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Assessment of Frog Meat Trade and Nutritional Composition of Selected Anura Species In Ibadan, Nigeria

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Abstract

This study investigated the frog meat trade in Ibadan city. Akinyele and Ibadan northlocal government areas (LGAs) were randomly selected from the five LGAs that make up Ibadan city. Structured questionnaires, field observation, laboratory test and personal interviews were used for data collection. Two sets of structured questionnaires were purposively administered to two categories of respondents in the study area. The first set of questionnaire was administered to all frog sellers (27) available at the markets in the study area. The second set of questionnaire was administered randomly to 100 frog consumers in the two local government areas. Three different species of dried frog specimen were bought from the market and proximate composite analysis was carried out using standard laboratory method (AOAC). Data obtained were analyzed using descriptive statistics while means were compared with Analysis of Variance (ANOVA). Frog meat was mostly consumed in Ibadan by females (80.0%), who were Yorubas (92.0%), and married (84.0%) with family size of 4-6 members (55.0%). Consumption of frog meat is not forbidden by any of the major religions in the study area. Frog traders in the study area were males (100%), Hausas (100%) and Muslims (100%). Majority of the trader respondents were married (77.8%), had a family size of 4 to 6 (63.0%) and were not educated (85.2%). Most traders have marketed frog meat in the community for more than 5 years. *Hildebrandtia ornate*, *Hoplobatrachus occipitalis*, *Ptychadena pumilio* and *Pyxicephalus edulis* were the predominately consumed frogs species in the study area. *Hoplobatrachus occipitalis* the most commercialized species, because of its large size and availability. The proximate analysis conducted showed that *Hildebrandtia ornate* had the highest percentage of moisture (16.57%). This was followed by *Ptychadena pumilio* (14.52%) while *Hoplobatrachus occipitalis* (13.07%) was the least. *Hildebrandtia ornate* also recorded the highest protein content (52.83%) and the lowest crude fat (7.58%). *Hoplobatrachus occipitalis* has protein content of 48.23%, with the highest crude fat percentage of 9.75%. *Hoplobatrachus occipitalis* also had the highest Ash content followed by *Hildebrandtia ornate* and *Ptychadena pumilio* with mean values of 25.49%, 19.6%, and 17.46% respectively. The analysis of variance (ANOVA) showed that there was significant difference in the moisture content, ash content, crude fat and crude protein among the three species of edible anurans at ($p < 0.05$). Frog meat from the four species serves as a good source of protein, minerals and income for the inhabitants of the study area. Hence, frog farming and periodic frog trade monitoring should be encouraged within and outside the study area.

Keywords: Frogs, frog meat, trade, Overexploitation, Consumption, Proximate composition

Introduction

Frogs are Anura in the class of vertebrate known as amphibians (animals that live partly on land and in water). Anura species are eaten in many parts of the world. The meat from frogs, popularly called frog meat has become an alternative source of animal protein for the ever increasing Nigerian population (Altherret *et al.*, 2011, Akinyemi and Efenakpo, 2015). Lameed (2008) identified food shortage as an obvious effect of human population growth and that African countries lie behind other European countries in food production. The shortage of protein as a result of increase in human population has made people to source for other forms of animal protein. This significant shortfall between the production and supply of animal protein to feed the ever increasing human population has led to an immense pressure on the utilization of frogs and other wild games including species that were previously neglected. FAO (2013) predicted that by 2050 people will have no choice but consume insects due to rapid increase in human population. Meanwhile, researches (Staurtet *et al.*, 2004, and 2008) have shown that amphibians are declining world wide as a result of over exploitation and other factors such as diseases and habitat degradation.

In Nigeria, and many other African countries, frogs are heavily hunted and traded majorly for their nutritional and medicinal benefits. This trade is not limited to African countries alone. Altherret *et al.*, 2011 reported that countries such as Belgium, France, USA, Indonesia and Netherlands are actively involved in frog legs trade. Altherret *et al.*, 2011, further identified Indonesia as the largest exporter of frog legs to European countries and that the frogs widely consumed are majorly sourced from the wild. More than 30 countries were reported to be involved in frog trade, which in 1998 was valued to be at approximately USD 48.7 million (Teixeira *et al.*, 2001).

Frog meat is a known trading item in some south western Nigerian markets (Onadeko *et al.*, 2011; Mohnke, 2011, Oduntan *et al.*, 2012, Akinyemi and Efenakpo, 2015). The work of Mohnke, 2011 on the unsustainable use of frogs in West Africa showed that a total of two million, seven hundred and thirty eight thousand six hundred and ten (2, 738, 610) various frog species were collected by thirty two (32) frog collectors annually in south-west states of Nigeria. Although frog farming is vastly practiced in Asia and some European countries, it is relatively new in Nigeria despite the immense pressure on wild species and the huge benefits derived from frog utilization. The farming of these utilized species of frogs in Nigeria has been generally neglected, while the utilization is continuously increasing. This study was therefore carried out in Ibadan Nigeria to assess the demographic characteristics of frog consumers and traders in Ibadan, the source of frog meats traded on, the species of frogs traded and the proximate composition of three majorly consumed species of frogs in the area.

Materials and Method

Study Area

Akinyele and Ibadan North were randomly selected from the five local government areas in Ibadan city. Ibadan city is geographically located on latitude 7°23' 47" N and longitude 3°55' 0" E (Figure 1). Ibadan is the capital of Oyo State.

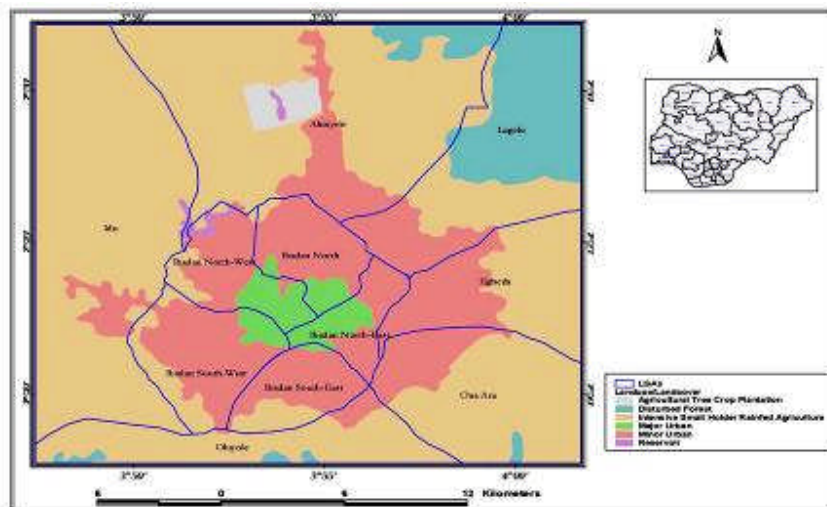


Figure 1: Map of Oyo State showing Ibadan, the study area

Method of Data Collection

Data for the study were obtained through pre-tested semi-structured questionnaires, in-depth interviews and field observations. Two sets of pre-tested semi-structured questionnaires were administered purposively to two categories of respondents. The first set of questionnaire was administered to all frog sellers (traders) available at the markets in each of the two selected local government areas. The second set of questionnaire was administered randomly to 50 frog consumers each from the two local government areas. In all 27 frog traders and 100 frog consumers were interviewed in the study area while traders involved in sales of frogs for medicinal purposes were also interviewed. The questionnaires were written in English to avoid communication problems, all interviews were carried out with the help of field assistants who speaks the local languages (Hausa and Yoruba). In general the questionnaires comprised questions eliciting information on the knowledge/experience the interviewees had concerning utilization/consumption and sales of frogs. Different species of dried frog specimen were bought from the market and taken to the laboratory for identification and proximate composite analysis was carried out using standard laboratory method

(AOAC, 1998). Specimen were blended and the parameters; protein, ash content, moisture and fat percentages were analyzed in three replicate to obtain results.

Moisture Content Determination

The moisture content was determined based on loss of water on drying of the specimen in the oven using the moisture extraction oven method at a temperature of 105 °C. About 5g of the specimen sample was accurately weighed in a dry and clean porcelain dish (crucible). The porcelain dish and the content were transferred into an air-tight oven at 105 °C and were allowed to dry for about 4 hours. It was then transferred into a desiccator and allowed to cool and re-weighed. The difference between the initial and final weight, expressed in percentage, corresponds to the moisture content.

$$\% \text{ Moisture} = \frac{\text{Wet weight} - \text{dry weight}}{\text{Wet weight}} \times 100$$

Ash Content Determination

The ash content was determined by weighing about 5g of specimen sample into a clean dry and weighed porcelain dish. The dish and content were placed over a bunsen burner flame in a fume cupboard and burnt until no more soot was given off. The dish and the content were then transferred into a muffle furnace and heated at 600 °C until it was fully ashed after about 2 hours then it was transferred to a desiccator to cool and the grey ash weighed. The ash content corresponds to the weight difference between the crucible containing the ash and the empty crucible, expressed as a percentage of the mass of sample used.

$$\% \text{ Ash} = \frac{\text{Ash weight (gm)}}{\text{Sample weight (gm)}} \times 100$$

Fat Determination

'Fat and oil' was determined using Soxhlet extraction method. A clean 250 cm³ boiling flasks was dried in an oven at a temperature of 105-110 °C for about 30 minutes and transferred into a desiccator to cool. Thereafter, 2gms of sample was accurately weighed into labeled thimbles and a corresponding labeled, cooled boiling flask was weighed. The boiling flask was filled with 300 cm³ of petroleum ether (boiling point 40 °C – 60 °C) and the extraction thimble was lightly plugged with a cotton wool. The Soxhlet apparatus was assembled and allowed to reflux for about 6 hours, after which the thimble was removed with care and the petroleum ether in the top container of the set-up was collected and drained into a container for re-use. When flask was almost free of petroleum ether, it was removed and dried at 105 °C – 110 °C for one hour after

which it was transferred from the oven into a desiccator and allowed to cool, afterward, weighed and the fat and oil content calculated using the formula below:

$$\% \text{ Fat} = \frac{\text{Weight of fat}}{\text{Wet weight of sample}} \times 100$$

Protein Determination

Method of Digestion (Kejeldahl Digestion Method)

The protein content was determined by the Kejeldahl digestion method. About 2 g of sample was weighed into a Kejeldahl flask with 4 tablets of Kejeldahl catalysts, sodium sulphate (each tablet contains 1gm of Na₂SO₄), 1gm of copper sulphate and 1 tablet of Kejeldahl catalysts selenium (each tablet contains 1gm of Na₂SO₄ + 0.05gm selenium), 25cc concentrated tetraoxosulphate VI acid and 5 glass bead (Glass bead prevent bumping during heating). This was placed in the fume cupboard, heated gently at first and then heat was increased with occasionally shaking till solution assumes a green colour. The Kejeldahl flask is occasionally cooled and black particles, showing at the mouth and neck of the flask were washed down with distilled water then re-heated gently at first, later turned the burner high and heated until the green colour disappeared, and later allowed to cool. After cooling, the digest with several washing was transfer into a 250cc volumetric flask and made up to mark with distilled water and distilled using Markham distillation apparatus.

Method of Distillation (Markham Distillation Method)

Before use, the Markham distillation apparatus was steamed for about 15 minutes, under the condenser, 100cc conical flask containing 5cc of boric acid indicator was placed such that the condenser tip was under the liquid, 5cc of the digest was pipetted into the body of the apparatus via the small funnel aperture afterward washed down with distilled water followed by 5cc of 60% NaOH hydroxide solution. It was steamed through for about 5-7 minutes to collect enough ammonium sulphate. The receiving flask was removed and the tip of the condenser was washed down into flask then the flame removed and the resultant developing vacuum removes the condense water. The solution was titrated in the receiving flask using N/100 (0.01N) hydrochloric acid and then calculated.

Reagents

A. Boric acid indicator

- i. Exactly 0.1% methyl red in ethanol 0.1% methylene blue in water 0.5% boric acid in water was prepared into a 1000cc vol. flask. Exactly 24cc methylene blue + 16cc methyl red were pipetted, mixed well and made up to

the mark with 0.5% boric acid solution. The content was left for about 3 days before use.

B. Sodium hydroxide

- i. Between 40 and 60gms of sodium hydroxide pellets were dissolved into 100cc volumetric flask, containing some quantity of water, and made up to the mark (when cooled) with water. The content was kept tightly stoppered in plastic vessel when not in use.

C. About 0.01N Hydrochloric acid

- i. About 8.9cc of 35% hydrochloric acid was placed into 1000cc standard flask containing about 600cc of distilled water and made up to the mark. This gave approximately 0.1N HCL. This was standardized by titration and then diluted 10 times.

Calculation:

$$\% \text{ Nitrogen} = \frac{V_S - V_B \times N_{\text{acid}} \times 0.01401 \times 100 \times X}{W \times Y}$$

Crude protein = % N x 6.25

Where:

- X = Total vol. of digested sample
 - V_S = Vol. (ml) of acid required to titrate sample
 - V_B = Vol. (ml) of acid required to titrate the blank
 - N_{acid} = Normality of acid 0.01N
 - W = Weight of sample in grams
 - Y = Volume pipette during distillation
- Protein constant = 6.25

Results

Demographic characteristics of respondents

Results on demographic characteristics of respondents in the study area are presented in tables 1 and 2. Table 1 shows consumers’ demographic data such as age, gender, marital status, ethnicity, religion, occupation, family size, literacy level, income and years spent in the study area. The age of consumer respondents ranged from below 30 to 64 years. Majority of the consumers were females (80.0%) and married (84.0%). Almost all the consumers (92.0%) were Yorubas. About 51.0% of the respondents were Muslims while 40.0% were Christians. Many of the respondents (55.0%) had a family size of 4 to 6. About 46.0% of the respondents had no educational background while 27.0% were not formally educated. Majority of the respondents had also lived in the community for more than 10 years (94.0%) and were traders by occupation (51.0%). A large proportion of the respondents (35.0%) earned less than or equal to ₦25,000 as

income.

Table 2 presents the demographic characteristics of frog traders in the study area. According to table 2 all the respondents (100%) were males, Hausas and Muslims with age that ranged from below 30 to 59 years. Majority (77.8%) of the trader respondents were married, had a family size of 4 to 6 (63.0%)and were not educated (85.2%). Most traders have marketed frog meat in the community for more than 5 years.

Table 1: Demographic characteristics of frog consumers in the study area

Parameters/ Variables	Frequency						Percentage (%)					
	ARI	BOD	IJAI	MON	OJO	CF	ARI	BOD	IJAI	MON	OJO	%CF
Age												
[Below 30]	5	4	2	2	5	18	25.0	20.0	10.0	10.0	25.0	18.0
[30-34]	5	3	2	1	5	16	25.0	15.0	10.0	5.0	25.0	16.0
[35-39]	4	2	0	4	1	11	20.0	10.0	0	20.0	5.0	11.0
[40-44]	2	2	3	4	3	14	10.0	10.0	15.0	20.0	15.0	14.0
[45-49]	2	3	3	6	1	15	10.0	15.0	15.0	30.0	5.0	15.0
[50-54]	0	5	9	3	5	22	0	25.0	45.0	15.0	25.0	22.0
[55-59]	1	1	1	0	0	3	5.0	5.0	5.0	0	0	3.0
[60-64]	1	0	0	0	0	1	5.0	0	0	0	0	1.0
[65 and above]	0	0	0	0	0	0	0	0	0	0	0	0.0
Gender												
Male	9	4	0	2	5	20	45.0	20.0	0	10.0	25.0	20.0
Female	11	16	20	18	15	80	55.0	80.0	100	90.0	75.0	80.0
Marital status												
Single	7	5	2	3	7	24	35.0	25.0	10.0	15.0	35.0	24.0
Married	13	11	14	14	12	64	65.0	55.0	70.0	70.0	60.0	64.0
Divorced	0	1	0	0	0	1	0	5.0	0	0	0	1.0
Widow/widower	0	3	4	3	1	11	0	15.0	20.0	15	5.0	11.0
Ethnicity												
Yoruba	13	19	20	20	20	92	65.0	95.0	100	100	100	92.0
Hausa	7	1	0	0	0	8	35.0	5.0	0	0	0	8.0
Religion												
Christianity	6	9	10	7	8	40	30.0	45.0	50.0	35.0	40.0	40.0
Islam	14	10	8	8	11	51	70.0	50.0	40.0	40.0	55.0	51.0
Traditional	0	1	2	5	1	9	0	5.0	10.0	25.0	5.0	9.0
Family size												
[1-3]	8	4	3	5	7	27	40.0	20.0	15.0	25.0	35.0	27.0
[4-6]	9	14	12	9	11	55	45.0	70.0	60.0	45.0	55.0	55.0
[≥7]	3	2	5	6	2	18	15.0	10.0	25.0	30.0	10.0	18.0

Literacy level												
[Nil]	9	6	14	11	6	46	45.0	30.0	70.0	55.0	30.0	46.0
[Informal]	6	7	4	6	4	27	30.0	35.0	20.0	30.0	20.0	27.0
[Primary]	1	0	1	0	2	4	5.0	0	5.0	0	10.0	4.0
[Secondary]	1	2	1	1	0	5	5.0	10.0	5.0	5.0	0	5.0
[OND/HND]	1	1	0	1	2	5	5.0	5.0	0	5.0	10.0	5.0
[Degree/Postgraduate]	2	4	0	1	6	13	10.0	20.0	0	5.0	30.0	5.0
Years in community [<5]												
[<9]	0	1	0	0	0	1	0	5.0	0	0	0	1.0
[≥10]	3	0	1	0	1	5	15.0	0	5.0	0	5.0	5.0
	17	19	19	20	19	94	85.0	95.0	95.0	100	95.0	94.0
Occupation												
Artisan	0	1	0	0	0	1	0	5.0	0	0	0	1.0
Civil servant	0	0	0	0	1	1	0	0	0	0	5.0	1.0
Farmer	0	0	7	7	0	14	0	0	35.0	35.0	0	14.0
Hair dresser	0	0	1	0	0	1	0	0	5.0	0	0	1.0
Housewife	3	1	1	1	1	7	15.0	5.0	5.0	5.0	5.0	7.0
Lecturer	0	0	0	0	1	1	0	0	0	0	5.0	1.0
Self employed	1	0	0	0	1	2	5.0	0	0	0	5.0	2.0
Student	3	3	0	2	4	12	15.0	15.0	0	10.0	20.0	12.0
Tailor	0	2	0	1	2	5	0	10.0	0	5.0	10.0	5.0
Teacher	0	2	0	1	2	5	0	10.0	0	5.0	10.0	5.0
Trader	13	11	11	8	8	51	65.0	55.0	55.0	40.0	40.0	51.0
Salary/ income												
[≤ 10,000]	0	0	0	1	0	1	0	0	0	5.0	0	1.0
[≤ 15,000]	2	2	0	0	1	5	10.0	10.0	0	0	5.0	5.0
[≤ 20,000]	2	4	4	4	5	19	10.0	20.0	20.0	20.0	25.0	19.0
[≤ 25,000]	11	3	12	4	5	35	55.0	15.0	60.0	20.0	25.0	35.0
[≤ 30,000]	3	6	1	8	4	22	15.0	30.0	5.0	40.0	20.0	22.0
[≤ 35,000]	1	2	3	1	3	10	5.0	10.0	15.0	5.0	15.0	10.0
[≤ 40,000]	1	0	0	2	0	3	5.0	0	0	10.0	0	3.0
[≤ 45,000]	0	1	0	0	0	1	0	5.0	0	0	0	1.0
[≥50,000]	0	2	0	0	2	4	0	10.0	0	0	10.0	4.0

Note: ARI= Arisekola, BOD=Bodija, IJAI= Ijaiye, MON = Moniya, OJO = Ojoo, CF= Cumulative frequency, %CF= Percentage of cumulative frequency

Source: Field survey 2014

Table 2: Demographic characteristics of frog traders in the study area

Parameters/ Variables	Frequency						Percentage (%)					
	ARI	BOD	IJAI	MON	OJO	CF	ARI	BOD	IJAI	MON	OJO	%CF
Age												
[Below 30]	1	2	0	1	3	7	16.7	28.6	0	16.7	100	25.9
[30-34]	0	0	1	3	0	4	0	0	20.0	50.0	0	14.8
[35-39]	3	2	2	0	0	7	50.0	28.6	40.0	0	0	25.9
[40-44]	2	0	0	2	0	4	33.3	0	0	33.3	0	14.8
[45-49]	0	1	1	0	0	2	0	14.2	20.0	0	0	7.4
[50-54]	0	0	1	0	0	1	0	0	20.0	0	0	3.7
[55-59]	0	2	0	0	0	2	0	28.6	0	0	0	7.4
[60-64]	0	0	0	0	0	0	0	0	0	0	0	0
[65 and above]	0	0	0	0	0	0	0	0	0	0	0	0
Gender												
Male	6	7	5	6	3	27	100	100	100	100	100	100
Female	0	0	0	0	0	0	0	0	0	0	0	0
Marital status												
Single	0	2	0	2	2	6	0	28.6	0	33.3	66.7	22.2
Married	6	5	5	4	1	21	100	71.4	100	66.7	33.3	77.8
Divorced	0	0	0	0	0	0	0	0	0	0	0	0
Widow/widower	0	0	0	0	0	0	0	0	0	0	0	0
Ethnicity												
Yoruba	0	0	0	0	0	0	0	0	0	0	0	0
Hausa	6	7	5	6	3	27	100	100	100	100	100	100
Religion												
Christianity	0	0	0	0	0	0	0	0	0	0	0	0
Islam	6	7	5	6	3	27	100	100	100	100	100	100
Traditional	0	0	0	0	0	0	0	0	0	0	0	0
Family size												
[1-3]	1	2	2	2	2	9	16.7	28.6	40.0	33.3	66.7	33.3
[4-6]	5	5	2	4	1	17	83.3	71.4	40.0	66.7	33.3	63.0
[≥7]	0	0	1	0	0	1	0	0	20.0	0	0	3.7
Literacy level												
[Nil]	6	5	4	5	3	23	100	71.4	80.0	83.3	100	85.2
[Informal]	0	1	0	1	0	2	0	14.3	0	16.7	0	7.4
[Primary]	0	1	1	0	0	2	0	14.3	20.0	0	0	7.4
[Secondary]	0	0	0	0	0	0	0	0	0	0	0	0
[OND/HND]	0	0	0	0	0	0	0	0	0	0	0	0
[Degree/Postgraduate]	0	0	0	0	0	0	0	0	0	0	0	0
Years in trade												
[<5]	1	3	2	3	2	11	16.7	42.8	40.0	50.0	66.7	40.7
[<9]	1	2	1	2	1	7	16.7	28.6	20.0	33.3	33.3	26.0
[≥10]	4	2	2	1	0	9	66.6	28.6	40.0	16.7	0	33.3

Note: ARI= Arisekola, BOD=Bodija, IJAI= Ijaiye, MON = Moniya, OJO = Ojoo, CF= Cumulative frequency, %CF= Percentage of cumulative frequency Source: Field survey 2014

Species of Frogs marketed for consumption in the study area

Plates 1, 2, 3, and 4 show African tiger frog (*Hoplobatrachus occipitalis*), African bull frog (*Pyxicephalus edulis*), *Hildebrandtia ornate* and *Ptychadena pumilio* respectively as the frog species marketed for consumption in Ibadan.



Plate 1: African tiger frog (*Hoplobatrachus occipitalis*) exhibited for sales at Bodija market



Plate 2: African bull frog (*Pyxicephalus edulis*) from Moniya market Ibadan



Plate 3: *Hildebrandtia ornate* used for food



Plate 4: *Ptychadena pumilio* used for food

Source of consumed frogs in Ibadan and numbers of people engaged in farming

Results on source of frogs consumed in Ibadan and respondents willingness to engage in frog farming are presented in table 3 and plate 5. Table 3 shows that all consumer respondents (100%) bought the frog meat consumed from traders (plate 5). About 40.0% of consumer respondents claimed that the traders always had frogs for sales while 57.0% perceived that the availability of frogs for sale is once in a week. None of the respondents was aware of any frog farm in Nigeria. All trader respondents (100%) sourced frogs for sale outside the study area (plate 6). Kebbi state was identified as the highest source of frogs in the study area. Plate 6 shows frog sellers in Bunza market Kebbi state preparing the frogs before shipment to other parts of Nigeria while plate 7 shows species of frogs have been packaged for export.

Table 3: Source of consumed frogs in Ibadan and numbers of people engaged in farming

Parameters /Variables	Arisekola	Bodija	Ijaiye	Moniya	Ojoo	Total	% CF
Consumers							
Source of frog meat							
Traders	20	20	20	20	20	100	100
Collectors	0	0	0	0	0	0	0
Regularity of sale							
Always	20	20	0	0	0	40	40.0
Once in a week	0	0	20	20	17	57	57.0
Once in 2 weeks	0	0	0	0	3	3	3.0
Once in a month	0	0	0	0	0	0	0
Consumer’s awareness of frog farms in Nigeria							
Aware	0	0	0	0	0	0	0
Unaware	20	20	20	20	20	100	100
List of frog meat markets consumers buy from							
	Arisekola	Bodija	Ijaiye	Moniya	Ojo		
	Bodija	Oje					
		Arisekola					
Traders							
Source of frog meat							
Traders	20	20	20	20	20	100	100
Collectors	0	0	0	0	0	0	0
Traders awareness of frog farms in Nigeria							
Aware	0	0	0	0	0	0	0
Unaware	20	20	20	20	20	100	100
List of frog meat markets traders buy fro							
	Kano	Arisekola	Arisekola	Arisekola	Arisekola		
	Kebbi	Kebbi	Bodija	Kebbi	Bodija		
	Maiduguri	Niger	Niger	Sokoto			
	Niger	Sokoto	Sokoto	Zamfara			
	Sokoto	Zamfara	Zamfara				
	Zamfara						

Source: Field survey, 2014



Plate 5: Selling of frogs at Moniya market in Akinyele local government area, Ibadan

Source: Field survey, 2014



Plate 6: A frog sellers in Bunza market, Kebbi state preparing the frogs before shipment to other parts of Nigeria



Plate 7: Frog species packaged for export to Ibadan

Proximate Compositions of Some Consumed Frogs in Ibadan

Results on proximate analysis of three majorly consumed frogs in Ibadan are presented in table 4. *Hildebrandtia ornate* (16.57%) had the highest percentage moisture content. This was followed by *Ptychadena pumilio* (14.52%) while *Hoplobatrachus occipitalis* (13.07%) was the least. *Hildebrandtia ornate* also recorded the highest protein content (52.83%) and the lowest crude fat (7.58%). *Hoplobatrachus occipitalis* has protein content of 48.23%, with the highest crude fat percentage of 9.75%. *Hoplobatrachus occipitalis* also has the highest Ash content followed by *Hildebrandtia ornate* and *Ptychadena pumilio* with mean values of 25.49%, 19.6%, and 17.46% respectively. All samples recorded 0 % for fiber content. The analysis of variance (ANOVA) showed that there was significant difference in the moisture content, ash content, crude fat and crude protein among the three species of edible anurans at ($p < 0.05$).

Table 4: Proximate composition of Anuran Species sold in Ibadan

Parameters	<i>Hoplobatrachus occipitalis</i>				<i>Hildebrandtia ornate</i>				<i>Ptychadena pumilio</i>			
Moisture (%)	13.13	12.92	13.15	*13.07	16.53	16.43	16.74	*16.57	14.47	14.52	14.58	*14.52
Ash content (%)	25.49	25.54	25.45	*25.49	19.55	19.61	19.64	*19.6	17.42	17.49	17.47	*17.46
Crude Fat (%)	9.65	9.69	9.91	*9.75	7.54	7.58	7.61	*7.58	8.49	8.41	8.52	*8.47
Crude fibre (%)	0.00	0.00	0.00	*0	0.00	0.00	0.00	*0	0.00	0.00	0.00	*0
Crude Protein (%)	48.16	48.16	48.38	*48.23	52.98	52.76	52.76	*52.83	49.25	49.22	49.19	*49.22

Note: Samples analyses were carried out in 3 replicate, * represent the mean sample
 Source: Laboratory Analysis, 2014

Discussion

Demographic Characteristics of frog consumers in Ibadan

Majority of the consumers fall within the age range of <30 and 54 years; which shows that many age classes consume frogs and rely on it as the source of dietary animal protein and minerals. The fact that a greater percentage of the respondents (80%) are females shows that frogs are well consumed in the study area. This is because females appear to be more selective than males in terms of food consumption in most areas. Majority of the consumer respondents are married (64%). This could be attributed to the fact that married people have relatively larger family sizes (table 1), face more survival challenges and therefore look for different means of survival (to cope) than singles. The study area, Ibadan is dominated by Yorubas who predominantly practice either Christianity or Islam religion. Consumption of frog is not abhorred by any of these predominant religions, unlike pigs that its consumption is forbidden by Muslims. Consumption of frogs by singles (24%) and respondents with less family size of 1-3 members (27%) shows that the species is not only consumed as a coping strategy but because of its desirability by

respondents. Nevertheless, it is more consumed by none educated respondents such as farmers and traders who are closer to the environment and poorer in many communities. About 20% and 30% of consumer respondents in Bodija and Ojoo are graduates. The two communities are close to the University of Ibadan and the polytechnic, Ibadan, which are major higher institutions in the study area. Students from these institutions patronize markets in both Bodija and Ojoo. Some of the students desire to consume frog meat. Majority of the consumers have spent up to ten years in the study area and therefore are quite aware of markets to procure frog meats in the study area.

Demographic Characteristics of frog traders in Ibadan

Most trader respondents are within the age range of below 30 and 44 years. This shows that respondents venture into the business early in life, at the age when they can travel from the northern part of Nigeria to western Nigeria. Only males at their active age can embark on such business that requires the risk of consistently travelling for long distances. All the trader respondents are Hausas and Muslims. Hausa Muslims marry early and start early to raise children. With relatively large family size respondents face the challenge of coping with little or no income and are forced to embark on such business. The fact that the respondents join the frog business early discourages them from becoming educated (table 2). Similar report was given by Ijeomah and Emodi (2012) in Pandam rural community of Plateau State. The experience of the traders spans from < 5 to > 10 years as the Hausas who dominate the business continuously introduce younger kinsmen into the business.

Predominantly consumed frog species

Hildebrandtia ornate, *Hoplobatrachus occipitalis*, *Ptychadena pumilio* and *Pyxicephalus edulis* were the predominately four frogs species utilized for food in the study area (Table 2). *Hoplobatrachus occipitalis* the most commercialized species, because of its large size. This result however, does not agree with the findings of Oduntan *et al.* (2012) but collaborated with the findings of Onadeko (2011) and Mohneke (2011).

Sources of frogs consumed in Ibadan

The frogs sold and consumed in the study area are not sourced therein, but from some northern states of Nigeria. This is because there are no frog farms in Ibadan. The fact that the frogs sold and consumed in the study area are imported from other states relatively protects the wild frogs in Ibadan from over exploitation. Among the northern states the traders admitted buying mostly from Kebbi and Sokoto states (Plate 6). The presence of transborder trade between Nigeria and Niger Republic and also Benin Republic was also mentioned by some traders. This result collaborated with the findings of Mohneke (2011) that identified frog meat being transported from northern part of Nigeria to south western states of Nigeria.

However, many sellers from Kebbi and Niger states harvest commercial quantities of frogs from the wild.

Nutritional Compositions of Consumed Frogs in Ibadan

All samples recorded 0 % of fiber content which conforms to animals having no fibre content thus allowing the three frog species to have high protein content. The analysis of variance (ANOVA) showed that there was significant difference ($p < 0.05$) in the moisture content, ash content, crude fat and crude protein among the three species of edible anurans. The consumers acquired more of the African tiger frog (*Hoplobatrachus occipitalis*) despite having lower protein content compared to *Hildebrandtia ornate*. This implies that the availability and size of the species were the major factors considered by the respondents for buying the species especially as consumers were unaware of the nutritional composition of various species. In buying most non timber forest products consumers always use size as a parameter to assess quality of products.

Conclusion and Recommendations

Frog meat is a traded commodity and a source of livelihood to traders in Ibadan, Nigeria. Various species of frogs such as the *Hildebrandtia ornate*, *Hoplobatrachus occipitalis*, *Ptychadena pumilio* and *Pyxicephalus edulis* are marketed for food in the study area. Despite the enormous quantities of frogs marketed in the study area the frog species were not sourced locally from the wild in Ibadan but were from northern part of Nigeria. The quantity of frogs supplied at a time (to Ibadan alone) from the northern states of Nigeria is so enormous that if frog farms are not established in many communities in Nigeria the wild stock would soon become depleted. Efforts should be made to protect frog species in their natural habitats through community participation and conservation studies. The marketing of frogs should be monitored and regulated in Nigeria and Ibadan city in particular as the increase in frog trade puts a lot of pressure on wild frog species.

Further researches should be carried out on:

- a) Level of hygiene and the possibilities of infestations from disease causing pest/pathogens on the traded frog meat in order to safe guard the health of frog meat consumers.
- b) Population dynamics of the wild species for proper planning and improvement of its conservation strategies.

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