ASSESSMENT OF MICROBIAL AND PARASITIC CONTAMINATION ON NIGERIAN CURRENCY NOTES AT NNAMDI AZIKIWE UNIVERSITY, AWKA NIGERIA

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ABSTRACT

Background: The pervasive use of currency notes in daily transactions makes them a potential vector for microbial contamination. Despite this there remains a notable lack of comprehensive studies specifically addressing the extent and types of microbial contamination present on Nigerian currency.

Aim: This study evaluated the bacterial and parasitic contamination of Nigerian currency notes at Nnamdi Azikiwe University, Awka.

Method: A cross-sectional study design was employed for this research. Currency notes were gathered from various locations on campus. A total of 70 samples of Nigerian currency notes were randomly collected. Samples were prepared for bacterial culture by swabbing with sterile saline moistened cotton swabs. Bacteria were cultured on Salmonella Shigella media, incubated, and analyzed for colony characteristics. Remaining samples underwent microscopic examination for protozoan parasites after centrifugation and resuspension.

Result: The identified protozoan parasites included *Entamoeba histolytica*, *Entamoeba coli*, and *Enterobius vermicularis*, with contamination rates of 35.7%, 57.1%, and 7.1%, respectively. Statistical analysis indicated no significant association between parasite species and overall prevalence (P = 0.06). Bacterial isolates included *Klebsiella spp*., *Proteus spp*., and *Escherichia coli*, with prevalence rates of 50%, 25%, and 25%, respectively,

and no significant association between bacterial species and prevalence (P = 0.4). Notably, polymer notes (10 to 50 naira) exhibited a 0.00% contamination rate, while paper notes showed varying prevalence: 35.7% for 100 naira, 28.6% for 200 naira, 14.3% for 500 naira, and 21.4% for 1000 naira. A significant association was found between currency denomination and prevalence (P = 0.01). Furthermore, the physical condition of the notes influenced contamination levels, with mutilated notes demonstrating the highest contamination rate (22.97± 4.51%). However, no significant association (P = 0.2).

Conclusion: The findings underscore the potential health risks posed by contaminated currency and highlight the need for public awareness and hygiene measures

Keywords: Bacterial, Parasitic, Currency note, Contamination

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INTRODUCTION

The proliferation of currency notes as a medium of exchange has long been recognized as a potential vector for microbial and parasitic contamination, raising significant public health concerns. In Nigeria, where cash transactions remain predominant, the role of currency notes in facilitating the transmission of pathogens is particularly alarming. Despite the growing body of literature on the microbial contamination of banknotes globally, there remains a conspicuous gap in research specifically addressing the extent and implications of such contamination within the Nigerian context. Recent studies have highlighted the presence of various pathogens on currency notes in different countries, indicating that these notes can harbor bacteria, viruses, and parasites capable of causing disease[1,2]. For instance, a study conducted in India found that 85% of examined currency notes were contaminated with bacteria, including *Staphylococcus aureus* and *Escherichia coli*, which are known to pose serious health risks [3] . Similarly, research in Brazil revealed that banknotes could serve as reservoirs for parasites such as Giardia lamblia and Entamoeba histolytica [4]. However, despite these findings, there is a notable lack of comprehensive studies focusing on Nigerian currency notes. The unique socio-economic and cultural dynamics of Nigeria, coupled with the high frequency of cash transactions, necessitate an urgent investigation into the microbial and parasitic load on its currency. Previous work has primarily concentrated on urban areas and has not adequately addressed the rural-urban divide or the potential implications for public health [5]. This study aims to fill this critical research gap by evaluating the microbial and parasitic contamination of Nigerian currency notes, thereby providing essential data that can inform public health policies and hygiene practices. Understanding the extent of contamination is vital for mitigating health risks

associated with cash transactions, especially in a country where the informal economy thrives and cash remains king.

MATERIALS AND METHODS

Study Area

The research was conducted at Nnamdi Azikiwe University in Awka, Anambra State, Nigeria, located at geographical coordinates 6° 16' 0" North and 7° 3' 0" East. The university spans over 100 acres, featuring a rich variety of flora and fauna[6]. The area includes several streams, agricultural lands, numerous buildings, and forested regions. Awka is situated within Nigeria's tropical rainforest zone, experiencing two distinct seasons: the wet season from April to October and the dry season from November to March. The average temperature ranges from 28.5º C between June and December to 33º C from January to April [7].

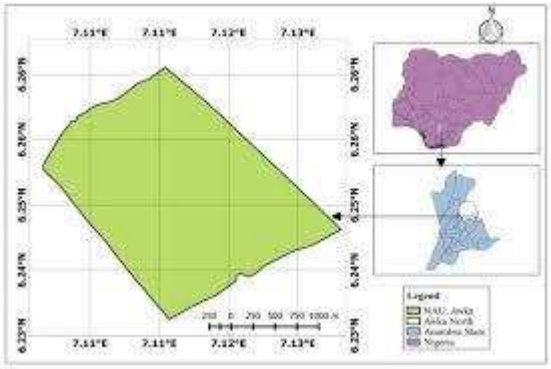

Fig 1: Map of the study area (Nnamdi Azikiwe University)

Sampling Design

A cross-sectional study design was employed for this research. Currency notes were gathered from various locations on campus, including shopping malls, lecture halls, hostels, cyber cafes, and bus stands. A total of 70 samples of Nigerian currency notes were randomly collected, comprising 10 pieces from each denomination (₦10, ₦20, ₦50, ₦100, ₦200, ₦500, and ₦1000) in both polymer and paper forms. A sample size of 70 currency notes was selected based on its adequacy to achieve a reasonable statistical power for detecting significant differences in microbial contamination levels. A sample size of 70 is considered sufficient to provide a robust estimate of the microbial load present on currency notes, given that the study does not involve complex group comparisons but rather a general assessment of contamination levels[8]. The collected notes were categorized based on their physical condition into four groups: mints, clean, dirty, and mutilated dirty, with the mint notes serving as the control group.

Ethical Considerations

The research objectives were clearly explained to the participants, and their verbal consent was secured prior to the collection and exchange of currency notes. The ethical approval for this study was obtained from the Department of Zoology, Nnamdi Azikiwe University, Awka. Currency notes of various denominations were gathered from multiple locations using sterile gloves and forceps to prevent any additional contamination. Notes were placed in sterile, sealed bags immediately after collection and stored at room temperature until analysis

Sample Preparation

The preparation of samples for bacterial culture was done using methods outlined by[9, 10]. This involved individually swabbing each currency note with sterile cotton swabs moistened with sterile saline (0.85% NaCl). The swabbing was conducted systematically across the entire surface of each note to ensure thorough coverage[11]. The swabs were then placed

into sterile tubes containing 1 mL of sterile saline. Bacterial samples were inoculated onto salmonella shigella culture media and incubated at 37°C for 24 hours. Following incubation, the plates were examined for colony morphology, including characteristics such as size, shape, color, and hemolytic properties. Distinct colonies were selected for further identification, which included Gram staining and biochemical tests.

For the identification of protozoan parasites, after isolating bacterial pathogens, the remaining suspension was subjected to microscopic examination[9]. A subsample of the swab suspension from each currency note was centrifuged at 3000 rpm for 10 minutes. The supernatant was discarded, and the pellet was resuspended in 1 mL of sterile phosphate-buffered saline (PBS). A drop of the resuspended sample was placed on a clean glass microscope slide and covered with a coverslip. The sample was then examined under a light microscope at various magnifications (100x, 400x, and 1000x) to identify protozoan cysts and trophozoites.

Statistical Analysis

Descriptive statistics were employed to summarize and provide an overview of the dataset, allowing for a clearer understanding of the distribution and characteristics of the microbial contamination observed on the currency notes. The collected data were analyzed using the Chi-square test to assess the significance of the prevalence of microbial parasites.

RESULT

The result of the study on assessment of microbial and parasitic contamination on Nigerian currency notes is shown below:

Protozoan Parasite Species Detected on Naira Notes Following Parasitological Analysis

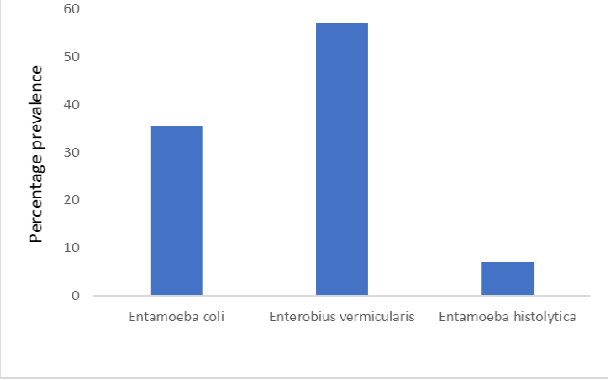

Fig 2: Prevalence of protozoan parasites on naira currency notes

The protozoan parasites identified and isolated in this study included *Entamoeba histolytica*, *Entamoeba coli*, *Enterobius vermicularis*, *Escherichia coli*. Out of the 70 samples analyzed, 35.7% were contaminated with *Entamoeba coli*, 57.1% with *Enterobius vermicularis*, and 7.1% with *Entamoeba histolytica*. The analysis showed no significant correlation between the various parasite species and their prevalence (P = 0.06).

Bacterial Parasite Species Detected on Naira Notes Following Parasitological Analysis

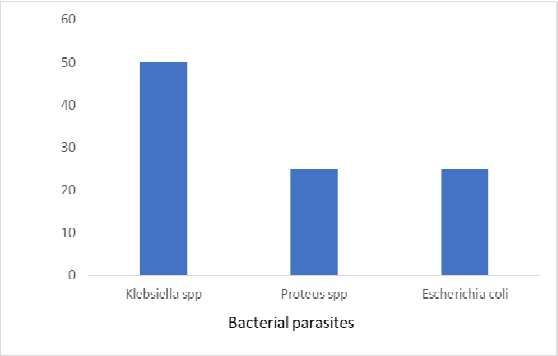

Fig 3: Prevalence of bacterial parasites on naira currency notes

The bacterial pathogens identified and isolated in this research include *Klebsiella spp*., *Escherichia coli*, and *Proteus spp*. Out of the 70 samples examined, 50% were contaminated with *Klebsiella spp*., while 25% showed contamination with Escherichia coli, and another 25% with *Proteus spp*. Statistical analysis indicated no significant correlation between the various bacterial species and their prevalence (P = 0.06).

Parasites prevalence on Naira notes in relation to currency denomination and types of notes

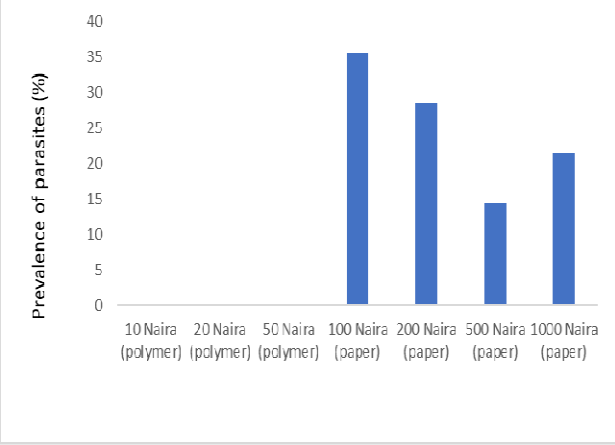

Fig 4: Prevalence of parasites on Naira notes in relation to currency denomination and types of notes

The assessment of microbial contamination indicated that polymer notes (10 to 50 naira) showed no signs of contamination (0.00%). In comparison, paper notes exhibited different levels of contamination: 100-naira notes had a contamination rate of 35.7%, 200-naira notes showed 28.6%, 500-naira notes recorded 14.3%, and 1000-naira notes had a prevalence of 21.4%. A statistically significant relationship was identified between the denomination of naira currency and the prevalence of contamination (P = 0.01).

Parasite species composition and prevalence on naira notes in relation to their physical condition

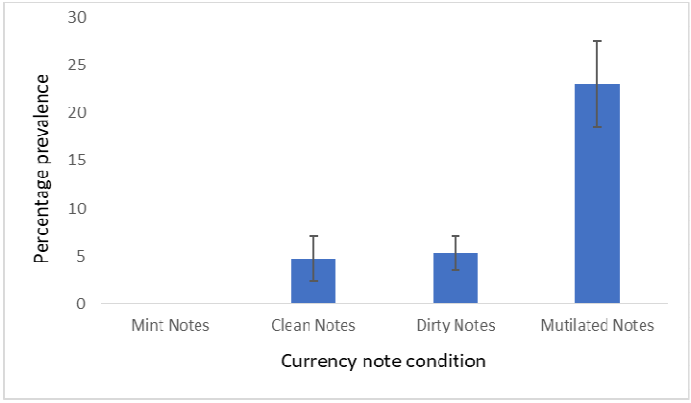

Fig 5: Parasite species prevalence on currency notes in relation to the notes physical condition

Mint notes showed no presence of parasites. Clean notes exhibited a contamination rate of 4.73± 2.37%, while dirty notes had a rate of 5.325± 1.775%. Mutilated naira notes displayed the highest level of contamination at 22.97± 4.51%. Additionally, there was no significant correlation found between the physical

condition of Naira notes and the prevalence of contamination (P=0.2).

DISCUSSION

The results of this study highlight a concerning level of microbial and parasitic contamination on Nigerian currency notes, particularly paper notes, which can serve as vectors for disease transmission. The identification of protozoan parasites such as *Entamoeba histolytica*, *Entamoeba coli*, and *Enterobius vermicularis*, alongside bacterial pathogens like *Klebsiella* spp., *Escherichia coli*, and *Proteus* spp., underscores the potential health risks associated with handling contaminated currency.

The prevalence rates found in this study, with *Entamoeba coli* at 35.7% and *Enterobius vermicularis* at 57.1%, are particularly noteworthy. The higher prevalence of *Enterobius vermicularis*, a common intestinal parasite, suggests that currency notes may act as a reservoir for transmission, especially in populations with limited access to sanitation. Previous studies have reported similar findings, indicating that currency notes can harbor a variety of pathogens, including helminths and protozoa [12, 13]. The lack of a significant association between parasite species and prevalence (P = 0.06) suggests that while multiple parasites are present, their distribution may not be uniform across the samples examined.

The stark contrast in contamination levels between polymer and paper notes is significant. The polymer notes (10 to 50 naira) showed no contamination, while various denominations of paper notes exhibited varying levels of contamination, with the 100-naira notes showing the highest prevalence at 35.7%. This finding aligns with previous research that has indicated that polymer banknotes are less conducive to microbial survival due to their non-porous nature [14]. The significant association between currency denomination and prevalence (P = 0.01) suggests that higher denomination notes may be handled more frequently or kept for longer durations, increasing the likelihood of contamination.

The study also examined the physical condition of the notes, revealing that mutilated and very dirty notes had the highest contamination rates (28.6%). However, the lack of a significant association between the physical condition of the notes and prevalence (P = 0.2) indicates that while dirtiness may correlate with higher contamination, it is not the sole factor influencing the presence of pathogens. This finding is consistent with the work of [15], which found that while dirty notes had higher microbial loads, the relationship was not statistically significant.

The presence of these pathogens on currency notes poses a potential public health risk, particularly in a country like Nigeria, where hygiene practices may vary widely. The transmission of pathogens via currency can contribute to the spread of gastrointestinal diseases and other infections, particularly in vulnerable populations. Public health campaigns emphasizing hand hygiene and the need for regular cleaning of currency notes could be beneficial in mitigating these risks.

CONCLUSION

This study has provided important insights into the microbial and parasitic contamination of Nigerian currency notes. The findings emphasize the need for

further research into effective strategies for decontaminating currency and promoting public health awareness regarding the potential risks associated with handling contaminated money. Continued surveillance of currency contamination and its implications for public health will be crucial in addressing these concerns. While, the limited number of samples used in the study may impact the statistical power of the results and the ability to generalize the result to a broader population. Future research should consider increasing the sampling size. It should also focus on understanding transmission pathways as well as the role of currency in the spread of disease especially during outbreaks.

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