

RECENT INVENTORY ON PARASITIC CONTAMINATION OF NIGERIA CURRENCY NOTES IN NSUKKA METROPOLIS, ENUGU STATE, NIGERIA

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ABSTRACT

*It is established that parasites can spread on the surface of banknotes as they are passed among individuals of different occupations and hygiene level. The Nigerian currency notes in Nsukka were evaluated for parasitic contamination. This was aimed at assessing the parasites that contaminate Nigerian currency notes. A total of 200 notes comprising the denominations currently in use were collected between March to June, 2021 from different occupational groups. The notes were collected into clean polyethylene bags and transported to the laboratory for analysis. The analysis was done following standard procedures. Out of the 200 notes analysed, 75(37.5%) were found to be contaminated with different parasites. Parasites isolated from the currency notes were *Ascaris lumbricoides* ova, *Enterobius* ova, *Entamoeba histolytica* cysts, hookworm larvae and unidentified cysts. *A. lumbricoides* recorded the highest prevalence, followed by *E. histolytica* and unidentified cysts, the difference was significant ($p < 0.05$). Currency notes collected from butchers were most contaminated while the least was recorded among cosmetic shopkeepers. The study also revealed that paper notes were significantly more contaminated than the polymer counterpart ($p < 0.05$). The findings from this study indicated that currency notes serve as routes for parasitic infections, hence, people should stop the practice of wetting their fingers with their tongues while counting money and thorough hand washing with detergent is advised after handling money. It is also advocated that the cashless policy of the Central Bank of Nigeria (CBN) should be embraced to reduce the incidence of parasitic infection through regular handling of money.*

Keywords: Parasites, Currency notes, Nsukka, Money, Contamination

INTRODUCTION

Parasites are part of our ecosystem and can be transmitted to humans by variety of routes. Enteric parasites can be transmitted either directly or indirectly through contaminated food or fluid, or through inanimate objects known as fomites.

Currency banknotes are described as fomites that are frequently exchanged in communities (Hassan *et al.*, 2011). Money whether in the form of coins or banknotes is the most widely handled article by people throughout the world (Bhat *et al.*, 2010). Money has been identified as a possible environmental vehicle for transmission of

pathogenic microorganisms (Hassan *et al.*, 2011; Gerba, 2015).

In ancient times, people did not need money for successful daily transaction; they practiced trade by barter as a medium of exchange that did not involve money (Prasai *et al.*, 2008; Alemu, 2014). Due to the numerous functions of currency notes such as payment of debts, buying and selling, deferred payment in economic activities, they serve as means of fuelling the spread of diseases and thereby posing a risk to public health (Angelakis *et al.*, 2014; Simon-Oke and Ajileye, 2019). The atmosphere, mode of storage and usage, handling and production processes could serve as definite sources for note contamination (Matur *et al.*, 2010; Neel, 2012). An individual living in unhygienic condition will therefore contaminate the notes and these notes act as vehicles that contaminate the next user since they provide a large surface area as a breeding ground for parasites (Uneke and Ogbu, 2007). Under unhygienic condition and practices such as unwashed hand after visiting the toilet, using saliva to count paper notes, placing or storing paper notes on/in dirty surfaces lead to the impurity of the notes, therefore acting as a vehicle for delivering eggs, cysts and larvae of parasites to the next user (Simon-Oke and Ajileye, 2019).

Some of the influencing factors on the contamination rate and type of parasites on the currency are as follows; season, environmental conditions, type of money (banknote, coin), the material from which the money is made (paper or polymer), local community flora and the public hygiene level of the population. Irrespective of material, more parasites are likely to be obtained from a dirty banknote than from a clean or mint note (Moosavy *et al.*, 2013).

Money is widely exchanged for goods and services worldwide (Uneke and Ogbu, 2007). Many individuals do not care how dirty their fingers are when handling money (Mensah *et al.*, 2002), hence, the butcher with bloody fingers, the artisan with dirty, dusty or oily fingers, the food

vendor with the wetly-oily fingers will just collect the Nigeria currency note with their dirty fingers, which lead to contamination of the notes with parasites (Mensah *et al.*, 2002). The contaminated currency notes go in circulation and continue to contaminate the hands of others who come in contact with them.

Handling money and ready-to-eat food can introduce the risk of cross-contamination to foods provided in food service establishments (Michaels, 2002). There are common unhealthy behaviours that might contribute to the ease of transmitting pathogens including parasites through contaminated currency (Leonard and Olajumoke, 2016). The most widely noted behaviours include wetting of fingers with saliva while counting banknotes as well as eating after handling money without washing hands with water and soap (Hassan *et al.*, 2011).

Currency notes are commonly passed among individuals and parasites can spread on the surface of the banknotes. Some currency notes are made of a rugged mixture of cotton and linen and offers suitable surface area for parasites to reside on both sides (El-Dars and Hassan, 2005). Vriesekoop *et al.* (2010) who analyzed both paper and polymer cotton-based notes reported similar findings.

El-Dars and Hassan (2005) also reported that lower denomination notes receive the most handling because they are exchanged more often and the longer the banknote remains in circulation, the more opportunity there is for it to become contaminated. In addition, the economic status of a country was associated with the concentration of microorganism on the currency and the average number of microorganisms detected on the banknotes is associated with the economic freedom of banknotes (Okwa and Bello, 2016).

Uneke and Ogbu (2007) in their study on the potential for parasite and bacterial transmission by paper currency in Nigeria, reported that there was a high prevalence of bacteria than of parasite contamination (53.2% versus 21.6%) in currency notes. Parasites

isolated from the currency notes include: *Ascaris lumbricoides* ova (8.0%), *Enterobius vermicularis* ova (6.8%), *Trichuris trichiura* ova (2.8%) and *Teania* spp. ova (4.0%). They also reported that parasitic contamination was most prevalent on dirty (mutilated notes collected from butchers, farmers and beggars).

Study by Hassan *et al.* (2011) sampled a total of 202 currency coins and banknotes of which 118(88.4%) were contaminated with intestinal parasites. Another study by Moosavy *et al.* (2013) reported bacterial contamination on Iranian currency. Similar study by Sucilathangam *et al.* (2016) reported the presence of bacteria in Indian paper currency in circulation. These currency handling behaviours informed our decision to study the contamination of Nigerian currency notes in circulation in Nsukka metropolis, Enugu State, Nigeria.

MATERIALS AND METHODS

Study Area: This study was conducted at Ogige market in Nsukka, Enugu State, Nigeria. The market is located along Enugu road, Nsukka. Nsukka is situated within the geographical coordinates 6°51'24"N 7°23'45"E (Wikipedia, 2023). It has a tropical climate and the vegetation is rainforest. Nsukka occupies the northern part of southeastern Nigeria and covers an area of about 473 m² on an elevation on a plateau of about 419.4 m above sea level, having its east and west escarpments descending gently into the Cross River and Anambra plains. Nsukka enjoys rainy season from April to October and dry season from November to March. Its average annual rainfall is about 1500 mm with a rainfall intensity of about 50 mm/hour. The average annual atmospheric temperature is 27°C except in harmattan (December to January) when atmospheric temperature is below 21°C (Nwite and Obi, 2008). It has an estimated population of 444,100 as at 2022 (City Population, 2023). The inhabitants are mostly farmers, traders, artisans and civil servants.

Sample Size and Collection: A total of 200 samples of Nigeria currency (Naira) notes comprising all the eight denominations (5, 10, 20, 50, 100, 200, 500 and 1000 Naira) were investigated for contamination with parasites. The currency notes were randomly collected between March to June 2021 from vegetable sellers, butchers, food sellers, shuttle drivers, motorcyclists, artisans (carpenters, mechanics, tailors) and cosmetic shop keepers. 25 samples of each of the denominations were randomly selected and analyzed. Informed oral consent was obtained from the participants before the exchange and collection of the Naira notes. The notes were aseptically collected and kept separately in a labeled new and sterile polythene bags and conveyed to the Department of Veterinary Parasitology and Entomology Laboratory, University of Nigeria, Nsukka for analysis. The notes were grouped based on source, denomination and nature (paper or polymer) of notes.

Parasitological Assay: The analysis was conducted based on the methods of Ahmed and Mujittapha (2015) and Leonard and Olajumoke (2016). Each note of the currency was inserted into a sterile bottle containing 20 ml of normal saline. The bottle was vigorously shaken and left standing for 30 minutes, then shaken all over again for the last time. The note was then removed using a pair of sterile forceps and transferred into a sterile polythene bag. The contents of each bottle were poured into test tubes and centrifuged at 1000 rpm for 5 minutes. The supernatants was carefully decanted, while the resultant sediment was stirred and a drop placed on a clean grease-free glass slide and then covered with a cover slip. The slide was then viewed under x10 followed by x40 objective lens of the microscope for the presence of parasites, parasites eggs, larvae and cysts.

Data Analysis: Data collected were analysed in Excel statistical software (Version, 2016). Descriptive statistics was used to calculate the

mean values of parasites, number of notes contaminated, and the denominations of the currency notes. *T. test* was used to determine the significant difference between paper and polymer notes.

RESULTS AND DISCUSSION

This study recorded overall contamination of the banknotes of 75(37.5%) out of the 200 notes examined. The different parasite species isolated from the currency notes included *A. lumbricoides* ova, Hookworms, *Enterobius* ova, *E. histolytica* cysts and unidentified cysts. Among these, *A. lumbricoides* recorded the highest prevalence, seen in 29(14.5%) of the banknotes examined (Figure 1).

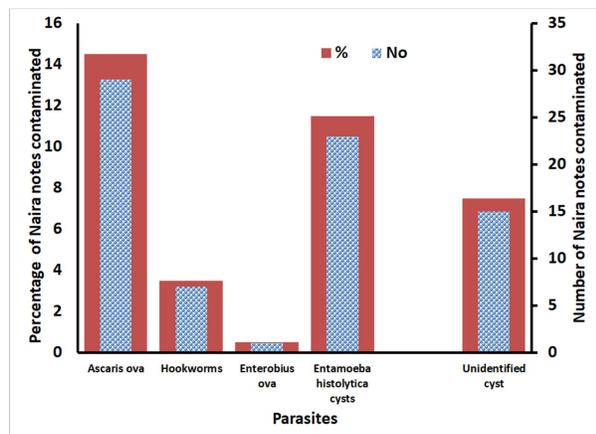


Figure 1: Parasite species isolated from Naira notes in Nsukka (n = 75; p<0.05)

This was followed by *E. histolytica* which recorded 23(11.5%) prevalence, unidentified cysts 15(7.5%), while the least in occurrence was *Enterobius* spp. which recorded 1(0.5%) prevalence, the differences in prevalence was statistically significant (p<0.05). Currency notes have been reported to be sources of parasitic and bacterial contamination (Hosen *et al.*, 2006; Umeh *et al.*, 2007; Hassan *et al.*, 2011; Okwa and Bello, 2016). The presence of these cannot be unconnected with faecal contamination of the environment and unhygienic practices of the people.

The findings of this study were comparable with the reports of El-Dars and Hassan (2005), Uneke and Ogbu (2007), Hassan *et al.* (2011), Umeh *et al.* (2007), Ahmed and Mujittapha (2015), Leonard and Olajumoke (2016) and Sucilathangam *et al.* (2016) who reported that currency notes serve as routes for parasite transmission.

Among the different denominations analysed, 100 Naira notes were the most contaminated denomination with 18(72.0%) rate of contamination, followed by 200 Naira which recorded 15(60.0%) and 500 Naira recorded 9(36.0%) (Figure 2).

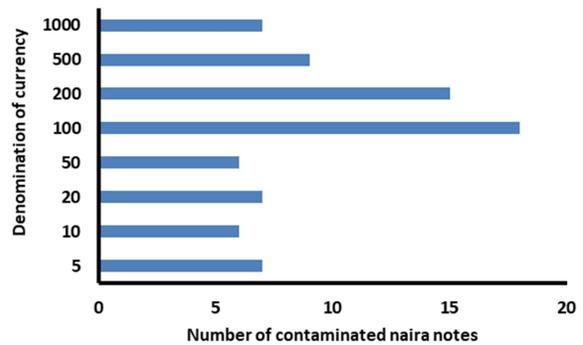


Figure 2: Prevalence of parasite species on the denominations of Nigeria currency notes in Nsukka (n=75; p<0.05)

In Nigeria, these denominations of paper notes are of higher denominations, hence, this indicated that the paper currency notes were more contaminated compared to the polymer notes (5, 10, 20 and 50 Naira notes). The high rate of contamination of the paper over polymer notes (Figure 3) may be as a result of their nature which is more suitable for retention and survival of the parasites. The result of this study was in agreement with the report of Vriesekoop *et al.* (2010) who examined currency notes for the presence of microorganisms in Mexico and stated that polymer-based bank notes were much less contaminated than cotton based notes. The result on the other hand disagreed with the report of El-Dars and Hassan (2005) who reported more contamination of lower denominations because they receive the most handling and are exchanged more.

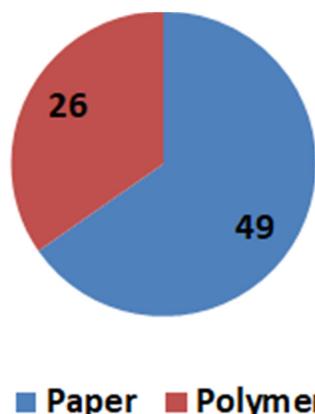


Figure 3: Occurrence of parasites on currency notes based on the nature of the notes

The prevalence of parasitic contamination of Naira notes from different occupational groups revealed highest prevalence among the Butchers (52%) followed by Artisans (48%), Food sellers (36.7%) and Vegetable sellers (34%) while the least prevalence was recorded among the cosmetic shop keepers (25%) (Table 1).

Table 1: Distribution of parasite species on currency notes from different occupational groups in Nsukka Metropolis, Enugu State, Nigeria

Occupation	Number of Currencies Examined	<i>Ascaris</i> ova	Hookworms	<i>Enterobius</i> ova	<i>Entamoeba histolytica</i> cyst	Unidentified cyst	Total (%)
Vegetable sellers	50	7	2	0	6	2	17(34)
Food sellers	30	4	0	0	4	3	11(36.7)
Butchers	25	4	2	0	3	4	13(52)
Shuttle drivers	20	2	0	1	3	0	6(30)
Motorcyclists	30	3	1	0	6	1	11(36.7)
Shop keepers	20	2	0	0	0	3	5(25)
Artisans	25	7	2	0	1	2	12(48)
Total	200	29	7	1	23	15	75(37.5)

The high rate of contamination recorded among notes collected from Butchers may likely be as a result of the fact that animals they slaughter may be infected with these parasites, hence serve as source of contamination of the notes. Most artisans such as motor mechanics, carpenters, vulcanizers and welders are comfortable handling money with their dirty hands thereby contaminating the notes with available parasites. The lowest prevalence of contamination recorded from cosmetic shop keepers may not be

unconnected with their relatively better hygiene. The level of contamination recorded among money collected from them can even be traced to other handlers that bought commodities from them. This was in agreement with the report of Uneke and Ogbu (2007) who stated that parasitic contamination was most prevalence on dirty notes collected from butchers.

Conclusion: The findings of this work showed that currency notes harbour parasitic organisms, hence, are possible source of infection. It is therefore suggested that individuals should improve upon their personal health consciousness by washing hands after handling of currency notes, just as we do after using the toilet. People should most importantly stop the practice of wetting their fingers with saliva during counting of banknotes.

People selling ready-to-eat food should be educated on the danger of handling money with ready-to-eat food. This is to avoid possible cross contamination between currency notes and food by stopping handling of money as they make their sales. Public awareness of the dangers associated with currency notes as a source of infection is also advocated. Though the number of currency notes studied was small relative to notes in circulation in the study area, this study is a representative indication of the dangers in handling of currency

notes. Effort should be made to reduce this contamination of currency notes by full implementation of the Central Bank of Nigeria (CBN) cashless policy.

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REFERENCES

- AHMED, A. and MUJITTAPHA, A. (2015). Prevalence of parasite eggs and cysts on the Naira notes in Katsina. *Journal of Natural and Applied Sciences*, 4(1): 61 – 69.
- ALEMU, A. (2014). Microbial contamination of currency notes and coins in circulation: a potential public health hazard. *Biomedicine and Biotechnology*, 2(3): 46 – 53.
- ANGELAKIS, E., AZHAR, E. I., BIBI, F., YASIR, M., AL-GHAMDI, A. K., ASHSHI, A. M., ELSHEMI, A. G. and RAOULT, D. (2014). Paper money and coins as potential vectors of transmissible disease. *Future Microbiology*, 9(2): 249 – 261.
- BHAT, N., BHAT, S., ASAWA, K. and AGARWAL, A. (2010). An assessment of oral health risk associated with handling of currency notes. *International Journal of Dental Clinics*, 2(3): 14 – 16.
- CITY POPULATION (2023). *Nsukka Local Government Area in Nigeria*. Citypopulation.de. https://citypopulation.de/en/nigeria/admin/enugu/NGA014013_nsukka/ Accessed May 19, 2023.
- EL-DARS, F. M. E. and HASSAN, M. A. (2005). A preliminary bacterial study of Egyptian paper money. *International Journal of Environmental Health Research*, 15(3): 235 – 239.
- GERBA, C. P. (2015). Environmentally transmitted pathogens. Chapter 22, Pages 509 – 550. *In: PEPPER, I. L., GERBA, C. P. and GENTRY, T. J. (Eds.). Environmental Microbiology*. 3rd Edition, Elsevier Incorporated, Houston, USA.
- HASSAN, A., FAROUK, H., HASSANEIN, F. and ABDUL-GHANI, R. (2011). Currency as a potential environmental vehicle for transmitting parasites among food-related workers in Alexandria, Egypt. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 105(9): 519 – 524.
- HOSEN, J. M., SARIF, D. I., RAHMAN, M. M. and AZAD, M. A. K. (2006). Contamination of coliforms in different paper currency notes of Bangladesh. *Pakistan Journal of Biological Sciences*, 9(5): 868 – 870.
- LEONARD, A. O. and OLAJUMOKE, M. (2016). Parasite contamination of Nigerian currencies in Ibadan City, South-West Nigeria. *Annual Research and Review in Biology*, 10(6): 1 – 6.
- MATUR, B. M., MALANN, Y. D. and EDHOMRIEGUE, Y. (2010). A survey of parasite cysts, eggs and bacteria on Nigerian currency in FCT, Abuja. *New York Science Journal*, 3(1): 10 – 13.
- MENSAH, P., YEBOAH-MANU, D., OWUSU-DARKO, K. and ABLORDEY, A. (2002). Street foods in Accra, Ghana: how safe are they?. *Bulletin of the World Health Organization*, 80(7): 546 – 554.
- MICHAELS, B. (2002). Handling money and serving ready-to-eat food. *Food Service Technology*, 2: 1 – 3.
- MOOSAVY, M., SHAVISI, N., WARRINER, K. and MOSTAFAVI, E. (2013). Bacterial contamination of Iranian paper currency. *Iranian Journal of Public Health*, 42(9): 1067 – 1070.

- NEEL, R. (2012). Isolation of pathogenic microorganisms from contaminated paper currency notes in circulation from different market places in Korogwe and Mombo towns in Tanzania. *Journal of Microbiology and Biotechnology Research*, 2(3): 470 – 474.
- NWITE, J. N. and OBI, M. E. (2008). Quantifying the productivity of selected soils in Nsukka and Abakaliki, Southeastern Nigeria using productivity index. *Agro-Science*, 7(3): 170 – 178.
- OKWA, O. O. and BELLO, S. A. (2016). Parasitic organisms on Nigerian currency notes in Ojo Local Government, Lagos, Nigeria. *International Journal of Pure and Applied Zoology*, 4(2): 221 – 224.
- PRASAI, T., YAMI, K. D. and JOSHI, D. R. (2008). Microbial load on paper/polymer currency and coins. *Nepal Journal of Science and Technology*, 9: 105 – 109.
- SIMON-OKE, I. A. and AJILEYE, O. D. (2019). Evaluation of parasites as contaminants of currency notes in Akure, Nigeria. *International Journal of Enteric Pathogens*, 7(2): 44 – 48.
- SUCILATHANGAM, G., REVENTH, A. M., VELVIZHIA and REVATHY, C. (2016). Assessment of microbial contamination of paper currency notes in circulation. *International Journal of Current Microbiology and Applied Sciences*, 5(2): 735 – 741.
- UMEH, E. U., JULUKU, J. U. and ICHOR, T. (2007). Microbial contamination of “Naira” (Nigerian Currency). *Research Journal of Environmental Sciences*, 1(6): 336 – 339.
- UNEKE, C. J. and OGBU, O. (2007). Potential for parasite and bacterial transmission by paper currency in Nigeria. *Journal of Environmental Health*, 69(9): 54 – 62.
- VRIESEKOOOP, F., RUSSELL, C., ALVAREZ-MAYORGA, B., AIDOO, K., YUAN, Q., SCANNELL, A., BEUMER, R. R., JIANG, X., BARRO, N., OTOKUNEFOR, K. and SMITH-ARNOLD, C. (2010). Dirty money: an investigation into the hygiene status of some of the world's currencies as obtained from food outlets. *Foodborne Pathogens and Disease*, 7(12): 1497 – 1502.
- WIKIPEDIA (2023). *Nsukka*. Wikipedia.org. <https://en.wikipedia.org/wiki/Nsukka> Accessed May 19, 2023.



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