

## Preliminary Investigation on the Microbial Contamination of Nigerian Currency

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**Abstract:** Naira, the legal tender of Nigeria has been ignored as a probable fomite despite the fact that it has been found to be a highly mobile inanimate article within the human community. Survey of the currency notes (Naira) in Nigeria for microbial contaminations revealed the capacity of the Naira to be a fomite. This study was on all the notes denominations obtained from different chosen occupational groups in Ibadan, Oyo State, Nigeria. The currencies were processed for microbial isolation using the Mac Conkey Agar, Blood agar and potato dextrose agar. The streaking technique was employed for the isolation and purification of the colonies. Ninety one bacterial isolates were recovered. Identification and characterization revealed active participation of the following species of organisms in the ascending order of percentage as *Pseudomonas* sp. 0.98%, *Bacillus* sp. 0.98%, *Citrobacter* sp. 7.8%, *Serratia* sp. 11.76%, *Klebsiella* sp. 13.72%, *Proteus* sp. 13.72%, *Staphylococcus* sp. 15.6% and *Enterobacter* sp. 24.5%. The fungal isolates were of the *Aspergillus* sp. (10.8%). The isolation of *Aspergillus* sp. may be the first report of fungal contamination of currency. These results suggest that paper currency is commonly contaminated with microbes and this contamination may play a role in the transmission of antibiotic resistant or potentially harmful organisms.

**Key words:** Preliminary, microbiol, investigation, contamination, currency

### INTRODUCTION

Fomites are inanimate objects capable of absorbing, harbouring and transmitting infectious microorganisms. Dust and dirt that commonly accumulate on such objects contain spores of infectious agents (Bailey and Scott, 1974). Currency, a fomite which can be contaminated by droplets during coughing, sneezing, touching with hands and placement on dirty surface are commonly handled by various categories of people during transaction. Thus, it becomes obvious that anything that gets on hands get on money. Paper currency is widely exchanged for goods and services in most countries worldwide. If some of these are contaminated, there is the potential to spread these organisms from person to person and across borders since money is not screened for microbes.

There had been fewer studies on the microbial contamination of currency worldwide (Abrams and Waterman, 1972; Pope *et al.*, 2002; El-Din El-Dars and Hassan, 2005). Various pathogens associated with tuberculosis, meningitis, pneumonia, tonsillitis, peptic ulcers, genital tract infections, gastroenteritis, throat infections and lung abscesses had been identified in damaged or soiled notes held together with bits of sticky tapes. A similar study in Egypt reported that 65% of the bills had bacteria like *staphylococcus albus*, *staphylococcus aureus* and *klebsiella pneumoniae* (El-Din El-Dars and Hassan, 2005).

Dirty money is not only confined to developing nations. Separate studies from the United States reported contamination of coins and paper bills (Abrams and Waterman, 1972) and the identification of agents like *staphylococcus aureus*, *E. coli*, *klebsiella enterobacter* (Gadsby, 1998; Chyse, 1998). Another survey isolated a total of 93 different types of bacteria belonging to the species *staphylococcus*, *Streptococcus*, *Enterobacter*, *Acinetobacter*, *Pseudomonas*, *Bacillus*, *Alcaligenes*, *Diphtheroids*, *Klebsiella pneumoniae* and *E. vulniferis* (Pope *et al.*, 2002). However, there is a dearth of information on the probable microbes associated with the Nigerian currency.

Despite the fact that no level of contamination can be regarded safe, there is need to study the bacterial contaminants of currency in Nigeria. This study then focused on the probable bacteria and fungal contaminants of Nigerian currency.

### MATERIALS AND METHODS

**Sample collection:** Samples were obtained wearing sterile gloves on both hands from the different chosen occupational groups. Each currency was kept in separate sterile nylon and transferred to the laboratory for analysis.

**Culturing, isolation, identification and characterization:** Currencies of all the available denominations were

processed for microbial isolation using the Mac conkey agar, blood agar and potato dextrose agar. The conventional methods of swabbing and streaking were used (Abrams and Waterman, 1972). Pure colonies of isolate organisms were identified and characterized using standard microbiologic technique (Chessbrough, 1984).

**Fungal isolates:** Presumptive identification of the fungal isolates was on the basis of macroscopic and microscopic examination of the cultures (Raper and Fennel, 1965).

**Currency:** Seventy samples of all the available denominations in Nigeria were obtained from artisans and non-artisans in Ibadan. While newly minted ones were obtained from a commercial bank were used as control. The currencies were observed to have been in circulation for about four to six years. The samples were graded using appearance and degree of dirtiness as new, moderate, old and tattered (Table 1).

Table 1: Grade of samples

Denomination	Total new	Total moderate	Total old	Total tattered	
N 500	2	8	-	-	10
N 200	2	6	2	-	10
N 100	1	3	6	-	10
N 50	1	1	7	1	10
N 20	-	1	8	1	10
N 10	1	1	5	3	10
N 5	4	1	4	1	10
Total sample	70	11	21	32	6

NB. Year of minting, New: 2003, Moderate: 2003, Old:2000, 2001 and Tattered: 1999, 2000

The bacterial isolated grew on both the Mac Conkey agar and the blood agar. Fungal growth was also observed on potato dextrose agar. The cultures yielded 102 isolates representing 89.22 and 10.78% bacterial and fungal isolates, respectively. The 89.22% bacterial isolates were identified and characterised using the standard microbiology techniques (Cheesbrough, 1984). Identification revealed the active participation of the following species in ascending order of percentage as *Bacillus* 0.98%, *Pseudomonas* 0.98%, *Citrobacter* 7.8%, *Serratia* 11.76%, *Proteus* 13.72%, *Klebsiella* 13.72%, *Staphylococcus* 15.6% and *Enterobacter* 24.5%. The fungal isolates were identified as *Aspergillus* species.

The results show that all the currency denominations had microbial contamination with N10 and N100 notes having the highest percentage of isolates. Table 2 showed the percentages of each organism recovered from each denomination. The highest level of contaminants (*Aspergillus*, *Enterobacter* and *Staphylococcus aureus*) was recovered from currencies obtained from the Artisans (meat seller, food vendors and market women) with the lowest found among the non-artisan group (the office workers) (Table 3).

## DISCUSSION

The study revealed that Nigerian currency (Naira notes) is commonly contaminated with microbes. This may be associated with the fact that paper money provided a large surface area as a breeding ground for

Table 2: Percentage occurrence of organism per denomination

Denomination	(%) <i>Aspergillus</i>	(%) <i>Bacillus</i>	(%) <i>Citrobacter</i>	(%) <i>Enterobacter</i>	(%) <i>Klebsiella</i>	(%) <i>Proteus</i>	(%) <i>Pseudomonas</i>	(%) <i>Serratia</i>	(%) <i>Staph aureus</i>	(%) <i>Staph epidermidis</i>
N 500	1.96	-	0.98	4.90	0.98	1.96	-	1.96	1.96	0.98
N 200	-	-	1.96	2.94	2.94	2.94	-	1.96	0.98	-
N 100	1.96	-	0.98	1.96	3.92	0.98	0.98	1.96	1.96	1.96
N 50	1.96	0.98	-	4.90	0.98	0.98	-	2.94	0.98	-
N 20	0.98	-	1.96	3.92	0.98	0.98	-	1.96	0.98	1.96
N 10	2.94	-	0.98	3.92	0.98	4.90	-	-	0.98	1.96
N 5	0.98	-	0.98	1.96	3.92	-	-	0.98	-	0.98

Table 3: Percentage total isolate from different occupational groups

Occupational groups	(%) <i>Aspergillus</i>	(%) <i>Bacillus</i>	(%) <i>Citrobacter</i>	(%) <i>Enterobacter</i>	(%) <i>Klebsiella</i>	(%) <i>Proteus</i>	(%) <i>Pseudomonas</i>	(%) <i>Serratia</i>	Stap. Aureus	(%) <i>Staph epidermidis</i>
Meat sellers	3.92	-	-	3.92	1.96	0.98	-	0.98	0.98	0.98
Fish sellers	0.98	-	0.98	3.92	1.96	1.96	-	0.98	-	0.98
Beggars	2.94	0.98	0.98	1.96	0.98	2.94	-	0.98	-	-
Mosque attendants	-	-	1.96	-	1.96	1.96	0.98	-	-	0.98
Bus conductors	-	-	0.98	1.96	-	-	-	3.92	0.98	1.96
Market women	1.96	-	-	-	-	-	-	-	4.90	0.98
Food vendors	-	-	0.98	5.88	2.94	1.96	-	1.96	-	-
Pharmacy store attendant	0.98	-	0.98	3.92	1.96	0.98	-	0.98	-	0.98
Students	-	-	0.98	0.98	1.96	2.94	-	0.98	0.98	-
Office workers	-	-	-	1.96	-	-	-	0.98	-	0.98

bacteria. Currencies therefore, may play a role in the transmission of potentially harmful organisms. This study reveals that the older the bills, the more microbes are present. This may not be unconnected with the usage and the length of time in which the money travels from hand to hand and a reflection of the state of hygiene.

The study revealed similar pattern of microbial contamination as those obtained from the previous studies (Pope *et al.*, 2002; El-Din El-Dars and Hassan, 2005). The bacterial isolates recovered were *Bacillus* sp. *Citrobacter* sp. *Enterobacter* sp. *Klebsiella* sp. *Proteus* sp. *Pseudomonas* sp. *Serratia* sp. and *Staphylococcus* sp. The isolation of *Aspergillus* sp. maybe the first report of fungal contamination of currency.

The presence of human pathogens on the samples is a cause for great concern because the notes may probably play a role in the transmission and spread of diseases. The N10 denomination was found to have the highest level of microbial contaminants. This accounts for the facts that these small denominations of naira are widely used and exchanged many times especially amidst the artisans and lower economic class.

Paper currencies recovered from the meat sellers and food vendors had the highest percentage of isolates. This showed conclusively that the meat sellers and food vendors generally do not give much attention to hygienic practices, which is a major concern especially in respect of the health status of the populace they provide for. The notes from office workers however, had less microbial load probably indicating that they are more likely to be conscious of safe personal hygiene as compared to the artisans.

The presence of *Staphylococcus* sp. on money could have been due to the rubbing off or may be surfing from a skin flake. Pathogenic Staphylococci harboured either by an asymptomatic carriers or a person with a disease, can be spread by the hands or expelled from the respiratory tract. Staphylococci has been associated with food poisoning and their presence on money notes from market women is highly significant. The coagulase positive strain of *Staphylococcus aureus* can cause severe chronic carbuncles, impetigo, scalded burn syndrome, wound infection, abscesses and several respiratory infections like laryngitis, pharyngitis, bronchitis and pneumonia in man (Prescott *et al.*, 2002) *Bacillus* sp. a vast group of hardy spore forming species that live in soil and are found in the environment could also be transferred on money due to its placement on dirty surfaces or handling with dirty hands. *Bacillus* produces an emetic exotoxin capable of inducing disease in man. (Silman *et al.*, 1987).

The majority of the isolates namely *Citrobacter* sp. *Enterobacter* sp. *Klebsiella* sp. *Proteus* sp. *Pseudomona*

sp. and *Serratia* sp. are enteric bacterial. The presence on the Nigerian currency is an indication of faecal contamination. This goes a long way to reveal the poor sanitary condition of the environment as well as poor personal hygiene practices observed by most of the artisans surveyed.

These organisms can cause diarrhoea and urinary tract infections besides skin burn and septicaemic infections. Pathogens from bank notes may infect the body through scratches on the hands, or when the hand touches the mouth, nose and through unhygienic practices.

The only fungal species identified was the *Aspergillus* sp. *Aspergillus* is present where organic debris abounds. This reflects the fact that money is handled carelessly and dropped on dirty surfaces. *Aspergillus* has been implicated in the pathogenesis of many diseases in the immunosuppressed individuals. The spores of *Aspergillus* can be inhaled leading to severe pulmonary aspergillosis.

## CONCLUSION

This study clearly showed that Nigerian currency had common pathogen of which staphylococcus aureus and klebsiella sp are more pathogenic. The others do not commonly cause disease in non-hospital host. However, in hospital or immunocompromised patients, these bacteria can cause clinically significant infection (Pope *et al.*, 2002). The economic implication of the presence of human pathogens on paper money is questionable as many immunosuppressed individuals due to HIV infection, malnutrition and drug abuse may become sick now or in future as a result of pathogens contracted from money.

The limitation of this study should be recognised. These 84 naira notes are only a small fraction of the billions of naira notes in circulation. A much larger study would be required in future. There is also a need to further investigate on the antibiogram and pathogenicity of the some the isolates obtained.

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