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Microbiological quality and safety of smoked fish from Kainji Lake area

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ABSTRACT: Microbiological qualities of 32 samples of smoked fish belonging to 4 species of fish namely: *Clarias gariepinus*, *Oreochromis niloticus*, *Citharinus citharus* and *Synodontis membranaceus*; from four (4) local markets (Monday Market, Sabo Market, Malale Market, Awuru Market) were studied. In most samples, moisture contents were high, 53.12% of the fish samples have moisture content above 30% level. The smoked samples were dominated by gram-positive bacteria however, potential pathogens, coagulase positive staphylococci, and *Escherichia coli* were isolated from some of the samples. Coliform were present in 78% of the samples.

Introduction

Fish are widespread over the Oceans and rivers of the world. They are a major source of food for humans providing a significant portion of the protein intake in the diets of a large proportion of the people, particularly so in the developing countries.

In Kainji Lake area of Nigeria, fish is eaten fresh, preserved or processed. And it formed the chief source of animal protein with little or no religious rejection of it. Because of the unavailability of modern preservation, smoking processes techniques majority of the fish caught are processed by smoking. Smoking of fish has been used for centuries 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 (Ward, 1995). Information on the quality and safety of smoked fish in this region has been scanty if at all there are; hence this present study was undertaken.

Materials and Methods

Thirty-two (32) samples of smoked fish belonging to four (4) species/varieties, collected from four (4) local markets were employed in this study. Total bacteria counts and coliform counts were determined according to the method of Sneath et al., (1986). *Feacal streptococci* and *Escherichia coli* in samples were

determined employing the methods described by Speak (1984). *Staphylococcus aureus* counts in samples were determined by employing the method of Bennett (1984). Moisture contents were estimated as per AOAC (1980). All samples were done in duplicates.

Results and Discussion

Moisture content of the smoked fish samples in the present study are presented in Table 1. Fish samples from Awuru market were found to have the highest percentage of moisture contents, while in most of the samples fish samples from Malale is least. However, fish samples from Monday markets have mixture of samples with low and other high moisture contents, this may be as a result of the fish brought from the interior local markets like Awuru and Malale to the Monday market which happen to be the central market in Borgu region of Kainji. Also, higher next to Awuru are the fish sample from Sabo market. A quick perusal of Table 1 will also reveal that only about 46.9% of all the fish samples were less than 30% moisture content. High fragmentability of products due to Higher Moisture levels was discussed by Poulter (1980). High moisture contents enhance bacteria spoilage and this may contributes to high economic losses as observed by Omojowo and Sogbesan (2003).

The total viable counts reported in this study ranged from 10^4 to 10^8 organisms per gram of the sample (Table 2). About 46% was observed to be higher than the recommended limit of $\log 10^7 \text{g}^{-1}$ (ICMSF, 1986). In this study, Coliforms were present in 25 samples, which amounts to 78% of the sample. This result is similar to that of Basu et al., (1989) who reported the presence of Coliforms in 80 percent of dry fish samples. Efiuvwevwe and Ajiboye (1996) also isolated Coliform and staphylococcus from smoked catfish. They also found out that smoked catfish stored for more than 4 days have microbial population higher than those prior to smoking.

There is likelihood than some of the fish samples have been smoked and stored for more than 4 days before bringing it to the market on the market day hence the high population of microbial count.

Similarly, in the study, *E. coli* were present in 18 samples, coagulase positive Staphylococci in 8 samples and Faecal streptococci in 11 samples (Table 2).

Most of the moisture content are not quite too different from the one recorded by Bhandary (1991), which has average of 33.88% and Ikeme (1991) which find the moistures contents of smokes *Decapterus punctatus* and *Clarias lazera* as 31.6 and 34.7 respectively.

However, the moisture contents are all higher, the moisture contents recorded by Omojowo and Adenike (2005) in Tilapia and Catfish smoked by themselves at intervals for 3 days in NIFFR Aviary, which were in range of 9.8-14%.

Conclusion and Recommendations

The present study indicates that close to half of the smoked fish samples from these areas were contaminated with these organism of public health concern as the result indicates that about 46% do not conform to ICMSF standards. Therefore enlightenment campaign should be made to fish processors to

- To always smoke high quality fresh fish because poor quality fresh fish will produce poor quality smoked fish and vice versa.
- To adopt the methods of Omojowo and Adenike (2005) for smoking where the moisture contents obtained for smoked catfish and tilapia were within the range of 9.8-14%.
- Proper hygiene should be maintained during the smoking processes to avoid cross contamination.

Table 1: Percentage moisture contents of Fish samples from 4 markets.

Fish samples/markets	Malale Market		Awuru Market		Sabo Market		Monday Market	
	Sample (a)	Sample (b)	Sample (a)	Sample (b)	Sample (a)	Sample (b)	Sample (a)	Sample (b)
<i>O. niloticus</i>	18.6	20.4	31.0	32.0	20.2	21.4	18.6	20.4
<i>S. membranaceous</i>	32.4	35.2	38.0	37.3	34.6	36.0	28.5	38.0
<i>C. citharus</i>	18.0	24.6	24.0	26.6	19.8	24.2	20.0	26.4
<i>C. gariepinus</i>	32.0	33.5	34.0	36.4	33.0	36.0	31.0	31.4

Moisture Contents Range	Percentage (%)
< 20%	15.63%
> 20 – 30	31.25%
> 30 – and above	53.25%

Table 2: Microbiological composition of smoked samples (count expressed as log CFUg⁻¹).

Microbial grp/vari-ables	Fish species/varieties	Malale Market		Awuru Market		Monday Market		Sabo Market	
		Sample (a)	Sample (b)	Sample (a)	Sample (b)	Sample (a)	Sample (b)	Sample (a)	Sample (b)
TVC	<i>O. niloticus</i>	5.35	5.68	6.69	6.86	4.92	5.32	6.02	7.06
	<i>S. membranaceus</i>	7.69	7.93	7.86	7.90	6.68	6.90	6.86	7.50
	<i>C. citharus</i>	6.33	7.37	7.93	8.46	6.55	7.44	6.90	7.44
	<i>C. gariepinus</i>	7.44	7.86	6.35	8.56	5.68	7.86	6.00	6.87
Coliform	<i>O. niloticus</i>	3.69	NR	4.86	4.69	NR	NR	3.90	NR
	<i>S. membranaceus</i>	4.25	4.77	5.00	5.55	4.14	4.55	3.76	4.14
	<i>C. citharus</i>	4.55	5.00	5.77	5.59	NR	4.90	4.07	4.50
	<i>C. gariepinus</i>	4.69	5.71	4.85	4.77	4.25	NR	NR	5.00
E. coli	<i>O. niloticus</i>	1.43	2.60	NR	NR	NR	NR	2.43	2.47
	<i>S. membranaceus</i>	NR	NR	1.92	1.57	NR	NR	2.66	3.14
	<i>C. citharus</i>	2.71	2.55	1.90	NR	2.86	2.55	NR	3.07
	<i>C. gariepinus</i>	NR	2.47	NR	NR	NR	2.77	1.55	2.50
F. Streptococcus	<i>O. niloticus</i>	NR	NR	2.34	NR	1.43	NR	NR	NR
	<i>S. membranaceus</i>	2.47	NR	NR	3.62	NR	NR	1.93	2.30
	<i>C. citharus</i>	NR	NR	NR	NR	NR	NR	2.47	NR
	<i>C. gariepinus</i>	3.90	3.30	2.34	NR	NR	NR	NR	2.00
Coagulase positive staphylococcus	<i>O. niloticus</i>	NR	NR	NR	NR	2.80	NR	NR	NR
	<i>S. membranaceus</i>	2.30	NR	NR	1.34	NR	NR	2.30	NR
	<i>C. citharus</i>	NR	2.34	NR	NR	NR	NR	NR	NR
	<i>C. gariepinus</i>	2.55	2.77	1.57	NR	NR	NR	NR	NR

NR = Not Recovered

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