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Organoleptic Assessment and Nutritive Values of *Clarias gariepinus* Smoked Using Coal and Firewood

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Abstract: The aim of the study was to investigate the Organoleptic and the nutritive value of *Clarias garepinus* smoked using different sources of energy from firewood and charcoal. These were sourced from the tree *Prosopis affricana*. The fish were smoked using the local smoking Kilns made from drums with a wire mesh placed on top of them. The firewood or the charcoal was introduced from the vent. The fish were weighted before and after the smoking processes. The initial weight of the fish used for the smoking process was 207.0±11.61 g and after was 54.68±1.14 g. The fish were left to smoke for 24 h at a temperature of 500°C to reduce the moisture to the minimum and were left to cool. The sensory evaluation was carried out by a 10-man evaluation panel using the 7-point Hedonic scale and the proximate composition was evaluated according to methods outline by AOAC (1990). The sensory evaluation showed there was a significant differences ($p<0.05$) between the fish smoked using charcoal and firewood in colour, flavour and general acceptability. However, there was no significant difference ($p>0.05$) in taste between the fish smoked using charcoal and firewood. There also a significant difference ($p>0.05$) in the proximate composition between fish smoked using charcoal and firewood in moisture, protein, fat, ash and crude fiber. This implies that charcoal is a better source of energy for smoking fish than firewood.

Key words: *Clarias gariepinus*, proximate composition, sensory attributes smoking, charcoal and firewood

INTRODUCTION

Smoke-drying of perishable foods dates back to civilization (Eyo, 1999). According to FAO (1999) and Bronwell (1985) smoking of fish is an old method of curing or preserving fish. Smoking of fish results in physical changes such as colour, flavor and texture of the fish. According to (Eyo, 1992) smoking of fish is the major way of preserving fish in Nigeria. Lin *et al*. (2008) have reported that smoking is a widely used way of preserving fish for the colour and flavor. Smoke can be generated from many sources, such as wood, coal, sawdust and even dry cow-dung. Smoke itself is produced by non complete burning of some type of wood which produces a mixture of many chemical compounds; however the chemical composition of smoke depends on the type of wood (FAO, 1981). Eyo (1985) reported about the various types of woods in the tropics suitable for fish smoking process.

Fish deterioration or spoilage is one of the greatest problems facing the fishing industry. Akande *et al*. (1998) has reported that about 40% of fish caught in Nigeria is lost to post- harvest losses which do not get to customers in a wholesome state. This spoilage comprises bacteria (Connell, 1995) and chemical changes that occur in the fish (Castrillion *et al*., 1917). According to Eyo (2001) all preservative methods are geared towards making the conditions in the fish uncomfortable for the bacteria and reduction of chemical reactions in the fish. According to FDF (2007) most of the fish are caught by the artisanal sector which is dominated by the fisher forks that do not have access to means of preserving their products apart from smoking. Smoking therefore according to Tabor (1982) and Eyo (1993) is the most popular method of preservation of fish in Nigeria. Tobor (1984) also reported that 45% of fish caught in the artisanal sector was processed into smoked fish products especially in L. Chad basin and Kanji lake area where they are transported to the Southern cities for sale to the consumers. Dvorak and Vognsrova (1997) have reported that difference in smoke quality can make the end-products to differ with respect to nutritional esthetic quality. Smoke which is as a result of incomplete combustion of wood is known to contain phenolic, carboxyl and some polynuclear aromatic hydrocarbons which according to Eyo (2001) can be carcinogenic. The flavor enhancing components of smoke are guaicol and syringol which are phenolic esthers. It also produces sooths on the body of smoked fish which can make the end products unattractive to consumers. However charcoal is the product of complete burning of wood by pyrolysis (Horner, 1992; Braigs, 2007) which produces less smoke, therefore by the process of its production most of the volatile compounds would have vaporized. It produces less

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smoke and heat generated is more intense to cook and dry fish easily as it burns hotter and cleaner than wood. Many of the important compounds present in smoke from hardwood lead to production of flavor, colour, anti-oxidative, bacteriostactic and bactericidal compounds (Gilbert and Knoule, 1975). Dvorak (1997) has reported that smoking causes decrease in the available lysine in the fish. Losses in other amino acids such as argine and histamine have also been observed. However, over 75% of protein, 50% vitamins and minerals are still retained in smoked fish (Sviensdottir, 1998; Afolabi *et al*., 1984).

MATERIALS AND METHODS

Samples of freshly caught fish from the University fish pond were washed, weighted and bent into horse-shoe shapes. The initial mean weight of the fish was 207±11.61 g. The fish were arranged on top of a wire-gauze placed on a drum smoking kiln for each of the treatments (firewood and coal). The fish were turned regularly to prevent charreding for 24 h until dried to a constant weight. Samples of the smoked fish were taken for the proximate analysis for moisture, crude protein, fiber, ash, lipids and Nitrogen free extract in the Animal production laboratory of the University of Agriculture, Makurdi. These parameters were determined using standard procedures of AOAC (1990). Organoleptic evaluation was carried out using a 10-man panel through a 7-point Hedonic scale to evaluate changes in flavor, colour, taste, fragrance and general acceptability. Analysis of Variance was used to test if there was any difference in the proximate composition of the smoked fish using firewood and coal and among the attributes.

RESULTS

Results of the proximate composition of fish smoked using firewood and charcoal are as shown in Table 1. The sensory evaluation of the fish smoked using charcoal and firewood by taste panel is as shown in Table 2.

DISCUSSION

The results obtained in this work showed that the moisture contents of the fresh fish of 67.43±1.15% was reduced to 19.51±0.51% for fish smoked using firewood and 20.00±0.55% for fish smoked using charcoal. Generally, the main aim of smoking fish according to Tobor (1995), Clucas (1982) and Eyo (1998, 2001) is to reduce the moisture content of fish to about 15-20%. This is to make the conditions in the fish that allows for spoilage organism and chemical activities in the fish to be reduced to minimum. The moisture contents of the smoked-dried fish of 19-20% as observed in the fish smoked with charcoal and firewood will reduce spoilage and subsequently prolong Shelf of the fish. Although, the moisture content of fish smoked with charcoal is less than that of the one smoked with firewood, there was no significant difference ($p<0.5$) in the amount of moisture lost for both treatments. The crude protein varied from 19.27-55.95% for fish smoked with charcoal and 54.38% for the one smoked with firewood. This agrees with similar works by Clifford *et al*. (1980), Eyo (2001) and Tiamiyu and Solomon (2007). They observed that the higher the moisture content of the fish the less the value of crude protein in the fish. This may be due to the fact that in fresh fish, the protein is less coagulated than in dried form which is said to increase the digestibility of the protein in fish.

The sensory attributes as observed by the response of the taste panel showed that people preferred fish smoked using charcoal than the ones smoked using firewood. However, there was no significant difference ($p<0.5$) in the sensory attributes of fish smoked using charcoal or firewood on the data got from general acceptability by the people. This however did not agree with an earlier work by Frazier and Westhoff (1978) that states that fish smoked with firewood had better colour, taste and flavor due to the presence of phenolic compounds in the smoke.

Fish therefore could be smoked using fire wood or charcoal without any fear of acceptability by the consumers, but would advice that fish should be smoked using charcoal than firewood as it has been observed that coal have under gone proper combustion which has reduced the amount of smoke-lading with phenolipic compounds that have been said to be carcinogenous (Eyo, 2001).

Table 1: Proximate composition of fresh and smoked *Clarias gariepinus* using firewood and charcoal

Test sample	Moisture (%)	Crude protein (%)	Lipid (%)	Ash (%)	Crude fibre	NFE
Fresh fish	67.43±1.15	19.27±0.57	07.50±0.50	2.63±0.37	3.50±0.50	0.32±0.30
Fish smoked with charcoal	19.51±0.51	55.95±0.55	11.60±0.80	5.40±2.30	5.84±0.16	1.70±1.70
Fish smoked with firewood	20.00±0.50	54.38±0.50	12.16±0.80	5.71±1.25	6.26±1.06	0.04±0.04

Table 2: Sensory attributes of smoked *C. gariepinus* using firewood and charcoal

Test sample	Colour	Flavor	Taste	General acceptability
Fish smoked with charcoal	6.60±0.16^a	6.80±0.13^a	6.90±0.10^a	6.70±0.15^a
Fish smoked with firewood	5.70±0.15^b	6.20±0.24^b	6.90±0.16^a	5.70±0.21^b

These values are the 7-point Hedonic scale of 10 men panel response to each attributes. The Hedonic scales are: 1 = Extremely poor; 2 = Very poor; 3 = Poor; 4 = Fair; 5 = Good; 6 = Very good and 7 = Excellent. Values in the same row with same superscripts are not significantly different at 0.05 level of probability

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