

# Prevalence and Health Implications of Microbial Load of Indian Paper Currencies and Coins

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**Abstract:** Globally, money is one of the items most frequently passed from hand to hand. During its passing, money can get contaminated and may thus play a role in the transmission of microorganisms to other people. Paper currency and coins can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placement on dirty surface. In the present study the following bacterial and fungal species were isolated from various currencies and coins. 28 bacterial isolates were obtained which included *Staphylococcus aureus*-14 (50%), *Klebsiella species*-6 (21.42%), *Escherichia coli*-3 (10.71%), *Bacillus species*-3 (10.71%) *Proteus vulgaris*-1 (3.57%) and *Staphylococcus epidermidis*-1 (3.57%). 46 fungal isolates were obtained which included *Aspergillus niger*-18 (39.13%), *Aspergillus fumigatus*-8 (17.39%), *Rhizopus species*-7 (15.21%), *Penicillium species*-7 (15.21%) and *Aspergillus flavus*-6 (13.03%). 2/14 (21%) were found to be Methicillin-resistant *S. aureus* (MRSA) by cefoxitin disc diffusion method. The antibiogram of bacterial isolates showed considerable resistance to commonly used antibiotics which makes the organisms even more dangerous and capable of causing significant infections which are difficult to treat.

**Key Words:** Currency, Coins, Bacteria, Fungi, Contamination, Antibiogram

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## INTRODUCTION

Money is considered the root of all evils but now it can also be considered to be the root cause of all kinds of infection from bacterial, fungal and to many other organisms. Paper currency is widely exchanged for goods and services in most countries worldwide. Research has shown that paper currency offers a larger surface area as a breeding ground for pathogens [1]. An individual living in unhygienic conditions having unhygienic habits will contaminate the notes with bacteria e.g. habits such as using saliva 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 currencies act as a tool for easy transfer of bacterial and thus cross contamination takes places [2].

Microbes may persist on it for longer periods. The older the paper note the more accumulation of microbes occurs. Several studies have reported contamination of coins and paper currencies with the presence of pathogenic microbes like *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella* and *Enterobacter*. Contamination of objects by pathogenic microorganisms is of much public health concern as contaminated materials can be sources of transmitting pathogens [3]. Knowledge of the microbial diversity of currency notes and coins in circulation can provide the basis for raise health consciousness in people during currency handling and effective control of infection transmission. The present study was taken up to investigate the likelihood of microbial contamination of Indian paper currency notes and coins.

## MATERIALS AND METHODS

### Sample Collection and Processing:

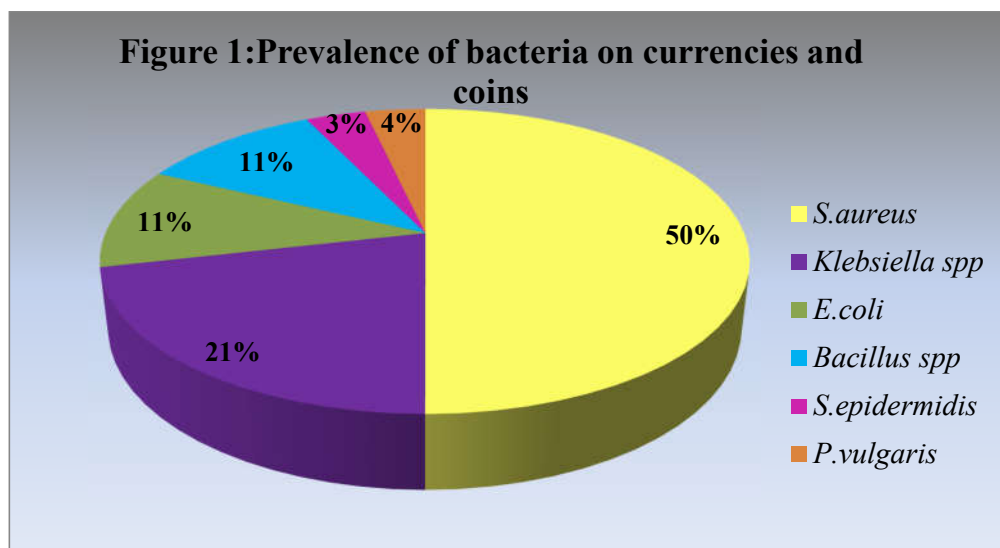
A total of twenty five samples of Indian currencies, comprising paper currency of five denominations (100 rupees, 50 rupees, 20 rupees, 10 rupees and 5 rupees) and coins (5 rupees coins, 2 rupees coins, 1 rupee coins, 50 paisa) were collected. Currency notes and coins were collected in a sterile plastic packet, which was sealed and was transported to the laboratory for microbial analysis [4]. Currencies and coins were obtained from the different occupational groups such as bus conductors, vegetable and fish vendors and from the departmental stores. A sterile, cotton swab moistened with sterile physiological saline was used to swab both sides of the currency note and coins. The swabs were directly inoculated on blood agar, nutrient agar, mannitol salt agar and MacConkey agar. The plates were incubated at 37°C for 24 hrs for bacterial growth [5]. Isolation of fungi was done by inoculating onto Sabouraud’s Dextrose agar and the plates were incubated at room temperature for 24-48 hours. The organisms were further identified based on the biochemical methods as per standard protocols.

### ANTIBIOTIC SENSITIVITY TESTING:

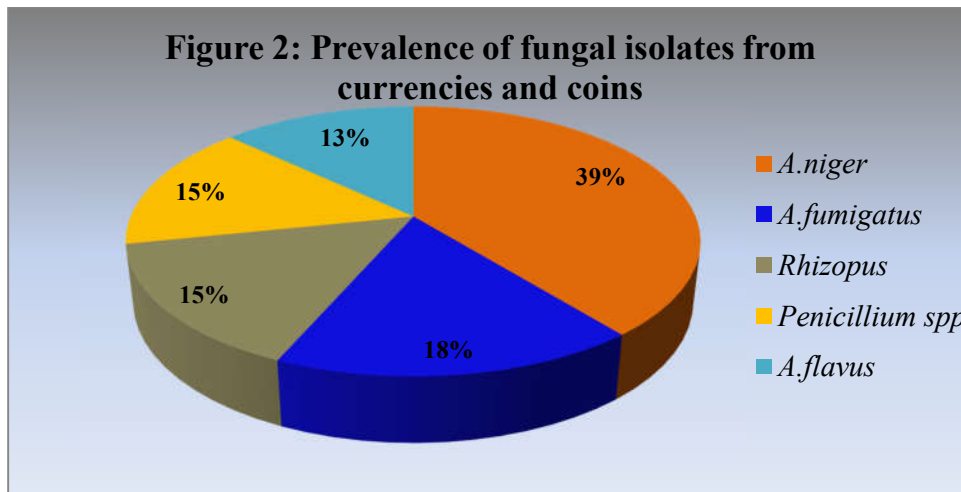
Antibiotic sensitivity testing was carried out by Kirby Bauer disc diffusion method for the following antibiotics- (in µg/disc) [6] ampicillin (10), amikacin (30), ciprofloxacin (5), gentamicin (10), netilmicin (30), norfloxacin (10), rifampicin, nalidixic acid, ceftazidime, ceftoxitin (30) and vancomycin (30).

## RESULTS

In the present study the following bacterial and fungal species were isolated from various currencies and coins. 28 bacterial isolates were obtained which included *Staphylococcus aureus*-14 (50%), *Klebsiella species*-6 (21.42%), *Escherichia coli*-3 (10.71%), *Bacillus species*-3 (10.71%) *Proteus vulgaris*-1 (3.57%) and *Staphylococcus epidermidis*-1 (3.57%). (Figure 1)



46 fungal isolates were obtained which included *Aspergillus niger*-18 (39.13%), *Aspergillus fumigatus*-8(17.39%), *Rhizopus species*-7 (15.21%), *Penicillium species*-7(15.21%) and *Aspergillus flavus*-6 (13.03%). (Figure 2 & Table 1)



**Table1: Percentage of bacterial and fungal isolates from different sources**

S.No	Source of	Percentage of Bacterial Isolates (n=28)	Percentage of fungi Isolates(n=46)
1.	Vegetable vendor	8 (28.5%)	12(26%)
2.	Fish vendor	11(39%)	19(41%)
3.	Departmental stores	3(11%)	6(13%)
4.	Bus conductor	7(25%)	9(19%)

**ANTIBIOTIC SENSITIVITY TESTING:**

The antibiogram of bacterial isolates suggests considerable resistance to commonly used antibiotics. Among the gram positive bacterial isolates, *S. aureus* showed 100% resistance to penicillin. 2/14 (21%) were found to be Methicillin-resistant *S. aureus* (MRSA) by cefoxitin disc diffusion method. The gram positive organisms were found to be highly sensitive to vancomycin (100%) followed by nalidixic acid (96%), ciprofloxacin (92%) and rifampicin (89%). Among the gram negative bacterial isolates highest resistance was exhibited by ampicillin (85%) followed by ceftazidime (68%) and norfloxacin(56%). They were found to be highly sensitive to gentamicin (90%) followed by netilmicin (81%).

**DISCUSSION**

Fomites or inanimate objects play a major role in indirect transmission of infections like diphtheria, trachoma, gastroenteritis, whooping cough and pathogenic agents causing diarrhoea [7]. 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, as it is the most widely handled article by people from all walks of life [8]. Currency is bound to get contaminated either from the environment or from the persons handling it. Paper currency is made of a rugged mix of 75% cotton and 25% linen, and offers surface area for bacteria and microorganisms to reside on both sides [9].

The isolation of bacterial and fungal agents from currency notes and coins from the present study has confirmed that currency might be a vector playing an important role in the transmission of pathogenic microorganisms in the community. Mixed bacteria and fungi were significantly higher in dirty currency than in clean currency. Bacterial agents that can contaminate currency notes, for example, some strains of *Streptococcus* and *Staphylococcus*, are known to have developed resistance to conventional antibiotics [10].

In the present study, 28 bacterial isolates were obtained which included *Staphylococcus aureus*-14 (50%), *Klebsiella species*-6 (21.42%), *Escherichia coli*-3 (10.71%), *Bacillus species*-3 (10.71%) *Proteus vulgaris*-1 (3.57%) and *Staphylococcus epidermidis*-1 (3.57%).

In our study gram positive organisms were found to be the predominant contaminants. However, the isolation of both gram positive and gram negative bacteria indicates that they could be serving as a reservoir of pathogenic organisms. Staphylococci (coagulase negative and *S. aureus*) were the predominant isolates in currency from all sources, an indication of their ubiquitous nature. These organisms are normal flora of the skin and mucous membranes. Coagulase-negative staphylococci have long been regarded as non-pathogenic but their important role as pathogens and their increasing incidence have been recognized and studied in recent years [11].

*Escherichia coli* is an inhabitant of human and animal intestines. The organism comes to the environment through fecal contamination. In our study, enteric pathogens like *E. coli*, *Klebsiella* spp and *P. mirabilis* were isolated from currencies and coins. Their detection in currency is indicative of fecal contamination and poor sanitary conditions of the environment and personal hygiene practices of currency handlers. These results were found to be in agreement with Goktas and Oktay (1992) [12].

*Bacillus* species are spore-forming organisms that inhabit the soil and are ubiquitous in the environment. The isolation of *Bacillus* species from currency shows contamination with soil material [13].

Forty six species of fungi were isolated from both currencies and coins from all sources which included *Aspergillus niger*- 18 (39.13%), *Aspergillus fumigatus*-8(17.39%), *Rhizopus species*-7 (15.21%), *Penicillium species*-7(15.21%) and *Aspergillus flavus*-6 (13.03%). These findings were found to be in consistent with that of Basavajappa (2006) [14], Kalpana (2005) [15]. *Aspergillus* species predominated. *Aspergillus* species produce ochratoxins and aflatoxins. Aflatoxins have been shown to be carcinogenic [16]. In addition, inhalation of spores of their spores may cause aspergillosis making this organism a health threat. *Penicillium* can cause pneumonia. *Rhizopus* is an agent for zygomycosis and eye infections [17,18].

The antibiotic sensitivity testing of the bacterial isolates showed resistance to commonly used antibiotics. MRSA and *Klebsiella* spp. are capable of causing community-acquired and hospital-acquired infections, and are most commonly involved in respiratory tract infections [19&20]. The antibiotic sensitivity pattern of these two organisms isolated also showed resistance to some of the most commonly used antibiotics, which makes these organisms even more dangerous and capable of causing significant infections which are difficult to treat.

## CONCLUSION

Money handled by various dealers may act as a route for the transmission of organisms which may include both commensals and pathogenic microorganisms. In this study currencies and coins were contaminated with both bacteria and fungi. Smaller unit notes appeared to be more highly contaminated than larger unit notes, probably because the smaller unit notes are most frequently handled in petty, daily monetary transactions and are often tattered and dirty. The antibiotic sensitivity testing of the bacterial isolates showed resistance to commonly used antibiotics which makes these organisms difficult to treat.

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