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Fungi Associated with Dried Tomato Chips Marketed in Sokoto Metropolis

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ABSTRACT:

Food spoilage is a multifarious process and excessive quantities of foods are lost as a result of microbial spoilage even with contemporary preservation practices. The high water activity in tomato makes it more vulnerable to spoilage by fungi. The fungi produce mycotoxins and if consumed, poses threats to immune-compromised individuals. This study is consequently conducted to isolate and identify the fungi associated with dried tomato chips marketed in Sokoto Metropolis, in Sokoto State, Nigeria. The fungi isolated were *Aspergillus niger, A. fumigatus, A. flavus, A. oryzae, Rhizopus stolonifer, and Scopularis Candida.* Isolates of *A. oryzae* has the highest percentage of occurrence (40%), followed by *A. niger*, and *S. candida* with (16%) respectively. *A. flavus* has the least percentage of occurrences (4%). Proper handling and adequate storage facilities must be employed to prolong the shelve life of tomato fruits. There is utmost need to devise means of minimizing contamination to meet the global standard of preservation practices.

Keyword: *Fungi, Dried Tomato Chips, Market Sample and Sokoto*

INTRODUCTION

Tomatoes (*Solanum lycopersicum L.*) are unarguably significant in the human diet as they provide color, flavor, and essential vitamins and minerals needed for good health [1, 2]. The cultivation of tomato has a potential of improving the livelihood of many smallholder farmers that live in the rural and peri-urban settlers by generating job opportunities and serving as a source of income [3]. However, despite these benefits, tomatoes are not only perishable but seasonal and easily become spoilt a few days after harvest. Perishability of the fruit is one of the major threats affecting its storage. Sugri [4] reported that 10 – 20% losses might occur due to delay in transportation. Hence, called for sun-drying as a means of preservation. According to Abdulmalik [5], dried tomato chips are commonly produced by direct sun-drying in the open. Although this technique is easy and cheaply carried out, the end product is contaminated with filth and sand; thus, posing threats to immune-compromised individuals.

Spoilage of tomatoes are those adverse alterations in the quality (appearance, smell, taste, and texture) of the fruit which are induced mainly by the action of physical and biological factors. According to Ghosh [6], fungi are the major causes of spoilage in tomatoes than bacteria. In the same vein, Etebu [7] reported *A. niger, A. phoenicis, Absidia spp, Penicillium spp, Geotrichum spp, Trichoderma spp, Mucor spp, Alternaria alternata, Fusarium oxysporum, F. moniliformis, Rhizopus stolonifer,* and *Phytophthora spp* as the major fungi affecting tomatoes. Spoilage of tomatoes induced by fungal infection has been reported to be recognized as a source of possible health threat to both humans and animals. This is because they produce mycotoxins, which upon ingestion or inhalation are capable of causing mycotoxicoses [8]. The infections by mycotoxins are diverse; they rapidly diffuse and contaminate all parts of the fruit, rendering them flabby for consumption. Curtailing these threats requires the water activity of the tomato fruit to be reduced by drying; and is one of the oldest and the most common forms of food preservation [9].

There exist various reports on their spoilage organisms in the African perspectives and the globe entirely, but there is ashortage of information on mycoflora in dried tomato chips in a developing city such as Sokoto, Nigeria. As such, there is need to assess the fungi associated with their spoilage. Thus, this study isolates, characterized, and identified the fungi associated with dried tomato chips marketed in Sokoto metropolis.

MATERIALS AND METHODS

Study Area

This study was carried out in Sokoto metropolis of the Sokoto state. The State geographically lies along longitude 110 30^{1} to 130 50^{1} East and latitudes 4o to 61 North and covers a total land mass of 26,648.48 square kilometers. Sokoto State shares boundary with Kebbi State to the south, Zamfara State to the east and the Republic of Niger to the north. The State has an estimated population of about 4,742,459 people as of 2015 with 95.9 persons per square kilometer, and 3% growth rate annually based on 2006 population census [10]. Occupation of the city inhabitants includes farming, trading; commerce, with a reasonable proportion of the population working in private and public sectors [11, 12]

Collection of samples

Healthy and sun-dried tomato chips were randomly selected from five different markets, namely; Kofar Rini, Marina, Tsohuwar Kasuwa, Unguwar Rogo, and Kasuwar Dankure located in Sokoto State, Nigeria. The tomato chips were put into sterile bags and properly labeled and taken to mycology laboratory for microbial analysis.

Isolation of fungi

Dilution plating method was the technique used for isolation of fungi in this study. According to Jarvis [13], this is the most common procedure used for examining feed and foodstuffs. About 1gr of the sample was sterilized with ethanol and mixed with 10ml of sterile distilled water. The mixture was thoroughly shaken,and 1 ml of suspension was pipetted into the sterile test tube containing

9ml of distilled water and thoroughly mixed. The sample was serially diluted and 1ml of aliquots of 10^{-4} and 10^{-5} were added to molten SDA plates. The plates were swirled gently to obtain a thorough mixing and were allowed to solidify and incubated at room temperature for 3-5 days. The fungal colonies were counted. Successive emplace of the tip were transferred until a pure culture of each fungus was obtained.

Identification of fungi

Morphology of fungi were macroscopically studied by observing the features of the colony and by staining with lactophenol cotton blue and observing under a compound microscope for the arrangement of spores, conidiophores, and conidia [14]. With the aid of the available literature, the fungi were identified [15].

RESULT

The fungi isolated from tomato chips samples (Table 1) revealed the presence of *Aspergillus niger, A. fumigatus, A. flavus, A. oryzae, Rhizopus stolonifer, and Scopularis Candida.* Moreover, *A. oryzae* has the highest frequency of occurrence (40%) followed by *A. niger* and *S. candida* (16%). On the other hand, *A. flavus* recorded the least frequency of occurrence (4%).

Table 1: Frequency of occurrence for fungal isolates from the tomato chips samples

Fungal Species	Frequency	Percentage (%)
A. niger	4	16
A. fumigatus	3	12
A. flavus	1	4
A. Oryzae	10	40
R. stolonifer	3	12
S. candida	4	16
Total	**25**	**100**

The study also revealed, as indicated in Table 2, that *A. oryzae* was the only fungi found in the sample from K/D market, and the frequency of occurrence stood at 3. Likewise, the sample from TSK market revealed the presence of *A. fumigatus* only, which also appeared twice. However, *A. oryzae* and *R. stolonifer* were the only species found in MRN, at the frequency of 3 respectively. *R. stolonifer* was not discovered in K/R and UWR samples. Though *A. niger* (2:2), *A. fumigatus* (1:0), *A. flavus* (0:1), *A. oryzae* (1:3), and *S. candida* (1:3) were found in the former and latter respectively.

Table 2. Fungi isolated from the spoilt dried tomato chips based on sampling site

Markets	Isolated fungi
K/R	*A. niger, A. fumigatus, A. oryzae,* and *S. candida*
MRN	*A. oryzae,*and*R. Stolonifer*
TSK	*A. fumigatus*
UWR	*A. niger, A. flavus, A. oryzae,* and *S. candida*
K/D	*A. oryzae*

Key
K/R = kofar Rini
MRN = Marina
TSK = Tsohuwar Kasuwa
UWR = Unguwar Rogo
K/D = Kasuwar Dankure

The fungal isolates from the markets (Table 2) revealed that samples from K/R and UWR contained all the fungi identified in this study except*A. flavus* for the former, and *A. fumigatus* for the latter respectively. Samples from MRN revealed *A. oryzae*, and *R stolonifer*, TSK and K/D showed the presence of *A. fumigatus*and *A. oryzae*; respectively.

Table 3: Distribution of fungi in the sampled markets

Markets	*A. niger*	*A. fumigatus*	*A. flavus*	*A.oryzae*	*R. stolonifer*	*S. candida*	(%)
K/R	2	1	0	1	0	1	20
MRN	0	0	0	3	3	0	24
TSK	0	2	0	0	0	0	08
UWR	2	0	1	3	0	3	36
K/D	0	0	0	3	0	0	12
Total	**4**	**3**	**1**	**10**	**3**	**4**	**100**

Key
K/R = kofar Rini
MRN = Marina
TSK = Tsohuwar Kasuwa
UWR = Unguwar Rogo
K/D = Kasuwar Dankure

With regards to the percentage occurrence of the fungi in the markets (Table 3), the fungi occurred most in the samples from Unguwar Rogo market (36%) while the least occurrence was documented in fruits from K/D market (12%).

DISCUSSION

This study investigated the fungi associated with dried tomato chips marketed in Sokoto metropolis, Nigeria, and the result revealed the presence of some fungi. The fungi isolated from the dried fruits were *A. niger, A. fumigatus, A. flavus, A. oryzae, R. stolonifer,* and *S. candida*. In a similar study conducted by Samuel and Orji [16] on fungi associated with post-harvest spoilage of tomato fruits sold in Awka, Nigeria, *A. niger, R. stolonifer, F. oxysporum, S. cerevisiae, A. alternata, P. digitatum* and *G.candidum* were identified. tr

The result of this study revealed that *A. oryzae* has the highest percentage of occurrence (40%), while *A. niger* and *S. candida* had a percentage of 16%; respectively. These findings were contrary to that of Ibrahim [17] and Samuel and Orji [15], who reported that *A. niger* had the highest frequency of occurrence among the fungi that induced the production of volatile compounds in the infected tomatoes. Moreover, *A. fumigatus* had a percentage frequency of 12%. Where with [18] also made a similar discovery in dried apricot and fig fruits. The study further revealed that *A. flavus* had the least percentage of occurrences (4%) in the infected dried tomato samples. The result is in-line with the work of Tournas [19] on the presence of fungi in selected nuts and dried fruits. It implies that harvest or post-harvest practices appeared to have effects on the mycoflora of the fruit.

The percentage occurrence of fungi in the context of the markets indicated that samples from UWG market has the highest percentage of occurrence (36%), followed by MRN, K/R, K/D, and TSK markets with 24%, 20%, 12%, 08% respectively. The detection of more fungi in the samples from UWG market could

be as a consequence of overcrowding, poor sanitation and storage as well as unsanitary practices of the fruit sellers.

Fungal contamination or infections by diseases are some of the major factors that affect storage and preservation of tomatoes [20]. The high water activity of tomato, condition of storage, mode of handling, as well as the quality of the fruit could be the determinant of spoilage by fungi; thus, a great source of mycotoxin contamination [21].

CONCLUSION

The dietary and nutritional qualities of tomato fruits cannot be overemphasized. Contamination by fungi could induce economic loss and pose health threats to immune-compromised individuals. The fruits are locally preserved by direct sun-drying and it is more economical, durable, and requires no additives. However, this technique exposes the end-product to fungal contamination. Therefore, good quality control measures must therefore be employed by the farmers, marketers,and consumers during handling and processing of the fruits. There is the need to enhance and standardize the drying process to guarantee excellent products that are free from fungal deterioration and to meet the global standards of good production practices.

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