AJSR
AFRICAN JOURNAL OF SCIENCE AND RESEARCH

African Journal of Science and Research,2016,(5)3:16-20
ISSN: 2306-5877
Available Online: http://ajsr.rstpublishers.com/

CONSUMPTION, PROXIMATE AND MINERAL COMPOSITION OF EDIBLE FROG *HOPLOBATRACHUS OCCIPITALIS* FROM MIDWEST AREAS OF CÔTE D'IVOIRE.

Yatanan Casimir Blé[1*], Bassa Antoine Yobouet[1,2], Adjéhi Dadié[1]

1)Université Nangui Abrogoua, Abidjan, Côte d'Ivoire, Department of Food Science and Technology, Laboratory of Biotechnology and Food Microbiology, Abidjan, Côte d'Ivoire.
2) Centre Suisse de Recherches Scientifiques, Abidjan, Côte d'Ivoire.
Email: yatanan12@hotmail.fr

Received:21,Apr,2016 ***Accepted:30,May,2016***

Abstract

Nowadays, there has been the recrudescence of frog meat consumption to cover the deficit in animal protein in Côte d'Ivoire. The study aimed to determine the rate of frog meat consumption and to evaluate their proximate and mineral composition. A survey was performed in seven localities with 1,020 households. The information about, species of frog consumed, consumption patterns, frequency of consumption were collected. Then, 60 samples of smoked frog Hoplobatrachus occipitalis were obtained from three markets were analyzed. Result showed that 563 (55.2%) households consumed frog meat. Frog meat was mainly consumed in smoked form cooked in sauce (37.7%) and fresh form cooked in sauce (32.3%). The crude protein, ash, and fat content expressed in mg/100g dry weight in the samples ranged from 53.7 - 75.5; 5.7 - 8.7 and 8.7 - 10.2 respectively. The gross energy value varies between 300.9 Kcal/g to 380.3 Kcal/g. Among the mineral determined, calcium (27.2 - 59.9 mg/g) was found to be highest followed by potassium (35.9 - 37.7 mg/g). The result revealed that H. occipitalis is a good source of protein and dietary mineral and it is therefore considered to be a rich source of essential nutrients for human nutrition and other omnivorous.

Keywords: *Frog consumption, Hoplobatrachus occipitalis, Proximate analysis, Mineral content, Côte d'Ivoire.*

INTRODUCTION

The frog meat is an attractive food choice in high-class restaurants in Europe (Cagiltay et al., 2014). Worldwide, more than 50 species of frogs are harvested from nature for human consumption (Neveu, 2004). The largest exporter of wild frog is Indonesia followed by Vietnam and Turkey while the largest importers are Belgium, France, Netherland and Italy (Altherr et al., 2011). The annual aquaculture production of frog in the world according to data from the United Nations Food and Agriculture Organization (FAO, 2012) was estimated at 80,000 t in 2010. Several studies have shown that frog meat had good nutritional composition and it is used as protein source in the diet of many consumers (Özogul, et al., 2008; Onadoke et al., 2011). They also contain essential fatty acids omega 3 and 6 who have an important role in human nutrition and nutritional physiology (Davis and Kris-Etherton , 2003). Frogs meat provide between 5% and 45% of daily mineral requirement of a human body for a consumption of one hundred grams of meat (Cagiltay et al., 2014). Frogs are eaten in several countries in Africa and the most consumed species are *Pyxicephalus adspersus* TSCHUDI, 1838, *P. edulis* PETERS, 1854, *Hoplobatrachus occipitalis* (GÜNTHER 1858), *Trichobatrachus robustus* BOULENGER, 1900, *Conraua* spp. or *Ptychadena* spp. (Mohneke et al., 2009). In some regions of Asia (Indonesia) and Africa (Nigeria), frogs are referred to as "jumping chickens," as the taste is perceived to be similar to chicken (Altherr et al., 2011). The frog meat is also appreciated and compared to fish and chickens because of their excellent taste, flavor and texture (Çaklı et al., 2009; Bahar et al., 2008).

In Côte d'Ivoire, frogs meat are traditionally used to supplement the diet of different ethnic groups from the west (Yacouba, Guéré, Wobé) where it serves as an important source of animal protein very highly appreciated by the consumers (Mohneke et al., 2010; Tohé et al., 2014). Frog meat is consumed by all social classes and all age. It is consumed preferentially smoked and fresh cooked in sauce with or without skin after evisceration. Nowadays, frog meat consumption could be widespread to neighboring regions (Midwest and central) due to rural migration and ethno-cultural mixing of populations. This is also observable in the south where frog consumption is very appreciated in restaurants of Abidjan and the most consumed species is *Hoplobatrachus occipitalis* (Tohé et al., 2014). Bushmeat serves as an important source of animal protein in both rural and urban households throughout Africa (Oduntan et al., 2012). Since banning of wild animal (Bushmeat) consumption, the population with low income has difficulties to afford other animal protein such as fish, cattle, chicken and pig because there are very expensive. For this reason, as an alternative source of animal protein, frog meat principally *Hoplobatrachus occipitalis* is increasingly consumed in many households in Côte d'Ivoire to cover the deficit in animal protein.

However, to our knowledge, there is no scientific data available about proximate composition and mineral content of edible frog *Hoplobatrachus occipitalis* in Côte d'Ivoire. Most studies on frogs were focused on taxonomy, systematics and diet (Tohé et al., 2014). The present study aimed to determine the rate of frog meat consumption and to evaluate the proximate composition and mineral content of edible smoked frog meat *Hoplobatrachus occipitalis*.

METHODOLOGY

Data collection

Between December 2014 and April 2015, a household cross-sectional survey pertaining to the consumption of frog meat was performed in the district of Abidjan, (Abobo, Yopougon and Port Bouët) and in the six municipalities located in the west and midwest of Côte d'Ivoire including Man, Issia, Zoukougbeu, Guessabo, Daloa and Sinfra selected after exploratory visits. In total 1,020 households was surveyed in this study with 423 females (whose 195 consumers) and 597 males (whose 368 consumers). Age of respondents varied from 16 to 69 years and one person (father, mother or young adults) was randomly selected to answer questions in each household. The questionnaire included questions eliciting information about consumption patterns and frequency of frog meat consumption.

Frog species consumed by the population were determined using a direct visual observation of frog photographs previously taken on the frog markets in each municipality according to the method described by Mohneke et al. (2010).

Sample Collection

A total of 60 samples of smoked *Hoplobatrachus occipitalis* were collected on three markets including Issia, Daloa and Issia (Midwest of Côte d'Ivoire). The species *Hoplobatrachus occipitalis* was chosen because it was the most consumed and sold in markets. All frogs sampled on the market were eviscerated and heart, kidney, lung and intestines were taken off and the carcass were smoked with the skin.

Evaluation of proximate composition

In the laboratory, each carcass of frog was washed dissected into small piece and were ground in the blender. Moisture, protein, fat, and ash contents of frog meat samples were determined following the standard procedures.

The moisture content of smoked frog were determined according AOAC method (1995) by drying 3 g of ground sample at 105°C until the weight became constant. Each value was an average of three measurements.

The crude ash was carried out by incineration of 1 g of ground sample in an oven at 550°C for 6 hours until the weight became constant (BIPEA,1976). Each analysis was done in triplicate. For the determination of crude protein, 1 g of ground sample was used according to BIPEA method (1976) using Kjeldahl. The protein content from each sample was expressed by multiplying the nitrogen content by 6.25 the conversion factor.

Crude fat was extracted by Soxhlet method according to AOAC (1995). About 10 g of ground sample was introduced into a cartridge and then introduced into an extractor. Then, 300 ml of hexane are introduced into a pre-weighed flask. The extraction was done at the solvent reflux for 6 hours. After 6 hours, the extraction flask is removed from the Soxhlet apparatus and the solvent evaporated on a rotary evaporator. The flask containing the fat is dried in an oven at 70°C for 12 hours and weighed. All samples were done in triplicate and result expressed as average of each element.

Determination of energy value in Kilocalorie

The energy value was calculated in kilocalories per 100g (kcal/100 g) by using specific Atwater and Benedict factors (1902) 4 kcal/g and 9 kcal/g for proteins and lipids respectively.

Mineral analysis

Minerals determined in this study were calcium, sodium, phosphorus, potassium, magnesium, manganese, zinc and iron. The determination of minerals was carried out by atomic absorption air-acetylene flame AAS 20 VARIAN. About 1 g of dried sample was placed in the crucible and then pre-calcined at 200°C for one hour, the calcined at high temperature 550°c for 6 h in an oven until the obtaining a white ash. After cooling, 5 ml of 1 N nitric acid (HNO_3 6M) was added to the resultant ashes, and the mixture was stirred on a hotplate until dryness. Then 5 ml of the nitric acid (HNO_3 3M) was added to the residue and the mixture was placed again in an oven for 30 min. The residue was recovered in 10 ml of hydrochloric acid and then placed in flask. The elements contained in the solution were determined by Atomic Absorption Spectrometry.

Data analysis

All data collected were double entered and analyzed using STATISTICA software version 7.1. Results are expressed as mean± standard deviation. The average of frog meat consumed per person per week was calculated taking into account the total number of frog consumed per meal, the size of the person in the household and frequency of frog consumption.The normality of data was tested with a Kolmogorov-Smirnov test and histogram frequencies. Non normally distributed data were normalized using the appropriate transformations. A one-way analysis of variance (ANOVA) was employed to determine the significance of differences means calculated. The differences were considered to be significant at $p<0.05$ using the HSD Tukey test.

RESULTS AND DISCUSSION

Frog meat consumption

Our results show that frog meat consumption mean rate was 55.2% (563/1020) and varied according to the municipalities, with a decreasing order: Man (75.8%), Zoukougbeu (70.3%), Issia (68.3%), Sinfra (66.4%), Guessabo (63.2%), Daloa (56.1%) and Abidjan (33.2%). The general rate consumption (55.2%) was lower than that obtained in Ganzougou (67.0%) in Burkina Faso during a survey conducted by Mohneke et al. (2010), but higher than that recorded in the southwest region of Nigeria (43.0%) (Onadoke et al., 2011).

Only frog meat consumers were included (n = 563 households) in further calculations.

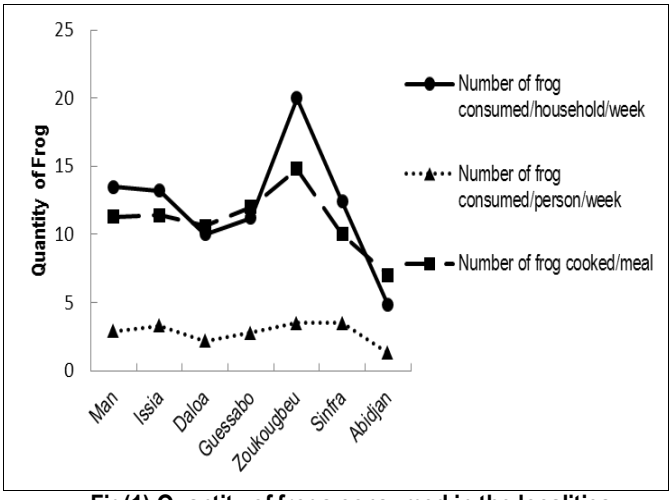
Frog meat was consumed by all social classes and all age bracket with a mean age of 33 ± 11 years. Frog meat was consumed preferentially in four different patterns: smoked cooked in sauce (37.7%), fresh cooked in sauce (32.3%), fried (1.9%) and braised (1.1%). Frog meat was consumed at home or in restaurants and in local beverage stands. Frog species consumed were *Hoplobatrachus occipitalis* (87.4%) against 12.6% for *Ptychadena* sp. and 4.7% for *Aubria* sp. This result is in line with the findings of Onadeko et al. (2011) and Akinyemi and Ogaga et al. (2015). In our study, the majority of consumers (60.6%) ate frog meat with a skin (Table 1). This practice did not agree with those reported by other authors such as Jenkins et al. (2009), and Neang (2010).

Table(1) Characteristics of frog meat consumer (n = 563)

Characteristics	Number of consumers (n=563)	Percentage (%)
Sex of consumers		
Male	368	65.4
Female	195	34.6
Educational level of consumers		
Uneducated	122	21.7
Primary school level	138	24.5
Secondary school level	187	33.2
University graduate	116	20.6
Frog meat consumption patterns		
Frogs unskinned	341	60.6
Frogs skinned	185	32.9
Frogs skinned and unskinned	37	6.6
Frequency of frog consumption		
One to 5 days/week	270	48
Occasionally (at least once/month)	293	52

The quantity average of frog meat consumed per person per week contain varies from 0.14 to 18 frogs with an average consumption per person per week 2.6 frogs. The average of weekly consumption per household is 11 frogs (min = 0.4, max = 90 frogs). These values vary from locality to another. Zoukougbeu had recorded the highest values. The quantity average of frog consumed per household per

week Zoukougbeu was 20 frogs following Man (13.5 frogs) and Issia (13.2 frogs). (Figure 1). The average amount of frog consumed per household per week (11.1 frogs) is much lower than that reported by Altherr et al. (2011) obtained in Burkina Faso (120 frogs). This would explained by several reasons including low supply of frog markets and the level of live of population surveyed. Indeed, harvesting of amphibians is often associated with the rural poor supplementing their diet with any available protein (Neang, 2010).



Fig(1) Quantity of frogs consumed in the localities

Proximate composition

Proximate composition of *H. occipitalis* is given in table 2. The results showed that the protein content was between 53.7 ± 0.5 and 75.5 ± 0.6. The highest protein content (75.5 ± 0.6 g / 100 g) was found in Issia market samples followed by those collected to Daloa (71.8 ± 0.8 g / 100 g) and Sinfra (53.7 ± 0.5 g / 100 g).

Fat content varied from 8.7 ± 0.1 to 10.2 ± 0.1 g / mg. Ash crude in smoked frog ranges from 5.7 ± 0.1 g / 100 g to 8.7 ± 0.1 g / 100 g with the highest rate recorded at Issia sample and lowest in Daloa market. The difference was significant between the values obtained ($P < 0.05$). The results recorded in this study are higher than those obtained by Onadeko et al. (2011) in Nigeria on the same species with 19.46±1.02% protein; 1.28 ± 0.14% ash and 1.06 ± 0.15% fat. Moreover, Baygar et al. (2010) showed that smoked meat of *Rana esculenta* frog contained a low protein content 25.55 ± 1.51%; 1.23 ± 0.17% lipid and 1.05 ± 0.34% ash compared to our results. The slightly higher ash content in our work would be explained according to Adebayo-Tayo et al. (2008) by the dirt on the frog meat during their drying on the ground in the open market. In other studies on sun-dried *R. esculenta* Odunta et al. (2012) found 6.95% protein and 2.09% of lipid content. While the following results: 19.23% protein, 0.80% ash and 0.80% lipid were recorded in the analysis of *R. esculenta* leg (Özogul et al., 2011). The analysis has revealed that *Pelophylax esculentus* contains 31.17% protein crude; 8.93% ash and 3.49% moisture (Mathew et al., 2015). The results showed a variation in the chemical composition according to the sites. These variations can be probably due to several factors such as climate, location, age of frogs and diet (Ojewola and Udom, 2005). However, many studies on other species of frogs showed high levels of protein, lipid, ash and moisture than those found in *H. occipitalis* in our investigations. Indeed, Ozogul et al. (2015) found 95.05% of protein crude in a study on *Rana esculenta* collected in Turkey in Curkuroya region. Appreciable crude protein value (68.6%) was also recorded for the same frog (*R. esculenta*) by Baygar et al. (2010) and it is higher than the results obtained at Sinfra samples. The crude ash (43.23%) and moisture content (9.0%) were found high in *R. esculenta* meat (Oduntan et al., 2012). In regard to moisture rate in our smoked samples, the results were found to be lower than the findings of Adebayo-Tayo et al. (2008). The low moisture content recorded indicate that the smoked frogs were sufficiently dried before selling and that could explain this difference.

Lipid level in the analysis performed by Mathew et al. (2015) was 16.22 ± 0.16% for *Pelophylax esculentus* founded in Hanyan Gwari region (Nigeria). Our data at Issia market sample were near to those of several authors. Adebayo-Tayo et al. (2015) found 53.98% a 52.39% crude protein for *aubria* sp collected in different markets.

A similar trend was observed by Muhammad and Ajiboye (2010) on *Rana galamensis* with 53.73 ± 0.89% protein and 9.52 ± 0.31% lipid content.

The protein content in smoked *Hoplobatrachus occipitalis* in this study was higher than those reported in bush meat such as Griant rat; Grasscutter and Griant Tree squirrel with 48.64%, 22.7%; 28.72% crude protein respectively Oduntan et al. (2012) and local chicken (Tougan et al., 2013).

The gross energy values obtained ranges from 300.9 kcal to 380.3 kcal show that *H. occipitalis* is a good energetic source compared to that of *lithobates catesbeianus* (74.89 kcal) found in the study of Rodrigues et al. (2014) and an unidentified frog (1.668 kcal) revealed by Ojewola and Udom (2005). But ours values are lower than that the edible frog *Pelophylax esculentus* registered in Nigeria which was 506.17 kcal / 100 g.

Table(2)Proximate composition [g/100 g of DM] of smoked frog *Hoplobatrachus occipitalis*

	Proximate composition [g/100g of DM]		
Parameters	Issia	Daloa	Sinfra
Moisture	5.8 ± 0.1^{a}	5.7 ± 0.1^{a}	5.1 ± 0.1^{b}
Ash	8.7 ± 0.1^{a}	5.7 ± 0.4^{b}	5.8 ± 0.3^{c}
fat	8.7 ± 0.2^{a}	10.2 ± 0.1^{b}	9.6 ± 0.1^{c}
Protein	75.5 ± 0.6^{a}	71.8 ± 0.8^{b}	53.7 ± 0.5^{c}
Energie [Kcal/100g DM]	380.3 ± 2.9^{a}	378.9 ± 3.8^{a}	300.9 ± 2.4^{b}

In a row, means values followed by different superscript are statistically different ($P < 0.05$), *DM: Dry matter

Mineral composition

The macro minerals determined in this study were calcium, potassium, phosphorus and magnesium. The results of the mineral composition are depicted in Table 3.

Table(3)Mineral contents (mg/100g) of smoked frog *Hoplobatrachus occipitalis*

	Mineral Composition [mg/100g of DM]		
	Issia	Daloa	Sinfra
Macro-mineral			
Calcium	59.9 ± 1.2^{a}	43.7 ±1.1^{b}	27.2 ± 0.5^{c}
Potassium	35.9 ± 0.4^{ab}	35.8 ± 0.5^{a}	37.7 ± 0.7^{b}
Phosphorus	27.5 ± 1.1^{b}	23.8 ± 0.5^{c}	34.4 ± 1.1 ^{a}
Magnesium	27.1 ± 0.6^{a}	27.5 ± 0.5^{a}	18.1 ± 0.7 ^{b}
Total	150.4 ± 3.3	130.8 ± 2.1	117.3 ± 3.0
Micro-mineral			
Iron	0.4 ± 0.01^{b}	0.6 ± 0.0^{a}	0.2 ± 0.0^{c}
Zinc	0.3 ± 0.0^{b}	0.2 ± 0.0^{c}	0.1 ± 0.0^{a}
Manganese	0.1 ± 0.01^{a}	0.1 ± 0.0^{a}	0.05 ± 0.0^{b}
Total	0.8 ± 0.02	0.9 ± 0.0	0.35 ± 0.0

In a row, means values followed by different superscript are statistically different ($P < 0.05$)

Among the macro- mineral determined, calcium was found high amounts (27.2 - 59.9 mg/g) on the three sites. The phosphorus content was between 23.8 mg / 100 g and 34.4 mg / 100 g with the lowest value obtained in Sinfra market. The significant variation observed could be attributed to the geographical position of sampling sites (Rao Subba et al., 2010). Our study shows that *H. occipitalis* has a low mineral content compared to those reported by several authors on different species of frogs. Odunta et al. (2012) obtained in mg per 100 g/DM frog meat: 1701 Mg, 982 K, 23371 Ca and 390 Fe. A similar study was investigated by Cagiltay et al. (2014) on the frog *Rana ridibunda* and theirs results have given 0.55 mg/100 g Fe; 17.00 mg/100 g Mg; and. Also according to Muhammad and Ajiboye (2010), *R. galamanensis* contained: 59.0 mg Fe; 429 mg Mg; and 2105 Ca.

The micro-mineral content such as calcium, potassium and magnesium obtained in the present study were higher than those of *Rana esculenta* reported by Özogul et al. (2008) and Cagiltay et al. (2014). Our data indicate that this frog contained essential mineral for human. Potassium plays an important role in the synthesis of amino acids and proteins (Savadogo et al., 2011). Some mineral like such as calcium and phosphorus, are involved in bone strengthening of adults and promote also the growth of children (Schapira, 1981).

CONCLUSION

This study is, to our knowledge, the first that reported the rate of frog consumption and the proximate and mineral composition of frog meat in Côte d'Ivoire. Frog meat consumption mean rate was 55.2% and the consumption of frog meat was extended from the west to the midwest areas. The result obtained from the chemical analysis of smoked *H. occipitalis* showed that this frog was rich in minerals, in protein and presented a high energy value. Thus, they could contribute significantly to remedy the protein and energy malnutrition in Côte d'Ivoire. This finding allows us to consider frog meat as an alternative protein source for human nutrition and other omnivorous.

Acknowledgements

We are sincerely thankful to all our partners including frog collectors, sellers and consumers of frog meat in various localities visited. We are indebted to the staff of Microbiology and Food Safety research and the team of the laboratory of Fishing and Aquaculture pole of Université Nangui Abrogoua, who helped to identify this specie.

Declaration of conflicting of interests

Authors declared that there is no conflict of interest concerning this manuscript.

References

1)Adebayo-Tayo BC, Adeyemi F, Odeneyi O, Olaseinde K. (2015). Mycoflora, Mycotoxine contamination and proximate mineral compositionof smoke-dried frog (*Aubria* sp.) (Konko) sold in Ibadan Oyo State, Nigeria. Turkish *Journal Agriculture-Food Science and Technology*, 3(11), 894-903.

2)Akinyemi A, Ogaga, RD. (2015). Frog Consumption pattern in Ibadan, Nigeria. *Journal for Studies in Management and Planning*; 1(3), 522-531.

3)Altherr S, Goyenechea A; Schubert DJ. (2011). Canapés to extinction: The international trade in frog's legs and it ecological impact. A report by Pro Wildlife, Defenders of Wildlife and Animal Welfare Institute (eds.), Munich (Germany), Washington, D.C. (USA).

4)AOAC. (1995). Official methods of Analysis of AOAC International, 16th ed. AOAC International Arlington, VA, 250 pp.

5)Atwater WO, Benedict FG. (1902). Experiments on the metabolism of matter and energy in the human body, 1898-1900. United States. Office of experiment stations. *Bulletin* No. 109. *Government Printing Office*, Washington, DC.

6)Bahar TB, Gurbuz DR, Özyurt G. (2008). Nutritional composition of frog (*Rana esculenta*) waste meal. *Bioresource Technology,* 99, 1332-1338.

7)Baygar T, Ozgur N. (2010). Sensory and chemical changes in smoked frog (*Rana esculenta*) leg during cold storage (4°C± 1). *Journal of Animal and Veterinary Advances*, 9(3), 588-593.

8)BIPEA. (1976). Recueil des méthodes d'analyse des communautés européennes. Bureau Interprofessionnel d'Études Analytiques, Gennevilliers. France, 140 pp.

9)Cagiltay F, Erkan N, Selcuk A, Ozden O, Tosun DD, Ulusoy S, Atanasoff A. (2014). Chemical composition of wild and cultured marsh frog (*Rana ridibunda*). *Bulgarian Journal of Agricultural Science*, 20 (5), 1250-1254.

10)Çaklı S, Kışla1 D, Cadun A, Dinçer T, Cağlak E. (2009). Determination of Shelf Life in Fried and Boiled Frog Meat Stored in Refrigerator in 3.2± 1.08°C. *Journal of Fisheries & Aquatic Sciences,* 26 (2), 115-119.

11)Davis BC, Kris-Etherton PM. (2003). Achieving optimal essential fatty acid status in vegetarians: Current knowledge and practical implications. *The American Journal of Clinical Nutrition*, 78, 640-646.

12)FAO. (2012). La situation mondiale des pêches et de l'aquaculture, 261 pp.

13)Jenkins RK, Rabearivelo BA, Chan C, Randrianavelona R, Randrianantoandro JC. 2009. The harvest of endemic amphibians for food in eastern Madagascar. *Tropical Conservation Science,* 2(1), 25-33.

14)Schapira G. (1981). Elément de biochimie Clinique et physiologie, éds Flammarion Médecine Science 20. Rue Vaugirard, 75006 Paris, 285 pp.

15)Mathew JT, Ndamito MM, Shaba EY, Mohammed SS, Salihu AB, Abu Y. (2015). Determination of the Nutritive and Anti-Nutritive Values of *Pelophylax esculentus* (Edible Frog) found in Hanyan Gwari, Minna Niger State, Nigeria, *Advances in Research*, 4 (6), 412-420.

16)Mohneke M, Onadeko AB, Rödel MO. (2009). Exploitation of frogs a review with a focus on West Africa, *SALAMANDRA*, 45, 193-202.

17)Mohneke M, Onadeko, AB, Hirschfeld M, Rödel MO. (2010). Dried or fried: amphibians in local and regional food markets in West Africa. *TRAFFIC Bulletin,* 22, 117-126.

18)Muhammad NO, Ajiboye BO. (2010). Nutrient composition of *Rana galamensis. African Journal of Food Science and Technology,* 1(1), 27-30.

19)Neang T. (2010). An Investigation into Frog Consumption and Trade in Cambodia. *Fauna & Flora International Cambodia Programme,* 25 pp.

20)Neveu A. (2004). La raniculture est-elle une alternative à la récolte? État actuel en France. INRA. *Production Animale,* 17 (3), 167-175.

21)Oduntan OO, Akintunde OA, Oyatogun MOO, Shotuyo ALA, Akinyemi AF. (2012). Proximate Composition and Social Acceptability of Sun-Dried Edible Frog (*Rana esculenta*) In Odeda Local Government Area, Nigeria. *Production Agriculture and Technology,* 8(1),134-143.

22)Ojewola GS, Udom SF. (2005). Chemical evaluation of the nutrient composition of some unconventional animal protein sources. *Internationa Journal of Poultry Science*, 4(10), 745-747.
23)Onadoke AB, Egonmwan RI, Salui JK. (2011). Edible amphibian species: Local knowledge of their consumption in Southwest Nigeria and their nutritional value. *West African Journal of Applied Ecology,* 19, 67-76.
24)Özogul F, Özogul Y, Ilkan Olgunoglu AI, Boga EK. (2008). Comparison of fatty acid, mineral and proximate composition of body and legs of edible frog (*Rana esculenta*). *International Journal of Food Sciences and Nutrition,* 59 (**7**), 558-565.
25)Rao Subba PV, Mantri VA, Ganesan K. (2010). Mineral composition of edible seaweed *Porphyra vietnamensis*. *Food Chem,*103, 215-218.
26)Rodrigues E, Seixas FJT, Mello SCRP, Castagna AA, Sousa MA, Silva UP. (2014). Frog meat microbiota (*Lithobates catesbeianus*) used in infant food. *Food Sci*. *Technol*, *Campinas,* 4(34), 51-54.
27)Savadogo A, Ilboudo AJ, Traoré A. (2011). Nutritional potentials of *Acacia macrostachya* (*Reichend*) ex Dc Seeds of Burkina Faso: Determination of Chemical Composition and Functional Properties. *Journal of Applied Sciences Research,* 7(7), 1057-1062.
28)Tohé B, Kouamé NG, Assemian NE, Gourène G, Rödel MO. (2014). Dietary Strategies of the Giant Swamp Frog *Hoplobatrachus occipitalis* in Degraded areas of Banco National Park (Ivory Coast). *International Journal of Scientific Research and Reviews,* 3(2), 34-46.
29)Tougan PU, Dahouda M, Salifou CFA, Ahounou GS, Kossou DN, Amenou C, Kogbeto, CE, Kpodekon MT, Mensah GA, Lognay G, Thewis A, Youssao IAK. (2013). Nutritional quality of meat from local poultry population of *Gallus gallus* species of Benin, *Journal of Animal &Plant Sciences,* 19, 2908-2922.