

Aerobic Bacteriological Contamination of Sudanese Currency in Port Sudan, Sudan

Abd Elrahman Mustafa Abd Elrahman Osman^{*}, Shingray Osman Hashim,
Mohammed Abdall Musa, Omer Mohammed Tahir

Medical Laboratory Sciences Division, Port Sudan Ahlia College, Port Sudan, Sudan

Email address:

abdo_rahman96@hotmail.com (A. E. M. A. E. Osman)

^{*}Corresponding author

To cite this article:

Abd Elrahman Mustafa Abd Elrahman Osman, Shingray Osman Hashim, Mohammed Abdall Musa, Omer Mohammed Tahir. Aerobic Bacteriological Contamination of Sudanese Currency in Port Sudan, Sudan. *International Journal of Chinese Medicine*. Vol. 1, No. 4, 2017, pp. 132-136. doi: 10.11648/j.ijcm.20170104.15

Received: November 22, 2017; Accepted: December 4, 2017; Published: January 3, 2018

Abstract: In this review, we show that contaminated money and coins are a public health risk when associated with the simultaneous handling of food, and currency may spread nosocomial infections. The currency circulating in different parts of the world could serve as a vehicle for transmission of drug resistant pathogenic or potential organisms and contamination could be due to currency usage and handling as mint notes were not contaminated. Cotton-based banknotes provide a fibrous surface, which provides ample opportunity for bacterial attachment. Therefore, hygienic measures such as thorough hand washing with soap after using currency notes and ATM machine should be observed and the practice of keeping money in shoes and socks and under the carpets should be discouraged. Further, we should avoid the use of saliva during counting of currency notes as well as desist from placing money in the mouth and biting off corners of currency notes. Moreover, ready-to-eat food sellers should be educated to avoid possible cross contamination between currency notes and the food they sell. The most common isolated bacteria were *Bacillus*, *Klebsellia*, *E. coli*, *Staph. aureus*, *Pseudomonas*, *Strepto. fecales*, *Enterobacter*, *Macrococus*. This study showed that the most contaminated bill denomination were those of low denomination (1,2 SDG). Notes obtained from Cafeterias and Drivers showed the highest rate of bacterial contamination.

Keywords: Bacillus, Klebsellia, *E. coli*, Staph Aureus, Pseudomonas, Streto Fecales, Enterobacter

1. Introduction

Contaminated currency is a potential public health hazard due to its high circulation among man. Hence facilitates dissemination of pathogens to susceptible hosts. Money, being a fomite can be contaminated by different microorganisms associated with unclean hands or dirty environment and therefore present high risk to public health [1]. Confirmation of contamination of money by drugs has been detected in the United States and United Kingdom [2].

Contamination from the skin, anal region, wounds, nasal secretions and aerosols generated by sneezing and coughing are potential sources of transfer of microorganisms to currency notes during handling [3]. Unhygienic practices among money handlers such as keeping in bra (women), handling after attending to patients with unwashed hands (physicians and medical personnel), and money transactions

with hands contaminated with body fluids (commercial sex workers) do not only deface but contaminate the currency. Bacteria causing different infections like pneumonia, tonsillitis, peptic ulcers, urino-genital tract infection had been reportedly associated with money [4].

A study by Hosen *et al.*, [5] in Bangladesh revealed *Coliform* contamination of 80% of thirty old twotaka notes, Pope *et al.* [4], isolated pathogenic or potentially pathogenic organisms from 94% of one-dollar bills and Basavarajappa *et al.* [6] found 96 out of 100 currencies contaminated with bacteria.

Studies in different parts of India show that predominant organisms isolated from contaminated currency are *Bacillus spp* followed by Coagulase negative *Staphylococci* (CNS) and *Microcococcus spp*. Other pathogenic bacteria present in the currency are *Klebsiellapneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, 3,4 *Pseudomonas spp*, *Salmonella*

sp., *Proteus sp.* A recent study conducted in Nagpur, *Escherichia coli* was found to be the most common organism. This finding resembles the data collected from the 1 study in Bangladesh. So, pattern of contamination varies from one place to another. Therefore, the present study was focused on the bacteriological niche of circulating currency in tertiary care hospital in rural Bengal. To the best of our knowledge this study is first of its kind conducted in a hospital setting in India. A classic characteristic of human parasitic and bacterial agents is the evolution of routes for transmission to susceptible hosts. The environment plays a critical role in transmission to humans, with many environmental materials serving as vehicles [7]. Microbial contaminants may be transmitted directly, through hand-to-hand contact, or indirectly, via food or other inanimate objects. 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 [8]. The possibility that currency notes might act as environmental vehicles for the transmission of potential pathogenic microorganisms was suggested in the 1970s [9]. Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce, from buying milk at a local store to trafficking in sex and drugs. All this trade is hard on currency, with lower denomination notes receiving the most handling because they are exchanged many times [10]. Although paper currency is made to take abuse (up to 4,000 folds in each direction) in most parts of the world, including in Nigeria (where paper currency is a rugged mix of 75 percent cotton and 25 percent linen), it lasts less than a few years in circulation [10]. The average U.S. dollar, for instance, like most currencies worldwide, lasts a mere 18 months [10]. Paper currency also provides a large surface area as a breeding ground for pathogens [11]. Money on which pathogenic microorganisms might survive represents an often overlooked reservoir for enteric disease [12]. In most parts of the developed.

When hands are used in cleaning up the anus after passing out faeces and are properly washed and are used to touch currency notes in any way the tendency of contamination in high other attitudes such as wetting of fingers with saliva or unclean water to lubricate the fingers in containing money could lead to passable transfer of microorganism from such medium to the notes and vice versa. An aspect of food service that frequently causes concern, particularly among enlightened consumers, is the way a food handler prepares the food, takes money for the purchase, returns change to the customer, and then prepares food for the next customer.

This pattern is most noticeable in sandwich bar operations, but is by no means restricted to outlets of that type. Anything that gets on hands can get on money. The study reported here, therefore, was designed to add to the limited body of literature on microbial contamination of currency notes and to address growing community concerns about the risks associated with microbial contamination and handling of

money worldwide.

2. Methodology

40 paper bills were collected randomly from a number of different services including drivers, butchers, vegetable seller, cafeteria and pharmacy. Each was preserved in plastic file bag in order to avoid further contamination. Bacterial examinations were carried out at the Department of microbiology port Sudan Ahlia college universal contains. Specimens were inoculated onto B. A & Macconkey medium by using sterile loop, then incubated at 37°C overnight. The primary culture on B. A & Macconkey medium that showed significant growth was examined. The morphological character, size, shape, colour were observed and recorded. Colonial characteristics were observed on B. A & Macconkey medium after overnight incubation isolated organisms were grown on B. A & Macconkey medium.

2.1. Biochemical Tests (Conventional Test)

These are called biochemical tests because they are tests which identify the bacteria on the basis of the presence of certain enzymes and other biochemical properties.

2.2. Kligler Iron Agar

Fifty – five grams of the powder were dissolved in 1000 ml distilled water by boiling. It was cooled to 50-55°C, distributed into tube (approx. 16-160mm) and sterilized by autoclaving at 121°C for 15 minutes. Then it was allowed to solidify in a sloped and butt position.

2.3. Citrate Utilization Test

This is for the ability of an organism to utilize citrate as the sole carbon and energy source for growth and an ammonium salt as sole source of nitrogen.

2.4. Indole Test

This test demonstrates the ability of certain bacteria to decompose the amino acid tryptophan to indole, which accumulates in the medium. Indole is then tested for by a colorimetric reaction with p-dimethylaminobenzaldehyde. Add 0.5 ml Kovacs reagent to see result.

2.5. Urease Test

The tested microorganisms were inoculated on a slope of urea agar medium, incubated at 37°C, change of colour of the medium to pink indicated a positive result.

2.6. Motility Test

In semi solid agar, motile bacteria (swarm) and give diffuse spreading growth easily recognized by the naked eye. motility may thus be detected more easily than by the microscopical method.

2.7. Antimicrobial Sensitivity Test

All isolated microorganisms were subjected to antimicrobial sensitivity test using multiple disc diffusion of Gram negative and positive.

3. Results

Paper denominations were collected from cafeteria, butchers, drivers andVegetable seller. The highest rate ofbacterial isolation documented in samples collected from cafeteria, and the least was detected in samples obtained from

butchers and drivers.

According to the cultural and biochemical characteristics, the most frequent bacteria isolated from paper notes were *bacillus* (29%) *klebsellia. pneumoniae* (26%) *E. coli* (18%) *Staph. aureus* (11%). *pseudmonus* (8%) *Streto. fecales* (3%) *Enterobacter* (3%) *Macrococus*(3%)

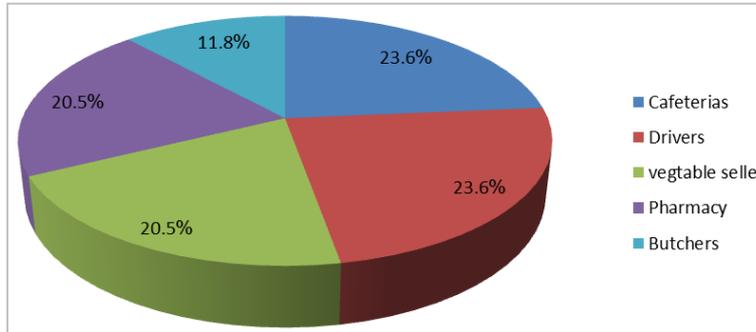


Figure 1. Percentage of bacterial isolates from each source.

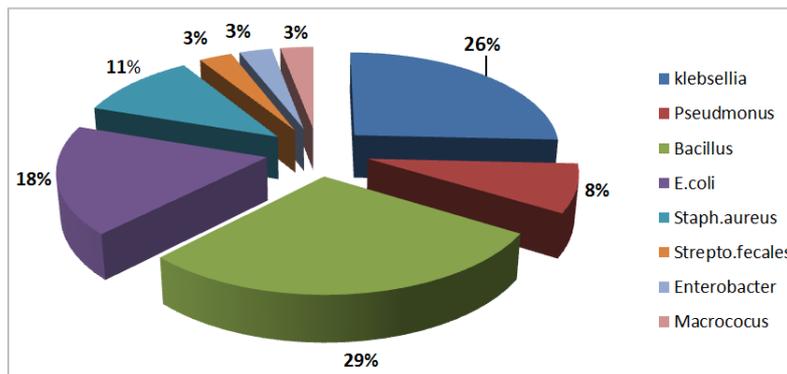


Figure 2. Types and percentage of isolated bacteria.

Table 1. Number and percentage of bacterial isolates from each source.

Source	Number of bacterial isolates	Percentage
Cafeterias	8	23.6%
Drivers	8	23.6%
Vegetable seller	7	20.5%
Pharmacy	7	20.5%
Butchers	4	11.8%
Total	34	100%

4. Discussion

Microbiological method were adopted in this study indicate that various species of bacteria have been isolated from Sudanese currency many of them could act as potential pathogen to human. The bacteria isolation from Sudanese currency notes are similar to other studies [13].

-Several mechanisms have been suggested to explain the contamination:-

Improper hand washing, counting paper notes using saline, coughing and sneezing on hands then exchanging money between individuals [4], and placement or storage of paper notes in dirty surfaces increase the chances for the notes to be contaminated [14].

These contaminations include pathogenic organism which

cause diseases in healthy individuals as well as bacteria that cause diseases for hospitalized or immune compromised patient [12].

-The majority of people are not aware they may be infected by pathogenic bacteria transmitted to them by handing paper currency [4].

The type of contamination on paper nodes depends on place and activity performed before handling currency node [12].

-The result of this study confirmed that currency nodes could serve as vector for disease transmission of pathogen and microorganism we found about 8 isolated which constituted 38% of total isolates; this is previously reported from Egypt [14]. But Lower than the Saudi Arabian.

-The money collected was commonly contaminated with normal skin flora and potentially pathogenic bacteria, such as *S. aureus*, *Klebsiella Spp*, *pseudomonas Spp*, *E. coli* Normal flora isolated include gram positive bacilli and gram negative bacilli

-The presence of pathogenic *Staphylococci* on currency was expected because *S. aureus* carriers and diseased persons are common in the population [15], infection by *S.aureus* is a major problem in hospitals, but over the past few decades the incidence of community acquired *S.aureus* infection has also increase.

Paper currency has recently been identified as made of transmission of community-acquired in *S.aureus*[16].

-In this study *Staphylococcus aureus* isolation rate about 11% Enteric bacteria, *Klebsella Spp*, *E. coli* and *Pseudomonas Spp* have been commonly isolates on paper currency in several studies [4].

E.coli is coliform bacteria indicating fecal contamination this reflects poor personal, isolated in this study with isolation rate of 18% (is similar to the findings of [17].

Since *Klebsella pneumonia* is widely distributed in nature (Soil, water, moist environment in hospitals), mouth and upper respiratory tract of human and animals also cause respiratory tract infection and associated with infection of urinary tract and wound [18] In this study, this species was 26% isolated rate.

Pseudomonas Spp involved in human diseases it can cause eye and skin infection as well as external otitis in this study with an isolation rate of 8% this finding is similar to the finding of Abrams and Vaterman [19], Gokatas and Oktay [13], Basavmjappa [20].

-*Bacillus* which is isolated is commonly found in the soil, it is common practice to keep nodes in contact with surfaces such as the ground, soil, table surfaces with isolation rate 29%. -*St. fecelaes* suggest facial contamination, the rate 3% [21]. The nodes were collected randomly (Transports, pharmacies, butchers, cafeterias and drivers) the pervasive presence of these bacteria isolates reveals the majority of people are exposed to contaminated money. This study clearly shown the aerobic bacteria contamination of some Sudanese currency.

The Port Sudan city is cosmopolitan with people from various socioeconomic and various hygienic habits being followed, which explain the level of contamination of the paper currency.

This study clearly showed the aerobic bacterial contamination of some Sudanese currency rates, and possibly other denomination in circulation in Port Sudan city.

The study confirms how important it for food handlers to refrain from handling money.

This study also addresses the threat contaminated money poses to immune compromised individual.

Improvement of personal hygiene standards is strongly recommended to reduce the risk of infection.

5. Conclusion

In this review, we show that contaminated money and coins are a public health risk when associated with the simultaneous handling of food, and currency may spread nosocomial infections. The currency circulating in different parts of the world could serve as a vehicle for transmission of drug resistant pathogenic or potential organisms and contamination could be due to currency usage and handling as mint notes were not contaminated. Cotton-based banknotes provide a fibrous surface, which provides ample opportunity for bacterial attachment Therefore, hygienic measures such as thorough hand washing with soap after

using currency notes and ATM machine should be observed and the practice of keeping money in shoes and socks and under the carpets should be discouraged.

The most common isolated bacteria were *bacillus. klebsellia. E.coli. Staph. aureus. pseudomonus, Streto. fecales. Enterobacter, Macrocoocus*. This study showed that the most contaminated bill denomination were those of low denomination (1,2 SDG).

References

- [1] Basch CH, Guerra LA, MacDonald Z, Marte M, Basch CE. Glove changing habits in mobile food vendors in New York City. *Journal of community health*. 2015 Aug 1;40(4):699-701.
- [2] Dulvy NK, Fowler SL, Musick JA, Cavanagh RD, Kyne PM, Harrison LR, Carlson JK, Davidson LN, Fordham SV, Francis MP, Pollock CM. Extinction risk and conservation of the world's sharks and rays. *Elife*. 2014 Jan 21;3:e00590.
- [3] Boyce JM, Pittet D. Guideline for hand hygiene in health-care settings: recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *American journal of infection control*. 2002 Dec 31;30(8):S1-46.
- [4] Pope, T. W. Ender, P. T. Woelk, W. K. Koroscil, M. A. and Koroscil, T. M. (2002). Bacterial Contamination Paper Currency. *Southern Medical Journal*, 95:1408-1410.
- [5] Rossi R, Pastorelli G, Cannata S, Tavaniello S, Maiorano G, Corino C. Effect of long term dietary supplementation with plant extract on carcass characteristics meat quality and oxidative stability in pork. *Meat Science*. 2013 Nov 30;95(3):542-8.
- [6] Nakagawa S, Cuthill IC. Effect size, confidence interval and statistical significance: a practical guide for biologists. *Biological Reviews*. 2007 Nov 1;82(4):591-605.
- [7] J. Keith Struthers, Roger P. Westran. *Clinical Bacteriology Textbook-192 Pages-282 Color* July 21, 2003 by CRC Press.
- [8] Duffie D. *Dynamic asset pricing theory*. Princeton University Press; 2010 Jan 27.
- [9] Santo CE, Morais PV, Grass G. Isolation and characterization of bacteria resistant to metallic copper surfaces. *Applied and environmental microbiology*. 2010 Mar 1;76(5):1341-8.
- [10] Gadsby, P. (1998). Filthy Lucre: bugs, drugs and grime hitch arid on the back of every buck. *Discover* 19:76-84.
- [11] Feglo P, Nkansah M. Bacterial load on Ghanaian currency notes. *African Journal of Microbiology Research*. 2010 Nov 18;4(22):2375-80.
- [12] Michael, B. (2002). Handling money and serving ready -to-eat food. *Food service technology J*, 2, 1-3.
- [13] Goktas, P. and Oktay, G. (1992). Bacteriological examination of paper money, Article in Turkish. *Mikrobiyol Bul*, 26:344-8.
- [14] El-Dars, F. M. S. and Hassan, W. M. H. (2005). A preliminary bacterial study of Egyptian paper money. *International Journal of Environmental Health Research* 15:235-239.

- [15] Naimi TS, LeDell KH, Como-Sabetti K, Borchardt SM, Boxrud DJ, Etienne J, Johnson SK, Vandenesch F, Fridkin S, O'boyle C, Danila RN. Comparison of community-and health care-associated methicillin-resistant *Staphylococcus aureus* infection. *Jama*. 2003 Dec 10;290(22):2976-84.
- [16] Navidinia M, Fallah F, Lajevardi B, Shirdoost M, Jamali J. Epidemiology of methicillin-resistant *Staphylococcus aureus* isolated from health care providers in Mofid children hospital. *Archives of Pediatric Infectious Diseases*. 2015 Apr;3(2).
- [17] Vriesekoop F, Russell C, Alvarez-Mayorga B, Aidoo K, Yuan Q, Scannell A, Beumer RR, Jiang X, Barro N, Otokunefor K, Smith-Arnold C. Dirty money: an investigation into the hygiene status of some of the world's currencies as obtained from food outlets. *Foodborne pathogens and disease*. 2010 Dec 1;7(12):1497-502.
- [18] Zomorodian K, Bandegani A, Mirhendi H, Pakshir K, Alinejhad N, Fard AP. In vitro susceptibility and trailing growth effect of clinical isolates of *Candida* species toazole drugs. *Jundishapur journal of microbiology*. 2016 Feb;9(2).
- [19] Abrams, B. I. and Waterman, N. G. Dirty money; *Journal of the American Medical Association*. 1972.219: 1202-1203.
- [20] Basavarajappa, K. G. Sridhar-Rao, P. N. and Suresh, K. (2005). Study of bacterial, fungal and parasitic contamination of currency note in circulation.
- [21] Galvani PF, Twitty MT. Effects of intertrial interval and exteroceptive feedback duration on discriminative avoidance acquisition in the gerbil. *Animal Learning & Behavior*. 1978 Jun 1;6(2):166-73.