



ASSESSMENT OF BACTERIAL LOAD ON PAKISTANI CURRENCY NOTES AND COINS IN CIRCULATION

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ABSTRACT

Fomites are inanimate articles that are accomplished of maintaining, absorbing and transferring transmissible microorganisms and it is a significant channel of the spread of microorganisms by fomites. Water, soil and food borne infections are supposed to be affecting almost half of the world people. Money is exchangeable fomite and one of the most routinely passed articles throughout the world. Money whether in the form of coins or notes is perhaps the most widely handled item by people everyday throughout the world. If pathogenic bacteria and fungi contaminate these currencies, they will cause diseases in human. This study was conducted on two hundred and sixty Pakistani currency notes and coins samples of all denominations collected from different professional groups in Lahore city, Pakistan to determine the bacterial contamination. Out of these two hundred and sixty samples, ten currency notes and coins were used as control. The control samples had not bacterial contamination, other samples were 100% contaminated with bacteria. Total thirty seven different Gram positive and Gram negative bacterial species were isolated from Pakistani coins and currency notes such as *S. aureus*, *S. epidermidis*, *S. saprophyticus*, *S. pneumoniae*, *S. viridans*, *S. pyogenes*, *E. faecalis*, *M. luteus*, *M. nishinomiyaensis*, *M. agilis*, *M. roseus*, *B. subtilis*, *B. cereus*, *B. vallismortis*, *B. thuringiensis*, *B. licheniformis*, *B. mycoides*, *B. weihenstephanes*, *Actinomycetes* spp., *E. coli*, *P. aeruginosa*, *P. putida*, *S. enterica*, *S. enteritidis*, *K. pneumoniae*, *K. oxytoca*, *S. sonnei*, *P. mirabilis*, *E. aerogenes*, *V. cholera*, *S. marcescens*, *A. salmonicida*. This work confirms that Pakistani money might play a significant role in the transmission of pathogenic and contagious microorganisms as well as in the spread of infectious diseases either they are food, water and soil borne infections. We suggested that coins and currency notes must be handled with care and the handling money is an urgent issue to prevent diseases.

KEYWORDS: Money, denomination, bacteria, pathogenic, contamination, infectious diseases, precautions.

INTRODUCTION

Currency is commonly traded for services, amenities and goods throughout world (Uneke and Ogbu, 2007). The surface of 'paper' banknotes is irregular, which can harbor many different types of microorganisms. So they may play a major role in transmission of pathogenic fungi and bacteria. The two main factors that determine the occurrence of bacteria on currency are (i) the material that the banknotes are made from and (ii) the age of the banknote. Modern paper currency notes are made from a distinct blend of 75% cotton and 25% linen with small segments of fiber. The 'paper' is referred to as the substrate during the manufacturing process. The linen/cotton/fiber mixture of the banknotes yields a strong bond and do not pull apart, unlike the fibers of normal paper. The average life span of a low denomination (morth) paper banknote is about 24 months (Vriesekoop, F *et al.*, 2010). Age of the banknote is important to consider as irrespective of whether a banknote is polymer based or cotton based, more bacteria are likely to be recovered from a used banknote than a

clean note. The older the banknote the more is the gathering of microorganism (Ghamdi AL *et al.*, 2011).

It is a very good pathway for spread of diseases (Wamae, 2009) and this is why the passage of currency notes from one individual to another possibly transmits the microorganisms. If infectious and pathogenic bacteria and fungi contaminate this money, the rate of diseases and death rate from these pathogenic agents will continue to rise (Suaad *et al.*, 2011 and Pope *et al.*, 2002).

Contagious diseases transmit through interaction with fomites and transmission through currencies is a very potential way (Pope *et al.*, 2002). Microorganisms are commonly spread via food, air and water, etc. Pathogenic organisms may also spread by mites. Currency notes which are transmitted from one person to other are well known to carry fungi and bacteria on their surface and responsible to transmit them (Hosen, 2006). Dirty money is generally wet and thus delivers a good surface for

fungal and bacterial growth. They provide optimistic conditions such as substrate acquired from human body and due to carry as well as dust from the surroundings (Haque, 2003).

Both currency notes and coins can be contaminated by droplets during touching, coughing and sneezing with formerly contaminated hands or other tools and site on unclean surface (Oyero and Emikpe, 2007).

Microorganisms commonly associated with banknotes include *Staphylococcus aureus*, α -hemolytic Streptococcus, Bacillus spp (form spores and stay attached for many years), *Escherichia coli*, Enterobacter spp, Acetobacter spp, Pseudomonas spp, Salmonella spp, viruses, fungi and eggs, larvae of worms, helminthes and parasites. Some banknotes associated bacteria are pathogenic, while others may cause opportunistic infections and it is also a common cause of food poisoning. The feasible role of influenza virus on banknotes in the transmission of this disease has been documented. One strain, H3N2, can remain infective for up to 3 days on banknotes, and other strains may be active for up to 17 days (Vriesekoop F *et al.*, 2010).

Numerous pathogens related with lung abscess, pneumonia, tonsillitis, throat infection, peptic ulcers, gastro enteritis and urinogenital tract infection had been reported (Saeed and Rasheed, 2011). Microbial contaminants may be spread directly via hand-to-hand contact, or indirectly, via water, food or other inanimate entities like fomites used as a vehicles. If this money is contaminated with hazardous bacteria, there is a possible to transmit these microorganisms and hence serve as a potential health hazard (Ahmad *et al.*, 2010).

It has been suggested that humans maintain strict adherence to hygiene practices before eating and drinking water after contact with money and sorting machines (Prasai *et al.*, 2008). Some Gram-negative bacteria can stay as long as eleven days on coins. Many coins have copper which can hindering growth of microorganisms. Currency notes offer a larger surface region as a breeding ground for pathogens (El-Dars and Hassan, 2005). For those in the food and catering industry and health care professions, hand washing after handling banknotes is essential. On a daily basis, millions of bacteria are transferred from person to person through the handling of money. The simple take-home message is that hands should be washed and dried after handling money and before handling food. Studies on the contamination of money with microbial agents do not exist in most developing countries. A lack of information could be involved in lack of public health strategies regarding currency usage, circulation and handling (Ghamdi *et al.*, 2011). The levels of hygiene to the community or society may participate in the amount of coins and currency notes microorganisms and thus the chance of transmission during handling of money. While resistance of antimicrobial steadily increasing, e.g. with

Extended-Spectrum Beta Lactamases (ESBL) producing *Escherichia coli* and Klebsiella spp (Gedik *et al.*, 2010), contaminated banknotes and coins contribute to the transmission of these multi-drug resistant microorganisms in the community. While this type of bacteria isolated between studies can vary, due to the methods used, season, environmental conditions, type of money or local community flora, in general, Gram positive bacteria were the most prevalent (Abrams and Waterman, 1972; Kuria *et al.*, 2009).

Prevention is the trademark of reducing morbidity and mortality. An efficient health awareness campaign program should be fully implemented to inform the public of the dangers of contaminated currency notes and even coins.

MATERIALS AND METHODS

Study Area and Design

Study was conducted in the Microbiology Laboratory, Institute of Molecular Biology and Biotechnology, The University of Lahore, Pakistan.

Sample collection

One hundred and thirty notes of different denominations as Rs-10, Rs-20, Rs-50 and Rs-100 and one hundred and thirty coins Re-1, Rs-2 and Rs-5 were collected from doctors/hospital staff, bankers, hawkers, vegetables/fruit vendors, sweepers, public transport conductors, beggars, butchers/fish vendors, cobblers and hotels staff in Lahore city of Pakistan. New paper currency notes and coins were collected from bank as reference for bacteriological analysis.

The individuals were asked to put the both coins and currency notes into the sterile polythene bag; currency notes and coins were not touched by the researcher via naked hands at any step of analysis. Samples thus collected were sealed, tagged (source, serial number, date of collection) and taken to the Microbiology Laboratory IMBB, The University of Lahore, soon after collection and examined for bacterial contamination (Kemka *et al.*, 2013).

Isolation and Identification of Bacteria

Isolation of numerous bacterial contaminants from the currency notes and coins was performed through standard methods described formerly (Singh *et al.*, 2002). Briefly, with the aid of sterile forceps all currency notes transferred aseptically in a test tube containing 10 ml of sterile normal saline water. The test tube was capped and shaken vigorously by hand for 2 min to dislodge the microorganisms into the fluid. The resulting liquid (normal saline water) served as the test sample, while the currency note was removed aseptically from the test tube with a sterile forceps, rinsed with water and dried to recover the note. Serial dilutions were prepared from the test sample as shown thus $1:10^1$, $1:10^2$, $1:10^3$ and $1:10^4$. This was done by transferring dispensed 1 ml of test sample into 9 ml of sterile normal saline water,

vortexed and then 1 ml aliquot transferred into the next tube. Starting with the highest dilution 0.1 ml of the test dilution (after agitation) was dispensed on nutrient agar plates for bacterial growth. The inoculum was spread evenly over the entire surface of the nutrient agar plates. Briefly, a sterile, cotton swab dipped with sterile normal saline was used to swab both sides of the coins. The swabs were inoculated on nutrient agar. The inoculated media was incubated aerobically at 37°C for 24 hours and then examined for bacterial growth according to standard protocol (Cheesbrough, 2000).

Bacterial purification was done by streaking the observed and isolated colonies on the nutrient agar plates (Uraku *et al.*, 2012). Using a sterile platinum loop, the inoculums were sub-cultured evenly on other selective and differential media's such as Mannitol Salt Agar, Eosin Methylene Blue, MacConkey agar, Salmonella Shigella agar, Polymyxin Pyruvate Egg Yolk Mannitol Bromothymol Blue Agar Base, Polymyxin-Lysozyme-EDTA-Thallos acetate base, Pseudomonas cetrimide agar, Thiosulfate Citrate Bile Salts Sucrose agar, Cystine lactose electrolyte deficient medium, Luria Bertani agar, Eaton's agar, Blood agar and Chocolate agar from pure culture. All the plates were incubated aerobically at 37°C for 24 hours by streak plate method. After incubation, plates were examined for growth. These sub-cultured plates were then used in the identification and characterization of the organisms (Ayandele *et al.*, 2011).

The individual colonies of bacteria were examined for their macroscopic traits such as color, size and morphology. The microscopic morphology and arrangement of purified bacteria were examined using Gram staining, Spore staining, Ziehl-Neelsen staining and Capsule staining (Cappucino and Sherman, 2007).

Different biochemical tests such as Catalase test, Coagulase test, Oxidase test, Indole production test, Methyl red test, Voges-Proskauer test, Citrate utilization test, Urease test (IMViC), Hydrogen Sulfide test (H₂S), Triple Sugar Iron (TSI) test (for dextrose, sucrose, and lactose fermentation), Nitrate Reduction test, Litmus milk reactions and Starch, Lipid, Gelatin hydrolysis tests were done for confirmation of isolated bacterial cultures on species level according to protocols described previously (Cheesbrough, 2000; Cappucino and Sherman, 2007).

RESULTS

A total of one hundred and thirty Pakistani currency notes were analyzed for bacterial contamination. Contamination was most prevalent among lower denominations according to the types of bacterial isolates, 661(100%) different bacteria were isolated in which Rs.10 Pakistani currency notes had 174 (26.32%), Rs.20 Pakistani currency notes had 166 (25.11%), Rs.50 had 165 (24.96%) and Rs.100 had 156 (23.60%). Total thirty three different bacterial isolates were identified. From bacterial isolates obtained 5 of them appeared to be any one of the bacillus spp. They were confirmed on the basis of culture characteristics that is *B. weihenstephanes*. Most prevalent bacterial isolates were *B. subtilis* 84 (12.71%), *S. epidermidis* 69 (10.44%), *S. aureus* 58 (8.77%), *M. luteus* 44 (6.66%), *E. coli* 40 (6.05%), *B. cereus* 36 (5.45%), *B. vallismortis* 35 (5.30%), *M. nishinomiyaensis* 32 (4.84%), *B. licheniformis* 22 (3.33%), *K. pneumoniae* 22 (3.33%), *P. aeruginosa* 20 (3.03%), *S. enterica* 16 (2.42%), Actinomycetes species 16 (2.42%), *E. aerogenes* 14 (2.12%), *S. sonnei* 12 (1.82%), *B. mycoides* 10 (1.51%), *V. cholerae* 10 (1.51%).

Table 1: Types of bacteria and their frequency of isolation from each denomination

No of isolated bacteria	Bacterial isolates	Currency notes					Coins			
		Rs.10	Rs.20	Rs.50	Rs.100	No. (%)	Bronze-Aluminium (Re.)	Brass-Aluminium (Rs. 1)	Cupro- nikel (Rs. 2)	No. (%)
1	<i>S. aureus</i>	18	13	11	16	58 (8.77%)	16	17	18	51(8.31%)
2	<i>S. epidermidis</i>	21	20	14	14	69(10.44%)	17	13	17	47(7.65%)
3	<i>S. saprophyticus</i>	2	1	2	0	5(0.76%)	7	5	8	20(3.26%)
4	<i>S. pneumoniae</i>	4	4	5	1	14(2.12%)	8	6	4	18(2.93%)
5	<i>S. viridans</i>	0	1	2	1	4(0.61%)	4	1	3	8(1.30%)
6	<i>S. pyogenes</i>	1	2	3	2	8(1.21%)	3	4	3	10(1.63%)
7	<i>E. faecalis</i>	0	1	3	1	5(0.76%)	2	4	4	10(1.63%)
8	<i>M. luteus</i>	14	10	9	11	44(6.66%)	16	17	18	51(8.31%)
9	<i>M. nishinomiyaensis</i>	5	11	8	8	32(4.84%)	8	15	8	31(5.05%)

10	<i>M. agilis</i>	3	1	0	1	5(0.76%)	3	1	4	8(1.30%)
11	<i>M. roseus</i>	2	2	4	1	9(1.36%)	2	3	0	5(0.81%)
12	<i>B. cereus</i>	10	9	8	9	36(5.45%)	5	6	7	18(2.93%)
13	<i>B. subtilis</i>	22	17	23	22	84(12.71%)	27	25	27	79(12.87%)
14	<i>B. vallismortis</i>	10	7	9	9	35(5.30%)	11	14	9	34(5.54%)
15	<i>B. thuringiensis</i>	1	2	2	3	8(1.21%)	10	4	11	25(4.07%)
16	<i>B. licheniformis</i>	5	2	8	7	22(3.33%)	6	3	3	12(1.95%)
17	<i>B. mycoides</i>	4	1	1	4	10(1.51%)	1	0	0	1(0.16%)
18	<i>B. polymyxa</i>	0	0	1	0	1(0.15%)	0	1	0	1(0.16%)
19	<i>B. weihenstephanes</i>	0	1	1	0	2(0.30%)	0	0	0	0(0.00%)
20	Actinomycetes spp.	3	5	4	4	16(2.42%)	0	0	2	2(0.33%)
21	<i>E. coli</i>	10	14	7	9	40(6.05%)	26	25	27	78(12.70%)
22	<i>P. aeruginosa</i>	2	8	6	4	20(3.03%)	7	11	7	25(4.07%)
23	<i>P. putida</i>	1	0	1	2	4(0.61%)	7	6	7	20(3.26%)
24	<i>S. enterica</i>	4	5	5	2	16(2.42%)	0	0	0	0(0.00%)
25	<i>S. enteritidis</i>	3	1	1	2	7(1.06%)	0	0	0	0(0.00%)
26	<i>K. pneumoniae</i>	7	7	5	3	22(3.33%)	2	6	8	16(2.61%)
27	<i>K. oxytoca</i>	1	1	0	0	2(0.30%)	0	0	0	0(0.00%)
28	<i>S. sonnei</i>	1	4	5	2	12(1.82%)	0	0	0	0(0.00%)
29	<i>P. mirabilis</i>	1	0	0	0	1(0.15%)	0	0	1	1(0.16%)
30	<i>E. aerogenes</i>	4	4	3	3	14(2.12%)	5	6	5	16(2.61%)
31	<i>V. cholera</i>	2	2	3	3	10(1.51%)	4	2	5	11(1.79%)
32	<i>S. marcescens</i>	1	0	2	0	3(0.45%)	0	0	0	0(0.00%)
33	<i>A. salmonicida</i>	2	0	2	1	5(0.76%)	0	2	2	4(0.65%)
Total		164 (26.33%)	156 (25.04%)	158 (25.36%)	145 (23.27%)	623 (100%)	197 (32.78%)	196 (32.61%)	208 (34.61%)	601(100%)

A total of one hundred and thirty coins were analyzed for bacterial contamination. Contamination was most prevalent among higher denominations according to the types of bacterial isolates, 601 (100%) different bacteria were isolated in which Bronze-aluminium (Rs.1) had 197 (32.78%), Brass-aluminium (Rs.2) had 196 (32.61%) and Cupro-nikel (Rs.5) had 208 (34.61%). Total twenty nine out of thirty eight different bacterial isolates were identified. Most prevalent bacterial isolates were *B. subtilis* 79 (12.87%), *E. coli* 78 (12.70%), *S. aureus* 51 (8.31%), *M. luteus* 51 (8.31%), *S. epidermidis* 47 (7.65%), *B. vallismortis* 34 (5.54%), *M. nishinomiyaensis* 31 (5.05%), *B. thuringiensis* 25 (4.07%), *P. aeruginosa* 25 (4.07%), *S. saprophyticus* 20

(3.26%), *P. putida* 20 (3.26%), *B. cereus* 18 (2.93%), *S. pneumoniae* 18 (2.93%), *K. pneumoniae* 16 (2.61%), *E. aerogenes* 16 (2.61%), *B. licheniformis* 12 (1.95%), *V. cholera* 11 (1.79%), *S. pyogenes* 10 (1.63%), *E. faecalis* 10 (1.63%). All other types of bacteria isolated from coins are listed with percentages in Table 1.

Total thirty seven bacterial isolates were isolated from currency notes and coins that were represented in the form of prevalence in Figure. In this figure blue color represented the bacterial isolates that were obtained from currency notes and red color represented the bacterial isolates that were obtained from coins. The most prevalent bacteria were *B. subtilis* in coins samples.

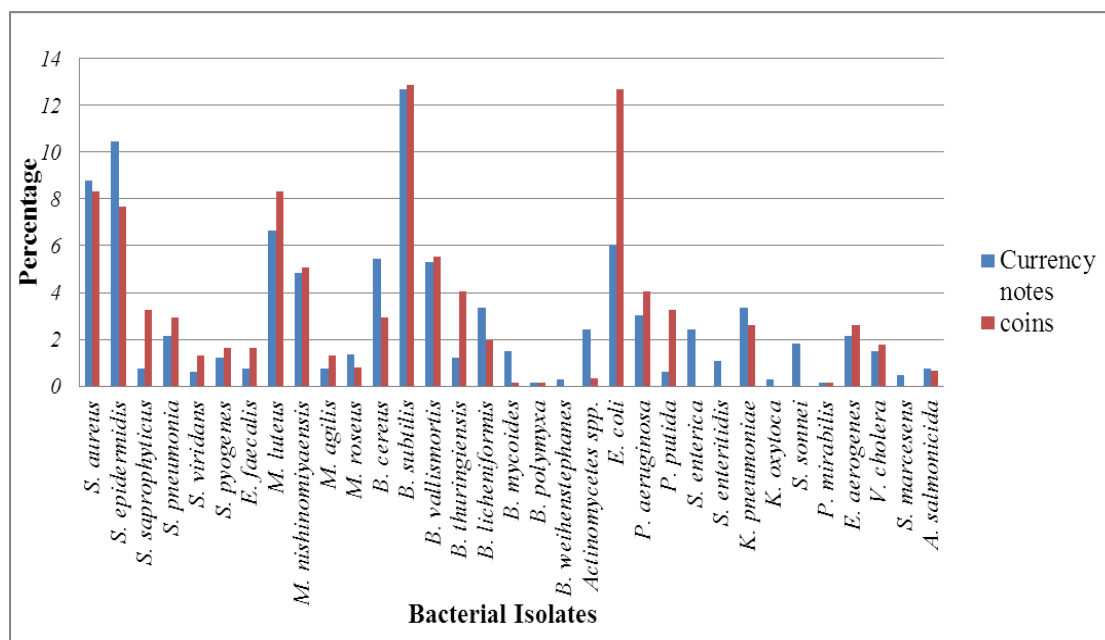


Fig 1: Prevalence of bacterial isolates from different denominations of currency notes and coins.

DISCUSSION

Contamination had a strong relation to the denominations of the currency notes and coins. The study revealed that percentage of bacterial contamination among lower denomination currency notes was found to be high than higher denomination currency notes while in case of coins, situation was opposite. A study conducted in Australia in 2010 between the currencies of ten different countries showed that the lower denomination of money contain higher bacterial content. Lower denomination money harbor the greatest bulk of infectious agents which are exchanged more than higher denomination money (Uneke and Ogbu, 2007).

In the present study total thirty three different bacterial isolates from currency notes samples were identified. Most prevalent bacterial isolates were *B. subtilis* 84 (12.71%), *S. epidermidis* 69 (10.44%), *S. aureus* 58 (8.77%), *M. luteus* 44 (6.66%), *E. coli* 40 (6.05%), *B. cereus* 36 (5.45%), *B. vallismortis* 35 (5.30%), *M. nishinomiyaensis* 32 (4.84%), *B. licheniformis* 22 (3.33%), *K. pneumoniae* 22 (3.33%), *P. aeruginosa* 20 (3.03%), *S. enterica* 16 (2.42%), *Actinomycetes* species 16 (2.42%), *E. aerogenes* and *S. pneumoniae* 14 (2.12%), *S. sonnei* 12 (1.82%), *B. mycoides*, *V. cholerae*, *M. pneumoniae*, *M. roseus* 9 (1.36%), *S. pyogenes*, *B. thuringiensis* 8 (1.21%), *S. enteritidis* 7 (1.06%), *S. saprophyticus*, *E. faecalis*, *M. agilis*, *A. salmonicida* 5 (0.76%), *P. putida*, *S. viridans* 4 (0.61%), *S. marcescens* 3 (0.45%), *K. oxytoca* and *P. mirabilis* 1 (0.15%).

Total twenty seven out of thirty three different bacterial isolates from coins samples were identified. Most prevalent bacterial isolates were *B. subtilis* 79 (12.87%), *E. coli* 78 (12.70%), *S. aureus* 51 (8.31%), *M. luteus* 51 (8.31%), *S. epidermidis* 47 (7.65%), *B. vallismortis* 34 (5.54%), *M. nishinomiyaensis* 31 (5.05%), *B.*

thuringiensis 25 (4.07%), *P. aeruginosa* 25 (4.07%), *S. saprophyticus* 20 (3.26%), *P. putida* 20 (3.26%), *B. cereus* 18 (2.93%), *S. pneumoniae* 18 (2.93%), *K. pneumoniae* 16 (2.61%), *E. aerogenes* 16 (2.61%), *B. licheniformis* 12 (1.95%), *V. cholera* 11 (1.79%), *S. pyogenes*, *E. faecalis* 10 (1.63%), *B. anthracis* 9 (1.47%), *S. viridans*, *M. agilis* 8 (1.30%), *M. roseus* 5 (0.81%), *A. salmonicida* 4 (0.65%), *B. globigii* 3 (0.49%), *Actinomycetes* species 2 (0.33%), *P. mirabilis*, *B. mycoides* 1 (0.16%), *B. weihenstephanes*, *S. enterica*, *S. enteritidis*, *K. oxytoca*, *S. sonnei*, *S. marcescens* were absent in coins samples.

Patrick Feglo and Michael Nkansah (2010) showed the isolated bacterial strains to be *Bacillus* species (41.07%), Coagulase negative *Staphylococcus* (33.04%), *Staphylococcus aureus* (7.14%), *Enterococcus faecalis* (7.14%), *Citrobacter freundii* (4.46%), *Klebsiella pneumoniae* (2.68%), *Shigella dysenteriae* (2.68%) and *Escherichia coli* (1.79%) and *Bacillus* species was the predominant bacterial isolate in Indian studies (Basavarajappa et al., 2005; Singh et al., 2002).

AK Al-Ghamdi et al., (2011) showed that 4th version notes had mixed bacterial growth: Gram-positive bacilli (79%), *Staphylococcus aureus* (38%), Coagulase-negative *Staphylococci* (75%), *Viridans* group *Streptococci* (VGS) (8%), *Pseudomonas* spp (19%), *Klebsiella* spp (21%), *Escherichia coli* (9%) and non-hemolytic *Streptococci* (4%). Seventy six percent of the newer 5th version notes had mixed bacterial growth: Gram-positive bacilli (68%), coagulase-negative *Staphylococci* (64%), *S. aureus* (13%), *Klebsiella* spp (9%), *E. coli* (2%) and VGS (2%).

Tagoe et al., (2011) observed that the isolates include *B. cereus* (32.5%), *S. aureus* (18.4%), Coagulase negative

Staphylococci (14.1%), *K. pneumoniae* (8.7%), *E. coli* (7.8%) etc. The most commonly isolated bacteria species were *B. cereus* (32.5%), *S. aureus* (18.4%), CNS (14.1%) and *E. coli* (7.8%) whilst the least isolated species were *S. pneumoniae* (0.5%), *Yersinia* spp. (0.5%), and *Salmonella* spp. (1.0%).

Bacteria isolated from the currency notes include *S. aureus* (18.4%), CNS (14.1%), *S. pneumoniae* (0.5%), *E. coli* (7.8%), *B. cereus* (32.5%), *Enterobacter* spp. (2.9%), *K. pneumoniae* (8.7%), *Salmonella* spp. (1.0%), *Yersinia* spp. (0.5%), *E. faecalis* (3.4%) and *P. mirabilis* (2.9%), which relates to more than 90% of isolates from other researchers (Singh et al., 2002; Umeh et al., 2007; Zarei et al., 2009).

Neel, (2012) have shown the percentage of predominant bacteria found in currency notes were *E. coli* (51.71%), *S. aureus* (30.75%), *K. pneumoniae* (16.78%) and *P. aeruginosa* (26.91%), *S. dysenteriae* (16.78%), *V. cholera* (13.21%), *S. typhi* (16.78%) and *B. subtilis* (59.41%).

Matur et al., (2010) Of the two hundred naira notes observed 32% were contaminated with different species of parasites and 58% with bacterial species while the mints harbor no contamination. Bacteria isolated after culture were *Staphylococcus* spp (30.5%), *Pseudomonas* spp. (6.5%), *Klebsiella* spp. (6.5%), *Escherichia coli* (9.0%), *Escherichia coli* (9.0%) and *Proteus* spp. (5.5%).

Nagesh et al., (2010) Of the 25 notes subjected to culture, three different species were isolated. *Escherichia coli* were present on all the 16 (64%) notes, *Staphylococcus aureus* on 5 (20%) notes and *Proteus* on 4 (16%) notes.

Ukwuru and Gabriel, (2012) Samples were more contaminated by bacteria than by mold. Organisms commonly isolated from the samples included *Staphylococcus* spp, *Escherichia coli*, *Shigella*, Lower currency denominations were more contaminated (70-100%) than the higher ones (0-40%).

Pal et al., (2013) 91% of currencies were contaminated with pathogenic organisms. 116 isolates of 11 different bacterial species were identified. *Enterococcus* sp (25%) was the most commonly isolated bacteria followed by Coagulase negative *Staphylococcus* (20.68%), *Staphylococcus aureus* (12.06%), *Bacillus* spp. (12.06%), *Escherichia coli* (9.48%), *Klebsiella* spp. (5.17%), *Micrococcus* spp (5.17%), *Diphtheroids* (4.31%).

Mohammed Rafiq et al., (2013) isolated aerobic spore forming bacilli (91%), *Staphylococcus epidermidis* (63.3%), *Klebsiella pneumoniae* (31.7%), *Enterococcus* (24.1%), *Enterobacter* (19.2%), *E. coli* (17.5%), *Lactobacilli* (10.8%), *Corynebacterium* (7.5%), *Staphylococcus aureus* (4.2%), alpha hemolytic *streptococcus* (4.1%), *Streptococcus pneumoniae* (1.7%),

Proteus (1.7%), *Pseudomonas aeruginosa* (0.8%), *Shigella flexneri* (0.8%) from samples of one hundred twenty currency notes.

Inaam J.AL-Abbasi, (2010) Bacterial contamination was shown as follow: *Bacillus* sp. 41.2%, *Staphylococcus aureus* 15.6%, coagulase negative staphylococci 13.1%, *Klebsiella* sp.11.2%, *E. coli* 11.2%, *Enterobacter* sp. 3.7% and *Proteus* sp. 3.7.

Sawsan M. Abdulla (2013) A total of one hundred and twenty eight Iraqi dinar notes were analyzed for bacterial contamination. Seventeen different bacteria species were obtained from currency notes from studied places representing 100% contamination. Isolated bacteria from the paper notes with its percentage of contamination were *Staphylococcus aureus* 83.3%, *Streptococcus pyogenes* 83.3%, *Pseudomonas* species 83.3%, *Klebsiella* species 75%, *Staphylococcus epidermidis* 66.6%, *Escherichia coli* 66.6%, *Staphylococcus saprophyticus* 58.3%, *Streptococcus pneumoniae* 58.3%, *Streptococcus faecalis* 58.3%, *Enterobacter* specie 58.3%, *Proteus* species 50%, *Citrobacter* species 41%, *Corynebacterium* species 25%, *Yersinia* species 25%, *Salmonella* species 25%, *Acinetobacter* species 16.6%. His results were quite in accordance with the results obtained from this study.

Orukotan, A. A1 and Yabaya A (2011) isolated microorganisms from the notes were *Escherichia coli* (14.98%), *Staphylococcus aureus* (9.84%), *Klebsiella* spp. (9.19%), *Salmonella* spp. (4.65%), *Streptococcus* spp. (3.42%), CNS (6.25%), *Proteus* spp. (3.29%), *Micrococcus* spp. (3.02%) and *Bacillus* spp. (2.48%).

Total seventy Ghanaian currency notes were analyzed for bacterial contamination. One hundred and twelve different bacterial isolates were obtained from sixty nine 69 (98.57%) currency notes contamination in which GH¢1 had 57(50.90%), GH¢5 had 45(40.17%), GH¢10 had 10 (8.93%). New currency notes did not grow any bacterium (Feglo and Nkansah, 2010).

In the present study, A total of one hundred and thirty Pakistani currency notes were analyzed for bacterial contamination, Contamination was most prevalent among lower denominations according to the types of bacterial isolates, 623(100%) different bacteria were isolated in which Rs.10 Pakistani currency notes had 164 (26.33%), Rs.20 Pakistani currency notes had 156 (25.04%), Rs.50 had 165 (25.36%) and Rs.100 had 145 (23.27%).

In the present study, A total of one hundred and thirty coins were analyzed for bacterial contamination, Contamination was most prevalent among higher denominations according to the types of bacterial isolates, 601(100%) different bacteria were isolated in which Bronze-aluminium (Rs.1) had 197 (32.78%),

Brass-aluminium (Rs.2) had 196 (32.61%) and Cupronikel (Rs.5) had 208 (34.61%).

CONCLUSION

The Pakistani money in circulation was found to be contaminated with different types of bacteria. Therefore dealing with paper money deserves special attention. There should be public awareness of the fact that money could be a source of infection and could be hazardous to health. To help control the spread of these pathogens, it is recommended that the central Bank of Pakistan should implement laws to deal with the Pakistani money. Individuals must improve their personal health awareness through wash their hands regularly with soap after handling money, prevent children from dealing with money and avoid the use of saliva during counting currency notes as well as refrain from putting money in the mouth and biting off corners of banknotes. The practice of keeping money in brassieres, handkerchiefs and in shoes should be discouraged. However, using wallets to keep money and maintaining proper hygiene should be advocated. Regular disinfection of money with ultraviolet light, fumigation or formalin vapors, the use of plastic/polymer-based currency notes, an awareness campaign and seminars should be conducted in rural and urban areas. Dirty and mutilated notes should be withdrawn from time to time.

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