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Prevalence of bacterial infection and the antibiotic susceptibility profile of microorganisms isolated from the Indian currency (notes and coins) in different part of Rampur (U.P.) India

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ABSTRACT

The aim of the study was to determine the prevalence of bacterial infection and the antibiotic susceptibility profile of microorganisms isolated from the Indian currency (Notes & Coins). Microorganisms are present nearly every where in our environment. Some microorganisms are useful but some are pathogenic. Microorganisms are known to spread via air, water, food etc. the major system of the proliferation of bacterium is by formites. Mostly the people are not aware of their dirty handswhen they have currency notes in their hands and count the money. The contaminated notes and coin continue in circulation and spread bacillus to others hands transferring pathogenic organisms in the process. The species of this study was to identify the micro-organisms present on the currency notes circulating in Rampur. A total of 30 currency (16 Notes & 14 Coins) Rs. 10, 20, 50, and 100 and coins Rs.1, 2, 5, 10 were randomly collected from butcher, vegetable vendor, fruit vendor, fish shop,milk man auto-rickshaw, bus conductor and hospital.

Persons handling the currency (Notes & Coin) were asked to deposit them in sterile envelopes and sterile cup. The currency notes were taken to the laboratory immediately and microorganisms isolated by using nutrient agar and Mac Conkey's agar. All the currency notes collected during this study were contaminated by micro-organisms. Species isolated were *Pseudomonas aeruginosa* (40%), *E.coli* (20%), *Klebsiellaspps.* (20%),*Staphylococcus aureus* and *Bacillus spps.*(8%).The study suggested that Indian paper currency notes are highly contamination with pathogenic microorganisms and this contamination may play a significant role in transmission of infectious disease. Hance, very care must be taken while handling money during the preparation and handing of food to avoid cross contamination.

KEYWORDS-Antibiotic Susceptibility, Currency (Notes &Coins) of Rampur, Contamination,Pathogenic microorganisms.

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INTRODUCTION

Currency (Money) has a great importance in our life. It essentially fullfills the requirements of every man, paper currency is immensely exchanged for commodities and services in countries all over the world. It is used for all kinds of business and trade. Paper currency imparts a vast area as a breeding ground for pathogens. Currency notes could transport probably pathogenic organisms[1].Currency in the form of notes is a universal medium for the transmission of pathogens in the environment and among humans. Probably currency notes are environmental means for the transmission of probable pathogenic microorganisms. Globally, money is one of the things most frequently passed from hand to hand. So money can get contaminated and may thus play a role in the transmission of microorganisms to other people.

A person living in insanitary conditions with unhygienic habits will pollute the notes with bacteria e.g. habits such as using saliva to count the paper notes also contaminates the notes and these notes will act as a vehicle delivering bacteria to contaminate the hands of the next user.

Study (Research have depicted that paper currency provides a huge surface area as a breeding ground for pathogens. Microbes may stay with it for longer periods. The older the paper note the more a multiplication of microbes takes place. Antimicrobial resistance is a global occurrence that is the outcome of high morbidity and fatality as a result of failures and increased health care costs . These findings indicate money as a vehicle for transmission of pathogens. Such information is necessary to facilitate infection control master plan. The major objective of this research was to analyze the bacterial identification in currencies under circulation in Rampur to identify the possible risk factors.

The probability that currency notes might perform as environmental conveyance for transmission of possible pathogenic microorganism was indicated in 1970s. Different pathogens which cause throat infection, pneumonia, tonsillitis peptic ulcers, urino-genital part infection, gastro enteritis and lung ulcer had been described.Researchers at the Regional Sophisticated Instrumentation Centre (RSIC) at the North Eastern university in shilong, India which examined Indian bank notes discovered germs which can cause tuberculosis, tonsillitis, meningitis, peptic ulcers, sore throat genital tract infections etc [10]. Studies of the contamination of currency with microbial agents are not insufficient in most developing countries. Lack of information may cause the absence of public health schemes relating to currency usage, handling and circulation .Money in small denominations gets in touch of the most hands because they frequently change hands more often. Money may serve as an unidentified reservoir for pathogenic and non-pathogenic bacteria. One type of pathogenic bacteria that can be regarded as an ultimatum is gastro colic bacteria.

Keeping of these notes in polythenes, cotton, leather bags in moist and dark conditions also support the growth of bacteria on these notes. It probable to find out the existence of particular bacteria on these notes by separating the pathogenic bacteria on their respective growth way followed by their recognition by poly phasicreaches; not withstanding this is too arduous, thus the commonest access is to search for indicator. *E .Coli* is one such microbe which can indicates organism for fecal pollution of water. It is a Gram negative aerobic or facultative anaerobic non spore producing bacteria that ferment lactose with the formation of acid and gas presence of *E.Coli* in water or food sample indicator the fecal contamination and also indicated that other intestinal viruses may also be found in the sample. Several scholars investigated that the transmitting of bacteria from currency notes to humans through food.

The present observation was chosen to recognize microbial contamination of Indian currency notes which are in circulation and to examine the antibiotic vulnerability pattern of the pathogenic isolates (protection).

MATERIALS AND METHODS

Sample Collection

The study was conducted in different parts of Rampur, (India) where various Indian currency denominations were randomly collected from everyday use from February 2018 to August 2018 and processing of samples were done at Department of Biochemistry Mohammad Ali Jauhar University (MAJU) Rampur (U.P). A total of 30 currency (16 notes and 14 coins) were randomly collected from different sample like butchers, vegetable vendor, fruit shop, milk man, auto-rickshaw, bus conductor and hospital. The currency collected and used were Rs.10, 20, 50, and 100 and coins of Rs.1, 2, 5, and 10. To collect the currency notes the individuals were asked to drop currency or money into a sterile cup and sterile envelope, which were sealed and immediately transported to the lab for microbial analysis.

Identification and Isolation of Microbes:

A sterile cotton swab was dipped in the sterile distilled water and rubbed on both the surfaces of currency notes and used to inoculate the nutrient agar and Mac Conkey's agar for each note. The plates were incubated at 37˚C for 24 hours, then the plates were observed for bacterial colonies. Pure isolated colonies were identified by Gram staining and then biochemically identified using Indole, Methyl Red (MR), Voges Proskauer, Citrate Utilization, Catalase, Oxidase, and Coagulase tests.

Antibiotic Susceptibility Profile:

Antibiotic susceptibility was determined by the agar diffusion technique on Mueller-Hinton agar according to CLSI guidelines (Clinical and Laboratory Standard Institute; 2012).Standard

antibiotic discs including Ampicillin (10µg), Amikacin (30µg), Gentamicin (10µg), Cotrimoxazole (25µg), Cefotaxime (30µg), Ceftazidime (30µg), Ceftriaxone (30µg), Ciprofloxacin (5µg), and Erythromycin (5µg). All the culture media, biochemical media and antibiotic discs used were obtained from Hi Media. Analysis of results was done by counts and percentages using MS Excel, 2007 version show in Table (1).

Antimicrobial agent	Disk Content	Interpretive Criteria (mm)		
		Sensitive	Intermediate	Resistant
Amoxicillin	10µg	≥17	14-16	≤13
Amoxicillin-clavulanic acid	20/10µg	≥18	14-17	≤13
Piperacillin-tazobactum	100/10µg	≥21	18-20	≤17
Cefepime	30µg	≥18	15-17	≤14
Ceftriaxone	30µg	≥23	20-22	≤19
Meropenem	10µg	≥23	20-22	≤19
Ciprofloxacin	5µg	≥21	16-20	≤15
Levofloxacin	5µg	≥17	14-16	≤13
Norfloxacin	10µg	≥17	13-16	≤12
Trimethoprim-sulfamethoxazole	25µg	≥16	11-15	≤10
Nitrofurantoin	300µg	≥17	15-16	≤14

Table 1: Interpretation criteria of antibiotics (CLSI 2012)

RESULTS ANDDISCUSSION:

In appeared new and this study total 30 currency samples (16Notes & 14 Coins) studies for isolation of pathogenic and non pathogenic organisms, five of the currency notes which clean did not grow any microorganisms. From the culture of their 30 currency (notes & coins), 25 different types of microorganisms were obtained via: *Pseudomonas aeruginosa* (40%), Bacillus spps. (8%), E.coli (20%), *Klebsiellaspps*.(20%) &*Staphylococcus aureus* (12%) show in table-1.

Table-2 show gram staining result, these gram staining result fruit vendor are 25% positive and 75% negative milk man and auto-rickshaw are results same, 33.33% positive and 66.66 negative butcher sample are 0% positive and 100% negative, vegetable vendor are 40%positive and 60% negative, whilebus conductor and hospital results are 0% positive and 100% negative and hospital are 0% positive and 100% negative.

Biochemical test characterization for butcher sample, vegetable vendor, fruits vendor, milk man, auto-rickshaw, bus conductor and hospital sample shown in table-3, Gram positive and negative bacteria were identified with the help of biochemical test. Gram negative E. coli were identified by biochemical test kit which includes four biochemical test and gram bacteria was also identified by Indole, MR, VP, Citrate, Oxidize, Catalase and Coagulase test. Indole test are positive for *E.coli* and negative for *Pseudomonaseaeruginosa, Staphylococcus aureus, Klebsiella spp.* and *Bacillusspp*. MR test are positive for *Staphylococcus aureus, E.coli* and negative for

Pseudomonaseaeruginosa, *Klebsiella spp*. And *Bacillus spp*. VP test are positive for *Staphylococcusaureus, Klebsiella spp*. and *Bacillus spp*. and negative for *Pseudomonaseaeruginosa* and *E. coli*. All bacteria are positive for catalase test in these results. Oxidase test are positive for *Pseudomonaseaeruginosa* and negative for *Staphylococcusaureus, E.coli, klebsiella spp.* and *Bacillus spp.* Nitrate test are positive for *Staphylococcus aureus, E.coli, Klebsiella spp.* and *Bacillus spp.* and negative for *Pseudomonaseaeruginosa.* Coagulase test are positive for *Staphylococcus aeruginosa* and negative for *Pseudomonaseaeruginosa, E. coli, Klebsiella spp.* and *Bacillus spp.*

Resistance pattern of all pathogenic Gram negative bacilli and Gram positive organisms were given in Table 4.Three isolates of *Staphylococcus aureus* was on Methicillin-resistant Staphylococcus aureus (MRSA) and all the Gram negative bacilli were resistant to Ampicillin. 5 strains of *E.coli* and 5 strains of *Klebsiella* were resistant to Ampicillin. These two bacteria were found to be sensitive to Gentamicin, Ciprofloxacin and Tobramycin. *Klebsiella* was more resistant to different cephalosporin groups whereas *E.coli* was less resistant. *Pseudomonas* was quite sensitive to Gentamicin, Ciprofloxacin, Tobramycin and cephalosporins.

Bacterial isolates	Total	Number (%)
Pseudomonas aeruginosa	10	40%
Staphylococcus aureus	3	12%
Klebsiellaspps.	5	20%
E.coli	5	20%
Bacillus cereus	2	8%

Table.1: Bacteria isolated from Indian Currency in Rampur

Sample Name	CurrencySample	Gram Characteristics	Microicopic Morphology
Butcher Sample	Note-50	-ve	Bacilli
	Note-20	-ve	Bacilli
	Coin-2	-ve	Bacilli
	Coin-1	-ve	Bacilli
Vegetable Veendor	Note-20	-ve	Bacilli
	Note-100	+ve	Cocci
	Coin-5	-ve	Bacilli
	Coin-2	-ve	Bacilli
	Coin-1	+ve	Bacilli
Fruit Vendor	Note-50	-ve	Bacilli
	Note-20	-ve	Bacilli
	Coin-2	+ve	Cocci
	Coin-1	-ve	Bacilli
Milk Man	Note-50	-ve	Bacilli
	Coin-10	-ve	Bacilli
	Coin-5	-ve	Bacilli
	Note-50	-ve	Bacilli

Auto Rickshaw	Note-10	-ve	Bacilli
	Coin-2	+ve	Bacilli
Bus Conductor	Note-50	-ve	Bacilli
	Coin-5	-ve	Bacilli
	Coin-2	-ve	Bacilli
Hospital	Note-10	-ve	Bacilli
	Coin-5	-ve	Bacilli
	Coin-2	-ve	Bacilli

Table.2: Different Currency (Notes and Coins) Sample of Gram Staining

Sample Name	Currency Sample	Catalase Test	Indole Test	MR Test	VP Test	Oxidase Test	Nitrate Test	Coagulase Test
Butcher Sample	Note-50	+	-	-	-	+	-	-
	Note-20	+	-	-	-	+	-	-
	Coin-2	+	-	-	+	-	+	-
	Coin-1	+	+	+	-	-	+	-
Vegetable Vendor	Note-100	+	-	+	+	-	+	+
	Note-20	+	-	-	-	+	-	-
	Coin-5	+	-	-	+	-	+	-
	Coin-2	+	+	+	-	-	+	-
	Coin-1	+	.	-	+	-	+	-
Fruits Vendor	Note-50	+	-	-	-	-	+	-
	Note-20	+	-	-	-	+	-	-
	Coin-2	+	-	+	+	_	+	+
	Coin-1	+	-	-	-	+	-	-
Milk Men	Note-50	+	-	-	-	+	-	-
	Coin-10	+	+	+	-	-	+	-
	Coin-5	+	-	+	+	-	+	+
Auto Rickshaw	Note-50	+	+	+	-	-	+	-
	Note-10	+	-	-	-	+	-	-
	Coin-2	+	-	-	+	-	+	-
Bus Conductor	Note-50	+	-	-	-	+	-	-
	Coin-5	+	+	+	-	-	+	-
	Coin-2	+	-	-	-	+	-	-
Hospital	Note-10	+	+	+	-	-	+	-
	Coin-5	+	-	-	-	+	-	-
	Coin-2	+	-	-	+	-	+	-

Table.3: Different Currency Sample (Notes and Coins) of Biochemical Test

	AMP		GEN		CIP		CTR		MRP		TOB		PIT	
	S	R	S	R	S	R	S	R	S	R	S	R	S	R
Pseudomonas spp	6	4	7	3	8	2	9	1	9	0	8	2	9	1
Klebsiellaspp	3	2	2	3	4	1	1	4	1	4	5	0	4	1
E.colispp	3	2	4	1	3	2	1	4	1	4	3	2	5	0
Staphylococcus spp	2	1	2	1	2	1	3	0	1	2	3	0	2	1
Bacillus spp	1	1	2	0	1	1	1	1	2	0	2	0	1	1
Total	15	10	17	8	18	7	15	10	14	10	21	4	21	4

Table.4: Antibiotic Sensitivity Pattern of Microbes isolated from Indian Currency Notes

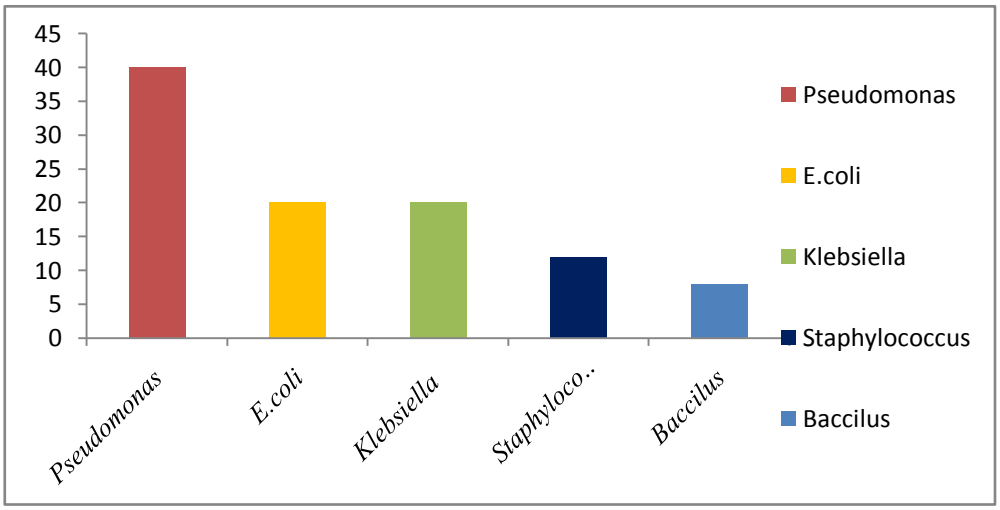

Fig:-1-Distribution of different bacterial isolates in Indian currency

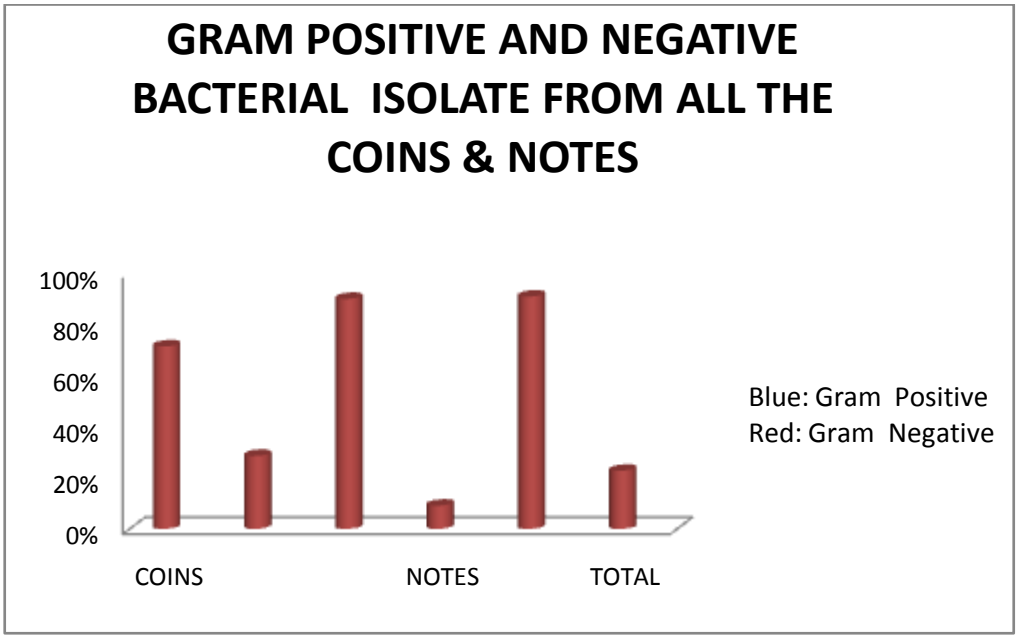

Fig.2: Gram positive and Gram negative bacterial profile of all the coins & notes

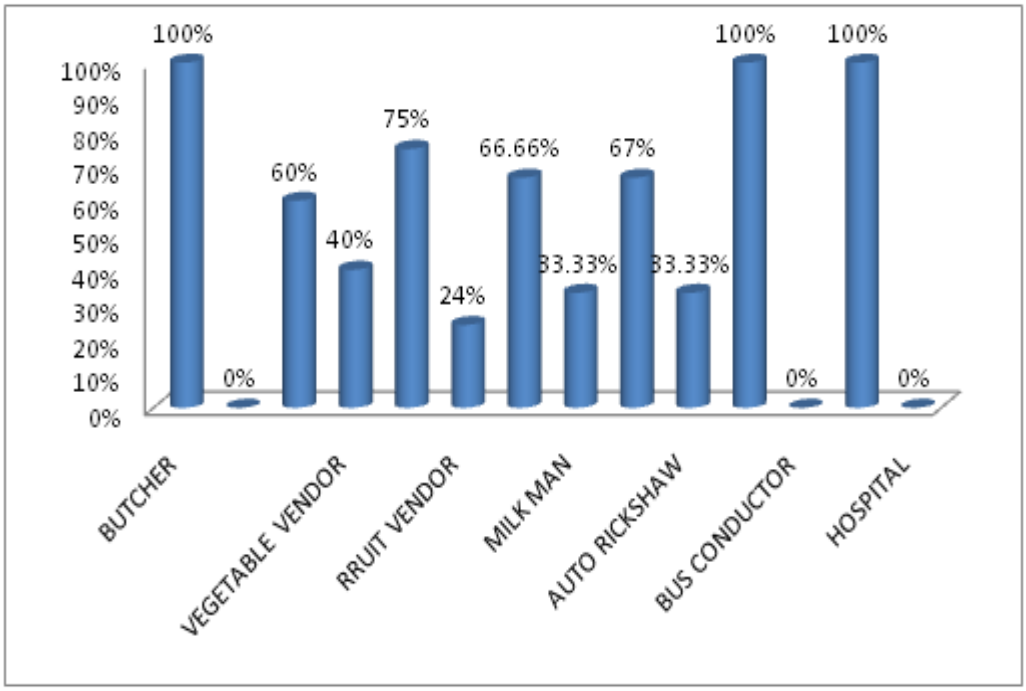

Fig.3: Gram positive and negative bacterial profile of the entire sample

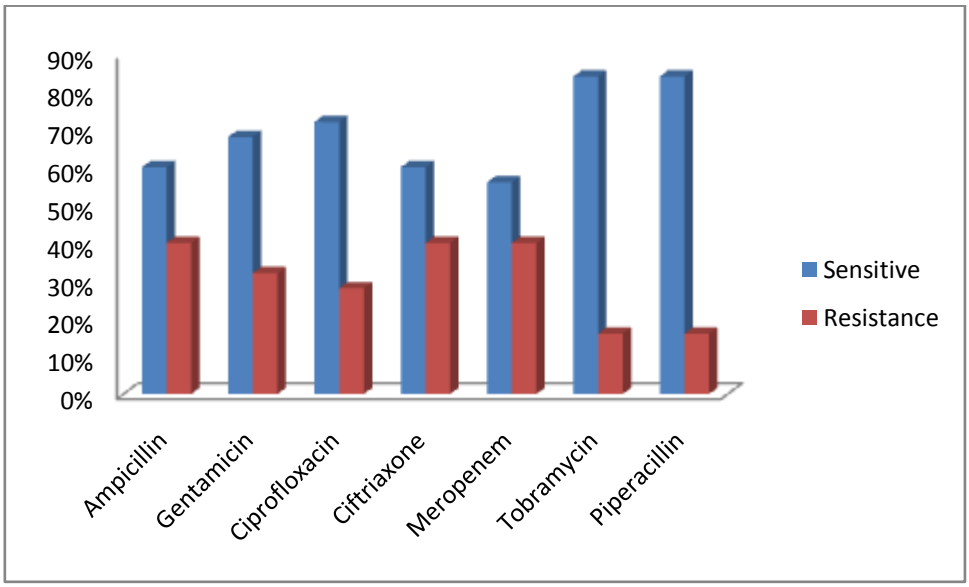

Fig 4: Antibiotic Sensitivity Pattern of Microbes isolated from Indian Currency Notes

Fig 5: Isolated Colonies of different bacteria on Mac Conkey Agar and Nutrient agar Plate

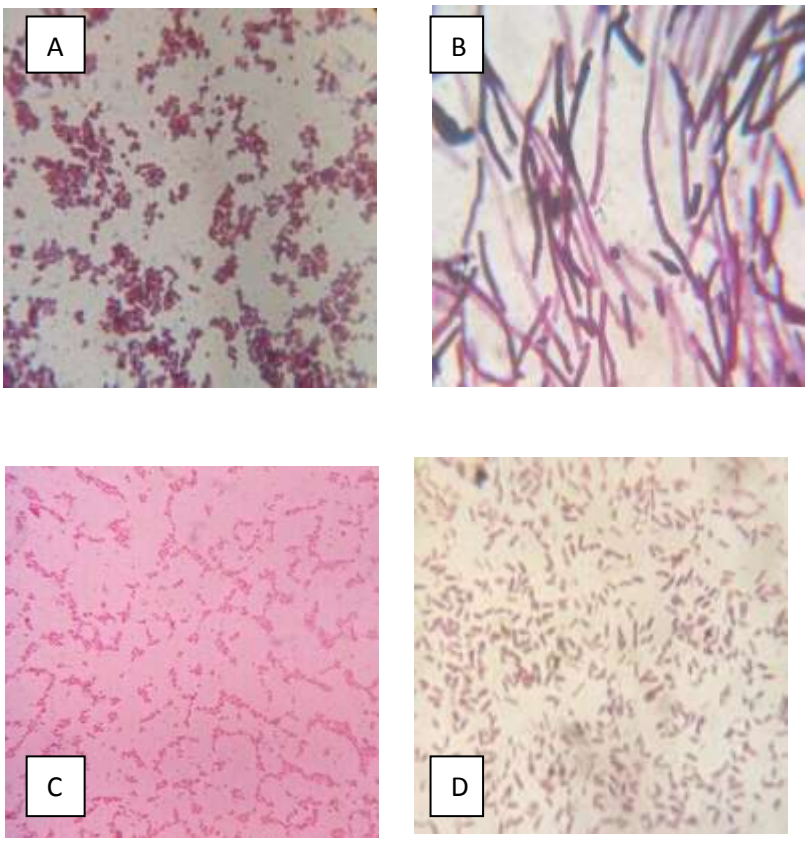

Fig 6: A-D Histomicrographial bacterial Identification (A) *Staphylococcus aureus* (B) *Bacillus spp* (C) *E.coli*(D) *Psuedomonasaeruginosa*

Day today paper in the form of currency notes changes hands frequently. It spreads bacteria which are present on paper currency notes. In our country paper currency notes are mismanaged. Most of the people in India do not keep money in wallets and squeezing of paper currency notes is a usual incidence. In this research a large number of currency notes were infected by *Bacillus spps. A*nd *S. aurous*. The use of lower denomination currency notes is so common in our daily life that notes get ragged and dirty and become more contaminated. Currency notes of both lower and higher denomination than notes those which were in good conditions.

In India, poor currency handing habit is extensive, and there is a random mishandling of currency notes. A great majority of the populace does not carry money in wallets and squeezing of currency notes is a common occurrence. Woman, especially who are uneducated, often keep money under their brassieres, on the other hand men keep it in their socks. In this way currency gets more and more contaminated and the risk of infection from contamination notes may also increase.

In a parallel investigation managedby[7] a total of 176 samples of the investigated 200 one Riyal notes (100 of the 4^{th} version and 100 of the 5^{th} version) had mixed ($\geq$ 2 types) bacterial growth. One hundred percent of the 4^{th} version notes had bacterial contamination, of which 60% were probably pathogenic bacteria: *Staphylococcus aureus, Klebsiella* species, *Pseudomonas* species and *E.coli*. The bacteria isolated from the 4^{th} version notes were: gram positive bacilli, Coagulase-negative *Staphylococci*, viridians group *streptococci* (VGS), and non-hemolytic *Streptococci.*

*Pseudomonas aeruginosa*occurred frequently in the highest forums in this very study (40%) which exhibits the presence of contamination via cross-contamination with raw products or bad personal cleanliness. Mostly insanitary conditions in the open-air markets in rural areas, traders get infected currency notes from the costumers (buyers) in return of the products and goods when contaminated currency notes go from one hand to the other, they may plunge the individuals in to the risk of ingesting enter pathogens (15).Contrary to it isolation of *E.coli* was only (20%) which are in according to the former (previous) researches (16,17). The other isolates found in the present study were *Staphylococcusaureus* (12%) and *Klebsiella spp.* (20%) which lower than the previous reports (18, 16).

CONCLUSION:

There is strong potentiality that money passes through various different hands and could be exhibited to many different environments comparatively high frequency. From the final findings of the present study, we draw the conclusion that Indian paper currency is commonly contaminated with pathogenic bacteria and this contamination may cause different kinds of diseases. We therefore strongly recommend a greater sensitivity in the handling of money. Generally public should be made

aware of avoiding the use of saliva on fingers for counting currency notes to prevent infection caused by contaminated currency; and practicing good personal hygiene should be created in the public. Personal cleanliness minimizes risk of infection so it should be recommended mainly for the people who simultaneously handle food and money.

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