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ORIGINAL ARTICLE

Effect of Smoking and Frozen Storage on the Nutrient Composition of Some African Fish

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ABSTRACT

The effect of smoking and frozen storage on the protein and fat content of five African fish species comprising, *Malapterurus electricus*, *Synodontis clarias*, *Chrysichthys nigrodigitatus*, *Clarias gariepinus* and *sarotherodon melanotheron* from lekki lagoon was evaluated. Frozen storage reduced both the percentage protein and fat content in all the species while smoking reduced the percentage protein content while simultaneously increasing the percentage fat content. The most susceptible fish to protein loss during smoking and frozen storage was *Clarias gariepinus* (44.33% - 23.00%) and (44.35% - 28.54%) respectively. Sarotherodon melanotheron was the least susceptible to protein loss during smoking (29.33% - 28.00%) while Chrysichthys nigrodigitatus was the least susceptible to protein loss during frozen storage (27.50% - 24.50%) smoking and frozen storage lead to a loss of nutrient quality in African fishes and fatty fishes were more susceptible to nutrient loss during processing.

Key words: Smoking, Frozen storage, Protein, Fat, Nigeria

Introduction

Fish is a highly perishable commodity recording considerable losses in quantity before consumption. Estimates of 40% post harvest losses of total fish landings have been reported in Nigeria (Akande 1996). Mayboom (1974) similarly reported that 15% of the total fish catch in Kanji Lake is lost because of spoilage and breakage between the source of supply and the consumers. Locally fish spoilage has been known to be influenced to a large extent by high ambient temperatures, considerable distances of landing ports to points of utilization and poor and inadequate infrastructure for post harvest processing and landing. Investigations into such losses revealed sorting from artisanal fishing nets, limitation of processing equipment, absence of cold storage on small fishing craft and poor water transport system as prevalent factors (Opele 2002).

Smoking and freezing are the most common methods used by fish processors in Nigeria. Though processing provides a higher production, less waste and low production costs (Andrade and Oliveira 2000). Processing has been known to affect the chemical composition of the fish processed. Several workers have linked the availability of vital nutrients in fish to the method of storage (Hardy & Smith 1976, Botta *et al*., 1978 and Ryder *et al*., 1993). Storage time and temperature are major factors implicated in the loss of quality and shelf life of fish (Whittle 1997). Most processing methods serve not only to conserve the fish but also to alter their nutrient levels either positively or negatively. Reports exist in the agro industry that smoking is not only a conservation method but also a flavour, aroma and coloration improving method which are attributes sought by consumers (Ferreira 1987).

Arannilewa *et al*., (2005) noted that protein decreased with increasing duration of frozen storage with fresh samples not frozen having higher protein content. Disadvantages such as product dehydration, rancidity, drip loss and product bleaching have an overall effect on the quality of frozen food (Kropf and Bowers 1992). For the fishing industry to be sustainbly developed the resources have to be as widely used as possible and

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Fig. 1: Map of Lekki lagoon, Lagos, Nigeria

not only traded as capture. A knowledge of the nutrient composition of fresh water fished and the relationship between their chemical composition, food value and stability while being processed into acceptable products is of significant practical interest.

Sarotherodon melanotheron, *Clarias gariepinus*, *Malapterurus electricus*, *Synodontis clarias* and *Chrysichthys nigrodigitatus* are important members of freshwater fishes in Nigeria, much sought after for their flavour and chemical composition. In view of their popularity to consumers and their contribution to the Local fishery, the present study was undertaken with the main objective of evaluating the effect of smoking and freezing which are the common processing methods locally on the chemical composition of the five fish species form Lekki lagoon, Nigeria.

Materials and methods

Study area

Lekki lagoon supports a major fishery in Nigeria. The lagoon is located in Lagos state, Nigeria and lies between longitudes $4^0$00' and $4^0$15'E and between a surface area of about 243km^2 with a maximum depth of 6.4m, a greater part of the lagoon is shallow and less than 3.0m deep.

The Lekki lagoon is part of an intricate system of water ways made up of lagoons and creeks that are found along the coast of South western Nigeria from the Dahomey border to the Niger Delta stretching over a distance of about 200km. It is fed by the River Oni discharging to the North eastern and Rivers Oshun and

Saga discharging into North western parts of the lagoon. Lekki lagoon experiences both dry and rainy seasons typical of the Southern part of Nigeria. The vegetation around the lagoon is characterized by shrub and raphia palms, *Raphia sudanica* and Oil palms, *Elaeis gueensis.* Floating grass occur on the periphery of the lagoon while coconut palms, *cocos nucifera* are widespread in the surrounding villages.

The rich fish fauna of the lagoon includes *Heterotis niloticus*, *Gymnarchus niloticus*, *Claris gariepinus*, *Malapterurus electricus*, *Synodontis clarias*, *Chrysichthys nigrodigitatus*, *Channa obscura*, *Mormyrus rume*, *Calamoichthys calabaricus Tilapia zilli*, *Tilapia galilae*, *Hemichromis fasciatus* and *Sarotherodon melanotheron* (Kusemiju 1981). Fig. 1 shows a map of Lekki lagoon, Nigeria.

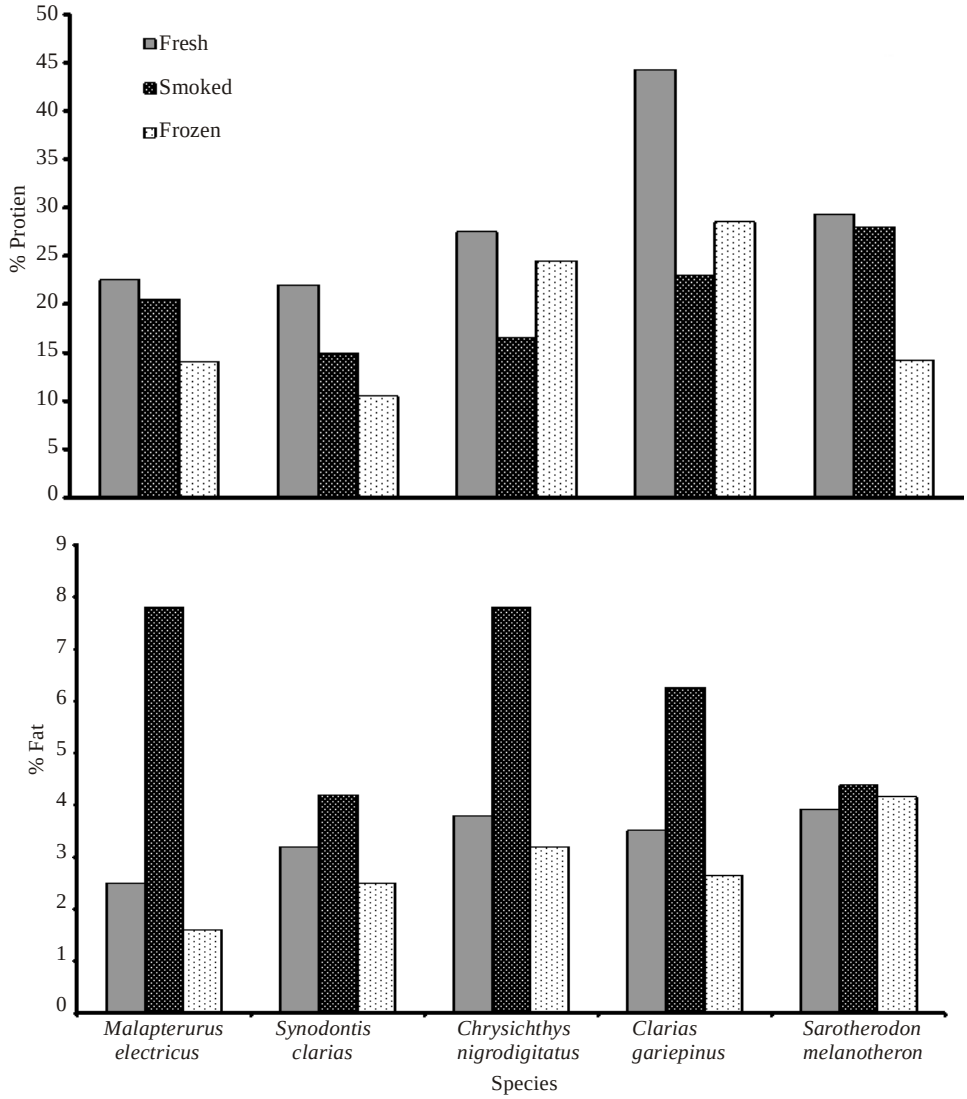

Fig. 2: Percentage fat and protein content of fresh, smoked and frozen fish from Lekki lagoon, Nigeria.

Collection and processing of fishes

A total of 45 specimens comprising of five species, *Malapterurus electricus*, *Synodontis clarias*, *Chrysichthys nigrodigitatus*, *Clarias gariepinus* and *Sarotherodon melanotheron* from lekki lagoon were randomly selected and purchased from fish mongers. The purchased fish were sorted out for processing, 3 fishes each from each species were smoked and frozen.

Smoking involved the use of a local smoking kiln for 4 hours at a temperature of 45^0C. The fishes were frozen at a temperature of 45^0C for duration of two months. The 3 categories of fishes, fresh frozen and smoked were analysed for fat and protein content as described by association of official analytical chemists (2000).

Results and discussion

The processing methods, smoking and frozen storage altered the percentage fat and protein of the five species from Lekki lagoon (Fig. 2). The vital nutrients of fishes have been known to depend largely on the methods of storage. Apendi *et al*., (1974) and Ojewola (2003) reported that processing methods and storage may have accounted for the differences observed in composition and gross energy content of all test samples.

Although freezing as a common practice in the meat and fishing industry, has been known to preserve the quality for an extended time, and offer several advantages such as minimum deterioration in product, colour, flavour and texture (Obuz and Dikeman 2003). In this study frozen storage reduced both the percentage protein and fat content in all the species. Several workers have similarly observed that protein and fat decreased with frozen storage (Omotosho, 1995; Kamal *et al*., 1996 and Arannilewa *et al*., 2005). This reduction in percentage protein is explained by denaturation (Reay 1993; Mills 1975) while reduction in percentage fat is associated with oxidation of the fat (McGill *et al*., 1974 and Josephson 1989). Smoking as a processing method reduced the percentage protein content of all the species while simultaneously increasing the percentage fat content Audrey morris *et al*., (2006) observed that smoking has been known to cause nutrient loss due to associated heat flow of gases and interaction of the smoke components with protein.

The most susceptible fish to protein loss during smoking and frozen storage was *Clarias gariepinus* (44.33% - 23%) and (44.35% - 28.54%) respectively. While the least susceptible to protein loss during smoking was sarotheroden melanotheron (29.33% - 28%) and during frozen storage was *Chrysichthys nigrodigitatus* (27.50% - 24.50%). Fatty fishes like *Clarias* with weak tissues are known to have limited cold and frozen storage time (Sengor *et al*., 2000). Omotosho (1995) observed that T.zilli was the least susceptible to protein loss after 12 weeks of frozen storage. This study served to confirm the fact that smoking and frozen storage lead to a loss of nutrient quality in African fishes and fatty fishes such as *Clarias gariepinus* are more susceptible to nutrient loss during processing.

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