

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

Abstract

This work aims to the effect of three different concentrations (20%, 40%, and 60%) of *Ocimum gratissimum* extract on the proximate, mineral composition and sensory acceptability of smoked catfish and mackerel samples. Fresh fish samples were hot smoked in a locally fabricated smoking kiln at 110°C. Results showed that the moisture content of smoked catfish and mackerel was significantly different ($P \leq 0.05$) from the control sample. The percentage of crude protein content decreased in smoked catfish and increased in mackerel samples and also differed significantly ($P \leq 0.05$) compared with the control. Ash and fat content decreased in smoked fish and the crude fibre content was slightly increased in smoked mackerel. The minerals composition showed a significant difference ($P \leq 0.05$) was observed although there were decrease in iodine and potassium content of catfish. There was a significant difference ($P \leq 0.05$) in organoleptic scores among the fish samples treated with 20% and 40% *Ocimum gratissimum* which were significantly higher than the control. This study concluded that *Ocimum gratissimum* inclusion does not have any adverse effect on the chemical composition of smoked fish sample but could improve their sensory quality.

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 product for 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. The traditional ways of preserving fish by drying, salting, pickling and smoking is still widely practiced by locals in developed and developing countries. 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*) parts are used as spices in the preparation of local dishes which are 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].

Therefore, this work aims to the effect of three different concentrations (20%, 40%, and 60%) of *Ocimum gratissimum* extract on the proximate, mineral composition and sensory acceptability of smoked catfish and mackerel samples

2. MATERIALS AND METHODS

Study area: The study was carried out at the Food Processing and Chemistry Laboratory, in the Food Science and Technology Department of 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) were used for the study. The catfish and Mackerel were obtained 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. 20g, 40g and 60g portions of the powder were reconstituted in 100 ml of distilled water respectively and left to stand at room temperature for 2 hours. The extracts were filtered using a muslin cloth and through a sterile whatman No1 filter paper and then used for the experiment.

2.2 Fish treatment: about 1.5kg fish samples were used for the experiment. Fish samples were washed to remove blood and unwanted parts, cut into three parts that are homogenous in size and weighing about 500g. The selected fishes were treated with *Ocimum gratissimum* extract 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 Hot Smoking process: The smoke was generated by burning hard wood. The fishes treated with *Ocimum gratissimum* extract were placed on racks above the generated smoke. The fishes were turned at intervals for uniformity. Until a golden brown colour was observed. 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 Ranjham and Gapal [8] was used to determine the moisture content, ash content, fat content, crude fibre and protein content of the fish samples. The moisture content was determined by hot air oven method at 105 °C. The drying and cooling steps were repeated until a constant weight was obtained. The Soxhlet extraction method was used for fat content evaluation. Crude protein was analysed using the Kjeldhal method and multiplied by 6.25. Ash content was determined by heating sample content in a muffle furnace at 600°C for 4 hours and Crude Fibre was analysed using from sample extracted with ether and boiled under reflux with 1.25% solution of sulphuric acid and filtered.

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

2.6 Determination of sensory evaluation: The sensory characteristics of the fish samples were determined by 30 untrained 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 respectively. There was a significant difference ($P \leq 0.05$) in the moisture content of the fish samples at different levels of treatments. The highest values of moisture content were found 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% (Table 1). There was a significant difference ($P \leq 0.05$) 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 led 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 smoked 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 (Table 1). The catfish had a higher fat content 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 content ranged from 0.22 to 0.48% and the least value was found in catfish at 20% concentration (Table 1). 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 18.66 to 28.67%. The control catfish had the highest value for protein but decreases with the concentrations increased while the mackerel increased as the concentration increased (Table 1). The increase showed that protein nitrogen was not denatured and moisture 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 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. The decrease in crude protein of the catfish obtained in this study may be due to the moisture content. 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 smoked fish samples

Treatments	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 Minerals compositions of the fish samples:

The effect of *Ocimum gratissimum* leaf extract on the mineral composition of the smoked 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 ($P \leq 0.05$) 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 (Table 2).

There was a decrease in the magnesium while sodium and potassium increased in both fish samples as the concentration of extract increased (Table 2). The increase 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 Ajayi [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: Minerals composition (mg/g) of the fish samples

Treatments	Sample (Mg/g)	Calcium	Magnesium	Potassium	Sodium	Iodine
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 smoked treated fish samples with plant extract are shown in Table 3. There was a significant difference ($P \leq 0.05$) in the sensory characteristics of the smoked fish samples with respect to their appearance which recorded the highest value 7.40 in catfish at 40% concentration. There was a significant difference ($P \leq 0.05$) in the aroma, texture and taste of the fish samples. Smoked Catfish recorded higher sensory scores than the mackerel (Table 3). The samples 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 smoked 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 smoked fish samples

Treatments	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 \pm 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% 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 smoked fish, there was no effect on the mineral content of both fish. This study also provides basic information on smoked catfish and mackerel regarding their nutritional benefits especially regarding the quality retention and improvement.

SIGNIFICANCE OF THE STUDY

This study investigated 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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