

Original Research

Microbial contamination of Indian currency notes in circulation

Authors:

Pradeep NV¹, Anupama¹,
Marulasiddaiah BS²,
Chetana M², Gayathri P²,
Maduri SN².

Institution:

1. Asst Professor,
Department of
Biotechnology, Ballari
Institute of Technology
and Management,
Bellary-583101, India.

2. B.E Scholar, Department
of Biotechnology, Ballari
Institute of Technology and
Management,
Bellary-583101, India.

Corresponding author:

Pradeep NV.

Email:

nagamallivpradeep@gmail.com

Phone No:

07760251535.

Web Address:

[http://jresearchbiology.com/
documents/RA0243.pdf](http://jresearchbiology.com/documents/RA0243.pdf)

ABSTRACT:

Paper currency, an exchangeable fomite, is constantly subjected to contamination. The objective of this study was to identify the micro-organisms present on the currency notes circulating in India. A total of 12 currency notes (Rs.10, Rs.50 and Rs.500) were randomly collected from bank, Municipal Corporation, food sellers, butchers, hospital. Persons handling the notes were asked to deposit them in sterile envelopes. The notes were taken to the laboratory immediately and microorganisms were identified using standardized microbiological techniques. All the notes collected during this study were contaminated by micro-organisms. Species isolated were *Escherichia coli*, *klebsiella pneumonia*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*. The currencies used by public (bank, hospital, Municipal Corporation) in India were found to be extremely contaminated with various pathogenic bacteria followed by the currency used by butchers and food sellers. Infected currency was identified as a potential public health hazard, as pathogens could spread by circulating the contaminated notes. We recommend that currency notes must be handled with caution.

Keywords:

Indian currency notes, pathogenic microorganisms, contamination.

Article Citation:

Pradeep NV, Anupama, Marulasiddaiah BS, Chetana M, Gayathri P, Maduri SN.
Microbial contamination of Indian currency notes in circulation.
Journal of Research in Biology (2012) 2(4): 377-382

Dates:

Received: 18 May 2012 **Accepted:** 25 May 2012 **Published:** 07 Jun 2012

This article is governed by the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0>), which gives permission for unrestricted use, non-commercial, distribution and reproduction in all medium, provided the original work is properly cited.

INTRODUCTION

Microorganisms are known to spread via air, water, food etc. an important mechanism of the spread of pathogens by fomites. Paper currency is widely exchanged for goods and services in countries worldwide (Felgo and Nkansah 2010; Alwakeel and Naseer, 2011). It is used for every type of commerce. Accumulated data obtained over the last 20 years on the microbial status and survival of pathogen on coins and currency notes indicate that this could represent a potential cause of sporadic cases of food borne illness. The paper/polymer currency notes and coins may harbor various deadly pathogenic microorganisms. Currency in the form of notes represent a universal medium for the transmission of bacteria in the environment and among humans. There is a possibility that currency notes might act as environmental vehicles for the transmission of potential pathogenic microorganisms (Prasai T *et al.*, 2009).

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 acts as a tool for easy transfer of bacterial and thus cross contamination takes places (Sushil Kumar *et al.*, 2011).

Research has shown that paper currency offers a larger surface area as a breeding ground for pathogens (Ayandele and Adeniyi, 2011). Microbes may persist on it for longer periods. The older the paper note the more accumulation of microbes occurs (Ghamdi AL *et al.*, 2011).

The possibility that currency notes might act as environmental vehicles for transmission of potential pathogenic microorganisms was suggested in 1970's. Various pathogens related with throat infection, pneumonia, tonsillitis peptic ulcers, urino-genital tract infection, gastro enteritis and lung abscess had been reported (Saeed and Rasheed, 2011).

Researchers at the Regional Sophisticated Instrumentation Center (RSIC) at the North Eastern University in Shilong, India, who examined Indian banknotes, found germs which can cause tuberculosis, meningitis, tonsillitis, peptic ulcers, throat infections, genital tract infections etc (Nagesh Bhat *et al.*, 2010).

Studies of the contamination of money with microbial agents is lacking in most developing countries. Shortage of information may contribute to the absence of public health policies regarding currency usage, handling, and circulation (Ghamdi-AL *et al.*, 2011).

Lower-denomination notes receive the most handling because they are exchanged more often. Money may serve as an unrecognized reservoir for pathogenic and non-pathogenic bacteria. One type of pathogenic bacteria that represents a threat is enteric bacteria (Oo *et al.*, 1989).

MATERIALS AND METHODS

Sample collection

A total of 12 currency notes were randomly collected from people like butchers, food sellers, bank, hospital and municipal corporation workers. The currency collected and used were Rs.10, Rs.50 and Rs.500. To collect the currency notes, the individuals were asked to drop currency or money into a sterile plastic packet, which were sealed and immediately transported to the lab for microbial analysis (Saeed and Rasheed, 2011).

Isolation of Microbes

A sterile cotton swab was dipped in the sterile distilled water and rubbed on both the surfaces of currency note and used to inoculate onto the nutrient agar and potato dextrose agar (PDA) for each note. The plates were incubated at 37°C for 24 hours. After 24 hours the plates were observed for bacterial colonies (Kawo *et al.*, 2009).

Morphological and biochemical characterization of the isolates

The bacterial isolates were characterized on the basis of their morphology, staining and biochemical tests. These tests were carried out according to the methods prescribed by Cappucino and Sherman (2007). Gram's staining was carried out to ascertain the morphology and Gram's reaction-behaviour of the bacterial isolates. In addition, the following biochemical tests were carried out: MR (methyl red) test, VP (Voges-Proskauer) test, Indole production test, Catalase test, Citrate utilization test, Starch hydrolysis test and Gelatin hydrolysis test.

RESULTS

Microbial examination was carried out for 12 currency notes in which all the currency notes were contaminated with microorganisms. Bacterial concentration was found to be high in butcher and municipal corporation samples when compared to bank samples.

Gram staining results for Butcher, Municipal Corporation, Food seller, Hospital and Bank samples are as shown in Table 1, 2, 3, 4 and 5.

Biochemical characterization for Butcher, Municipal Corporation, Food sellers, Hospital, and Bank samples are shown in Table 6, 7, 8, 9 and 10.

Bacteria isolated from bank, butcher, Municipal Corporation, hospital and food seller sample are pathogenic. Based upon the morphology, gram staining and biochemical characterization, the micro-organisms found may be *Staphylococcus aureus*, *Klebsiella pneumoniae*, *E.coli* and *Pseudomonas aeruginosa*.

DISCUSSIONS

In India, poor-currency-handling culture is widespread, and there is an indiscriminate abuse of currency notes. A great majority of the populace does not

Table No.1: Butcher sample.

Bucher Sample	Gram character	Microscopic morphology
Rs.10	-ve	Bacilli
Rs.50	+ve	Cocci
Rs.500	-ve	Cocci

Table No. 2: Municipal corporation sample.

Municipal Sample	Gram character	Microscopic morphology
Rs.10	+ve	Bacilli
Rs.50	-ve	Bacilli

Table No. 3: Food seller's sample.

Food Seller's Sample	Gram character	Microscopic morphology
Rs.10	+ve	Bacilli
Rs.50	-ve	Bacilli

Table No. 4: Hospital sample.

Hospital Sample	Gram character	Microscopic morphology
Rs.10	+ve	Bacilli
Rs.500	-ve	Cocci

Table No. 5: Bank sample.

Bank Sample	Gram character	Microscopic morphology
Rs.10	-ve	Bacilli
Rs.50	-ve	Bacilli
Rs.500	-ve	Bacilli

carry money in wallets and squeezing of currency notes is a common occurrence. Women, especially among the unenlightened, often place money underneath their brassieres, while men place it in their socks. These activities not only enhance currency contamination but may also increase the risk of infection from contaminated notes.

In a similar study conducted by Ghamdi-AL *et al.*, (2011) a total of 176 samples of the examined 200 one Riyal notes (100 of the 4th version and 100 of the 5th version) had mixed (≥ 2 types) bacterial growth. One hundred percent of the 4th version notes had bacterial contamination, of which 60% were potentially pathogenic bacteria: *Staphylococcus aureus*, *Klebsiella* species, *Pseudomonas* species and *Escherichia coli*. The bacteria isolated from the 4th version notes were: gram-positive bacilli,

Table No. 6: Butcher sample.

Bucher Sample	Catalase	MR	VP	Citrate	Gelatin	Starch	Indole
Rs.10	+ve	+ve	-ve	-ve	+ve	-ve	-ve
Rs.50	+ve	+ve	-ve	-ve	+ve	-ve	-ve
Rs.500	+ve	+ve	-ve	-ve	+ve	-ve	-ve

Table No. 7: Municipal corporation sample.

Municipal Sample	Catalase	MR	VP	Citrate	Gelatin	Starch	Indole
Rs.10	+ve	+ve	-ve	-ve	+ve	-ve	-ve
Rs.50	+ve	+ve	-ve	-ve	+ve	-ve	-ve

Table No. 8: Food seller's sample.

Food Seller's Sample	Catalase	MR	VP	Citrate	Gelatin	Starch	Indole
Rs.10	+ve	-ve	+ve	-ve	-ve	-ve	-ve
Rs.50	+ve	-ve	+ve	+ve	-ve	-ve	-ve

Table No. 9: Hospital sample.

Hospital Sample	Catalase	MR	VP	Citrate	Gelatin	Starch	Indole
Rs.10	+ve	-ve	+ve	-ve	-ve	-ve	-ve
Rs.500	+ve	+ve	-ve	+ve	-ve	-ve	+ve

Table No. 10: Bank sample.

Bank Sample	Catalase	MR	VP	Citrate	Gelatin	Starch	Indole
Rs.10	+ve	+ve	-ve	-ve	-ve	-ve	+ve
Rs.50	+ve	+ve	-ve	+ve	-ve	-ve	-ve
Rs.500	+ve	+ve	-ve	+ve	-ve	-ve	+ve

coagulase-negative *staphylococci*, viridans group *streptococci* (VGS), and non-hemolytic *streptococci*.

Janardan et al., (2009) in their study isolated bacteria from Nepal currency notes. The microorganisms were coagulase-negative *Staphylococcus*, alpha-hemolytic *Streptococcus*, *Enterobacter* species, *Acinetobacter* species, non-aeruginosa species of *Pseudomonas*, *Bacillus* species, *Alcaligenes* species, diphtheroids, and *Escherichia vulneris*, which do not typically cause infections in healthy people rather they were known to cause significant infections in those with depressed immune systems, including those infected with HIV, undergoing cancer chemotherapy, or taking other medications that depress the immune system. Those bacteria may also cause infection in hospitalize patients.

Igumbor et al., (2007) tested 240 banknotes for microbial contamination. All the notes were contaminated by bacteria or fungi. 84-100% of all the banknotes obtained from the various sources were

contaminated with bacteria. 12 different bacterial species were isolated, with the most common isolates being *Staphylococcus epidermidis*, *Klebsiella* species, *Staphylococcus aureus* and *E.coli*. Only one fungus, *Candida albicans*, was isolated.

Ahmed et al., (2010) suggested that the Bangladesh paper currency commonly contaminated with pathogenic microorganisms and this contamination may play a significant role in the transmission of potentially harmful microorganisms or different diseases such as cholera, diarrhea, skin infections and also poses antibiotic resistant.

CONCLUSION AND RECOMMENDATIONS

From this study it can be concluded that Indian currency is commonly contaminated with pathogenic bacteria and this contamination may play a significant role in the transmission of infectious diseases. Compared to butcher, municipal, hospital and food seller's sample,

the bank sample was less contaminated and the recommendations are as below:

- It is recommended that currency notes must be handled with caution and great care especially during the preparation and handling of food to avoid contamination.
- Personal hygiene to reduce risk of infection is recommended especially for those who simultaneously handle food and money.
- Food sellers and butchers, and other common people should be educated to avoid possible cross contamination between currency notes and food.
- There should be public awareness of the fact that currency notes could be a source of infection and could be dangerous to health.
- Regular microbial testing of currency notes and establishment of method for large scale replacement of contaminated currency should be employed.
- Introduction of plastic currency notes which can be washed easily as in Australia can serve as an alternate.

REFERENCES

Ahmed, Parveen S, Nasreen T and 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 and Naseer AL. 2011. Bacterial and fungal contamination of Saudi Arabian paper currency and cell phones. *Asian journal of biological sciences*. 4(7):556-562.

Ayandele AA and Adeniyi SA. 2011. Prevalence and antimicrobial resistance pattern of micro organisms isolated from Naira notes in Ogbomoso North, Nigeria. *Journal of Research in Biology*. 8:587-593.

Cappucino and Sherman. 2007. Microbiology- A laboratory Manual, 8th edition. Benjamin Cummings

Publisher.

Felgo P and Nkansah M. 2010. Bacterial load on Ghanaian currency notes. *African Journal of Microbiology*. 4(22):2375-2380.

Ghamdi-AL AK, Abdelmalek SMA, Bamaga MS, Azharl EI, Wakid MH and Alsaied Z. 2011. Bacterial contamination of Saudi ONE Riyal paper notes. 42:711-716.

Igumbor EO, Obi CL, Bessong PO, Potgieter N and Mkasi TC. 2007. Microbiological analysis of banknotes circulating in the Venda region of Limpopo province, South Africa. *South African Journal of Science*. 103:365-366.

Janardan L, Adhikary S, Gautam P, Maharjan R and Dhakal B. 2009. Risk of handling paper currency in circulation chances of potential bacterial transmittance. *Nepal Journal of Science and Technology*. 10:161-166.

Kawo AH, Adam MS, Abdullahi BA and Sani NM. 2009. Prevalence and public health implications of microbial load of abused Naira notes. *Bayero Journal of Pure and Applied Sciences*. 2(1):52-57.

Nagesh B, Bhat S, Asawa K, Agarwal A. 2010. An assessment of oral health risk associated with handling of currency notes. *International Journal of dental clinics*. 2(3):14-16.

Oo KN, Win PP, Han AM, Aye T. 1989. Contamination of currency notes with enteric bacterial pathogens. *J Diarrhoeal Dis Res.*, 7:92-94.

Prasai T, Yami DK and Joshi RD. 2009. Microbial load on paper/polymer currency and coins. *Nepal Journal of Science and Technology*. 9:105-109. (3173-10991-1-PB.pdf)

Saeed S and 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.

Sushil Kumar B, Verma S and Verma KB. 2011.

Coliform contamination on different paper currency in Ajmer, Rajasthan, India. *Universal Journal of Environmental Research and Technology*. 1:552-556.

Submit your articles online at jresearchbiology.com

Advantages

- **Easy online submission**
- **Complete Peer review**
- **Affordable Charges**
- **Quick processing**
- **Extensive indexing**
- **You retain your copyright**

submit@jresearchbiology.com

www.jresearchbiology.com/Submit.php