Research Paper

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# Survey of The Microbiological Quality of Frozen Fish Marketed in Abakaliki Metropolis and its Implications for Consumer Health

Microbiology

**KEYWORDS :** Microbiological quality, Frozen fish, Abakaliki Metropolis, Consumer health

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## ABSTRACT

*Majority of the frozen fishes sold in Abakaliki Metropolis are sold in open markets, hence this exposure of frozen fish encourages the growth of microorganisms which might facilitate increased transmission and prevalence of pathogens. The microbiological quality of 20 frozen fish from Kpirikpiri and Meat market in Abakaliki were ascertained. A total of 18 bacterial isolates and 7 fungal isolates were obtained from the frozen fishes. The bacteria isolates identified were Bacillus spp. (16.7%), Escherichia spp. (22.2%), Vibrio spp. (11.1%), Pseudomonas spp. (16.7%), Streptococcus spp. (11.1%) and Staphylococcus spp. (22.2%), while the fungal isolates were identified as Aspergillus spp. (28.6%), Mucor spp. (14.3%), Fusarium spp. (42.8%) and Rhizopus spp. (14.3%). The result obtained indicates that frozen fresh fish marketed within Abakaliki Metropolis contain various microorganisms; hence all hygienic measures must be performed during handling, processing and preparing of frozen food to prevent the reach of mould and their toxins to safe the consumer health.*

## INTRODUCTION

Fish encompasses all sea foods including crustaceans with a chitinous exoskeleton such as lobsters, crabs, shrimps and mollusks such as mussles cockles, clams and oysters (Adams and Moss, 1995). Fish is one of the most important sources of animal protein available in the tropics and has been widely accepted as good source of protein and other elements for maintenance of health body. Subsequently, its harvesting, handling, processing and distribution provide livelihood for millions of people (Andrew, 2001; Al-jufaili and Opara, 2006). Fish is regarded a healthier meat option due to the high content of Long Chain Polyunsaturated Fatty acids (LCPUFAs), which are associated with improving health and preventing diseases of old age (Kabaherd *et al*., 2009).

Fish is a very perishable, high-protein food that typically contains a high level of free amino acids. Microbes metabolize these amino acids, producing ammonia, biogenic amines such as putrescine, histamine, and cadaverine, organic acids, ketones, and sulfur compounds (Emborg *et al*., 2005; Olafsdottir *et al*., 2005; Baixas-Nogueras *et al.,* 2005; Dalgaard *et al*., 2006; Doyle, 2007).

Microbiological quality is of importance to public health as it directly relates to spoilage of fish and becomes the cause of food poisoning. Microbial hazards causing infections and poor health are closely related to food safety concerning with animal proteins derived from marketed food - fish, fishery products, meat and meat products. This creates a burning question for all consumers with a high risk commodity with regard to pathogenic bacterial contaminations alarming to food safety challenge (Nilla *et al*., 2012).

Majority of the frozen fishes are sold in the open markets. However, the ones sold in supermarkets are either imported frozen or those caught in Nigerian waters and frozen on board (Oramadike *et al*., 2010). 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). In spite of some disadvantages associated with frozen storage freezing is accepted as effective way of preserving fish (Arannilewa *et al*., 2005). There is paucity of information on quality of fish sold in Nigeria supermarkets (Oramadike *et al*., 2010).

Majority of the frozen fishes marketed in Abakaliki Metropolis, Ebonyi State are sold in open markets, so exposes these frozen fishes to dust and contaminated air. Hence this exposure of frozen fish encourages the growth of microorganisms which might facilitate increased transmission and prevalence of pathogens. Moreover, poor personal hygiene such as neglecting to wash hands after handling contaminated materials encourages contamination of frozen fish with pathogenic organisms. Hence, this study attempts to assess the microbiological quality of frozen fish sold in Abakaliki Metropolis.

## MATERIALS AND METHODS

### Collection and Processing of Samples

20 frozen fishes were collected from Kpirikpiri and Meat market in Abakaliki into sterile container and transported immediately to the laboratory for microbial analysis. Frozen fish samples were aseptically removed from the container. Using a sterile, the different fishes were dissected to remove the intestine, gills, skin and also the fins respectively. Each sample was blended separately for homogenicity and about 10g taken for microbiological analysis.

### Enumeration, isolation and identification isolates

A ten fold serial dilution was made and appropriate dilutions were used for microbial enumeration using standard pour plate method. The pour plates were made using Nutrient agar, MacConkey agar, and Sabouraud Dextrose agar for total heterotrophic bacterial counts, total coliform counts, and total fungal counts respectively. The plates were incubated at 37$^0$C for 24-48h except for fungal plates which were incubated at room temperature (28+2 $^0$C) for 3-7 days. Discrete colonies were sub-cultured into fresh agar plates aseptically to obtain pure cultures of the isolates. Colonies identifiable as discrete were carefully examined macroscopically for cultural characteristics. All isolates were Gram stained to determine their gram

reaction. The isolates were identified by comparing their characteristics with those of known taxa, as described by Jolt *et al*. (1994) and Oyeleke and Manga (2008). Fungal isolates were subcultured on SDA and identified based on their morphological and cultural characteristics.

**RESULTS**

A total of 18 bacterial isolates and 7 fungal isolates were obtained from frozen fishes sold in Kpirikpiri and Meat markets (Table 1 and 2), the bacteria isolates identified were *Bacillus* spp., *Escherichia* spp., *Vibrio* spp., *Pseudomonas* spp., *Streptococcus* spp. and *Staphylococcus* spp. at the following frequency 16.7%, 22.2%, 11.1%, 16.7%, 11.1% and 22.2% respectively, as indicated in Figure 1, while the fungal isolates were identified as as *Aspergillus* spp. (28.6%), *Mucor* spp. (14.3%), *Fusarium* spp. (42.8%) and *Rhizopus* spp. (14.3%) as shown in Figure 2.

**Table 1: Characteristics of the bacteria isolates from frozen fish**

| Morphological characterization | | Gram staining | Catalase Test | Oxidase Test | Indole Test | Voges Proskauer | Motility Test Glucose | Sugar Fermentation Test | | | Suspected Organisms |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lactose | Fructose | | |
| Colour | Consistency/ Texture | | | | | | | | | | |
| Light yellow | Slightly raised | - | + | + | - | - | - | + | - | - | Pseudomonas species |
| Grayish | Small round colony | + | - | + | - | - | - | + | - | - | Bacillus species |
| Creamy | Raised/ smooth edge | + | + | - | - | - | - | + | - | - | Staphylococcus species |
| Creamy | Flat colonies | - | + | + | - | - | + | + | - | - | Vibrio species |
| White mucoid | Rough surface | + | - | - | - | - | - | + | - | - | Streptococcus species |
| Greenish | Rough surfaces | - | + | - | + | - | - | + | + | - | Escherichia species |

The fungal isolates were *Aspergillus* species, *Rhizopus* species, *Mucor* species and *Fusarium* species as in Table 2.

**Table 2: Morphological and microscopic feature of fungi isolated from inorganic fertilizer enriched soil**

| Morphological Characteristics | Microscopic Examination | Suspected Organisms |
|---|---|---|
| Velvety filamentous white growth that sporulate black powdery spores | Long septate hyphae with conidiophore bearing brown spores and phialide at its apex | Aspergillus species |
| Long hyphael growth which sporulated within two days to turn to black spore | Non-septate, branched mycellium with round shaped sporangia | Rhizopus species |
| White and wooly aerial growth that darkens as it sporulate | Non-septate hyohae with straight sporangiophore with many spherical spores. | Mucor species |
| Pink fluffy and spreading colonies which is creamy around edges | Septate hyphae with sickle chlamydospores at the hyphae | Fusarium species |

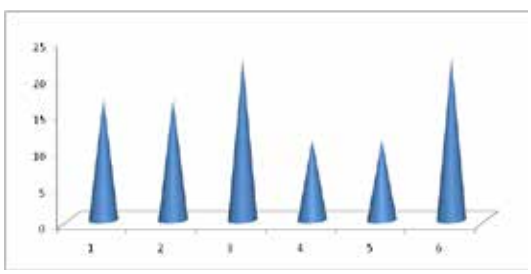


**Figure 1: Frequency of bacterial isolates**

Key: 1. Pseudomonas spp., 2. Bacillus spp. 3. Staphylococcus spp., 4. Vibrio spp., 5. Streptococcus spp. and 6. Escherichia species

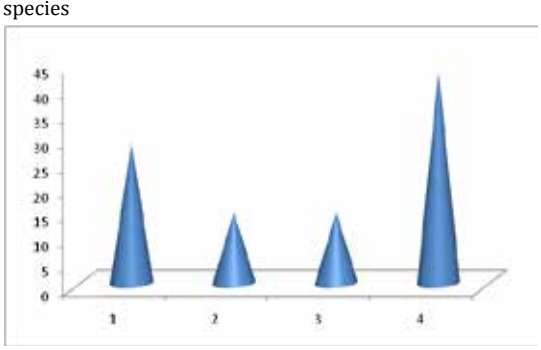


**Figure 2: Frequency of fungal isolates**

Key: 1. Aspergillus spp., 2. Rhizopus spp. 3. Mucor spp. and 4. Fusarium spp.

**DISCUSSION**

Fish has been widely accepted as a good source of protein and other elements necessary for the maintenance of healthy body. It is an important food commodity in the international trade but they deteriorate rapidly especially when storage facilities are lacking (Adebayo-Tayo *et al*., 2012). Fish are highly perishable and prone to vast variations in quality due to differences in species, environmental habitats, feeding habits and antibiotic treatment (usage) in fish production. Infectious agents associated with water and food products (especially fish) are seen to cause gastroenteritis (diarrhoea or dysentery) in humans, which may result in fatalities. However, the greatest risk posed to human health is consumption of raw or poorly processed fish and fish products (Babalola *et al*., 2011).

The microorganisms isolated and identified from the fresh fish samples can be said to be normal flora of the fish e.g. *Bacillus* sp. (Ola *et al*., 2004). The normal microbial flora of the fish are not initially harmful, as they even help in preventing the invasion of the fish flesh by other microorganisms but they become pathogenic when there is an enabling environment that promotes their growth e.g. bad handling which can lead to bruises, poor hygiene and delayed processing and preservation of the fish after harvest (Abolagba and Igbinevbo, 2010).

*Staphylococcus* species (22.2%) and *Escherichia* species (22.2%) were identified as the most dominant bacteria in all the fish samples studied, followed by *Pseudomonas* species (16.7%) and *Bacillus* species (16.7%), while *Vibrio* species (11.1%) and *Streptococcus* spp. (11.1%) were the least bacteria isolated as shown in Table 1 and Figure 1. This work is in line with the work of Okonta and Ekelemu (2005) who reported *Staphylococcus* spp. and *Escherichia* spp. as the predominant microorganisms affecting frozen fish and causing their spoilage. Contrarily, Nwabueze and Nwabueze (2011) reported that *S. aureus* counts were lower compared with *E. coli* count. But it is also an indication that both *Staphylococcus* spp. and *Escherichia* spp. can be isolated from frozen fish. The Isolation of *Staphylococcus aureus* in this work is of practical impact. It is an evidence of poor sanitary condition and lack of or inadequate packaging of the products as they are always exposed at the markets (Okonko *et al*., 2009). In the same vein, Abolagba and Igbinevbo (2010) *Pseudomonas* species as the most prevalent cause of frozen fish spoilage. Subsequently, Abolagba and Igbinevbo (2010) reported that *Bacillus* spp. was present in virtually all fish samples tested, which is also in line with the report of this study. Two *Bacillus sp*. are considered medically significant; *B. anthracis* which causes anthrax and *B. coagulase* also causes food spoilage (Martinko, 2005). Isolation of *Vibrio* spp. and *Streptococcus* spp. at the lowest frequency in this study is in agreement with the work of Babalola *et al*. (2011).

According to the Center for Food Safety and Applied Nutrition (2001), most fish- related food borne illnesses are traced to *Salmonella*, *Staphylococcus spp., Escherichia coli*, *Vibrio parahemolyticus, Clostridium perfringens, Clostridium botulinum* and Enteroviruses.

Four fungal isolates were obtained from the frozen fish sold at Kpirikpiri and Meat markets as shown in Table 2 and Figure 2. *Fusarium* spp. (42.8%) was the highest isolated, followed by *Aspergillus* spp. (28.6%), while the least were *Rhizopus* spp. (14.3%) and *Mucor* spp. (14.3%). Nearly similar results were recorded by (Ammar, 2001; and El- Ahl, 2010 and Hassan *et al.,* 2011). It is worthwhile from the recorded results that the most of the isolated moulds are toxigenic types and have the ability to produce mycotoxins whenever the condition are right and become of public health hazards previously reported by (El-Ahl, 2010 and Hassan *et al*., 2010). The fungal contamination of fish could be attributed to improper sanitation during catching, handling, manufacturing, storage, transportation and marketing of fish. These findings were supported by the view reported by (Ward and Baji, 1988 and Hassan, 2003). The contaminated feeds, water supply and worker hands used fish breeding play the essential role on the health status of fish (Hassan and Abdel Dayem, 2004 and Hassan *et al*., 2007).

*Fusarium* spp., *Aspergillus* spp., *Rhizopus* spp. and *Mucor* spp. were incriminated in cases of pulmonary infections, urinary tract infection , arthritis, osteomylitis , dermatitis, endocarditis, meningitis and eye infection (Mossel and Shennan, 1976).

The result of this study revealed that frozen fish sold at different markets in Abakaliki Metropolis could be a source of foodborne bacterial and fungal pathogens.

**CONCLUSION**

All the pathogens isolated are of food and public health implication and hence hazardous and injurious to human health if consumed. Hence, all hygienic measures must be performed during handling, processing and different stages of preparing of frozen food to prevent the reach of mould and their toxins to safe the human health.

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