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EFFECTS OF PROCESSING ON THE NUTRIENTS COMPOSITION OF A SELECTED FRESH AND BRACKISH WATER AFRICAN CATFISH (*Clarias gariepinus*) IN ONDO STATE NIGERIA

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ABSTRACT

Treated fish samples (fried, boiled with/without salt solution and roasted) were analyzed for proximate (ash, fat, moisture and protein) and minerals composition (Ca, Zn, Fe, Mg, P and I). The highest protein concentrations (%) (Ogbese, 73.25; Igbokoda, 72.52) of fish samples were recorded by boiling with water while the ones roasted recorded the least values of 57.51 and 58.33 %, respectively. The iodine level (μg I/100g) in the flesh of fish varied with size, treatment and location; it appeared to increase with size, reduced by some treatments (boiling with either water or NaCl solution) while frying and roasting had the highest level compared to boiling. The least iodine concentration was 93.45 (Ogbese fish boiled with NaCl solution) and 160.94 (Igbokoda fish boiled with either water or NaCl solution). On the whole, Igbokoda brackish water fish (160.94-314.08) had higher iodine content than Ogbese fresh water fish (93.45-205.06) with the highest concentration in fried and roasted fish samples (205.06, 314.08) in Ogbese and Igbokoda water bodies respectively. Higher mineral compositions were equally found in the brackish water body, which equally increases with sizes and reduced by some treatments (boiling and frying). Considering the nutrient contents of the fish samples for the various treatments, iodine can be made more available by roasting and frying while protein can be made more available by boiling.

KEYWORDS: Catfish, Iodine, Brackish Water, Fresh Water And Nutrient Composition.

INTRODUCTION

Food processing began several thousands of years ago when early man preserved his harvest, fresh meat and fish for winter reserve by drying in the sun, later expanding to smoking and salting. It provides a plentiful supply and large variety of nutritious foods throughout the year. Food processing, however, results in certain nutrient losses (Anderson, et al., 1976).

Fish has been widely accepted as a good source of proteins and other elements necessary for the maintenance of healthy body (Andrew, 2001). Fish is one of the most important animal protein foods available in the tropics. The less developed countries capture 50% of the world harvest and a large proportion of that catch is consumed internally (FAO, 1985). In many Asian countries over 50% of the animal protein intake come from fish while in Africa the proportion is 17.5%(Willman, et al., 1998). In Nigeria fish constitute 40% of the animal protein intake (Olatunde, 1989). This implies that any shortfall in fish availability will affect the animal protein intake of the people in tropical countries.

Mineral composition of fish is another reason of interest that makes fish unavoidable in the diet. Fish is a source of different minerals that contribute greatly to good health. Fish is considered to be a good source of fluorine and iodine, which are needed for the development of strong teeth and the prevention of goitre or enlargement of the thyroid gland situated in the neck (Andrew, 2001).

Seawater fish and other marine foods are frequently regarded as the most important natural source of dietary iodine (Clugston and Hetzel, 1994), but there is little information on processed salt-water fish versus fresh water fish nutrient composition.

The present studies aim at determining the effect of different convectional processing methods (frying, boiling with ordinary/ salt water solution and roasting) on the iodine distribution and other nutrient composition of selected fresh and brackish water African Catfish (*Clarias gariepinus*) in two selected water bodies in Ondo State, Nigeria.

MATERIALS AND METHODS

Materials

African Catfish (*Clarias gariepinus*) of different sizes were collected from Igbokoda brackish and

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Table 1.: Summary* (mean±SD) of size, length and weight of fishes from the study location.

Location	Size	Length (cm)	Weight (g)
Ogbese River	S	30.83±2.75	195.00±5.00
	M	36.67±1.53	275.00±27.80
	L	41.83±2.63	536.67±47.26
Igbokoda	S	30.33±1.53	191.67±7.64
	M	37.50±0.50	303.33±40.41
	L	49.67±1.53	726.00±46.19

*The number of fish per group was 3.

S: Small sized fish
M: Medium sized fish
L: Large sized fish

Table2. Proximate composition (dry weight basis) of fish samples from Ogbese River subjected to different treatments (mean ± SD).

Location	Size	Protein (%)	Fat (%)	Ash (%)	Moisture Content (%)
Control	S	60.62^{b}±0.87*	8.67^{a}±0.89	10.97^{d}±0.4	4.58^{d}±0.35
	M	62.34^{cd}±0.62	9.23^{a}±0.87	10.93^{d}±0.52	4.37^{d}±0.87
	L	63.12^{d}±0.44	10.62^{b}±0.44	10.97^{d}±0.70	3.70^{c}±0.44
BWW	S	70.29^{gh}±0.78	8.67^{a}±0.53	9.07^{c}±0.86	3.75^{c}±0.52
	M	71.35^{h}±0.61	9.32^{a}±0.87	9.03^{c}±0.35	2.2^{ab}±0.26
	L	73.25^{i}±0.61	10.63^{b}±0.87	9.11^{c}±0.36	1.98^{a}±0.10
BWS	S	66.55^{e}±0.61	8.60^{a}±0.34	8.14^{b}±0.10	3.72^{c}±0.2
	M	68.12^{f}±0.87	9.20^{a}±0.10	8.19^{b}±0.26	2.02^{a}±0.10
	L	69.80^{g}±0.61	10.59^{b}±0.26	8.10^{b}±0.44	1.89^{a}±0.10
Fried	S	56.98^{a}±0.52	8.61^{a}±0.17	7.34^{a}±0.35	6.21^{e}±0.17
	M	60.45^{b}±0.26	9.21^{a}±0.10	7.12^{a}±0.36	5.69^{e}±0.10
	L	63.23^{d}±0.8	10.64^{b}±0.26	7.34^{a}±0.15	4.32^{d}±0.17
Roasted	S	57.51^{a}±0.53	8.53^{a}±0.13	11.25^{d}±0.16	2.63^{b}±0.12
	M	60.35^{b}±0.74	9.33^{a}±0.16	11.02^{d}±0.21	1.95^{a}±0.13
	L	61.42^{bc}±0.53	10.57^{b}±0.13	10.99^{d}±0.43	1.67^{a}±0.50

Mean with the same superscript in a column are not significantly ($p > 0.05$) different.

BWW: Fish samples boiled with ordinary water
BWS: Fish samples boiled with sodium chloride solution (Table salt)

S: Small sized fish
M: Medium sized fish
L: Large sized fish

Ogbese fresh water bodies in Ondo State, Nigeria. The fish samples were categorized into three groups of Small (S), Medium (M) and Large (L), each group containing three fishes per group. The fish samples were subjected to various treatments (boiling with ordinary water, boiling with salt solution, frying and roasting). The various treated samples were oven dried for 24 hours at 85-90°C and then ground to a fine powder prior to analysis. The chemicals used were of analytical grade, while the water used was glass distilled.

Sample analysis

The nutritional composition (ash, fat and moisture content) of the fish samples were evaluated using the standard AOAC (1984) method. The protein content was determined using the micro-Kjedal method (NX 6.25). Iodine content was determined using Belling (1993) method. While Ca, Zn, Mg, P and Fe contents were determined on aliquots of the solutions of ash by established flame atomic absorption spectrophotometric procedure using a Perkin-Elmer (1982) atomic absorption spectrophotometer (Model 372).

RESULTS AND DISCUSSION

In view of the fact that fish has been widely accepted as a good source of protein and other elements necessary for the maintenance of healthy body (Andrew, 2001) and that food processing provides nutritious food with certain nutrient loss (Anderson, et al., 1976), this work

Table 3: Proximate composition (dry weight basis) of fish samples from Igbokoda River subjected to different treatments (mean ± SD).

Treatment	Size	Protein (%)	Fat (%)	Ash (%)	Moisture Content (%)
Control	S	63.72^{cfg}±1.04	12.72^{a}±0.13	9.49^{d}±0.87	4.11^{c}±0.35
	M	68.17^{j}±0.87	13.90^{b}±0.43	9.45^{d} ±0.36	3.73^{dc}±0.53
	L	70.53^{k}±0.87	16.37^{c}±0.44	9.41^{d} ±0.26	1.72^{a}±1.00
BWW	S	64.56^{fgh}±0.70	12.67^{a}±0.11	8.09^{d} ±0.12	2.45^{c}±0.76
	M	70.34^{k}±1.18	13.78^{b}±0.13	8.12^{c}±0.53	1.87^{ab}±0.50
	L	72.52^{l}±1.33	16.45^{c}±0.13	8.08^{c}±1.00	1.51^{a}±0.51
BWS	S	65.31^{ghi}±0.87	12.65^{a}±0.16	6.72^{ab}±0.13	3.40^{d}±0.29
	M	66.10^{hi}±0.62	13.88^{b}±0.13	6.65^{ab}±0.11	2.81^{c}±0.50
	L	66.87^{ij}±0.87	16.09^{c}±0.13	6.92^{b}±0.10	2.33^{bc}±1.00
Fried	S	60.21^{bc}±0.8	12.75^{a}±0.13	9.20^{d}±0.21	3.48^{d}±0.50
	M	62.10^{dc}±1.10	13.92^{b}±0.10	9.07^{d}±0.44	2.32^{bc}±0.50
	L	63.40^{ef}± 1.11	17.10^{d}±0.53	9.25^{d}±0.26	1.77^{a}±0.21
Roasted	S	58.33^{a}±1.15	12.50^{a}±0.51	6.37^{ab}±0.26	3.67^{dc}±0.50
	M	58.61^{ab}±0.71	13.67^{b}±0.35	6.42^{ab}±0.26	2.77^{c}±0.20
	L	61.31^{cd}±1.20	15.98^{c}±0.36	6.12^{a}±0.53	1.61^{a}±0.44

Mean with the same superscript in a column are not significantly ($p > 0.05$) different

BWW: Fish samples boiled with ordinary water
BWS: Fish samples boiled with sodium chloride solution (Table salt)

S: Small sized fish
M: Medium sized fish
L: Large sized fish

Table4: Iodine level (µg/100g) in the flesh of fish samples from the study Locations.

Treatment	Size	Ogbese	Igbokoda
Control	S	129.79^{d}±9.34	194.68^{c}±4.41
	M	160.94^{e}16.75	212.85^{d}16.75
	L	202.47^{f}±11.42	311.49±5.96
BWW	S	96.04^{ab}±5.96	160.94^{a}±2.60
	M	111.62^{c}±2.58	176.51^{b}±2.60
	L	158.34^{e}±11.42	215.45^{d}±2.60
BWS	S	93.45^{a}±4.41	160.94^{a}±5.96
	M	109.02^{bc}±5.19	176.51^{b}±9.06
	L	158.34^{e}±2.60	215.44^{d}±2.60
Fried	S	133.16^{d}±3.89	196.50^{c}±5.97
	M	163.53^{e}±9.06	212.85^{d}±2.60
	L	205.06^{f}±6.75	285.53^{e}±9.34
Roasted	S	132.38^{d}±2.60	194.68^{c}±4.4
	M	160.94^{e}±4.41	210.25^{d}±5.96
	L	202.47^{f}±6.75	314.08^{f}±5.96

*Means with the same superscript in a column are not significantly ($p > 0.05$) different.

BWW: Fish samples boiled with ordinary water
BWS: Fish samples boiled with sodium chloride solution (Table salt)

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was designed to establish the effect of some of the convectional processing techniques (boiling frying and roasting) on the nutritional potential of fish with a view to predicting the best method(s) of making iodine, protein and other nutrients more readily available.

Proximate composition of the treated fish samples (*Clarias gariepinus*) from Igbokoda brackish and Ogbese fresh water bodies are presented in Tables 2 and 3.The highest protein content (%)(72.52, 73.25) was found in fish samples boiled in ordinary water from the two water bodies respectively. The least protein content was found in fried fish samples for Ogbese fresh water fish (56.98%) and in roasted samples (58.33%) for Igbokoda brackish water fish. These results tend to support the observation that mild heat treatment enhances protein digestibility by inactivating antidigestive factors and denatures the protein content while excessive heat treatment such as frying can cause browning capable of decreasing protein bioavailability (Osinubi and Eka, 1981; Lund, 1982). Protein content was equally found to increase with the size of the fish. This may be due to the accumulation of protein with age.

The highest fat content (%)(10.64,17.10) was found in fried fish samples in Ogbese and Igbokoda water bodies respectively while the least was found in roasted samples (%)(8.53,12.50) in the two water bodies. This tends to conform with the fact that majority of the

Table 5: Levels (mg/100g) of minerals in the edible portion of Ogbese fish samples

Treatment	Size	Ca	Zn	Fe	Mg	P
Control	S	10.00 ±1.10	2.00± 0.21	1.40± 0.1	40.20±1.00	150.20±2.00
	M	12.10 ± 1.00	2.20± 0.11	1.22± 0.10	42.00±1.00	165.10±2.51
	L	15.20 ± 0.20	2.50± 0.17	1.31± 0.20	47.00± 0.02	172.00±1.70
BWW	S	5.20± 0.20	1.00± 0.20	1.10± 0.10	25.00± 1.00	87.00± 6.00
	M	5.48± 0.10	1.30± 0.23	0.37± 0.50	27.00± 0.05	135.10±2.11
	L	6.20± 0.10	1.60± 0.12	5.90± 0.10	28.50± 0.50	147.20±0.15
BWS	S	4.50± 0.20	1.10± 0.11	1.00± 0.11	20.00± 1.30	83.00± 3.20
	M	5.00 ± 0.20	1.28± 0.13	1.00± 0.09	23.00± 1.70	91.50± 2.20
	L	5.82± 0.21	1.42± 0.21	0.80± 0.17	25.00± 1.70	145.00±1.00
FRIED	S	3.00± 0.23	1.10± 0.10	0.70± 0.05	21.10± 1.00	130.25±1.50
	M	3.70± 0.11	1.40± 0.13	0.80± 0.17	23.20± 0.13	96.00± 1.71
	L	4.70± 0.13	2.70± 0.89	2.50± 0.30	26.11± 1.70	142.43±1.50
RSTD	S	17.30± 0.20	1.40± 0.11	1.60± 0.10	32.00±1.00	32.00± 1.00
	M	20.00 ± 0.11	1.60± 0.10	1.40± 0.00	38.00±0.00	160.30±2.20
	L	23.00 ± 0.15	2.00± 0.10	1.45± 0.10	41.20± 1.10	167.44±1.54

RSTD: Roasted fish samples.
BWW: Fish samples boiled with ordinary water
BWS: Fish samples boiled with sodium chloride solution (Table salt)

S: Small sized fish
M: Medium sized fish
L: Large sized fish

Table 6: Levels (mg/100g) of minerals in the edible portion of Igbokoda fish samples

Treatment	Size	Ca	Zn	Fe	Mg	P
Control	S	12.00 ±1.20	2.42± 0.10	1.52± 0.10	43.20±1.52	107.8±1.12
	M	15.10 ± 2.00	2.50± 0.05	1.31± 0.21	47.10±1.73	120.00±1.00
	L	17.20 ±1.00	2.90± 0.12	1.10± 0.10	53.50± 0.10	180.0± 2.50
BWW	S	6.00± 0.10	1.20± 0.02	1.20± 0.00	30.50±0.07	68.00± 1.50
	M	7.21± 0.11	1.50± 0.10	1.17± 0.05	37.20± 0.05	75.00± 0.58
	L	9.00± 0.10	1.70± 0.08	4.80± 0.58	42.00± 0.12	82.00± 1.00
BWS	S	7.00± 0.10	1.20± 0.13	1.40± 0.10	16.10±1.00	125.0± 1.00
	M	7.60 ± 0.08	1.60± 0.10	1.30± 0.10	25.00±1.10	137.0± 1.50
	L	8.20± 0.11	2.70± 0.11	1.10± 0.10	26.00±1.21	150.0± 3.00
FRIED	S	3.10± 0.12	1.30± 0.00	1.32± 0.10	25.50±1.10	88.00±0.00
	M	5.20± 0.14	1.50± 0.17	1.23± 0.10	27.30±1.00	97.00±2.20
	L	5.72± 0.10	1.70± 0.10	1.10± 0.00	31.10±0.90	120± 0.00
RSTD	S	19.20± 0.08	1.00± 0.00	7.40± 0.12	23.10±1.00	23.10±1.00
	M	22.42± 0.10	1.30± 0.30	5.20± 0.13	26.20±0.00	74.00±0.17
	L	26.50± 0.12	1.60± 0.10	5.60± 0.10	28.00±1.00	92.00± 1.00

RSTD: Roasted fish samples.
BWW: Fish samples boiled with ordinary water
BWS: Fish samples boiled with sodium chloride solution (Table salt)

S: Small sized fish
M: Medium sized fish
L: Large sized fish

reactions that were promoted by the various processing techniques are hydrolytic in nature, thereby leaving the free fatty acids present in food available for digestion (Odoemena and Onyeneke 1998). Higher fat in fried fish samples may be due to the absorption of the cooking oils.

Iodine concentration of the treated fish samples from Igbokoda brackish and Ogbese fresh water bodies are presented in Table 4.The results show that iodine content of the brackish water fish samples were higher than that of the fresh water fish samples and that iodine concentration varies with processing with higher concentration in fried and roasted samples (205.06, 314.08) in Ogbese and Igbokoda water bodies respectively The result also revealed that iodine concentration varies with different sizes with higher concentration in large sized fish. Higher concentration of iodine in brackish fish species and large sized fish may be the result of higher iodine concentration in salt water versus fresh water body and the accumulation of iodine with age (Karen and Amund, 1997).

Mineral composition of the treated fish samples are presented in Tables 5 and 6.The results show that the evaluated mineral content (Ca, Zn, Fe, Mg and P) were higher in the selected brackish water fish samples. Higher mineral content in the brackish water fish samples may be as a result of higher salt level of the water body (Karen and Amund, 1997).

It is therefore evident from the study that the best method of processing to increase the bioavailability of iodine in fish could be by roasting and frying while protein bioavailability could be enhanced by boiling. The study further revealed that size is a factor to be considered by the population dependent on fish as a source of proteins, iodine and other vital elements.

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