

ASSESSMENT OF BACTERIAL ON SOME COLD-SMOKED FISH IN FIVE MARKETS IN ADO-ODO LGA, OGUN STATE

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ABSTRACT

Cold-smoked *Scromber* sp., *Trachurus* sp., *Gadus* sp. and *Clupea* sp. were examined for the presence of pathogenic bacteria and fungi. Retailed samples of the cold-smoked fishes were obtained from five major Markets; Ota, Sango, Oju-ore, Atan and Lusaída. The samples were analyzed for Total Plate Count (TPC) for bacteria and fungi; *Staphylococcus aureus*, *Escherichia coli*, *Salmonella* sp. and *Coliforms* count respectively. The variations in the microbial loads of the analyzed smoked fishes were relatively significant. *Trachurus* sp. recorded a very high TPC-bacteria in Atan market at 13.1×10^4 cfu/g. *Staphylococcus aureus* count of smoked fish samples was nil (0) in *Scromber* sp. (Ota), *Trachurus* sp. (Sango and Atan), *Gadus* sp. (Atan) and highest in *Trachurus* sp. (Ota) at 4.3×10^4 cfu/g. The *Escherichia* sp. count was highest in *Trachurus* sp. (Lusaída) and *Gadus* sp. (Oju-ore) at 5.3×10^1 cfu/g while *Salmonella* sp. count was nil (0) in *Scromber* sp. (Oju-ore), *Gadus* sp. (Ota, Sango and Lusaída) and *Clupea* sp. (Ota and Sango). *Coliforms* count was higher in *Trachurus* sp. (Ota) 5.9 MPN/g. However, by the recommended standards, all the analyses smoked fish in the study area were safe for human consumption.

Keywords: Cold-smoked, Bacterial contaminants, Fish, Markets, Ogun state

INTRODUCTION

Fish is a very vital source of high-quality protein and constitutes an important part of man's diet. It supplies a good balance of vitamins, minerals, has a relatively 10% calories content hence its role in nutrition is recognized and better digested than beef or other types of protein (Bukola *et al.*, 2008). Fish and fish products constitute more than 60% of the total protein intake with little or no religious rejection of it, which gives it an advantage over pork or beef (Ligia, 2002). Fish flesh is tender due to bundles of muscle fibres, which are held together by a fibrous material when heated.

Immediately fish dies, it remains in first-class quality only for a short while. However, spoilage soon sets in which is occasioned by an increase in the ambient temperature that triggers favourable conditions for microorganisms to thrive. Other factors are the poikilothermic nature of fish, a high postmortem pH in the flesh, the presence of non-protein nitrogen (NPN) in large quantities and the presence of trimethylamine oxide (TMAO). The presence of NPN and TMAO in the flesh of fish give rise to off flavour (Abolagba and Igbinevo, 2010). Because of perishability nature of fish, it must be preserved in some ways.

Smoking of fish is one of the ancient processing technologies. It has been for a century used for preservation and is still widely used for this

purpose among several communities in the third world where up to 70% of the catch is smoked for preservation. Hard curing by salting and smoking permits lengthy preservation by removing moisture, which is essential for bacteriological and enzyme spoilage. In industrialized countries, however, smoking of fish is done to enhance flavour and texture. (Ligia, 2002).

The identification of the bacteria responsible for the spoilage of smoked fish is important to allow a better understanding of the mechanisms involved in spoilage and of any changes in the product during the salting and smoking process that limit the growth of spoilage flora; the development of convenient means of counting the spoilage flora and design of a model for predicting deterioration in the quality of smoked fish products. WHO (2007) reported that the quality of smoked fish is essentially linked to processing and post-processing procedures

Smoked fish is part of the daily diet of most Nigerians and smoking of fish has been conducted by all manners of persons and in different kinds of conditions both hygienic and unhygienic, resulting in health challenges in the form of foodborne diseases. When contaminated smoked-dried fish is ingested it may cause abdominal pain, acute gastroenteritis, bloody mucous, diarrhoea, nausea and vomiting (Daramola *et al.*, 2007; Akinjogunla *et al.*, 2009).

Smoked fish are contaminated with bacteria among other organisms associated with man, such as Enterobacteriaceae and Staphylococcus which grow well at 30 – 37°C (Adam and Moss, 1999).

This study aimed at evaluating the quality of locally smoked fish products (Atlantic Mackerel fish; *Scromber scombrus*, Atlantic Cod fish; *Gadus morhua*, Atlantic Herring fish: *Clupea harengus* and Atlantic Horse Mackerel fish; *Trachurus trachurus*, sold in our local markets for consumption and to evaluate the microbial loads in the smoked fish products in order to highlight their health implications for the unsuspecting consumers.

MATERIALS AND METHODS

The study sites used in this research project were Ota, Sango, Oju-Ore, Atan and Lusaida markets, all in Ota metropolis at Ado-Odo Local Government Area of Ogun State, Nigeria.

A sample size of sixty (60) pieces of the four fish types was bought at each of the named markets in Ota. The samples were collected randomly from three fish retailers in three locations of the study market into sterile zip-lock bags and transported to Microbiology laboratory, Bells University of Technology, Ota. The study was carried out on fish samples from each market for a period of one week. The samples were analysed for the presence of microflora isolates with attention on spoilage bacteria.

Microbiological Analysis

Samples of cold-smoked *Scromber scombrus* (Atlantic mackerel), *Trachurus trachurus* (Atlantic horse mackerel), *Gadus morhua* (Atlantic cod) and *Clupea harengus* (Atlantic Herring) were analysed for bacterial and mould growth and count. The microbial parameters determined were total count (TPC), Total Coliform count (TCC), the presence of *Escherichia coli*, the presence of *Salmonella*, Total *Staphylococcus* count and Mould count.

RESULTS

The result of TPC in cfu/g of bacteria (Table 1) in smoked fish samples shows that *Trachurus sp.* recorded a very high TPC-bacteria in Atan market at 13.1 and least in Oju-ore market at 2.4×10^4 cfu/g. Also, the TPC-bacteria of *Gadus sp.* was highest in sample collected from Sango market at 8.2 and least in Lusaida at 5.1×10^4 cfu/g while *Clupea spp.* had the highest TPC-bacteria in Sango market at 8.5 and least in Lusaida at 5.7×10^4 cfu/g.

In Table 2, *Scromber sp.* had the highest TPC-fungi in Sango market (3.9×10^4 cfu/g) and least

in Atan (1.8×10^4 cfu/g). *Trachurus sp.* recorded close values for TPC-fungi in the five markets; the values however, ranged from 2.8 (Sango) to 3.8×10^4 cfu/g (Lusaida). TPC-fungi of *Gadus sp.* was highest in the sample collected from Sango market at 4.3 and least in Oju-ore at 2.8×10^4 cfu/g. Also, *Clupea sp.* had the highest TPC-fungi in Atan (3.2×10^4 cfu/g) and least in 1.9×10^4 cfu/g.

Scromber sp. had nil (0) value for *Staphylococcus* count in Ota market while the highest was in Atan market at 4.0×10^4 cfu/g. Also, *Trachurus sp.* recorded a very high *Staphylococcus* count in Ota market at 4.3 and had nil (0) values in Sango and Atan markets. Meanwhile, the *Staphylococcus* count of *Gadus sp.* was highest in the sample collected from Ota market at 3.5×10^4 cfu/g and nil (0) at Atan market. *Clupea sp.* had the highest *Staphylococcus* count in Ota at 2.7 and least in Sango market at 0.5×10^4 cfu/g as Shown in Table 3.

Also, in Table 4, *Scromber sp.* had the highest *Escherichia* count in Sango market (3.7×10^1 cfu/g) and least in Oju-ore (1.2×10^1 cfu/g). *Trachurus sp.* recorded *Escherichia* count values ranging from 1.4 (Sango and Atan) to 5.3×10^1 cfu/g (Lusaida). *E. coli* count of *Gadus sp.* was highest in the sample collected from Oju-ore market at 5.3 and least in Ota 0.7×10^1 cfu/g. Furthermore, *Clupea sp.* had the highest *Escherichia* count in Lusaida (1.8×10^1 cfu/g) and nil (0) values in Sango and Oju-Ore markets.

Scromber sp. had nil (0) value for *Salmonella* count in Oju-Ore market while the highest was in Ota market at 2.3×10^1 cfu/g. Also, *Trachurus sp.* recorded a very high *Salmonella* count in Ota market at 5.7 and had least in Oju-ore at 0.4×10^1 cfu/g. The *Salmonella* count of *Gadus sp.* was highest in the sample collected from Atan market at 2.7×10^1 cfu/g and nil (0) values were recorded for samples from Ota, Sango and Lusaida markets. *Clupea sp.* had nil (0) values in *Salmonella* count from Ota and Sango markets while the highest was from Atan market at 3.7×10^1 cfu/g as seen in Table 5.

Similarly, in Table 6, *Scromber sp.* had nil (0) value for *Salmonella* count in Oju-ore market while the highest was in Ota market at 2.3×10^1 cfu/g. Also, *Trachurus spp.* recorded a very high *Salmonella* count in Ota market at 5.7 and had least in Oju-ore at 0.4×10^1 cfu/g. Meanwhile, the *Salmonella* count of *Gadus spp.* was highest in sample collected from Atan market at 2.7×10^1 cfu/g and nil (0) values were recorded for samples from Ota, Sango and Lusaida markets. *Clupea sp.* had nil (0) values in *Salmonella* count from Ota and Sango markets while the highest was from Atan market at 3.7×10^1 cfu/g.

Table 1: Mean Total Plate Count- Bacteria (x 10⁴ cfu/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	5.4	7.1	7.4	4.7	7.9
<i>Trachurus sp.</i>	6.2	6.7	2.4	13.1	6.9
<i>Gadus sp.</i>	7.4	8.2	5.9	6.5	5.1
<i>Clupea sp.</i>	6.7	8.5	6.5	8.2	5.7

Table 2: Mean Total Plate Count- Fungi (x 10⁴ cfu/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	2.0	3.9	3.6	1.8	3.3
<i>Trachurus sp.</i>	3.0	2.8	3.1	3.2	3.8
<i>Gadus sp.</i>	3.0	4.3	2.8	4.0	3.0
<i>Clupea sp.</i>	1.9	2.1	2.0	3.2	4.0

Table 3: Mean Staphylococcus Count (x 10⁴ cfu/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	0.0	3.0	2.0	4.0	2.7
<i>Trachurus sp.</i>	4.3	0.0	1.7	0.0	3.7
<i>Gadus sp.</i>	3.5	1.8	1.7	0.0	3.3
<i>Clupea sp.</i>	2.7	0.5	1.5	2.4	1.0

Table 4: Mean Escherichia Count (x 10⁴ cfu/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	1.5	3.7	1.2	2.5	3.5
<i>Trachurus sp.</i>	1.7	1.4	2.5	1.4	5.3
<i>Gadus sp.</i>	0.7	1.4	5.3	2.3	2.0
<i>Clupea sp.</i>	1.3	0.0	0.0	1.7	1.8

Table 5: Mean Salmonella Count (x 10⁴ cfu/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	2.3	0.7	0.0	1.8	1.4
<i>Trachurus sp.</i>	5.7	1.1	0.4	1.3	1.0
<i>Gadus sp.</i>	0.0	0.0	1.4	2.7	0.0
<i>Clupea sp.</i>	0.0	0.0	1.0	3.7	1.3

Table 6: Mean Coliforms Count (MPN/g)

Species	Markets				
	Ota	Sango	Oju-ore	Atan	Lusaida
<i>Scromber sp.</i>	4.2	2.6	0.0	1.7	1.9
<i>Trachurus sp.</i>	5.9	1.4	1.3	1.6	1.7
<i>Gadus sp.</i>	2.3	1.6	0.3	3.5	1.9
<i>Clupea sp.</i>	3.2	2.3	1.0	3.9	2.0

DISCUSSION

Generally, the higher levels of microorganisms identified from smoked fish which were purchased from the markets can be attributed to poor fish handling and improper smoking process adopted by fish mongers (Abolagba and Igbinvbo, 2010).

Trachurus sp. recorded a very high TPC-bacteria in Atan market at 13.1×10^4 cfu/g $\times 10^4$ cfu/g and least in Oju-Ore market at 2.4×10^4 cfu/g. The coliform counts and the presence of *E. coli* may indicate contamination from faecal water or from the evisceration process (Ramos, 1999). According to ICMSF (1986) criterion, the presence of pathogens such as *Salmonella* is considered a hazard and cooking would reduce the degree of hazard posed by the pathogens (Fernandez *et al.*, 1997).

Staphylococcus sp. count of smoked fish samples was nil (0) in *Scromber sp.* (Ota), *Trachurus sp.* (Sango and Atan), *Gadus sp.* (Atan) and highest in *Trachurus sp.* (Ota) at 4.3×10^4 cfu/g. The natural reservoir of *Staphylococcus aureus* is human skin, hair and superficial mucous membrane (nose), while it is not a part of the normal flora on fish and fish product. Presence of large numbers indicates the possible presence of enterotoxin and/or faulty sanitary and production practice. Moshood and Tengkuhazyamin (2012) reported that *Staphylococcus spp* had the highest frequency (47%) in smoked-dried fish sold in Bauchi metropolis.

Escherichia sp. count was nil (0) in *Clupea sp.* (Sango and Oju-Ore) while it was highest in *Trachurus sp.* (Lusaida) and *Gadus sp.* (Oju-ore) at 5.3×10^1 cfu/g. Contamination of food with *E. coli* implies a risk that one or more of enteric pathogens may have gained access to the food. Adelaja *et al.* (2013) reported that *E. coli* caused diarrhoea and kidney damage as well as uncomplicated community-acquired urinary tract infections

Salmonella sp. count was nil (0) in *Scromber sp.* (Oju-Ore), *Gadus sp.* (Ota, Sango and Lusaida) and *Clupea sp.* (Ota and Sango); the highest was in *Trachurus sp.* (Ota) at 5.7×10^1 cfu/g. Also, the natural reservoir of *Salmonella* is present in human skin, hair and superficial mucous membrane (nose), while it is not a part of the normal flora on fish and fish product. This implies that the presence of this organism indicates contamination from the processors. Small numbers are, however, expected in products handled by humans (Huss, 1998). The low *S. aureus* count of these samples could imply that they were freshly smoked as at the time of sample collection. The heat treatment during preparation might have destroyed or inactivated the pathogens (Fernandez, *et al.* 1997).

Coliforms count was nil (0) in *Scromber sp.* (Oju-Ore) and highest in *Trachurus sp.* (Ota) at 5.9 MPN/g. Coliforms are particularly useful as indicators of contamination when they occur in small numbers. According to Aghoghovwia (2017), the presence of microbes in a surface water sample is strong evidence of faecal contamination. However, the available report shows that the most serious water pollution in terms of human health worldwide are pathogenic organisms such as *Pseudomonas* and *Salmonella* (Cunningham, 2005).

CONCLUSION

Though the level of pathogenic microbes in the smoked fish samples in this study has not reached a hazardous level, their presence should be of health concern. Therefore, there is the need to continue to investigate smoked fish samples available in our markets and educate smoked fisher folks on the best hygienic way of smoking fish, handling techniques in order to prevent contamination, transport in safe and wholesome form and store in a healthy condition and environment.

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