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Bacteria associated with smoked catfish sold at Bida Modern market, Northcentral Nigeria

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Abstract
In Nigeria, Fish serves as the affordable source of animal protein, where most individuals consume smoke fish as a food delicacy. This study was carried out to identify and ascertain the bacteria contamination of smoked catfish sold at Bida modern market in Northcentral Nigeria. A total of Fifty (50) samples of smoked Catfish were purchased from fish traders in the market. The fish samples were analyzed using standard bacteria techniques and procedures. The result shows mean bacterial loads of 184 colonies with a population of 1.84×10^6 Cfu/g. A total of seven (7) species of bacteria were isolated from the sample. The bacteria species consist of four (4) gram-positive bacteria and three (3) gram-negative bacteria. The bacteria isolate encountered in this study were *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Bacillus* sp., *Micrococcus* sp., *Escherichia coli*, *Salmonella* sp. and *Proteus mirabilis*. The study revealed that smoked catfish sold in Bida modern market are contaminated by different groups of bacteria, which could be due to the unhygienic nature of the market and the fish handlers. The presence and abundance of this groups of bacteria in smoked catfish fish could result into food poisoning, which is a matter of public health concern.

Keywords: Smoked catfish, bacteria, contamination, market, Bida

Introduction
Fish are considered as one of the most affordable sources of proteins, vitamins and minerals, there are also an essential supplement in the nutrients requirement of both infant and adult diets [1, 2]. In West Africa, Fish and fish products play an important role in the diets of the population and it constitutes more than 60% of the total protein, particularly the rural population. The steady increase in the cost of beef and other animal protein sources makes fish the nearest option in resolving protein shortage as there are a very rich source of protein, contains mineral oils, lipids and vitamins, another product of fish, aside fish meal is fish oil which contains omega-3-essential fatty acid which is important for the proper functioning of the brain, heart and immune system [2].

Fishes are perishable food which are prone to fast spoilage and its spoilage are caused by enzymatic and bacteria breakdown of the flesh, especially in the tropic region, which is characterized with high temperature [3]. There is a need to preserve fish after capturing both from wild and artificial environments to preserved loss due to spoilage and the major process of preservation employed in the tropics is smoking [4]. Technically smoking is the process in which meat or fish flesh are exposed to thermal combustion of wood and it penetrates their flesh [5]. The quality of preserved fish also depends on the smoking procedure employed [3]. Fish smoking using wood for its preservation purpose dates back to civilization [1]. Smoking of fish gives the fish and its product a desirable taste and it also extends its shelf-life using its anti-bacterial and oxidative effects, lowering of pH, the drying process and acting as an antagonist to spoilage agents [4]. Food contamination caused by bacteria often results in food spoilage causing life-threatening health implications like food poisoning [6]. Prevention thus helps in the preservation of food quality and public health enhancement Fish and other food sources are considered to be microbiologically unsafe owing to the presence of microorganisms such as bacteria which may invade the human system and cause harm by bacteria producing toxins such as *Staphylococcus aureus*, *Clostridium botulinum* and *Bacilus cereus* ingested together with the food [7].

Aquaculture products harbors both pathogenic and non-pathogenic bacteria which are part of the natural microflora of the environment. Food contamination caused by bacteria often results in food spoilage causing life-threatening health implications like food poisoning [6]. Furthermore, In Nigeria unhygienic conditions of our local markets, handlers of fish, and fish processing facilities can also contribute to the presence of microorganisms in smoked fish. These can arise from persistence of food poisoning, which is of public health importance in developing countries where sanitation is low [8]. This study is aimed at isolating and identifying the bacteria associated with smoked Catfish Sold at Bida Modern Market in Northcentral Nigeria

Materials and Methods

Sample source and collection

A total of Fifty (50) samples of smoked Catfish were purchased from fish traders in Bida Modern market, popularly called Gwadabe Market by the indigenes. Bida is the headquarter of Bida Local government in Niger state, which is located in Northcentral Nigeria. The study area is lies in between the latitudes 9°05" North and longitudes 6°01" East. The fish samples were randomly collected from the fish sellers. The fish samples collected were packed and covered in a sterile new polyethylene bag. The collected samples were transported to the laboratory of Biological sciences, Microbiology and Biotechnology department in the Nile University of Nigeria Abuja for bacteriological studies.

Sample preparation

In the laboratory, the fish samples were crushed separately into a smaller fraction using a mortar and the crushed samples were homogenized with the aid of a blender. For the bacteriological analysis, 1.0 g of the crushed fish samples were poured and mixed thoroughly in 9 ml of sterile water. The ten-fold serial dilution method was employed using sterile distilled water and 1 ml of the desired dilution levels were plated in duplicates on a Petri dish containing prepared media using the pour plate method.

Media preparation and inoculation of sample

28g of Nutrient agar was dissolved in 1000ml of distilled water and mixed till the suspension was uniformed, the media was heat to boiling point to dissolve the medium completely, the medium was sterilized by autoclaving at 121 °C for 15minutes. The media was dispensed accordingly in a sterilized Petri-dish and the Petri dishes was inverted to prevent condensation, droppings from the lid of the plate onto the surface of the media was allowed to gel by cooling, all the Petri dishes were carefully labeled.

1 ml of the samples was taken with the aid of a pipette from the serial diluted samples and was place over a prepared solidify nutrient, agar in a Petri dishes. The Petri dishes was incubated at 37 °C for 24hrs [9]. Each bacteria colonies that appeared on the culture plates were counted with the aid of a colony counter and recorded as a colony-forming unit (cfu/g). All isolates were sub-cultured and transferred to a slant media to obtain a pure culture where a gram-staining and other biochemical test was, catalase test, coagulase test, methyl red test, indole test, citrate utilization and Sugar fermentation test were conducted to identify the isolates based on the method described by Cheesbrough [9].

Data Analyses

The data obtained were presented in tables using the Microsoft office excel package, 2007.

Results

The result of bacterial colony counts of catfish in the Bida modern market ranged from 151-210 and mean bacterial loads of 184 colonies with a population of 1.84×10^6 cfu/g as shown in table 1. From table 2, a total of seven species of bacteria were isolated from the sampled smoked catfish from Bida modern Market. The bacteria species consist of four (4) gram-positive bacteria and three (3) gram-negative bacteria. The gram-negative bacteria isolated in this study include *Staphylococcus aureus*, *Bacillus* sp., *Micrococcus* sp. and Staphylococcus *epidermidis. Escherichia coli*, *Salmonella* sp. and *Proteus mirabilis* were the gram-negative bacteria isolated from the sampled smoked fish from Bida modern market.

Table 1: Number of colony of observed

Dilution factor	Colony range	Mean colony	Population in Cfu
10^4	151-210	184	1.84×10^6

Table 2: Biochemical properties of bacteria isolated from smoked Catfish sold at Bida Mordern market

Colony characteristics	Shape	Gram test	Catalase	Oxidase	Urease	Citrate	Methyl red	Indole	Glucose	Lactose	Sucrose	Suspected organisms
Brown blackish colonies	Cocci	+	+	-	+	+	+	-	+	+	+	*Staphylococcus aureus.*
Grey white colonies	Rod	+	+	+	-	+	+	-	+	+	+	*Bacillus* sp
Creamy-grey colonies	Cocci	+	+	-	+	-	-	-	-	-	-	*Micrococcus* sp
Brown blackish colonies	Cocci	+	+	-	+	-	+	-	+	+	+	Staphylococcus *epidermidis*
Metallic sheen with Blue-black coloration	Rod	-	+	-	-	-	+	+	+	+	-	*Escherichia coli*
Brown to blue black c	Rod	-	+	-	-	-	+	-	+	-	-	*Salmonella* sp
Brownish colonies	Rod	-	+	-	+	-	+	-	+	-	-	*Proteus mirabilis*

Keys; +=Positive, -= Negative

Discussion

In the tropical region of the world, both fresh and processed aquaculture products such as smoked and sundried catfish are prone to contamination by both pathogenic and non-pathogenic bacteria, which are part of the natural micro-flora of fish [2, 10]. The bacterial colony counts result of catfish in Bida modern market shows a mean value of 1.84×10^6 cfu/g, this high population of bacterial colony could be due to poor or unhygienic conditions of the environment in which the fish samples were processed, packaged and preserved [11], and also personal hygiene of the fish handlers [1, 2, 10]. Also, gross contamination of the fishes can be attributed to means or

source of transport employed in transporting the fishes from their sources and processing to the market as they are exposed to dust and other environmental issues [12, 13]. The result of the present study revealed a total of seven bacteria species consisting of four (4) gram-positive bacteria and three (3) gram-negative bacteria. *Staphylococcus aureus, Bacillus* sp., *Micrococcus* sp. and Staphylococcus *epidermidis, Escherichia coli, Salmonella* sp. and *Proteus mirabilis* were the bacteria isolates associated with smoked fish from Bida modern market Niger state. Similarly, the presence of this groups of bacteria's have also been reported in the bacteriological assessment of some fresh and smoked catfish in Nigeria [2, 10-13]. The present of most of this species of bacteria can be attributed to contamination of sampled fish by man through handling and processing [14]. Furthermore, the environment in which fishes are displayed also contribute to the contamination of the fish as the market is not always hygienic and fish sellers often display both fresh and smoke-dried fish sample in open trays beside the gutter or refuse heaps, this also encourages fungi and bacteria attack and subsequent production of toxins [7, 15]. Moshood and Tenghaziyamin [6] reported that bacteria contamination the fish through human handlers and environmental factors such as air, water and soil. The presence of this organisms in the smoked catfish is not surprising since Shinkafi and Ukwaja [16] reported that fish lives in a habitat comprising of microorganisms and confirmed that bacteria flora associated with some freshwater fish culture to include *Bacillus* sp., *Staphylococcus* sp., *Micrococcus* sp. and other group of bacteria.

Conclusion

This research finding shows that Catfish sold in Bida modern market were contaminated with some pathogenic bacteria such as *Staphylococcus aureus, Staphylococcus epidermidis, Bacillus* sp., *Micrococcus* sp. *Escherichia coli, Salmonella* sp. and *Proteus mirabilis*. There tends to be a potential risk associated with eating contaminated fish, improperly cooked or processed fish from this market, especially the catfish. Therefore, adequate efforts should be made toward the reduction of contamination of fish through good personal hygiene of those processing the fishes and those selling the fish in the market. Similarly, an adequate and necessary waste disposal system should be put in place to avoid indiscriminate waste disposal in the environment where the fish are processed and market surrounding were the fish are being sold.

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