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Original Article

Contamination of Currency notes and Coins as Sources of Transmissible Diseases

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ABSTRACT

Objective: To find out the contamination in currency notes and coins and their source of infection. Experimental approach: A total of 108 Paper currency notes of Rwanda Frank (500,1000,2000,5000 Rwf and 55 of coins of 10, 20, 50 and 100 Rwf) were randomly collected from vegetable sellers in market places in Musanze district (Rwanda) during November 2017, took swab samples and Microbiological analysis was done for all currency notes and coins.**Findings:** We analyzed for bacterial, fungal and protozoan contamination. Swab samples were analyzed in microbiology lab. In 108 paper currency notes, 25 notes contain *E.coli* were 23%, 20 notes with *Klebsiella pneumonia*, and *Pseudomonas aeruginosa*(18%). 40 notes contain *Staphylococcus aureus* (36%), 45 notes with S*treptococcus pyogenes* (41%), 32 notes with Clostridium spp (29.5%), 22 notes with *Bacillus subtilis,* Vibrio spp (21%). Fungi, 38 notes with penicillium spp (35%), 20 notes with Aspergillus spp (18%), 18 notes with Rhizopus, Candida and Alternaria (16%). protozoan parasites, 29 notes with *Entamoeba hystolytica* (27%), 28 notes with Giardia (26.5%), 29 notes *Taenia solium* (27%) and 17 notes with *Taenia saginata* (28.5%) and 5 coins with *Trichuris trichiura* (9%). Out of 55 coins, 30 coins were contaminated with *Entamoeba hystolytica* (55%), 29 coins with *Taenia solium* (54.5%), *15 coins with* Fusarium spp(27%), *25 coins with Giardia lamblia* (45%). Bacteria 20 coins with *Staphylococcus aureus*(36%), 20 coins with non pathogenic *staphylococci spp(*36%) 10 coins with *Clostridim spp* and Bacillus spp (18%). Fungi were 10 coins with Aspergills spp (18%), 13 coins with Mucor spp and candida spp (24%). **Discussion:** Many pathogens were found in lower denomination paper currency notes than higher denominations. The coins were found to contain more parasites than bacteria and fungi. The older currency notes carried lot of pathogenic bacteria.

Conclusion: Currency notes may be the source of infections.

1. 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. Bacteria have been shown to be spread from person to person via contact with fomites.

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Currency is commonly and routinely passed among individuals. Thus, bacteria could be spread on the surface of paper currency [1, 2].

We can say that paper currency offers a larger surface area as a propagation medium for pathogens. Microorganisms may endure on it for longer periods of time. A large number of microbes can be found accumulated on older paper notes [3]. Banknotes and coins can also serve as pathogen reservoirs [4, 5]. Simultaneous handling of food and money by waiters or vendors can have serious consequences as the food they serve is ready to eat and does not require any further heating. Additionally, the people ordering that food usually do not wash their hands prior eating [4].

Currency (paper notes and coins) is a further common contact surface whereby pathogens can be transferred within a population although the significance remains unknown. Given that currency is frequently handled and transferred over large geographical areas there is the potential to readily disseminate contamination across the globe [5-7]. This is the first kind of study in Rwanda.

2. MATERIALS AND METHODS

Paper currency notes and coins were obtained from different vegetable sellers in Musanze district. Samples were randomly obtained from 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 Biotechnology, **INES Ruhengeri, Rwanda**, 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.

Microbiological Analysis: Isolation of various bacterial contaminants from the currency notes were performed via standard techniques described previously (Gilchrist, 1993). 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 [9]. The author was 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 [9]. Bacteria were identified but were not quantified.

Isolation and identification of fungi

The growth of fungi was examined on Sabroaud dextrose media after 24 hrs of incubation instead of 1 week. The observed colony was Gram stained instead of mounting on Lacto phenol cotton blue and the fungal species were identified with help of compound microscope. The fungi was isolated and identified by few modifications in method described earlier by (Neel R. 2012) [10].

Parasitologicalanalysis

For parasitological analysis, little modification in the protocol of (Uneke and Ogbou, 2007) [11] was made as 5 ml of 10% formal saline used instead of 10 ml. First the swab was made using a very light foam sheet with an approximate thickness of half inch. Foam was cut into pieces 2 cm x 2 cm, washed with detergent, and sterilized by dipping several times in a dilute solution of sodium hypochlorite. The pieces of foam were then rinsed in water instead of 70% ethanol and dried in air. The foam pieces were then tied with thin wooden sticks about 15 cm in length to make the final swabs. Finally the swabs were wrapped in paper, oven dried at 65^{o}C for 24 hours and stored at room temperature till used. For each currency sample the swab was first moistened with a 10 % formal – saline solution and was swabbed on both sides of the currency sample. The swab was placed in a capped bottle containing 5 ml of 10% formal-saline solution, and was vigorously shaken. Thereafter, the swab was pressed against the inner sides of the bottle to squeeze the solution out of the swab and was removed. The solution was poured into a sterile 15 ml BD Falcon™ Tube and centrifuged at 14,000 rpm for 10 minutes instead of 2000 g for 5 minutes. The supernatant was discarded in 10% bleach solution, and a properly mixed drop of the sediment was placed on a glass slide. It was covered with a glass cover slip and examined microscopically for parasitic ova, cysts or the protozoan cells. Observations were made using 10X, 40X and 100 X magnifications.

3. RESULTS

From the analysis of the 108 paper currency notes and 55 coins were collected from vegetable sellers in market places of Musanze district. Rwanda. Number of isolates found in notes and coins in (Table No.1)

Table 1: Isolation microbes from paper currency notes and coins

Isolation microbes from paper currency notes and coins			
Notes	**Pathogen**	**Percentage of incidence**	
Isolation from paper currency notes (108 numbers)			
25	*E.coli*	23%	
20	*Klebsiella pneumonia*	18%	
20	*Pseudomonas aeruginosa*	18%	
40	*Staphylococcus aureus*	36%	
32	Clostridium spp	29.5%	
45	*Streptococcus pyogenes*	41%	
22	*Bacillus subtilis*, Vibrio spp	21%	
38	penicillium spp	35%	
20	Aspergillus spp	18%	
18	Rhizopus, Candida	16%	
18	Alternaria	16%	
29	*Entamoeba hystolytica*	27%	
29	*Taenia solium*	27%	

28	Giardia	26.5%	
17	*Taenia saginata*	28.5%	
Isolation from coins (55 numbers)			
20	*Staphylococcus aureus*	36%	coagulase
20	*staphylococci spp*	36%	Non coagulase
10	*Clostridim spp*	18%	
10	and Bacillus spp	18%	
10	Aspergills spp	18%	
13	Mucor spp	24%	
13	candida spp	24%	
30	*Entamoeba hystolytica*	55%	
29	*Taenia solium*	54.5%	
15	Fusarium spp	27%	
25	*Giardia lamblia*	45%	
05	*Trichuris trichiura*	09%	

4. DISCUSSION

We have isolated Escherichia coli, Klebsiella, Staphylococcus aureus,, Salmonella sp,0% - 28.57% Vibrio cholerae, 0% - 25% Bacillus sp and, Pseudomonas sp, similar results were found with (Md. Shakir Uddin Ahmed. 2010) [12]. In our research we found *E. coli*, Baillus spp, Vibrio spp, clostridium, *Staphylococcus aureus* (coagulase positive) and staphylococci (non coasgulase positive) similar results were found with (Mir-Hassan M,2013) [13]. There was hge incidence of *Staphylococcus aureus*. *Candida* species and *Aspergillus, Rhizopus* spp *and Penicillium*spp, similar reports were found with (Venkatesh P, 1999, and Alwakeel SS,2011, Nasser LA, 2011, Varusha Sharon C,2017 and Murugan.T, 2014) [14-18].

Parasites *Trichuris trichiura* and *Taenia* spp which are dangerous found in our findings also found in (Uneke CJ, 2007) [19] research. Similarly *Entamoeba histolytica* & *Giardia lamblia found in Pakistan currency* (Afshan Butt. August 2015) [20].

We isolated Fungi, Penicillium spp, Aspergillus spp, Mucor sp., Fusarium, Rhizopus, Altenaria spp, Candida spp. Same fungi found in Kenyan coins (Kuria JK, 2009 and S. C. Enemuor, 2012) [21, 22].

Currency notes guidelines should be taught in school level. In place of paper currency notes plastic currency should be introduced where microbes cannot multiply. Government should conduct the awareness programs frequently on how to handle currency notes

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