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Fungal Diversity on Indian currency: A Case study

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Abstract

The ability of paper money to become contaminated was discovered through an analysis of fungal contamination on the currency notes. The ten, twenty, fifty and hundred rupee notes were collected in and around of Calicut Medical College campus from various sources such as Bus conductor, chicken shops, fruit shop, vegetable market, medical shop, beggers etc. Potato dextrose agar medium was used to culture the currencies for fungal isolation, and PDA plates were left to incubate for 48 hours at room temperature. The studies were conducted by direct macroscopic and microscopic examination in the laboratory. A total of five fungal species were isolated. All the species of fungi isolated belonged to the sub division Pezizomycotina of division Ascomycota. The fungi belonged to three families Aspergillaceae, Nectriaceae, Pleosporaceae, three genus *Aspergillus, Curvularia* and *Fusarium* one upto species level *Aspergillus niger*. Among the identified and isolated fungi *Aspergillus* is the more frequently present. Our research suggests that handling currency should be done so in a hygienic manner. We also strongly suggested using the digital payments system and credit or debit cards.

1. Introduction

The economic world were ruled by the exchange of currency, which is used as a measure of value. Majority of developing countries, hand touch exchange of currency fulfill the daily economic needs of a common man, because it is used as a medium for exchange of goods and services, settlement of debts, for deferred payments in economic activities (Sharma & Sumbali, 2014).

The endless circulation of currency among the different social classes of people may get contaminated by different pathogens. An individual living in unhygienic conditions and having unhygienic habits will contaminate the notes like keeping currency notes in socks, shoes and pockets, under the carpet or rugs and squeezing them in the hand frequently introduces an array of microbes to the notes (Sharma &Sumbali, 2014). Paper currency can also be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and by their placement on dirty surfaces. Contamination from the anal region, wounds and nasal secretions are also potential sources of transfer of micro organisms to currency notes during handling (Igumbor *et al*., 2007). The pathogenic microorganisms are including bacteria, fungi, protist, virus etc. Among the potential pathogens, fungi plays a major role in

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spreading diseases. The pathogenicity of fungal species were varying and it is much effected in immune compromised patients.

Several studies have been concluded trough the world to get a knowledge on the diversity of fungi that are usually present on these fungi are extremely important for understanding how human fungal pathogens get disseminated. Studies on fungal diversity on currency notes have been carried out from Algeria, Brazil, Ethiopia, Iran, Nigeria, Pakistan, Poland, Saudi Arabia, South Africa, USA etc and studies on bacterial, fungal and parasitic contamination has been carried out in India by Basavarajappa*et al*., (2005); Abirami*et al*., (2012); Sharma and Sumbali (2014); Singh *et al*., (2015); Subashini*et al*., (2016).

We have not come across any similar studies from Kerala. This study's goal was to ascertain the variety of fungi on notes that were being circulated in the Kozhikode district's medical college area.

2. Methodology

2.1. Sample collection

A total of 10 Samples of currency notes of the denominations of ten, twenty, fifty and hundred were collected from Bus conductor, chicken shops, fruit shop, vegetable market, medical shop, beggers located in and around in Kozhikode district'smedical college area during the period of November 2019 to January 2020. The collected samples were put in polythene bags and brought to the laboratory and stored in refrigerator for further studies.

2.2. Isolation of fungal species

The collected currency notes and five rupee coins were directly placed on Potato dextrose agar medium- Potatoes 200g, Oxoid Agar-20g, Dextrose – 15g Tap water-1l- in a Petridish, and PDA plates were incubated at room temperature for 48 hrs.

2.3. Identification of fungi

The isolated fungal species were identified by cultural characters and study of morphological features by lactophenol cotton blue staining. The isolated fungal colonies were aseptically transferred onto clean glass slides and one drop of Lacto phenol cotton blue was added to above the fungal colonies. A cover slip was placed above the fungal colony, and was observed using the high power objective of a compound microscope.

3. Results and discussion

During this study the results indicated that 100% of the currency notes were contaminated with fungi. The following fungi were identified based on their morphological characters:

Aspergillus niger

Division:-Ascomycota

Sub division:-Pezizomycotina

Class:-Eurotiomycetes

Order:-Eurotiales

Family:-Aspergillaceae

Colonies effuse, blackish brown to black. Mycelium superficial, hyphae colour less, 3-4µ thick. Conidiophores

erect, colourless. 16µ thick. Swollen at the apex into spherical vesicle, surface of the vesicle covered by elongate metulae. Phialides on the apex of the branches, each branch giving rise to 2 or three phialides. Conidia globos to sub globose, brown, 3-10µ long, 2.5 – 7.5 µ thick.

***Aspergillus* sp. 2**

Division:-Ascomycota

Sub division:-Pezizomycotina

Class:-Eurotiomycetes

Order:-Eurotiales

Family:-Aspergillaceae

Colonies dense, yellow. Mycelium partly superficial, hypae colourless to pale yellow, upto 2µ thick. Conidiophores erect, colourless, swollen to vesicle having narrow end, 15µ thick, flask shaped phialides on the surface of vesicle 7.5µ long, 2µ wide. Conidia globose, pale yellow, smooth walled, 2-3µ long, 1.5-4µ wide.

Aspergillus* sp. *3

Division:-Ascomycota

Sub division:-Pezizomycotina

Class:-Eurotiomycetes

Order:-Eurotiales

Family:-Aspergillaceae

Colonies effuse, greenish. Mycelium partly immersed, partly superficial, hyphae colourless,2.5-4µ thick. Conidiophores erect, upto 10µm thick, colourless, swollen at the apex into a spherical vesicle having 30-35µ diameter. Phialides in groups at the surface of vesicle, flask shaped, 10-12.5µ l0ng, 6µ wide, narrow at the tip. Conidia borne on tip of phialides, hyaline, globose to sub globose, smooth walled, 3.06-7.5µ long and 3 x 7 µ thick.

***Curvularia* sp.**

Division:-Ascomycota

Sub division:-Pezizomycotina

Class:-Dothideomycetes

Order:-Pleosporales

Family:-Pleosporaceae

Colonies effuse, dark brown, conidiophores pale to mid brown, flexose, septate, 5-6 µ thick, septa usually 3-5 in number. Conidia borne in cluster at the ends of the conidiophores, conidia curved, 2-4 septate, the broader cells mid brown, end cells polar, smooth, thick walled upto3.7µ, 16-30 µlong and 8-11µ thick at the broadest part.

***Fusarium* sp.**

Division:-Ascomycota

Sub division:-Pezizomycotina

Class:-Sordariomycetes

Order:- Hypocreales

Family:-Nectriaceae

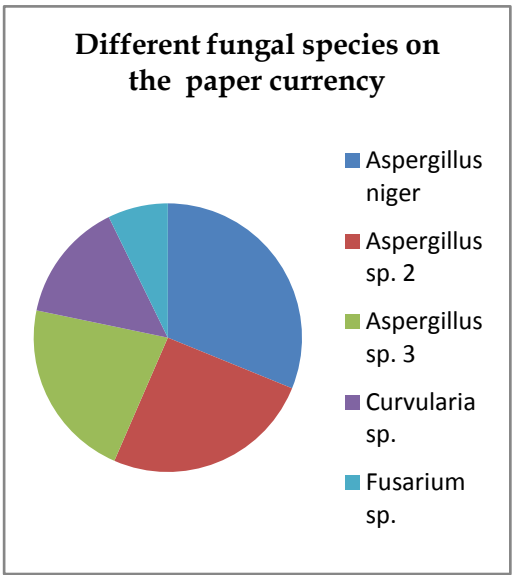
Colonies effuse, white, mycelium mostly immersed. Conidiophore branched, hyaline, septate, thin walled, 2.44µ thick and becoming narrower towards tip. Conidia born on the tip of conidiophores. Macroconidia fusiform with roundish ends with one end having a slight projection, 1-3 septate, hyaline. Microconidia small, hyaline, 5-7 µ tall and 2.5-3.8µ thick.

Results showed that themajority of paper money was tainted with a range of fungi, some of which were harmful. With the available taxonomic character, description and available identification guides and literature we were able to identify one taxon

upto species level, the rest were identify upto genus level only. The studies were conducted by direct macroscopic and microscopic examination in the laboratory. A total of five fungal species were isolated. All the species of fungi isolated belonged to the sub division Pezizomycotina of division Ascomycota. The fungi belonged tothree families Aspergillaceae, Nectriaceae, Pleosporaceae, three genus Aspergillus,Curvularia and Fusarium, one upto species level *Aspergillusniger*. Among the identified and isolated fungi Aspergillus is the more frequently present(figure**1**), similar results were also obtained from different studies conducted in Indian currency. Wanule et al., (2011) concluded that heavy contamination of currency notes with *Aspergillus* and lower frequency in the isolation of Penicillium sp., Cladosporium sp., Rhizopus sp., Alternaria sp., Curvularia sp., Fusarium sp. and Trichoderma sp. Abirami et al., (2012) also reported that Aspergillus species were the predominant among other fungal species over the Indian currency collected from ten important public places.

The presence of Aspergilli spp. Can cause Invasive aspergillosis is a common infection in patients who are immunocompromised Andriole, V. T. (1993). Hence Paper currency may be a means of dispersing potentially dangerous microorganisms across the environment.

Fig. 1 Different fungal species on the paper currency



4.Conclusion

The results of this investigation make it abundantly evident that the paper money notes that are in circulation in Kozhikkode District's Medical college area have the potential to be a significant source of fungal contamination, which is detrimental to human health.

We strongly advise the use of credit or debit cards and the digital payments system. This can be addressed by taking the necessary actions to lower the people's risk of contamination. Raising people's awareness of hygiene and good practices reduces the possibility of contamination in paper money that is in circulation.

The present study was carried out in a limited time period with limited samples and resources, a more thorough comprehensive study is required to better understand the spread of many human diseases(Major and minor) in our society.

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