

# **B**ACTERIAL CONTAMINATION OF NAIRA NOTES AMONGST MARKET TRADERS IN MAKURDI METROPOLIS, BENUE STATE NIGERIA

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## **ABSTRACT**

**M**oney is very important in the everyday activities of man. Money as a means of exchange of goods and services are contaminated through handling process. Thus, this study was carried out to assess the bacteria contamination of Nigerian currency notes. A total of thirty two (32) samples of different naira notes from three occupational groups which consist of traders, meat sellers and food vendors. The controls were mint currency obtained from the Central Bank of Nigeria Makurdi branch. The swabbing method and serial dilution of sample culture was employed. A total of six (6) bacteria genera was isolated which are, *Staphylococcus aureus*, *Eschericia coli*, *Klebsiella*, *Salmonella typhi*, *Shegella* and *Proteus*. *Staphylococcus aureusi* had the highest

## **Introduction:**

Money is an invention of the human mind. Before the evolution of money, exchange was done by barter, which involved the direct exchange of one good for some quantity of another good. In common usage money refers more specifically to currency, particularly the many circulating currencies with legal tender status. Paper money (or, paper currency) refers to notes of different denominations made of paper and issued by the central bank or the government of a country (Ogbonda *et al.*, 2013). Currency notes are widely exchanged for goods and services worldwide and differs from country to

*bacteria occurrence of 7(31.8%), Shigella and Proteus had the lowest each with 2(9.1%). The mean bacteria load shows that the highest bacterial contamination of the currency notes was observed in #100 across the entire occupational group and there was a significant difference in the contamination ( $P < 0.05$ ) as complained to control of the currency in relation to occupation. The highest bacteria frequency among the denominations was observed in #100 and #200, while #5, #10 with the lowest occurrence. Paper notes had the highest occurrence of bacteria 14 (63.63%) and polymer notes were less contaminated with 8(36.36%). It was concluded from this study that Nigerian currency are contaminated with pathogenic microorganisms which are of Public Health importance. Thus, it was recommended that good hygienic measures should be practiced and Nigerian currency notes should be coated with antimicrobial properties.*

*Keywords: Naira, notes, Bacteria, food, vendors, Public Health.*

**C**ountry (Uneke and Ogbu, 2007). Naira note is the legal tender in Nigeria and it is of two types; Polymer and Paper. The paper naira note is a mixture of 75% cotton and 25% linen (Brady and Kelly, 2000), while the polymer is made from a polymer which is biaxially oriented polypropylene (BOPP). The Nigerian currency notes come as five (5), ten (10), twenty (20), fifty (50), one hundred (100), two hundred (200), five hundred (500), and one thousand (1000) naira notes (Ogbonda *et al.*, 2013).

Money plays an important role in the daily life of consumers, producers, businessmen, traders, academicians, politicians, administrators as a means of exchange. These daily transactions have made the naira note to pass through many hands and pathogens become imposed on them before they are finally deposited in banks (Awodi *et al.*, 2000). In Nigeria, the naira notes presently in circulation are abused by the different ways they are handled and stored which may include but not limited to squeezing, spraying, stapling, cello-taping, keeping naira notes in brassiere, socks and

pockets, under the carpet or rugs, writings on them (Ameh and Balogun, 1997). The contaminated currency notes go in circulation and contaminate the hands of others and across borders transmitting microorganisms in the process since money is not screened for microbes (Pope *et al.*, 2002). Most of these organisms are pathogenic while others are normal flora of the human skin; however, some e.g. *S. aureus* and *P. aeruginosa* can be opportunistic pathogens. This suggests that the notes could serve as fomites for some infectious agents. These routes of transmission are of great importance in the health of many populations in developing countries, where the frequency of infection is a general indication of local hygiene and environmental sanitation levels (Adelowo, 1990).

## Methodology

### Study Area

Benue state lies in the river Benue trough in the middle belt region of Nigeria and has its state capital as Makurdi. Its geographic coordinates are 7° 47' and 10° 0' East, and 6° 25' and 8° 8' North; covering an area of 34,059 square kilometres and shares boundaries with five other states namely: Nasarawa State to the north, Taraba State to the east, Cross-River State to the south, Enugu State to the south-west and Kogi State to the west. The state also shares a common boundary with the Republic of Cameroon on the south-east. Benue state has a population of 4,219,244 people (National Population Commission, 2007).

### Collection of Samples

A total of Twenty four (24) samples of naira notes of each denomination (N5-1000) were collected from meat sellers, traders and food vendors within Makurdi. Samples of notes were obtained by exchanging notes with new notes or after buying items with bigger denominations. The notes were collected with hands covered with disposable sterile gloves and were immediately transferred into polythene bags and labeled accordingly. The notes were taken to the Microbiology Laboratory of Benue State University for bacteriological examinations.

### Bacterial Isolation and Identification

The method of Races *et al.* (2014) was adopted for this study. Isolation of various bacterial contaminants was performed using the swabbing method. A sterile swab stick moistened with normal saline was used to swab both sides of the currency note. The swab stick was streaked on the surface of the prepared media. The inoculated plates were incubated at 37°C for 24 hours and observed for growth. Plates with mixed colonies were further subculture in order to obtain pure colonies. Colony growth was observed for morphological characteristics such as the extent of growth, colour, shape, elevation, texture and nature of colony edge. Final characterization was conducted by carrying out some biochemical test such as gram staining techniques, catalase test as well as citrate utilization were carried out. Identification of the isolated bacteria was done using the Bergey's Manual of Determinative Bacteriology as reported by Cheesbrough, (2002).

### Data Analysis

Data was presented using descriptive statistics and Chi-square test was used to show significant relationship between contaminations and denomination of the currency notes at 5% level of probability

### RESULTS

The mean bacterial load of each Naira note from the sampling group was presented in Table 2. It was observed that N 100 has the highest bacterial load in traders and meat sellers with  $139 \times 10^3$  and  $186 \times 10^3$  cfu/ml respectively. In food vendors, N 200 has the highest bacterial load with  $156 \times 10^3$  cfu/ml. N 5 has the least bacterial load across the three occupations with  $21 \times 10^3$ ,  $31 \times 10^3$ , and  $25 \times 10^3$  cfu/ml respectively. There was a significant relationship ( $P < 0.05$ ) in the mean bacterial load of currency with respect to the occupation.

**Table 1. Physical conditions of each denomination**

Denominations (N)	Condition
Mint	Neat
5	Fairly clean and wrinkle
10	Cellotape, dirty and wrinkle

20	Torned, dirty and wrinkle
50	Dirty, wrinkle and odorous
100	Very dirty and odorous
200	Fairly dirty, torned and soiled
500	Fairly clean and torned
1000	Dirty and odorous

Table 2. Mean bacterial load of each Naira note sample associated with targeted group

Bacterial load ( $\times 10^3$ ) cfu/ml			
denomination	Traders	Meat sellers	Food vendors
5	21	31	25
10	43	41	52
20	33	42	36
50	35	65	45
100	139	186	126
200	106	171	156
500	93	157	106
1000	71	155	76

$F_{(2,2015)} = 7.78, P < 0.05$

Table 3 shows the frequency of isolated bacteria from each Naira denominations. Six (6) bacteria species of *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella*, *Salmonella typhi*, *Shigella* and *Proteus*. *S. aureus* has the highest occurrence with 7 (31.81%), followed by *E. coli* and *S. typhi* with four (4) each (18.18%) and the lowest being *Shigella* and *Proteus* with Two (2) each (9.09%). The result showed that the highest bacterial count was found in N 100 and N 200 each with 5, followed by N 20, N 50 and N 500 each with 3 and the lowest count was found in N 5, N 10 and N 1000. Although there was no significant relationship ( $\chi^2 = 5.407, P > 0.05, df =$ ) in bacteria occurrence on naira notes.

Table 3 Bacterial isolate from each denomination

Bacterial Isolates	Naira (N)								Total
	5	10	20	50	100	200	500	1000	
<i>Staphylococcus aureus</i>	1	0	0	1	1	2	2	0	7
<i>Escherichia coli</i>	0	1	1	0	0	1	1	0	4
<i>Klebsiella</i>	0	0	1	0	1	0	0	1	3
<i>Salmonella typhi</i>	0	0	1	1	1	1	0	0	4
<i>Shigella</i>	0	0	0	1	1	0	0	0	2
<i>Proteus</i>	0	0	0	0	1	0	0	1	2
Total	1	1	3	3	5	4	3	2	22

$$\chi^2 = 5.407, P > 0.05, df =$$

The percentage occurrence of bacteria isolates from each occupation was shown in Table 4. The highest occurrence of bacteria was found in meat sellers with 12 (54.54%), followed by Traders with 6 (27.27%) and food vendors with 4 (18.18%).

Table 4. Percentage occurrence of bacteria isolates from different population group

Bacterial isolates	Traders	Meat sellers	Food vendors	Total
<i>Staphylococcus aureus</i>	2(33.33)	4(33.33)	1(25)	7 (31.81%)
<i>Escherichia coli</i>	1(16.66)	3(25)	0(0)	4 (18.18%)
<i>Klebsiella</i>	1(16.66)	1(8.33)	1(25)	3 (13.63%)
<i>Salmonella typhi</i>	1(16.66)	2(16.66)	1(25)	4 (18.18%)
<i>Shigella</i>	0(0)	1(8.33)	1(25)	2 (9.09%)
<i>Proteus</i>	1(16.66)	1(8.33)	0(0)	2 (9.09%)
Total	6 (27.27%)	12 (54.54%)	4 (18.18%)	22 (100)

Table 5. Biochemical test on isolated bacteria

	Triple Sugar Iron Agar									
	Ca	Co	Ci	Ur	GR	Gas	H2S	Glu	Lac	Suc
<i>S.aureus</i>	+	+	+	+	+	-	-	-	-	-

<i>E. coli</i>	+	-	-	-	-	+	-	+	+	-
<i>Klebsiellasp</i>	+	-	+	+	-	+	-	+	+	+
<i>S.typhi</i>	+	-	-	-	-	+	+	+	+	-
<i>Shigella</i>	+	-	-	-	-	+	-	+	-	-
<i>Proteussp</i>	+	-	+	+	-	+	+	+	-	-

**Key: + present, - Absence**

Ca: Catalase

Co: Coagulase

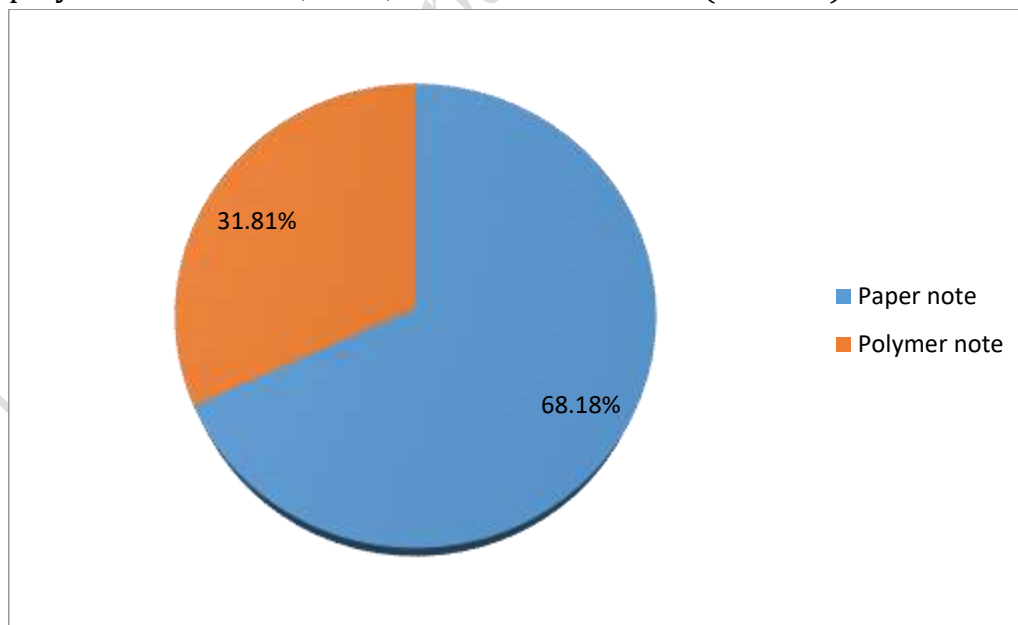
Ci: Citrate

Ur: Urease

GR: Gram reaction

TSI: Triple sugar Iron Agar

Figure 1 was a representation of the bacterial frequency associated with the type of naira note. There are two naira note which are the polymer and the paper note. It was observed that paper note of N 100, N 200, N 500 and N 1000 had the highest rate of contamination with 14 (63.63%) and polymer note of N 5, N 10, N 20 and N 50 had 8 (36.36%).



**Figure1.** Bacterial contamination on different types of currency note.



## Discussion

Money is a valuable item and a means of exchange in everyday activity. The results from this study on the bacteria contamination of Nigerian currency note revealed that the currency notes are contaminated with bacteria. From this study, Six (6) bacteria genera of *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella*, *Salmonella typhi*, *Shigella* and *Proteus* were found to be associated with contamination of Nigerian currency note. This research is similar to works carried out by other researchers such as; Adamu *et al.* (2012) who reported to isolate *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella*, *Proteus*, *Pseudomonas* and *Streptococcus* sp. from Nigerian currency note. Also Raeces *et al.* (2014) isolated bacteria genera of *Escherichia coli*, *Staphylococcus aureus*, *Salmonella sp.*, *Proteus*, *Streptococcus pneumoniae*, *Mirabilis* and *Bacillus* sp. Also. Mbajiuka *et al.* (2014); Kawo *et al.* (2009); Umeh *et al.* (2007) have also reported bacteria genera of *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella*, *Pseudomonas*, *Salmonella typhi*, *Streptococcus faecalis*, *Listeria*, *Micrococcus*, *Clostridium* and *Listeria* in contamination of Nigerian currency note. Money is used in day to day transactions and is being handled by persons of varying health and hygienic standards which might account for these bacteria organisms found associated with Nigerian currency. Also unhygienic habits/practices of keeping money or handling such as keeping money in socks, shoes, underwear, counting of money with saliva have all been attributed to ways through which these organisms are introduced and contaminate the money (Sanjogita and Geeta, 2014).

The bacteria genera of *S.aureus* show the highest frequency of occurrence with 7 (31.81%). This findings concurs with works of Adamu *et al.* (2012); Mbajiuka *et al.* (2014) who all reported *S.aureus* to have the highest occurrence in their research. *S.aureus* is a virulent, non-spore forming organism that survives outside a living host for a prolonged period of time and can be attributed to the reason for its high frequency on these notes (Pope *et al.*, 2002). Also *S.aureus* can cause a range of illnesses from minor skin infections such as pimples to life threatening diseases. *Klebsiella* is a virulent organism that causes both community and hospital acquired



infections such as pneumonia along with urinary tract infections. The presence of *E.coli* was an indicator of poor hygiene.

The result on the frequency of bacteria isolated from each denomination on Table 3 showed that the highest bacterial occurrence were recorded in N 100 and N200 with 5 (22.73%) and 4 (18.18%) respectively while the least were found on N 5, N 10 each with 1 (4.55). This agrees with the work of Adamu *et al.* (2012) who reported N 100 and N 200 to have the highest bacteria occurrence. However, this was in contrast to Mailafia *et al.* (2009) who reported N5, N 10 and N 20 to be more contaminated. The highest frequency of bacteria obtained on those currencies in this study can be attributed to the fact that they are mostly used nowadays in day to day petty transactions. Also these smaller denominations are more and easily abused and often mal-handled thus rendering the currency tattered and dirty and more likely to be exposed to risk of being contaminated (Awe *et al.*, 2010).

Result obtained in respect to occupational groups on Table 4 revealed that contamination was highest in meat sellers with 12 (54.54%) than the other group. The higher microbial count on the currency from this occupational group can be attributed to the environment in the market which is low level of sanitation in addition to the questionable personal hygiene of the fish sellers. There was no significant relationship ( $\chi^2= 1.570$ ,  $P>0.05$ ) in occurrence of bacteria among the group. The type of materials from which currency are made of also contribute to their occurrence and contamination. Paper note has the highest bacteria occurrence with 68.18% while polymer note has the least with 31.81%. Comparative analysis on work done on the cotton based bank notes and the polymer note using electron microscope was reported by Vrieselo *et al.* (2010). It was reported that the cotton based notes had rough surfaces while the polymer notes are a biaxial polypropylene based substrate that provide a relatively smooth surface that hinder adherence of bacteria .

## Conclusion

From findings in this project work, it was concluded that different genera of bacteria contaminate the naira notes in circulation in Makurdi. The potential health danger of mutilated naira notes is obvious and the chances

of contracting infection are enhanced by the non-withdrawal of the mutilated notes from circulation. These naira notes pass from person to person without any sanitization or disinfection and can therefore act as vehicles of transmission of infectious agents (that is, acts as fomites). Findings also show that the low denominations were less contaminated than the higher denominations. Also, the work reveals that the level of microbial contaminations varies within the occupational group and the currency notes. The species of microbes isolated from the different notes in the different sampling group show clearly that pathogens are harboured by the notes and this was considered a threat to the safety of the money users.

### Recommendation

Based on the findings from this research it is therefore proposed the following recommendations;

Hygienic measures such as thorough hand washing with soap after using currency notes should be observed and public enlightenment campaigns on good money handling practices should be done by money regulating agencies, Schools and Stakeholders

Monies deposited in banks should be thoroughly disinfected using ultraviolet light and also ATM machines should be in built with antimicrobial sanitizers either through heating process or with antimicrobials to destroy the microbes

### REFERENCES

- Adamu, J.Y., Jairus, Y. and Ameh, J.A. (2012). Bacterial contaminants of Nigerian currency notes and associated risk factors. *Research Journal of Medical Sciences*, 6(1):1-6.
- Adelowo, O.A. (1990). Intestinal Helminthiasis in a post-secondary institution in Ilorin, Kwara State, Nigeria. *The Nigerian Journal of Parasitology*, 9(11):91-94.
- Ameh, J.B. and Balogun, Y.O. (1997). The health implications of microbial load of abused naira notes. *The Spectrum*, 4:138-140.

- Awe, S., Eniola, K.I.T., Ojo, F.T. and Sani, A. (2010). Bacteriological quality of some Nigerian currencies in circulation. *African Journal of Microbiology Research*, 4: 2231-2234
- Awodi, N.O., Nock, I.H. and Aken'Ova, I. (2000). Prevalence and public health significance of parasitic cyst and eggs on the Nigeria currency. *The Nigerian Journal of Parasitology*, 22:137-142.
- Cheesbrough, M. (2002). District Laboratory Practice in Tropical countries: Part 2. UK: Cambridge CBZ ZRU. Cambridge University Press, pp. 97 – 105.
- Kawo, A.H., Adam, M.S., Abdullahi, B.A. and Sani, N.M. (2009). Prevalence and public health implications of the microbial load of abused naira notes. *Bayero Journal of Pure and Applied Sciences*, 2(1):52-57
- Mbajiuka, C.S., Obeagu, E.I., Nwosu, D.C. and Agbo, C.E. (2014). Microbiological evaluation of naira notes handled by fish sellers in Umuahia metropolis. *World Engineering and Applied Sciences Journal*, 5(2):44-52
- National Population Commission (2009), Federal Republic of Nigeria Official Gazette. 96 (2).
- Ogbonda, K.H., Oku, I.Y., Okwelle, A.A. and George, T.S. (2013). The incidence of human disease-causing fungi on Nigeria paper money. *International Journal of Microbiology and Immunology Research*, 10(1):6-10
- Pope, T.M., Ender, P.T., Woelk, W.K.K. and Koroscil, T.M. (2002). Bacterial contamination of
- Races, B., Shafiq, A., Hakim, S.T. and Nadeem, S.G. (2014). Paper Currency: A potential formite for pathogenic bacteria. *Journal of Medical Mycology Research*, 5(2):22-27
- Sanjogita, S. and Geeta, S. (2014). Contaminated money in circulation: A review. *International Journal of Recent Scientific Research*, 5(9):1533-1540.

- Umeh, E.U., Juluku, J.U. and Ichor, T. (2007). Microbial contamination of Naira (Nigerian currency) notes in circulation. *Research Journal of Environmental Sciences*, 1(6):336- 339.
- Uneke, C.J. and Ogbu, O. (2007). Potential for parasites and bacterial transition by paper currency in Nigeria. *Journal of Environmental Health*, 69:54-60.
- Vriesekoop, F., Russell, C., Mayorga, B.A., Aidoo, K., Yuan, Q., Scannell, A., Beumer, R.R., Jiang, X., Barro, N., Otokunefor, K., Arnold, C.S., Heap, A., Chen, J., Iturriaga, M.H., Hazeleger, W., Landes, J., Kinley, B., Wilson, K., and Menz, G., 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*, 7:1497-1502.