Science World Journal Vol 12 (No 1) 2017
www.scienceworldjournal.org
ISSN 1597-6343

ASSESSMENT OF THE NUTRITIONAL QUALITY OF SMOKED CATFISH (*CLARIAS GARIEPINUS*) IN LAPAI, NIGER STATE, NIGERIA

Ibrahim Baba Usman

Department Of Biological Sciences, Faculty Of Natural Sciences, Ibrahim Badamasi Babangida University, Lapai, Niger State. Nigeria.

Email address: ibrahimsayuti@yahoo.com

ABSTRACT
This study examined the nutritional quality of smoked Catfish *Clarias gariepinusI* obtained in three different markets in Lapai, Niger State, Nigeria for a period of three months. Proximate compositions of smoked *Clarias gariepinus* were determined. The highest protein content (49.27 ± 2.59) was recorded in smoked fish obtained from Baddegi market and was not significantly different from that of other sampling sites (P>0.05), while the least protein (46.68 ± 0.52) recorded from Central market also shows no significant differences (P>0.05) from other sampling sites. Similar results were obtained for the fat, the differences in proximate composition of smoked fish in Lapai markets were not significant (P>0.05). The ash content of smoked fish in Efugwaja, Central and Baddegi markets showed significant differences (P<0.05) and these were also exhibited within the months. Sensory evaluation of smoked fish revealed that the taste was significantly different (P<0.05) in all the three market samples, while that of colour, texture and appearance were not significant (P>0.05).There was a significant different (P<0.05) in two minerals, Potassium and Sodium from Baddegi and Efugwaja markets. This study therefore recommends smoked method as one of the preservative process to maintain a longer shelf life for *Clarias gariepinus* for both commercial and domestic purpose, and still retain its nutritional qualities.

Keywords: Smoked fish, *Clarias gariepinus,* Proximate composition, Fats, Protein, Ash contents

INTRODUCTION

Clarias gariepinus is a very important freshwater fish in Nigeria. It has enjoyed wide acceptability in most parts of the country especially in North, because of its unique taste, nutrients, flavor and good texture (Adebowale *et al.,* 2008). It is widely distributed and extensively cultivated in ponds. Aquacultures have begun to smoke the fish to attract a better price from local and international markets. Fish being highly perishable after harvest requires proper preservation and storage to increase the shelf life (Clucas and Ward, 1996). Major methods of fish processing and preservation have been identified such as freezing, smoking and drying. In most markets in Lapai Local Government Area, and in Nigeria, fish is sold to consumers as either frozen (ice fish) or cured (smoked).

Fish is highly nutritious with high protein content. However, it is a suitable medium for growth of micro-organism (Tull, 1997). Researchers are concerned about the quality of products, this was apparent from the investors forum that was jointly organized recently by the Nigerian Institutes for Oceanography and Marine Research and the Raw Materials Research and Development Council, where participants called for better handling, processing and packaging of products to meet the required standards set by regulatory authorities in the countries of export (Oyeleye, 2003).

Thus, as dried fish continues to occupy its important place as a delicacy in the dishes of Nigerians. Drying of fish extend its shelf life thereby increasing the availability of fish all year round (Afolabi *et al*., 1984). Fish smoking and drying naturally developed along the coastal fishing communities, the main objective being preservation of the catch for use over a long period of time (Adesulu, 2007). The traditional methods of processing are often inefficient and unhygienic, involving substantial post-harvest losses in terms of mould, fragmentation, infestation by flies and beetles, loss of quality by charring e.t.c. The traditional or conventional methods can be improved, and losses can be reduced by the use of Nigeria Institute of Marine and Oceanography Research (NIOMR) smoking kiln and oven. It is instructive that the method has the effect of imparting a pleasant flavour to the product besides the preservative effect of the smoke itself (Burgress *et al*., 1965; Tull, 1997).

The most important factor affecting the quality of a fish product is the freshness of the raw fish immediately prior to processing (Gokoglu *et al*., 2004). Poor quality raw fish produces poor quality end product. Processing can only help to slow down the rate of deterioration, and using spoiled fish as the raw material can only produce poor quality product (Wu and Mao, 2008).

The objective of this study is to assess the nutritional quality of smoked fish in Lapai environment , in order to establish the effectiveness of this preservative method in maintaining the nutritional quality of the fish.

MATERIALS AND METHOD

Study Area

The study was conducted in Lapai town, Niger State, Nigeria. Lapai is situated between the latitudes 09°04' N and 09°05' N and longitudes 06° 34' E and 06°35'E of the equator. The major economic activity of the people of Lapai is farming with specialization in crops, animal husbandry and fishing.

Fish Used

Smoked fish samples were obtained from three different markets in Lapai town:- Lapai central market, Efugwaja market and Badegi market. The fish samples were conveyed to the laboratory and oven dried at 45^{o}C – 55^{o}C.

Proximate Analysis

Some aspect of the proximate analysis determined included moisture, ash, fat and crude protein content using Association of Analytical Chemist Method (AOAC, 2000).

Organoleptic Characteristics Method

Subjective analysis was used for organoleptic characteristics analysis, in which students were used to carry out the tests. Ten members of the panel were selected for each parameter like flavour, texture, appearance and palatability trained on the rudimentary aspects of organoleptic characteristics and how to apportion mark to each parameter. Fish products samples were issued out in conjunction with questionnaires. The fish samples were given out with questionnaires for the panel members to feel and taste the fish products and score based on how the taste, texture, palatability and odour appealed to them. The questionnaires were returned and marks were appropriately apportioned to each parameter.

Statistical Analysis

The data was analyzed using two-way analysis of variance. Differences among the mean were separated using Bonferroni multiple comparism test. All analysis was carried out using Graphad Prism Version 5.0 software package.

RESULTS AND DISCUSSION

Table 1: Mean Proximate Composition of Smoked *Clarias gariepinus* from the Sampling Stations in Lapai, Niger State, Nigeria

Parameters	Ash (%)	Moisture (%)	Protein (%)	Fibre (%)	Fat (%)
Efugwaja Market	5.13±2.74 ^{a}	9.01±1.31^{a}	49.04±2.09^{a}	7.73±0.67^{b}	15.53±2.63^{a}
Badegi market	4.93±2.56^{b}	9.10±1.15^{a}	49.27±2.59^{a}	6.40±0.20^{c}	15.00± 2.82 ^{a}
Central market	4.62±2.35^{c}	7.70±0.88^{c}	46.67±0.30^{b}	8.66±0.23^{a}	14.47±1.48 ^{a}

Mean value within the column with the same superscript are not significant (P<0.05)

Table 1, presents the proximate composition of smoked *Clarias gariepinus* from the sampling sites. The highest Ash content (5.13% ± 2.74) was observed in Efugwaja market follow by 4.93% ± 2.56 in Baddegi market sample while the lowest value (4.62% ± 2.35) recorded in Central market sample. The Ash contents were significantly different in the sampling stations (P>0.05). The moisture contents in smoked *Clarias gariepinus* were not significantly different (P<0.05) in sampling stations Efugwaja and Baddegi markets, the highest recorded (9.10% ± 1.15) in Baddegi followed by Efugwaja (9.01% ± 1.31) and the lowest recorded (7.70% ± 0.88) in the Central market. The protein contents were not significantly different in Baddegi and Efugwaja markets, with the highest value of 49.27% ±2.56 and 49.04%±2.09 respectively, and the lowest (46.68% ± 0.52) was recorded in Central market. Fiber contents recorded significant differences in the three markets, the highest value of 8.67% ± 0.23 was in Central market, followed by Efugwaja (7.73% ± 0.67) and the lowest value recorded (6.40% ± 0.20) in Baddegi market. The value of fat recorded were also not significantly different in the markets respectively Efugwaja, Baddegi and Central markets 15.53% ± 2.63, 15.00% ± 2.82, and 14.47% ± 1.48..

Table 2: Mean Monthly Proximate Composition of Smoked *Clarias gariepinus* in Lapai, Niger State, Nigeria

Parameter	Ash (%)	Moisture (%)	Protein (%)	Fibre (%)	Fat (%)
May	9.98±0.38^{c}	11.60±0.29^{a}	50.80±2.36^{a}	7.83±0.83 ^{a}	19.53±0.79^{d}
June	2.40±0.14^{b}	7.42±0.16^{b}	48.27±1.04^{b}	7.80±0.50 ^{a}	13.23±0.34^{d}
July	2.30±0.07^{d}	7.71±0.82 ^{b}	45.92±0.68^{c}	7.17±0.87 ^{a}	12.57±0.50^{d}

Mean value within the column with the same superscript are not significantly different (P<0.05)

Table 2, present the mean monthly proximate composition of smoked *Clarias gariepinus* in Lapai. The highest Ash content (9.98%±0.38) was recorded in the month of May which is highly significant different (P<0.05) from June and July respectively (2.40%±0.14; 2.30±0.07). There was no significantly different (P<0.05) in the moisture contents of June and July (7.71%±0.82, 7.42%±0.16) respectively, however they were significantly different from that of May (11.60%±0.29).There was high protein in the month of May follow by June and July respectively (50.80%±2.36, 48.27±1.04 and 45.92%±0.68), and the values shows no significant differences (P>0.05). There was no significant differences (P>0.05) in Fiber content throughout the three months (May, June and July), with the following values respectively 7.83%±0.83, 7.80%±0.50 and 7.17%±0.87. Fat content shows significant differences throughout the three months (P<0.05) May, June and July, with the following values respectively 19.53%±0.79, 13.23%±0.34 and 12.57%±0.50.

Table 3: Mean Mineral Composition of Smoked *Clarias gariepinus* from Sampling Stations in Lapai, Niger State, Nigeria

Sampling stations	Phosphorus (mg/l)	Potassium (mg/l)	Minerals Sodium (mg/l)	Calcium (mg/l)	Magnesium (mg/l)
Efugwaja Market	80.00±2.00^{a}	71.33±0.67^{b}	68.33±0.30^{c}	65.33±1.76 ^{a}	33.33±1.45 ^{a}
Baddegi Market	77.33±1.67 ^{a}	80.00±1.51^{a}	80.67±3.33^{a}	69.33±0.67 ^{a}	31.33±0.67 ^{a}
Central Market	81.33±1.67 ^{a}	75.00±0.33 ^{b}	70.00±2.00^{b}	67.33±1.67 ^{a}	34.67±0.67 ^{a}

Mean value within the column with the same superscript are not significantly different (P<0.05)

Table 3, revealed the mineral analysis of smoked *Clarias gariepinus* from the sampling sites on phosphorus, potassium, sodium, calcium, and magnesium. The result indicated that phosphorus, calcium, and magnesium were not significantly different in the three (3) markets sampled (P>0.05), while in the case of potassium, there was no significant differences (P>0.05) in the values of Efugwaja (71.33mg/l ±0.67) and Central markets (75.00mg/l ±0.33), however they were significantly different (P<0.05) from that of Baddegi market (80.00 mg/l ±1.51). The value of sodium were significantly different in all the three markets sampled (P<0.05) Efugwaja market (68.33 mg/l ±0.30), Baddegi market (80.67mg/l±3.33) and Central market (70.00 mg/l ±2.00).

Table 4: Mean monthly mineral composition of smoked *Clarias gariepinus* in Lapai, Niger State, Nigeria

Month	Phosphorus(mg/l)	Potassium(mg/l)	Minerals Sodium(mg/l)	Calcium(mg/l)	Magnesium(mg/l)
May	81.33±1.20^{a}	76.66±2.91^{a}	74.67±4.80 ^{a}	69.00±0.58 ^{a}	34.00±1.51 ^{a}
June	81.33±1.20^{a}	81.33±1.20^{b}	69.67±2.33 ^{a}	65.33±2.40 ^{a}	33.67±1.20 ^{a}
July	76.00±1.51^{b}	76.00±2.31^{a}	74.66±4.81^{a}	67.67±0.88 ^{a}	31.67±1.20 ^{a}

Mean value within the column with the same superscript are not significantly different (P>0.05)

Table 4, revealed the mineral composition of smoked *Clarias gariepinus* within the months, with the mean values of phosphorus showing no significant differences (P>0.50) for May (81.33mg/l ±1.20) and June 81.33mg/l ±1.20, while the values of May and June were significantly different (P<0.50)from that of July (76.00mg/l ±1.51).The mean monthly value of Potassium were not significantly different (P>0.50) for the months of May (76.66mg/l ±2.91) and July (76.00mg/l ±2.31), however these

values were significantly different (P<0.50) from that of June (74.33mg/l ±2.33). The monthly mean values of sodium, calcium and magnesium as indicated in table 4 shows no significant differences (P>0.05) for the three months sampling duration.

Table 5: Mean Sensory Evaluation of Smoked *Clarias gariepinus* from the Sampling Stations in Lapai, Niger State, Nigeria

Sampling Stations	Parameters				
	Color (%)	Texture (%)	Appearance (%)	Taste (%)	Aroma (%)
Efugwaja market	2.26±0.72[a]	1.84±0.73[b]	2.19±0.63[c]	2.16±0.86[a]	1.77±0.92[c]
Badeggi Market	2.39±0.76[a]	2.35±0.55[b]	2.32±0.70[c]	2.45±0.62[b]	2.45±0.56[a]
Central market	2.35±0.70[a]	2.29±0.69[b]	2.39±0.49[c]	2.13±0.80[a]	2.13±0.71[b]

Mean value within the column with the same superscript are not significant different (P>0.05)

Table 5 presents the mean values of the sensory (Organoleptic) parameters (colour, texture, appearance, taste, and aroma) of *Clarias gariepinus* obtained from the three (3) sampled markets Efugwaja market, Baddegi market and Central market . There were no significant differences (P>0.05) in the mean values of colour, texture, appearance and taste for the sampled markets. However, the mean values of aroma for Baddegi market (2.45(%)±0.56) and Central market (2.13(%)±0.71) shows no significant differences (P>0.05), but differ significantly (P<0.05) from that of Efugwaja market (1.77(%)±0.92).

Table 6: Mean monthly Sensory evaluation of smoked *Clarias gariepinus* in Lapai, Niger State, Nigeria

Months	Parameters				
	Color (%)	Texture (%)	Appearance (%)	Taste (%)	Aroma (%)
May	2.37±0.67[a]	2.03±0.67 [a]	2.23±0.56[a]	2.20±0.66[a]	2.13±0.57[a]
June	2.00±0.79[a]	2.20±0.71[a]	2.30±0.70[a]	2.20±0.76[a]	2.17±0.98[a]
July	2.63±0.61[a]	2.30±0.65[a]	2,40±0.67[a]	2.40±0.86 [a]	2.07±0.78[a]

Mean value within the column with the same superscript are not significant different (P>0.05)

Table 6, showed that there was no significant differences in the colour, texture, appearance, taste and aroma of smoked *Clarias gariepinus* for the three months sampling duration (P<0.05) of sensory parameters evaluation of the fish.

DISCUSSION

The proximate compositions values obtained in this study showed variations both for the sampling stations and months of the study. The range of the values recorded for moisture contents (7.70 – 9.01) and Protein (46.67 – 49.27) in the present study agreed with the value ranges recorded by Adebowale *et al.* (2008), in the study of proximate composition of Nigeria smoked catfish 7.16 – 10.71 for moisture contents and 33.66 – 66.04 value ranges for protein. However, value of fat and ash contents in the present study deviates from that of Adebowale *et al.* (2008), range of 14.47 – 15.53 for fat and ash content range of 9.21 – 12.16 were obtained in the present study as against 1.58 – 6.09 and 4.61 – 5.13 recorded by Adebowale *et al.* (2008) for fat and ash contents respectively. The higher value of crude protein recorded for *Clarias gariepinus* may be attributed to the fact that the fish species consumed more of artificial diet (35% - 45%) crude protein (Abolagba and Melle, 2008). The results of this study was in agreement with those reported earlier by Omogwu (2014) on proximate composition of pond raised and wild *Oreochromis niloticus* and *Clarias gariepinus* and recorded the range of chemical composition of protein to be 54 – 68%, 5 – 7% fat, 9 – 11% moisture and 5.4 – 15 ash. Ikeme (1991) studied the characterization of traditional smoked fish in Nigeria, and reported the range of chemical composition to be 60 – 80% protein, 6 – 15% fat, 7 – 19% moisture and 5.4 – 15 ash. This result agreed with the observation of Shearer, (1994), that the protein composition of fish is affected by diversity of factors such as size, sexual maturation, temperature, salinity, exercise, ration, time and frequency of feeding, starvation, type and amount of dietary ingredient. Smoked *Clarias gariepinus* is a good source of pure protein and would be adequate to prevent malnutrition in children, and as well desirable for a growing child and adult who feed solely on fish as a main source of protein.

The crude fibre values recorded in the samples from the markets within the three months duration is due to the fact that the energy content in smoked *Clarias gariepinus* is high because crude fiber is considered as indigestible. The crude fibre content indicates the amount of cell walls in the feed.

The most important contribution of sensory attribute to eating quality was tenderness with flavor and juiciness (Safari *et al*., 2001). Simko, (2002) highlighted factors that influence quality of smoked fish product to include:- properties of fish, age, sex, seasonal variation, and factors involve in the smoking procedure such as wood type, composition of smoked, temperature, humidity and density of the smoke.

The ash content is high in the smoked fish samples as observed in the present study with a range of 2.30 – 9.98. This also confirmed the findings of Ande *et al.,* (2012) and Ikeme (1991) who reported a range value of 5.4 – 15 ash content. Salan *et al.,* (2006) also reported that increase in ash content of smoked fish sample is due to loss of humidity.

The mineral contents of the sampled fish during the study period revealed that high calcium and phosphorus content ranges from 65.33 to 69.00, and from 76.00 to 81.33 respectively from the sampled markets are of nutritional benefit, particularly for children and the aged who need higher intakes of calcium and phosphorus for bone formation and maintenance. Food is considered 'good' if Ca/P ratio is above two, and this helps to increase the absorption of calcium in the small intestine, and poor if the ratio is less than 0.5 (Nickelson and Finne, 1992). Ca/K ratio is usually called thyroid ratio because calcium and potassium play a vital role in regulating thyroid activity and the ratio in this study is around the range (8-16) needed to maintain the regulation of thyroid activity in good balance (ARL, 2012). Ca/Mg ratio in the fish from the markets is within the range 2.0 and above, which enhances mental and emotional stability, whereas ratio beyond 1.6 or less than 2 is associated with mental and emotional disturbances (ARL, 2012). Variations in proximate compositions of smoked fish are said to be caused by different factors, such as fish species, smoking methods, smoking time and salt concentration (Abolagba and Melle, 2008). Smoking decreases the water activity in fish tissue (Sveinsdottir, 1998) and if the smoked fish is not properly stored afterward, the efforts involved in smoking may not yield the expected preservative effect. Jallow (1995) reported that fish with 10 - 15% moisture content has a shelf life of 3 - 9 months when stored properly. Thus, the concentrations of chemicals in smoked fish are contingent on the storage time and temperature.

In conclusion, the outcome of this study indicates that moisture contents of fish is of great importance, as most of the biochemical reactions and physiological changes in fish depends on moisture

content. Protein content in smoked fish samples were observed to increase, as a result of increase in the dry matter content per unit weight following sample dehydration during smoking. Therefore, the increase in mineral content, ash content and crude fibre can be due to an increase in the dry matter content per unit weight following sample dehydration.

The design for smoking technique is to ensure that the fish come out with low moisture content and longer shelf life. This study therefore recommended the need for the adoption of good processing practices and storage methods of smoked fish. In other words, the people that are involved in the processing and selling of smoked fish should maintained hygienic environment and practices, so as to ensure that safety standards are maintained in smoked fish industry in order to preserved market worthiness of the products.

REFERENCES

Abolagba, O. J. and Melle, O. O.(2008). Chemical composition and keeping qualities of a scaly fish tilapia,*Oreochromis niloticus* smoked with two energy sources. *African Journal of General Agriculture* 4(2):113 – 117.

Adebowale, B. A., Dongo, L. N., Jayeola, C. O. and Orisajo, S. B. (2008). Comparative quality assessment of fish (*Clarias gariepinus*) smoked with cocoa pod husk and three other different smoking materials. *Journal of Food Technology*, 6:5-8.

Afolabi, O. A., Arawomo, O. A. and Oke, O. L. (1984). Quantity changes of Nigerian traditional

processed freshwater species 1: Nutritive and organoleptic changes. *Journal for Food Technology,* 19: 333-340.

Adesulu, E. A. (2007). *The Fresh Water Fishes and Fisheries of Nigeria.* Macmillan Nigeria Publishers, Lagos, Nigeria, 397pp.

Ande, S., Leke, I., Eneji, I. and Yakubu, S. (2012). Proximate analysis of smoked and unsmoked fish (Catfish and Tilapia) in Ombi River Lafia Nassarawa State, Nigeria, *Elixir Food Science 53,11801 – 11803pp.*

AOAC (2000). *Official Methods of Analysis.* 17th edition. Association of Official Analytical Chemist. Washington D.C.

ARL (2012). *Basic ratios and their meaning.* Analytical Research Labs. Inc. (602): 955-1580. www.arltma.com /Articl/Ratio.Doc.htm.

Burgress, G. H. O., Cutting, C. L., Lovern, J. A. and Waterman, J. J. (1965). *Fish Handling and Processing.* Her Majesty's Stationary Office, London, UK., 70 - 101 pp.

Clucas, I. J. and Ward, A. R.(1996). *Post – Harvest Fisheries Development: A guide to Handling/Preservation, Processing and Quality*. Natural Resource Institute Chatham Meantime, Kent, United Kingdom, 443pp.

Gokoglu, N., Yerlikaya, P. and Cengiz, E.(2004). Effects of cooking methods on the proximate composition and mineral contents of Rainbow trout (*Oncorhynchus mykiss*). *Food Chemistry Journal*, 84: 19-22.

Ikeme, A. I. (1991). Studies on the fragmentation of smoked fish: *In Processing of the FAO Export Consultation on Fish Technology in Africa No.467.*

Jallow, A. M. (1995). Contribution of Improved chorkor oven to artisanal fish smoking in the Gambia. Workshop on seeking improvement in Fish Technology in West Africa. *IDAF Technical Report, No. 66.*

Nickelson, R. and Finne, G. (1992). *Fish, crustaceans and precooked sea foods.* In: Compediun for the Microbiological examination of foods, American Public Health Association, 3rd ed. Ch. 47, Carl Vanderzant and Don Splittstoesser (Ed.), Washington, DC.

Omogwu, N. J.(2014).*The proximate composition and fatty acid composition of pond raised and wild Oreochromis niloticus,* Graduation Thesis. University of Benin, Benin City.*(Unpublished work)*

Oyeleye, O. (2003). *Export potentials of smoked fish trade in Nigeria.* The Guardian 19 (8916): 27, Guardian Newspaper Publication, Lagos, Nigeria.

Safari, E., Fogarty, N. M., Ferrier, G. R., Hopkins, L. D. and Gilmour, A. (2001). Diverse lamb genotypes. Eating quality and the relationship between its objective measurement and sensory assessment. *Meat Science*, 57(2): 157 – 159.

Salan, O. E., Juliana, A. G. and Marilia, O.(2006).Used of smoking to add value to Salmon trout. *Brazilian Archieves of Biology and Technology,* 49: (1)57 – 62pp.

Shearer, K. D. (1994). Factors affecting the proximate composition of cultured fishes with emphasis on salmonids. *Aquaculture* 119: 63 - 88pp.

Simko, P. (2002). Determination of polycyclic aromatic hydrocarbons in smoked meat products and smoked meat products and smoke flavouring food additives B: Analytical Technologies in the Biomedical and Life Sciences, *Journal Chromatography,* 770: 3- 18

Sviensdottir, K. (1998). The Process of Fish Smoking and Quality Evaluation. M.Sc Disertification University of Denmark. *(Unpublished)*

Tull, A. (1997). *Food and Nutrition.* 2nd Edn., Oxford University Press, Oxford, U.K.,104-109pp.

Wu, T. and Mao, L. (2008). Influences of hot air drying and microwave drying on nutritional and odorous properties of Grass Carp (*Ctenopharyngodon idellus*) fillets. *Food Chemistry Journal*, 110: 647-653.