

Assessment of Mycological Quality of Smoked African Catfish (*Clarias gariepinus*) Sold at Sabon-Gari Market, Kano Nigeria

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ABSTRACT

Smoked African catfish (*Clarias gariepinus*) fish is one of the most popular types of fish products sold in Sabon gari market, Kano, Nigeria. A research is conducted on the mycological quality of the smoked fish vended in the market with the aim of providing first-hand information on the safety issues associated with the consumption of this fish. A total of thirty (30) samples were collected from 3 smoked fish hawkers in the market. The samples were analyzed microbiologically using pour plate method on Potato Dextrose Agar to determine fungal isolates. The isolates were characterized by cultural characteristics and microscopy. The results from this study revealed a highest fungal count of 2.50×10^3 CFU/g from smoked fish obtained from retailer B. The least fungal count of 1.85×10^3 CFU/g was found from the smoked fish of retailer C. The result also revealed the presence of eight different fungal species associated with the smoked fish samples with difference degree of prevalence as follows; *R. stolonifer* was the most predominant with 23%, followed by *A. niger* (19.7%), *Mucor* 18%, *Saccharomyces* 11.5%, *Aspergillus fumigatus* 9.8% and *Penicillium notatum* 8.2%. *Alternaria* and *Fusarium* were the least abundant fungal species on the smoked fish accounted for 4.9% each. The present level of fungal contamination of the smoked fish can probably be either due to the level of moisture in the smoked fish or unhygienic handling. Attention of the health care providers and the authorities concerned is therefore needed towards orienting the retailers and the consumers towards proper methods of storing such smoked fish and that the consumers have to properly boil the fish before consumption.

Keywords: Assessment, Cat-fish, Fungi, Sabon-Gari Market, Smoked fish.

INTRODUCTION

Food quality and safety is an increasingly important public health issue as consumers need to purchase safe products that do not involve any kind of risk for health [1]. More so, assessment of food quality helps to ensure that all attributes that influence the value of a product for the consumer; this includes negative attributes such as spoilage, contamination with filth, discoloration, off-odors and positive attributes such as the origin, color, flavor, texture and processing method of the food [2]. The contamination of food products with microorganisms presents a problem of global concern, since the growth and metabolism of microorganisms can cause serious food borne intoxications and a rapid spoilage of the food products. Thus, the acceptance and safety of a food product for the consumers depends in great part on the presence and nature of microorganisms. Fungi, molds and bacteria are

the agents responsible for various types of food spoilage and food borne intoxications [3].

Fish is one of the major sources of proteins upon which a large number of Nigerian populations depend. In Nigeria, fish and fish products constitute more than 60% of the total protein intake in adults [4]. The problem of fish in Nigeria however, is its high rate of perishability especially since the relative ease of preservation is not readily attainable, hence the Difficulty in handling.

Preserving fish involves processes that impede growth of microorganisms either by the addition of growth inhibiting ingredients or adjusting storage conditions by freezing or drying [5]. Processing methods affect the microorganisms in fish in different ways, resulting in different types of micro-flora and different risks from spoilage organisms and pathogens. Generally, the different preservation methods are: drying,

smoking, freezing, chilling and brining. Depending on the preservation method these species can proliferate and adulterate the product. However despite the fact that smoking is the most common method of fish preservation in Nigeria [6] its effectiveness as an international source of foreign exchange is gradually losing ground [7]. This is attributed to the exportation of smoked fish to developed countries is becoming increasingly stringent due to the emergence of food safety and agricultural health standard, along with the fact that buyers keep changing their requirements. Food poisoning organisms can multiply profusely in foods without initially altering the appearance, taste or odor. A large number of people suffer from gastrointestinal upsets annually, as a result of eating contaminated food which leads to a considerable loss of man-hour with accompanying consequences. Sometimes death occurs. In many instances, outbreaks result from lack of understanding of food hygiene in the preparation, cooking and care of food. These problems might hinder the attainment of Sustainable Development Goals' objectives. In order to avert such outbreaks, safety evaluation is necessary [2]. This study therefore aimed at evaluating the fungal quality of smoked fish sold at Sabin gray market, Kano state with the view of providing first-hand information on possible dangers associated with the consumption of these fish.

MATERIALS AND METHODS

Sample Collection

Thirty (30) samples of smoked African catfish (*Clarias gariepinus*) were randomly procured from three (3) different retailers at Sabin gray market, Kano, Nigeria. The samples were carefully packed into separately labeled polythene bags and kept in a clean container and transported to the laboratory of the Department of Microbiology, Kano University of Science and Technology; where they were properly identified according to the identification keys described by Holden and Reed [8], weighed individually and stored in a refrigerator prior to mycological analysis.

Isolation of Fungal Flora One gram of each fish sample (trunk region) was taken and crushed in a sterile mortar with pestle under laboratory condition. Nine milliliters sterile distilled water was added and serially diluted up to 10^{-6} fold as described by Syllabi and Façade [9]. 0.1ml aliquots of 10^{-4} dilutions were

aseptically removed separately with a sterile pipette and transferred into labeled sterile Petri dishes and 20ml melted Potato Dextrose Agar (PDA) was added by pour plate method. The PDA (Biotech, USA) was prepared according manufactures instruction. After rotating gently, the plates were incubated at 27°C for 72 hours. Pure colonies were isolated from mixed culture and inoculated onto the surface of freshly prepared PDA which was supplemented with 30mg/ml of Chloramphenicol (Micro Lab Limited) to inhibit bacterial growth. The plates were incubated at 27°C for 72 hours.

Identification of Fungal Flora

The fungal isolates were identified based on the macroscopic and microscopic characteristics as described by Fayola and Oslo [10], Pepper and Gerber [11] and James and Natalie [12]. Microscopy was carried out by observing the morphological characteristics like size, shape growth and color of the plate. Microscopic identification of fungi and fungus like organisms involve the observation of morphological features such as shape, size of hyphen, shape of sporangia, conidia, conidiophores and spores. This was done using a flamed inoculating needle, the edge of each colony is picked and slides of the different colonies are made, a drop of lacto phenol cotton blue stain is added to the slides and covered with cover slip and examine under the microscope using x100 magnification. The resultant microscopic characteristics were compared with the scheme provided by Claus [13] and Ellis *et al.* [14].

RESULTS

The average mycological count of the samples from different retailers is presented in Table 1. The results from this study revealed a highest fungal count of 2.50×10^3 CFU/g from smoked fish obtained from the second retailer (Retailer B). The least fungal count was found from the smoked fish of retailer C.

Table 1: Average Mycological Counts from Smoked Fish Obtained from different Retailers in Sabin Gary Market, Kano

S/N	Retailers	Fungal count (FCU/g)
1	A	$1.97 \pm 0.21 \times 10^3$
2	B	$2.50 \pm 0.23 \times 10^3$
3	C	$1.85 \pm 0.15 \times 10^3$

The cultural and microscopic characteristics of the fungal isolates obtained from smoke fish samples are presented in the table below (Table

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2). From the results obtain, a total of 8 fungal isolates were identified namely; *Aspergillus Niger*, *Aspergillus fumigates*, *Alter aria alternata*, *Fusarium sp.*, *Macro mucked*, *Rhizopus stolonifer*, *Penicillium notatum* and *Saccharomyces cerevisiae*

Table 2: Cultural and Microscopic Characteristics of Fungal Isolates from Smoked Fish samples

Isolate	Cultural Characteristics	Microscopic Characteristics	Fungi Identified
1	Purple-red cottony colony on PDA plate	Oval conidia on branched conidiophores	<i>Fusarium sp</i>
2	White to grey cotton candy growth	Black sporangium on irregular septate hyphen	<i>Macro mucked</i>
3	White cottony growth on PDA plate	Non septet hyphae and irregular in size	<i>Rhizopus stolonifer</i>
4	Blue-black mould on PDA plates	Thick septate hyphen, chain of conidia on sterigmata	<i>Aspergillus niger</i>
5	Pink mold rot radial colony on PDA plate	Erect conidiophores with cylindrical conidia	<i>Alternaria alternata</i>
6	Dense felt dark green colouration on plate.	Hyphae is septate and is small in size	<i>Aspergillus fumigates</i>
7	Green to blue mould with powdery texture	Green septate hyphae with chain of conidia	<i>Penicillium notatum</i>
8	White-creamy coloured on PDA plate	Oval shaped without conidia	<i>Saccharomyces cerevisiae</i>

The prevalence of fungal isolate of fungal flora on the smoked fish vended in Sabin gray market (Table 3) revealed the presence of eight (8) different fungal species associated with the smoked fish in the market. *R. stolonifer* was the most predominant with 23%, followed by *A.*

Niger (19.7%), *Macro* 18%, *Saccharomyces* 11.5%, *Aspergillus fumigates* 9.8% and *Penicillium notate* 8.2%. *Alternaria* and *Fusarium* were the least abundant fungal species on the smoked fish accounted for 4.9% each.

Table 3: Prevalence of Fungal Flora in 30 smoked fish samples from different Retailers at Sabon-Gari Market, Kano

S/N	Fungal isolates	Frequency	Prevalence (%)
1	<i>Aspergillus niger</i>	12	19.7
2	<i>Mucor sp</i>	11	18.0
3	<i>Saccharomyces cerevisiae</i>	7	11.5
4	<i>Fusarium sp</i>	3	4.9
5	<i>Aspergillus fumigates</i>	6	9.8
6	<i>Rhizopus stolonifer</i>	14	23.0
7	<i>Penicillium notatum</i>	5	8.2
8	<i>Alternaria alternata</i>	3	4.9
	Total	61	100

DISCUSSION

In view of excellent possibilities to achieve Sustainable Development Goals (SDG), food safety is the basic tenet. To achieve such objectives of the SDGs, food sources need to be free from harmful microbes that impart clinical health hazards to the public. The results from this study revealed a highest fungal count of 2.50×10^3 CFU/g from smoked fish obtained from the second retailer (Retailer B). However, the highest value of fungal counts obtained by this study is lower than those obtained by many researches in Nigeria. Adegunwa *et al.* [15] studied the

microbial quality of smoked herring (*Sardinella macleod*) obtained from Odder local government, Gun state, Nigeria and reported highest fungal counts of 3.50×10^3 CFU/g. Daniel teal. [16] Also reported the highest fungal count of 4.98×10^6 CFU/g from smoked fish vended in Benin City, Nigeria. Similarly, Adebayo-Tao teal. [17] Reported fungal counts of from smoked fish vended in Oyo, Nigeria as 7.6×10^3 CFU/g, 8.4×10^4 CFU/g and 9.0×10^2 CFU/g. But the result is contrary to the findings of Wage and Iasi [18] who reported values lower than that observed in this study. They reported highest fungal counts of 1.53×10^3 CFU/g and

1.78×10³CFU/g from roasted fish species sold in Benin City, Nigeria.

The least fungal count was found from the smoked fish of retailer C. The range of fungal counts observed in the smoked fish samples is also in consistent with the range of values (1.693 x 10⁵ – 9.043 x 10⁵CFU/g) reported by Udochukwu *et al.* [19] From smoked and fresh fish sold in Benin City, Nigeria.

Furthermore, the result of the macroscopic and microscopic identification of the eight fungal species isolated from smoked fish vended in Sabin gray market is presented in Table 2. The occurrence of *Aspergillus sp.*, *Rhizopus sp.*, *Fusarium sp.* and *Penicillium sp.* in the smoked fish species was attributed by Christianah *etal.* [20] to the fact that during storage, the fish sample reabsorbed moisture from the environment which then supported the growth of the microorganisms in addition to the contamination during processing, handling and display on the market stalls. Similarly, fungal contamination occurs probably during hawking where the fish is exposed to fungal and fungal spores contamination as reported by Dike-Ndudim *et al.* [21]. This as Eklund *et al.* [22] puts it, that any handling of fish and the associated sanitary practice from the point of harvesting can potentially contribute to the micro flora on the final product. More so, the result for the prevalence of fungal flora on the smoked fish vended in Sabon gari market (Table 3) revealed the presence of eight (8) different fungal species associated with the smoked fish in the market. *R. stolonifer* was the most predominant with 23%, followed by *A. niger* (19.7%), *Mucor* 18%, *Saccharomyces* 11.5%, *Aspergillus fumigates* 9.8% and *Penicillium notatum* 8.2%. *Alternaria* and *Fusarium* were the least abundant fungal species on the smoked fish accounted for 4.9% each. The microorganisms isolated in this study have been reported in some fish species by Gram and Huss [23]. Dike-Ndudim *et al.* [21], Akinwumi *et al.* [24] and Udochukwu *et al.* [19] who independently reported these organisms as the major causes of microbial spoilage of fish and the microbial count on the different media suggests contamination. This result has proven that the smoked fish are contaminated right from the factory point. This implies that smoking is not

an effective means of preservation and prevention of microbial proliferation in fish for long period of time. Furthermore, the fungal species identified in this study were aflatoxigenic fungal species that produce mycotoxins which have pathogenic effects on man; it destroys the liver and kidney resulting to death. The presence of the organisms could be as a result of handling during smoking and also cross contamination during storage, after smoking and handling during sales of smoked fish as reported by Adelaja *et al.* [25]. More so, the isolation of these fungal species as mycocontaminants of smoked fish indicated a potential health hazard as stressed by Gupte [26].

CONCLUSION

It was concluded that, eight different fungal species were associated with the smoked fish sold in Sabon-gari market, Kano Nigeria. *Rhizopus stolonifer* and *Aspergillus niger* were the most abundant species. Although the fungal density on the smoked fish is moderate, yet the tendencies of gastrointestinal tracts infections and Aspergillosis among the consumers is high due to the pathogenic fungal species detected in the fish. The smoked fish either due to the level of moisture in it or not properly smoked as well as unhygienic handling was contaminated thereby supporting the relative growth of fungal microbes. Attention of the health care providers and the authorities concerned is needed towards orienting the retailers and the consumers towards proper methods of storing such smoked fish and that for consumers, the fish has to be properly boiled in water before consumption.

ACKNOWLEDGEMENT

The authors wish to acknowledge to the technical staff of Biological Science Department of Kano State University of Science and Technology Wudil, Kano for use of laboratory facilities. Thanks to Fish Sellers Association Sabon gari Market, Kano for their support and cooperation.

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Citation: Sa'adatu A Jere, Nura Salisu and Muhammad Ali, " Assessment of Mycological Quality of Smoked African Catfish (*Clarias gariepinus*) Sold at Sabon-Gari Market, Kano Nigeria", *Annals of Microbiology and Infectious Diseases*, 2(1), pp.13-18.

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