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Currency: A contagion

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ABSTRACT

Background

We always talk about transmission of diseases through air, water, food and vectors like mosquitoes and rodents due to unhygienic habits and so on, but Currency is not thought of as a Contagion.

Objectives

The objectives of this study were:

1. **To find out whether currency is a carrier of pathogens**
2. **To find out whether currency can transmit diseases**
3. **What denomination of notes has the highest contamination?**

Methodology

A total of 10 currency notes, two of each denomination of Rs.10, Rs. 20, Rs.50, Rs. 100, Rs.500. were randomly collected aseptically, in sterile envelopes from different vendors, and immediately taken to Dr. Prabhakar Kore Basic Science Research Centre, KLE Academy of Higher Education and Research (BSRC KAHER). The currency notes were then subjected for isolation procedure. After which, they were added to sterile double distilled water and kept for 2-3 minutes. Next, with currency note treated water, plating (inoculation) was done on BHI agar and incubated at 37oC for 24-48hrs. The plates were then observed for bacterial growth and Calculation of Colony forming units (CFU) per ml of sample was done. The colonies were picked by using sterile inoculation loop and processed for colony morphology, biochemical tests like gram staining for the identification of microorganisms to differentiate between gram positive and gram negative bacteria. Colonies were further tested for coagulase and catalase test.

Result

Stained smear showed gram positive cocci and gram negative bacilli. Coagulase test, was negative indicating presence of coagulase negative *Staphylococcus species* and catalase test was positive indicating presence of *Pseudomonas species*. Further, Rs 10 Notes had colony formation of 18 x 108 CFU/ml. Rs 20 had colony formation of 9 x108CFU/ml and Rs 100 which had colony formation of 6 x108CFU/ml.

Conclusion

We conclude currency notes are contaminated with *Pseudomonas* and *Staphylococcus species* which are infectious and hence currency notes are carriers of pathogen and potential mode of transmission of disease. Lower denomination currency notes had more number of bacterial colonies as compare to higher denominations.

Keywords: Currency, Contagion, Infection

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INTRODUCTION

In modern society even to purchase the basic needs like water and food, currency is a must. We always talk about transmission of diseases through air, water, food and vectors like mosquitoes and rodents due to unhygienic habits and so on, but many times we witness road side vendors turning the currency notes by applying the most sophisticated lubricant that is their saliva. On observing this a question arises in our little mind that: **Are we not transferring disease by currency?** This question pestered us to find out an answer. With inquisitiveness we started our project. On reviewing literature we found that researchers from New York University have found 3,000 bacteria types on the surface of dollar bills.[1] Another study in France has shown the potential of paper currency and coins as sources of pathogenic agents. They found Staphylococcus aureus, Salmonella species, Escherichia coli and S. aureus.[2] In India too in Lucknow a study conducted by microbiology department of King George' Medical University currency is contaminated with microbes and this contamination may play a role in disease transmission.[3]

HYPOTHESIS

We hypothized that currency is a carrier of pathogens.

OBJECTIVES

1) To find out whether currency is a carrier of pathogens
2) To find out whether currency can transmit diseases
3) What denomination of notes has the highest contamination?

MATERIAL AND METHODS

Collection of Currency Notes

A total of 10 currency notes, two of each denomination of Rs.10, Rs, 20, Rs.50, Rs 100, Rs.500, were randomly collected aseptically in sterile envelopes from BSRC KLE Academy of Higher Education and Research.

Procedure

The currency notes were taken to BSRC KAHER immediately. They were then subjected for isolation procedures. The currency notes were added to sterile double distilled water and kept for 2-3 minutes. This currency note treated water was then plated on BHI agar plates. BHI agar is a nutrient rich agar which is prepared by infusion from porcine heart and brain. The culture media plates were kept for incubation at 37 °C for 24-48 hours. Which is the optimum temperature and time period for growing microorganisms. The plates were then observed for bacterial growth and colonies were observed and counted per ml of sample. The colonies were picked by using sterile wire loop and smeared on glass slide by using normal saline and processed for gram staining for the identification of microorganisms to differentiate between gram positive and gram negative bacteria. Each procedure was repeated three times for validation.

Flowchart

Isolation of bacteria from Indian currency notes

The currency notes are collected from different vendors, Auto drivers etc.

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The currency notes are collected and transferred aseptically to laboratory (BSRC)

↓

The currency notes are subjected for isolation procedures

↓

Currency notes added to sterile double distilled water and kept for 2-3 min

↓

(Serial Dilution technique)

The currency note treated water is plated on BHI (Brain heart infusion) agar plates

↓

The media plates were kept for incubation at 37°C for 24-36 hrs

↓

The plates were observed for bacterial growth

↓

Growth on BHI Plates was observed the colonies were picked and processed for staining (Gram staining) and Morphological characters of colonies

The gram staining procedure was as follows:

1) Fixation: This is the process in which we prepare the smear by diluting the colony with a drop of normal saline on a sterile dry slide. After which it is passed through a flame 1-2 times for heat fixation.
2) Primary stain: in this step we add a few drops of crystal violet and let it stay for 1 minute. Rinse with H_2O. Gram positive bacteria's have thin cell wall therefore crystal violet penetrates into the cell, whereas gram negative bacteria's have thick cell walls therefore it resist the crystal violet resulting in staining of only cell wall.
3) Mordant: which is also called as Iodine treatment. In this step we add a few drops of Gram's Iodine. Rinse with water. It makes the bond between dye and cell. Letting it penetrate through gram positive and add a layer to gram negative.
4) De-colorization: in this step the bacteria are de-colorized with the use of Acetone for 2-3 seconds. Rinse with water. Gram positive bacteria will not change the color and remain violet whereas gram negative bacteria will turn transparent or colorless.
5) Counter stain: in this step we use a few drops of safranin by which gram negative will take pink color and gram positive will resist the pink and stay as usual.

Importance of Gram Stain:

Gram staining differentiates gram positive and gram negative micro-organisms. Gram positive cocci are oval in shape, violet in color and arranged as a single, pair, chains and clusters and gram negative bacilli are rod in shape, pink in color and arranged in the form of single, pairs, groups and chains

Biochemical Tests

These tests are used for the identification of bacterial species based on the differences in the biochemical activities of different bacteria.

Coagulase Test

The gram positive cocci colonies were further tested for coagulase test.

Slide Coagulase Test

Procedure: a few colonies of bacteria are emulsified in a drop of normal saline on a clean glass slide and mixed with a drop of human plasma.
Result: prompt clumping of the suspension.
Interpretation: coagulase test positive

Tube Coagulase Test

Procedure: growth of organism is mixed with 0.5 ml of a 1 in 5 dilution of human plasma, the tubes were incubated in a water bath as incubator at 37^{o} C for 3 -6 hrs.
Result: plasma clots does not flow when the tube is inverted.
Interpretation: coagulase test positive.

Catalase Test

The gram negative bacilli colonies were tested for catalase test.
Principal: certain bacteria have an enzyme catalase which act on hydrogen peroxide to release oxygen.
Procedure: pick a few colonies with platinum loop or wooden stick from a BHI agar, mix it in a drop of hydrogen peroxide on a clean glass slide or test tube.
Result: gas bubbles are formed immediately.
Interpretation: catalase test positive.

Counting of Colonies:

Colony formation on BHI plates for each denomination were observed and counted.

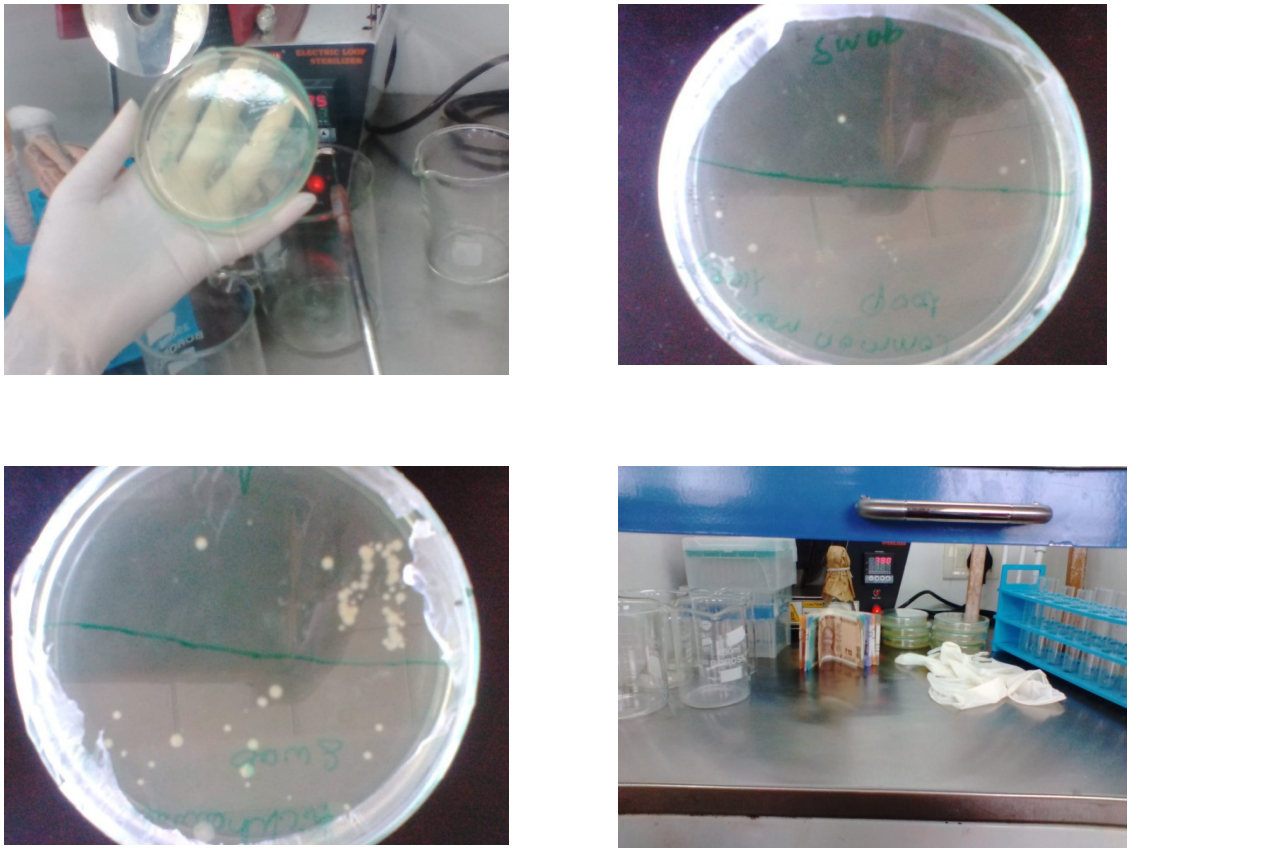

Fig 1 Isolation Photos

RESULTS

Microscopic examination: When we observed the colonies after gram staining. We saw that gram positive bacteria were cocci which are oval in shape, violet in color and were found in clusters, single and in pairs. Gram negative bacteria they were bacilli which are rod in shape, pink in color and were found in groups, chains, pairs and single.

Biochemical Test

By the Slide coagulase test procedure, we observed there is no prompt clumping of the suspension and by the tube coagulase test we observed there is no plasma clots when the tube is inverted indicates coagulase test negative. *This indicates presence of coagulase negative staphylococcus species.*

By the catalase test we observed when colonies treated with hydrogen peroxide we observed gas bubbles are formed immediately it indicates catalase positive *indicating presence of pseudomonas species.*

The inference is drawn that the isolated colonies belong to *Pseudomonas species* and *Staphylococcus species*.

Table 1 Morphology and Biochemical Properties

S. No	Morphology and Biochemical	Biochemical	Species name
1.	Motile, Flagellated and Gram negative rods	Catalase positive	*Pseudomonas* species
2.	Gram positive, and Cocci shaped	Coagulase negative	*Staphylococcus* species

Calculation of Colony Forming Units (CFU)

Lower Denomination i.e Rs 10 Notes had colony formation of 18 x 10^8 CFU/ml as compared to Rs 20 and Rs 100 which had colony formation of **9 x10^8CFU/ml and 6 x10^8CFU/ml** respectively.

Table 2 Calculation of Colony Forming Units (CFU) per milliliter of sample

S. No	10 rupee Note	20 rupee Note	100 rupee Note
CFU/ml	18x10^8CFU/ml	9 x10^8CFU/ml	6 x10^8CFU/ml

CONCLUSION

We concluded that currency notes are carries of various pathogens like staphylococcus and pseudomonas species which can cause infectious diseases like skin, eye, respiratory and gastrointestinal infections and which can also transmit from one person to another. One way to prevent transmission of these diseases is by doing cashless transactions with BHIM, Tej App, PhonePe, Paytm, payphone etc. Regular hand wash however remains the best method of maintaining hygiene and good health.

RECOMMENDATION

1) Disseminate information on Currency a Contagion as widely as possible.
2) Teach small vendors how to use BEAM, Paytm or other mobile apps for cashless transactions.
3) We suggest to the Govt. to make all banks to install money laundering machines.

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