Original Research Article

Bacteriological Evaluation of Nigerian Paper Currency (Naira Notes) Circulating In Owerri, Imo State

ABSTRACT

Generally, the contamination of currencies with various microbial species is increasingly being reported. This usually results from improper handling during exchange of goods, services and certain environmental factors. This study on the bacteriological evaluation of the Nigerian paper currency (Naira notes) circulating in Owerri, Imo State was carried out with the aim of evaluating the prevalence of bacteria contaminants of Nigerian currency notes in circulation. A total of One hundred and twenty (120) Naira notes of ₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500 and ₦1000 denominations were collected in separate polythene bags from traders, students, hawkers, meat sellers, food vendors, taxi drivers, keke drivers and banks for the study. The notes were chosen on the basis of denominations and physical appearance (Mint, Neat, dirty, very dirty and mutilated). Each of the notes was inserted into a sterile bottle containing 10mls of distilled water and allowed to stand for twenty minutes. Double dilution of the solution was inoculated into Nutrient agar, MacConkey agar, Mannitol Salt agar and Salmonella and Shigella agar for viable counts. Further identification of the bacteria was carried out using standard morphological and biochemical tests. The data from this study were subjected to statistical analysis using percentage, charts and anova. The result from the analysis showed that, 82 (68.33%) out of the

120 samples evaluated were contaminated. The study showed that dirty naira notes are potential routes for bacteriological disease transmission to man during handling and constitutes a public health risk. Therefore, the appropriate authorities should embark on public enlightenment campaign targeted at the handlers and associated risks.

Keywords: Paper Currency, Naira Notes, Nigeria, Contamination, Bacteria

1.0. INTRODUCTION

In ancient times, people did not need money for successful daily transactions, they practiced trade by barter as a medium of exchange that did not involve money [1, 2].

The naira note is the official currency of the federal republic of Nigeria, issued and regulated by the central bank of Nigeria (CBN). Abused naira notes were reported as vehicles of bacteria and agents of cross contamination. They serve as means of fueling the spread of diseases and thereby posing a risk to public health [3].

Contamination of different objects by potential pathogenic microorganisms is a serious concern of public health because items that pass from one hand to another gives the opportunity of contamination with wide range of pathogenic microorganisms [4]. The physical transfer of material from hands, surfaces and the environment can contaminate paper currencies due to the fact that almost every socio-economic setting regularly handle the paper currencies [5].

Evidences of microbial contamination of currency notes have been reported by various researchers from Myanmar [6], Turkey [7], Australia [8], India [9], China [10] and Ghana [11].

In Nigeria, the paper currency is highly abused especially through handling. Presently, it is commonly seen faded, torn, stapled, cello-taped, squeezed and written on them. The contamination of the naira notes could also be from several sources as listed above. Also, it may occur from the atmosphere during production, after production and during storage [12].

In Nigeria, few studies have reported the microbial contamination of Naira paper currency notes. Studies of the contamination of money with microbial agents is lacking in Owerri, Imo state. Knowledge of the microbial diversity of currency notes in circulation can provide the basis for raise health consciousness in people during currency handling and effective control of infection transmission. Hence, this study was undertaken to identify microbial contamination of Nigerian currency notes in circulation and evaluate prevalence of bacteriological organisms on Nigerian currency notes.

2.0. MATERIALS AND METHODS

Sample Collection

A total of 120 samples of the Nigerian Notes consisting of Fifteen (15) pieces of each Naira denomination (₦5 to ₦1,000) notes were collected, three from each category according to the state of the currency (Neat, Dirty, Very dirty, Dirty and mutilated and Mint).Collections were made from Keke drivers, Taxi drivers, Students of Imo State University Owerri, Food vendors and individuals living at shell camp, Meat seller, Hawkers etc and Banks in Owerri which served as control. The nature of the notes collected were categorized as follows: clean notes (neat notes), dirty notes, very dirty notes, dirty and mutilated notes and mint (fresh notes).

Bacterial Quality Analysis

Each currency note was soaked in a 10ml of sterile water contained in a clean sterile universal container for 10minutes at room temperature. The containers bearing the notes were covered and intermittently rotated to dislodge the cells into the suspension. The naira notes were removed using a pair of forceps and transferred to a polythene bag. 1.0ml of water from each soaked naira note was collected and dispensed in 240 (two hundred and forty) sterile petri dishes before pouring molten agar. Molten MacConkey agar was poured into one hundred and twenty (120) petri dishes that contain 1.0ml of water from each soaked naira notes while molten nutrient agar was poured into the remaining 120 petri dishes. After pouring the agar used as dictated above into the petri dishes, each was rotated to mix, allowed to cool and solidify before incubation at 37^0C for 24 hours. After 24 hours incubation, the number of colony forming unit (cfu/ml) was counted and the bacterial load of each naira notes was determined (Nutrient agar cultured petri dishes were used for colonial count, while MacConkey agar cultured plates were used for morphological identification).

Identification

The pure isolates were sub-cultured into nutrient agar slant for 24 hours at 37^0C for bacterial identification. Then the discrete bacterial colony in each medium was characterized based on colonial morphology, cellular morphology, staining and biochemical characteristics using standard microbiological technique.

Statistical Analysis

The statistical analysis was carried out using frequency distribution tables and ANOVA was used also to determine the degree of significance between the different group means.

3.0. RESULTS

Table 1: Mean± SD of viable count of the bacteria for the various denominations in relation to mint(controls).

Denomination (₦)	**Number of Samples Examined**	**Mean ± SD Viable Count (Cfu/ml)**	**P value**
5	12	6.0 ± 1.8	**.698**
10	12	5.6 ±1.6	**.508**
20	12	7.3 ±1.6	**.363**
50	12	6.1 ±1.3	**.383**
100	12	6.5 ±6.4	**.398**
200	12	4.8 ±3.2	**.522**
500	12	4.7 ±1.3	**.750**
1000	12	4.5 ±7.6	**.713**
Controls	24	3.5 ±1.7	

When P value < 0.05 = Significant and P value > 0.05 = Not Significant. df (7)

There was no statistically significant difference between the mean ± SD values of the viable counts of the various Naira notes used for this study when compared with the controls.

Table 2: Rate of Contamination of the various denominations

Denomination (₦)	**Number of Samples Examined**	**Number of Samples Contaminated**	**Rate of Contamination**
5	12	10	83.3%

10	12	11	91.6%
20	12	11	91.6%
50	12	11	91.6%
100	12	9	75.0%
200	12	9	75.0%
500	12	8	66.6%
1000	12	5	41.6%
Controls	24	8	33.3%
Total	120	82	68.33%

From table 2 above, the currencies were grouped into 3; the lower currencies, the higher currencies and the control currencies. Out of the 120 currencies that was analyzed, 82 (68.33%) was contaminated, 43 out of 82 was from the group of lower currencies while 32 out of 82 was from the higher currencies, while 8 out 82 was from the control.

Table 3: Rate of contamination of the various states of the currency with no respect to denominations.

State of Currency	Number of samples Examined	Number contaminated	Rate of contamination
Neat	24	18	75%
Dirty	24	24	100%
Very dirty	24	24	100%
Dirty and mutilated	24	24	100%
Mint (Control)	24	8	33.33%

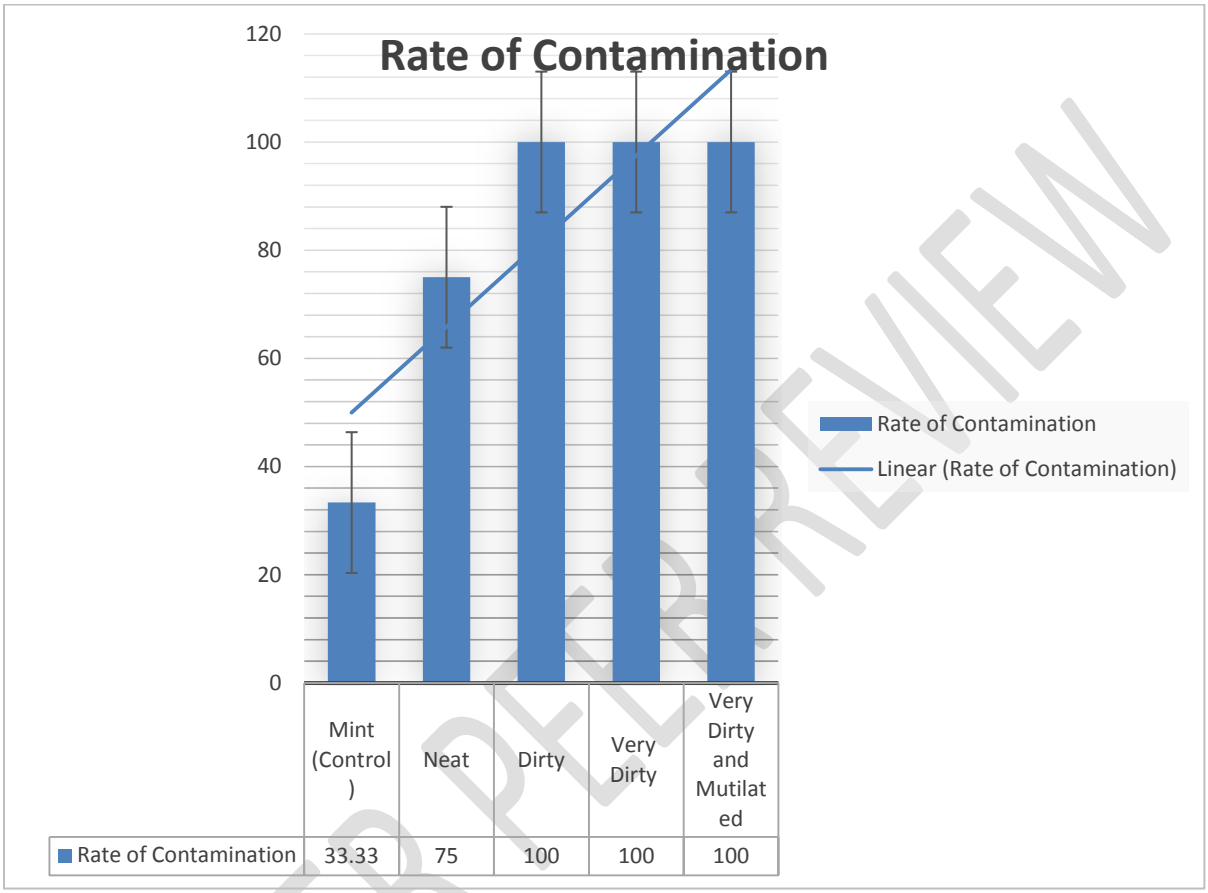

Figure 1: Rate of Contamination of the various groups of currency in relation to control

From the chart above, allthe currencies grouped as dirty, very dirty and dirty and mutilated were contaminated 100% contamination, 75% of the currencies in the neat was contaminated while 33.33% of the control was contaminated.

Table 4: Bacterial prevalencewith respect to various groups of the currency in relation to control.

State of currency	**Bacteriological colonial counts (%) of the organisms that contaminated the Naira notes**						**Prevalence (%)**
	Yersinia species	***Staphylococcus aureus***	***Bacillus species***	***Escherichia coli***	***Pseudomonas species***	***Klebsiella Species***	
Neat	10(6.85%)	7(4.79%)	2(1.37%)	1(0.68%)	1(0.68%)	5(3.42%)	26(17.81%)
Dirty	11(7.53%)	13(8.90%)	2(1.37%)	5(3.42%)	1(0.68%)	4(2.74%)	36(24.66%)
Very dirty	8(2.72%)	7(4.79%)	7(4.79%)	7(4.79%)	3(1.37%)	6(3.42%)	38(26.03%)
Dirty and mutilated	11(5.48%)	14(5.48%)	7(4.79%)	2(1.37%)	1(0.68%)	2(1.37%)	37(25.34%)
Mint (control	0(0%)	4(2.72%)	3(2.05%)	0(0%)	0(0%)	2(1.37%)	9(6.16%)

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TOTAL	40(27.40 %)	45(30.82%)	21(14.38 %)	15(10.27 %)	6(3.42%)	19(13.01 %)	**146(100 %)**

From the table above, the most isolated organism was *Staphylococcus aureus* 45(30.82%),followed by *Yersinia species* 40(27.40%), *Bacillus species* 21(14.38%), *Klebsiella species* 19(13.01%), *Escherichia coli* 15(10.27%) and *Pseudomonas species* 6(3.42%).Also, the very dirty, the dirty and mutilated and dirty had very high prevalence, 38(26.03%), 37(25.34%) and 36(24.66%) respectively, with the neat having a relatively lower prevalence of 26(17.81%) in relation to the mint (control currencies) which had a relatively lower prevalence 9(6.16%) in relation to other groups of currencies.

Table 5: Bacterial prevalence with respect to denominations of the currency in relation tocontrol.

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Naira notes	Bacteriological colonial counts (%) of the organisms that contaminated the Naira notes	Prevalen

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	Yersinia species	***Staphylococcus aureus***	***Bacillus species***	***Escherichia coli***	***Pseudomonas species***	***Klebsiella Species***	
5	3 (2.05%)	7 (4.79%)	2(1.37%)	1 (0.68%)	0 (0%)	0 (0%)	13(8.9%)
10	1 (0.68%)	8 (5.48%)	0 (0%)	4 (2.74%)	1 (0.68%)	0 (0%)	14(9.59 %)
20	4 (2.72%)	5 (3.42%)	3 (2.05%)	2 (1.37%)	0 (0%)	3 (2.05%)	17(11.64 %)
50	5 (3.42%)	4 (2.72%)	2 (1.37%)	0 (0%)	3 (2.05%)	0 (0%)	14(9.59%)
100	8 (5.48%)	8 (5.48%)	5 (3.42%)	0 (0%)	0 (0%)	1 (0%)	22(15.07 %)
200	4 (2.72%)	0 (0%)	5 (3.42%)	5 (3.42%)	2 (1.37%)	5 (3.42%)	21(14.38 %)
500	8 (5.48%)	7 (4.79%)	0(0%)	3 (2.05%)	0 (0%)	3 (2.05%)	21(14.38 %)
1000	7 (4.79%)	2 (13.3%)	1 (0.68%)	0 (0%)	0 (0%)	5 (3.42%)	15(10.27 %)
Control	0 (0%)	4 (2.72%)	3 (2.05%)	0 (0%)	0 (0%)	2 (1.37%)	9 (6.16%)
Total	40(27.40 %)	45(30.82%)	21(14.38 %)	15(10.27 %)	6(4.11%)	19(13.01 %)	**146(100 %)**

In table 5, the control currencies had a prevalence of 9 (6.16%) which is relatively lower compared with the rest of the denominations. The denomination with the highest prevalence was the 100 Naira currency notes 22 (15.07%) followed by the 200 and 500 Naira notes with 21 (14.38%) each, N20, 17(11.64%), N1000, 15(10.27%), N50 and N10, 14(9.59%) each and the N5, 13 (88.9%).

DISCUSSION

This study has shown that there was no statistically significant difference between the mean ± SD values of the viable counts of the various Naira notes used for this study when compared with the controls as shown in table 1. This means that most Nigerian currency notes within Owerri Imo State metropolis are contaminated with a variety of micro-organism some of which are pathogenic, including the mint (control currencies).This finding is consistent with high contamination rate reported by other researchers across the country [13].

The lower denomination of ₦5, ₦10, ₦20 an ₦50 had higher rates of contamination than the higher denomination of₦100, ₦200, ₦500 and ₦1000, etc. as shown in table 2.This finding corresponds to the works of Matur *et al.,* [12]; Okoh *et al.,* [14] and Simeon-Oke, *et al.,*[15].The reason may be that these smaller denominations are being used in our everyday petty transaction. Also, the high level of contamination of Nigerian currency notes as shown in table 2 is a potential threat to man because of the fact that money is continuously circulated hence the possibility of bacteria been transmitted as demonstrated by Oluduro *et al.,*[16].

From table 3, the dirty, very dirty and dirty and mutilated had 100% rate of contamination which corresponds to all (24), in each group being contaminated, while the neat had 75% contamination which corresponds to (18). In relation to control, 33.33% rate of contamination which corresponds to 8 out of 24 samples. Similarly, in a neighboring West Africa country, 100 % contamination rate has been reported in some currencies[17, 18].Also, 100 % contamination of certain currencies has been recorded outside of Africa like in Pakistani and Europe[19, 20].The contamination may have aroused from simultaneous handling of the currency notes and various articles during exchange at selling points [21].

From table 4 above, the most isolated organism was *Staphylococcus aureus* 45(30.82%),followed by *Yersinia species* 40(27.40%), *Bacillus species* 21(14.38%), *Klebsiella species* 19(13.01%), *Escherichia coli* 15(10.27%) and *Pseudomonas species* 6(3.42%).Also, the very dirty, the dirty and mutilated and dirty had very high prevalence, 38(26.03%), 37(25.34%) and 36(24.66%) respectively, with the neat having a relatively lower prevalence of 26(17.81%) in relation to the mint (control currencies) which had a relatively lower prevalence 9(6.16%) in relation to other groups of currencies. Most of the bacteria encountered in this study are members of the human flora and the environment. This suggests that humans are the major source of bacteria on naira notes. The notes could have been colonized when placed in places where they make direct contact with the skin.

The predominance of *Staphylococcus aureus*, is followed by *Yersinia spp* and other enteric Gram-negative bacteria among the isolated bacteria may be due to poor hygiene (both personal and environmental) in the study area. This is in contrast with a result of a study in Nigeria by Olowo-okere *et al.*, [18] where *E. coli* isolates were the most prevalent detected among the bacteria isolated in his study with the Naira paper currency notes.

In table 5, the control currencies had a prevalence of 9 (6.16%) which is relatively lower compared with the rest of the denominations. Generally, it can be deduced that lower denominationshad the highest prevalence. The heavy contamination of lower denomination currencies observed in this study concurs with the findings of other researchers [22, 23]. This may be attributed to high use and frequent exchange of lower denomination currencies than the higher denominations in daily cash transactions.

CONCLUSION

The naira notes pass from person to person without any sanitization or disinfection. They can therefore act as vehicles of transmission of infectious agents (fomites) as shown in this study. Therefore, the likelihood of contacting infection due to contact with dirty naira notes is thus high. The present study has shown that abused naira notes are contaminated with various microbial agent which may be through cash transactions in the community. The occurrence of the heavy load of micro-organisms on the abused naira notes can constitute a potential health hazard to users. It is therefore advised that money should be handled in a manner that does not get contaminated with dirt, disease-causing agents or become unduly mutilated. Handler of notes especially those who put them in areas where there is intimate contact with the skin should exercise caution; as there is risk of infection by bacteria resident on the notes. Also, the habit of wetting finger with saliva while counting naira notes should be avoided, organism on the notes could be transferred to the mouth by this action.

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