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Annals of Biological Research, 2014, 5 (7):31-34
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Prevalence of bacteria in frozen fish sold at Oja-Oba and Bodija Markets – Southwest Nigeria

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ABSTRACT

Considering the erratic power supply in Nigeria, and poor means of transportation of fish, there is the need to evaluate the quality of frozen fish sold in Nigeria open markets. Seventy-two frozen fish samples comprising two different species: Sardine (Sardinella eba) and Chub Mackerel (Scomber japonicus) were purchased at different hours of the day, from six purposively selected fishmongers each in Bodija and Oja-oba markets. Total Viable Bacterial Counts (TVBC) and Total Coliform Counts (TCC) were investigated. The TVBC and TCC of the fish samples increase with hour of the day. It may be safer to purchase fish at midday. Though, the fish sold in both markets were not wholesome for consumption, consuming fish sold at Oja-oba came with a higher risk of infection. Since many of the fishmongers don't know how to vend fish items in the most hygienic manner, there is an urgent need to mount an intensive public health education on foodborne illnesses in Nigeria.

Key Words: Bacteria, Frozen fish, Nigeria, Prevalence

INTRODUCTION

Fish is a valuable source of nutrients in the diet of many countries [1]. It constitutes the cheapest source of animal protein in Africa [2]. Most families are used to consumption of frozen fish, especially mackerel (*Scomber japonicus*) because they are more commonly available in most Nigerian markets [3].

Marketing of fish in Nigeria is mostly carried out by local fishmongers at ambient temperature [4]; a condition that favours contamination by and proliferation of microorganisms. Damp, unhygienic market environment and packaging/storage facility further facilitate contamination of fish by microorganisms [5]. Food (fish) handlers have a major responsibility in the prevention of contamination associated with food (fish) during production as well as distribution, and if personal hygiene is unsatisfactory, they may cross-contaminate raw and processed foodstuffs [6]. Thus, consumption of fish may cause disease due to infection [5], [7] since the foods we eat influence our health [3]. Fish contamination should be prevented to ensure its safety for consumption [8]. The microbiological contamination concern has been on high loads of unspecified spoilage bacteria like *Salmonella* sp., *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Escherichia coli* [9]. Initial micro-flora on fish is directly related to the surrounding aquatic environment while the bacterial flora in the gastrointestinal tract corresponds to the condition of the fish [10]. It has been well known that fish can harbor human pathogenic bacteria particularly the coliform group [11]. Pathogens may be found on raw fish as a result of poor sanitary practices on the harvest vessel, unclean hands,

insanitary utensils and equipment, contaminated water, or sewage [7]. Changes in microbial population are one of the indices for assessing fish quality. [12]. Therefore, retaining the nutritional value of the fish, preserving the benefits of its rich composition and avoiding costly and debilitating effects of fish-borne illnesses are vital [1].

Thus, considering the erratic power supply in Nigeria as well as poor means of transportation of fish, which pre-disposes the frozen fish to temperature fluctuations; and various forms of mishandling, observed among the fishmongers, there is need to evaluate the quality of the frozen fish consumed by the populace. This study was therefore aimed at detecting and quantifying pathogenic microorganisms and also comparing the safety of fish sold in Nigeria open markets with recommended standard.

MATERIALS AND METHODS

Sample collection

72 frozen fish samples comprising two (2) different species: Sardine (*Sardinella eba*) and Chub Mackerel (*Scomber japonicus*) were used for this study. 36 samples of each species were purchased at 8:00, 12:00 and 16:00 hours, from six (6) purposively selected fishmongers each in Bodija and Oja-oba markets. The choice of the two (2) sampling locations was informed by their population densities and high commercial activities while the choice of fish species premised on the most consumed by the populace. The samples were collected in sterile polythene bags and transported in ice packs to the laboratory for analysis. Microbiological parameters considered were: Total Viable Bacterial Counts (TVBC), and Total Coliform Counts (TCC).

Analysis of samples for bacterial load

One gram (1g) each of the fish samples was cut from the head, middle and tail regions with a sterile knife into 10 ml sterile water in test tube, shaken vigorously on a vortex mixer and then serially diluted. From it, 1ml of 10^6 dilutions were plated on to Nutrient Agar (NA), and MacConkey Agar (MCA). The media namely nutrient agar (NA) and MacConkey Agar (MCA) were prepared according to manufacturer's instructions. The media was sterilized at 121^{o}C for 15 minutes in an autoclave and was poured into sterile disposable petri dishes.

The plates were inoculated with 1ml of the diluent at 10^6 dilution factor using Pour plate method. The NA and MCA were then incubated for 48 hours at 37^{o}C. The bacteria counts were done using colony counter. All assays were done in triplicate.

Statistical analysis

The data represent the mean ± standard deviation of the samples. The mean values for TVBC were grouped into allowable limit ($\leq 5.0 \times 10^5$) and unallowable limit ($>5.0 \times 10^5$) while the mean values for TCC were also grouped into allowable limit ($\leq 1.0 \times 10^2$), unallowable limit ($> 1.0 \times 10^2$) according to international standards [13], [14].

RESULTS AND DISCUSSION

Table I Relationship between TVBC (CFU/g) of fish samples in the two markets and hour of the day.

Hour of the day	TVBC (CFU/g)			
	Sardine		Chub mackerel	
	Bodija	Oja-oba	Bodija	Oja-oba
8:00	$3.76\times10^5\pm2.65\times10^5$	$3.78\times10^5\pm2.43\times10^5$	$3.62\times10^5\pm2.52\times10^5$	$3.40\times10^5\pm2.12\times10^5$
12:00	$3.81\times10^5\pm2.59\times10^5$	$3.83\times10^5\pm2.63\times10^5$	$3.31\times10^5\pm2.09\times10^5$	$3.60\times10^5\pm2.53\times10^5$
16:00	$3.89\times10^5\pm2.62\times10^5$	$3.88\times10^5\pm2.65\times10^5$	$3.42\times10^5\pm2.42\times10^5$	$3.68\times10^5\pm2.08\times10^5$

Table I shows Total Viable Bacteria profiles of fish samples and hour of the day. The TVBC of the fish samples increases with hour of the day except for Chub mackerel purchased at Bodija market. This may be attributed partly to the custom of fishmongers in selling the unsold and preserved left-over fish of the previous day in the early hour of the next day before opening a fresh pack of frozen fish. As shown in the Table above, Sardine purchased at 8:00 hour from Bodija and Oja-oba had TVBC mean values of $3.76\times10^5\pm2.65\times10^5$ and $3.78\times10^5\pm2.43\times10^5$ respectively while Chub mackerel purchased at the same hour from Bodija and Oja-oba had TVBC mean values of $3.62\times10^5\pm2.52\times10^5$ and $3.40\times10^5\pm2.12\times10^5$ respectively. Sardine purchased at 16:00 hour from Bodija had higher TVBC mean values ($3.89\times10^5\pm2.62\times10^5$) than Sardine from Oja-oba ($3.88\times10^5\pm2.65\times10^5$) while Chub mackerel purchased at the same hour from Oja-oba had higher TVBC mean values ($3.68\times10^5\pm2.08\times10^5$) than Chub mackerel from Bodija ($3.42\times10^5\pm2.42\times10^5$). These TVBC values were within the ranges in the findings of [15] and [11]

Table II Relationship between TCC (CFU/g) of fish samples in the two markets and hour of the day.

Hour of the day	TCC (CFU/g)			
	Sardine		Chub mackerel	
	Bodija	Oja-oba	Bodija	Oja-oba
8:00	$3.67\times10^5\pm1.31\times10^5$	$3.78\times10^5\pm1.27\times10^5$	$3.28\times10^5\pm1.54\times10^5$	$3.04\times10^5\pm1.24\times10^5$
12:00	$3.81\times10^5\pm1.21\times10^5$	$3.91\times10^5\pm1.65\times10^5$	$3.01\times10^5\pm1.16\times10^5$	$3.23\times10^5\pm1.11\times10^5$
16:00	$3.98\times10^5\pm1.59\times10^5$	$4.13\times10^5\pm1.60\times10^5$	$3.19\times10^5\pm1.07\times10^5$	$3.34\times10^5\pm1.59\times10^5$

Table II shows the relationship between TCC (CFU/g) of fish samples and hour of the day. Indicator organisms as the Total Coliform Counts (TCC) were found in all the samples analyzed. The presence of coliform suggests external contamination of fish because coliform are not normal flora of bacteria in fish [11]. Although, none of the fish samples met the international acceptable limit of $\leq 1.0 \times 10^2$ CFU/g for frozen products, the Table shows that contamination increases with hour of the day, except for Chub mackerel from Bodija. Factors responsible for this include poor hygiene in handling and packaging of the fish. These results are similar to the findings of [16] and [5]. The Table shows that fish samples from Oja-oba were more contaminated than samples from Bodija. It can thus be concluded that though, the fish sold in both markets are not wholesome for consumption since the observed TCC levels were higher than the recommended level, consuming fish sold at Oja-oba comes with a higher risk of infection with pathogenic microorganisms

Table III Relationship between TVBC, TCC allowable limits and hour of the day

Hour of day	TVBC (CFU/g) AL ($\leq 5.0 \times 10^5$)				TCC (CFU/g) AL ($\leq 1.0 \times 10^2$)			
	Allowable		Unallowable		Allowable		Unallowable	
	Bodija	Oja-oba	Bodija	Oja-oba	Bodija	Oja-oba	Bodija	Oja-oba
8:00	7 (58.3)	8 (66.7)	5 (41.7)	4 (33.3)	0	0	12 (100.0)	12 (100.0)
12:00	10 (83.3)	8 (66.7)	2 (16.7)	4 (33.3)	0	0	12 (100.0)	12 (100.0)
16:00	6 (50.0)	5 (41.7)	6 (50.0)	7 (58.3)	0	0	12 (100.0)	12 (100.0)

AL- Allowable limit; N (%)

Table III shows that 58.3% and 66.7% of the fish samples purchased at 8:00 hour from Bodija and Oja-oba respectively met the allowable TVBC limit while 50.0% and 41.7% of the fish samples at 16:00 hour from Bodija and Oja-oba respectively met the allowable TVBC limit. From the analysis, it may be safer to purchase fish at midday since 83.3% and 66.7% of the fish samples at 12:00 hour from Bodija and Oja-oba respectively met the allowable TVBC limit. The Table also reveals that none of them met allowable TCC limit. .

Table IV Relationship between TVBC, TCC allowable limits and fish types

Fish type	TVBC (CFU/g) AL ($\leq 5.0 \times 10^5$)				TCC (CFU/g) AL ($\leq 1.0 \times 10^2$)			
	Allowable		Unallowable		Allowable		Unallowable	
	Bodija	Oja-oba	Bodija	Oja-oba	Bodija	Oja-oba	Bodija	Oja-oba
C.mackerel	13 (72.2)	11 (61.1)	5 (27.8)	7 (38.9)	0	0	18 (100.0)	18 (100.0)
Sardine	10 (55.6)	10 (55.6)	8 (44.4)	8 (44.4)	0	0	18 (100.0)	18 (100.0)

AL- Allowable limit; N (%)

Table IV shows that 72.2% and 61.1% of Chub mackerel purchased at Bodija and Oja-oba respectively met the allowable TVBC limit while 55.6% of Sardine in both markets met the allowable TVBC limit. None of the fish samples met the allowable TCC limit. It can thus be inferred from the TCC values that none of the fish samples is healthy for human consumption.

CONCLUSION

Although, there are no available surveillance data on foodborne disease in Nigeria, this study confirmed the assertions of [17] that laboratory studies have revealed the presence of foodborne pathogenic bacteria in some foods. Thus, there is an urgent need to mount an intensive public health education on foodborne illnesses in Nigeria since [11] opined that undercooked fish was the main cause of bacterial infections contracted from fish.

Acknowledgment
We appreciate Mr Oladapo Muftau Olalekan of Institute of Agricultural Research & Training (IAR&T) Ibadan, for his assistance during laboratory analysis

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