

Isolation of the Pathogenic Bacteria from Banknotes and Coins in Khartoum City Pre-COVID-19 Era, Sudan

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Abstract

Background: Coinage notes and moneys are widely exchanged between various communities for trade, which may serve as a carrier of microbes and lead to transmission of infectious diseases. The aim of this study is to isolate microbial contamination of Sudan currency notes and coins that life threatening condition of Sudanese people. **Methods:** One hundred samples (48 currency notes and 52 coins) were collected from various place of society namely, bus conductor, cafeteria, vegetable seller and pharmacies to reveal the bacteria profile of circulating coins and currency notes. **Results:** Out of the total number of all isolates from all the coins and currency put together was 169, of which the pathogenic isolate count 62(36%) organism *Staphylococcus aureus* 28(17%), *Klebsiella pneumonia* 14(8%), *Enterobacter species* 9(5%), *Enterococcus faecalis* 6(4%), *Pseudomonas aeruginosa* 3(2%), *Escherichia coli* 2(1%). While the remnant which consider as Normal flora was form 107 (64%) organism *Bacillus species* 33 (20%), *Staphylococcus epidermidis* 24(14%), *Micrococcus Species* 1(1%) and fungi was present 49(29%) of all isolates. The result of sensitivity test toward the pathogenic isolates showed that overall isolates Exhibited high resistance to vancomycin and Penicillin, while absent or little resistance was against antibiotics like, gentamicin, ciprofloxacin, and tetracycline. **Conclusion:** The study suggested that Sudanese paper currency and coins are highly contaminated with pathogenic microorganisms and this contamination may play a significant role in transmission of infectious diseases. Hence, great care must be taken while handling money during the preparation and handling of food to avoid cross contamination.

Keywords: Banknotes, Coins, Sudanese currency.

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INTRODUCTION

Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce [1]. At the beginning of the seventies, banknotes and coins were reported as carriers of potentially pathogenic microorganisms [2, 3]. The risk of transmission of pathogenic microorganisms and diseases by currency was reported worldwide but most of these studies were performed in the tropical or sub-tropical regions of the world [4-6].

Trading has been part of mankind from time immemorial. Items that are passed from hand to hand likely to be contaminated with disease causing microorganisms especially if handled with unclean hand or kept in dirty surrounding [7].

Money is use as a medium for exchange for goods and services, settlement of debts and for deferred payments in economic activities. Daily transactions have made the note to pass through many hands and pathogens become imposed on them before they are finally depositing in banks [8].

The environment plays an important role in transmission of microbial agents to humans, with many environmental materials serving as vehicles, currency notes and coins are one of them. Contamination may occur during production, storage after production and use. Money, therefore presents a particular risk to public health. Currency notes and coins on which pathogenic microorganisms might survive represent an often overlooked reservoir for enteric diseases, food poisoning, wound and skin infections, respiratory and

gastrointestinal problem to life threatening diseases like septicemia, meningitides etc [9].

The contamination of currency notes could be from several sources; atmosphere during storage, usage, handling or production [10]. The contaminated currency notes go in circulation and contaminate the hands of others, transmitting microorganisms in the process. Currency and coins are important items most frequently passing from hand to hand during its passing and counting. Currency gets contaminated with normal flora and pathogens from the skin, respiratory secretions, gastro-intestinal tract water, soil and aerosols. Most of the people do not care how dirty their hands are when handling and count the money [8].

Currency notes and coins may act as a universal vehicle for transmission of pathogenic and potentially pathogenic microorganisms among persons directly, either through hand to hand contact, or indirectly, through water and food [11]. The contaminated notes and coins go in circulation and spread-contaminated microbes to others hands and transmitting pathogenic organisms in the process. Potential pathogens have been isolated from currency notes and these include species of *Staphylococcus*, *E. coli* and *Pseudomonas*. Cross contamination by simultaneous handling of money and animal products, poor sanitation practices in market, slaughterhouses and restaurant also increase the risk of infection by multi-resistant strains [8].

Survival of various microorganisms on paper money and coins indicates that this could represent a potential cause of sporadic cases of food borne illness and represents an often-overlooked enteric disease reservoir [1]. The presence of pathogenic microorganisms on currency notes is of great concern because the notes might play a role in the transmission and spread of diseases. In the hands of bus conductors and fish and meat sellers, currency notes become literally pestilent. Currency notes carry various bacteria [12].

The objective is to isolate and identify the pathogenic bacteria from banknotes and coins in Sudan and determine their susceptibility to certain antimicrobial pattern.

MATERIALS AND METHODS

Study Design

A prospective descriptive cross sectional community based study. It was carried out at Khartoum state of Sudan. The study was conducted between the periods of February to May 2016. The currency notes and coins were obtained from different communities namely Bus conductors, Pharmacies at Hospitals, Vegetable sellers and Cafeteria counter men. One hundred samples of coins and currencies (52 coins and 48 currencies) were collected randomly with hands

covered with plastic gloves and forceps and were placed immediately into sterile polythene bags and labeled accordingly.

Isolation and Identification of Bacteria

Sterile cotton swab was dipped in the sterile Peptone water, was rubbed on both the surfaces of currency notes, and then inoculate onto the Blood agar and MacConkey agar (Himedia Company, India) for each note. While coins aseptically transferred into sterile container containing 10 mL of sterile buffered Peptone water, which was then gently, shaken to give us resultant and incubated overnight at 37°C aerobically before inoculation, after overnight incubation the turbidity was observed visually and the subculture made on Blood agar and MacConkey agar (Himedia Company, India). Isolation and identification of bacteria by Gram stain and biochemical test (Indole test, Urea hydrolysis test, Motility, Citrate utilization test, Kligler's Iron Agar and Oxidase test for Gram negative bacteria while Catalase test, Coagulate test, Mannitol salt agar medium, DNA-ase test, Litmus milk decolorization, Esculin hydrolysis test, for Gram positive) [13].

Antibiotic Susceptibility Tests

This test was carried out on Mueller-Hinton agar using the Kirby-Bauer technique (disk diffusion). Using following antibiotics: penicillin (10µg), Gentamicin (10µg), Ciprofloxacin (30µg), vancomycin (30µg), and tetracycline (30µg) (Himedia Company, India). Zone of inhibition measured by millimeters according to CLSI (Clinical Laboratory Standard Institute) [14].

RESULTS

From the analysis of the 100 paper currency notes (48) and coins (52) were collected from several area (bus conductors, vegetable sellers, pharmacies, cafeteria countries) in Khartoum city of Sudan, it was established that bacteria and fungi were present on the money.

This study was conducted to isolate pathogenic bacteria from coins and currency in Khartoum city. The result showed that Currency notes were more contaminated with pathogenic bacteria than coins with rate of 55% to 45% from total samples. On the other hand, the pathogenic Gram-positive bacteria overwhelm the Gram negative. The most common contaminated money type is coins with 77(46%) isolate (59 (35%) one SD and 18 1/2(11%) SD) while the currencies type showed 96 (54%) isolate (33(19%) 2SD, 34(20%) 5SD, 21(14%) 10SD and 4(2%) 20 SD).

The total number of all isolates from coins and currency together were 169, of which the pathogenic organism isolate count 62 (36%) (There were *Staphylococcus aureus* 28(17%), followed by *Klebsiella pneumoniae* 14(8%), *Enterobacter* species 9(5%),

Enterococcus faecalis 6(4%), *Pseudomonas aeruginosa* 3(2%), *Escherichia coli* 2(1%). While the other consider as Normal flora was form 107 (64%) (There were *Bacillus* species 33 (20%), followed by *Staphylococcus epidermidis* 24(14%), *Micrococcus* Species 1(1%) and fungi was present 49(29%) of all isolates.

Out of 100, 25 samples were obtained from Bus conductor gave 34 (20%) organism out of which contributed by *Staphylococcus epidermidis*, followed by *Bacillus* species, *Staphylococcus aureus* and *Enterococcus faecalis* and fungi of the total bacterial populations on coins and currency.

Out of 100, 40 samples were obtained From Pharmacies yield 83(49%). Which contributed by *Bacillus* species 25, followed by *Staphylococcus aureus* 12, *Klebsiella pneumoniae* and *Staphylococcus epidermidis* 8 isolate both shard the same count beside 2 isolate of *Pseudomonas aeruginosa* and *Enterobacter* species, and one isolate for each *Escherichia coli* and *Micrococcus* Species, 22 fungi isolated from total organisms isolate on coins and currency.

Out of 100, 15 samples were obtained from Cafeteria counters yield 20 (12%) organism, The first position is occupied by *Staphylococcus aureus* 5,

Bacillus species 3, *Staphylococcus epidermidis* 2, and in the last position *Klebsiella pneumoniae* 1 and fungi 9 from the total of isolates.

Out of 100, 20 samples were obtained from vegetables sellers yield 32(19%) organism, *Klebsiella pneumoniae* presented the highest count 5, followed by *Enterobacter* species 7, *Staphylococcus aureus* and *Staphylococcus epidermidis* both shared the same count 4, *Enterococcus faecalis* 2, *Escherichia coli* and *Pseudomonas aeruginosa* count1, fungi 9 from all total isolates.

Antimicrobial sensitivity tests indicated that the pathogenic gram positive isolated was more resistant to majority of use antibacterial when compared with pathogenic gram-negative isolated. *Staphylococcus aureus* was more resistant to penicillin and more sensitive to ciprofloxacin, while *Enterococcus faecalis* was more sensitive to vancomycin but resistant to penicillin. *Escherichia coli* was resistant to vancomycin and sensitive to ciprofloxacin, *Klebsiella pneumoniae* is more resistant to vancomycin and sensitive to ciprofloxacin, *Pseudomonas aeruginosa* was resistant to penicillin and sensitive to Gentamycin, *Enterobacter* species was sensitive to tetracycline and more resistant to vancomycin (Table-1).

Table-1: Showed the Antibiotic Sensitivity Pattern of Microbes isolated from Sudan Currency and Coins

Antibiotics organisms	Penicillin		Vancomycin		Ciprofloxacin		Gentamycin		Tetracycline	
	S	R	S	R	S	R	S	R	S	R
<i>Staphylococcus aureus</i>	6	21	23	4	27	0	27	0	23	4
<i>Staphylococcus epidermidis</i>	15	5	17	3	20	0	20	0	15	5
<i>Enterococcus faecalis</i>	0	3	3	0	3	0	3	0	3	0
<i>Escherichia coli</i>	0	2	0	2	2	0	2	0	2	0
<i>Klebsiella pneumoniae</i>	0	9	1	8	9	0	9	0	9	0
<i>Pseudomonas aeruginosa</i>	0	3	0	3	3	0	3	0	3	0
<i>Enterobacter</i> species	2	9	4	7	11	0	10	1	11	0
<i>Micrococcus</i> Species	0	1	0	1	1	0	1	0	1	0

DISCUSSION

The results of this study revealed that currency notes and coins were commonly contaminated with various bacteria. We found that 97% of tested currency notes and coins were contaminated with bacteria, which our study disagree with previously reported studies from Tanzania [15], India [16, 17], and where almost all the notes were contaminated Different species of bacteria isolated in our study are almost agree with the studies done in Nepal [18], Iraq [8] and Nigeria [7]. All these studies established gram-positive bacteria as the major isolates from the contaminated coins and currencies.

Transmission of microorganisms is possible from any place where they are attached. Hand to hand Transfer of money plays important role in spread of diseases The number of transferring organisms from coins or notes depends on a series of factors such as

The number of organisms present and their ability to survive in dry environment [19]. The form of contact also makes a difference, whether it is by touching contaminated money, which can transfer the organisms to the hand The source of contamination may be chiefly dirty hands, food and water. Coliform and *Staphylococcus aureus* can be re-introduced in food by many ways. It was observed that, during vending operations, the same hand alternatively served and held food and money [20].

Money handling constitutes another risk factor of street food contamination [12]. These routes of transmission are of great importance in the health of many populations in developing countries where the frequency of infection is general indication of local hygiene and environmental sanitation levels. To date no outbreaks of foodborne and other illness have been associated with infection from money. However,

evidence for the presence of pathogenic bacteria on currency reinforces the need for strict adherence to hygienic practices among money handlers who also handle food and water.

This study show higher frequencies of *Staphylococcus aureus* and *klebsiella pneumoniae* similar to the results obtained by [21, 16]. They had collected currency notes and coins from different communities e.g. Bus conductors, public toilets agents and pharmacies to reveal the bacteria profile of circulating coins and currency notes [21], other study tested to isolate various loads of microorganisms on currency notes and coins [16]. At the same time lower frequencies was appeared with *Escherichia coli*, *Citrobacter* species and *Pseudomonas aeruginosa* in both studies.

This study also showed lower frequencies in *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Escherichia coli* than the studies that made by [15] in Tanzania and [8] in Iraq. Also show higher frequencies in *staphylococcus* than the previous study that made by [18]. In other hand in this study absence or little resistance against Gentamycin and Ciprofloxacin was appeared with same study that done by [8].

In addition, this study showed higher frequencies in *Staphylococcus aureus* than the other studies that was done by [22, 17]. At the same time lower frequencies with *Escherichia coli* was appeared in both studies.

It can be concluded that currencies and coins in (bus conductors, pharmacies, cafeteria counters and vegetables seller) is commonly contaminated with different pathogenic and potential pathogenic bacteria and all the people handling currency are invariably exposed to those microorganisms. So, awareness related to the improvement of personal hygiene and good money handling practice such as washing hands properly with soap and water after handling currency before eating and avoiding using saliva during counting money are strongly recommended as the main pillar to reduce the risk of infection. It is suggested that the public should be further enlightened on the importance of hand wash act at restaurants and homes and after going to the toilet and we expect that regular usage of disinfectants during COVID-19 pandemic will reduce contamination of moneys with pathogens.

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