Original Research Article

Chemical and Sensory Evaluation of Processed Fish Treated with *Ocimum gratissimum* Extract

Abstract

This work was aimed at assessing the potential of *Ocimum gratissimum* as for treatment of processed fish as it is being used to improve the sensory characteristics of smoked fish. This study investigated the treatment of smoked fish samples with the *Ocimum gratissimum* extract and the sensory acceptability, proximate and the mineral composition of the smoked fish. Fresh Catfish and mackerel fish were treated with three different concentrations (20%, 40%, and 60%) of *Ocimum gratissimum* extract. They were then smoked in a locally fabricated smoking kiln. The proximate, mineral and sensory evaluations of the fish were evaluated. Results obtained showed that the moisture content significantly differed (P≤0.05) from the control for the catfish and mackerel. The percentage crude protein content also differed significantly (P≤0.05) with the control with a decrease in catfish and an increase in mackerel. A decrease was observed in the ash and fat content of the two fish and a slight increase on the crude fibre content of mackerel. The mean mineral composition showed that a significant difference (P≤0.05) was observed as the concentrations increased although there were decrease in iodine and potassium content of catfish. There was a significant difference (P≤0.05) in organoleptic scores among the fish samples treated with 20% and 40% *Ocimum gratissimum* which were significantly higher than the control. This study showed that *Ocimum gratissimum* inclusion does not have any adverse effect on the chemical composition of processed fish but improved the sensory quality of the processed fish.

Keywords: Smoked fish, Plant extract, Crude protein, Catfish, Mackerel fish

1. INTRODUCTION

Fish provides an important component of diet for many people, and often provides the required nutrients for a healthy living. Fish serves as a major source of dietary protein, which is very inexpensive when compared to other food proteins [1]. Fish is an excellent component of human diet which is now evident around the world. This is as a result of fish being cheap source of animal protein. Fish protein is now rated higher over other protein of animal origin, and compares very well with that of milk, egg and meat in its amino acid composition. With this quality, fish protein is practically indispensable to developing countries, such as Nigeria, for diet supplementation, where the staple diet or food consist primarily of starchy foods [2].

Processing of fish is a way of preserving fish. Modern ways of processing and preservation have led to the consumption of many species of fish. Plants have been known to play vital role as a good source of

food and maintenance of good health since ages. Research reports indicate that plants play vital roles in the maintenance of good health [3].

Proximate analysis of most Nigerian vegetables have been found to be rich sources of carbohydrates, proteins, ash, crude fibre, fats, vitamins and minerals [4]. Spices are food adjuncts that are used as flavouring agents and as preservatives in food products. There have been reported mixed feelings from consumers over health challenges such as hypertension, cancer and obesity resulting from excessive use of artificial food additives. (*Ocimum gratissimum*) whose parts are used as spices in the preparation of local dishes is better used to replace these artificial spices [5].

In Nigeria, indigenous people traditionally use plants as food and medicine. These plants constitute great reservoir of a wide variety of compounds which exhibit some medicinal and nutritive properties, thus are popularly used as spices and medicine. *Ocimum gratissimum* has been known and used as a culinary ingredient and as traditional medicine [6].

The success of this work will encourage the development of natural spices from an indigenous plant to replace the numerous artificial spices that are commonly used. This work is aimed at assessing the potential of this plant *Ocimum gratissimum* as it is being used to improve the sensory characteristics of smoked fish. This study investigated the treatment of smoked fish samples with the *Ocimum gratissimum* extract. It also determined the sensory acceptability of the smoked fish and evaluated the proximate and the mineral composition of the smoked fish.

2. MATERIALS AND METHODS

Study area: The study was carried out at Food Science and Technology Department, Food Processing and Chemistry Laboratory Michael Okpara University of Agriculture Umudike from July 2019 to November 2019.

2.1 Sample collection and preparation: Two different fish samples (catfish and mackerel) that are commonly smoked in Nigeria were used for the study. The catfish and Mackerel were gotten from a fish pond at the National Root Crops research Institute Umudike Nigeria. The scent leaves (*Ocimum gratissimum*) were also collected from a farmland in Michael Okpara University of Agriculture, Umudike in Abia state and were confirmed at the Department of crop science, Michael Okpara University of Agriculture, Umudike. The method of Rebeca *et al. [*7] with slight modification was used for the plant extraction. The fresh leaves were cleaned and washed to remove sand and debris, the leaves were air dried for 48hours then dried in a Carbolite hot air oven for 45minutes at a temperature of 50°C. The dried leaves were ground into fine powder. Measurements of 20g, 40g and 60g portions of the ground leaves were reconstituted in 100 ml of distilled water respectively and left to stand at room temperature. The extracts were sieved using a muslin cloth and filtered through a sterile whatman No1 filter paper and then used for the experiment.

2.2 Fish treatment: The fish samples were washed to remove blood and unwanted parts, cut into three places and *Ocimum gratissimum* extract was injected into the fish at different concentrations of 20%, 40%

and 60% respectively using a syringe. Finally, the fish samples were placed on a rack and smoked. Smoked fish without extract was used as control.

2.3 Smoking process: The smoke was generated by hard burning wood. The fishes were placed on racks above the generated smoke. The fishes were turned at intervals for uniformity. After smoking; the products were packed in transparent polyethylene bags, sealed with a masking tape, labeled and used for the experiments.

2.4 Determination of proximate composition: The method described by Ranjiham and Gapal [8] was used to determine the moisture content, ash content, fat content, crude fibre and protein content of the fish samples.

2.5 Determination of Mineral properties: The method described by Das *et al.* [9] was used to determine calcium and magnesium, sodium, iron and potassium was determined using a digital flame photometer.

2.6 Determination of sensory evaluation: The sensory characteristics of the fish samples were determined by 30 panelists. The panelists evaluated the following quality attributes (appearance, aroma, texture, taste, and general acceptability).

2.7 Data Analysis: Analysis of variance was used for the determination of significant differences ($p<0.05$) among treatment means and separation of means was carried out using the SPSS version 20.0. Separation of means was carried out by Duncan Multiple range test and values were reported as means and standard deviation.

3. RESULTS AND DISCUSSION

3.1 Proximate compositions of the fish samples: The effect of *Ocimum gratissimum* leaf extract on the proximate composition of fish samples are shown in Table 1. The moisture content ranged from 30.23 to 46.17 % for the mackerel and catfish samples. There was a significant difference ($P\leq0.05$) in the moisture content of the fish samples at different levels of treatments. The highest values were seen at 60% concentration in both fish and catfish recorded the highest value of 46.17%. The increase in moisture content could be due to the treatment that was given to the fish. The catfish had the highest value of moisture when compared to the mackerel fish at 60% concentration this could be attributed to the fact that catfish has high water content which predisposes them to microbial spoilage if not properly preserved after harvest as reported by Olayemi *et al [*10].

The ash content ranged from 1.83 to 6.20%there was a significant difference ($P\leq0.05$) as the concentrations increased. There was a decrease in the ash content of the fish; this could be due to the increase in moisture content of the fish as water loss in fish leads to high ash content of fish. The mackerel fish sample recorded the lowest value when compared to the catfish. Values obtained for mackerel were higher than the values obtained by Egbal *et al.* [11] for smoked *Clarias lazera* which had the value of 1.50% and values obtained for catfish were higher than the values obtained by Ogbonnaya and Ibrahim [12] which recorded a value of 3.92% for dried catfish.

The fat content ranged from 1.46 to 8.11% and a significance difference was observed. There was a decrease in the fat content of the fish except for catfish which had the same value 8.10% at 60% concentration. Decrease in the fat content could be attributed to the composition of the leaf which has low protein and lipid contents. It is reported that vegetables and fruits are generally poor sources of protein Joanne *et al.* [13]. The catfish had a higher value compared to the mackerel, this is due to the fact that catfish is a fatty fish. Also the decrease in fat could be attributed to the fact that fat may have been exuded with the evaporation of the moisture content during smoking.

The crude fibre ranged from 0.22 to 0.48% and the least value was seen in catfish at 20% concentration. There was an increase on the crude fibre content of the mackerel while a decrease was observed on the crude fibre content of the catfish. The increase in the crude fibre content could be attributed to the presence of the plant ingredients which are fibrous in origin.

The crude protein content ranged from 18.66to 28.67%.The control catfish had the highest value for protein but decreases as the concentrations increased while the mackerel increased as the concentration increased. The increase showed that protein nitrogen was not lost during smoking. The difference in protein content could be due to level of assimilation of the nutrients from their diets also it is reported that low fat fish contain high amount of protein as it is reported that mackerel feed on fish items: crustacean, mollusks, algae and diatoms Shrinivas *et al.* [14]. Also Felix [15] reported that smoking resulted in the concentration of nutrients such as protein as the moisture content is reduced. However some studies has reported reduction in the quality of protein as a result of smoking. Salan *et al.* [16] reported that smoking leads to increase in the protein though he did not state the temperature at which this will occur. The decrease in crude protein of the catfish obtained in this study may be due to the effect of smoke on crude protein. Also Eyo [17] reported that the raw state of catfish has a low protein content, fibre and high moisture content. However the values obtain in this study on catfish is higher than the values obtained by Egbal[11] 23.15 and 22.15% for smoked *Clarias lazera* and *Oreochromis niloticus* respectively.

Table 1: Proximate composition of the fish samples

	Sample (%)	Moisture	Ash	Fat	Crude fibre	Protein
CTRL	Catfish	40.53 ^{d}±0.12	6.20 ^{a} ±0.01	8.10 ^{a} ±0.01	0.48 ^{a} ±0.01	28.67 ^{a} ±0.58
	Mackerel	30.23 ^{g}±0.06	2.71 ^{e} ±0.02	3.20 ^{d} ±0.01	0.28 ^{d}±0.06	18.66^{g}±0.01
20%	Catfish	38.63 ^{f}±0.58	4.36 ^{d}±0.01	7.51 ^{c}±0.02`	0.22 ^{e}±0.01	25.63 ^{d}±0.06
	Mackerel	40.17^{e}±0.06	1.83 ^{h}±0.01	1.46 ^{g}±0.01	0.31 ^{d}±0.01	19.71 ^{f}±0.01
40%	Catfish	42.30^{c}±0.00	4.48 ^{c}±0.01	7.96 ^{b}±0.01	0.31 ^{d}±0.01	25.80 ^{c}±0.00
	Mackerel	42.37^{c}±0.06	1.87 ^{g}±0.00	1.57 ^{f}±0.01	0.37 ^{c}±0.01	19.82^{e}±0.01
60%	Catfish	46.17 ^{a} ±0.6	4.51 ^{b}±0.01	8.10 ^{a} ±0.01	0.36 ^{c}±0.00	26.27 ^{b}±1.28
	Mackerel	43.17^{b}±0.06	1.93 ^{f}±0.00	1.59^{e}±0.01	0.42^{b}±0.00	19.87^{e}± 0.01

Values show the mean of duplicate analysis and ± standard deviation. Figures with different superscript down the column are significantly different ($p<0.05$).

3.2 Mineral compositions of the fish samples:

The effect of *Ocimum gratissimum* leaf extract on the mineral composition of fish samples are shown in Table 2. The calcium content ranged from 150.33 to 172.67 mg/g, magnesium 2.00 to 4.20mg/g, potassium 226.47 to 496.33 mg/g, sodium 202.67 to 374.00 mg/g and iodine 1.00 to 2.91 mg/g. There was a significance difference (P≤0.05) in the mineral content. There was an increase in the calcium content of the fish samples. The highest value was seen on mackerel. There was a decrease in calcium at 20% concentration for both catfish and mackerel while an increase was observed at 40% and 60% concentration.

There was a decrease in the magnesium while sodium and potassium increased as the concentration increased. The increase seen in the mineral content of the fish could be attributed to the mineral content of the *Ocimum gratissimum* leaf which has high level of calcium, potassium, magnesium, and nitrogen as reported by Ajay [18]. These minerals are required for repair of worn out cells, strong bones and teeth in human, building of red blood cells and for body mechanism [18]. The high levels of these elements show that they can provide alternative sources of calcium and potassium in diets. The catfish had higher mineral content than the mackerel fish samples, this could be attributed to the difference in the fish in relative to their body composition and surrounding.

There was a decrease in the iodine content of the catfish as the iodine content of the mackerel remained unchanged. The decrease in iodine content of the catfish could be the leaching and evaporation of fish body fluid [19]. Iodine occurs in form of the hormone thyroxin [20]. There would also be inorganic iodides absorbed from water and digested food. At high temperature and relative humidity inorganic iodides are oxidized to molecular iodine which evaporates [21]. This would cause iodine loss during smoking. Differences in the ability of heat to penetrate and ease fluid loss during smoking could influence the rate of iodine loss leading to different degrees of iodine loss in the fish [19]

Table 2: Mineral composition of the fish samples

	Sample (Mg/g)	Calcium	Magnesium	Potassium	Sodium	Iron
CTRL	Catfish	151.33^{d}±0.58	2.01^{g}±0.01	496.33^{a} ±0.58	373.67^{a} ±0.58	2.91^{a} ±0.01
	Mackerel	172.67^{a} ±0.58	4.20^{a} ±0.01	226.47^{b} ±1.75	202.67^{e} ±0.58	1.00^{e}±0.00
20%`	Catfish	150.33^{e}±0.58	2.00^{h}±0.00	490.33^{a}±0.58	370.33^{c}±0.58	2.48^{c}±0.01
	Mackerel	171.37^{b}±0.06	3.81^{d}±0.01	301.3^{b} ±0.58	202.33^{e} ±0.06	1.00^{e}±0.00
40%	Catfish	151.67^{d}±0.58	2.05^{f}±0.01	491.67^{a}±0.58	371.67^{b}±0.58	2.49^{b}±0.00
	Mackerel	172.03^{ab} ±0.06	3.82^{c}±0.00	303.00^{b} ±1.00	204.23^{d} ±0.58	1.01^{de}±0.00
60%	Catfish	154.00^{c} ±0.00	2.08^{e} ±0.01	494.00^{a}±0.00	374.00^{a} ±0.00	2.50^{b}±0.01
	Mackerel	172.13^{ab} ±0.06	3.86^{b} ±0.00	305.67^{b} ±0.58	204.50^{d}±0.00	1.02^{d}±0.00

Values show the mean of duplicate analysis and ± standard deviation. Figures with different superscript down the column are significantly different ($p<0.05$).

3.3 Sensory evaluation of the fish samples:

The sensory evaluation of the treated fish samples are shown in Table 3. There was a significant difference (P≤0.05) in the sensory characteristics of the fish samples with respect to their appearance which recorded the highest value 7.40 in catfish at 40% concentration. There was a significant difference (P≤0.05) in the aroma, texture and taste of the fish samples. Catfish received higher sensory scores than the mackerel. The samples that were accepted by the panelist in terms of taste were catfish at 20% and 40% concentrations. Aroma was accepted by the panelist for all fish samples at different concentrations, this is as a result of the aromatic flavor contained in the *Ocimum gratissimum* leaf [22]. Both catfish and mackerel fish sample were accepted by the panelist at 20% and 40% concentrations. This agrees with the literature that *Ocimum gratissimum* has been known and used for years as culinary agent because of its rich flavor [23].

Table 3: Sensory evaluation of the fish samples

	Sample	Appearance	Texture	Taste	Aroma	General acceptability
CTRL	Catfish	7.07^{ab} ±1.84	6.87^{ab}±1.66	6.67^{abc}±1.84	6.70^{a}±1.68	6.90^{ab}±1.83
	Mackerel	6.03^{bcd}±1.63	5.90^{b} ±1.84	6.27^{ab} ±1.60	6.57^{a} ±1.68	6.43^{b} ±1.92
20%	Catfish	7.20^{a} ±0.81	7.17^{a} ±1.18	7.70^{a} ±1.15	6.83^{a} ±1.42	7.67^{a} ±1.02
	Mackerel	5.83^{b} ±1.46	6.20^{ab} ±1.37	6.37^{ab} ±1.79	6.47^{a} ±1.59	6.77^{ab} ±1.22
40%	Catfish	7.40^{a} ±1.28	7.10^{ab} ±1.99	7.30^{ab} ±1.64	7.17^{a} ±1.73	7.00^{ab} ±1.91
	Mackerel	6.07^{bcd} ±1.34	6.20^{ab} ±1.47	6.23^{ab} ±1.50	6.13^{a} ±1.76	6.40^{b} ±1.59
60%	Catfish	6.97^{abc} ±1.19	6.97^{ab}±0.93	6.40^{ab}±1.77	6.57^{a} ±1.57	6.80^{ab} ±1.63
	Mackerel	5.90^{cd} ±2.04	5.97^{ab} ±1.65	5.73^{b} ±1.74	6.27^{a} ±1.82	6.20^{b} ±1.40

Values show the mean of duplicate analysis and ± standard deviation. Figures with different superscript down the column are significantly different ($p<0.05$).

4. CONCLUSION

The results obtained from this study showed that *Ocimum gratissimum* does not have any adverse effect on the chemical composition of smoked fish. The fish treated *with Ocimum gratissimum* manifested a high mineral content level, which can be used to complement diets that are lacking in calcium and potassium. Also it was observed that the protein content increased in mackerel fish. *Ocimum gratissimum* extract has enhanced the eating quality of fish in this study especially on the fish samples treated with 40% and 60% *Ocimum gratissimum* extract as it improved the flavor assaying the organoleptic property of any fish product. In general, there was a significant influence of the *Ocimum gratissimum* extract on the sensory property of the processed fish, there was no effect on the protein content of the mackerel and the mineral content of both fish which is of great importance. This study also provides basic information on smoked catfish and mackerel.

SIGNIFICANCE STATEMENT

This study discovers the potential of this plant *Ocimum gratissimum* as it is being used to improve the sensory characteristics of smoked fish. The success of this work will encourage the development of natural spices from an indigenous plant to replace the numerous artificial spices that are commonly used especially in smoked fish.

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