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Bacteriological evaluation of currency notes of vegetable market of Nagpur city: Chances of potential bacteriological transmittance

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ABSTRACT

The objective of the present study was to study bacteriologically the currency notes circulating in vegetable market of Nagpur city. A total of 60 samples of currency notes of denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were collected from vegetable market. The cultures from the collected currency notes yielded 84 isolates representing selected 7 different types of bacterial species. Identification showed the active participation of these seven species in descending order of percentage as Escherichia coli 36%, Staphylococcus aureus 30.66%, Pseudomonas spp. 13.33%, Salmonella spp., 8%, Enterobacter spp. and Proteus spp. 5.33% each and Klebsiella spp. 1.33%. Antibiotic resistance profile showed organism wise variation in resistance pattern. It is concluded that the currency notes circulating in vegetable market of Nagpur city may serve as a vehicle for the transmission of potentially pathogenic microorganisms. This may play a significant role in the transmission of various diseases. The lower denomination currency notes appeared to be more highly contaminated with bacterial pathogens than higher denomination currencies. The mutilated currency notes had the highest prevalence of bacterial contamination (94.66%) than the non-mutilated currency notes (5.33%).

INTRODUCTION

Currency is the most widely handled article by people from all walks of life. Currency contaminated by microbes might also act as fomite playing an important role in the transmission of microorganisms and also in the spread of drug resistant strains in the community (Pope *et al.,* 2002; Singh *et al*., 2002). Paper currency can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placements on dirty surface. Paper currency is commonly handled by various categories of people during transaction (Oyero and Emikpe, 2007).

Contamination of objects by pathogenic microorganisms is of much public health concern as contaminated materials can be sources of transmitting pathogens. Paper money therefore presents a particular risk to public health, since communicable diseases can be spread through contact with fomites. Although paper paper money is impregnated with disinfectants to inhibit microorganisms, several pathogens have been isolated from paper currency notes (Michaels, 2002; Charnock, 2005; Xu *et al.*, 2005*,* Yazah *et al.*, 2012) .

Studies in different parts of the world have reported high rates of microbial contamination of currency notes in circulation (Abrams and Waterman, 1972; Goktas and Oktay, 1992; El-Dars and Hassan, 2005; Lamichhane *et al.,* 2009). A recent study in Bangladesh has showed reported that *Escherichia coli*, *Klebsiella*, *Staphylococcus aureus*, *Salmonella spp., Bacillus spp.* and *Pseudomonas spp.* Were dominantly present on the recovered from paper currency notes of vegetable markets in Bangladesh (Ahmed *et al*., 2010) and Nigeria (Yazah *et al.*, 2012).

Similarly Rote *et al.,* (2010) have conducted a study to evaluate currency samples of different denominations

from different occupational groups for isolation of microbial contaminant which included butchers, food sellers, students, beggars, vegetable sellers, petrol pumps, book sellers, grocery shops, banks and cobblers. It has been confirmed carry to microbes such as *Staphylococcus aureus*, *Escherichia coli, Bacillus spp., Klebsiella spp., Proteus mirabilis* and fungus like *Aspergillus niger* and *Fusarium.* The antibiotic susceptibility test showed antibiotic resistant strains of different pathogenic organisms like *Staphylococcus aureus, Escherichia coli, Bacillus spp.* and *Klebsiella spp*. Saadabi *et al.,* (2010) have isolated and identified the pathogenic bacteria and fungi from Sudanese banknote currency. The bacteria isolated were *Escherichia coli, Citrobacter spp., Klebsiella spp., Proteus spp., Bacillus spp., Corynebacterium spp.* and *Staphylococcus spp*. The fungal genera *Trichophyton spp., Microsporum spp., Epidermophyton spp., Taenia spp., Aspergillus spp.* and *Saccharomyces spp.* were isolated and identified.

Alwakeel and Nasser (2011) made a survey of the bacterial and fungal contamination of paper money samples in Riyadh, Saudi Arabia. Of the 390 currency notes, 282 (72.3%) were contaminated with bacteria which included *Aspergillus niger, Aspergillus flavus, Candida spp., Penicillium spp., Rhizopus spp.* and bacteria which included *Enterobacter cloacae, Klebsiella ozaenae, Cedecea davisae, Yersinia pseudotuberculosis, Acinetobacter iwoffii, Staphylococcus warneri* and *Enterobacter agglomerans*. All isolated bacterial species were sensitive to ciprofloxacin, gentamicin, ticarcillin, tobramycin and trimethoprim-sulfamethoxazole.

Dehghani *et al.,* (2011) evaluated the degree of contamination of Iranian currency. A total of 30 old paper notes and 15 fresh paper notes were collected from artisans and bank treasury. It resulted into the occurrence of *Escherichia coli, Staphylococcus aureus, Bacillus, Klebsiella, Streptococcus, Serratia, Salmonella, Pseudomonas, Citrobacter, Shigella, Listeria, Enterobacter* and *Micrococcus*, however two fungal genera found were *Apergilus spp.* and *Penicillium spp.*

The data regarding the bacteriological contamination of currency is scanty and a recent medical literature search revealed only a few studies on this topic. Moreover the bacteriological study on currency notes circulating from vegetable markets and antibiotic resistance profile is the main aim of the study. Because it helps to investigate the likelihood of bacterial contamination of currency notes and this study can also provide the basis for raise health consciousness in people during currency handling.

MATERIALS AND METHODS

Paper currency notes: A total of 60 samples of currency notes having denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were obtained from vegetable market of Nagpur. The samples were graded using appearance and degree of dirtiness as mutilated and non-mutilated currency notes. Five mutilated and five non-mutilated currency notes of each denomination were collected. Out of 60 currency notes 30 were mutilated and 30 non-mutilated.

Sample Collection: Vegetable sellers handling the notes were asked to deposit the notes in sterile polythene bags. The samples were then transported immediately to the microbiology laboratory for bacteriological analysis. They were compensated with other currency of same denomination.

Isolation and Identification of Bacteria: A sterile cotton swab was dipped in the sterile physiological saline and rubbed on both the surfaces of currency note. The swab was inoculated in 5 ml of sterile nutrient broth and incubated for 6-8 hours at 37^{o}C. Thereafter the broth cultures were plated on Mannitol Salt Agar, MacConkey Agar and Cetrimide Agar. The plates were incubated at 37^{o}C for 24 hours. After incubation the isolated colonies were identified on the basis of morphological, cultural and biochemical characteristics (Collee and Marr, 1996) and results were compared with Bergeys's Manual of Determinative Bacteriology, 9th edition.

Antibiotic Sensitivity Test: All the confirmed bacterial pathogens were subsequently tested for antibiotic sensitivity patterns by disk diffusion method on Mueller Hinton agar. The antibiotic discs used in the study were categorized into 3 different sets of 10 different discs in each set obtained from Hi-media Laboratories Pvt. Ltd. Mumbai (Table 1 a,b). Finally, the zone size of inhibition was recorded in mm (Bauer *et al.*, 1966) and results were interpretated as per Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2007)

RESULTS AND DISCUSSION

The present study revealed the extent and the level of contamination of Nagpur paper money with pathogenic microorganisms. A total of 60 currency notes of denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were collected from vegetable market.

Contamination of Bacterial Pathogens on Currency Notes:

The cultures from the collected currency notes yielded 84 isolates representing selected 7 different types of bacterial species. Identification showed the active participation of these seven species in descending

order of percentage as *Escherichia coli* 36%, *Staphylococcus aureus* 30.66%, *Pseudomonas spp.* 13.33%, *Salmonella spp.,* 8%, *Enterobacter spp.* and *Proteus spp.* 5.33% each and *Klebsiella* spp. 1.33% (Table 2). The results showed the prevalence of pathogenic microorganisms isolated from currency notes of vegetable market.

The study is in accordance with Ahmed *et al.,* (2010) who showed that the microorganisms isolated from currency notes of vegetable market in Nigeria were *Escherichia coli 63.63%, Klebsiella spp.,* 54.54%, *Salmonella spp., 18.18%, Pseudomonas spp.* and *Staphylococcus aureus* 9.09% each.

***Staphylococcus aureus* Contamination:**
In the present study, the isolation of Gram positive as well as Gram negative bacteria from currency notes confirmed that currency might be playing an important role as a vector in the transmission of pathogenic bacteria in the community. The presence of *Staphylococcus aureus* on paper money could have been due to rubbing off or may be surfing from a skin flake. Pathogenic *Staphylococci* harbored either by an asymptomatic carriers or a person with a disease which can be spread by hands or expelled from the respiratory tract (Saeed and Rasheed, 2011).

The *Staphylococci* are natural inhabitants of the animal body, which is the source of those found elsewhere. As saprophytes, *Staphylococci* are ubiquitous, being found on normal skin and in the nose, mouth and intestine as well as in the air, water, milk and sewage and on fomites. Infections occur when *Staphylococci* enter the body through breaks, cuts and abrasions in the skin (Pelczer and Reid, 1965).

Though *Staphylococcus aureus* is the normal flora of the skin and mucous membranes, its high incidence has clinical significance and it is considered as a well-recognized pathogen. A number of studies have documented the clinical significance of *Staphylococcus* aureus as a causative agent of urinary tract infections (Tessema *et al.*, 2007). *Staphylococcus aureus* have also been reported to cause conjunctivitis (Everitt *et al.*, 2006). Furthermore, *Staphylococcus aureus* is also associated with toxic shock syndrome, skin infections and respiratory tract infections (Miller *et al.*, 2007; Yamaguchi *et al.*, 2006).

Enterobacteriaceae Family Members' Contamination:
The presence of the members of Enterobacteriaceae family revealed the poor sanitary condition of the environment as well as poor personal hygiene practices observed by most of the people surveyed. The presence of *Salmonella spp.* is an indicator of poor hygiene and sanitation standards. Among the pathogenic bacteria isolated, *Escherichia coli* is a virulent organism that can cause urinary tract infections, community-acquired pneumonia, bacteremia, sepsis etc. (Chang *et al.*, 2006; Sun *et al.*, 2006; Jayaseelan *et al.*, 2007). *Klebsiella* spp. is also the most important cause of community-acquired and nosocomial infection (Rukavina *et al.*, 2006). *Klebsiella spp.* has also been observed as one of the leading cause of Gram-negative sepsis as well as bacteremia. *Klebsiella spp*. can cause fatal acute bacterial myocarditis, pneumonia, meningitis and wound infections (Bentzel *et al.*, 2004; Fang *et al.*, 2005; Janardan *et al.*, 2009). *Proteus spp.* is also a causative agent of cystitis and pyelonephritis in patients with urinary catheters or structural abnormalities of the urinary tract (Grude *et al.*, 2001).

***Pseudomonas spp.* Contamination**:
Pseudomonas spp. is one of the principle agent of bacteremia, soft tissue infections, conjunctivitis, endophthalmitis, pneumonia, meningitis, brain abscess, infections in burns, cystic fibrosis, endocarditis, wound infection and otitis media (Armour *et al.*, 2007; Damas *et al.*, 2007; Valle *et al.*, 2007). *Pseudomonas spp*. is pathogenic when introduced into areas devoid of normal defences e.g., when mucus membrane and skin are disrupted by direct tissue damage. The organism attaches to and colonizes the mucus membrane or skin, invades locally and produces systemic disease (wounds and meningitis) (Yazah *et al.*, 2012).

Bacterial contamination on mutilated and non-mutilated currency notes: The study revealed a significant association between bacterial contamination and the type and condition of the currency with high rate of contamination on mutilated currency notes than non-mutilated currency notes. The mutilated currency notes had the highest prevalence of bacterial contamination (94.66%) than the non-mutilated currency notes (5.33%). It supports the finding that non-mutilated currency notes are particularly dangerous (Table 2). This finding has very important health and economic implications, especially in underdeveloped and developing tropical nations of the world (Siddique, 2003).

The presence of mutilated currency notes and failure to consistently withdraw them from circulation are common phenomena in many parts of the country. The climatic and environmental conditions of the tropics favor the thriving of many pathogenic microorganisms, and in the face of underdevelopment, inadequate water and sanitation, crowded living conditions, lack of access to health care, and low levels of education, a greater proportion of the populace, particularly the poor, become highly susceptible to infection and disease (Podhajny, 2004). The persistence of mutilated

currency notes in active circulation could elevate their contributory role in transmission of some pathogens, thereby constituting potential public health hazard.

Denominationwise Bacterial Contamination on Currency Notes:

The study reported here found relatively more prevalence of bacteria among lower denomination notes; presumably as a result of a higher rate of handling and hand-to-hand exchange (Lamichhane *et al.,* 2009). The results showed that currency notes of lower denominations Rs. 5 (25.33%), Rs. 10 (28%) and Rs. 20 (17.33%) had more contamination of pathogens than the currency notes of higher denominations Rs. 50 (10.66%), Rs.100 and Rs. 500 (9.33% each). These lower denomination paper money are used frequently for different normal daily activities. Higher denominations are not used as frequently as lower denominations (Ahmed *et al.,* 2010).

Antibiotic Resistance Profile of Currency Note's Pathogens:

Antibiotic resistance profile showed organism wise variation in resistance pattern. *Staphylococcus aureus* (43) was highly resistant to Ampicillin (41), Penicillin G (41), Methicillin (39) and Oxacillin (37). Out of 14 *Pseudomonas* spp., 6 were found to be resistant to Carbenicillin and Cefepime each (Table 3a). *Escherichia coli* (42) was resistant to Cephalexin (33), Ciprofloxacin (32), Gatifloxacin (37), Levofloxacin (36), Nalidixic acid (34), Norfloxacin (37) and Ofloxacin (35). *Enterobacter* spp. (5) was resistant to Ciprofloxacin (4), Gatifloxacin (4), Levofloxacin (4), Nalidixic acid (5), Norfloxacin (5) and Ofloxacin (4). *Klebsiella* spp. (3) was resistant to Cephalexin (3), Nalidixic acid (3) and Norfloxacin (3). Proteus spp. (7) was resistant to Nalidixic acid (6) and Norfloxacin (5). *Salmonella spp*. (12) was found to be resistant to Nalidixic acid (12) (Table 3b). The low susceptibility (that is, higher resistance) of the isolates to the common and cheap antibiotics is not surprising as these drugs are more commonly abused or misused leading to development of resistance. The higher susceptibility to other antibiotics suggests the use of relatively costly antibiotics which are not easily affordable to permit abuse/misuse (Alwakeel and Nasser, 2011).

The results of the study reported here suggest that paper currency recovered from vegetable market were found to be contaminated with bacterial pathogens. Vegetable sellers' way of exchanging the currency notes was just touching the goods like vegetables and then exchanging the notes by the same people. This may play a significant role in the transmission of various diseases. This scenario is a major concern especially in respect of the health status of the population. Therefore handling of paper currency deserves special attention. Depending on the results of this study, one suggestion may be made to peoples to improve their personal health consciousness by washing hands after handling the currency notes, taking no foods even snacks after touching money notes, avoiding using saliva during counting of paper currency notes, avoiding baby to handle the currency notes.

Table 1 (a): Antibiotics used against *Staphylococcus spp*. and *Pseudomonas spp*.

Staphylococcus spp.				*Pseudomonas* spp.			
Antibiotics	Abbreviation	Antibiotic Classification	Concentration	Antibiotics	Abbreviation	Antibiotic Classification	Concentration
Amikacin	AK	Aminoglycosides	30 mcg	Aztreonam	AT	Monobactams	30 mcg
Ampicillin	AMP	Penicillins	10mcg	Carbenicillin	CB	Extended Spectrum Penicillins	100 mcg
Ampicillin/ Sublactam	A/S	Extended Spectrum Penicillins	10/10 Mcg	Cefepime	CPM	4th Generation Cephalosporins	30 mcg
Clindamycin	CD	Lincosamides	10 mcg	Ciprofloxacin	CF	Quinolones	5 mcg
Erythromycin	E	Macrolides	15 mcg	Gentamicin	GEN	Aminoglycosides	10 mcg
Linezolid	LZ	Oxazolidinone	10 mcg	Imipenem	IPM	Carbapenems	10 mcg
Penicillin G	P	Penicillins	10 units	Piperacillin	PI	Extended Spectrum Penicillins	100 mcg
Methicillin	MET	Penicillinase Resistant Penicillins	30 mcg	Piperacillin/ Tazobactam	PIT	Extended Spectrum Penicillins	100/ 10 mcg
Oxacillin	OX	Penicillinase Resistant Penicillins	5 mcg	Ticarcillin	TI	Extended Spectrum Penicillins	75 mcg
Vancomycin	VA	Glycopeptides	30 mcg	Tobramycin	TOB	Aminoglycosides	10 mcg

Table 1 (b): Antibiotics Used against Enterobacteriaceae

Antibiotics	Abbreviation	Antibiotic Classification	Concentration
Amikacin	AK	Aminoglycosides	30 mcg
Cephalexin	CN	1st Generation Cephalosporins	30 mcg
Ciprofloxacin	CF	Quinolones	5 mcg
Co-trimoxazole	COT	Sulfonamides	1.25/ 23.75 mcg
Gatifloxacin	GF	Quinolones	5 mcg
Gentamicin	GEN	Aminoglycosides	10 mcg
Levofloxacin	LE	Quinolones	5 mcg
Nalidixic Acid	NA	Quinolones	30 mcg
Norfloxacin	NX	Quinolones	10 mcg
Ofloxacin	OF	Quinolones	5 mcg

Table 2: Occurrence of Bacterial Pathogens on Currency Notes of Different Denominations in Circulation in Vegetable Market

Organism	Rs.5		Rs.10		Rs.20		Rs.50		Rs.100		Rs.500		Total		Grand Total	
	N	NM	N	NM	N	NM	N	NM	N	NM	N	NM	N	NM		
Staphylococcus aureus	5	2	5	0	3	0	3	0	3	0	2	0	21	2	23	30.66%2
Escherichia coli	5	0	5	0	5	0	5	0	4	0	3	0	27	0	27	36%
Enterobacter spp.	1	1	0	0	0	0	0	0	0	0	2	0	3	1	4	5.33%
Klebsiella spp.	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1.33%
Proteus spp.	2	1	1	0	0	0	0	0	0	0	0	0	3	1	4	5.33%
Salmonella spp.	2	0	4	0	0	0	0	0	0	0	0	0	6	0	6	8%
Pseudomonas spp.	0	0	5	0	5	0	0	0	0	0	0	0	10	0	10	13.33%
Total	15	4	21	0	13	0	8	0	7	0	7	0	71	4		
Grand Total	19		21		13		8		7		7				75	
	25.33%		28%		17.33%		10.66%		9.33%		9.33%		94.66%	5.33%		

Table 3 (a): Antibiotic Resistance Profile of Organisms Isolated from Currency Notes in Vegetable Market

Antibiotics	*Staphylococcus aureus* (n= 43)			Antibiotics	*Pseudomonas spp.* (n =14)		
	S	I	R		S	I	R
Amikacin	36	2	5	Aztreonam	14	0	0
Ampicillin	2	0	41	Carbenicillin	8	0	6
Ampicillin/Sulbactam	21	0	22	Cefepime	7	0	6
Clindamycin	39	0	4	Ciprofloxacin	10	1	2
Erythromycin	40	3	0	Gentamicin	10	2	3
Linezolid	39	0	4	Imipenem	13	1	0
Penicillin G	2	0	41	Piperacillin	13	1	0
Methicillin	0	4	39	Piperacillin/Tazobactam	14	0	0
Oxacillin	6	0	37	Ticarcillin	12	2	0
Vancomycin	38	3	2	Tobramycin	13	0	1

Table 3 (b): Antibiotic Resistance Profile of Organisms Isolated from Currency Notes in Vegetable Market

Antibiotics	Escherichia coli (n= 42)			Enterobacter spp. (n= 5)			Klebsiella spp. (n= 3)			Proteus spp. (n= 7)			Salmonella spp. (n= 12)		
	S	I	R	S	I	R	S	I	R	S	I	R	S	I	R
Amikacin	38	2	2	5	0	0	3	0	0	5	2	0	12	0	0
Cephalexin	0	9	33	0	4	1	0	0	3	0	4	3	11	1	0
Ciprofloxacin	8	2	32	0	1	4	2	1	0	4	3	0	12	0	0
Co-trimoxazole	36	6	0	5	0	0	3	0	0	7	0	0	9	3	0
Gatifloxacin	5	0	37	0	1	4	3	0	0	6	1	0	5	7	0
Gentamicin	39	3	0	5	0	0	3	0	0	7	0	0	12	0	0
Levofloxacin	6	0	36	0	1	4	1	2	0	7	0	0	12	0	0
Nalidixic Acid	2	6	34	0	0	5	0	0	3	0	1	6	0	0	12
Norfloxacin	3	2	37	0	0	5	0	0	3	0	2	5	2	10	0
Ofloxacin	4	3	35	0	1	4	0	3	0	5	2	0	12	0	0

Furthermore, regular disinfection of the currency notes be carried out by the banks; regular withdrawal of mutilated notes should be put in place by the authorities; public enlightment campaigns on non-mutilated (good) money handling practices should be done and lastly more similar study should be carried out on a continuous basis in order to build a global information network on money hygiene being in mind the public health implications of contaminated currency notes.

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REFERENCES

Beard, A. P. & Rawlings, NC. (1999) Thyroid function and effects on reproduction in ewes exposed to the organochlorine pesticides lindane cr pentachlorophenol (PCP) from conception. J. Toxicol. Environ. Hlth.(A) : 58, 509-530.

Abrams BI & Waterman NG. (1972) Dirty money. J. Am. Med. Ass. 219: 1202-1203.

Ahmed SU, Parveen S, Nasreen T & Feroza B. (2010) Evaluation of the microbial contamination of Bangladesh paper currency notes (Taka) in circulation. Advances in Biological Research. 4(5): 266-271.

Alwakeel SS & Nasser LA. (2011). Bacterial and Fungal contamination of Saudi Arabian paper currency and cell phones. Asian Journal of Biological Sciences. 4: 556-562.

Armour AD, Shankowsky HA, Swanson T, Lee J & Tredget EE. (2007) The impact of nosocomially acquired resistant *Pseudomonas aeruginosa* infection in a burn unit. J. Trauma. 63(1): 164-171.

Bauer AW, Kirby WMM, Sherris JC & Turck M. (1966) Antibiotic susceptibility testing by a standardized single disc method. Am J Clin Pathol. 45:493-496

Bentzel DE, Elliot TB, Keller CE, Brook I, Shoemaker MO & Knudson GB. (2004) Antimicrobial therapies for pulmonary *Klebsiella pneumoniae* infection in B6D2F1/J mice immunocompromised by use of sublethal irradiation. Comp. Med. 54(2): 185-192.

Chang YS, Kang S, Ko SY & Park WS. (2006) Pre-treatment with N-nitro-L-arginine methyl ester improved oxygenation after inhalation of nitric oxide in newborn piglets with *Escherichia coli* pneumonia and sepsis. J. Korean Med. Sci. 21(6): 965-972.

Charnock C. (2005) Swabbing of waiting rooms magazines reveals only low levels of bacterial contamination. Br. J. Gen. Pract. 55: 147-148.

CLSI (2007) Performance standards for antimicrobial susceptibility testing: 17th Informational supplement. Approved standard M100-S17, Wayne, USA: Clinical and Laboratory Standards Institute.

Collee JG & Marr W. (1996) Tests for identification of bacteria and Laboratory control of antimicrobial therapy. Chapter 7 and 8. In: Mackie & McCartney Practical Medical Microbiology, Collee JG, Fraser AG, Marmion BP & Simmons A. 14th ed. Pp. 131-151 (Ed.),14th ed., Churchill Livingstone: New York.

Damas C, Saleiro S, Gomes I & Marques JA. (2007) Cystic fibrosis in adults. Rev Port Pnemol. 13(3): 335-347.

Dehghani M, Dehghani V & Estakhr J. (2011) Survey of microbial contamination of Iranian currency papers. Research Journal of Pharmaceutical, Biological and Chemical Sciences. 2(3): 242-248.

El-Dars FMS & Hassan WH. (2005) A preliminary bacterial study of Egyptian paper money. Int. J. Environ. Health Res. 15: 235-240.

Everitt HA, Little PS & Smith WF. (2006) A randomized controlled trail of management strategies for acute infective conjunctivitis in general practice. BMJ. 333: 321-323.

Fang FC, Sandler N & Libby SJ. (2005) Liver abscess caused by mag A+ *Klebsiella pneumoniae* in North America. J. Clin Microbiol. 43(2): 991-992.

Goktas P & Oktay G. (1992) Bacteriological examination of paper money. Mikrobiyol. Bull. 26: 344-348.

Grude N, Tveten Y & Kristiansen BE. (2001) Urinary tract infections in Norway: Bacterial etiology and susceptibility. A retrospective study of clinical isolates. Clin. Microbial Infect. 7: 543-547.

Janardan L, Satish A, Prson G, Rajani M & Bishal D. (2009) Risk of handling paper currency in circulation chances of potential bacterial transmittance. Nepal J. Sci. Technol. 10: 161-166.

Jayaseelan S, Young SK, Fessler MB, Liu Y, Malcolm KC, Yamamoto M, Akira S & Worthsn GS. (2007) Toll/IL-1 receptor domain containing adaptor including IFN-beta (TRIF)-mediated signaling contributes to innate immune responses in the lung during *Escherichia coli* pneumonia. J. Immunol. 178(5): 3153-3160.

Lamichhane J, Adhikary S, Gautam P, Maharjan R & Dhakal B. (2009) Risk of handling paper currency in circulation chances of potential bacterial transmittance. Nepal. J. Sci. Technol. 10: 161-166.

Michaels B. (2002) Handling money and serving ready-to-eat food. Food Servo Technol. 2: 1-3.

Miller LG, Quan C, Shay A, Mostafaie K, Bharadwa K, Tan N, Matayoshi K, Cronin J, Tan J, Tagudar G & Bayer AS. (2007) A prospective investigation of outcomes after hospital discharge for endemic, community-acquired methicillin resistant and susceptible *Staphylococcus aureus* skin infection. Clin. Infect. Dis. 44(4): 483-492.

Oyero OG & Emikpe BO. (2007) Preliminary investigation on the microbial contamination of Nigerian currency. Int. J. Trop. Med. 2(2): 29-32.

Podhajny MR. (2004) How dirty is your money? Paper, Film & Foil Converter (PFFC). Penton Media, Inc. 330 N. Wabash, Suite 2300, Chicago, IL 60611-3698. Retrived May 5, 2005. Internet: http:// pffc.Online.com/material-science/paper, dirty-money.

Pope TW, Ender PT, Woelk WK, Koroscil MA & Koroscil TM. (2002) Bacterial contamination of paper currency. Southern med. J. 95: 1406-1410.

Rote RB, Deogade NG & Kawale M. (2010) Isolation, characterization and antibiotic sensitivity of organism from Indian currency. Asiatic Journal of Biotechnology Resources. 3: 255- 260.

Rukavina T, Ticac B & Vasiljev V. (2006) I1-10 in antilipopolysaccharide immunity against systemic *Klebsiella* infections. Mediators of Inflammation. 1: 1-5.

Saadabi AM, Ali LF, Omer AB, Ahmed GA & Al Asa R.K. (2010) Isolation and identification of pathogenic bacteria and fungi from some Sudanese banknote currency. Research Journal of Medical Sciences. 4(5): 315-318.

Saeed S & Rasheed H. (2011) Evaluation of bacterial contamination of Pakistani paper currency notes (Rupee) in circulation in Karachi. European Journal of Biological Sciences. 3(3): 94-98.

Siddique S. (2003) Dirty money. You're carrying more than cash in your wallet. Manila-Philippine Headline News online. Reported by Vanzi, S.J. Internet: http:// www.ewsflash.org /2003/05/si/si001628.htm.

Singh DV, Thakur K & Goel A. (2002) Microbiological surveillance of currency. Indian Journal of Medical Microbiology. 20 (1): 53.

Sun HY, Chen SY, Pan SC, Su CP & Chen YC. (2006) Community onset *Escherichia coli* and *Klebsiella pneumoniae* bacteremia: influence of health care exposure and antimicrobial susceptibility. Diagn Microbiol Infect Dis. 55(2): 135-141.

Tessema B. Kassu A, Mulu A & Yismaw G (2007) Predominant isolates of urinary tract pathogens and their antimicrobial susceptibility patterns in Gondar University Teaching Hospital, Northwest Ethiopia. Ethiop Med. 45(1): 61-67.

Valle DD, Castilb BJM, Fernandez FMJ, Buseo SE, Casa MJM & Sanchez GJ (2007) Endogenous *Pseudomonas* endophthalmitis in an immunocompetent patient. Eur J. Ophthalmol. 17(3): 461-463.

Yamaguchi K, Ohno A & Ishii Y. (2006) In vitro susceptibilities to levofloxacin and various antibacterial agents of 18, 639 clinical isolates obtained from 77 centers in 2004. Jpn. J. Antibiot. 59(6): 428-451.

Yazah AJ, Yusuf J & Agbo AJ. (2012) Bacterial contaminants of Nigerian currency notes and associated risk factors. Research Journal of Medical Sciences. 6(1): 1-6.

Xu J, Moore JE & Millar BC. (2005) Ribosomal DNA (rDNA) identification of the culturable bacterial flora on monetary coinage from 17 currencies. J. Env. Health. 67(7): 51-55.