EUROPEAN ACADEMIC RESEARCH
Vol. III, Issue 3/ June 2015

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Effects of Different Processing Methods on the Proximate Composition of *Chrysichthys nigrodigitatus* from Great Kwa River, Nigeria

I.G. OLALEYE
P. ASUQUO
I.U. IMEH
Fisheries and Aquaculture Unit
Institute of Oceanography
University of Calabar, Cross River State
Nigeria

Abstract:

Proximate composition of Chrysichthys nigrodigitatus was studied using different processing methods; smoking, boiling, deep frying and oven drying. The mean moisture contents, protein, fat, ash, fiber, carbohydrate for all the different processing methods were recorded. Oven drying proved to be most effective in processing the fish to save moisture content which prolong the shelf life of fish and make it suitable for local consumption and export. However, there was no significant difference of all the processing methods on proximate compositions of catfish with F-ratio of 0.265 at 0.05% confidence level.

Key words: Proximate composition, *Chrysichthys nigrodigitatus*, processing methods.

Introduction

Fish is an important source of animal protein which has been accepted worldwide and it accounts for about 37% of Nigeria's total protein intake (Agbabiaka et al., 2012). The estuarine catfish, Chrysichthys nigrodigitatus (Lacepede, 1803), of the

family Bagridae, occurs commonly in West Africa and it contributes substantially to the fisheries of the river, lakes and lagoon in Nigeria (Philo *et al*., 2013).

It is commonly known that fish is highly perishable and undergoes spoilage (change in skin colour, texture and chemical composition) as soon as is been harvested (Gupta &Gupta 2006).

Processed fish is a traditional part of diet of a large section of a world's population (Ogbonnaya & Shaba, 2009). However, the gap between the demand and supply of processed fish product is widening due to increase in population, poor post –harvest handling which is an unacceptable waste of scares natural resources and lack of storage and processing facilities which are all a reason for decline in fish resource (FAO, 2003).

The major principle of processing fish is focused on reducing the moisture necessary for bacterial growth which can eventually cause deterioration (Akinwumi *et al.*, 2011) this can be done using different processing methods such as smoking, boiling, deep frying, oven drying, steaming, freezing, salting and even the use of modified atmosphere (Gupta &Gupta, 2006). The most commonly used processing method in Nigeria is smoking, frying, boiling, oven drying and freezing (Osibona *et al*., 2010; Eyabi 1998).

The basic scientific reason for heating food product is to make it safe for consumption or to prevent or minimize spoilage during storage. The processes of heating before consumption can give rise to major changes in composition (Weber *et al*, 2008; Ghecichpour & Shanbanpour, 2011). It has been observed that different processing and drying methods have different effect on the nutritional composition of fish. This is because different processing method leads to physical and chemical changes and therefore digestibility (Tao *et al.*, 2008).

This study aims to determine the proximate composition of processed Chrysichthys nigrodigitatus under different processing methods.

Materials and Methods

Sample collection

Thirty six freshly caught samples of C.nigrodigitatus were obtained from fisherman landing of the Great Qua river which is located within Longitude 8°20' & 8°25'E and Latitude5°10' & 5°30'N. The samples were carried fresh in ice chest for processing.

Sample preparation

The samples were washed thoroughly with water in a clean container to remove blood and slime. The samples were further prepared by evisceration, beheading and cutting into sizeable portions. They were rinsed again in clean water prior processing.

Sample processing

The processing methods used are those common in Nigeria, which include boiling, oven-drying, deep frying and smoking. The samples were divided into four portions for the four processing methods to be used

Boiling

The first portion of the prepared sample was place in a pot of boiling water at 100°C and left to cook for five minutes. After boiling, the sample was left to cool and was place in an airtight container then kept in the refrigerator prior analysis (Peplow *et al*, 1973).

Oven-drying

The second portion of the prepared sample was placed in an electric oven at temperature of 120°C for thirty minutes (Ogbonnaya & Shaba, 2009).

Deep-frying

The third portion was fried in frying vegetable oil with the aid of a domestic camp gas at temperature of 205oC for 10minutes (Ghelichpour & Shabanpour, 2011).

Smoking

The smoking process was done with the aid of a traditional smoking kiln. The kiln was constructed using a drum cut horizontally into half; a dryer made up of wire netting placed on the cut portion as covering for the sample was placed on the dryer. The smoking chamber was further divided into half to bring the heat closer to the sample. Monogamy coal was used as fuel to generate heat in the chamber. The smoked samples were placed in an air tight container to avoid contamination and placed in a refrigerator prior analysis (Kumolu –Johnson *et al*., 2010).

Laboratory analysis

The processed samples were subjected to analysis carried out in triplicate for moisture, protein, ash fat and carbohydrates in accordance with the method as described by AOAC (1993) in Department of Chemistry laboratory, University of Calabar Nigeria. All chemicals used were of analytical grade.

Statistical analysis

One –way Analysis of Variance was also used to test any significant difference between the studied variables using F-ratio=MSb/MSw; where MSb is between group variance estimate and MSw is within group variance estimate.

Results

The mean length and weight of the fish were 31.33$\pm$5.4cm and 248.83$\pm$116.74g respectively. The results of the proximate composition (moisture content, ash, fat, fibre, protein and

carbohydrate) of C.*nigrodigitatus* sampled for three months are shown in Figures 1 to 4 below. The summary mean of their proximate composition under different processing methods are shown in Table 1.

Table 1: Proximate composition of C.*nigrodigitatus* under different processing methods

	Smoking		Boiling		Deep frying		Oven drying	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Moisture	29.00	1.00	50.00	2.00	21.00	1.00	16.00	1.00
Ash	3.97	0.06	5.67	0.21	5.30	0.10	3.63	0.15
Fiber	3.43	0.15	3.27	0.50	5.47	0.81	3.58	0.52
Fat	5.97	0.95	5.33	0.58	5.47	0.81	3.57	0.51
Protein	39.00	0.13	43.41	0.83	35.86	0.38	30.86	0.28
Carbohydrate	0.86	0.10	0.26	0.25	0.32	0.03	0.56	0.33

Fig1: Monthly variations in proximate composition of C. *nigrodigitatus* under smoking method.

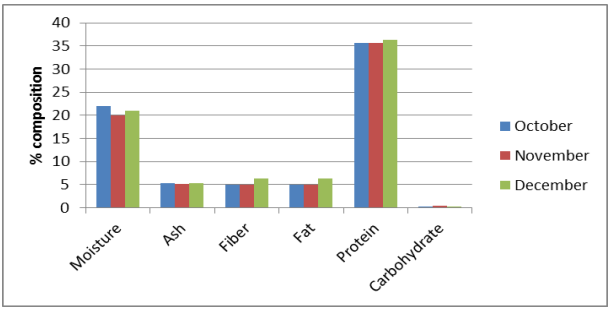

Fig 2: Monthly variation in proximate composition of *C. nigrodigitatus* under boiling method.

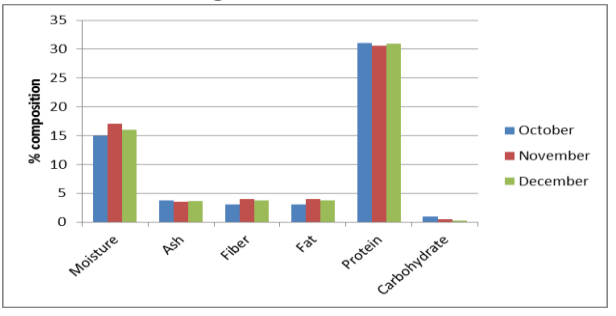

Fig 3: Monthly variation in proximate composition of *C. nigrodigitatus* under deep frying method.

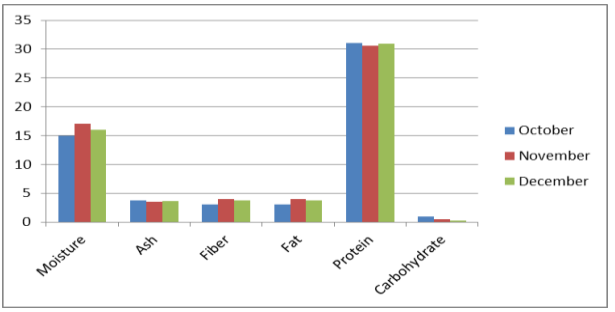

Fig 4: Monthly variation in proximate composition of *C. nigrodigitatus* under oven drying method.

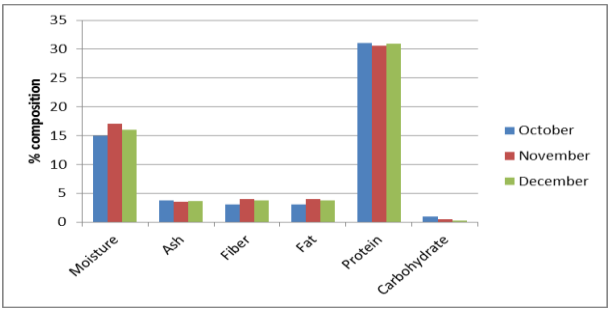

Table 2: Summary of ANOVA table

Processing methods	N	Mean	SD	
1. Smoking	6	13.71	16.12	
2. Boiling	6	17.99	22.42	
3. Deep frying	6	12.24	13.54	
4. Oven drying	6	9.70	11.69	
Source of variation	SS	DF	MS	F-ratio
Between-groups	215.43	3	71.81	0.265*
Within-groups	5412.503	20	270.63	
Total	5627.93	23	99368.3	

*Not significant at 0.05 level (critical $F_{3,20}$=3.10)

Test of Hypothesis

Null Hypothesis: There is no significant difference between proximate composition and different processing methods (boiling, smoking, deep frying and oven drying).

To test the stated hypothesis, the calculated F-ratio was compared with the F-value read-off from the F-table (critical value). From the ANOVA result, the critical value (F=3.10) is greater than the calculated value (F=0.265). Therefore, the null hypothesis which stated that there is no significant difference between proximate composition and different processing methods (boiling, smoking, deep frying and oven drying) is adopted and the alternate rejected. It can therefore be concluded that the proximate composition of C.*nigrodigitatus* using different processing methods aforementioned are statistically the same; that is the observed differences are not significant.

Discussion

Chrysichthys nigrodigitatus under the different processing methods showed no significant different in proximate composition with F-value of 0.265. Mean moisture contents were 29±1.00, 50±2.00, 21±1.00, and 16±1.00 for smoking, boiling, deep frying and oven drying respectively. Mean protein contents were 39±0.13, 43.41±0.83, 35.86+0.38 and 30.86±0.28 for boiling, smoking, deep frying and oven drying respectively. Moisture and protein contents were generally high in all samples. However, the highest moisture and protein value was recorded under boiling method. Moisture and protein contents followed similar order: boiling>smoking>deep frying>oven drying. This result is in line with the work of Clucas (1982) and Ahmed *et al*., (2011).

The lower moisture content will help increase the shelf life of the products of and hinder growth of mould which agreed with Clucas (1982) who reported that a fish's moisture content reduced to 25% will not be affected and if further reduced to 15%, the growth of mould will cease and increase the shelf life. He also reported that as moisture content reduces the protein content increases.

Mean fat contents were 5.97±0.95, 5.33±0.58, 5.47±0.81, and 3.57±0.51 for smoking, boiling, deep frying and oven drying respectively. Fat content in the sampled fish was higher in smoked fish and least in dried fish following the order: smoking>deep frying>boiling>oven drying similar to that observed by Mendez *et al*., (1996) and Dumas *et al*., (2007).

Mean ash contents were 3.97±0.06, 5.67±0.21, 5.30±0.10 and 3.63±015 for smoking, boiling, deep frying and oven drying respectively. The highest ash content was recorded for boiled fish while the least was recorded for oven dried fish. Mean fiber contents were 3.43±0.15, 3.27±0.50, 5.47±0.81 and 3.58±0.52 for smoking, boiling, deep frying and oven drying respectively. The highest fiber content was recorded for deep fried fish while the least was recorded for boiled fish. This result is in line with that of Natarkman &Sreenivasan (2012) who found ash and fiber contents to be more than 3% in their analysis.

Mean carbohydrate contents were 0.86±0.10, 0.26±0.25, 0.32±0.03, and 0.56±0.33 for smoking, boiling, deep frying and oven drying respectively. The low carbohydrate contents is in agreement with the work of Payne *et al*., (1999) who reported that carbohydrate content in fish is generally low and practically zero.

The present findings showed no significant difference between proximate composition of C.nigrodigitatus and the processing methods with F-value of 0.265 at 0.05 confidence levels. From the results, oven drying proved to be the most effective in processing fish to safe moisture content which can prolong the shelf life of fish and make it suitable for export.

Conclusion

The above results show that different nutritional components of fish undergo different changes at elevated temperatures. However, oven drying could improve the protein quality and prevent lipid oxidation as compared with the conventional

smoking kiln drying and other methods used in this study. Lastly since there was no significant difference between proximate composition of C.nigrodigitatus and the processing methods, boiling, smoking and deep frying are nutritionally suitable at least for local consumption. The present study also provides a possible application of oven drying as an efficient drying process for fish in Nigeria and elsewhere.

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