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Journal of Proteomics & Bioinformatics

Research Article

Fungal Infestation of Garri Sold Around Dutsinma Metropolis

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ABSTRACT

This study was conducted to determine the fungal contaminants of garri in Dutsinma metropolis. A total of 150 samples were bought at random, 75 each of white and red garri from three different markets including Wednesday market, Abuja road market and Old market respectively. The fungi isolated using standard microbiological techniques were *Alternaria spp.* (3.7%), *Aspergillus spp.* (14.8%), *Cladosporium spp.* (27.8%), *Fusarium spp.* (9.3%), *Mucor spp.* (12.9%), *Penicillium spp.* (16.7%) and *Rhizopus spp.* (14.8%) in white garri. For yellow garri: *Alternaria spp.* (2.9%), *Aspergillus spp.* (8.8%), *Cladosporium spp.* (29.4%), *Fusarium spp.* (8.8%), *Mucor spp.* (11.8%), *Penicillium spp.* (20.6%) and *Rhizopus spp.* (17.6%) with *Cladosporium* and *Rhizopus* recording the highest occurrence in both white and yellow garri. Higher fungi species were isolated from white garri (54) compared to yellow (34) samples. Moisture content recorded showed higher content in white garri than in the yellow garri. Identification of the isolated fungi based on their morphological and cultural characteristics was carried out. The results show that consumers are exposed to the risk of aflatoxin poisoning. Efforts should therefore be made to improve the quality of *Cassava* farina by addressing its handling and processing practices.

Keywords: Fungal; Infestation; *Cassava*

INTRODUCTION

Fungi are non-photosynthetic protists growing as a mass of branching, interlocking filaments (hyphae) known as mycelium. Although the hyphae exhibit cross walls, the cross walls are perforated and allow free passage of nuclei and cytoplasm. The entire organism is thus coenocyte which is a multinucleated mass of continuous cytoplasm confined within a series of branching tubes [1].

All fungi are eukaryotic organisms and each fungi cell has at least one nuclear membrane, endoplasmic reticulum, mitochondria and secretory apparatus. Most fungi are obligate or facultative aerobes. They are chemotrophic, secretory enzymes that degrade wide variety of organic substrates into solute nutrients which are then passively absorbed on taken into the cell by active transport [2]. Fungal contaminant are also responsible for substantial effects in stored foodstuffs including discoloration, losses of nutritional value, product of odors, deterioration in technological quality and contamination of mycotoxin [3,4].

Cassava production is primarily used for human consumption. It represents staple food and a major contributor to food security in producing areas and Africa consume almost its entire production. *Cassava* products fermented or not, are also devoted to foodstuff [5]. *Cassava* tubers are processed into an amazing variety of foods. Traditionally processing techniques varies from region and ethnic group with a given area. In Africa, the two common products of *Cassava* tubers are farina (gari) and fufu (sticky dough made by pounding cooked of fermented tubers into paste. Garri is the product of *Cassava* tubers obtained from peeled, grated, fermented and roasted *Cassava* tubers. It is consumed by several millions of people of West Africa [1].

This study was aimed at determining the fungi (mold) associated with *Cassava* farina sold in Dutsinma metropolis with the following objectives; to access *Cassava* farina for the presence of molds and to isolate and identify molds in farina.

MATERIALS AND METHODS

Study area

The study was carried in Dutsinma Local Government Area of Katsina State Nigeria. It has a total land area of about 527 km^2 and a population of 1,190,711 as at the 2006 census. Dutsinma is situated on latitude 12.4728° N and Longitude 7.4860° E North West of Nigeria. The inhabitants of the area are predominantly

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Received: May 11, 2020, **Accepted:** July 20, 2020, **Published:** July 27, 2020

Citation: Orpin JB, Mzungu I, Usman-Sani H (2020) Fungal Infestation of Garri Sold Around Dutsinma Metropolis. J Proteomics Bioinform. 13:7. doi: 10.35248/0974-276X.1000511

Hausa's and Fulani's. Their main occupation is farming and animal rearing. Dutsinma lies in the savanna zone of Northern Nigeria, it experiences two distinct seasons: the dry season which lasts from October to May and the raining season which is between June to September. Inhabitants are predominantly farmers and rearers.

Sample collection

A total of 150 samples of garri were collected at random from three major markets within Dutsinma metropolis including Wednesday market, Abuja road market and Old market for assessment. Samples were collected in sterile plastic containers and transported to Biological Sciences laboratory of Federal University Dutsinma for analysis.

Sample preparation

The spread plate count method as described by Ogiehor et al. [1] was used by weighing 10 g of each processed sample aseptically into 90 ml of 0.1% (w/v) sterile peptone water in a sterile 500 ml beaker, and allowed to stand for 5 min with occasional stirring using a magnetic stirrer. Further serial dilution method was carried out using 1 ml of initial suspension in the beaker in 9 ml of sterile distilled water in a 1:10 dilution to obtain up to 10-5 dilutions as described by Jonathan et al. [6].

Moisture content

The moisture content was determined by weighing 5.0 g each of all the samples and drying in an oven maintained at 105°C for 7 to 8 h for a constant weight to be obtained. Thereafter, they were stored in desiccators to cool and then re-weighed. The difference in weight was used to obtain the moisture content as described by AOAC et al. [7].

Isolation and identification of moulds

A 0.1 ml of each dilution prepared earlier was pipetted and spread-plated in sterile Petri dish containing potato dextrose agar (PDA) with 0.1% concentrated lactic acid to inhibit bacterial growth. Inoculated plates were thereafter incubated at 28°C for 5 to 7 days. Total viable fungal counts was carried out and expressed as colony forming units per gram (CFUg-1) of sample after incubation. Identification of the isolated moulds based on their morphological and cultural characteristics was carried out using the descriptions of Alexopoulus et al. [8].

Statistical analyses

The various data obtained from this study were subjected to statistical analyses: ANOVA and student's t test to compare significant differences of means ($p< 0.05$) in the white and yellow garri using statistical software, SPSS version 17.0.

RESULTS

One hundred and fifty samples of garri were examined and the following fungi were isolated *Alternaria spp.* (2%), *Aspergillus spp.* (7.3%), *Cladosporium spp.* (16.7%), *Fusarium spp.* (5.3%), *Mucor spp.* (7.3%), *Penicillium spp.* (10.7%) and *Rhizopus spp.* (9.3%) (Table 1).

Cladosporium spp. had the highest frequency of occurrence in both white garri (20%) and yellow garri (13.3%). *Aspergillus spp.* was more in white garri (10.7%) than in yellow garri (4%). The least occurrence was recorded with the *Alternaria spp.* having 2.7% in the white garri and 1.3% in the yellow garri. Generally, higher fungi species were isolated from white garri 54 (72%) compared to yellow garri 34 (45.3%) samples.

Moisture content of both white and yellow garri samples are presented in Figure 1. The results indicate that white garri had higher moisture content than yellow garri. The ranges of the moisture contents for the white and yellow garri were 2.5 to 4.3 and 1.4% to 2.4% respectively (Figure 2).

Identification of the isolated moulds based on their morphological and cultural characteristics was carried out using the descriptions of Alexopoulus et al. [8] (Table 2).

DISCUSSION

The moulds isolated had different rates of appearance in the samples assessed with the presence of *Alternaria spp*, *Aspergillus spp*, *Cladosporium spp*, *Fusarium spp*, *Mucor spp*, *Penicillium spp.* and *Rhizopus spp.* and varied significantly ($P\geq0.05$) in the white and yellow garri respectively. The mould contamination could have

Table 1: Frequency of occurrence of fungi species obtained from garri samples (n=150).

Fungi	White garri (n=75)	Yellow garri (n=75)
	Number positive %	Number positive %
Alternaria spp.	2 2.7	1 1.3
Aspergillus spp.	8 10.7	3 4
Cladosporium spp.	15 20	10 13.3
Fusarium spp.	5 6.7	3 4
Mucor spp.	7 9.3	4 5.3
Changes in occurrence of fungi in white and yellow garri	**Changes in occurrence of fungi in white and yellow garri**	**Changes in occurrence of fungi in white and yellow garri**
Rhizopus spp.	8 10.7	6 8
Total	**54** **72**	**34** **45.3**

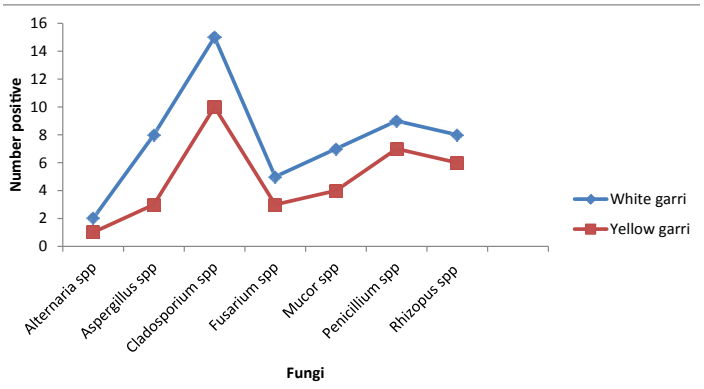

Figure 1: Changes in occurrence of fungi in white and yellow garri.

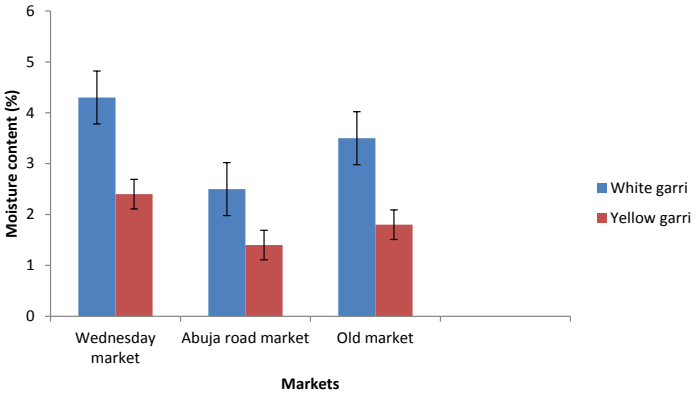

Figure 2: Moisture content of the two types of garri.

Table 2: Macroscopic and microscopic characteristics of molds isolates.

Colonial characteristics	Hyphae	Rhizoid	Sporangia/ Conidia	Sporangiosphore/ Conidiosphore	Fungi species
Moderately rapid growing colonies that appeared white.	Septate	Present	Conidia	Conidiophore	*Fusarium spp.*
Fast growing colonies that fill up the petridish, with abundant woody aerial mycellium	Non-septate	Absent	Sporangia	Sporangiophore	*Mucor spp.*
Fast growing colonies that rapidly filled the petri dish with loose, light grey mycellium	Non-septate	Absent	Sporangia	Sporangiophore	*Rhizopus spp.*
Colonies are white to cream mealy and subsurface resembling yeast	Septate	Absent	Conidia	Conidiophore	*Cladosporium spp.*
Colonies appear light blue to green with moderate growth rate.	Septate	Absent	Conidia	Conidiophore	*Aspergillus spp.*
Moderately fast growing colonies that appeared white and then velvet with bordered white	Septate	Absent	Conidia	Conidiophore	*Penicillium spp.*
Rapidly growing colonies which appears white at first with a wooly surface then became dark grey	Septate	Absent	Conidia	Conidiophore	*Alternaria spp.*

been introduced during local method of processing, exposure to bio-aerosols during sale in the market and post processing handling of such product [1,9,10].

Cladoporium spp. recorded the highest frequency of occurrence with 20% and this agrees with the work of Peter et al. [11] who recorded high prevalence in Ghana. This result agrees also with the work of Ogiehor et al. [12] who isolated similar fungi from fermented *Cassava* not handled hygienically. Obadina et al. [13] also reported the isolation of similar moulds from their study on garri during assessment of some fermented *Cassava* products. Results also show that yellow and white garri harbours array of fungal contaminants reported in other studies [1,14]. *Cladosporium spp.* was the most predominant mould isolated from both white and yellow garri samples respectively which is in contrast with that of Aguoru et al. [15] and Georgia et al. [16] who reported *Aspergillus spp.* and *Penicillium spp.* with highest occurrences respectively. The presence of these moulds in food put the consumers at risk for instance *Penicillium spp.* contains citrinin which had been reported to have nephrotoxic, hepatotoxic and cytotoxic effects [17]. *Aspergillus spp.* was been implicated as one of the most important fungi that causes black mold disease in fruits [18], ear infections in human and food poisoning [14].

The moisture content percentage of white garri (3.4%) and yellow garri (1.9%) do not support the values reported by Aguoru *et* who reported higher values of 11.7% and 12.5% for white and yellow garri respectively and Ogugbue et al. [19] who also reported higher moisture content in garri. In this research, it was also observed that white garri had higher moisture content than yellow garri which could be attributed to the yellow garri being mixed with palm oil during processing and as such discouraging growth of the moulds. The moisture content was highest at the Wednesday market which happens once in a week and attended by multitude from about five neighboring local government areas and thought to encourage increased storage and could eventually cause deterioration of the stored products. Halliday et al. [20] reported that the major important factor that could encourage mould contamination and proliferation of garri is the high initial moisture content or increase in moisture content during storage.

CONCLUSION

Identification of the isolated moulds was based on their morphological and cultural characteristics and was achieved by colony appearance, colony colour, colony growth rate, colony morphology, conidial and phialide morphology and size separated all the seven species. Apart from *Mucor spp.* and *Rhizopus spp.* which show non septate hyphae, absence of rhizoids and presence of sporangia; *Cladosporium spp, Aspergillus spp, Penicillium spp, Alternaria spp.* and *Fusarium spp.* show septate hyphae, presence of rhizoids and absence of sporangia which agrees with the standard characteristics of fungi.

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