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RESEARCH ARTICLE

AN ANALYSIS OF BIO CHEMICAL WITH MINERALS COMPOSITION OF THREE DIFFERENT SPECIES FISH BY DRYING METHODS (*BONGA* SPP., *SARDINELLA* SPP. AND *OREOCHROMIS NILOTIEUS*)

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ABSTRACT

Three methods of drying (oven, sun and smoke) were used to dry *Bonga* spp., *Sardinella* spp. And *Oreochromis nilotieus*. The physico-chemical and minerals contents of the sample were determined using standard methods. Oven dried *O. niloticus* recorded the highest (16.42%) moisture content while the least moisture content 9.27% were obtained in oven-dried and sun-dried *Sardinella* sp. Highest protein content (51.06%) was found in sundried *Sardinella* sp., while the highest and the least fat value of 60.36% and 12.13% were recorded for smoke-dried and sun-dried *O. niloticus*, respectively. *Banga* sp. has the highest ash content of all the fish evaluated for proximate composition. The highest value of the major elements were obtained in this decreasing order K > Na > Mg > Ca in *Sardinella* sp. (ovendried) *O. niloticus* (sun-dried) *O. niloticus* (smoke-dried) and *Sardinella* sp. (oven-dried). The highest value of major element K (250 mg), Na (218 mg), Mg (183 mg) and Ca (150 mg) were obtained in *Sardinella* sp. (oven-dried), *O. niloticus* (sun-dried), *O. niloticus* (smoke-dried) and *Sardinella* sp. (oven-dried), respectively. Zinc had he highest value of all the trace elements determined while Copper had the least value. The panellists found smoke-dried and oven-dried sample most palatable, while the ones with most attractive colour were smoke-dried samples.

INTRODUCTION

Nutritional quality of a food is very important. The nutriational importance of seafood has increased substantially because of beneficial effects of eating seafood fats and oils (Azam et al., 2004). Seafood is also an important source of high quality and highly digestible protein and a respectable source of essential minerals (Nettleton, 1992). Body part of the seafood being consumed, method of handling, processing (including cooking at home), season of harvest, sex and species (Krzynowek, 1988) affect the nutritional quality of seafood. Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as a good source of protein and other elements for the maintenance of healthy body (Andrew, 2001).The sub- stantial percentage of the protein needs of the population of the villages and towns is supplied through fishing in several Nigerian communities (Ako and Salihu, 2004).

The less developed countries capture 50% of the world fish harvest and a large proportion of the catch are consumed internally (FAO, 1985). In many Asian countries over 50% of the animal protein intakes comes from fish while in Africa; the proportion is 17.50% (Williams et al., 1988). In Nigeria, fish constitute 40% of the animal protein intake (Olatunde, 1998). The annual fish demand in Nigeria between 1980 - 1990 was estimated as 1.2 million tons. Consumption of fish provides an important nutrient to a large number of people worldwide and thus makes a very significant contribution to nutrition. Fish has edge over meat because it is cheaper and relatively more abundant in Nigeria (Eyo, 1983). Smoking is the preferred cheap method to preventing fish spoilage. This is carried out over smoldering wood, sawdust or other local source of energy using traditional kilns constructed with locally sourced materials.

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This has the effect of imparting pleasant flavours to the product beside the preservative effect of the smoke itself (Burgress et al., 1965; Tull, 1997). Nevertheless, the pre-treatment of fish for smoking, packaging and storing may differ widely, so that fish obtained in the market have vast variable qualities. It was, therefore, imperative to conduct this present study to determine the concentration of food constituents and mineral composition in fish subjected to three methods of fish drying; oven drying, sun drying and smoke drying.

MATERIALS AND METHODS

The three species of fish (*Oreochromis niloticus*, *Sardinella* spp. and *Bonga* spp.) were purchased from,Nagapttinam district in Tamil Nadu state, India. The fish samples were washed with tap water to remove the ice, rinsed with distilled water, cut into slices and subjected to oven, sun and smoke drying. The representative samples were taken from the head, rear and the middle of each species and blended together into a powdery form and kept in airtight containers. This were neatly labeled and stored in a refrigerator pending analysis. The crude fat was extracted with petroleum ether (40 – 60% boiling range) from the dry powdered sample using Soxhlet apparatus (Joslyn, 1970). The protein (N x 6.25) and crude fiber were determined using the method described by AOAC (1990). Carbohydrate concentration was estimated by difference. The moisture content was determined by evaporating the samples at 105^{o}C and the ash content was estimated by dry-ashing at 550^{o}C. The sensory evaluation was carried out by a group of panelist according to the method described by Potter (1968). The mineral analysis was carried out by dry-ashing the sample, dissolving in 10% HCl, followed by filtering and aspiration into atomic absorption spectrophotometer (Mode 372).

Each metal was then determined using their corresponding pure salt. Data obtained were subjected to analysis of variance by one way ANOVA, using the New Duncan's Multiple Range Test (Zar, 1984).

RESULT AND DISCUSSION

Generally, fish has been regarded as a good source of protein and is widely accepted to in developing countries (FAO, 1985). Inadequate preservation techniques would imply a substantial shortfall in fish availability thereby affecting the protein intake (Wilman et al., 1998). Drying is a common practice in meat, fish and other animal protein based industry, because it preserved the quality for an extended time and offers several advantages such as insignificant alterations and minimum deterioration in the product. Proximate composition of the three species of fish subjected to different methods of drying is presented in Table 1. The moisture content ranges from 9.79 to 16.42%. The protein, fat, ash and carbohydrate contents vary with species and mode of drying (Table 1). Azam *et al.*,(2004) has also reported similar protein, fat and ash contents of 10 species of fish. The protein content of the sun dried fish (22.47 - 51.00%) is higher than for oven-dried (31 – 49%) and smoke-dried (13.04 – 40.54%) samples. The lower protein content in oven dried and smoked samples could be connected with denaturation of fish protein associated with oven dried and smoked fish (Akinneye, unpublished). The highest fat content (12.73 – 60.30%) was observed in fish samples that were smoked while the least 12.13 – 26.42% was recorded for fish samples that were sundried. The lower fat content observed in sundried method could be associated with the oxidation of fat during the period of sun drying (McGill et al., 1974).

The mineral content of the three species of fish analysed are presented in Table 2. The highest value of the major elements (Na, K, Ca, Mg) ranged from 90 – 250 mg/100 g was observed in oven-dried samples while the least value (33 – 218 mg/100 g) was recorded for sun dried samples. Among the major elements (Na, Mg, Ca, K), well defined order of magnitude within the same species was evident. *Sardinella* spp. (oven-dried, sundried and smoked), *Bonga* spp. (oven-dried and smoked) and *O. niloticus* (oven dried) have well defined decreasing order; K > Na > Mg > Ca. This findings tallies with the observation of Oladimeji and Sadiku (1991) where the decreasing order K >Na>Mg>Ca was found in oven-dried edible muscles of *Sarotherodun galilaeus*, *Lates niloticus* and *Syodonitis sehal*. Teeny *et al.*,(1984) reported a similar decreasing order for several species of fish. In *Bonga* spp. (sun-dried) and *O. niloticus* (smoked and sun-dried), no well-defined order of magnitude was evident in the major elements (Na, K, Mg, Ca). Ako and Salihu (2004) have also reported lack of well-defined decreasing order of magnitude in major elements evaluated. However, Kirchgessner and Schwall (1986) observed a well-defined order; Ca > K > Na > Mg. With regard to the trace elements, copper was found to be lowest while Zn was found to be highest in concentration among the elements determined. This result tallies with the work of Teeny *et al.*,(1984) that zinc was found to be highest in concentration among the element determined. A well-defined decreasing order Fe > Mn > Cu of magnitude was evident in all the three species of fish subjected to the three drying methods except in the case of iron (Fe) were *Sardinella* spp. Have the highest concentration in sun-dried samples with this decreasing order of magnitude; Fe > Mn > Cu > Pb. This result agrees with the findings of Ako and Salihu (2004) that appreciable degree of consistency was evident. Teeny *et al.*,(1984) reported that iron was found to be highest in concentration among the elements determined as was observed in this study (Fe > Mn > Cu > Pb) except in *Sardinella* spp. (sun-dried) where Fe was found to be highest in concentration (Fe Mn > Cu > Pb). Khan *et al.*, (1987) and other researchers did not observe any definite order in the magnitude of the elements However nutritional composition of fish muscles varies both from species to species and within species from one season to another (Burgress, 1975). This view is supported by the findings of Window *et al.*,(1987) and Khan *et al.*,(1987), which showed that variation in the concentrations of elements from one sample of fish to another was due to the chemical forms of the element and

Table1 Proximate composition (%) of oven, sun and smoke dried fish samples

Sample	Drying method	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Crude fibre (%)	Carbohydrate (%)
Bonga spp	Oven	12.76± 0.74	3.80± 0.04	33.36 ± 0.01	33.36 ± 0.01	Not detected	12.76± 0.01
	Sun	10.74± 0.14	27.29 ±0.01	26.23 ± 0.03	26.23 ± 0.03	Not detected	4.74± 0.12
	smoke	14.12±0.08	27.23 ± 0.54	40.45± 0.54	40.45± 0.54	NDC	08.12±0.08
Sardinella spp	Oven	7.79± 0.17	3.97 ± 0.11	34.36 ± 0.09	34.36 ± 0.09	NDC	17.79± 0.17
	Sun	9.19± 0.17	2.42 ± 0.01	16.23 ± 0.01	56.23 ± 0.01	NDC	22.19± 0.17
	smoke	14.77± 0.77	3.35 ± 0.08	10.45± 0.03	10.45± 0.03	NDC	44.77± 0.77
Oreochromis nilotieus	Oven	16.42± 0.05	2.07 ± 0.01	33.36 ± 0.04	33.36 ± 0.04	NDC	26.42± 0.05
	Sun	12.88± 0.08	2.73 ± 0.03	16.23 ± 0.03	26.23 ± 0.03	NDC	52.88± 0.08
	smoke	15.61 ± 0.04	1.13 ± 0.08	63.45± 0.04	13.45± 0.04	NDC	9.61 ± 0.04

Means followed by the same letter on the vertical column are not significantly different (P >0.05) from each other using New Duncan's Multiple Range Test.

Table2 Mineral composition of oven, sun and smoke dried fish samples

Sample	Drying method	Na (mg/100 g)	K (mg/100 g)	Ca (mg/100 g)	Mg (mg/100 g)	Pb (mg/100 g)	Fe (mg/100 g)	Cu (mg/100g)	Mn (mg/100g)	
Bonga spp	Oven	212.76± 0.74	212.76± 0.74	112.76± 0.74	112.76± 0.74	Not detected	5.36 ± 0.01	0.36 ± 0.01	2.36 ± 0.01	12.76± 0.01
	Sun	110.74± 0.14	50.74± 0.14	110.74± 0.14	110.74± 0.14	Not detected	3.23 ± 0.03	0.23 ± 0.03	3.23 ± 0.03	4.74± 0.12
	smoke	214.12±0.08	54.12±0.38	99.12±0.08	92.12±0.08	Not detected	4.45± 0.54	0.45± 0.54	1.45± 0.54	08.12±0.08
Sardinella spp	Oven	257.79± 0.17	150.79± 0.17	187.79± 0.17	181.9± 0.17	Not detected	4.36 ± 0.09	0.36 ± 0.09	2.36 ± 0.09	17.79± 0.17
	Sun	169.19± 0.17	89.19± 0.17	139.19± 0.17	139.19± 0.17	Not detected	8.23 ± 0.01	0.23 ± 0.01	1.23 ± 0.01	22.19± 0.17
	smoke	214.77± 0.77	64.77± 0.77	120.77± 0.77	134.77± 0.77	Not detected	8.45± 0.03	0.45± 0.03	1.45± 0.03	44.77± 0.77
Oreochromis nilotieus	Oven	216.42± 0.05	96.42± 0.05	125.42± 0.05	125.42± 0.05	Not detected	4.36 ± 0.04	0.36 ± 0.04	4.36 ± 0.04	26.42± 0.05
	Sun	72.88± 0.08	32.88± 0.08	112.88± 0.08	112.88± 0.08	Not detected	3.23 ± 0.03	0.23 ± 0.03	0.23 ± 0.03	52.88± 0.08
	smoke	95.61 ± 0.04	45.61 ± 0.04	185.61 ± 0.04	185.61 ± 0.04	Not detected	3.45± 0.04	0.45± 0.04	1.45± 0.04	9.61 ± 0.04

Means followed by the same letter on the vertical column are not significantly different (P >0.05) from each other using New Duncan's Multiple Range Test

Table3 Sensory Evaluation of oven, sun and smoke dried fish samples.

Sample	Drying method	Taste	Colour	Flavor	Appearance	Texture	General acceptability	Palatability
Bonga spp	Oven	Good	Light brown	Good	Moderate attractive	Moderate hard	Good	High
	Sun	Moderate	Ash colour	Poor	Attractive	Very hard	Moderate	Moderate
	smoke	Very good	Fairly black	Very good	Very attractive	soft	Very good	Very high
Sardinella spp	Oven	Good	Dark brown	Good	Moderate attractive	Very hard	Good	High
	Sun	Moderate	Brown	Moderate	Attractive	Moderate hard	Moderate	Low
	smoke	Very good	Dark brown	Very good	Very attractive	Soft	Very good	High
Oreochromis nilotieus	Oven	Good	Light brown	Good	attractive	Very hard	Good	Moderate
	Sun	Moderate	Grey	poor	Attractive	Hard	Moderate	Moderate
	smoke	Good	brown	Good	Very attractive	soft	Very good	high

their concentrations in the local environment. The sensory evaluation is presented in Table 3. The result obtained showed that, there were changes in all the sensory parameters after subjecting the fish to different drying methods. There were significant change in colour, flavour, taste and texture in all the fish species subjected to the three drying methods. The best taste was recorded for all fish samples that were smoked and oven-dried. The most attractive appearance was recorded for smoked samples while the least attractive was recorded for sun-dried samples.

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