Medical Implications Of The Fungi Flora Of Naira - “A Nigerian Currency”

J Ajobiewe, S Olorunmaiye, K Akinmusire, H Ajobiewe, A Dangana

Abstract

Study Background
Despite the impregnation of paper currency notes with disinfectant to inhibit microorganisms, pathogens had long been isolated from currency notes. The microorganisms implicated included members of the family Enterobacteriaceae, Mycobacterium tuberculosis, Vibrio cholera, e.t.c. Simultaneous handling of food and money contributes to the incidence of food-related public health incidents. This work focuses on the fungi flora load of Nigerian currency and the associated medical hazard. Study Design/ Methods: A completely randomized sample collection design was adopted. A total of 160 dirty and tattered notes, and 40 minted denominations were randomly collected from various groups using the currency in Maiduguri Metropolis and Federal Capital Territory Abuja. Culture was by the pour plate method. Other routine fungi isolation techniques were adopted. RESULT: The fungi flora of the various denominations of Nigerian currency Notes does not differ significantly- As the fungi loads of the various Aspergillus species, and Blastomyces dermatitidis isolated from the various currency denominations had statistical calculated F value less than table value using the one-way ANOVA technique. CONCLUSION: All currency notes in use may be potential sources of disseminating hazardous fungi pathogens no matter the type, - dirty, tattered, nor minted naira notes

INTRODUCTION

Money is defined as anything that is widely used for making payments and accounting for debts and credits. The possibility that currency notes might act as environmental vehicles for the transmission of potential pathogenic microorganisms was first suggested by Abram’s and Waterman (1972). Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce, ranging from buying milk at a local store to trafficking in sex and drugs.

The official currency in Nigeria is the naira notes. Its denomination ranges from N5, N10, N20, N50, N100, N200, N500 and N1000 notes. Mishandling of naira notes by people usually lead to its contamination. The contamination of naira notes and its public health implications have not been well documented especially those of fungi contaminants because little or no research has been done on this area. Contamination may be introduced to the naira notes during production, from the atmosphere or from various uses and abuses of the naira notes - likewise during storage.

STUDY DESIGN/METHODS

A completely randomized sample collection design. A total of 160 dirty, tattered, and 40 minted naira notes of each denomination were collected from students, food sellers, market traders and banks around Maiduguri Metropolis and Federal Capital Territory Abuja. Samples were collected inside sterile polythene bags with hand gloves. Each of the naira notes was rinsed in a sterile container containing 20ml of distilled water. After 5 – folds of serial dilution, 1ml of the resulting liquid was transferred into Petri dish by pipette and Saboraud dextrose (Oxoid) agar was poured on it. The plate was gently swirled to allow proper mixing and then incubated at room temperature for 3 -21days. After 3days of incubation, fungi growth of different colonies was observed on the plates. Different colonies from the mixed cultures of the fungal isolates were then sub cultured into another Saboraud Dextrose (Oxoid) Agar to obtain a pure colony of the fungal isolates. Identification of Fungi: Presumptive identification of the fungal isolates was based on macroscopic and microscopic examination of the cultures. Macroscopic Examination: Macroscopic growth pattern of the fungi and their colour on the plates were observed. Microscopy Preparation of slides: A drop of lacto phenol –
cotton blue (Oxoid) was placed at the centre of a clean dry slide and fungal isolate colonies picked with transparent and sterile cello tape, used in securely covering it. The slide was observed under the microscope with x10 objective and x40 objective lenses.

**HYPOTHESIS**

Ho; The fungi flora of the various denominations of Nigerian currency Notes does not differ significantly.

Ha; The fungi flora of the various denominations of Nigerian currency Notes differ significantly.

**RESULTS**

Macroscopic examination revealed colonial appearance of fungi grown from 5 naira denomination as whitish and brown colonies on Saboraud dextrose agar at 25°C; those from 10 naira denomination as smoky gray-green with slightly yellow colonies on Saboraud dextrose agar at 25°C; those cultured from 20 naira denomination as black brown and pale yellow colonies on Saboraud dextrose agar at 25°C; those from 50 naira denomination as smoky gray-green with slightly yellow colonies on Saboraud dextrose agar at 25°C; those from 100 naira denomination as whitish and brown colonies on Saboraud dextrose agar at 25°C; those from 200 naira denomination as black brown and pale yellow colonies on Saboraud dextrose agar at 25°C; those from 500 naira denomination as smoky gray-green with slightly yellow colonies on Saboraud dextrose agar at 25°C; while colonial appearance from those cultured from 1000 naira denomination has black brown and pale yellow colonies on Saboraud dextrose agar at 25°C, irrespective of the appearance nor the length of time these notes had been in circulation. See Table 1 for reference.

Microscopic examination showed that the Conidiophores from 5 naira denomination and 100 naira denomination were short and Blastomyces dermatitidis was hence identified with these morphological features; Conidiophores of 10, 50, 500 naira denomination were smooth-walled, long, and terminate in a dome-shaped vesicle, thus Aspergillus fumigatus was identified with these features; Conidiophores of 20, 200, 1000 naira denomination were long and smooth. Conidia were brown to black and rough; hence, Aspergillus niger was also identified.

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**Table 1:** Macrophscopic Observation from Subcultured Colonies After a Very High Serial Dilution

<table>
<thead>
<tr>
<th>S/No</th>
<th>Sample</th>
<th>Description of colonies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>Colonies on Saboraud dextrose agar at 25°C appeared whitish on the surface and brownish on the reverse.</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Colonies on Saboraud dextrose agar at 25°C were smoky gray-green with a slight yellow reverse.</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>Colonies on Saboraud dextrose agar at 25°C were bluish brown on the surface and pale yellow on the reverse.</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>Colonies on Saboraud dextrose agar at 25°C were smoky gray-green with a slight yellow reverse.</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>Colonies on Saboraud dextrose agar at 25°C appeared whitish on the surface and brownish on the reverse.</td>
</tr>
<tr>
<td>6</td>
<td>200</td>
<td>Colonies on Saboraud dextrose agar at 25°C are blackish brown on the surface and pale yellow on the reverse.</td>
</tr>
<tr>
<td>7</td>
<td>500</td>
<td>Colonies on Saboraud dextrose agar at 25°C were smoky gray-green with a slight yellow reverse.</td>
</tr>
<tr>
<td>8</td>
<td>1000</td>
<td>Colonies on Saboraud dextrose agar at 25°C were bluish brown on the surface and pale yellow on the reverse.</td>
</tr>
</tbody>
</table>
Table 2: MICROSCOPIC OBSERVATION FROM PURE CULTURE

<table>
<thead>
<tr>
<th>No</th>
<th>Samples</th>
<th>Description</th>
<th>Identified organism</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>Conidiophores were short</td>
<td>Blastomyces dermatitidis</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>Conidiophores were smooth-walled, long, and terminate in a dome-shaped vesicle.</td>
<td>Aspergillus niger</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>Conidiophores were long and smooth; Conidia were brown to black, very rough.</td>
<td>Aspergillus niger</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>Conidiophores were smooth-walled, long, and terminate in a dome-shaped vesicle.</td>
<td>Aspergillus niger</td>
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<td>5</td>
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<td>Conidiophores were smooth-walled, long, and terminate in a dome-shaped vesicle.</td>
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</tr>
<tr>
<td>8</td>
<td>1000</td>
<td>Conidiophores were long and smooth; Conidia are brown to black, very rough.</td>
<td>Aspergillus niger</td>
</tr>
</tbody>
</table>

Table 3: NUMBER OF NOTES POSITIVE TO FUNGI CONTAMINATION

<table>
<thead>
<tr>
<th>DENOMINATION</th>
<th>Aspergillus niger</th>
<th>Blastomyces dermatitidis</th>
<th>Aspergillus fumigatus</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>200</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1000</td>
<td>30</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5000</td>
<td>60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10000</td>
<td>80</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td>180</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>MEAN</td>
<td>18</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>STANDARD DEVIATION</td>
<td>3.8</td>
<td>2.0</td>
<td>1.7</td>
</tr>
</tbody>
</table>

RESULT FROM SUBCUTURED COLONIES AFTER A HIGH SERIAL DILUTION

5 naira denomination had 5 colonies of Aspergillus niger, 15 colonies of Blastomyces dermatitidis, 5 colonies of Aspergillus fumigatus. 10 naira denomination had 10 colonies Aspergillus niger, 5 colonies of Blastomyces dermatitidis, 10 colonies of Aspergillus fumigatus. 20 naira denomination has 20 colonies Aspergillus niger, 5 colonies of Aspergillus fumigatus. 50 naira denomination had 25 colonies of Aspergillus fumigatus. 100 naira denomination had 25 colonies of Blastomyces dermatitidis. 200 naira denomination had 20 colonies Aspergillus niger, 5 colonies of Aspergillus fumigatus. 500 naira denomination had 10 colonies Aspergillus niger, 15 colonies of Aspergillus fumigatus. 1000 naira denomination had 20 colonies Aspergillus niger, 5 colonies of Aspergillus fumigatus.
Figure 6
Figure 2: Aspergillus fumigatus pure culture

Figure 8
Figure 4: Blastomyces dermatitidis pure culture

Figure 7
Figure 3: Micrograph of Blastomyces dermatitidis (x1000)

Figure 9
Figure 5; Micrograph of Aspergillus niger (x1000)
Figure 10
Figure 6: Aspergillus niger pure culture

TABLE 4: ONE-WAY ANOVA TABLE OF MEAN COLONIES OF THE DIFFERENT SPECIES OF FUNGI ISOLATED

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>DF</th>
<th>Sum of Square</th>
<th>Mean sum of Square</th>
<th>F Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between the naira</td>
<td>2</td>
<td>102.03</td>
<td>51.02</td>
<td>0.68</td>
</tr>
<tr>
<td>Error</td>
<td>21</td>
<td>1581.33</td>
<td>75.30</td>
<td></td>
</tr>
</tbody>
</table>

The tabulated F value was 3.47 on the statistics table, whereas the calculated value was 0.68, hence there was no significant difference in the fungi flora of the different Naira Note denominations.

HYPOTHESIS: We therefore accept the null hypothesis i.e. The fungi flora of the various denominations of Nigerian currency Notes does not differ significantly.

DISCUSSION
The F statistics showed that the calculated value was far less than the tabulated value; we thus accepted the null hypothesis i.e. “The fungi flora of the various denominations of Nigerian currency notes does not differ significantly”. This simply implied that the fungi flora was quite independent of the denominations of the Nigerian currency notes. The study thus shows that Nigerian currency notes are indiscriminately contaminated with a variety of fungi species some of which are pathogens. This finding confirms the report that currency notes are contaminated with microorganisms such as fungi. Some authors had similarly reported such findings. In fact, currency notes serve as vehicles for transmitting infectious diseases to humans. This current research identified the following medically important fungi: Blastomyces dermatitidis, Aspergillus niger, Aspergillus fumigatus. Blastomyces dermatitidis is a thermally dimorphic fungus and a probable saprobe of the soil. It specifically inhabits decaying wood material. It is very rarely isolated as a natural habitat. Isolation from the environment is most likely when the sample contains soil and is rich in organic material such as animal faeces, plant fragments, insect remains, and dust. If the substrate is moist, lacks exposure to direct sunlight, contains organic debris, and has a pH of less than 6.0, isolation of Blastomyces dermatitidis is probable. It is the causative agent of blastomycosis, which is one of the true systemic (endemic) mycoses. Cutaneous and systemic (disseminated) blastomycosis are the two clinical forms of the disease. Blastomycosis in general is acquired by inhalation and initially presents with a pulmonary infection, which may later disseminate to other organs and systems. Primary cutaneous infection due to direct inoculation of the fungus into the skin is also likely. Haematogenous spread of the organism results in infection of skin, bones, kidneys, and male urinogenital system. Blastomycosis of the central nervous system (CNS), eyes, larynx, par nasal sinuses, tongue, adrenal glands, uterus, ovaries, gastrointestinal tract, liver, and spleen have so far been reported. Otitis media, resulting in cranial osteomyelitis may also develop. Reactivation blastomycosis and subclinical, self-limited infections have been defined.

Although Blastomyces dermatitidis is a pathogenic fungus and blastomycosis occurs mainly in immunocompetent hosts. It may also affect immunocompromised patients, indicating that Blastomyces dermatitidis has now emerged as an opportunistic pathogen. Aspergillus niger is ubiquitous in nature. The surface colonies are initially white, quickly becoming black with conidial production. Reverse is pale yellow and growth may produce radial fissures in the agar. The organism is a common secondary invader following bacterial otitis. It may also cause pulmonary disease in immunocompromised patients and the production of oxalate crystals in clinical specimens. A niger is less likely to cause human disease than some other Aspergillus species, large amount of spore inhaled, a serious lung disease Aspergillosis can occur. Aspergillus fumigatus is a saprophytic fungus that
plays an essential role in recycling environmental carbon and nitrogen. Its natural ecological niche is the soil, wherein it survives and grows on organic debris. Although this species is not the most prevalent fungus in the world, it is one of the most ubiquitous of those with airborne conidia. Inhalation of conidia by immunocompetent individuals rarely has any adverse effect, since the conidia are eliminated relatively efficiently by innate immune mechanisms. Thus, until recent years, A fumigatus was viewed as a weak pathogen responsible for allergic forms of the disease, such as farmer’s lung, a clinical condition observed among individuals exposed repeatedly to conidia, or aspergilloma, an overgrowth of the fungus on the surface of pre-existing cavities in the lungs of patients treated successfully for tuberculosis. Because of the increase in the number of immunosuppressed patients, however, and the degree of severity of modern immunosuppressive therapies, the situation has changed dramatically in recent years. For most patients, the main portal of entry and site of infection for A fumigatus is the respiratory tract. Although other sites of infections have been described in the normal or immunocompromised host, such as the skin, peritoneum, kidneys, bones, eyes, and gastrointestinal tract, non-respiratory infections are infrequent and are not discussed here. Pulmonary diseases caused by a fumigatus can be classified according to the site of the disease within the respiratory tract and the extent of mycelial colonization or invasion, both of which are influenced by the immunological status of the host. Although, paper money is impregnated with disinfectant to inhibit microorganisms, pathogens had been isolated from currency notes. The microorganisms implicated included members of the family Enterobacteriaceae, Mycobacterium tuberculosis, Vibrio cholera, Bacillus spp, Staphylococcus spp, Micrococcus spp, Corynebacteria spp, Mucor and Aspergillus spp. In most parts of the developed world, there is a popular belief that the simultaneous handling of food and money contributes to the incidence of food-related public health incidents. Over the last two decades, data indicating that simultaneous handling could indeed be a cause of sporadic food-borne-illness cases; as accumulated from studies of the microbial status and survival of pathogens on coins and currency notes in Turkey; the United States; Australia; China; and Spain. We sincerely thank all the colleagues and friends in the department of Microbiology University of Maiduguri, Imo-state University Owerri, Abuja study centre, and Gwagwalada Teaching Hospital Abuja, F.C.T. Students of Regina Pacis college Abuja, ---for their contributions both at sample collection and for assistance in other highly specialized areas of the study, worthy of mention are Drs. Aloysius Ebedi, Dr. Falodun of the National Hospital Abuja, Dermatology Department, Jonathan Madukwe, Eze Glory Obiageli.

CONCLUSION
All currency notes in use may be potential sources of disseminating hazardous fungi pathogens no matter the type, - dirty, tattered, nor minted naira notes. Serious caution must be taken while they are in circulation as compulsory media for business transactions. --as a check towards the acquisition of mycological borne infectious diseases.

ACKNOWLEDGEMENT
We sincerely thank all the colleagues and friends in the department -dirty, tattered, nor minted naira notes. Serious caution must be taken while they are in circulation as compulsory media for business transactions. --as a check towards the acquisition of mycological borne infectious diseases.

References
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