. The apparatus used to determine the moisture content are analytical weighing balance, moisture extraction oven, desiccator containing desiccant, moisture can and tongs. 2.0g of both samples was weighed into a washed and dried moisture can of a known weight W_1, while the sample and can were recorded as W_2, before drying took place. The can the sample was put in an oven and dried at 105°C for about 4-5hours. The oven dried samples were put in a desiccator to cool at room temperature and the weighed again. The weight of the can and the sample after oven drying was recorded to be W_3. The moisture content was calculated apply the equation below

% moisture content = W_2-W_1/W_2-W_3 x 100

Where; W_1 = weight of empty dried moisture can, W_2 = weight of moisture can + sample before oven drying, W_3 = weight of moisture can + sample after oven drying

Determination of Ash Content

Muffle furnace, weighing balance, desiccator, long tongs, and crucibles are apparatus used to determined the ash content. The crucible was washed, dried and placed in a desiccator to cool and weighed W_1 about 2.0g of the sample was weighed into the crucible, the weight of the crucible and samples W_2 was recorded. The crucible and its content were placed in the muffle furnace and carbonized at 450°C for about 30minutes. The furnace temperature was then regulated at 550°C for four hours until the ash is shows grey colour. The crucible containing the ash was bought out, put in a desiccator and allowed to cooled at room temperature and was weighed W_3. The percentage ash content was calculated using

% Ash = W_3- W_1/ W_2- W_1 x 100

Where: W_1 = Weight of empty dried crucible, W_2 = Weight of empty dried crucible + sample, W_3 = Weight of empty dried crucible + Ash

Crude Fibre

Apparatus such as Weighing balance, oven, heating mantle, desiccator, Buckner funnel, muslin cloth, muffle furnace, crucible, beaker. 2.00g of sample was weighed and placed in 200ml of 1.25% H_2SO_4 and boiled for 30 minutes. The suspension was filtered through a buckner funnel equipped with muslin cloth and held firm with elastic band. The hot acid sample solution was filtered and the residue washed with boiling water to remove acid from it. The residue was returned completely into 200ml boiling 1.25%NaOH and boiled for 30 minutes, filtered and progressively washed with boiling water, 1% Hcl and lastly boiling water to remove the 1% Hcl from it. The residue was

washed trice with about 10ml of ethanol and trice with about 10ml of petroleum ether to remove fat components of the sample. The residue was drained, transferred completely into a crucible, oven dried to constant weight, cooled in a desiccator and weighed W_1. It was then incinerated at 600^0C for 2 hours in a muffle furnace. The crucible and its content was cooled in a desiccator and weighed W_2. The loss in weight on incineration was due to crude fibre.

%Crude fibre = W_1-W_2 x 100

Where: W 1 = Weight of dried residue and crucible before incineration and W 2 = Weight of crucible and remains of residue after incineration.

Crude Fat (Ether Extract) Determination for Dry Solid Samples

A known weight of ground or powered sample was accurately weighed and placed into an extraction thimble of known weight W_1. The weight of the thimble and that of the sample was recorded W_2. The thimble and its content was placed in the soxhlet extractor column fixed into a clean dried flask of known weight F_1 containing about 150$cm^3$of solvent (i.e petroleum spirit or n- Hexane) rightly position on a heating mantle and extracted for about 6 hours. After extraction, usually when the solvent is clear in the column, the defatted sample was carefully removed and the solvent in the flask recovered. The flask containing the extracted fat was put in an oven and dried at 60^oC to constant weight. The weight of the flask and fat/oil was recorded F_2. The crude fat content was calculated using the formula

%Crude fat = F_2- F_1X100

Where F_2 = Weight of flask + fat, F_1 = Weight of flask, Weight of sample = W_2- W_1

Crude Protein

Kjeldahl method was used to determine the crude protein on the both samples. 0.5g of the samples was weighed and digested by heating with concentrated sulphuric acide (H_2SO_4) in the present mixture which contains 1.5g of Na2SO4 and 1.5g of CuSO4. The mixture was then made alkaline. The ammonia evolved was steam distilled into an Erlenmayer flask containing 10ml of 5% boric solution into which 2 drops of double (Methylred-Methyl blue) indicator has been added. This was titrated against 0.1NHCL solution until a purple-pink colour was obtained as the end point. The total protein was then calculated by multiplying the amount of nitrogen with gravimetric factor of protein (6.25) as

% Nitrogen = (X-Y) x N x 0.014 x D x100/Weight of Sample x V

% Crude Protein = 6.25 x %Nitrogen

Where; X = Sample titration reading, Y = blank titration reading, N = normal of HCL, D = dilution of sample after digestion, V= volume taken of distillation, 0.014 = Milli equivalent weight of Nitrogen.

Carbohydrate by Difference

In this method, carbohydrate content was obtained by calculation having estimated all the other fractions of the food by proximate analysis i.e:

%Available carbohydrate = 100- (%moisture + %ash + %Protein + %fiber + %fat) However, this method can lead to erroneous result due to experimental errors in any of the other methods, and so it is usually better to directly measure the carbohydrate content for accurate measurements.

Nitrogen free extract:

The Nitrogen Free Extract (NFE) was calculated by difference method after analyzing all the other parameters in the proximate analysis. Therefore

NFE = 100 – (% moisture + %crude Protein + % crude lipid (fat) + % crude fibre + % ash)

Mineral Analysis

Mineral content of both frog and acute mud snails were analyzed using atomic absorption spectrophotometer (AOAC, 2000). The minerals Ca, Mg, Fe, Zn and Mn were investigated for both samples. Samples were acid-digested (wet digestion); Aqua Regia (HNO3 and H2SO4 in ratio of 3:1) in the fume-cupboard until a clear mixture was obtained. This was then diluted and filtered into 100ml volumetric flask and made up to 100ml mark with distilled water. The sample so prepared was then taken for the mineral analysis in the atomic absorption spectrometer machine.

RESULTS AND DISCUSSIONS

Using standard procedure, the proximate compostion, mineral contents and drying rates of both The Red palm weevil, (*Rhynchophorus ferrugineus*) and *Orycytes rhinoceros (Izon Okpokuru)* were evaluated and the results presented in table 1. and 2 respectively.

Table 1: Result of proximate composition and micro-nutrient of Red palm weevil larvae, (*R. ferrugineus)*

S/N	Nutrient composition (%)	*Orycytes rhinoceros (M±SD*
1.	Moisture content	21.60± 0.02
2.	Ash content	2.17± 0.001
3.	Fibre	5.95± 0.03
4.	Fat content	43.25± 0.12
5.	Protein content	21.03± 0.14
6.	Carbohydrate	6.00± 0.01
7.	Copper (mg/100g)	0.076± 0.02

S/N	Nutrient composition (%)	*Orycytes rhinoceros (M±SD*
8.	Iron (mg/100g)	0.053± 0.01
9.	ZInc (mg/100g)	3.086± 0.02
10.	Sodium (mg/100g)	0.081± 0.01
11.	Magnesium (mg/100g)	0.019± 0.02
12.	Potassium (mg/100g)	1.695± 0.02
13.	Boron (mg/100g)	Not detected

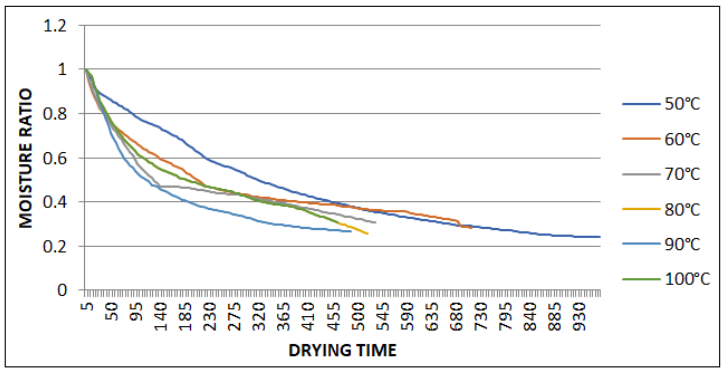

Fig 1: Drying curve at different temperature for red palm weevil larvae, (*R. ferrugineus)*

As shown in Table 1 Palm weevil larvae, (*R. ferrugineus)* contains 21.60% moisture, 2.17% ash, 43.25% fat, 21.03% protein, 5.95% fibre, and 6.00% carbohydrate, and for the micro-nutrient Copper 0.076, Iron 0.0053, Zinc 4.086, Sodium 0.0081, magnesium 0.019, potassium 1.695 free extract and boron was not detected. Figure 1 is a plot of moisture ratio of the samples against drying time for the chosen temperature level. It shows the availability of water for chemical reactions and microbial growth. Therefore, preservation must commence immediately after their harvest to control deterioration. The moisture contents recorded here are lower than those of beef meat (68.3%), chicken (59.5%) and catfish (58.0%) as reported by Nielsen (2002). Protein which forms the building blocks of all cell structures were present in significant quantities in the samples (Table 1). Palm weevil larvae, (*R. ferrugineus)* had average values 21.03% of proteins. The protein values in Palm weevil larvae, (*R. ferrugineus)* are higher than those of Tilapia (20.78%) and electric fish (18.35%) as reported by Adeniyi *et al.*, (2012) and also higher than beef meat (28.5%) and Tuna fish (24.2%) as reported by Nielsen (2002).

The Nitrogen free extract (i.e. carbohydrate) play a vital role in human nutrition as energy reserves. Lipids are a group of substances that are soluble in organic solvents and are sparingly soluble in water. When lipids combine with proteins and carbohydrates, they constitute the principal structural components of foods. Lipids are also considered as a store house for energy. The lipid content in frog and acute mud snail were recorded as 43.25. These lipid values are in the same range with those reported for Clarias (13.86%), Tilapia (6.53%), electric fish (10.82%) by Adeniyi *et al*., (2012) and beef meat (4.59%), broiler meat (4.34%) by Olayemi *et al*., (2011) and Cod fish (0.4%), but lower than those of pork (33%) and bacon (65%) as presented by Nielsen (2002).

Table 2: Result of proximate and micro-nutrient of *Orycytes rhinoceros (Izon Okpokuru)*

S/N	Nutrient composition (%)	*Orycytes rhinoceros (M±SD*
1.	Moisture content	20.703± 0.02
2.	Ash content	2.53± 0.001
3.	Fibre	4.97± 0.03
4.	Fat content	44.03± 0.12
5.	Protein content	19.67± 0.14
6.	Carbohydrate	8.00± 0.01
7.	Copper (mg/100g)	0.064± 0.02
8.	Iron (mg/100g)	0.049± 0.01
9.	ZInc (mg/100g)	3.22± 0.02
10.	Sodium (mg/100g)	0.085± 0.01
11.	Magnesium (mg/100g)	0.022± 0.02
12.	Potassium (mg/100g)	1.59± 0.02
13.	Boron (mg/100g)	Not detected

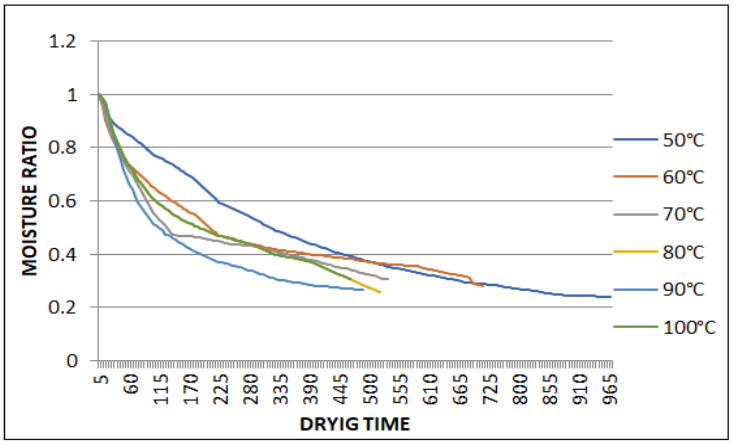

Figure 2: Drying curve at different temperature for Okpokuru *(Oryctes rhinoceros)*

As shown in Table 2 Okpokuru *(Oryctes rhinoceros)* contains 2.53% moisture,2.53% ash, 44.03% fat, 19.67% protein, 4.97% fibre, and 8.00% carbohydrate, and for the micro-nutrient Copper 0.064, Iron 0.049, Zinc 3.22, Sodium 0.085, magnesium 0.022, potassium 1.59 free extract and boron was not detected. Figure 2 is a plot of moisture ratio of the samples against drying time for the chosen temperature level. It shows the availability of water for chemical reactions and microbial growth. Therefore, preservation must commence immediately after their harvest to control deterioration. The moisture contents recorded here are lower than those of beef meat (68.3%), chicken (59.5%) and catfish (58.0%) as reported by Nielsen (2002). Protein which forms the building blocks of all cell structures were present in significant quantities in both samples. Okpokuru *(Oryctes rhinoceros)* had average values 19.67 % of proteins. The protein values Okpokuru *(Oryctes rhinoceros)* are higher than those of Tilapia (20.78%) and electric fish (18.35%) as reported by Adeniyi *et al.,* (2012) and also higher than beef meat (28.5%) and Tuna fish (24.2%) as reported by Nielsen (2002).

The Nitrogen free extract (i.e. carbohydrate) play a vital role in human nutrition as energy reserves. Lipids are a group of substances that are soluble in organic solvents and are sparingly soluble in water. When lipids combine with proteins and carbohydrates, they constitute the principal structural components of foods. Lipids are also considered as a store house for energy. The lipid content in Okpokuru *(Oryctes rhinoceros) was* recorded as 44.03. These lipid values are in the same range with those reported for Clarias (13.86%), Tilapia (6.53%), electric fish (10.82%) by Adeniyi *et al*., (2012) and beef meat (4.59%), broiler meat (4.34%) by Olayemi *et al*., (2011) and Cod fish (0.4%), but lower than those of pork (33%) and bacon (65%) as presented by Nielsen (2002).

Drying Rates

Drying rate, which is defined as the amount of water evaporated from biomaterial overtime, has serious engineering implications. Prominent amongst its importance is the prediction of total drying time, for the storage of agricultural products. The drying rates of Palm weevil larvae, (*R. ferrugineus)* at temperatures 50 60,70, 80, 90 and 100°C are presented in Figure 1 increased steadily for 2.4hrs and became constant for the next 1hr and then decreased steadily for the remaining 1hr of drying. Similar drying behaviour was observed for *Orycytes rhinoceros (Izon Okpokuru).* samples when subjected to the other temperature levels, although, at shorter drying times. For *Orycytes rhinoceros (Izon Okpokuru)* (Fig 2) the drying rates were observed to increase with increase in drying temperatures levels, and higher drying temperatures also found to encouraged shorter drying times for both samples. The decrease in drying rates at the later stages of drying could be attributed to difficulties in diffusion of low concentration of moisture from the interior to the surface of the samples for evaporation. Similar observations have been made on other biomaterials during drying (Bala and Mondol, 2001).

CONCLUSION AND RECOMMENDATION

The proximate composition and mineral content of Red palm weevil, (*Rhynchophorus ferrugineus*) and *Orycytes rhinoceros (Izon Okpokuru)* were investigated. Results indicated that Red palm weevil and *Orycytes rhinoceros* contains acceptable levels of nutrients and minerals. They can therefore be used as good sources of crude proteins, crude lipids, fibre, and minerals such as calcium, magnesium, iron and zinc.

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