Research Paper

Microbial Contamination of Indian Currency Notes and Coins in Kolkata, West Bengal- A Survey

Biomedical Science

Mahuya Mukhopadhyay	Department of Microbiology, Lady Brabourne College, P1/2 Suhrawardy Avenue, Kolkata 700017, West Bengal, India
Sukanya Podder	Department of Microbiology, Lady Brabourne College, P1/2 Suhrawardy Avenue, Kolkata 700017, West Bengal, India
Swarnali Bhattacharya	Department of Microbiology, Lady Brabourne College, P1/2 Suhrawardy Avenue, Kolkata 700017, West Bengal, India

ABSTRACT   *Currency notes and coins are widely exchanged between various communities for trade, which may serve as a carrier of microbes and lead to transmission of infectious diseases. In this survey, the life threatening condition of Indian people was observed by studying the microbial contamination of Indian currency notes and coins. Here 40 samples of notes and coins were collected from various place of society and were tested to isolate various loads of microorganisms on currency notes and coins. Among the tested samples, yeast were present in 85%, Staphylococcus spin 75%,Pseudomonas sp. were in 65%,vibrio sp. were in 22.5%, fungi were in 45% and coliform were in 15% of samples. Among them, some colonies are resistant to generally used antibiotics. The Methicillin Resistant Staphylococcus aureus(MRSA) were also identified in 25% of the tested samples.*

The environment plays an important role in transmission of microbial agents to humans, with many environmental materials serving as vehicles, currency notes and coins are one of them. Contamination may occur during production, storage after production and use. Money, therefore presents a particular risk to public health. Currency notes and coins on which pathogenic microorganisms might survive represent an often overlooked reservoir for enteric diseases, food poisoning, wound and skin infections, respiratory and gastrointestinal problem to life threatening diseases like septicaemia, meningitides etc. (Elumalai et al., 2012). The present study was undertaken to identify the different microbial contamination of Indian currency notes and coins in Kolkata City, West Bengal.

Previously in a study with 136 currency notes in Tanzania, the predominant bacteria found were *Staphylococcus aureus* (30.75%), *Escherichia coli* (51.71%), *Klebsiella pneumoniae(*16.78%), and *Pseudomonas aeruginosa* (26.91%), *Shigella dysentriae* (16.78%), *Vibrio cholerae* (13.21%), *Aeromonas hydrophila* (6.25%), *Salmonella typhi* (16.78%) and *Bacillus subtillis* (59.41%), protozoa like *Giardia duodenalis* (3.12%), *Entamoeba histolytica* (10.09%), where as fungi like *Aspergillus niger* (23.76%), *Penicillium* (37.92%) were predominant in lower denominations (Neel, 2012). In Ghana, bacteria isolated from the 100 currency notes include Coagulase negative *Staphylococci*, *S.aureus*, *E. coli*, *Bacillus species*, *Klebsiella species*, *Enterobacter* species, *Enterococci species*, and *Proteus species* (Tagoe et al., 2010). Same types of pathogenic microbial isolates were also identified from currencies of Bangladesh, Nepal and Nigeria (Ahmed et al.,2010, Lamichhane et al.,2009, Ahmed et al.,2010).

In India pathogenic bacteria like *Staphylococcus epidermidis* (63.3%), *Staphylococcus aureus* (4.2%), *Enterococcus* (24.1%), alphahemolytic *Streptococcus* (4.1%), *Streptococcus pneumonia* (1.7%), *Corynebacterium* (7.5%), *Lactobacilli (10.8%), Klebsiella pneumoniae* (31.7%), *Enterobacter* (19.2%), *E. coli* (17.5%), *Proteus* (l.7%), *Pseudomonas aeruginosa* (0.8%), *Shigella flexneri* (0.8%) were found from 120 paper money samples in Coimbatore City, TamilNadu, India (Khan et al., 2013) . In Chennai, among 116 isolates of bacteria, *S. aureus* was dominant (19 %). Whereas *P. aeuroginosa* (2%), *E. faecalis* (2%), *S. pyogenes* (5%), *C. diptheriae* (4%), *E. coli* (2%), *K. oxytoca* (2%), *P. mirabilis* (1%) *C. freundii* (3%) *S. pneumoniae* (2%) and *E. faecium* (1%) were found in lower proportion (Thiruvengadam et al., 2014). Antibiotic resistant gram positive, gram negative bacteria and coagulase negative

Staphylococci and methicillin resistant *Staphylococcus aureus* were isolated from Indian currency circulating in hospitals in rural Bengal (Pal et al., 2013). But no such study was done in Kolkata yet, so, the main aim of this study is to identify the load of microbial contamination of Indian currency in Kolkata city.

MATERIALS AND METHODS

Re.1 coin and Rs.10 notes were collected in sterile bag from various place of society like grocery shop, college canteen, fruit seller, hospital, railway station master, fish seller, butcher shop, bus conductor, vegetable vendor, roll shop, banker. Microorganisms were isolated in different types of media like Nutrient agar (NA), Yeast Peptone Dextrose Agar (YPDA), Sabouraud's Dextrose agar (SDA), Mannitol Salt agar (MSA), Thiosulfate-Citrate-Bile Salts-Sucrose agar (TCBSA), and Eosin Methylene Blue Agar (EMBA) using saline suspension of the soaked samples. Some strains of coliform (C1,C2), *Vibrio* (V1,V2), *Pseudomonas* (P1,P2) and *Staphylococcus* (St) were selected and their antibiotic sensitivity were checked against commonly used antibiotics. Colonies on MSA plates were replica plated on the same medium containing antibiotics like ampicillin and cephalosporin (2-4 µg/ml) to identify MRSA strains.

RESULTS AND DISCUSSIONS

40 currency samples were tested for microbial contamination on different types of media containing plates (Table1). Yeasts were predominant and were present in 85% of samples, *Staphylococcus* sp reported in 75%, *Pseudomonas* sp. were in 65%, *Vibrio* sp. were in 22.5%, fungi were in 45% and coliform were in 15% of samples. This result shows some similarities with the previously done studies in different countries as *E.coli* was also found in currencies of Tanzania, Ghana, and Bhopal (Neel 2012, Tagoe et al., 2010, Sadawate et al 2014). *Pseudomonas* sp. was also isolated from currencies of Tanzania, Bhopal and India (Neel, 2012, Sadawate et al., 2014).Fungi was found in currencies of Tanzania and Bhopal too. (Neel, 2012, Sadawate et al., 2014).

From the results in Table2, it can be concluded that, C2 is the most alarming isolate among the selected coliform strains as it shows resistance to all tested antibiotics. All of the *Vibrio* strain showed sensitivity or intermediate sensitivity to most of the antibiotics used. Selected *Pseudomonas* strains were not found so harmful as they show intermediate sensitivity to the selected antibiotics, but *Staphylococcus* showed resistance to most of the antibiotics used. So the currency circulating in Kolkata city were

contaminated with different pathogenic and potential pathogenic bacteria including multi drug resistant strains as suggested previously by Pal et al., (2013) while studying with Indian currency circulating in hospitals of rural Bengal.

Staphylococcus sp. isolated from bus conductor, hospital outdoor, butcher's shop, railway station master, roll shop, fish seller showed to be MRSA strains(Table 3). The presence of MRSA strains in butcher's shop, roll shop and fish seller currency may indicate there is a correlation between animal meat and presence of MRSA. MRSA strains are very difficult to treat as they are multidrug resistant. Similarly MRSA strains were also reported from food serving areas of Zambia (Neel, 2013). In another study with Indian currencies circulating in hospitals of rural Bengal 35.71% of isolated *S.aureus* were MRSA. So the need to improve health consciousness among people while handling currency is an urgent issue (Pal et al., 2013).

Table 1: Microbial loads on currency notes and coins (x10^4 cfu/ml)

Sample source	Sample Number	Sample type	NA	PPA	YPDA	MSA	TCBSA	EMBA	SDA
Bus conductor	1	Note	U	U	100	360	-	420	100
		Coin	742	347	50	235	-	230	
	2	Note	780	150	30	-	-	-	50
		Coin	150	70	U	U	-	-	
Fruit seller	1	Note	60	112	50	254	-	20	100
		Coin	12	227	-	274	-	-	
	2	Note	870	40	-	-	-	-	250
		Coin	170	-	100	-	-	-	
Hospital outdoor	1	Note	1937	166	200	1163	-	-	100
		Coin	1460	257	50	722	-	-	
	2	Note	350	150	U	U	-	-	60
		Coin	200	-	100	300	100	-	
Butcher shop	1	Note	390	150	530	3600	60	-	U
		Coin	233	163	200	1200	-	-	
	2	Note	U	-	400	-	-	-	200
		Coin	U	-	100	1500	20	-	
Canteen	1	Note	U	296	150	12	6		10
		Coin	200	U	50	10	-		
	2	Note	1300	30	610	15	-	-	40
		Coin	880	-	230	-	-	-	
Railway Station master	1	Note	U	262	300	211	-	-	200
		Coin	U	335	215	122	-	-	
	2	Note	U	U	240	-	-	-	300
		Coin	150	-	140	-	-	-	
Roll Shop	1	Note	U	U	200	292	-	-	60
		Coin	59	U	-	100	-	-	
	2	Note	U	-	300	U	-	600	-
		Coin	500	-	70	800	10	-	
Fish seller	1	Note	U	U	50	29	-	-	10
		Coin	U	U	-	22	-	-	
	2	Note	3000	-	30	-	-	-	
		Coin	175	-	40	360	-	-	
Vegetable vendor	1	Note	U	520	80	11	11	-	U
		Coin	U	U	50	69	-	-	
	2	Note	U	40	70	-	-	-	100
		Coin	U	-	18	U	70	200	
Grocery shop	1	Note	2000	-	50	600	-	-	50
		Coin	800	-	20	-	-	-	
Banker	1	Note	179	-	-	167	833	520	20
		Coin	221	13	-	284	525	-	

U: uncountable

Table 2: Antibiotic sensitivity of selected microorganisms against antibiotics

Antibiotics	Diameter of inhibition zone (cm) and sensitivity						
	C1	C2	V1	V2	P1	P2	St
Erythromycin	1.5 (I)	- (R)	3.2 (S)	- (R)	2 (I)	- (R)	- (R)
Vancomycin	- (R)	- (R)	1.8 (S)	0.8 (R)	1.9 (S)	2.2 (S)	- (R)
Azythromycin	2.4 (S)	1.3 (R)	3.2 (S)	1.7 (I)	2.3 (S)	- (R)	- (R)
Clindamycin	- (R)	- (R)	- (R)	2 (I)	2 (I)	- (R)	2.4 (R)
Tetracyclin	- (R)	- (R)	1.8 (I)	1.5 (S)	1.8 (I)	3 (S)	2.4 (I)
Gentamycin	1.7 (S)	- (R)	2.6 (S)	1.3 (S)	2.1 (S)	1.8 (S)	3.4 (S)
Amoxicillin	- (R)	- (R)	- (R)	0.7 (R)	-(R)	1 (R)	- (R)
Ciprofloxacin	2.4 (S)	1.5 (R)	2.6 (S)	1.2 (R)	2.3 (S)	3 (S)	2.8 (I)
Ofloxacin	- (R)	1 (R)	2.5 (S)	2.4 (S)	2.4 (S)	2.1 (S)	2.5 (I)

S= Sensitive, I= Intermediate, R=Resistant

Table 3: Identification of Methicillin Resistant *Staphylococcus aureus*

Sample source	Sample number	Sample type	MRSA	MSSA
Bus conductor	1	Note	Present	-
		Coin	Present	-
	2	Note	-	Present
		Coin	Present	-

Fruit seller	1	Note	-	Present
		Coin	-	Present
	2	Note	-	Present
		Coin	-	Present
Hospital outdoor	1	Note	-	Present
		Coin	-	Present
	2	Note	Present	-
		Coin	Present	-
Butcher shop	1	Note	-	Present
		Coin	-	Present
	2	Note	-	Present
		Coin	Present	-
Canteen	1	Note	-	Present
		Coin	-	Present
	2	Note	-	Present
		Coin	-	Present
Railway station master	1	Note	Present	-
		Coin	Present	-
	2	Note	-	Present
		Coin	-	Present
Roll shop	1	Note	Present	-
		Coin	-	Present
	2	Note	Present	-
		Coin	-	Present
Fish seller	1	Note	Present	-
		Coin	-	Present
	2	Note	-	Present
		Coin	-	Present
Vegetable vendor	1	Note	-	Present
		Coin	-	Present
	2	Note	-	Present
		Coin	-	Present
Grocery shop	1	Note	-	Present
		Coin	-	Present
Banker	2	Note	-	Present
		Coin	-	Present

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