

Bacteriological Study Of Naira Notes From Sokoto Kara Market And Sokoto Abattoir Sokoto State, Nigeria

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ABSTRACT

The aim of this research was to carry out the bacteriological quality assessment of Nigerian naira notes circulating in Sokoto Kara market and Sokoto Abattoir. A total of 16 samples of the naira notes were collected from Sokotokara market and abattoir market (eight per market). Each currency notes were collected and transferred aseptically into sterile polythene bag and transported to Microbiology laboratory, Swab sticks were used to swab both surfaces of naira notes. The samples of all denomination collected was inoculated into a test tube containing nutrient broth was incubated 37°C for 24 hours. The bacterial isolates were characterized and identified by gram staining method, microscopic examination and biochemical tests. From the results obtained in this research the bacteria identified, includes, *Aeromonas hydrophilic*, *Sporocercineureae*, *Enterococcus faecalis*, *Aeromonas faecalis*, *Bacillus megaterium*, *Lactococcus lactus*, *Bacillus subtilis*, *Micrococcus luteus*, *Proteus vulgaris*, *Bacillus cereus*. The percentage of the occurrence of the bacterial isolate showed that *Aeromonas hydrophilis* had the highest occurrence (76.9%) followed by *Aeromonas faecalis*, *Bacillus megaterium* and *Bacillus subtilis*, (69.2% each), *Proteus vulgaris*, (61.5%), *Bacillus cereus* (53.8%) *Micrococcus luteus*, *megaterium* and, *lactococcus* had the lowest percentage of currency (46.2%). All the bacterial isolates showed 100% resistant to nalidixic acid,

pefloxacin, augmentin, septrin, ampicin and ceporex. The isolates showed 70% resistance to ciprofloxacin, 60% resistance to ofloxacin, and 30% resistance to gentamycin. However, all the bacterial isolates showed susceptibility to streptomycin with zones of inhibition ranging from 19mm to 13mm.

I. BACKGROUND TO THE STUDY

Money is any material that is generally accepted as a means of exchange for goods and services and measure of value (Frederick and Apostolos, 2010). Money serves as a medium of exchange for goods and services, a unit of account, a store value, means of deferred payment in economic activities and as means of settlement of debt (Awe et al., 2010; Ogunleye, 2005; Okonet al., 2003).

The Naira note is the official currency of the federal republic of Nigeria, issued and regulated by the central bank of Nigeria (CBN). The Naira note was introduced into Nigeria in 1945 and since then several changes have been made to different denominations used as a legal tender (Ogba, 2007). Currently, there are eight denominations of naira notes comprising of ₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500, ₦1000 notes. The naira notes are classified into two categories; the paper category (1000, 500, 200, 100-naira notes) which is made up of 75% cotton and 25% linen and polymer category (50, 20, 10, 5-naira notes) which are made up of polymer such as Biaxially Oriented Polypropylene (BOPP) (Brady and Kelly, 2000). The ₦5, ₦10, ₦20,

₦50, ₦100, ₦200-naira notes are the most common and widely used and are more involved in daily cash transactions. They are common among Nigerians especially those living in the local areas and small towns, while the N500 and N1000 notes are commonly used among the wealthy and in corporate transactions (Vriesekoopet al., 2010; Okonet al., 2003).

Naira notes are transferred from one individual to other during exchange of goods and services and often placed in dirty spots giving rise to imposition of pathogens on them before they are finally deposited in banks (Hosen, 2006; Awodiet al., 2000). Contaminated Naira notes can serve as an environmental vehicle for transmission of potential pathogenic microorganisms across different populations and seen as a fomite (Mändaret al., 2016; Angelakis et al., 2014; Shakiret al., 2010; Pope et al., 2002; Abrams and Waterman, 1972). Dust and dirt that commonly accumulate on Naira notes might contain spores of infectious agents (Oyero and Emikpe, 2007).

The sources of contamination of Naira notes could be from the atmosphere, during storage, usage, handling or production (Maturet al., 2008; Umehet al., 2007). Other sources of contamination of money include skin, anal region, wounds, nasal secretions by sneezing and coughing, handling after attending to patients with unwashed hands by health personnel, body fluids from commercial sex workers, bus conductors, butchers, spraying during ceremonies and market (Pope et al., 2002).

Bacteria causing different infections like pneumonia, tonsillitis, peptic ulcer, urino-genital tract infection have been reportedly associated with Naira notes (Pope et al., 2002). Bacteria that contaminate Naira notes include some strains of *Streptococcus* sp, *Staphylococcus* sp., Coliforms such as *Escherichia coli*, *Klebsiellasp*, *Proteus* sp, *Salmonella* sp and *Shigellasp* that may cause dangerous fever, diarrhea and dysentery (Basuarajappa et al., 2005).

1.1 Statement of the Problem

The habit of poor handling and abuse of Naira notes is widely prevalent in Nigeria. The older the Naira notes the more accumulation of microbes occurs (Ghamdiet al., 2011; El-Dars and Hassan, 2005). Research has shown that paper currency offers a larger surface area as a breeding ground for pathogens (Ayandele and Adeniyi, 2011). Potentially pathogenic bacteria which may cause throat infection, pneumonia, peptic ulcers, tonsillitis, urino-genital

tract infections, gastro enteritis and lung abscess have been isolated from Naira notes (Saeed and Rasheed, 2011; Xu et al., 2005; Khinet al., 1989). Previous studies have 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 (Shukla, 1980; Oyler et al., 1996; Pachter et al., 1997; Havas, 2000). Pathogenic microorganisms isolated from paper currency 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) and serve as a potential source of enteropathogens (Michaels, 2002; Cardoenet al., 2009; Lamichhane et al., 2009).

Accumulated data over the past two decades indicates simultaneous handling of paper currency and food is associated with sporadic cases of food borne illness and enteric disease (Barry 2002; Michaels, 2002; Brady and Kelly, 2000). Study showed that several microbial pathogens contaminate animals and food products, which caused foodborne disease incidence and spread (Okpala&Ezeonu, 2019). During the meat handling processes in the abattoir, the contamination of currency notes can take place, particularly involving diverse flora and fauna, aerosols generated by coughing and sneezing, anal region, wounds, to the skin, water, and soil (Agarwalet al., 2015; Thiruvengadam et al., 2014)

II. AIM AND OBJECTIVES

Aim

This study aimed at investigating the bacteriological quality of Nigerian Naira notes circulating in Sokoto Kara market and abattoir

Objectives

The objectives of the study were to:

- 1 Isolates bacterial associated with Naira notes circulating in Sokotokara market and Sokoto abattoir.
- 2 Identify and characterize the isolates associated with the Naira notes

III. MATERIALS AND METHOD

3.1 Study Site

The study was conducted in Sokoto Kara Market and Abattoir, Sokoto. Sokoto is the capital city of Sokoto State and lies between latitude 13°3' 49°N, longitude 5° 1 4' 89°E and at an altitude of 272

m above sea level. It is located in the extreme North Western part Nigeria. Sokoto metropolis is estimated to have a population of 427,760 people (NPC/FGN, 2007) and by the virtue of its origin, the state comprises mostly Hausa/Fulani and other groups such as Gobirawa, Zabarmawa, Kabawa, Adarawa, Arawa, Yoruba, Ibos and others. Occupation of city inhabitants include trading, farming, commerce, with a reasonable proportion of the population working in private and public sectors (MOI, 2008). The Sokoto township is in dry Sahel surrounded by sandy terrain and isolated hills. Rainfall starts late (in June) and ends early in September but maysometimes extend into October. The average annual rainfall is 550 mm with peak in the month August. The highest temperatures of 45°C during the hot season are experienced in the months of March and April. Harmattan, a dry/cold and dusty condition is experienced between the months of November and February. Modern Sokoto city is a major commercialcentre in leather crafts and agricultural products (MOI, 2008).

Study Design and Sampling Method

The study was conducted on eight denominations of Naira notes circulating in Sokoto Kara Market and Abattoir. Sixteen (16) samples of Naira notes were collected from the animal sellers and meat vendors. This sample represented the whole dominations circulating in the market and abattoir.

3.3 Sample

A sixteen (16) samples of the eight (8) denominations of Naira note (₦5, ₦10, ₦20, ₦50, ₦100, ₦200, ₦500, ₦1000) were randomly collected from the animal sellers and meat vendors in Sokoto Kara Market and Abattoir. The samples were collected aseptically in polythene bags using disposable hand gloves. Each sample was placed in single polythene bag to the microbiology laboratory for analysis.

Microbiological analysis

The media used was Nutrient agar (NA). It involves measuring nutrient powder using weighing balance and diluting it using sterile water and autoclaved at 121°C for 15minutes (AdesemoyeandAdedire 2005).

3.5 Isolation of Bacteria

The bacterial contaminants on the Naira notes were isolated using swapping method (Uko2017). For each sample that was taken, the sample was immediately inoculated into the test tube containing nutrient broth.

Inoculation of the swapped notes was done into ten (10) test tubes containing the nutrient broth was carried out from the first test tube to the last test tube and were plugged with cotton wool and foil paper. The test tubes were incubated for 24hours at 37°C.

3.6 Identification of Bacterial Isolates

Bacterial isolates were identified based on microscopy and biochemical tests as described by Oyeleke and Manga (2008).

Gram staining was carried out according to the methods describe by Oyeleke and Manga, (2008). A smear of the pure bacterial isolates was prepared by placing a drop of normal saline on a clean slide. A sterile wire loop was used to pick a colony and emulsified on the slide. The smear was heat fixed by passing the slide over a Bunsen flame. After fixation, the smear was covered with crystal violet for 30 seconds then washed with sterile water, and then iodine solution was applied for 60 seconds and washed with water. The smear was then decolorized with ethanol, adding it drop wise on the slide until all free colour (blue) has been removed and then rinsed with water. The slide was then flooded with Safranin (counter stain) for 30 seconds the back of the slide was cleaned with cotton wool and allowed to air dry and examined microscopically using oil immersion x100 objective.

IV. RESULTS

4.1 Biochemical Identification of Bacteria Isolated from the Naira notes

Table 4.1 shows the biochemical and gram staining reactions ofbacteria isolated from the Naira notes circulating inSokoto Abattoir. Based on the biochemical analysis and microscopic procedure unique to each isolate, total of seven (7) isolates were identified across the naira notes. The bacteria,Aeromonasfaecalis,Bacillusmegaterium,Bacillusubtilis,Micrococcusluteus,Proteus vulgaris, and Bacillus cereus were identified in ₦10, ₦20, ₦50, ₦200, ₦500 and ₦1000, respectively. However, the denominations, ₦5 and ₦100 found to be contaminated with the same organism, Aeromonashydrophilis(Table 4.1).

Table 4.1: Biochemical and gram staining reactions of bacteria isolated from the Naira notes circulating in Sokoto Abattoir

DENOMINATION	ORGANISM	G R	SH	BIOCHEMICAL TEST												
				Glucose	Sucrose	Lactose	Motility	H ₂ S	Catalase	Catalase	Methyl red	Voges-Proskauer	Indole	Urease	Citrate	Starch
₦5	Aeromonas hydrophils	-ve	Cocci	+	+	-	+	+	+	-	+	-	+	+	+	+
₦10	Aeromonas faecalis	-ve	Rods	+	-	-	-	+	+	-	+	+	+	+	+	+
₦20	Bacillus megaterium	+v	Rods	+	+	-	+	+	-	-	+	-	+	+	+	+
₦50	Bacillus subtilis	+v	Cocci	+	+	-	+	+	-	-	+	-	+	+	+	+
₦100	Aeromonas hydrophils	-ve	Rods	+	+	-	+	+	-	-	-	+	+	+	+	+
₦200	Micrococcus luteus	-ve	Rods	-	-	-	-	+	-	-	+	-	+	+	+	+
₦500	Proteus vulgaris	-ve	Rods	-	+	-	+	+	-	-	+	-	+	+	+	+
₦1000	Bacillus cereus	+v	Rods	-	-	-	+	-	-	+	-	+	+	+	+	+

GR = Gram reaction, SH = Shape, +v = gram positive reaction, -v = gram negative reaction, Glu=Glucose, Suc = Sucrose, Lac = Lactose, Mot= Motility, H₂S= Hydrogen sulphide, Cat= Catalase, MR= Methyl red, VP=Voges-Proskauer, Ind = Indole, Ur = Urease, Cit = Citrate, Stch = Starch

The biochemical and gram staining reactions of bacteria isolated from the Naira notes circulating in Sokoto Kara Market are shown in Table 4.2. The biochemical analysis and microscopic technique revealed a total of six (6) bacterial isolates across the naira notes. The bacteria, Aeromonas faecalis, Lactococcus lactis,

Sporosarcinae, Entrococcus faecalis and Aeromonas hydrophils were identified in ₦5, ₦10, ₦20, ₦50, and ₦500, respectively. However, the denominations, ₦100, ₦200 and ₦1000 found to be contaminated with mBacillus megaterium (Table 4.2).

Table 4.2: Biochemical and gram staining reactions of bacteria isolated from the Naira notes circulating in Sokoto Kara Market

DENOMINATION	ORGANISM	GR	SH	BIOCHEMICAL TEST												
				Glucose	Sucrose	Lactose	Motility	H ₂ S	Catalase	Catalase	Methyl red	Voges-Proskauer	Indole	Urease	Citrate	Starch
₦5	Aeromonas faecalis	-ve	Rods	-	-	-	-	+	-	+	+	-	+	+	+	+
₦10	Lactococcus lactis	+ve	Rods	+	+	-	-	-	-	-	-	+	-	-	-	+
₦20	Sporosarcinae	+ve	Cocci	-	-	-	+	+	-	-	+	-	-	+	-	+
₦50	Entrococcus faecalis	+ve	Cocci	+	+	+	-	-	-	-	+	-	+	-	-	+
₦100	Bacillus megaterium	+ve	Rods	+	+	+	+	-	-	+	+	-	-	+	+	+

₦200	Bacillus megaterium	+ve	Rods	+	+	+	+	-	-	+	+	-	-	+	+	+
₦500	Aeromonashydrophils	-ve	Rods	+	+	-	+	-	-	+	+	-	-	-	+	+
₦1000	Bacillus megaterium	+ve	Rods	+	+	-	+	-	-	+	+	-	-	+	+	+

GR = Gram reaction, SH = Shape, +v = gram positive reaction, -v = gram negative reaction, Glu=Glucose, Suc = Sucrose, Lac = Lactose, Mot= Motility, H₂S= Hydrogen sulphide, Cat= Catalase, MR= Methyl red, VP=Voges-Proskauer, Ind = Indole, Ur = Urease, Cit = Citrate, Stch = Starch

4.2 Frequency and Percentage Occurrence of Bacterial Isolates on Different Denominations Naira Notes

Table 3 shows the frequency and percentage occurrence of bacterial isolates on different denominations Naira notes circulating in Sokoto Abattoir. The highest occurrence (76.9%) of the bacterial isolate (Aeromonashydrophils) was found in

the ₦5 denomination. The denomination ₦1000 harbored the least number (7) of the bacterial isolate (Bacillus cereus) with 53.8% percentage occurrences. Of all the isolates, Aeromonashydrophils has the highest rate occurrence on ₦5 (76.9%) and ₦100 (69.2) denomination (Table 4.3).

Table 4.3: Frequency and percentage occurrence of bacterial isolates on different denominations Naira notes circulating in Sokoto Abattoir.

ISOLATES	ORGANISM	FREQUENCY	PERCENTAGE (%)
₦5	Aeromonashydrophils	10	76.9
₦10	Aeromonasfaecalis	9	69.2
₦20	Bacillusmegaterium	9	69.2
₦50	Bacillusubtilis	9	69.2
₦100	Aeromonashydrophils	9	69.2
₦200	Micrococcus luteus	6	46.2
₦500	Proteus vulgaris	8	61.5
₦1000	Bacillus cereus	7	53.8

The result for the occurrence of bacteria isolated from different Naira notes circulating in Sokoto Kara Market is shown in Table 4.3. The denominations ₦100 and ₦200 demonstrated the highest occurrence (69.2%) of the bacterial isolate (Bacillusmegaterium), while the least occurrence

(30.7%) of the isolate (Lactococcuslactis) was found on the ₦10 (Table 4.3). More bacterial isolate (Bacillusmegaterium) was found in ₦100, ₦200 and ₦1000 denomination with percentage occurrence 69.2%, 69.2% and 61.5%, respectively (Table 4.4).

Table 4.4: Frequency and percentage occurrence of bacterial isolates on different denominations Naira notes circulating in Sokoto Kara Market.

ISOLATES	ORGANISM	FREQUENCY	PERCENTAGE (%)
₦5	Aeromonasfaecalis	7	53.8
₦10	Lactococcuslactis	4	30.7
₦20	Sporosarcinsureae	5	38.5
₦50	Entrococcusfaecalis	6	46.2
₦100	Bacillusmegaterium	9	69.2
₦200	Bacillusmagaterium	9	69.2
₦500	Aeromonashydrophils	7	53.8
₦1000	Bacillusmagaterium	8	61.5

4.3 Antibiotics Sensitivity Patterns of the Bacterial Isolates

Table 6 showed the Antibiotics sensitivity pattern of the isolated bacteria against selected antibiotics. All the bacterial isolates showed 100% resistant to nalidixic acid, pefloxacin,

augmentin, septrin, ampicin and ceporex. The isolates showed 70% resistant to ciprofloxacin, 60% resistant to ofloxacin, and 30% resistant to gentamycin. However, all the bacterial isolates showed susceptibility to streptomycin with zones of inhibition ranging from 19 to 13mm (Table 4.5).

Table 4.5: Antibiotics sensitivity patterns of the bacterial isolates

ORGANISMS	ANTI-BIOTIC									
	OFX	NA	PFX	GEN	AUG	CPX	SPT	STR	PN	CEP
Aeromonashydrophilus	-	-	-	13	-	-	-	15	-	-
Aeromonasfaecalis	-	-	-	14	-	-	-	17	-	-
Bacillusmagaterium	14	-	-	-	-	19	-	16	-	-
Bacillussubtilis	-	-	-	13	-	-	-	13	-	-
Bacillus cereus	14	-	-	17	-	-	-	15	-	-
Enterococcusfaecalis	17	-	-	17	-	19	-	17	-	-
Lactococcuslactis	19	-	-	-	-	-	-	19	-	-
Proteus vulgaris	-	-	-	12	-	-	-	15	-	-
Micrococcus luteus	-	-	-	-	-	12	-	13	-	-
Sporosarcinsureae	-	-	-	14	-	-	-	17	-	-
Percentage resistance (%)	60	100	100	30	100	70	100	0	100	100

KEYS: Resistance (-), Ofloxacin (OFX), Nalidixic acid (NA), Pefloxacin (PFX), Gentamycin (GEN), Augmentin (AUG), Ciprofloxacin (CPX), Septrin (SPT), Streptomycin (STR), Amplicin (PN)and Ceporex (CEP).

V. DISCUSSION

The result of the study shows the presence of different bacterial isolates on the Naira notes circulating in both Sokoto abattoir and Sokoto Kara Market. The contamination of the Naira notes with the different bacterial isolates is in line with the report that currency notes can be contaminated with enteropathogens and represents a reservoir of enteric diseases (Adamuet al., 2012). Many studies reported the occurrence of different microorganisms from the currency notes in their countries (Awe et al., 2010; Feglo and Nkansah, 2010; Maturet al., 2010; Shakiret al., 2010). The result of this study is in agreement with the studies by many literatures in different countries including United States of American (Pope et al., 2002), Indian (BasavaraJappaet al., 2005), Nepal (Janardanet al., 2009), Ghana (Feglo and Nkansah, 2010, Tagoeet al., 2010) and Sudan (Sandabiet al., 2010).

The occurrence of different bacterial species on currency notes has been documented (Pope et al.,

2002). It has been reported that increase in the rate of contamination of Naira notes with pathogenic bacteria should be attributed to unhygienic ways people handle the naira notes (Ukwuru and Gabriel, 2012; Yakubuet al., 2014; Butt and Malik, 2015). The presence of bacteria on the Naira notes should be attributed the socio economic life style of the people in the abattoir and the market. However, handling of money by the animal and meat vendors might facilitate transmission of potential pathogenic organisms to their clients.

The result of this study showed that all the bacterial isolates were resistant to nalidixic acid, pefloxacin, augmentin, septrin, ampicin and ceporex but susceptible to streptomycin. The microbial resistance to the drugs observed in this study is in agreement to observation reported in other studies (Demain and Sanchez, 2009; Davies and Davies, 2010). Study by Emikpe and Oyero (2007) revealed that organisms isolated from the Naira notes were resistant to first line antibiotics. Therapeutic failures of bacterial infections are due to antimicrobial

resistance and this remains health-care problem (Martins et al., 2013). Antimicrobial resistance are due to genetic changes resulting from certain factors typically antibiotic misuse; prolong exposure to the agents; and sometimes inadequate access to drugs (Martins et al., 2013). Antimicrobial resistant microorganisms are presence in warm-blooded animals, food and the environments and are capable of spreading from person to person and between people and animals (WHO, 2016). The result of this study indicated that infections that may occur from the bacterial isolates might be difficult to treat and also the treatment might be very expensive because of the resistance of the isolates to the common antibiotics drugs.

VI. CONCLUSION

This study showed that Naira notes circulating in Sokoto Kara market and Abattoir were contaminated with different pathogenic and potential pathogenic bacteria. The isolated organisms showed high resistance to most of the commercially available antibiotics, thereby making their treatment, in cases of infection, more difficult and complicated. Therefore, there is need to educate the populace on the effect of improper handling of naira notes and advised them to maintain good proper hygiene and handle naira notes with care to avoid coming in contact with pathogenic bacteria.

Recommendations

The following recommendations should be observed to forestall possible health hazards associated with mishandling of naira notes.

- Naira notes must be handled with caution and great care especially during the preparation and handling of meat to avoid contamination.
- Proper hygiene measures should be observed such as washing the hands thoroughly immediately after handling money.
- Money handlers, especially women should avoid putting the currency notes on their braziers as this can be harmful to their health.
- The common practice of using saliva when counting Naira notes should be discouraged as the microorganisms
- There should be public awareness of the fact that currency notes could be a source of infection and could be dangerous.

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