

Bacteriological Examination of Currency notes in Atbara Town in Sudan

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Abstract: Currency notes and coins serve as an agency of transmission of microorganisms since they are passed freely from hand to hand as a medium of exchange. A research, with an objective to explore the microbial load on Sudanese paper currency notes and coins, was carried out at Faculty of Education, Department of life science and Environmental Studies ,Nile Valley University . All together 60 samples of Sudanese pounds (1, 2, 5 and 10 for paper notes and one pound only for coin currency) were randomly collected from different sources at Atbara town (bus conductors ,butcher, vegetable sellers, restaurant and grocery) and were analyzed for bacterial contamination. Among the total aerobic bacteria, 98% were contaminated with coliform bacteria ,98 % showed presence of Staphylococci ,90 % for Bacillus spp. The percentage of predominant bacteria found in paper currency notes were S.aureus (33. 5%), E.coli (41.8 %),S. epidermidis (36.7%), Streptococcus spp. (3 6.8%), Bacillus spp. (27.8%) , Micrococcus (6.7%), while in coins were, S.aureus (17.7%), E.coli (13.3 %),S. epidermidis (17.8. %), Streptococcus spp.(17.8%), Bacillus spp., (6.7%) , Micrococcus sp. recorded in paper banknotes only (6.6%) and Shigella sp. was isolated from coin only (4.4%), Paper notes was heavily contaminated when compared with coin. The presence of high microbial load on currency notes and coins indicate the potentials of such currencies for possible spread in the human communities.

Key words: currency notes, coins, heterotrophic bacteria, Coliform bacteria, Staphylococci, Streptococcus,Bacillus spp.

Introduction:

Contamination of different objects by potential pathogenic microorganisms is of public health importance as contaminated materials can be possible sources of transmission of such pathogens. Items that are passed from hand to hand are of considerable likelihood to be contaminated with disease-causing microorganisms especially if handled with unclean hands or kept in dirty or contaminated surroundings. Microorganisms are known to spread via air, water, food etc. an important mechanism of the spread of pathogens by fomites. Paper currency notes which are transferred from one individual to other are known to carry bacterial on their surface and are responsible for transmitting them [1] and [2]. Money, whether in the form of coins or paper notes is perhaps the most widely handled article by people everyday throughout the world. Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce. The paper currency notes and coins may harbor various pathogenic microorganisms. Currency in the form of notes and coins represents a

Sampling and sample collection

The study objects (paper notes and coins) were collected randomly from different sources in Atbara town. The samples were collected from grocery shops, vegetable sellers butcher, restaurant and buses conductors. During the collection of paper banknotes and coins, users were

universal medium for the transmission of bacteria in the environment and among humans [3].Paper Currency, can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials or placed on dirty surface. Money is commonly handled by various categories of people during transaction [4].Although there is no direct evidence that presence of potential pathogens on currency notes or coins results in infections but contaminated notes may act as potential source of infections. Therefore, this study aims to investigate the bacteria that might play a significant role in order to explore the possibilities of transmission of infectious agents through currency notes and coins.

Materials and Methods:

A descriptive quantitative study was conducted taking all together 60 samples of paper notes and coins collected from different sources in Atbara town. The objects were analyzed for the presence of bacteria at the Microbiology Laboratory at Department of Life Science during December 2013- April2014.

requested to put these objects into sterile plastic bags. The sealed bags were then immediately transported to the laboratory where further analysis was carried out. Each paper currency notes was placed, aseptically, in a test tube (25ml capacity) containing 10 ml of nutrient broth (10-1 dilution) and then shakes using vortex shaker for one to

two minutes so that microbes adhered over the note surface come out to normal saline then the tubes were incubated at 30 °C for 6 hours . After this, the objects were taken out aseptically and then washed. The contents of test tubes were used for detection of bacteria. In case of coins, each coin was placed in a beaker (50-100ml) containing 10 ml nutrient broth (10-1 dilution) with the help of sterile forceps

Heterotrophic plate count

Total aerobic heterotrophic plate count was carried out by pour plate technique using plate count agar (PCA). The plates were incubated at 37 ° C for 24 hours and total number of colony forming units (cfu) were Counted.

Coliform count

Total coliform count was carried out by pour plate technique using violet red bile salt (VRBA). The plates were incubated at 37° C for 24 h and pink colonies were enumerated.

Staphylococcal count

Total *staphylococci* count was carried out by pour plate technique using mannitol salt agar (MSA). The plates were incubated at 37°C for 24 h. and typical yellow colonies were counted.

Identification of Staphylococci

to laboratory investigation, 10 were coins and 40 paper banknotes (Table 1). Paper notes analyzed were that of S.P. 1, 2 ,5and 10, and coins of S.P. 1 only.

Table (1). Sampling location distribution of paper notes and coins in Atbara town

Sources.	No. of paper note samples (Sudanese pound 1, 2,5 and10)	No. of coin samples (Sudanese pound 1)
Grocery shop	8	2
restaurant	8	2
Butcher	8	2
Vegetable seller	8	2
Bus conductors	8	2
Total No. of samples	40	10

Coliform Count

Faecal indicator organism 'coliform' were enumerated in all samples. It was estimated that 100% paper notes and 90% coins were contaminated with coliforms. The level of microbial load was the same as that of heterotrophic plate count , that is paper notes heavily contaminated when compared with coins. The coliform bacterial count was 1520 and 247 cfu per note/coin respectively (Table 3).

and gently shakes for one to two minutes and also incubated at 30 °C for 6 hours. Then the coins were taken out aseptically, washed with normal saline. These were further used for detection of microbes. The wash of currency notes and coins were subjected to the following microbiological tests [5].

Typical colonies of *Staphylococci* were subjected to identification ,which was based on gram staining and biochemical tests [6].

Bacillus spp. count

Total *Bacillus* spp. count was carried out by pour plate technique using nutrient agar . The plates were incubated at 37°C for 24 h and typical *Bacillus* colonies were counted.

Identification of Bacillus spp.

Typical colonies of *Bacillus* were subjected to identification based on morphological and biochemical tests as described by [7].

Identification of Shigella and Micrococcus spp.

Typical colonies of *Shigella and Micrococcus* were identified using S.S.agar medium for *Shigella* spp. And Macconkey agar for *Micrococcus* respectively. The identification was based on gram staining and biochemical tests [7].

Results:

The present study revealed the extent and the level of contamination of Sudanese paper money and coin with pathogenic microorganisms. Among 60 samples subjected

Heterotrophic plate count bacteria:

All samples of paper currency notes (n=40) and coin (n=10) were contaminated. Paper currency notes were found to be heavily contaminated (average load 4530.6 cfu/note), while in coin contamination level is low and the average bacterial count was 356.5cfu/ coin (Table 2).

Table (2). Table 2. Heterotrophic plate count

Paper /Coin	Sample with presence of bacteria (%)	Average HPC (cfu/note or coin)
Paper notes (40)	(40)100	4530.6
Coins (10)	(10)100	356.5
Total (No.50)	(50)100	2443.6

Table (3): Coliform count

Paper /Coin	Sample with presence of bacteria (%)	Average HPC (cfu/note or coin)
Paper notes (40)	(40)100	1520
Coins (10)	(1) 90	247
Total (No.50)	(49) 98	981.7

Staphylococci Count

Staphylococci were detected in 100% paper currency notes and 90% in coin samples. In average 98% samples were found to be contaminated with *Staphylococci*. The average load detected was 583.5 and 123.5 cfu per paper note/coin respectively (Table 4).

Table (4). Staphylococcal count

Paper /Coin	Sample with presence of bacteria (%)	Average HPC (cfu/note or coin)
Paper notes (40)	(40) 100	583.5
Coins (10)	(9) 90	123.5
Total (No.50)	(49) 98	336.1

Bacillus Count:

Bacillus were detected in 95% paper currency notes and 70% in coin samples. In average 90% samples were found to be contaminated with *Bacillus*. The cultures from the collected Sudanese paper currency and coin were representing in seven different of genera and species of bacteria. Identification showed that the active participation of these seven genera and species in descending order of percentage *Escherichia coli* 41.8%, *Streptococcus sp.* 36.8%, *staphylococcus epidermidis*, *staphylococcus aureus* 31.4%, *Bacillus spp.* 27.8% , *Micrococcus sp.* 6.7% in paper currency notes ,whereas in coins *Escherichia coli* , *Streptococcus sp.* *staphylococcus epidermidis*, *Staphylococcus aureus* and *Bacillus sp.* were 13.3%,17.8%,17.8% ,17.7% and 6.7% in order. *Micrococcus sp.* not detected in coins while *Shigella sp.* was detected in coins only at low percentage(4.4 %) table 6).

contaminated with *Staphylococci*. The average load detected was 363.5 and 83.4 cfu per paper note/coin respectively (Table5).

Table (5). Bacillus spp. count

Paper /Coin	Sample with presence of bacteria (%)	Average HPC (cfu/note or coin)
Paper notes (40)	(38) 95	363.5
Coins (10)	(7) 70	83.4
Total (No.50)	(45) 90	279.3

Table (6). Percentage occurrence of bacterial incidence per denomination of Sudanese paper currency and coins from different sources in Atbara town.

Denominations	Relative occurrence of bacterial genus and species (%)						
	<i>Shigella</i> sp.	<i>Bacillus</i> sp.	<i>Micrococcus</i> sp.	<i>Strep.sp.</i>	<i>Staph.</i> <i>epidermid</i> <i>is.</i>	<i>Staph.</i> <i>aureus</i>	<i>E.coli</i>
1S.P.(coin)	4.4	6.7	-	17.8	17.8	17.7	13.3
1S.P.(paper)	-	37.8	6.7	47.8	42.2	38.6	46.1
2S.P.(paper)	-	20	13.3	31.04	35.5	35.5	55.7
5 S.P.(paper)	-	40	6.7	37.8	37.8	34.6	40.02
10S.P.(paper)	-	13.3	-	30.4	30.5	30.5	25.2
Average for paper notes	1.1	27.8	6.7	36.8	36.7	31.4	41.8

Discussion:

There is a possibility that currency notes might act as environmental vehicles for the transmission of potential pathogenic microorganisms [8]. Human occupational activities, without hygienic intervention, especially those involving simultaneous money handling, could introduce the risk of infections. Contaminated currency is identified as a potential public health hazard as pathogens can be spread by circulating banknotes [9].

The results of this study revealed that currency notes are commonly contaminated with various bacteria. We found that 100% of tested currency notes and coins were contaminated with bacteria, which is agreed with the results obtained by [1] and [10] and higher than that previously reported by [11] in Nigeria. Also the current research has shown that most locally used paper currency banknotes and coins are contaminated with different types of bacteria, some of which are pathogenic. Such results agree with reports from other countries which elucidated that currency banknotes are usually contaminated by pathogenic microorganisms[1]; [12] and [13].The colon-inhabitant normal microbiota, *E. coli*, was the most common isolated bacterium. This situation may be attributed to the possibility that some people disregard hand wash after using toilets. Such finding is in line with what has been reported that currency banknotes are contaminated with enteropathogens [3] Furthermore, the results explain that

currency banknotes act as a potential source of enteric diseases. *Staphylococcus* and *Streptococcus* species recorded the second high percentage in this study the first one produces many toxins responsible for toxic shock syndrome, *Staphylococcus aureus* is commonly present on the skin and in the nasal passage of about one third of the human population. The *Streptococcus* sp isolated although they are normal commensally on human which reflect improper hygiene practice such as pocking nose with fingers [14]. Average percentage of *Bacillus* spp. in this study was 27.8%. This genus comprise a vast group hardy spore forming species that live in soil and are found in the environment could also be transferred on money due to its placement on dirty surfaces or handling with dirty hands. *Bacillus* produces an emetic exotoxin capable of inducing disease in man [15]. The level of microbial load in coins was lower than paper banknotes, although in this study coins carry a good number of potential pathogens. Every coin sampled was found to carry diggerent genera and species of bacteria. Common causative agents of food poisoning *Streptococcus* spp., *Staphylococcus epidermidis* and *S. aureus* were isolated from from coins (17.8%, 17.8 and 17.7 in order). *E.coli* 13.3% *Bacillus* spp. 6.7% and *Shigella* sp. 4.4% which was isolated only from coins.

Transmission of microorganisms is possible from any place where they are attached. Hand to hand transfer of money. 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

Conclusion:

It can be concluded that currency in Atbara town 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

environment [16].

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

References:

- [1] K. Basavarajappa, P .Rao, K. Suresh. Study of Bacterial, Fungal, Parasitic Contaminaiton of Currency Notes in Circulation. *Ind J. Path. Micro*;48(2): 278-9 , 2005.
- [2] C. Uneke, and O. Ogbu . Potential for Parasite and Bacteria Transmission by Paper Currency in Nigeria. *J Environ Health*, 69 54–60, 2007.
- [3] J. Xu, , J. Moore and , B. Millar . Ribosomal DNA (rDNA) Identification of the Culturable Bacterial Flora on Monetary Coinage from 17 Currencies. *J. Environ. Health*, 67 (2005) 51-55, 2005.
- [4.] O.G. Oyero and B.O. Emikpe. Preliminary Investigation on the Microbial Contamination of Nigerian Currency. *Int. J. Trop. Med.* 2(2): 29-32 , 2007.
- [5] H. J. Benson. *Microbiological Applications: A Laboratory Manual in General Microbiology*, (6th Edition), Wm C. Brown Company Publishers, Dubuque Iowa 1994.
- [6] D. Baird, Staphylococcus: Cluster forming Gram positiv cocci. In: *Mackie and MaCartny Practical Medical Microbiology* (Eds. J. G. Collee, A. G. Fraser, B. P. Marmion, & A Simmons) (14th Edition). Churchill Livingstone. pp. 245-61, 1996.
- [7] D. Claus and P. C. W. Berkeley. Genus Bacillus In: "Bergey's Manual of systematic Bacteriology". Vol. 2: Sneath, P. H. A., Bair, N. S., Sharpe, M. E. and Holt, J. G. (eds) ,1989.
- [8] B. L. Abrams and N. G. Waterman. Dirty money. *J. American Med. Assoc.*219: 1202-1203 ,1972.
- [9] C.L. Igumbor, P.O. Obi, N. Potgieter Bessong, and T.C. Mkasi .Microbiological analysis of banknotes circulating in the Venda region of Limpopo province, South Afr. *Res Action* 103 (9 & 10): 365-366 , 2007.
- [10] A. Al-Ghamdi, S. Abdelmalek, M. Bamaga, E. Azhar, M. Wakid, and Z . Alsaied. Bacterial Contamination of Saudi "One" Riyal Paper Note. *Southeast Asian J. Trop. Med Public Health* ,42 (3):711-716, 2011.
- [11] EU .Umeh, JU. Juluku and T. Ichor). Microbial Contamination of 'Naira' (Nigerian Currency Notes in Circulation. *Res J Envir Sci.* 1(6):336-9, 2007.
- [12] F. El-Dars, and W. Hassan, A preliminary Bacterial Study of Egyptian Paper Money. *Int. J. Environ. Health Res.*,15235-240 2005.
- [13] S. Siddique, Dirty money: You're Carrying More than Cash in your Wallet. Philippine Headline News Online (August 20), 2003. <http://newsflash.org/2003/05/si/si001628.htm>.
- [15] R. Silman, S. Rahm and D.M. Shales,. Serious Infections Caused by *Bacillus* sp. *Medicine.* 66: 218-223 ,1987.
- [16] R. Beumer,. Filthy lucre? *New Scientist Magazine* ,2634: 81,2007.

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