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Research Article

Isolation and Identification of Fungi Associated with Stored Cowpea (*Vigna unguiculata*) (L.) Seeds in Mashi and Mai'Aduwa Markets, Katsina State, Nigeria

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ABSTRACT

This research aimed at isolating and identifying fungal species associated with stored cowpea (*Vigna unguiculata*) seeds, the cowpea samples were first surface sterilized using sodium hypochlorite for 2-3mins and then rinsed four times using sterile distilled water. Five seeds from each of the 6 sterilized sub-samples were separately plated directly on three Petri dishes each containing Potato Dextrose Agar (PDA), streptomycin was added to the medium before it was poured into the Petri dishes. The inoculated plates were incubated at room temperature and observations were made daily for possible development or growth of seed borne fungi. Observed colonies were sub-cultured onto freshly prepared PDA plates containing streptomycin and incubated for 7 days. Eight Fungal genera isolated and identified with their percentage abundances were *Aspergillus flavus* (31.59%), *Rhizoctonia* sp. (21.05%), *Fusarium* sp. (15.79%), *Penicillium* sp. (10.53%), and least are, *Colletotrichum* sp., *Curvularia* sp., *Rhizopus* sp., and *Mucor* sp., each with percentage abundance of (5.26%,). However this study should be considered as preliminary and further research is required to determine the extent of fungal contamination in other Cowpea varieties in other markets. Studies should also be conducted to identify the source and the risk factors that determine the presence of fungi in the Cowpea varieties. Government and health organizations like NAFDAC should also take proactive measures to reduce the fungal contamination of Cowpea.

Keywords: Cowpea, markets, fungi, *Aspergillus flavus*, *Rhizoctonia*, *Penicillium*, *Colletotrichum*, *Curvularia*,

Introduction

Cowpea, (*Vigna unguiculata* L.) (Walp.) is an important crop, belonging to the family Leguminosae, mostly grown in tropics where its seeds serve as good source of protein for millions of people (Boukar *et al*., 2017). Cowpea is mostly produced and consumed in the sub-Saharan Africa, especially Central and West Africa.

The main world producers are Nigeria, Brazil and Niger, among others (Marques *et al*., 2015). Nigeria has an annual grain production of approximately 2.14 million metric tons, Burkina Faso and Niger Republic are other major producers with 0.57 and 1.59 million metric tons per annum respectively (FAOSTAT, 2017).

Vigna unguiculata is better adapted to drought, high temperatures and other biotic stresses such as damage caused by nematodes, insects, weeds etc. compared with other legumes (Martins *et al*., 2003). The seeds are major source of plant proteins, vitamins for humans, feed for animals and also a source of income for farmers, the mature grain contains 20 to 25% protein (Addoquate *et al*., 2011), 1.3 to 1.5% lipids and 5.1 to 5.8% crude fiber (Tshovhote *et al*., 2003). It has the ability to prevent erosion and improve soil fertility; this makes it an important economic crop in many developing countries (Gogile *et al*., 2013). Some biotic stresses such as fungal, viral and bacterial diseases adversely affect the productivity of cowpea, leading to drastic reduction in yield and deterioration of seeds during storage (Boukar *et al*., 2017).

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However, grains of pulses especially cowpea seeds are susceptible to fungal contamination when stored under poor conditions (Etaware, 2019). These fungi are known to produce metabolites called mycotoxins, and the higher the number of fungi associated with the seeds, the higher the level of the mycotoxins, (Rahim *et al*., 2013). Ibeh *et al.* (1991) detects presence of mycotoxins produced by *Aspergillus* species in cowpea seed samples. Habish *et al.* (1972) report presence of aflatoxin from the cowpea samples collected from Sudan. Houssou *et al.* (2009) also reported the presence of aflatoxin from the cowpea samples collected from West Africa. As the number of storage fungi increases, the Nutritive quality, Viability, and germination of the seeds reduces (Agarwal and Sinclair, 1996; Rahim *et al*., 2013).

Fungal encroachment of stored seeds can result in yield loss, decrease in seed viability and quality (Etaware, 2019). Discoloration, poor growth, mycotoxin production and decay (Kritzinger *et al*., 2003; Castillo *et al.*, 2004). Fungi and insects play significant roles in the reduction of the quality of stored cowpea seeds, and the situation is mostly aggravated by high relative humidity and temperature (Richard *et al.*, 2009). The physiological impact of fungal encroachment on stored cowpea seeds include: increased seed temperature and mustiness, increased fatty acid production, reduced sugar quality and respiration rate, production of mycotoxins (which if consumed may be harmful to man and animals) and loss in seed weight and viability, even the quality of cowpea seeds were further reduced by discoloration, unpleasant taste, flavor or smell, and also decrease in nutritive value (Bawa *et al.*, 2012). In the early 1970s, Cowpea seeds from Western Nigeria were reported to harbor fungi such as *Aspergillus flavus, A. niger, Fusarium vertilliodes, F. solani, Penicillium digitatum* and *Rhizopus* sp. (Esuruoso, 1975). Emechebe and Mcdonald, (1979) reported that cowpea seeds from Ibadan markets in Sourthern Nigeria contained *Ascochyta* spp., *Colletotrichum lindemuthianum, C. truncatum, Rhizoctonia solani, F. oxysporum, F. solani, Macrophomina phaseolina, Septoria vignae* and *Corticium rolfsii*.

Cowpea seeds collected from local markets in South Africa and Benin were contaminated with *Fusarium equiseti, F. graminearum, F. semitectum, F. proliferatum, F. chlamydosporum, F. sambucium, and F. subglutinans* (Kritzinger *et al.*, 2003). The loss of cowpea seeds during storage to microorganisms has been a serious threat to farmers in Nigeria (Law-Ogbomo and Egharevba, 2006). Fungi are serious parasites to stored cowpea seeds (Embaby and Abdel-Galil, 2006).

The objectives of this study therefore, are to isolate and identify the fungal species in stored cowpea (*Vigna unguiculata*) seeds in Mashi and Mai'duwa Markets in Katsina State, Nigeria and to determine the percentage abundance of fungi in the stored cowpea seeds. This will ascertain the types of fungi associated with stored cowpea seeds and possible fungal pathogens of stored cowpea.

Materials and Methods

Cowpea Sample Collection and Study Area

Six different samples of cowpea seeds landraces were collected, three of them Namely (Dan tanis, Drum, and Dan arba'in)^{H}, were collected from Mai'aduwa market, in Mai'aduwa L.G.A., and other three samples Namely (Jan wake, Manyan wake, and kananan Dan Arba'in)^{H} were collected from Mashi market, in Mashi L.G.A., each aseptically collected and put into separate, airtight, polythene bags. The samples were transported to the mycology laboratory of the Department of Crop Protection, Institute for Agricultural Research, Ahmadu Bello University Zaria, which is situated at latitude $11^{0}12''$North and longitude 7^{0} 33'' East. On arrival in the Laboratory, the Cowpea samples were stored at room temperature until use.

Surface Sterilization

The sample size was firstly reduced by quartering, and then sterilized to remove surface contaminants that may interfere with the growth of the fungi during culturing and further studies. This was done by completely dipping the seeds in 1% sodium hypochlorite solution for 3-4 minutes.

The seeds were then rinsed four times with sterile distilled water to remove all traces of the sterilizing agent from the seeds.

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Media Preparation

A 200g of Irish potato was peeled, chopped and cooked using 1 liter distilled water the suspension was filtered through muslin cloth, more distilled water was added to the residue and filtered again until the filtrate marked 1L in the glass jug, the filtrate was poured back into the pot, then Agar agar and dextrose agar were added and stirred gently, the mixture was boiled again for about 10min until the added materials dissolve, the mixture was then dispensed into conical flask and covered with aluminum foil paper, the media was sterilized at 121ºC or 15 psi for 20 minutes, streptomycin was added prior to pouring in to Petri dishes.

Cultivation and Isolation of Fungi

Five seeds from each of the 6 sterilized sub-samples were separately plated directly on Petri dishes in triplicates, each containing Potato Dextrose Agar (PDA) medium, streptomycin was added to the medium before it was poured in to the Petri dishes, to inhibit bacterial growth, and then the samples were cultured at room temperature (25-29ºC) for 24 hours. Before the first observation of any seed borne diseases that come out, afterward, Distinct Fungal colonies were isolated, and then sub-cultured in to another freshly prepared PDA containing streptomycin for 7 days mimicking (Klich, 2002; Samson, *et al*., 2010).

Fungal Identification

This was done by macroscopic and microscopic observation of the fungal pure culture isolates, the macroscopic identification was done by observing morphological characteristics such as the color, texture, topography and general morphology of the sub-cultured fungal isolates using a light microscope. Scanning electron microscope was used for microscopic identification by looking at Vegetative and reproductive characteristics of the fungi in order to confirm their taxonomic genus.

A small portion of fungal isolates from each of the sub-cultured fungal Petri dish were placed on a glass slide, containing two drops of lactophenol cotton blue stain, separately, this help to enhance the visibility of the fungal structures.

The prepared slide was mounted under the microscope and observations on the samples were done by looking for the presence of fungal spores, hyphae, fruiting bodies and all vegetative and reproductive characteristics.

The confirmation of the identified fungi was done based on the description of the gross morphological appearance of fungal colonies on the PDA culture medium and the slide culture technique for microscopic evaluation with reference to the Manual of Fungal Atlas (Barnett and Hunter, 1972; Samson *et al*., 2004).

Determination of Percentage Abundance of Fungi

This was done using the formula of Abu *et al*. (2015):

$$\%\text{tage Abundance of fungi} = \frac{\text{Number of times a fungus is encountered} \times 100\%}{\text{Total number of fungi isolated}}$$

Statistical Analysis

Percentage abundance of fungi, associated with the stored cowpea seeds of Mashi and Mai'aduwa markets were reported in Pie chart.

Results

Fungi Isolated and Identified from Stored Cowpea (*Vigna unguiculata*) Seeds

The results of the macroscopic and microscopic characteristics of the fungi that were isolated from the Stored Cowpea (*Vigna unguiculata*) seed samples and their probable identity is as presented in Table 1. Eight fungi genera were isolated from the Stored Cowpea (*Vigna unguiculata*) seeds. The fungal isolates were identified as *Aspergillus flavus, Colletotrichum* sp., *Curvularia* sp. *Fusarium* sp., *Mucor* sp. *Penicillium* sp. *Rhizopus* sp., and *Rhizoctonia* sp.

Results of the images of the macroscopic or colonial features (A) and microscopic features at x40 magnification (B) of pure cultures of fungi isolated during the study are as shown in Plates I to VIII.

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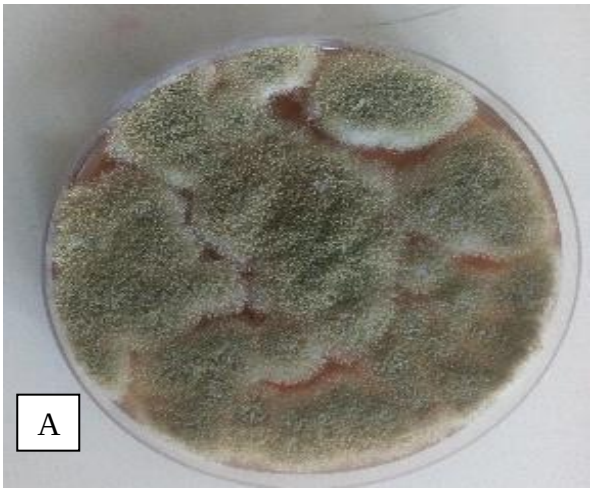
Table 1: Macroscopic and Microscopic features of Isolated Fungal species

Fungal Species	Macroscopic Features	Microscopic Features
Aspergillus flavus	Yellowish green colony color with creamy edge, Powdery texture with flat topography	Presence of conidiophore, conidia, and vesicles.
Curvularia sp.	Grey colonies and grayish-black as the colony aged, cottony texture and raised topography	The hyaline, spherical shaped, and septate hyphae that a rose terminally
Colletotrichum sp.	This species is small, thread-like, blackish color, cottony texture and raised topography	This species has small, round spores with a smooth surface
Fusarium sp.	Whitish color, with cottony texture and flat thread-like topography	This species has long, spindle-shaped and septate micro and macro conidia
Penicillium sp.	Dark green color, with velvety texture and flat topography	Conidiophores forming finger-like structure, septate and branched hyphae
Mucor sp.	Black cotton like structure	Aseptate hyphae, irregular in size and ribbon like
Rhizopus sp.	Whitish color, with tiny black dots at the top of the cottony textured and raised topographic colonies.	Presence of rhizoids It has large, cylindrical spores with a ridged surface.
Rhizoctonia sp.	It's gray in color, has a hard, leathery texture, and forms tight, compact colonies.	It has branched, septate and elongated hyphae



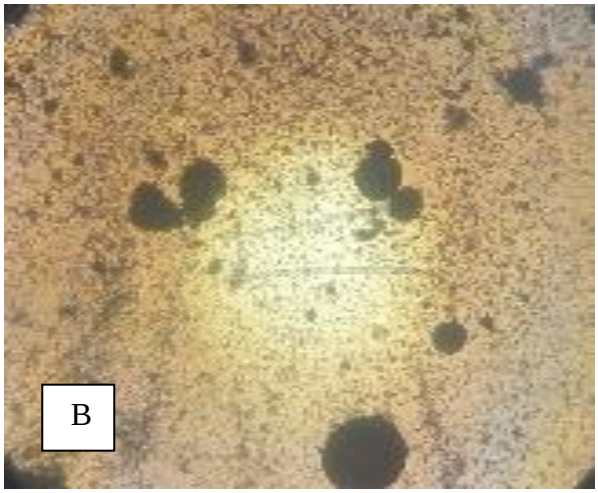


Plate I: Pure culture of *Aspergillus flavus*
A = Macroscopic feature

B = Microscopic feature, Mg×40

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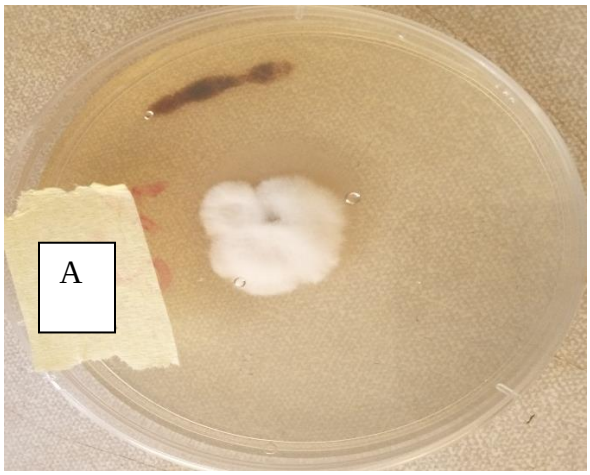
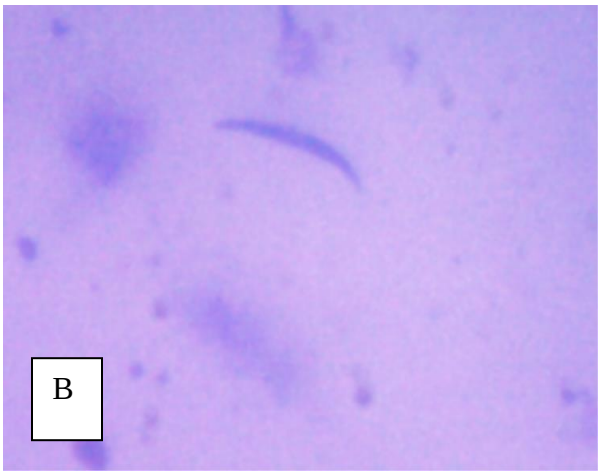


Plate II: A Pure culture of *Colletotrichum* sp
A = Macroscopic feature



B = Microscopic feature, Mg×40

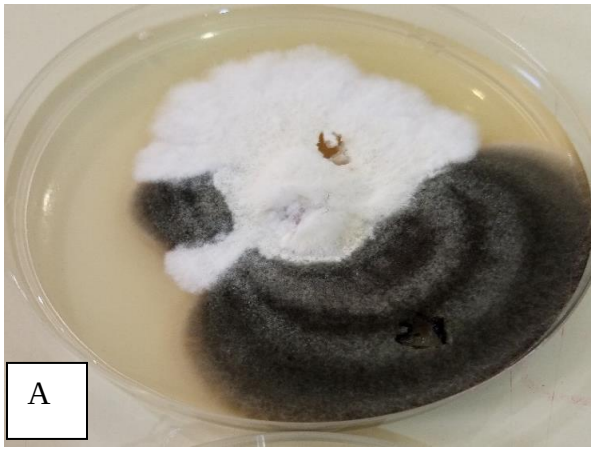
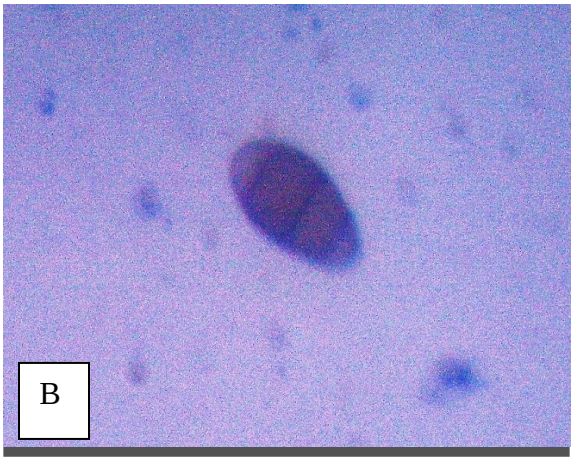


Plate III: A Pure culture of *Curvularia* sp.
A = Macroscopic feature



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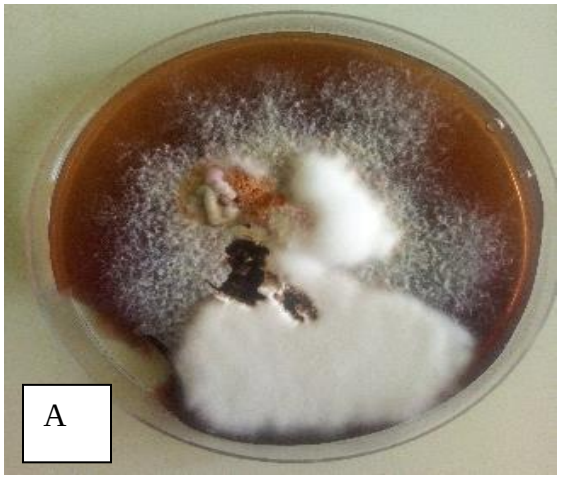
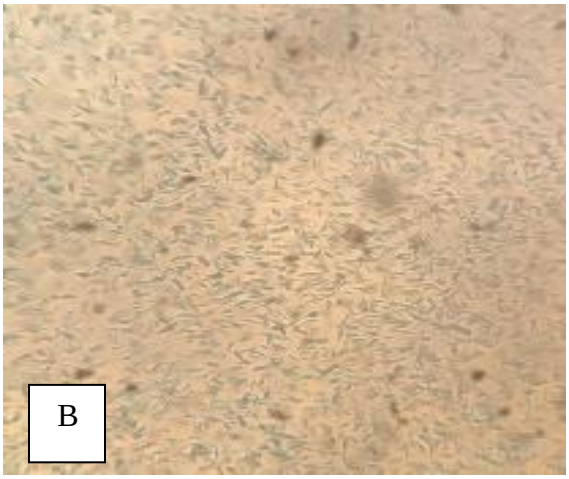


Plate IV: A Pure culture of *Fusarium* sp.
A = Macroscopic feature



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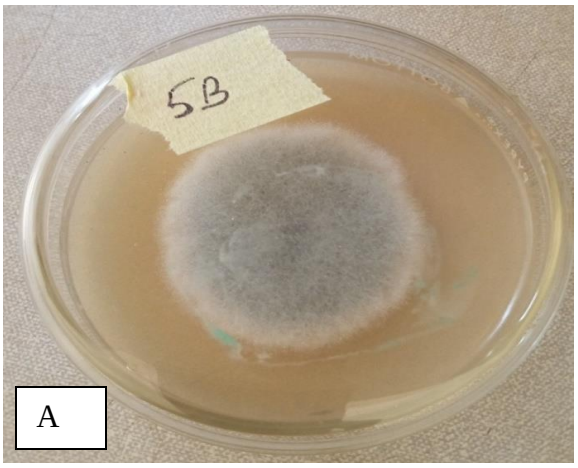
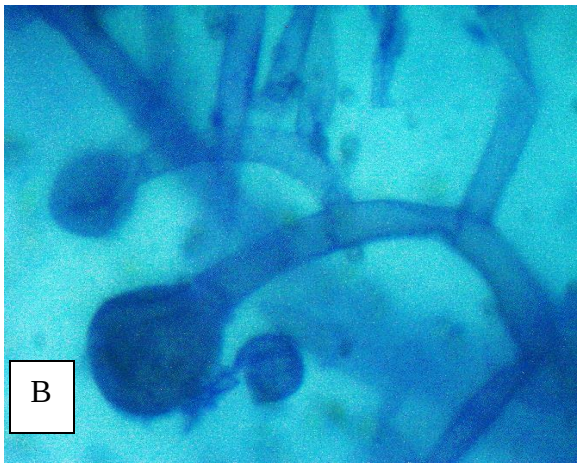


Plate V: A Pure culture of *Mucur* sp.
A = Macroscopic feature



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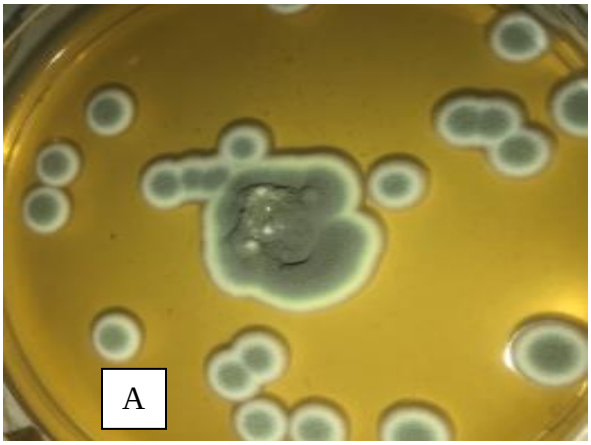
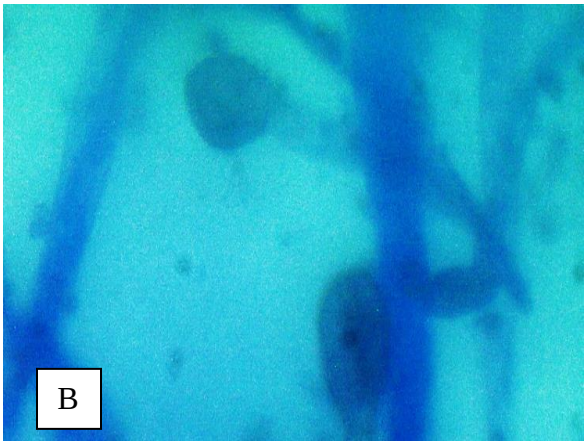


Plate VI: A Pure culture of *Penicilium* sp.
A = Macroscopic feature



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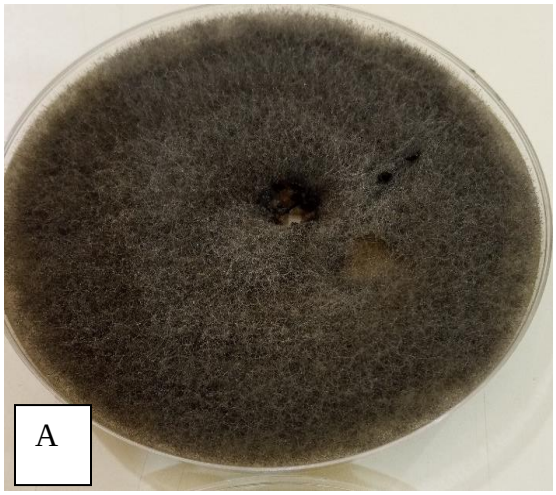
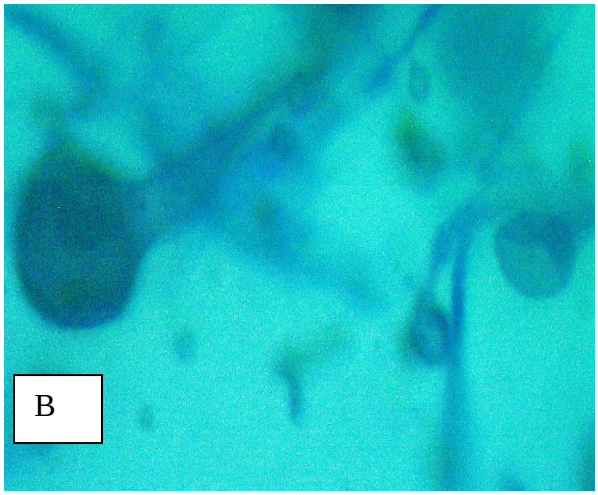


Plate VII: A Pure culture of *Rhizopus* sp.
A = Macroscopic feature



B = Microscopic feature, Mg×40

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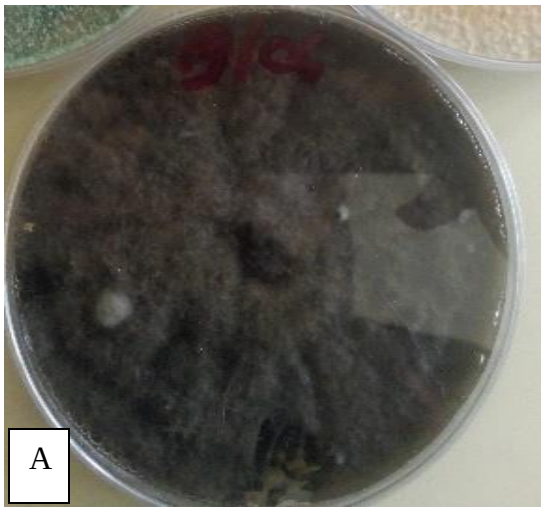
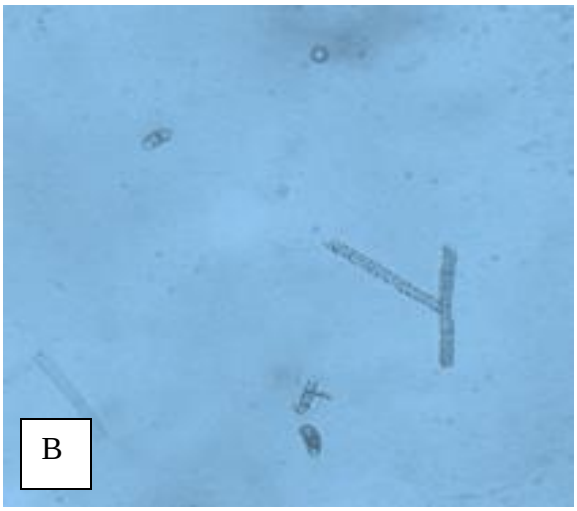


Plate VIII: A Pure culture of *Rhizoctonia* sp.
A = Macroscopic feature



B = Microscopic feature, Mg×40

The result of the distribution of isolated and identified fungi from cowpea seeds in the markets is as presented in Table 2. It was observed that, some species were found to be present in both Mashi and Mai'aduwa Markets, while others were found to be present in only one of the markets.

Percentage Abundance of Fungi Associated with the Stored Cowpea Seeds

A total number of 19 fungi were isolated from the selected local Cowpea varieties in Mashi and Mai'aduwa Markets in Katsina State and identified during the study.

The results of the percentage abundance of the fungi isolated from the varietis of cowpeas are as shown in Figure 1. Of the 19 isolates, *Aspergillus flavus*, had the highest frequency of isolation/occurrence, with percentage abundance of 31.59%, this was followed by *Rhizoctonia* sp. with percentage abundance of 21.05%, *Fusarium* with a percentage abundance of 15.79%. *Penicillium* sp., had a percentage abundance of 10.53%, and least are, *Collectotrichum* sp., with percentage abundance of 5.26%, *Curvularia* sp. With a percentage abundance of 5.26%, *Rhizopus* sp., had a percentage abundance of 5.26% and *Mucor* sp. also had a percentage abundance of 5.26%.

Table 2: Distribution of Isolated and Identified Fungi from Cowpea Seeds

S/N	Fungal species	Markets	
		Mai'adua	Mashi
1.	*Aspergillus flavus*	+	+
2.	*Rhizoctonia* sp.	+	+
3.	*Colletotrichum* sp.	+	+
4.	*Curvularia* sp.	+	-
5.	*Fusarium* sp.	+	-
6.	*Mucor* sp.	-	+
7.	*Penicillium* sp.	+	+
8.	*Rhizopus* sp.	-	+

Key: + = Present - = Absent

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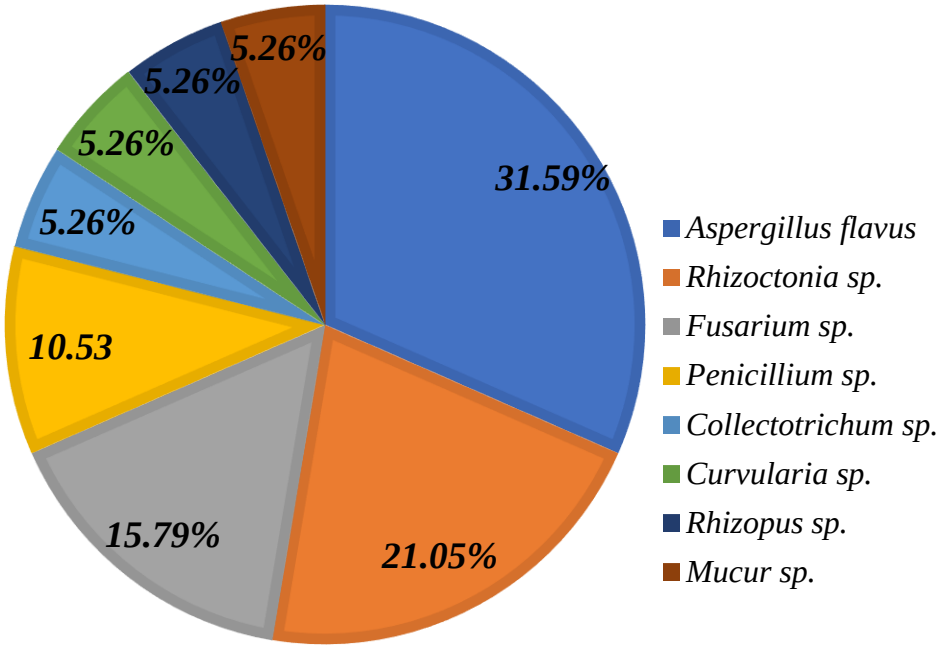

Figure 4.1: Percentage abundance of fungi obtained from the Cowpea seeds

Discussion

The results obtained are important for understanding the fungal diversity in local cowpea varieties of Mashi and Mai'aduwa markets. The presence of eight different fungal genera in the cowpea varieties is probably due to the fact that cowpea is widely grown in the tropical region and serve as a major food source, and also due to the fact that fungi are ubiquitous organisms (Pitt and Hocking, 1997). These results demonstrate the prevalence of *Aspergillus flavus* in the local Cowpea varieties. *A. flavus* is a common species of fungi associated with stored grains and vegetables, and can produce mycotoxins that are harmful to human and animal health (Reddy *et al.*, 2007). They also affirmed the predominance of *Aspergillus* genera in tropic environments. In addition to being present in all of the samples, *A. flavus* also have highest Percentage abundance (31.59%) compared to all other isolated and identified fungi in the study.

These results are similar to those of Gyasi *et al*. (2022) who reported highest percentage abundance of *A. flavus* (54.5%) in infected samples of cowpea seeds produced in Ghana. In the same line, Afolabi *et al.* (2019) have reported 52.5% percentage abundance of *Aspergillus* strains from cowpea seed samples collected from markets of three states (Lagos, Ogun and Oyo) in Nigeria.

Moreover, two species (*A. niger* and *A. flavus)* were found to be associated with cowpea seed infection (with percentage abundance of 23.57% and 16.42%, respectively) in India by (Zanjare *et al*., 2020). Contamination from field, during post-harvest operations, or storage could explain the presence of *A. flavus* strains in the Cowpea seeds (Degraeve *et al.*, 2016). Inappropriate harvesting, drying, and storage practices of cowpea contribute to the development of fungi, mainly the genus *Aspergillus* sp.

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Numerous plant and agricultural produce illnesses occur due to several factors, ranging from harvest to processing transformation, and are mostly caused by *Aspergillus* sp. The presence of *Aspergillus* sp. also conforms to those isolated by (Okayo *et al*., 2020; and Ono *et al*., 2021), with ability to produce aflatoxins and ochratoxin A (OTA), two toxins that could be the cause of liver cancer (Imane and Muhammad, 2012). *A. flavus* is an important mycotoxin-producing fungus, and its presence in cowpea varieties is a major concern for public health (Wang *et al*., 2018). The ability of these fungi to adapt to a wide temperature range may also be the reason for the prevalence of *A. flavus* in both Mashi and Mai'aduwa Markets, even though *Aspergillus* sp. has a wide geographical distribution, but is more frequently found in areas with warm temperature, majority of *Aspergillus* species prefer temperatures between 25˚C and 40˚C for optimum growth (Perrone *et al*., 2017). For this reason, they grow very well in the so-called "dry" food products like cowpea. The higher dominance of *Aspergillus* species may also be associated with their wide range of growth requirement and ability to grow on poor nutrient medium, it was earlier been reported by Khare *et al*. (2016) who affirmed the presence of these seedborne fungi in cowpea seeds from Botswana. These were further substantiated in different studies of other researchers who found similar mycoflora associated with cowpea seeds (Rodrigues and Menezes 2005; Houssou *et al*., 2009). Thus, precautions must be taken during post-harvest activities and storage to avoid contamination of cowpea crops by these ubiquitous organisms.

The presence of *Rhizoctonia* sp. and *Curvularia* sp. conform with the findings of Jaradi *et al*. (2018) who reported *Rhizoctonia solani* and *Curvularia* sp. on seeds of *Vigna unguiculata* in Ibadan, High percentage abundance of *Rhizoctonia* sp. (21.05%) found are similar to those isolated in several studies, indeed, Jyoshna and Neeti, (2021) have found the genus *Rhizoctonia* on cowpea seeds produced in India. Thies *et al*. (2019) reported that *R. solani* was one of the most important pathogens of cowpea in the USA, causing roots rot, especially in cold weather. The occurrence of these fungi on cowpea seeds can affect agricultural production as well as the health of consumers.

In order to reduce seed infestation and mitigate the impact of fungi on cowpea production, it is necessary to improve appropriate harvesting and storage practices. The study found *Fusarium* sp. having third highest dominance with percentage abundance of (15.79%) to be associated with the stored cowpea seeds; this is in line with the findings of Taylor *et al*. (2016) who identified *Fusarium* sp. together with some other fungal species on cowpea seeds in Sierra Leone. Awurum *et al*. (2014) also identified *Fusarium* species in their studies on seed-borne mycoflora of stored cowpea in Nigeria.

The infection rate of seeds by *Fusarium* sp. could be explained by late harvesting of the cowpea. Because *Fusarium* is a field fungus, and the long stay of cowpea pods in the field and their contact to the soil favors their contamination by this fungus. Khare *et al*. (2016) also isolated *Fusarium* species from cowpea seeds grown in Botswana with 5% infection rates. Shahnaz *et al*. (2015) obtained 3.5% infection rate of *F. oxysporium* on cowpea samples grown in Pakistan.

In addition, *Fusarium* species have been found on seeds of other legumes such as Bambara groundnut in Burkina Faso (Ouili *et al*., 2022), and in millet seeds in Tunisia (Bouajila *et al*., 2020). *Fusarium* species are cosmopolitan and are found in all regions of the world, their ideal growth temperature is between 22˚C and 37˚C (Pfohl-Leszkowicsz *et al*., 1999). *Fusarium* species are the causal agent of head blight in cowpea and is one of the major diseases threatening cowpea production worldwide (Omoigui *et al*., 2018). Several species of this fungus are saprophytic but can be parasites or plant pathogens by infecting fruits, vegetables, grains, and seeds. These include *F. oxysporium*, *F. solani*, *F. proliferatum* etc. (Aoki *et al*., 2014; Askun, 2018). Some species such as *F. graminearum*, *F. culmorum*, *F. equiseti* can produce several types of toxins of which the best known are zearalenone, fumonisin, moniliformin and trichotchenes (Holban and Grumezescu, 2017; Askun, 2018). *Fusarium* mycotoxins have a toxic effect in humans and animals and can cause birth defects, abortions and even cancers (Askun, 2018). The study also found *Penicillium* sp. to be associated with the cowpea seeds, its presence could be due to inadequate storage techniques.

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According to Kpatinvoh *et al*. (2017) this fungus proliferates mainly during storage. *Penicillium* spicie was also isolated from the stored cowpea seeds produced in, Benin, India, and Nigeria, in studies by (Khare *et al*., 2016; (Kpatinvoh *et al.,* 2017; Afolabi *et al*., 2019) respectively. Jyoshna and Neeti, (2021) also isolate *Penicillium* species from cowpea seeds in Botswana. Several toxins are produced by a variety of *Penicillium* species during food transport and storage operations. These include cyclopiazonic acid (*P. chrysogenum*), penicillic acid (*P. cyclopium*), patulin or clavacin (*P. expansum*, *P. griseofulvum*), citrinin (*P. expansum*), ochratoxin A (*P. verrucosum*) (Kpatinvoh *et al*., 2017).

Rhizopus Species were also found to be associated with the stored cowpea seeds; this conforms to the findings of Shahnaz *et al*. (2015) who also isolate species of *Rhizopus* and *Macrophomina* from cowpea seeds produced in Pakistan with infection rates of 30.8% and 1% respectively. *Rhizopus* sp., have also been reported to be associated with cowpea seeds in Botswana by (Khare *et al*., 2016). *Rhizopu*s sp. are highly present in the soil, and contact of the pods with their spores during harvesting, could explain their presence in the analyzed cowpea seeds samples, (Khare *et al*., 2016). In addition, there is a lack of good dehulling, drying, and seed storage practices by the farmers of Mashi and Ma'aduwa LGAs, *Rhizopus* sp. are classified in the order Mucorales. They rapidly colonize decaying plants and fruits where they develop as filaments.

The study also revealed the presence *Colletotrichum* sp. which conform to the findings of Shahnaz *et al*. (2015) in Pakistan. Iyanyi and ataga, (2014) also isolate *Colletotrichum* species, with lower percentage abundance compared to other fungi they have isolated. Afolabi *et al*. (2020) have also reported fungi belonging to *Colletotrichum* sp., *Aspergillus* sp., *Penicillium* sp., and *Fusarium* on different cowpea varieties sold in Nigerian markets. The presence of *Mucur* sp. *also* conform to the findings of Adebayo *et al*. (2020) who reported *Mucor* sp., *Rhizopus* sp., *A. flavus, A. niger,* and *Colletotrichum* sp. in the Cowpea seeds.

Mucor species are also known to cause seed rot in cowpea, which can lead to significant losses in crop yield (Garg *et al.,* 2019).

Therefore, proper storage of Cowpea varieties is essential to prevent contamination with these species.
The results obtained from the study is similar to that of Makun, (2012) who showed the presence of fungi and their percentage occurrences as *Aspergillus sp.* (19.78%), *Fusarium* sp. (14.85%), *Mucor* spp. (5.95%), *Penicillium* spp. (4.95%) and *Rhizopus* spp. (0.99%) in cowpea seeds in Nigeria. Gyasi, (2022) also isolated seven (7) fungal species, namely, *Aspergillus flavus, Aspergillus niger, Aspergillus tamari, Penicillium* sp., *Rhizopus* sp. *Fusarium* sp. and *Colletotrichum* sp. from cowpea seeds in Ghana.

This research provides valuable insights into the fungal diversity of the local cowpea varieties in Mashi and Mai'aduwa markets of Katsina state, the distribution of fungal isolates observed in this study can generally be linked to poor post-harvest handling practice and environmental factors amongst others, as suggested in another study by (Salari, *et al.,* 2012). The presence of different genera of fungi indicates the potential for disease and yield losses in the region. Therefore, it is important to take preventive measures such as crop rotation, proper management of crop residues, and use of resistant varieties to minimize the risk of these diseases in the field. Furthermore, proper storage of cowpea varieties can reduce the risk of fungal infection and maintain the quality of the Cowpea seeds.

In conclusion, this study on the selected Cowpea landraces in Mashi and Mai'aduwa markets of Katsina state, isolated 8 fungal species, that were identified as *Aspergillus flavus, Fusarium,* sp. *Penicillium* sp., *Rhizoctonia* sp., *Colletotrichum* sp., *Curvularia* sp., *Rhizopus* sp. and *Mucor* sp. The percentage abundance of each species was determined as follows, *Aspergillus flavus* (31.59%), *Rhizoctonia* sp. (21.05%), *Fusarium* (15.79%), *Penicillium* sp., (10.53%), *Colletotrichum* sp. (5.26%), *Curvularia* sp. (5.26%), *Rhizopus* sp. (5.26%) and *Mucor* sp. (5.26%).

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