Research Article

BACTERIOLOGICAL EXAMINATION OF PAPER CURRENCY NOTES IN TANGA IN TANZANIA

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ABSTRACT

A total of 136 Paper currency notes of Tanzania Shilling (500, 1000, 2000, 5000 and 10,000 Tshs) were randomly collected from fish, instant food, fruits and vegetable sellers in market place and analyzed for bacterial contamination. Swab samples were analyzed in microbiology lab. The percentage of predominant bacteria found in currency notes were *S.aureus* (30.75%), *E.coli* (51.71%), *klebsiella pneumonia (*16.78%), and *Pseudomonas aeruginosa* (26.91%), *Shigella dysentriae* (16.78%), *Vibrio cholera* (13.21%), *Aeromonas hydrophila* (6.25%), Protozoa *Giardia duodenalis* (3.12%), *Entamoeba histolytica* (10.09%), *Salmonella typhi* (16.78%) and *Bacillus subtillis* (59.41%). Fungi were *Aspergillus niger* (23.76%), *Penicillium* (37.92%) were isolated from lower denominations. Protozoa *Giardia duodenalis* (13%) was least prevalent and only found in lower denominations. Similarly new currency notes were tested for bacterial contamination as reference higher denomination currency showed lower contamination. The older currency notes carried lot of pathogenic bacteria. Currency notes may be the source of contamination and infection diseases.

Keywords: Contamination, Paper currency notes, Tanga market places, pathogenic microbes.

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 for mites. Paper currency notes which are transferred from one individual to other are known to carry bacteria[1] on their surface and are responsible for transmitting them.

An individual having unhygienic habits will contaminate the notes with bacteria e.g. habits such as tongue-wet their fingers when counting money notes also leads to the contamination in notes will act as a vehicle delivering bacteria to contaminate the hands of the next user. The money makes for easy transfer of bacterial and thus cross contamination[2]. Currency notes can be commonly contaminated with enteropathogens[3,4].

Money is used as a medium for exchange for goods and services, settlement of debts and for deferred payments in economic activities[5]. The contamination of the naira notes could also be from several sources, it could be from the atmosphere, during storage, usage, handling or production[6]. In India, Basavarajappa studied on bacterial, fungal, and parasitic contamination of currency notes in circulation[7].

The survival of various microorganisms on money and their transmission via the hands of food vendors is often overlooked as enteric disease reservoir[8]. Paper Currency, can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placement on dirty surface. Paper currency is commonly handled by various categories of people during transaction[9]. The aim of this study was to investigate the microbial contamination of Tanzanian currency.

MATERIALS AND METHODS

Collection of samples

The study was conducted from March to April 2012**.** 136 notes of different denominations paper currency notes of 500, 1000, 2000, 5000 and 10,000 Tsh were collected from fish sellers, instant food sellers, fruits and vegetable sellers in market place from Tanga District place in Tanzania. We did not collect coin currency.

Simultaneously we collected new paper currency notes from Bank as reference for bacteriological analysis. We did not collect coin currency.

Samples were randomly obtained by using large-denomination notes to smaller denominations by respective group. Each currency note was collected directly into a sterile plastic bag and transported to the Laboratory of the Department of Science, Sebastian Kolowa University College, Lushoto soon after collection and examined for bacterial contamination. Swab samples were dipped in 1% peptone water. The swab samples were carried to lab for further examined for microbiological analysis.

Bacteriological Analysis

Isolation of various bacterial contaminants from the currency notes was performed via standard techniques described previously[10,11]. Briefly, a sterile, cotton-tipped swab moistened with sterile physiological saline was used to swab both sides of the currency note. The swabs were

directly inoculated on blood agar and MacConkey agar. The pairs of inoculated media were incubated aerobically at 35-370C for 24 hours and then examined for bacterial growth according to standard protocol described previously[12]. The authors isolated bacteria by assessing colony characteristics and Gram reaction, and by conducting catalase and coagulase tests; hemolysis, sugar fermentation, and other biochemical tests, including tests for indole production, citrate utilization, and urase activity; triple sugar iron (TSI) agar tests (for glucose, sucrose, and lactose fermentation); gas and hydrogen sulfide production tests; and oxidase tests, according to protocols described previously[12]. Bacteria were identified but were not quantified.

Parasitological Analysis

Standard concentration techniques for the isolation of enteric parasites were used as described previously[13,14]. The swab was made of very light foam material, which was cut into pieces 2 cm x 2 cm, washed with detergent, and sterilized in a dilute solution of sodium hypochlorite. The pieces of foam were then rinsed in water, air-dried, and rinsed in 70 percent alcohol. They were oven-dried and stored in a well-covered container until used. Each piece of foam was moistened with formol-saline solution and used to swab both sides of the currency note. The swab was placed in a capped bottle containing 10 mL of formol-saline solution, and the bottle was shaken vigorously. Thereafter, the swab was pressed against the inner sides of the bottle with a sterile forceps and removed. The solution was poured into a centrifuge tube and centrifuged at 2,000 g for 5 minutes. The supernatant was decanted, and a drop of the sediment was placed on a glass slide, covered with a glass cover slip and examined microscopically for parasite ova. Identification of parasites was made according to standard guidelines[15]. Parasites were identified, but were not quantified.

Identification of fungi

The growth of fungi on Sabaroud dextrose agar was examined critically after 1 week using prepared microscope slides. The prepared specimens were mounted on Lacto phenol cotton blue and identification of the fungal species was performed with aid of binocular compound microscope (40X) adopting the techniques[16].

RESULTS AND DISCUSSION

From the analysis of the 136 paper currency notes collected from market places of Tanga city of Tanzania, it was established that bacteria, protozoa, and fungi were present on the notes. See table no.1.

Table 1: Percentage occurrence of microorganisms incidence per denomination of Tanzanian paper currency from Market places, Tanga.

Currency denomination and number	*Staphylococcus aureus*	*E.coli spp*	*Klebsiella pneumonia*	*Pseudomonas aeruginosa*	Giardia duodenalis	*Shigella dysentriae*	*Vibrio cholera*	*Entamoeba hystolytica*	*Aeromonas hydrophila*	*Salmonella typhi*	*Bacillus subtilis*	*Penicillium*	*Aspergillus niger*
500Tsh(n=32)	15.65%	25%	12.5%	15.65%	3.12%	9.37%	9.37%	6.25%	6.25%	9.37%	25%	18.75%	12.5%
New currency notes 500Tsh(n=5)*	-0-	-0-	-0-	-0-	0	-0-	-0-	-0-	-0-	-0-	0	-0-	-0-
1000Tsh(n=26)	11.53%	11.53%	11.53%	7.69%	-0-	3.84%	3.84%	3.84%	-0-	3.84%	19.23%	7.69%	7.69 %
New currency notes 1000Tsh(n=5)*	-0-	-0-	0	0	-0-	-0-	0	-0-	-0-	0	-0-	-0-	0
2000Tsh(n=28)	3.57%	7.14%	3.57%	3.57%	-0-	3.57%	-0-	-0-	-0-	3.57%	7.14%	7.14%	3.57%
New currency notes 2000Tsh(n=5)*	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
5000Tsh(n=23)	-0-	4.34%	-0-	-0-	--0-	-0-	-0-	-0-	-0-	-0--	4.34%	4.34%	-0--
New currency notes 1000Tsh(n=5*	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
10000Tsh(n=27)	-0-	3.70%	-0-	-0-	--0--	-0-	-0-	-0-	-0-	-0-	3.70%	-0--	--0-
New currency notes 1000Tsh(n=5)*	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total %	**30.75%**	**51.71%**	**16.78%**	**26.91%**	**3.12%**	**16.78%**	**13.21%**	**10.09%**	**6.25%**	**16.78%**	**59.41%**	**37.92%**	**23.76%**

n= number of sample per denomination. *****Indicate new currency notes bank notes (as control)

After bacteriological analysis we did not find single bacterium from unused new paper currency notes obtained from Bank. But in lower denominations were more dirty and microbial load than higher denominations. 500 Tshs showed highest incidence of different bacteria includes *S.aureus* (15.65%), *E.coli* (25%), *klebsiella pneumonia (12.5%)*, *Pseudomonas aeruginosa* (15.65%), *Shigella dysentriae* and *Vibrio cholera* (9.37%), *Aeromonas hydrophila* (6.25%), Protozoa *Giardia duodenalis* (3.12%), *Entamoeba histolytica (6.25%), Salmonella typhi* (9.37%) and *Bacillus subtilis* (25%). Fungi were *Aspergillus niger* (12.5%) and *Penicillium* (18.75%)

Percentage of contamination in 1000 Tshs also showed equal contamination as 500 Tsh, *s.aureus*, *E.coli* and *klebsiella pneumonia (11.53%)*. *Pseudomonas aeruginosa*

*(7.69%), Shigella dysentriae, Vibrio cholera (*3.84%*), Protozoa Entamoeba histolytica (*3.84%*), Salmonella typhi (*3.84%*) and Bacillus subtilis (*19.23%*). Fungi were Aspergillus niger and Penicillium (7.69%).*

2000Tsh showed contamination and incidence of pathogenic organisms lesser than 1000Tshs.

Percentage of contamination in 2000Tshs, *S.aureus Pseudomonas aeruginosa, klebsiella pneumonia, Aspergillus niger, Salmonella typhi and Shigella dysentriae (*3.57%), *E.coli (*7.14%*), Bacillus subtillis* and *Penicillium (*7.14%*)*

Percentage of contamination and incidence of pathogenic organisms in 5000Tshs *E.coli, Penicillium* and *Bacillus subtillis (*4.34%*).*

Percentage of contamination in 10,000 Tshs were less when compared to lower currency notes, we found some contaminants, *E.coli* and *Bacillus subtillis* (3.70%).

From this study, the bacterial isolates that were isolated were associated with oral, nasal, skin and faecal contamination. This is an indication that money contamination is associated to unhygienic practice of people. These practices include indiscriminate sneezing, coughing and defecation with indecent handling of currency notes[11,17].

Dirty notes are usually moist and thus provide a good surface for bacterial growth. They provide favourable conditions such as substrate acquired from human body and due to handling as well as dust from the environment[18].

This prevalence signals high possibility of transmission of these parasites through these infected food vendors to their customers especially in cases where such food vendors are unhygienic in food handling. The facts that these food handlers are asymptomatic make them cysts and/ or egg passers and are unaware that they are possible transmitters of parasitic infections/diseases[19]. Vendors involved in child care activity may have acquired infection from infected children since close relationship with infected children may predispose to infection.

Staphylococcus aureus causes disease of the skin usually results in a localized collection of pus, known as an abscess, boil, food poisoning and diarrhea. *Klebsiella pneumonie* is associated with infections of urinary tract and wounds. *Salmonella typhi* can cause enteric fever in humans. *P. aeruginosa* can cause hospital infections, especially in patients with immune compromised. It is a frequent cause of nosocomial infections such as pneumonia, urinary tract infections (UTIs), and bacteremia[20-22].

S. dysenteriae are common causes of food-borne and water-borne illnesses, gastroenteritis worldwide[23,24].

Aspergillus niger and *Penicillium* can cause allergy and skin infections[25].

In humans *Entamoeba histolytica* causes Amoeba Cutis; Amoebic Lung Abscess, dysentry and *Giardia duodenalis* parasite that causes the diarrheal illness known as giardiasis[26].

Aeromonas hydrophila and *Vibrio cholera* is also known as an opportunistic pathogenic bacterium, it spreads from people who handle fish products as well as currency notes and known to cause massive diarrhea and gastroenteritis, ocular infections, urinary tract infections in humans[27,28].

Studies have revealed that parasite cysts and ova are more prevalent on very dirty objects, and mutilated materials and currency notes, while clean notes harbors no parasite. The report of is in consonance with this fact[29]. Currency with lower-denomination notes receiving the most handling because they are exchanged many times[30].

51.71% of *E.coli* our results, where lower currency notes 500Tshs 25% contamination showed were in Nigerian currency notes showed the presence of *E.coli* (13.2%)[31]. 30.75% *S.aureus* were found in our reports, similar reports were found in Nigerian currency notes[32].

26.91% of highest contamination of *Pseudomonas aeroginosa* found in our reports, similar reports (but less incidence) were found in Nigerian currency notes[32].

59.41% of *Bacillus subtilis* were found in our report, similar reports of 28% *Bacillus subtilis* found in from Nigerian currency notes[32].

13.21% of *vibrio cholera* found in our report Similar report 28.57% *Vibrio cholera* in Bangladesh currency[33].

Highest incidence of *klebsiella pneumonia* (16.78%) was found in our report, but it was less in Pakistani currencies showed 2.8%[34].

3.12% of *Giardia duodenalis* found in our report, *Giardia duodenalis* (13%) found in Nigerian notes[19].

In our reports 10.09% *Entamoeba hystolytica* were found in only500 and 1000Tshs, similar reports were found with[31,35-37].

23.76% of *Aspergillus niger* found in our report, similar reports were found in soudi currency[38], in Indian currency notes[7] and Nigerian currency[39].

37.92% of *Penicillium spp* were found in our reports, similar reports (17.64%) were found in Egyptian paper currency[40] and in Nigerian notes[39].

16.78% of *Shigella dysenteriae* found in our finding, but there was less incidence in Ghaian currency (2.68%)[41].

16.78% of *Salmonella typhi* were found in our reports, similar reports were found in Indian currencies[7].

30.75% of *Staphylococcus aureus* were found from 136 currency notes, similar report were found Ghanian currencies (7.14%)[41].

CONCLUSION

Currency notes could be a source of Source of contamination and infection. Public education on proper handling and care of currency is advocated, in order to reduce currency contamination. Dirty and mutilated notes should be withdrawn from circulation from time to time. The practice of keeping money in brassieres, handkerchiefs and in shoes should be discouraged.

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REFERENCES

1. Hosen, J. M., Sarif, D. I., Rahman, M. M. and Azad, M. A. K. Contamination of coliforms in different paper currency notes of Bangladesh. Pak. J.Biol. Sci., 9: 2006; 868 - 870.
2. Ameh, J. B and Balogun, Y. O. The health Implications of Microbial load of abused naira notes. The Spectrum. 4:1997; 138 –140.
3. Umeh, E. U., Juluku, J. U. and Ichor, T. Microbial contamination of Naira (Nigerian Currency) notes in circulation. Res. J. Environ.Sci. 1: 2007; 336-339.
4. Larkin EA, Carman RJ, Krakauer T. Staphylococcus aureus: the toxic presence of a pathogen extraordinaire. Curr.Med.Chem. 16: 2009; 4003-4019.
5. Beg, M.O. and Fisher. Major Means of Exchange in the Tropics now and before. Journal of History. 4: 1997; 13-34.
6. Awodi, N.O., Nock, I. H. and Aken'Ova .I. Prevalence and Public Health Significance of Parasitic Cysts and Eggs on the Nigerian Currency. The Nigerian Journal of Parasitology. 22: 2000; 137-142.
7. K G Basavarajappa, P N Sridhar Rao, K Suresh. Study of bacterial, fungal, and parasitic contaminaiton of currency notes in circulation. Indian journal of pathology microbiology 48(2),2005; 278-279
8. Michaels, B. Handling money and serving ready-to-eat food. Food Serv. Technol. 2:2002; 1-3.
9. Oyero, O.G. and B.O. Emikpe. Preliminary Investigation on the Microbial Contamination of Nigerian Currency. Int. J. Trop. Med. 2(2): 2007; 29-32.
10. Gilchrist, M.J.R. Microbiological culturing of environmental and medical device surfaces. In H. Eisenberg (Ed.), Clinical microbiology procedures handbook (p. 11.10.4). Washington. 1993; DC: American Society for Microbiology.
11. Singh, D.V., K. Thakur, A. Goel. Microbiological Surveillance of Currency. Indian Journal of Medical Microbiology. 20(1):2002; 53.
12. Cheesbrough, M. District Laboratory Practice in Tropical Countries, Part 2. Cambridge. UK: Cambridge University Press. 2000.
13. Cheesbrough, M. District Laboratory Practice in Tropical Countries, Part 1. Cambridge, UK: Cambridge University Press. 1998.
14. World Health Organization (WHO). Manual of basic techniques for a health Laboratory (2nd ed.). 2003;Geneva: Author.
15. World Health Organization (WHO). Bench aids for the diagnosis of intestinal parasites [CD-ROM]. 2004; Geneva: Author.
16. Bruge,H.P. Comparative merits of eight popular media in aerometric studies of fungi. Allergy.Clinical Immunology. 60:1977; 199-2003.
17. Emikpe. Preliminary Investigation on the Microbial Contamination of Nigerian Currency. Int. J. Trop. Med. 2(2): 2007; 29-32.
18. Haque Z. Currency Notes as germ carriers. HHP: 2003; (www.nation_online.com/20021/22/-n2122208.htm).
19. OA Idowu. Oral fecal parasites and personal hygiene of food handlers in Abeokuta, Naigeria. Afr Health Sci. 6(3): 2006 September; 160–164.
20. Prescott LM, Harley JP and klein DA. microbiology. 7th edition. Mc Graw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 2008; 10020.
21. WHO. World Health Organization Guidelines for drinking water I (Recommendation) Mac, o; oam. Ceuterock. 1984a; 11-38.
22. Jensen MM, Wright DN, Robison RA. Microbiology for the Health Sciences. 1997;Prentice-Hall, Inc. New Jersey.
23. Sapsford KE, Rasooly A, Taitt CR, Ligler F. Detection of campylobacter and Shigella species in food amples using an array biosensor. Anal Chem. 76: 2004; 433-440.
24. Guerin P J, Brasher C. Shigella dysenteriae serotype 1 in West Africa: intervention strategy for an outbreak in Sierra Leone. Lancet. 362: 2003; 705-706.
25. Chakraborthy. A text book of Microbiology. 2007; 5th edition.
26. Chakraborthy, Medical parasitology. 2009; 2nd edition
27. G. Olivier, R. Lallier, S. Larivière. A toxigenic profile of Aeromonas hydrophila and Aeromonas sobria isolated from fish. Canadian Journal of Microbiology. 27(3):1981: 330-333
28. Ananthanarayan And Paniker. Text book of Microbiology, Orient Blackswan, Dec 1, 2006; 665 pages.
29. Fashuri, S. A. The prevalence of Helminthes eggs in human faeces deposit on the streets of Lagos. West African Medical Journal. 2:1983; 135 – 138.
30. Gadsby, P. Filthy lucre-Money contaminated with bacteria. Discover. 19: 1998; 76.
31. Uneke CJ, Potential for parasite and bacteria transmission by paper currency in Nigeria. J Environ Health. 69(9):2007 May; 54-60.
32. S. Awe. Bacteriological quality of some Nigerian currencies in circulation. African Journal of Microbiology Research. 4(21): 2010; 2231 – 2234.
33. Md. Shakir Uddin Ahmed. Evaluation of the Microbial Contamination of Bangladesh Paper Currency Notes (Taka) in Circulation. Advances in Biological Research. 4 (5):2010; 266-271.
34. Sabahat saeed,.Evaluation of bacterial contamination of Pakistani currency notes in circulation in Karachi. Europian Journal of Biological Science. 3(3):2011; 94-98.
35. N. Orji, E. Esiaka , L. Anyaegbunam, R. Obi, D. Ezeagwuna: Parasite Contamination Of Nigerian Currency (Paper and Polymer Notes) In The Ihiala Local Government Area Of Anamber State, Nigeria.. The Internet Journal of Infectious Diseases. 10(1):2012.
36. I M Ekejindu. Prevalence Of Parasitic Oocysts And Ova On Currency.Journal of Biomedical investigation. Vol 3: No 2. 2005.
37. Matur. A Survey of Parasite Cysts, Eggs and Bacteria on Nigerian Currency in FCT, Abuja. New York Science Journal. 3(1): 2010.
38. Suaad S. Alwakeel and Laila A. Nasser.Bacterial and Fungal Contamination of Saudi Arabian Paper Currency and Cell Phones.Asian Journal of Biological Sciences. 4: 2011; 556-562.
39. F. I. Okungbowa. Fungal flora of Nigerian currency notes in circulation in Benin City, Nigeria. Indian Journal of Microbiology. Volume 50, Supplement 1.2010; 139-141.
40. A.F. Sahab. Studies on Fungal Contamination of Current Egyptian Paper Banknotes. International Journal of Microbiological Research. 3 (1):2012; 75-81.
41. Patrick Feglo, 2010. Bacterial load on Ghanaian currency notes. African Journal of Microbiology Research. 4(22):2010; 2375-2380.

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