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Research Article

Antibiotics Susceptibility Profile of Microbes Associated with Naira Paper Currency in Circulation among Madonna University Students, Elele, Rivers State

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Abstract: Daily transactions have exposed naira notes to pathogenic microbes on their surfaces, leading to contamination and the harbouring of possible infectious disease to the users. Therefore, the aim of this study was to assess the antibiotic susceptibility profile of microbes associated with Naira paper currency in circulation among Madonna University students in Elele, Rivers State, Nigeria. A total of forty (40) samples of both old and redesigned naira paper notes were collected from male and female students. Microbial analysis was done using standard procedures. Isolates were identified and characterised using biochemical methods. The antibiotic susceptibility tests of the isolates were evaluated using the disc diffusion method. The total heterotrophic bacterial counts for 1000, 500, 200, and 100 naira for old and redesigned paper notes ranged from 1.5 x 103 CFU/ml to 4.7 x 103 CFU/ml. Total fungal counts for 1000, 500, 200 and 100 naira old and redesigned samples ranged from 1.0 x 103 CFU/ml-2.8 x 103 CFU/ml. The bacterial and fungal genera identified and frequency of occurrence was Bacillus (31.3%), Escherichia coli (20.8%), Staphylococcus (16.7%), Streptococcus (12.5%), Micrococcus (10.4%), and Salmonella (8.3%). Aspergillus (33.3%), Penicillium (22.2%), Fusarium (16.7%), Mucor (16.7%), and Rhizopus (11.1%), respectively. Staphylococcus and Streptococcus were susceptible to chloramphenicol (22.0mm) and were more resistant to levofloxacin, rifampicin, and norfloxacin. Gram negative bacteria were susceptible to gentatmycin and more resistant to ampillicin and septrin, respectively. This study was able to reveal that naira paper notes, both old and redesigned, harbour potential pathogenic microorganisms that may be detrimental to the public's health. The study also revealed that the lower denomination had the highest microbial load. Therefore, there should be adequate personal hygiene in handling paper notes among the users.

Keywords: *Naira currency contamination, Antibiotic susceptibility, Microbial load, Paper currency microbiology, Public health risk, Bacterial isolates, Fungal isolates, Antimicrobial resistance*

1. Introduction

Cash transactions remain an integral component of everyday economic activities, particularly in developing economies such as Central Bank of Nigeria, where physical currency continues to dominate informal and formal exchanges. The Nigerian Naira, issued in denominations ranging from ₦5 to ₦1000, circulates extensively across diverse socioeconomic settings. Lower denominations tend to experience more frequent handling among the general populace, whereas higher denominations are more commonly utilized by businesses and individuals engaged in high-value transactions (Ndubuisi et al., 2016; Mbaya et al., 2016).

The continuous and widespread handling of these notes inevitably facilitates the transfer of human microbiota, including potentially pathogenic microorganisms, onto currency surfaces. Such contamination presents a significant public health concern, as it may contribute to the transmission of infectious agents associated with conditions such as

respiratory and gastrointestinal disorders (Girma, 2014). Naira notes are exposed to a broad spectrum of contaminants originating from environmental sources such as soil, air, and water as well as direct human contact through skin, saliva, and open wounds.

In addition, prevailing storage and handling practices further exacerbate contamination risks. Currency is often kept in unhygienic locations, including wallets, brassieres, socks, and other personal spaces, thereby creating favorable conditions for microbial persistence and proliferation (Sani et al., 2016). Empirical studies have identified a diverse array of microorganisms on Naira notes, including *Citrobacter* spp., *Salmonella* spp., *Shigella* spp., *Escherichia coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, among others (Prasai et al., 2008). The fibrous composition of paper currency enhances microbial adherence, while prolonged circulation increases cumulative contamination levels.

Moreover, the microenvironment in which these notes are stored often dark, moist, and enclosed in materials such as polythene, cotton, or leather further supports microbial survival and growth. Contamination is therefore a multifactorial phenomenon, driven by atmospheric exposure, unsanitary handling, and inadequate storage practices (Sucilathangam et al., 2016). Cultural practices, including the indiscriminate spraying and handling of money during social ceremonies, also contribute significantly to microbial transmission (Ogo et al., 2004).

Although some of the microorganisms isolated from currency are part of the normal human skin flora, others function as opportunistic pathogens capable of causing disease under favorable conditions. The persistent detection of such organisms on circulating currency underscores the urgent need for systematic investigation into the hygienic status of paper money. This concern is particularly pronounced in developing countries, where research remains limited and public health policies addressing currency hygiene are often inadequate (Chauwa et al., 2020; Agersew, 2014). Nonetheless, similar findings have been reported in developed nations, indicating that currency contamination is a global public health issue (Ahmed et al., 2010).

From a historical perspective, the transition from barter systems to modern monetary economies has significantly increased the frequency and scale of human contact with exchange media. While this evolution has enhanced economic efficiency, it has concurrently introduced new pathways for the transmission of infectious agents (Wamae, 2009; Ogbonna et al., 2012). Consequently, there is a compelling need for heightened awareness, improved hygiene practices, and robust research efforts to mitigate the potential health risks associated with contaminated currency.

2. Materials and Methods

2.1 Study Area

This study was conducted within the Madonna University Community in Elele, Rivers State, Nigeria, from April to August 2023.

2.2 Study Population

Forty samples of both old and newly redesigned Naira notes were collected from four strategic locations within the university community, with ten samples of each denomination (₦100, ₦200, ₦500, and ₦1000).

2.3 Sample Collection

Samples were obtained from male and female students at Madonna University, Elele, with additional control samples sourced from May Fresh Bank, following approval from the bank manager. All samples were collected using sterile gloves and bags and promptly transported to the Microbiology Laboratory at Madonna University for analysis (Sani et al., 2016).

2.4 Sterilization

All materials, including media and glassware, were sterilized by autoclaving at 121°C for 15 minutes or by ethanol immersion and burning, with aseptic techniques maintained throughout.

2.5 Preparation of Media

Media for microbial analysis included Nutrient agar, MacConkey agar, *Salmonella Shigella* agar (SSA), Mannitol salt agar, Blood agar, and Potato Dextrose agar (PDA), prepared according to manufacturer specifications.

2.6 Microbiological Analysis

Each note was immersed in sterile buffered peptone water for 60 minutes. The resulting solution was subjected to serial dilution, and aliquots were cultured on various media. Plates were incubated at 37°C for 24 hours for bacteria and at room temperature for 72 hours for fungi. Colonies were counted and recorded (Ndubuisi et al., 2016).

2.6.1 Sub-Culture

Growth on plates was morphologically identified, counted, and recorded. Colonies between 30 and 300 were considered, with sub-culturing performed to obtain pure cultures for further analysis (Cheesbrough, 2006).

2.6.2 Identification and Characterization

Bacteria were identified using Gram staining and biochemical tests including Indole, Sugar fermentation, Oxidase, Citrate, Catalase, Methyl Red Voges Proskauer (MRVP), Motility, and Triple Sugar Iron tests (Cheesbrough, 2006; Nworie et al., 2012; Anele et al., 2021). Fungal identification was conducted through morphological observation and Lactophenol Cotton Blue staining (Nworie et al., 2016).

2.7Antibiotic Susceptibility Testing

The disk diffusion method was used to test susceptibility against antibiotics such as Erythromycin, Septrin, Pefloxacin, Gentamycin, Ampiclox, Amoxicillin, Rocephin, Ciprofloxacin, Streptomycin, and Zinnacef. Inhibition zones were measured and classified according to Clinical and Laboratory Standard Institute (CLSI) guidelines and WHO standards. Multi-drug resistance was defined as resistance to at least three antibiotics (Bauer et al., 1996; Cheesbrough, 2006; Anele et al., 2021).

3. Results and Discussion

3.1 Results

Total Heterotrophic Bacteria Count (THBC) obtained from the Naira paper currency among Male and Female students of Madonna University Elele, Rivers State, Nigeria

The total heterotrophic bacterial count (THBC) for 1000 naira old paper notes and redesigned paper naira notes samples among the male and female students of Madonna University Elele, Rivers State ranged from 1.5 X 10^3CFU/ml- 4.1 X 10^3CFU/ml. The highest bacterial count was recorded on the male student's old paper notes of 1000 naira with the value of (4.1 X10^3 CFU/ml), and the least was found in 1000 naira redesigned paper notes of the female students with (1.5 X 10^3CFU/ml). Also, the control samples had a value of (1.0 X 10^3CFU/ml) lower than the both samples.

Old 500 naira notes and redesigned paper naira notes for male and female students bacterial count ranged from 2.2 X 10^3CFU/ml- 3.8 X 10^3CFU/ml. The female student's old 500 naira note had the highest bacterial count of (3.8 X 10^3CFU/ml) and the lowest was recorded on the redesigned 500 naira paper notes of control samples from May Fresh Bank with (0.5 X 10^3CFU/ml).

Old 200 naira notes and redesigned paper naira notes for male and female students bacterial count ranged from 3.4 X 10^3CFU/ml- 4.7 X 10^3CFU/ml. The female student's old 200 naira note had the highest bacterial count of (4.7 X 10^3CFU/ml) and the lowest was recorded on the

redesigned 200 naira paper notes of control samples from May Fresh Bank with (0.7 X 10^3CFU/ml).

Old 100 naira notes for male and female student's bacterial count ranged from 2.4 X 10^3CFU/ml- 3.0 X 10^3CFU/ml. The male student's old 100 naira note had the highest bacterial count of (3.0 X 10^3CFU/ml). The control from May Fresh Bank 100 naira notes had the lowest bacterial count recorded with the value of (0.5 X 10^3CFU/ml).

Table 1: Total Heterotrophic Bacteria Count (THBC) obtained from the Naria paper currency among Male and Female students of Madonna University Elele, Rivers State, Nigeria

Sample codes	Male CFU/ml	Female CFU/ml
AON 1000	4.1 X 10^3	3.2 X 10^3
ARDN 1000	2.5 X 10^3	1.5 X 10^3
ACtrl 1000	0.2 X 10^3	0.2 X 10^3
BON 500	3.5 X 10^3	3.8 X 10^3
BRDN 500	2.7 X 10^3	2.2 X 10^3
BCtrl 500	0.5 X 10^3	0.5 X 10^3
CON 200	4.2 X 10^3	4.7 X 10^3
CRDN 200	3.4 X 10^3	3.9 X 10^3
CCtrl 200	0.4 X 10^3	0.4 X 10^3
DON 100	3.0 X 10^3	2.4 X 10^3
DCtrl100	0.5 X 10^3	0.5 X 10^3

Keys: AON= Alphabet Old Naira, ARDN= Alphabet Redesigned Naira, ACtrl= Alphabet Control, CFU=Colony forming unit

Total Fungal Count (TFC) obtained from the Naira paper currency among Male and Female students of Madonna University Elele, Rivers State, Nigeria

The Total Fungal count (TFC) for 1000 naira old paper notes and redesigned paper naira notes samples among the male and female students of Madonna University Elele, Rivers State ranged from 1.0 X 10^3CFU/ml- 2.5 X 10^3CFU/ml. The highest fungal count was recorded on the female student's old paper notes of 1000 naira with the value of (2.5 X10^3 CFU/ml), and the least was found in 1000 naira redesigned paper notes of the male

students with (1.0 X 10^3CFU/ml). Also, the control samples had a value of (0.4 X 10^3CFU/ml) lower than the both samples.

Old 500 naira notes and redesigned paper naira notes for male and female students fungal count ranged from 1.0 X 10^3CFU/ml- 1.7 X 10^3CFU/ml. The male student's old 500 naira note had the highest fungal count of (1.7 X 10^3CFU/ml) and the lowest was recorded on the redesigned 500 naira paper notes of the control samples from May Fresh Bank with (0.2 X 10^3CFU/ml).

Old 200 naira notes and redesigned paper naira notes for male and female students fungal count ranged from 1.6 X 10^3CFU/ml- 2.5 X 10^3CFU/ml. The female student's redesigned 200 naira note had the highest fungal count of (2.5 X 10^3CFU/ml) and the lowest was recorded on the old 200 naira paper notes of the control samples from May Fresh Bank with (0.5 X 10^3CFU/ml) respectively.

Old 100 naira notes for male and female student's fungal count ranged from 2.0 X 10^3CFU/ml- 2.8 X 10^3CFU/ml. The male student's old 100 naira note had the highest fungal count of (2.8 X 10^3CFU/ml). The control from May Fresh Bank 100 naira notes had the lowest bacterial count recorded with the value of (0.4 X 10^3CFU/ml).

Table 2: Total Fungal Count (TFC) obtained from the Naira paper currency among Male and Female students of Madonna University Elele, Rivers State, Nigeria

Sample codes	Male CFU/ml	Female CFU/ml
AON 1000	2.1 X 10^3	2.5 X 10^3
ARDN 1000	1.0 X 10^3	1.2 X 10^3
ACtrl 1000	0.4 X 10^3	0.4 X 10^3
BON 500	1.7 X 10^3	1.4 X 10^3
BRDN 500	1.3 X 10^3	1.0 X 10^3
BCtrl 500	0.2 X 10^3	0.2 X 10^3
CON 200	1.6 X 10^3	2.2 X 10^3
CRDN 200	1.9 X 10^3	2.5 X 10^3
CCtrl 200	0.5 X 10^3	0.5 X 10^3
DON 100	2.8 X 10^3	2.0 X 10^3
DCtrl100	0.4 X 10^3	0.4 X 10^3

Keys: AON= Alphabet Old Naira, ARDN= Alphabet Redesigned Naira, ACtrl= Alphabet Control, CFU=Colony forming unit

Frequency of occurrence of Bacterial isolates obatined from Old and Redesigned Naira Paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State, Nigeria

The percentage frequency of occurrence of bacteria isolated from old and redesigned naira notes shows in Table 3. From the results gotten, 60.4% of the isolates were from old Naira paper notes whereas, 39.6. % was identified from the redesigned Naira paper notes. In this study, the bacterial organisms isolated and their frequency of occurrence followed the hierarchy such as *Bacillus* sp (31.3%, n=15) as the highest predominant organism. This was followed by *Escherichia coli* (20.8%, n=10), *Staphylococcus* (16.7%, n=8), *Streptococcus*

(12.5%, n=6), *Micrococcus* (10.4%, n=5), and *Salmonella* sp (8.3%, n=4) was the lowest predominant isolated bacteria.

Also, the female had the highest percentage value of (55.2%, n=16) for the old naira paper note meanwhile, the male student had the highest percentage occurrence in the redesigned naira paper note with (52.6 %, n=10).

Table 3: Frequency of occurrence of Bacterial isolates obtained from Old and Redesigned Naira Paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State, Nigeria

Bacterial Isolates	Frequency (%)	Old Paper Note	M	F	Redesigned Paper Notes	M	F
Bacillus sp	15 (31.3)	10	6	4	5	4	1
Escherichia coli	10(20.8)	6	2	4	4	1	3
Staphylococcus sp	8(16.7)	5	2	3	3	2	1
Streptococcus sp	6(12.5)	3	1	2	3	1	2
Salmonella	4 (8.3)	2	1	1	2	1	1
Micrococcus	5(10.4)	3	1	2	2	1	1
Total	**48(100)**	**29 (60.4)**	**13(44.8)**	**16(55.2)**	**19(39.6)**	**10(52.6)**	**9(47.4)**

Keys: M= Male, F=Female, %= Percentage

Frequency of occurrence of Fungal isolates gotten from Old and Redesigned Naira Paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State, Nigeria

The percentage frequency of occurrence of bacteria isolated from old and redesigned naira notes shows in Table 4. From the results gotten, 58.3% of the isolates were from old Naira paper notes whereas, 41.7. % was identified from the redesigned Naira paper notes. In this study, the fungal organisms isolated and their frequency of occurrence followed the hierarchy such as *Aspergillus* sp (33.3%, n=12) as the highest predominant organism. This was followed by *Penicillium* sp (22.2%, n=8), *Fusarium sp* (16.7%, n=6), *Mucor* sp (16.7%, n=6), and *Rhizopus* sp (11.1%, n=4) was the lowest predominant isolated fungal organism.

Also, the female had the highest percentage value of (60.0%, n=9) for the old naira paper note meanwhile, the male student had the highest percentage occurrence in the redesigned naira paper note with (40.0 %, n=6).

Table 4: Frequency of occurrence of Fungal isolates obtained from Old and Redesigned Naira Paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State, Nigeria

Bacterial Isolates	Frequency (%)	Old Paper Note	M	F	Redesigned Paper Notes	M	F
Penicilliums	8 (22.2)	4	1	3	4	2	2
Aspergillus	12(33.3)	8	5	3	4	1	3
Fusarium	6(16.7)	3	1	2	3	1	2
Rhizopus	4(11.1)	2	1	1	2	1	1
Mucor	6 (16.7)	4	3	1	2	1	1
Total	**36(100)**	**21 (58.3)**	**11(52.4)**	**10(47.6)**	**15(41.7)**	**6(40.0)**	**9(60.0)**

Keys: M= Male, F=Female, %= Percentage

Antibiotics sensitivity pattern of Gram-positive bacteria isolates obtained from old and redesigned naira paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State

The susceptibility pattern of the bacteria isolates is presented in Table 5. The antibiotic susceptibility result of this research study indicate the Gram positive antibiotic susceptibility testing against the bacteria isolates in which Chloramphenicol showed more susceptibility to *Staphylococcus* (22.0mm), *Streptococcus* (22.0mm), *Micrococcus* (21.0mm) and *Bacillus* (22.0mm) respectively. Levofloxacin, Rifampicin, and Norfloxacin, respectively, showed resistance to the tested Gram positive bacteria isolates in this study.

Table 5: Antibiotics sensitivity pattern of Gram-positive bacteria isolates obtained from old and redesigned naira paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State.

Bacterial	Antibiotics/Diameter of zone of inhibition (mm)									
Organism	**CPX**	**NOR**	**GEN**	**AML**	**STR**	**ERY**	**RIF**	**CHL**	**APX**	**LEV**
Staphylococcus sp	13.0(R)	9.0 (R)	21.0(S)	17.0(I)	20.0(S)	19.0(I)	4.0 (R)	22.0(S)	22.0(S)	0.0(R)
Streptococcus sp	12.0(R)	10.0(R)	20.0(S)	16.0(I)	20.0(S)	18.0(I)	0.0(R)	22.0(S)	19(I)	0.0(R)
Micrococcus sp	17.0(I)	9.0 (R)	21.0(S)	17.0(I)	20.0(S)	16.0(I)	5.0(R)	21.0(S)	15.0(I)	0.0(R)
Bacillus spp	16.0 (I)	20.0 (S)	22.0 (S)	15.0 (1)	19.0(I)	19.0 (I)	7.0 (R)	22.0 (S)	2.0 (R)	4.0 (R)

Keys: CPX= Ciprofloxacin, NOR= Norfloxacin, GEN=Gentamycin, AML=Amoxil, STR= Streptomycin, ERY= Erythromycin, RIF= Rifampicin, CHL= Chloramphenicol, APX= Ampiclox, LEV=Levofloxacin.

Clinical and Laboratory Standard Institute (CLSI) Guidelines 2021: 31st Edition: Sensitive (S)= > 20.0, Intermediate (I)=15-19, Resistant (R)= < 14

Table 6: Antibiotics sensitivity pattern of Gram-negative bacteria isolates obtained from old and redesigned naira paper notes in circulation among Male and Female students of Madonna University Elele, Rivers State.

Bacteria	Antibiotic/ Diameter of zone of inhibition (mm)									
Organisms	OFX	PEF	CPX	AU	CN	S	CEP	NA	SXT	PN
E.*coli*	17.0(I)	15.0(I)	22.0(S)	18.0(I)	22.0(S)	22.0(S)	0.0(R)	0.0(R)	4.0(R)	0.0 (R)
Salmonella spp	12.0(R)	10.0(R)	22.0(S)	8.0(R)	22.0(S)	9.0(R)	2.0(R)	0.0 (R)	5.0 (R)	1.0 (R)

Keys: OFX= Tarivid, PEF= Reflacine, CPX=Ciprofloxacin, AU= Augementin, CN=Gentamycin S= Streptomycin, CEP= Ceporex, NA= Nalidixic Acid, SXT= Septrin PN= Amplicin.

Clinical and Laboratory Standard Institute (CLSI) Guidelines 2021: 31st Edition: Sensitive (S)= ≥ 20.0, Intermediate (I)=15-19, Resistant (R)= ≤

3.2 Discussion

This study evaluated the total culturable heterotrophic bacterial load associated with Naira paper currency (₦100, ₦200, ₦500, and ₦1000) in circulation among male and female students. The findings revealed bacterial counts ranging from 1.0×10^3 to 4.1×10^3 CFU/ml in samples obtained from male students and 1.0×10^3 to 4.7×10^3 CFU/ml in those from female students. These results are in agreement with the observations of Mfoniso et al. (2017), who reported comparably elevated microbial loads on Naira notes collected from traders in Akwa Ibom State. The consistency across these studies reinforces the notion that frequently circulated currency constitutes a significant reservoir of microbial contaminants, irrespective of the population group under investigation.

A notable finding in the present study is the comparatively higher bacterial load associated with the ₦200 denomination both old and redesigned handled by female students relative to their male counterparts. This observation, while not universally reported in the literature, may reflect variations in handling frequency, storage practices, or personal hygiene behaviors. It is important to interpret this finding cautiously; rather than attributing contamination solely to gender, it is more plausible that behavioral and contextual factors such as how and where currency is stored (e.g., handbags versus pockets), frequency of exchange, and exposure to diverse environments play a determining role. Thus, the present study partially diverges from studies that report no significant gender-based differences, suggesting that demographic factors may interact with environmental and behavioral variables to influence contamination levels.

The study further substantiates the role of currency notes as fomites capable of harboring both pathogenic and non-pathogenic microorganisms. This finding is in agreement with Sani et al. (2016) and other related studies, which emphasize the epidemiological significance of paper money in microbial transmission. Control samples obtained directly from the Central Bank of Nigeria exhibited markedly lower bacterial counts, thereby affirming that contamination is largely acquired during circulation. This underscores the critical influence of usage patterns, handling practices, and hygiene standards on the microbial burden of currency.

With respect to fungal contamination, total fungal counts ranged from 1.0×10^3 to 2.8×10^3 CFU/ml in samples from male students and 1.0×10^3 to 2.5×10^3 CFU/ml in those from female students. These findings are in agreement with Sani et al. (2016), who documented similar fungal proliferation on abused Naira notes. The significantly lower fungal counts observed in control samples (0.2×10^3 to 0.5×10^3 CFU/ml) further corroborate the premise that fungal contamination is primarily a function of environmental exposure and prolonged usage. Interestingly, the highest fungal contamination was recorded on old ₦200 notes among male students and redesigned ₦200 notes among female students.

This pattern suggests that both note age and handling dynamics contribute synergistically to fungal colonization, a conclusion that aligns with the broader understanding of microbial ecology on inanimate surfaces.

Microbiological analysis yielded 48 bacterial isolates spanning six genera *Bacillus*, *Escherichia coli*, *Staphylococcus*, *Streptococcus*, *Salmonella*, and *Micrococcus*. This distribution is in agreement with the findings of Sani et al. (2016), thereby reinforcing the ubiquity of these genera in currency-associated microbiota. Similarly, 36 fungal isolates representing five genera *Penicillium*, *Aspergillus*, *Fusarium*, *Rhizopus*, and *Mucor* were identified, further validating previous reports. The recurrence of these microbial taxa across independent studies strengthens the reliability and generalizability of the present findings.

From a clinical perspective, the detection of enteric and opportunistic pathogens on currency notes carries important public health implications. The presence of *Salmonella* spp., implicated in typhoid fever, and *Escherichia coli*, associated with acute enteritis, is in agreement with Ndubuisi et al. (2016). Likewise, members of the family Enterobacteriaceae identified in this study are well-documented etiological agents of gastrointestinal infections, particularly in settings characterized by inadequate sanitation. The predominance of *Bacillus* species (31.3%) is also consistent with Ogbonda et al. (2012) and Mbaya et al. (2016), who highlighted the resilience of spore-forming bacteria in adverse environmental conditions. Their persistence on currency underscores their potential role in indirect disease transmission.

The relatively high prevalence of *Escherichia coli* (20.8%) aligns with the findings of Girma (2014), further suggesting fecal contamination and poor hygiene practices among currency handlers. The detection of *Staphylococcus* spp. (16.7%) is in agreement with Chauwa et al. (2020) and may be attributed to contamination from skin contact or respiratory secretions. This organism is of particular concern due to its ability to cause infections when introduced into the body through breaches in the skin barrier.

Among the fungal isolates, *Aspergillus* spp. emerged as the most prevalent (33.3%), a finding in agreement with Sahab et al. (2012). Given its association with aspergillosis ranging from allergic manifestations to severe pulmonary infections its presence on currency is clinically significant. *Rhizopus* spp., identified in 11.1% of samples, is also noteworthy due to its role in causing zygomycosis, particularly in immunocompromised individuals. These findings collectively highlight the pathogenic potential of fungal contaminants on widely circulated currency.

The antibiotic susceptibility profile of *Staphylococcus* isolates revealed resistance to Levofloxacin, Rifampicin, and Norfloxacin, with intermediate resistance to Ampicillin and Erythromycin, while demonstrating susceptibility to Chloramphenicol, Streptomycin, Gentamycin, and Amoxicillin. These findings are in agreement with Nwankwo and Offiah (2016), who reported increasing antimicrobial resistance among bacterial isolates from environmental sources. The observed resistance patterns raise significant concerns regarding the therapeutic management of infections, particularly in resource-limited settings where antibiotic misuse is prevalent.

Therefore, the findings of this study are largely in agreement with existing literature, while also offering nuanced insights into the influence of demographic and behavioral factors on microbial contamination of currency. The study underscores the urgent need for improved public health awareness, better hygiene practices, and policy interventions aimed at reducing the microbial risks associated with paper money.

4. Conclusion

The study found that naira paper notes, both old and redesigned, contain pathogenic and non- pathogenic microorganisms that could harm public health. Older notes had the highest microbial load, indicating improper handling. Bacteria from these notes were resistant to common antibiotics, highlighting the need for caution.

5. Recommendations

1. It is important to follow basic hygiene guidelines, such as properly washing hands after handling cash.
2. Handlers of money, particularly women, should refrain from placing cash in their braziers as this may be hazardous to their health.

3. Saliva is also frequently used by money handlers to count naira notes; however, as the bacteria present in the currency might be hazardous to human health, this practice ought to be avoided.

6. Contributions to Knowledge

1. The study was able to uncover the specific bacterial species present on frequently handled Naira notes, highlighting potential sources of microbial transmission among university students.
2. The study provides critical data on whether antibiotics remain effective against bacteria commonly found on currency, informing healthcare practices and treatment protocols.
3. Furthermore, the study lays the groundwork for future research on the environmental and public health impacts of currency-borne microbes, potentially influencing currency design and sanitation practices.

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