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PREVALENCE AND PUBLIC HEALTH IMPLICATIONS OF THE MICROBIAL LOAD OF ABUSED NAIRA NOTES

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ABSTRACT
A hundred and forty (140) pieces of abused Naira notes were randomly and aseptically collected in Kano metropolis and examined microbiologically for the load and type of microorganisms (bacteria and fungi) using swab-rinse and standard plate count techniques. The mean average bacterial counts on the notes ranged between 3.59 x 10^2 cfu/ml and 1.29 x 10^5 cfu/ml while fungal counts ranged between 3.24 x 10^2 cfu/ml and 1.59 x 10^6 cfu/ml. The lowest and highest counts for both bacteria and fungi were found in the ₦500 and ₦5 abused naira denominations respectively. The bacteria isolated include the genera of Bacillus, Brucella, Clostridium, Corynebacterium, Listeria, Micrococcus and Staphylococcus while fungi include the genera of Aspergillus, Fusarium, Mucor, Penicillium and Rhizopus. There was no recovery of both bacteria and fungi in the control. The implications of the results have been discussed.

Keywords: Microbiological load, abused naira notes, public health, Kano.

INTRODUCTION

The Naira note is the official currency of the Federal Republic of Nigeria, issued and regulated by the Central Bank of Nigeria (CBN). According to CBN, the expected lifespan of the Naira notes is 24 months but the mishandling reduces this to less than 6 months. The abused Naira note denotes the currency, which had been fairly long (not more than 24 months) in circulation, mishandled, structurally disfigured, literally mutilated and for most of the time they are dirty. Incidentally, abused Naira notes were reported as vehicles of bacterial, mold and other parasitic infections and agents of cross contamination (Jolaoso, 1981; Awodi *et al*., 2001; Itoda, 2001). Studies from other parts of world (Shukla, 1980; Oyler *et al*., 1996; Pachter *et al*., 1997; Havas, 2000) have also shown that bank notes revealed the presence of high load of germs, which could cause tuberculosis, meningitis, pneumonia, tonsillitis, peptic ulcers, genital tract infections, gastro-intestinal tract infections and lung diseases. Contact with contaminated currency notes could also cause diarrhoea and urinary tract infections besides skin burn and septicaemic infections. The abused Nigerian currency became an issue of concern particularly in the recent times when the CBN embarked on a nationwide enlightenment campaigns aimed at educating the public on the proper ways of handling the Naira notes. This study aims at determining the types and population of the microorganisms (bacteria and fungi) on the abused Naira notes from Kano metropolis.

MATERIALS AND METHODS

Samples collection

A total of 140 pieces of abused Naira notes (20 pieces of each of the denominations of ₦5, ₦10, ₦20, ₦50, ₦100, ₦200 and ₦500) were randomly collected from bus conductors, taxi drivers, traders, business operators, food sellers, beggars and other individuals in Sabon-gari market (Kano metropolis) and Bayero University old campus. On the other hand, 2 pieces of fresh Naira mints of each denomination were also obtained from the Central Bank of Nigeria, Kano branch, which served as a control. Samples were collected in sterile leather bags using disposable sterile hand gloves. These were immediately taken to the laboratory for analysis (Baker and Silverton, 1985).

Inoculation of samples

The inoculation of the samples was carried out using swab-rinse and standard plate count methods (Baker and Silverton, 1985). Twenty pieces of the abused Naira notes of each denomination were used. Each abused Naira note was soaked in 100 ml aliquots of sterile buffered (0.1% w/v) peptone water (oxoid) for 20 minutes at ambient temperature. The washed water of the soaked notes was serially diluted (10^{-1} to 10^{-3}) and the 10^{-1} dilution (1.0 ml) of each washing was inoculated (using pour-plate method) on sterile plates of nutrient (oxoid) agar medium for bacteria and sabouraud dextrose (oxoid) agar medium for fungi. The plates for bacterial counts were incubated at 37ºC for 24 hours while those for fungal counts were incubated at room temperature (27±1ºC) for 3-5 days. On the other hand, selective and differential growth media (serum dextrose agar, glucose blood agar, MacConkey agar and peptone water) were also inoculated and incubated at 35ºC for 18-24 hours. For the isolation of *Clostridium* species, the incubation was done anaerobically (using anaerobic jar) at 37±1°C for 24 hours. The numbers of colony forming units were counted, recorded and expressed in colony forming units per milliliter (cfu/ml).

This was arrived at by counting discrete colonies in each plate and multiplying the number of colonies counted by the reciprocal of the dilution factor and the average recorded. The isolates were purified and identified to genus level on the basis of cultural, morphological and biochemical characteristics (Cheesbrough, 1984; 2000).

Cultural, morphological and biochemical characterization of the isolates

This was carried out according to the method of Cheesbrough (1984; 2000). Here, colony appearance, haemolysis, hydrogen gas production, motility and spore staining were observed and recorded while Gram's staining was carried out to ascertain the morphology and Gram's reaction-behaviour of the bacterial isolates. In addition, the following biochemical tests were carried out: catalase, oxidase, coagulase, citrate, urease and lactose fermentation tests. For the identification of fungi, cotton-blue in lactophenol was used and the hyphae examined microscopically at X10 and X40 objective lens (Collins and Lyne, 1976; Cheesbrough, 2000).

RESULTS AND DISCUSSION

The results of the study are presented in Tables 1-4. Table 1 shows that both bacteria and fungi were found on the abused Naira notes but the bacteria were more predominant. However, there was no recovery of both bacteria and fungi on the fresh naira mints (control) examined in this study. Generally, the lower denominations (₦5, ₦10, ₦20 and ₦50) had the highest microbial counts while higher denominations (₦100, ₦200 and ₦500) had the least. The reasons for this might be that the lower denominations are probably more frequently exchanging hands than those of higher denominations. Table 2 shows that a total of 255 microbial isolates (167 for bacteria and 88 for fungi) were recovered from the seven examined abused Naira denominations. The cultural, morphological and biochemical properties of these isolates showed that they belonged to seven bacterial genera namely *Bacillus*, *Brucella*, *Clostridium*, *Corynebacterium*, *Listeria*, *Micrococcus* and *Staphylococcus* (Table 3) while five were of fungal genera, namely *Aspergillus*, *Fusarium*, *Mucor*, *Penicillium*, and *Rhizopus* (Table 4). The ₦100 denomination had the highest microbial isolates of 42(16.5%) while ₦5 denomination harbored the least {31(12.2%)}.Generally, *Bacillus* species was the most isolated {69(27.3%)} while *Rhizopus* was the least {1(0.4%)}. These microorganisms could have come in contact with the money through soil, clothing, food and/or hands of users. Some of these microorganisms are potential disease agents. For example, *Bacillus*, *Clostridium* and *Staphylococcus* species have been known to be responsible for food intoxication and poisoning (FAO, 1979; Turk *et al*., 1983; Adesiyun, 1984; Adams and Moss, 1995). *Brucella*, *Corynebacterium* and *Listeria* species are agents of respiratory and skin infections, enteritis, meningitis, stomach disorders and sinusis (Cowan, 1974; Cruickshank *et al*., 1980; Havas, 2000; Jenkins, 2001). The fungal isolates could elaborate mycotoxins in foods, which are dangerous to human and other animal health (Grundy and Grundy, 1974; FAO, 1979). In addition, the findings of this work further suggest that dirty currency could host harmful microorganisms. In a similar study, El-din-El-dars (2005) isolated twenty-five (25) genera of bacteria including the strains of *Staphylococcus* and *Bacillus* and a lower proportion of fungal isolates from Egyptian paper notes. Itoda (2001) reported 97.0% of the samples of the Naira notes examined to have been contaminated with bacteria, predominantly *Staphylococcus aureus*, *Escherichia coli* and *Corynebacterium diphtheriae*. In Nigeria, cash transactions are used more frequently than credit cards, traveller's cheques and money orders. The habit of keeping money in bags, pockets, wallets, brassier, local pots and table covers have been observed among the majority of Nigerians, which may have largely contributed to the high bacterial and fungal loads observed in this study.

CONCLUSIONS AND RECOMMENDATIONS

The present study has shown that abused Naira notes are contaminated with various microbial agents, which may be through cash transactions in the community. The occurrence of the heavy load of microorganisms on the abused Naira notes can constitute a potential health hazard to users. It is therefore advised that money be handled in a manner that does not get contaminated with dirt, disease-causing agents or become unduly mutilated. From the results of the study, it is instructive that hands should be washed thoroughly after handling abused Naira notes as of a mark of personal hygiene.

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Table 1: Bacterial and fungal counts from abused Naira notes in Kano metropolis

Denomination (Naira)*	Number examined	Bacterial count (cfu/ml)	Fungal count (cfu/ml)
500	20	3.59×10^2	3.24×10^2
200	20	9.69×10^3	3.66×10^2
100	20	1.27×10^5	8.50×10^2
50	20	8.64×10^4	8.69×10^2
20	20	6.45×10^4	3.48×10^4
10	20	6.03×10^4	1.50×10^5
5	20	1.29×10^5	1.59×10^6

*There was no recovery of both bacteria and fungi from the control samples

Table 2: Prevalence of bacteria and fungi isolated from different denominations (n = 140) of the abused Naira notes (figures in parentheses are percentages)

Bacterial and fungal isolates	₦500	₦200	₦100	₦50	₦20	₦10	₦5	Total
Bacillus species	11(7.9)	8(5.7)	9(6.4)	8(5.7)	14(10.0)	12(8.6)	7(5.0)	69(27.1)
Brucella species	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	1(0.7)	1(0.7)	2(1.4)
Clostridium spp	3(2.1)	2(1.4)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	5(1.9)
Corynebacterium species	2(1.4)	1(0.7)	0(0.0)	2(1.4)	6(4.3)	2(1.4)	1(0.7)	14(5.5)
Listeria species	0(0.0)	6(4.3)	2(1.4)	1(0.7)	0(0.0)	1(0.7)	0(0.0)	10(3.9)
Micrococcus spp	1(0.7)	2(1.4)	0(0.0)	0(0.0)	3(2.1)	0(0.0)	0(0.0)	6(2.4)
Staph. aureus	1(0.7)	1(0.7)	2(1.4)	2(1.4)	3(2.1)	3(2.1)	1(0.7)	13(5.1)
Staphylococcus spp.	3(2.1)	1(0.7)	15(10.7)	13(9.3)	0(0.0)	8(5.7)	8(5.7)	48(18.8)
Aspergillus spp	5(3.6)	9(6.4)	8(5.7)	4(2.9)	3(2.1)	8(5.7)	5(3.6)	42(16.5)
Fusarium spp	0(0.0)	1(0.7)	3(2.1)	1(0.7)	2(1.4)	2(1.4)	4(2.9)	13(5.1)
Mucor spp	6(4.3)	5(3.6)	3(2.1)	4(2.9)	4(2.9)	2(1.4)	3(2.1)	27(10.6)
Penicillium spp	1(0.7)	1(0.7)	0(0.0)	0(0.00)	2(1.4)	0(0.0)	1(0.7)	5(1.9)
Rhizopus spp	0(0.0)	0(0.0)	0(0.0)	1(0.7)	0(0.0)	0(0.0)	0(0.0)	1(0.4)
Total	**33(12.9)**	**37(14.5)**	**42(16.5)**	**36(14.1)**	**37(14.5)**	**39(15.3)**	**31(12.2)**	**255(100)**

Table 3: Cultural, morphological and biochemical characteristics of the bacterial isolates

Colony appearance	No.	GS	Mo	H	H_2S	Spore	Ci	Ca	Co	Ox	La	Urease	Organism
On nutrient agar, colonies were greyish, granular discs, 2-3mm in diameter. On blood agar, colonies produced very slight haemolysis	69	Gram-positive bacilli	+	+	NT	+	NT	+	ND		-	NT	*Bacillus* species
Small, smooth, transparent, Low convex with entire edge, almost 1-2µm in diameter on peptone water medium	02	Gram-negative bacilli	-	-	NT	-	-	+	ND	+	+	+	*Brucella* species
Small, large, regular, convex, Skightly opaque colonies on Blood agar, colonies with red centers on tetrazolium glucose agar (oxoid) medium	05	Gram-positive bacilli	-	+	NT	+	NT	+	ND	ND	+	+	*Clostridium* spp.
Smooth, greyish or black colonies, often 2-3mm in in diameter on MacConkey agar and blood agar media	14	Gram-positive bacilli	-	+	NT	+	NT	+	ND	ND	-	NT	*Corynebacterium* spp.
Small, 0.5-1.5mm in diameter, smooth and translucent colonies on blood (oxoid) agar	10	Gram-positive bacilli	+	+	NT	-	NT	+	ND	ND	-	NT	*Listeria* species
Deep-yellow colonies almost 2mm, raised and entire edges	06	Gram-positive cocci	-	+	+	-	+	+	-	+	+	NT	*Micrococcus* spp.

Table 3 continuation

Colony appearance	No.	GS	Mo	H	H_2S	Spore	Ci	Ca	Co	Ox	La	Urease	Organism
Smooth, circular, low convex, glistering and butyrous colonies, usually 1-3mm in diameter on MacConkey agar and Blood agar media	13	Gram-positive cocci	-	NT	NT	-	-	+	+	-	+	NT	*Staph. aureus*
Smooth, circular, low convex, glistering and butyrous colonies, usually 1-3mm in diameter on MacConkey agar and Blood agar media	48	Gram-positive cocci	-	NT	NT	-	-	+	ND	-	+	NT	*Staph.* species
Total number of isolates	**167**												

Key: GS = Gram's stain reaction; Mo = Motility; H = Haemolysis; H_2S = Hydrogen sulphide gas; Ci = Citrate; Ca = Catalase; Co = Coagulase; Ox = Oxidase; La = Lactose fermentation; + = Positive; - = Negative; ND = Non-detectable; NT = Not tested.

Table 4: Cultural and morphological characteristics of the fungal isolates

Colony appearance	Morphology	Organism	Number
White colonies, which changed to blue, black, yellow, green, etc.	Septate and multinucleate hyphae with sprinkler conidia	*Aspergillus* species	42
Pink, purple/yellow, white and fuzzy colonies	Septate mycelium bearing crescent conidia on the conidiophores	*Fusarium* species	13
Initially white colonies, which later turned grey-black	Non-septate, thick hyphae with round columella and sporangia	*Mucor* species	27
Blue to green colonies, colour changed very often	Septate hyphae with conidiophores bearing brush-like conidia	*Penicillium* species	05
Large, white colonies, which latter turned brown	Non-septate, cottony mycelium with stalon and rhizoids	*Rhizopus* species	01
Total number of isolates			**88**

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