GRADING AND PRICING OF MINILIVESTOCK (EDIBLE PALM WEEVIL LARVAE) MARKETED IN PORT HARCOURT, NIGERIA

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ABSTRACT

This study evaluated types, grades and prices of edible palm weevil larvae in Port Harcourt. Sixty (60) respondents were interviewed using semi-structured questionnaires in addition to interviews of five key informants for data on larvae types, grades, weight and prices. Similar data was collected from food vendors selling stewed chicken meat. Larvae and stewed chicken meat weights were sampled using a battery-powered digital scale. Data were analyzed using Statistical Package for Social Sciences. Results indicated that two types of larvae sold include Rhychophorous ferrugineus and Oryctes nasicornis. R. ferrugineus larvae were the most supplied, demanded, sold and preferred by consumers. O. nasicornis larvae weighed more than R. ferrugineus. A stick of R. ferrugineus sold for ₦ 116.67.00 ± 3.33, while a stick of O. nasicornis sold for ₦ 100.00 ± 2.99. One kilogramme of R. ferrugineus was costlier than that of O. nasicornis. R. ferrugineus larvae was sold in three grades (large, medium and small) and sold for different prices by weight. Price of a kilogramme of larvae (₦ 6,927.00 ± 48.04) was higher (p<0.05) than that of stewed chicken meat (₦ 2,040.00 ± 11.22) by 237.75 %. The study concludes that sellers of R. ferrugineus could make more money selling per stick while buyers could gain by buying per worm. Also, consumers prefer and could pay more for R. ferrugineus though there is no financial or weight advantage in preferring medium to small grade.

Keywords: Minilivestock, Unconventional animal protein, Edible palm weevil larvae, Grade, Price

INTRODUCTION

Minilivestock, erroneously called microlivestock, refers to animal species smaller (<20 kg) than conventional livestock (e.g. cattle, goat and pig); popularly used locally in certain places (directly or indirectly) for food, feed and income; which support sustainable use of renewable natural resources; and substitute gathering, hunting and poaching with controlled production (Hardouin, 1995; Bindelle, 2011). Minilivestock could be vertebrates and invertebrates. Invertebrate minilivestock include land snails, earthworms, fly maggots, grasshoppers, caterpillars and edible palm weevil larvae (Hardouin *et al*., 2003). Edible palm weevil larvae are popular unconventional animal protein delicacy in Rivers State and Niger Delta region (Ukoroije and Bobmanuel, 2019; Thomas and Briyai, 2019). The commonest species of edible palm weevil larvae consumed are *Oryctes* spp. (tough skinned) and *Rhynchophorus* spp. (soft skinned).

The nutritive value of the different species differs. *Rhynchophorus* spp. is rich in crude protein (71.63 %), ash (11.97 %), fat (8.25 %) and crude fibre (1.59 %) (Braide and Nwaoguikpe, 2011). Comparatively, *Oryctes*

spp. larvae according to Omotoso (2018) contains 70.76 % crude protein, 8.29 % ash, 7.47 % fat, 1.04 % moisture, and high phosphorus (113.15 mg/100 g) and magnesium (71.54 mg/100 g).

Thomas and Briyai (2019) ascertained the high acceptability (≥92 %) and use of *R. phoenicis* larvae as food by the Ijaw, Ikwerre, Ogoni, Ibo, Ibibio, Urhobo, Bini, Itsekiri and Efik ethnic groups of Niger Delta. They are either eaten raw, fried, dried, cooked or roasted with frying as the most preferred processing method. The same study indicated that these tribes consumed the larvae alone or in combination with garri, farina, tapioca, rice and yam, and is sometimes presented as gifts-of-honour to guests. Assessing the acceptability of *Rhynchophorus* spp*.* as meat and animal protein supplement for residents of Bayelsa State, Nodu *et al*. (2013) reported that Bayelsans accept and enjoy edible palm weevil larvae either cooked or fried. They relish it due to its ease of preparation, taste, texture, flavor and nutritive value. Ijeomah and Alagoa (2012) assessed the use of invertebrate wildlife species in Niger Delta and found that consumption of edible palm weevil larvae from raffia palm was not influenced by age, level of education, occupation and gender but by household size and knowledge of the species. Furthermore, the study found that the larvae were consumed by only 28.7 % of the population, while only 63 % of them knew it could be used as human food.

Despite the high consumption and acceptability of edible palm weevil larvae by people of Niger Delta in general and Port Harcourt in particular, there are potential risks to this food habit. Braide and Nwaoguikpe (2011) evaluated the microbiological and nutritional worth of *R. phoenicis* larvae in Port Harcourt and isolated some microbes such as *Lactobacillus plantarum*, *Staphylococcus aureus*, *Bacillus* spp., *Penicillium verrecosum*, *Aspergillus flavus*, *Fusarium poae* and yeast from the larvae meat. Also, a high bacterial count (1.68×10^5 cfu/g) was observed in *Rhynchophorus* spp*.* meat, thus indicating the meat could pose risks to human health through contamination. In another study, *Oryctes spp.* had non-significant anti-nutritional factors, thus, suggesting that the larva may not pose nutritional challenges to man (Omotoso, 2018). In addition, some other factors that could obstruct the use of edible palm weevil larvae as human food include; skin irritation after consumption, cultural and religious beliefs and poor knowledge of the species (Ijeomah and Alagoa, 2012).

The consumption of edible palm weevil larvae supports livelihoods of several households. Many flourishing small-scale businesses have grown around the gathering of wild edible palm weevil larvae, their processing and marketing to consumers in cities and markets (Thomas and Briyai, 2019). This would likely lead to expansion of the market for this larvae and quality service to consumers. In such circumstances, there is need to standardize the grading and pricing of different species of edible palm weevil larvae in the market. In Port Harcourt, and possibly elsewhere in Nigeria, the diversity of species of processed ready-to-eat larvae sold in the markets, their grades and prices are poorly documented. Documenting these indices will support the standardization and development of edible palm weevil larvae market. This study assessed the grades and prices of ready-to-eat edible palm weevil larvae marketed in Obio-Akpor Local Government Area (LGA), Rivers State, Nigeria.

MATERIALS AND METHODS

Study Area: The study was carried out in Obio-Akpor Local Government Area, Rivers State. Obio-Akpor is the largest Local Government Area in Rivers State. Combined with Port Harcourt City and Eleme Local Government Areas, they form Port Harcourt metropolis. Obio-Akpor Local Government Area is sandwiched between Port Harcourt City Local Government to the south, Oyigbo and Eleme Local Governments to the East, Ikwerre and Etche Local Governments to the North and Emohua Local Government to the West. The Local Government is between latitudes 4°45'N and 4°60'N and longitudes 6°50'E and 8°00'E, a lowland zone, sitting at less than 30 meters above sea level (Oyegun and Adeyemo, 1999).

Obio-Akpor is in humid tropics with long and heavy rainy season and brief dry seasons

with enough atmospheric moisture all over the year, thus ensuring heavy and consistent rains. The rainfall ranges from 367 mm in September to 20 mm in December. Temperature in Obio-Akpor range from 21 to 34^{o}C with April to October witnessing the maximum values (Yakubu, 2018). The landmass of Obio-Akpor is 260 square kilometers with alluvial sedimentary soil that is sandy to sandy-loam, thick mangrove forests, light rainforest and many raffia palms.

The population of Port Harcourt was estimated to be 2,130,000 people in 2019 (Demographia, 2019), while that of Obio-Akpor was 464,789 people in 2006 Census (NPC, 2006) but projected to rise to 597,989 people in 2014 and 649,600 in 2016 (Ayotamuno and Enu-Obari, 2017). Residents are mainly of Ikwerre ethnic group and predominantly Christians. Port Harcourt city is witnessing rapid urbanization as well as commercial and population growth. The major farming systems in Obio-Akpor and Port Harcourt are fishing, farming of food crops such as cocoyam, yam, sweet potato, pumpkin, waterleaf, scant leaf and rearing of small ruminants (Oyegun and Adeyemo, 1999).

Sampling, Data Collection and Analysis: Key actors engaged in edible palm weevil larvae marketing were purposively sampled using the snowball method. Five key informants were also interviewed in addition to participant observation. Respondents included twenty (20) each of consumers, retailers and wholesalers (60 in all). Respondents were interviewed in major markets, motor parks and road junctions in Choba, Rumuokoro, Oil Mill and Rumuola areas of Obio-Akpor LGA. Closed-ended questions were drafted with sections on larvae species diversity, market prices and consumers' preference, validated and pretested before administering to the respondents. To compare with other edible animal proteins, samples of the ready-to-eat palm weevil larvae, stewed chicken meat and their selling prices were obtained from interviewees. Samples were weighed using a battery-powered digital laboratory scale.

Data Analyses: Closed-ended responses from questionnaire were scored and analysed descriptively for their central tendencies using Statistical Package for Social Sciences (SPSS). Comparison of means for the two larvae types (*R. ferrugineus* and *O. nasicornis*) and those of *R. ferrugineus* larvae meat with ready-to-eat chicken meat were done using t-test. Data collected on the grades, price and weight data were analyzed using analysis of variance (ANOVA). Significant means were separated using Least Significant Difference in SPSS. Results are presented in pictures, charts and tables.

RESULTS AND DISCUSSION

Types, Quantity and Consumer Preference for Palm Weevil Larvae Sold in Obio-Akpor: Participant observation revealed two types of palm weevil larvae were sold in the market: *Rhychophorous ferrugineus* (soft-skinned) and *Oryctes nasicornis* (tough-skinned) (Figures 1 and 2).

Figure 1: *Rhychophorous ferrugineus* (soft-skinned palm weevil larvae) (Source: Nangai and Martin, 2017)

Figure 2: *Oryctes nasicornis* (tough-skinned palm weevil larvae) (Source: Depositphotos, 2019)

Processed larvae were as stick meat. The sticks were of different lengths carrying varying number of larvae depending on the grade. Majority (90 %) of the larvae sold were *R. ferrugineus,* while 10 % were *O. nasicornis* (Figure 3).

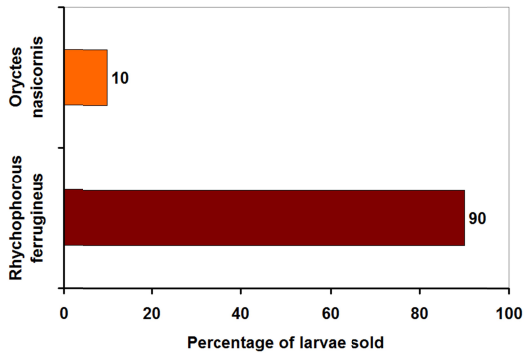

Figure 3: Quantity of palm weevil larvae sold in Obio-Akpor

Eighty percent (80 %) of the consumers preferred the soft-skinned larvae while only 20 % preferred the tough-skinned larvae (Figure 4).

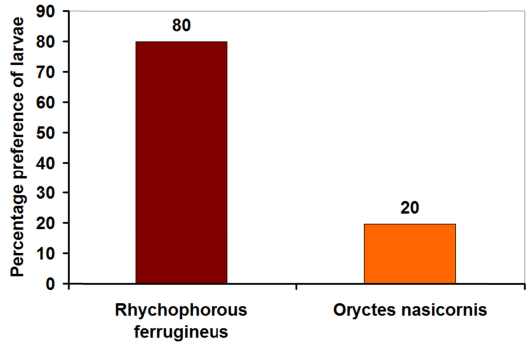

Figure 4: Consumer preference for palm weevil larvae sold in Obio-Akpor

Consumer preference for the soft-skinned larvae in this study was in agreement with the report by Thomas and Briyai (2019). Consumer preference for the soft-skinned larvae could be due to the higher oil content (Cerda *et al*., 2001; Olowu *et al.,* 2012). This is so because according to Miller (2004) oil content of animal proteins enhances their palatability and taste.

Comparison of Types of Palm Weevil Larvae Sold in Obio-Akpor: Table 1 compared the two types of palm weevil larvae sold in Obio-Akpor. Results indicated that a stick of *R. ferrugineus* marketed in Obio-Akpor contains six larvae, while that of *O. nasicornis* contains four larvae.

Table 1: Comparison of types of palm weevil larvae sold in Obio-Akpor

Parameter	Types of larvae	
	R. ferrugineus	***O. nasicornis***
Number of worms per stick	6.00 ± 0.01	4.00 ± 0.03
Total weight of worms per stick (g)	16.21 ± 0.56^{b}	21.63 ± 1.20^{a}
Mean weight per worm (g)	2.63 ± 0.14^{b}	5.41 ± 0.23^{a}
Price (₦) of worms per stick	116.67 ± 3.33^{a}	100.00 ± 2.99^{b}
Price per worm (₦)	18.41 ± 0.25^{b}	25.00 ± 0.23^{a}
Price per g (₦)	6.89 ± 0.09^{NS}	4.66 ± 0.30^{NS}
Price per kg (₦)	6,927.00 ± 48.04^{a}	4,660.00 ± 44.08^{b}

^{a,b,c}Means on the same row with different superscripts are significantly different ($p<0.05$); ^{NS}Not significantly ($p>0.05$); ₦= Nigerian Naira; g = gramme; kg = kilogramme

There was no significant difference ($p>0.05$) between the soft and tough-skinned varieties in the number of larvae per stick. This could be due to sellers' strategy of encouraging buyers to buy the less preferred *O. nasicornis* because according to Arias *et al*. (2013) small and medium-scale business people through experience have a better understanding of consumer preferences.

The total weight of larvae per stick ranged from 21.63 ± 0.56 g in *O. nasicornis* to 16.21 ± 0.56 g in *R. ferrugineus*. There was significant difference ($p<0.05$) in the total weight of larvae per stick. *O. nasicornis* had the highest weight (21.63 ± 0.56 g), while *R. ferrugineus* had the least weight (16.21 ± 0.56 g). The average weight of single soft-skinned larvae was 2.63 ± 0.14 g, while that of tough-skinned variety was 5.41 ± 0.23 g. There was significant difference ($p<0.05$) between the two varieties for total weight of larvae in a stick and weight of single larva. *Oryctes nasicornis* had the highest values for this parameter, while *R. ferrugineus* had the least. This implied that

weight-for-weight, a stick of larvae or single larvae of the tough-skinned type had higher weight than that of soft-skinned variety. The findings were in agreement with the findings that *O. nasicornis* has higher dry matter content (weight-for-weight) than *R. ferrugineus* as most of the weight of *R. ferrugineus* is moisture (Ekpo and Onigbinde, 2005; Okaraonye and Ikewuchi, 2009).

On the average, a stick of *R. ferrugineus* sold for ₦ 116.67 ± 3.33, while that of *O. nasicornis* sold for ₦ 100.00 ± 2.99. Also, the mean price per larvae of *R. ferrugineus* was ₦ 18.41 ± 0.25, while that of *O. nasicornis* was ₦ 25.00 ± 0.23. There was significant difference ($p<0.05$) between the two types of larvae for price per stick and price per larvae. *R. ferrugineus* was the most expensive per stick, while *O. nasicornis* was the most expensive per worm. This implied that sellers of *R. ferrugineus* make more money selling per stick, while buyers save money buying per larvae. This was the reverse for *O. nasicornis*. Differences in pricing regimes between the two varieties could be due to higher quality of *R. ferrugineus* as perceived by consumers (Olowu *et al*., 2012). In addition, Steenkamp (1988) reported that higher quality products attract higher prices in the market.

On weight-for-weight basis, the cost per gramme of the two larvae types ranged from ₦ 4.66 ± 0.30 (*O. nasicornis*) to ₦ 6.89 ± 0.09 (*R. ferrugineus*), while the cost per kilogramme ranged from ₦ 4,660.00 ± 44.08 (*O. nasicornis*) to ₦ 6, 927.00 ± 48.04 (*R. ferrugineus*). There was no significant difference ($p>0.05$) between the two types of larvae for price per gramme. However, significant difference ($p<0.05$) was observed between the two types of larvae for price per kilogramme. This implied that a kilogramme of soft-skinned larvae was costlier than that of tough-skinned. The high cost of the soft-skinned larvae correctly reflects the higher value, demand and preference for this variety by consumers. This is because all things being equal, the higher the demand, the higher the price and vice versa. The observation was in agreement with the report of Osho and Uwakonye (2003) that in Nigeria, as value and demand for meat (beef and chicken) increases as price increases accordingly.

Grades of Palm Weevil Larvae: Three grades of *R. ferrugineus* larvae were observed: large, medium and small. A grade was a number of larvae pinned to a stick made from back of raffia palm branch. The grades were differentiated by lengths of the sticks and number of larvae on them. The number of larvae per stick ranged from 5.00 ± 0.04 (small) to 7.00 ± 0.04 (large) with average of 6.00 ± 0.05 (Table 2). There was no difference ($p>0.05$) in the number of larvae among the three grades. This agreed with Polkinghorne and Thompson (2010) that number of meat pieces do not mean much in meat marketing. What is important is meat weight (muscle weight) excluding the bone. Therefore, consumers of larvae may be better off buying on weight basis.

The mean weight of larvae per stick ranged from 10.27 ± 0.05 (small) to 24.60 ± 0.90 g (large) with average of 16.21 ± 0.88 g. There was significant difference ($p<0.05$) among mean weight of larvae per stick. The large grade had the highest ($p<0.05$) weight, while the small grade had the least ($p<0.05$). However, the least weight was not different ($p>0.05$) from that of the medium grade. It implies that those buying medium grade will not have better value for money weight-for-weight than those buying the small grade. Therefore, spending money to buy the small grade will be waste of money. This observation corroborates MasterClass (2019) that some meat (beef) grades marketed in the United States though sold at different prices, do not differ in actual sense because the grading did not use criteria that matter most to meat quality.

The average price of a stick of larvae in naira ranged 50.00 ± 0.99 (small) to 200.00 ± 5.34 (large) with average of ₦ 116.67 ± 4.02. There was significant difference ($p<0.05$) in the price per grade. The large grade had the highest price, followed by the medium and small larvae. The trend in price of larvae agreed with Zhang *et al.* (2018) who reported that as the grade and quantity of meat increases, the price will also increase with a precondition that all the quantities/grades are of the same quality.

Table 2: Grades and prices of *Rhychophorous ferrugineus* larvae sold in Obio-Akpor

Parameter	Grades of larvae			Overall Mean
	Large	Medium	Small	
Mean number of larvae /stick	7.00 ± 0.04^{NS}	6.00 ± 0.03^{NS}	5.00 ± 0.02^{NS}	6.00 ± 0.05
Mean weight (g)/stick	24.60 ± 0.90^{a}	13.77 ± 0.61^{b}	10.27 ± 0.05^{b}	16.21 ± 0.88
Mean price (₦)/stick	200.00 ± 5.34^{a}	100.00 ± 2.01^{b}	50.00 ± 0.99^{c}	116.67 ± 4.02
Mean weight (g)/larvae	3.38 ± 0.02^{a}	2.29 ± 0.02^{b}	2.22 ± 0.03^{b}	2.63 ± 0.02
Mean price/larvae (₦)	28.57 ± 1.01^{a}	16.67 ± 0.60^{bc}	10.00 ± 0.08^{c}	18.41 ± 0.99
Mean price of larvae (₦)/g	8.14 ± 0.08^{a}	7.28 ± 0.07^{b}	5.24 ± 0.04^{c}	6.89 ± 0.59
Mean price of larvae (₦)/kg	8,260.00 ± 44.08^{a}	7,280.00 ± 33.00^{b}	5,240.00 ± 23.90^{c}	6,927.00 ± 48.04

$^{a\ b,c}$Means on the same row with different superscripts are significantly different (p<0.05); ^{NS}Not significantly (p>0.05); ₦ = Nigerian Naira; g = gramme; kg = kilogramme

Since there was no difference (p>0.05) in weight between the medium and small grade, the extra ₦ 50 spent to buy the medium grade would be a waste. Therefore, if the buyer is not satisfied with the small grade, they could go for the large grade instead of medium.

The weight per larvae ranged from 2.22 ± 0.03 g (small) to 3.38 ± 0.02 g (large) with average of 2.63 ± 0.02 g. There was significant difference (p<0.05) among the larvae weights. The large grade had the highest weight (p<0.05), followed by the medium grade. But, the larvae weight of medium grade was similar (p>0.05) to that of the small grade. The average weight of larvae in this study was close to 2.47 g reported by Al-Ayedh (2011) for larvae cultured with natural diets. However, since the small and medium grade weighed similar, acquiring the medium grade at higher price will not benefit the buyer.

The price per worm ranged from ₦ 10.00 ± 0.08 (small) to ₦ 28.57 ± 1.01 (large) with average of ₦ 18.41 ± 0.99. The price per worm showed significant difference (p<0.05) among treatment means. The highest (p<0.05) price was recorded for large grade followed by the medium. Nevertheless, the price per worm of the medium grade was not different (p>0.05) from that of the small grade. The price differences among the three grades of larvae correspond to the average weight of similar larvae grades, thus, agreeing with Osho and Uwakonye (2003) that price of meat corresponds with grade of the meat.

The price per gramme and price per kilogramme ranged from ₦ 5.24 ± 0.04 (small) to ₦ 8.14 ± 0.08 (large) and ₦ 5,240.00 ± 23.90 (small) to ₦ 8,260.00 ± 44.08 (large), with averages of ₦6.89 ± 0.59 and ₦ 6,927.00 ± 48.04, respectively. Both parameters showed significant differences (p<0.05) among treatment means. The large grade had the highest price (p<0.05) followed by the medium and small in that order. The prices per gramme and per kilogramme had the similar trends, wherein different grades had significantly different prices and as grades increases, the prices increase. This trend was in agreement with several authors (Steenkamp, 1988; Osho and Uwakonye, 2003; Polkinghorne and Thompson, 2010) that grades of meat determine price and the higher the grade, the higher the price.

Prices of *R. ferrugineus* Larvae Compared to Stewed Chicken Meat Sold in Obio-Akpor: Table 3 compared the selling prices in gramme and kilogramme as well as percentage difference in prices between two animal protein sources (*R. ferrugineus* larvae and stewed chicken meat) sold by retailers in Obio-Akpor.

Table 3: Prices of *Rhychophorous ferrugineus* larvae compared with stewed chicken meat sold in Obio-Akpor

Prices (w/w)	Animal protein source		*Difference (%)*
	R. ferrugineus larvae	*Stewed chicken meat*	
Naira/g	6.89 ± 0.59^{a}	2.04 ± 0.01^{b}	237.75
Naira/kg	6,927.00 ± 48.04^{a}	2,040.00 ± 11.22^{b}	237.75

$^{a\ b,c}$Means on the same row with different superscripts are significantly different (p<0.05); ^{NS}Not significantly (p>0.05); ₦= Nigerian Naira; g=gramme; kg=kilogramme

Table 3 revealed that the price of a kilogramme of edible palm larvae was ₦ 6,927.00 ± 48.04, while that of stewed chicken was ₦ 2,040.00 ± 11.22. Weight-for-weight, the price of a kilogramme of larvae was higher ($p<0.05$) than that of stewed chicken meat by 237.75 %. The relatively higher ($p<0.05$) cost of the larvae could be due to its cultural significance in the dietary habits of the major tribes in Obio-Akpor. The demand and willingness to pay for culturally significant delicacy such as palm weevil worm is rarely constrained by high costs. This is because food–buying decisions which are influenced by culture are rarely rationally. In rational buying decision-making, consumers reduce demand as price increases. For instance, in a country such as Nigeria, where consumers make buying decisions mainly based on price of product, consumers of food delicacies (e.g. oil palm weevil worm), rarely consider price of product as a priority in their buying decision (Akpan, 2016).

Conclusion: The study evaluated the types, grades and prices of ready-to-eat edible palm larvae marketed in Obio-Akpor, Rivers State. There are two types of edible palm weevil larvae sold in the study area: *R. ferrugineus* (soft skinned) and *O. nasicornis* (tough-skinned). The soft-skinned was costlier per kilogramme weight than tough-skinned. Sellers of edible larvae could make more money selling per stick while buyers could gain by buying per worm. Also, consumers prefer and could pay more for *R. ferrugineus*. But, there is no advantage (financial or weight-of-weight) in preferring medium to the small grade.

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