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Paper Currency: A Potential Fomite for Pathogenic Bacteria

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ABSTRACT

Currency is proved as a vector, vehicle or as a fomite for the transmission of various diseases and spreading the disease from one to another. Currency's condition depends upon the people varying health, hygiene and living standards and also on the environmental and storage factors of the money. Due to this, money carry potential pathogenic organisms and these organisms became the reason of illness of the people who handled or receive them from other. The aim of the study is to isolate and to identify the organisms present on the currency. Swab samples collected from the paper currency of different places i.e. market place, food vendor, butcher shop and green grocery shop and subjected for the bacteriological analysis. In the present study *Escherichia coli*, *Pseudomonas spp*, *Staphylococcus aureus* were observed in high percentage and *Streptococcus pneumonia*, *Proteus mirabilis*, *Salmonella spp*, *Bacillus spp* in lower percentage. It is concluded from the study that these organisms are part of our environment, and currency act as a transmitting vehicle of these organism which further became the source of different infectious diseases so these must be handled with great care so as to reduce the risk of disease transmission.

Keywords: *Paper currency, Contamination, Market places, Pathogenic microorganisms*

INTRODUCTION

It was suggested in 1970s that the currency notes can act as fomite and environmental vehicle of transmission of potential microorganisms, as it is used continuously for the exchange of goods and services (Abrams & Waterman, 1972). Due to this, circulation of paper currency from one individual to another potentially spreads microorganisms. It is a very good vector for transmission of diseases (Wamae, 2009). If these currencies are contaminated by pathogenic bacteria, the rate of infection and death rate from these infectious agents will continue to rise (Pinner *et al.*,1996; Pope *et al.*, 2002).).The contamination of notes could also be from several sources, it could be from the atmosphere, during storage, usage, handling or production (Awodi *et al.*, 2000). The butcher with the bloody fingers, the artisan with dirty dusty and oily fingers, the teacher with the chalky and inky fingers, the street-food vendor with the wetly-oily fingers, etc., will just receive or pick currency notes with the dirty fingers, leading to the contamination of the notes with microorganisms (Mensah *et al.*, 2002). An individual living in unhygienic conditions having unhygienic habits will contaminate the notes with bacteria e.g. habits such as using soling to count the paper notes also leads to the contamination and these 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 (Tagoe *et al.*, 2011) Paper money, presents a particular risk to public health, since communicable diseases

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can spread through contact with fomites (Pope *et al.*, 2002). 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 (Oyero, O.G, 2007). Currency notes of lower denomination receive the roughest handling as they are circulated among people from various occupations and walks of life, like beggars, street food vendors, shoe-shiners, school children, butchers, etc. Therefore, there are chances of higher levels of microbial contamination on lower denomination notes (Sharma and Sumbali, 2014).

Storage of these notes in polythenes, cotton, leather bags in humid and dark conditions also favor the growth of bacteria on these notes. It is possible to detect the presence of particular bacteria on these notes by isolating the pathogenic bacteria on their respective growth media followed by their identification by polyphasic approach (Lamichhane *et al.*, 2009; Reither *et al.*, 2007). The microorganisms most commonly isolated on money included members of the family Enterobacteriacea, *Vibrio cholerae*, *Bacillus sp.*, *Staphylococcus sp.*, *Micrococcus sp.* and *Corynebacterium sp.* Common background contaminants of paper money were environmental organisms such as gram-positive flora (especially *Bacillus sp.*) and those arising from human normal skin flora such as *Staphylococcus aureus* (Ahmed *et al.*, 2010).

Currencies with different denominations collected from people of various categories i.e., butchers, fish mongers, sweepers, roadside vendors, carpenters has shown the presence of various pathogenic microorganisms. Most of the dirty paper currencies collected from bank, Municipal Corporation, food sellers, butchers, hospital showed that currencies used by public (bank, hospital, Municipal Corporation) were found to be extremely contaminated with various pathogenic bacteria followed by the currency used by butchers and food sellers (Pradeep *et al.* 2012; Dehghani *et al.*, 2011). This may cause a wide variety of diseases from food poisoning, wound and skin infections, respiratory and gastrointestinal problems to life threatening diseases such as meningitis and septicemia (Jane-Francis *et al*, 2014) The matter of great importance is that not only children and immuno compromised (including those with HIV, undergoing chemotherapy, or taking other medications that suppress the immune system) but also healthy people are prone to serious dangers, due to presence of different and abundant pathogens on paper notes (Matur *et al*, 2010).

The aim of the present study was to determine the presence, type and nature of bacterial contamination on currency notes which were in circulation.

MATERIAL AND METHODS

Sample Collection: 25 notes of different denominations paper currency notes of 10, 20, 50 and 100 were collected from various shops of green grocery, butcher, cafeteria, street food vendors and pan shop. Each currency note was collected directly into a sterile plastic bag. Soon after collection, they were examined for bacterial contamination.

Bacteriological Analysis: Isolation of various bacterial contaminants from the currency notes was performed via standard techniques. 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 culture media. The inoculated media were incubated at 37°C for 24 hours and then examined for bacterial growth according to standard protocol. Isolated bacteria were identified 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 urease activity; triple sugar iron (TSI) agar tests (for glucose, sucrose, and lactose fermentation); gas and hydrogen sulfide production tests; and oxidase test (Chressborough, 2000).

RESULTS

The study revealed the contamination of Pakistani paper money with the level of pathogenic microorganisms. The cultures from the collected Pakistani paper currency yielded many isolates representing selected 7 different types of bacterial species. *E.coli* was found in high order of percentage, means it is most abundant found on the currencies. *Salmonella sp.*, *Bacillus sp.*, *Pseudomonas sp.*, *Staphylococcus aureus*, *Proteus sp.*, *Steptoccocus sp.* were also found on the currency notes.

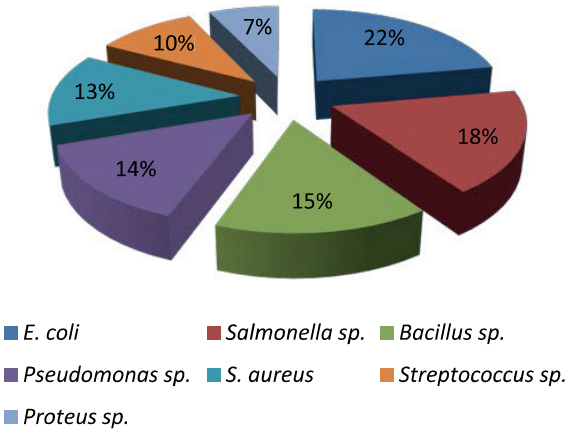

Figure 1. Prevalence of Bacterial Isolates from Currency Notes

DISCUSSION

The occupational activities of human, without hygienic care especially those who handle the money simultaneously could increase the risk of contamination and infections. The circulation of contaminated currencies identified as a potential public health hazard as the pathogen can spread through the contaminated notes. (Igumbor *et al.*, 2007). This study was done to reveal that currencies are commonly contaminated with various bacteria and we found that 100% of the currencies were contaminated with microorganisms which can cause infections and can act as a health hazard. Evidences of microbial contamination of currency notes has been reported by various researchers from Myanmar (Khin *et al.* 1989), Turkey (Goktas and Oktay,1992), Australia (FSA, 2000), India (Singh *et al.*, 2002), China (Xu *et al.*, 2005) and Ghanna (Feglo and Nkansah, 2010). Food handlers may be the source of food contamination either as carriers of pathogen or through poor hygienic practices. Most of these foods contained higher than acceptable contamination level. Most ready-to-eat foods were contaminated with enteric bacteria and other potential food poisoning organisms with bacterial counts higher than the acceptable levels.

Table I. Percentage occurrence of different isolates from different shops. (n=25)

Occupational Group	*E.coli*	*S.aureus*	*Proteus sp.*	*Pseudomonas sp.*	*Bacillus sp.*	*Salmonella sp.*	*Streptococcus sp.*
Meat seller	28 %	16 %	06%	08%	17	22%	05%
Vegetable shop	24%	17%	04%	18%	13%	15%	09%
Cafeteria	25%	14%	10%	11%	14%	16%	10%
Pan shop	18	11%	12%	19%%	12%	18%	08%
Street vendor	13%	4%	13%	14%	22%	19%	15%

*n = number of samples.

The results of the study revealed that the normal microbiota of enteric region was abundantly found on the currency note. Most of the reported outbreaks of gastrointestinal disease have been associated with bacterial contamination, particularly with members of the Enterobacteriaceae family (Pollack S. 2001). These organisms also transfer by hand to hand transfer of money (Allende *et al.*, 2002). This situation may be attributed to the possibility that some people disregard hand wash after using toilets. (Xu *et al.*, 2005). Among the bacterial isolates, *E.coli* was abundantly isolated from meat sellers, vegetable shops, cafeteria, pan shops and street vendors. *Salmonella sp.* and *Bacillus sp.* were recorded the second highest percentage in this study. *Salmonella spp.* were abundantly isolated from the currency notes collected from meat sellers which are the causative agent of Salmonellosis, an acute gastroenteritis with sudden onset of headache, abdominal pain, diarrhea, nausea, and sometimes vomiting. Several researchers have reported that the meat samples were contaminated with high level of *Salmonella sp.* (Oconto *et al.*, 2010). Meat is not only highly susceptible to spoilage, but also frequently implicated to the spread of food-borne illness, various biochemical changes and microorganisms are associated with meat, during the process of slaughter, processing and preservation (Olaoye and Nilude, 2010). Food-borne pathogens are able to disseminate from contaminated meat,by people who handle that meat and also by the things which were in use of those people like currency is one of them which can transfer the meat pathogens to the healthy individuals and can spread infections in the community (Gorman *et al.*, 2002). Bacillus 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 (Silman *et al.*, 1987). High percentage of *Bacillus sp.* were isolated from street vendors. Street-vended foods are also prone to contamination because they are sold in the open and are often not covered. Additionally, because street vendors prefer to take their products to their customers, they often operate from places such as bus terminals, industrial areas, schools, market places, streets. Such locations usually do not meet food and safety requirements. *Staphylococcus aureus* and *Streptococcus species* were also recorded the in this study. *Staphylococcus aureus* is commonly associated with food borne outbreaks while *Streptococcus sp.* are normal commensal of human which reflect improper hygiene practice such as pocking nose with fingers. *Pseudomonas sp.* and *Proteus sp.* were found comparatively less or in lower percentage than other organisms.

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 environment. The epidemiology of food borne disease has changed rapidly over the last decades as, shortly after some major human pathogens were recognized to be spread from animal reservoirs, fresh vegetables have emerged as new vehicles for the transmission of these infectious diseases (Hamilton *et al.*, 2006). Great care should be taken when the person facilitates the handling of money to avoid cross contamination. To control the spread of such organisms we recommend: (i) periodic withdrawal of old, dirty and mutilated currency notes from the circulation, (ii) set up of currency decontaminating facilities by the competent authority, (iii) awareness buildup among the people to wash their hands after counting money and not to wet their hands by saliva before counting paper currency, (iv) introduction of plastic currency notes for higher

denominations. We recommend that currency notes must be handled with utmost caution to limit the spread of pathogenic bacteria.

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