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Bacteriological Evaluation of Naira Notes Used In Aba, Nigeria and There Antibiotic Susceptibility Pattern

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***Abstract**: Bacteria associated with mutilated Nigerian currencies in circulation were investigated. The Naira notes were randomly collected within Aba, Abia state and analysed microbiologically using standard method. The mean viable count of the currencies ranges from 0.8x108 to 5.0x10^8 cfu/ml. The ten naira notes (N10) had the highest average total viable count of 5.0x10^{8}cfu/ml, followed by two hundred naira notes (N200) 3.0x10^8 cfu/ml, one hundred naira notes (N100) 2.6x10^8 cfu/ml five hundred naira notes (N500) 2.3x10^8 cfu/ml, twenty naira notes (N20)2.0x10^8 and fifty naira notes (N50) 2.0x10^8 cfu/ml while one thousand naira notes and five naira notes (N1000 and N5) had the least mean viable count of 0.8x10^8 and 1.9x10^8 cfu/ml respectively. Three bacterial species were isolated which included Staphylococcus aureus, Klebsiella sp., and, Bacillus subtilis. The Antibiotic susceptibility test showed the most isolates were susceptible to the test antibiotics except for Amoxil, Nalidixic Acid and Septrim. The present study therefore suggests need for public awareness on the risk of improper handling and use of currency notes especially among children.*

***Keywords:** Currencies, Naira Notes, Antibiotic Resistance, Susceptibility.*

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I. Introduction

Paper and polymer currency notes are extensively used in barter and trade (exchange for goods and services), settlement of debts and for deferred payments in economic activities. 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 etc (Ameh and Balogun, 1997). However, There is well documented evidence suggesting that currency notes could act as fomites with enormous potential to carry microbes.

The contamination of the naira notes could be from several sources, it could be from the atmosphere, during storage, usage, handling or production (Ogba, 2007). 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. aeroginosa* can be opportunistic pathogens. This suggests that the notes could serve as formites 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).

The survival of various microorganisms on money and other fomites, with their transmission via the hands of market men and women and other users is often overlooked as enteric disease reservoir (Michaels, 2002). Pathogenic microorganisms that may survive on currency notes may serve as a potential source of enteropathogens (Michaels, 2002; Cardoen *et al*., 2009; Lamichhane *et al.*, 2009). Contamination of objects by pathogenic microorganisms is of much public health concern as contaminated meat, butcher's hands, utensils, tables and the exchange of currency can be sources of transmitting pathogens. In addition, currency notes have also been evaluated for their potential to transmit infectious pathogens like *Ascaris lumbricoides*, *Enterobius vermicularis*, *Trichuris trichiura* and *Taenia species* (Uneke and Ogbu, 2007). Carrier micro-organisms apart from reducing the lifespan of the notes, have been documented to cause infections in the skin, eye, gastrointestinal tract, internal organs (Yildiran, *et al.*, 2006), as well as the respiratory tract (Denning, 2006) in humans. Microorganisms such as *Micrococcus* spp., *Corynebacterium* spp., *Vibrio cholerae*, *Mycobacterium tuberculosis* and members of the *Enterobacteriacea* family top the list subsequently.

In Nigeria, Naira note is the legal tender and it's 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) (https://en.wikipedia.org/wiki/Polymer_banknote).

II. Materials And Method

SAMPLE COLLECTION

The different denomination of Nigeria currency (old and New) from N5 to N1, 000 notes were collected within Aba, Abia State and the new (mint) Notes were obtained from a banks. The samples were collected with gloves into a separate sterile polythene bags labelled and were transported to microbiology laboratory, Abia State Polytechnic, Aba for microbial analysis.

SAMPLE ANALYSIS

Each of the naira notes was aseptically transferred in the a sterile beaker containing 50ml of sterile peptone water which was then gently shaken to give us the resultant test sample for inoculation. The solution was then homogenized and a 10-fold serial diluted from 10^{-1} to 10^{-7} was made. A 1.0ml aliquot of the 10^{-4} serially diluted sample was inoculated in MacConkey and Nutrient agar, Eosin methylene blue agar, Mannitol salt agar and Potatoes dextrose agar (fungi) in pairs and the inoculated plates were incubated in an inverted position at 35 to 37°C for 24h (bacteria) and fungi (PDA plates) at room temperature for 24 to 72h. The plates were then examined for bacterial and fungal growth after the incubation period.

ISOLATION OF BACTERIAL AND FUNGAL COLONIES

Observed mixed colonies on MacConkey agar and nutrient agar for the bacterial cultures were sub-cultured on fresh Nutrient agar by streaking according to (Cheesbrough, 2000) and the plates were incubated in an inverted position at 37^{o}C for 24h. The mixed growth of the fungi on PDA was sub-cultured on fresh potato dextrose agar and they were incubated for 72h at 25^{o}C for discrete growth. The discrete colonies on each fresh agar plate were observed and recorded. The cultural, morphological and biochemical characteristics was done according to Cheesbrough, 2000.

III. Result

Table1: Mean Microbial count on the Currency (Old And New) Samples

OLD SAMPLES	TVBC NA cfu/ml	TCC (MCA) cfu/ml	TFCC cfu/ml(EMB)
5	1.9×10^8	2.0×10^8	0
10	5.0×10^8	4.1×10^8	0
20	2.0×10^8	2.5×10^8	0
50	2.0×10^8	3.5×10^8	0
100	2.6×10^8	3.1×10^8	0
200	3.0×10^8	0	0
500	2.3×10^8	0	0
1,000	0.8×10^8	0	0
NEW SAMPLS			
5	1.0×10^8	0	0
10	1.3×10^8	0	0
20	0	0	0
50	1.3×10^8	0	0
100	1.0×10^8	0	0
200	0.9×10^8	0	0
500	0	0	0
1,000	0	0	0

TABLE 2: Occurrence Of Bacteria In The Sample

BACTERIA	NO OF ISOLATES	OCCURRENCE (%)
Bacillus sp	12	54.54%
Klebsiella sp	5	22.73%
Staphylococcus sp	5	22.73%
Total	**22**	**100%**

TABLE 3: Antibiotics Susceptibility Pattern Of Gram Positive Bacteria Isolated From Nigerian Currency

ANTIBIOTICS	*Bacillus* sp	*Staphylococcus* sp
S = Streptomycin	S	S
NB= Norfloxacin	S	S
CH= Chloramphenicol	S	S
CN= Gentamycin	S	S
Cpx= Ciprofloxacin	S	S
E= Erythromycin	S	S
RD= Rifampicin	S	S
LEV= Levofloxacin	S	S
Apx = Ampiclox	S	S
Aml= Amoxil	S	I

TABLE4: Antibiotics Susceptibility Pattern Of Gram Negative Bacteria Isolated From Nigerian Currency

ANTIBIOTICS	*Klebsiella* sp
Ofx= Tarivid	S
Cpx = Ciprofloxacin	S
CEP = Ceporex	S
NA = Nalidixic Acid	I
PN = Amplicin	S
SxT = Septrin	I
S = Streptomycin	S
Au = Augmentin	S
PEF =Reflacine	S
Apx = Ampiclox	S

IV. Discussion

This study determines the antibiotic susceptibility pattern of bacteria isolated from Nigeria currency circulated in Aba Abia State. The bacteria isolated were *Bacillus* species, *Staphylococcus* species and *Klebsiella* species. The result demonstrated that Nigeria currency notes in circulation are contaminated with both Gram positive and gram negative bacteria. The mean viable count of the currencies ranges from 0.8x108 to $5.0x10^8$ cfu/ml. The ten naira notes (N10) had the highest average total viable count of $5.0x10^8$cfu/ml, followed by two hundred naira notes (N200) $3.0x10^8$ cfu/ml, one hundred naira notes (N100) $2.6x10^8$ cfu/ml five hundred naira notes (N500) $2.3x10^8$ cfu/ml, twenty naira notes (N20)$2.0x10^8$ and fifty naira notes (N50) $2.0x10^8$ cfu/ml while one thousand naira notes (N1000) had the least mean viable count of $0.8x10^8$ cfu/ml, followed by five naira notes ($1.9x10^8$ cfu/ml. The total coliform ranges from 2.0 $x10^8$cfu/ml to $4.1x10^8$ cfu/ml,N10 notes also had the highest coliform of $4.1x10^8$ cfu/ml followed by(N50) notes with count of $3.5x10^8$ cfu/ml and N5 notes had the least count of $2.0x10^8$ cfu/ml (table 1). N10 notes used in this work had the highest contamination because it is commonly found in circulation as they can be found in the hands of school children and poor people who are leaving in an unhygienic environment. Similar works done by Oyero and Emikpe, (2007) reported highest level of microbial contamination for ten naira notes (N10) among Nigerians currencies notes examined. Ten naira notes (N10) are the most commonly used among the small denomination in Nigeria and it is exchanged frequently among artisans and lower economics class people. Shakir *et al.,* (2010) had earlier reported highest contamination rate among the small denomination notes in Bangladesh currencies. N200 had high bacterial load because it is available in circulation as a result of frequent handling especially by people in Aba (South east of Nigeria) being a commercial hub. And again it is made up of paper which is easy attracted to microorganisms thereby making it second highest in contamination. The level of contamination seen in the present study can be attributed the socio economic life style of the people in Aba, being that they are mainly traders and business men. N1000 notes and five naira notes had the least means viable count. These could possibly be due to the fact that highest currency notes are not common among school children and market women who will always need the lower denomination as balance (commonly called "change") in their daily transaction; except for those who trade on expensive goods. The reduction observed in N5 could be due to the depreciation of economic value and recession. From the study the new (mint) Nigerian currency notes collected from banks had low microbial count and may be attributed to handling and dispensary operations (Uraku *et al.,* 2012). The result for the occurrence of bacteria isolated from different naira notes analyzed in this study (table 4.3), showed that *Bacillus species* had the highest occurrence of 54.54%, *Staphylococcus species* and *Klebsiella* species had the least occurrence of 22.73%. Similar by Awe *et al.,* (2010), Feglo and Nkansah, (2010) Matur *et al.,* (2010) and Shakir *et al.,* (2010) had also reported the occurrence of different microorganisms from the currency notes in their countries. The ability of bacteria growing on currency notes has been documented (Pope *et al.,* 2002) and the findings in this study supports reports from other parts of the world such as United States of American (Pope *et al.,* 2002), Indian (BasavaraJappa *et al.,* 2005; Negesh *et al.,* 2010) south Africa (Igumbor *et al.,* 2010) Nepal (Janardan *et al.,* 2009), Ghana (Feglo and Nkansah, 2010, Tagoe *et al.,* 2010) and Sudan (Sandabi *et al.,* 2010). The presence of *Staphylococcus* on the currency notes could be because the organism is a normal skin flora and soil (Igumbor *et al.,* 2007, Larkin *et al.,* 2009) and *Staphylococcus* infection occur when *staphylococcus* enter the body through cuts and abrasion in the skin (Shakir *et al.,* 2010) and it is also associated with impetigo carbunades and food intoxication (Jensen *et al.,* 1997). *Klebsiella* species is a virulent organisms that may cause both community and hospital acquired infection such as pneumonia typically along with urinary tract and wound infection particularly in immunocompromised individual (Janardan *et al.,* 2009). It is also an enteric microorganisms that are potential pathogen especially when they change their habitant (Basavarajappa *et al.,* 2005). The antibiotic sensitivity pattern of the isolate showed that all the isolates were susceptible the to the various antibiotics except for Amoxil, Nalidixic Acid and Septrim. Similar work by Emikpe and Oyero (2007) revealed that organisms isolated from Nigerian notes were resistant to some antibiotics. The occurrence of these organisms on the surfaces of Nigerian currencies pose serious public health issue as they may serve as sources of disease transmission and the transfer of resistance gene among microorganism if not carefully handled. There is therefore need for public awareness on the risk of improper handling and use of currency notes especially among children.

V. Conclusion

From the result of the present study, The likelihood of contacting infections due to contact with mutilated naira notes is high considering the microbial count gotten in the study The potential health danger of mutilated naira notes is obvious and the chances of contracting infection is on the increase. Handlers of notes especially those who put them in their brassiere or other sensitive areas where there is intimate contact with the skin should exercise caution and also the habit of wetting finger with saliva while counting naira notes should be avoided; organisms on the notes could be transferred to the mouth by this action.

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