



Investigation of Surface Microbial Contamination on Indian Currency Notes and Coins

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Abstract

Currency notes and coins are among the most frequently exchanged objects in daily life and can serve as potential carriers of pathogenic microorganisms. The present study was conducted to investigate the microbial contamination associated with Indian currency notes and coins collected from different public locations, including vegetable markets, grocery shops, milk parlours, and public bus conductors. A total of thirty-two currency samples were collected and analyzed using standard microbiological techniques. The samples were cultured on nutrient agar media and incubated under suitable laboratory conditions to observe microbial growth. The results revealed that all currency samples were contaminated with microorganisms, indicating widespread microbial presence on circulating money. Currency notes showed a comparatively higher microbial load than coins due to their porous surface and frequent handling. The highest contamination was observed on ₹10 and ₹20 notes collected from vegetable markets and public transport sources. Morphological, microscopic, and biochemical characterization identified several bacterial and fungal isolates. The major bacterial species included *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus spp.*, while fungal isolates mainly belonged to *Aspergillus* and *Penicillium species*. The study highlights the role of currency as a potential source of microbial transmission and emphasizes the

importance of proper hand hygiene and safe currency-handling practices. Public awareness regarding the health risks associated with contaminated currency can help reduce the spread of infectious microorganisms.

Keywords: Currency notes, Coins, Microbial contamination, *Staphylococcus aureus*, *Escherichia coli*, Public health, Hygiene.



1. Introduction

Money is one of the most commonly used object in daily life and continuously passes through many hands during transaction. In India, currency notes and coins are widely used in markets, grocery shops, public transport, milk parlour and other public places .Due to frequent handling under different hygiene condition, currency becomes contaminated with dust, moisture, sweets, food particles and microorganisms. Therefore Indian currency can act as a potential source for the transmission of harmful microbes.(Vriesekoop et al., 2010)

Microorganisms such as bacteria and fungi are present everywhere in the environment and some of them can cause diseases in humans. Poor hygienic practices like handling money with unwashed hands, coughing or sneezing while exchanging currency, and storing money in dirty places increase microbial contamination on currency surfaces. Old, torn, dirty, and moist currency notes usually carry higher microbial load because their fibrous surfaces support microbial attachment and survival. Coins may also become contaminated through repeated handling by different individuals. (Ahmed et al., 2010)

Several studies have reported the presence of microorganisms such as *Staphylococcus aureus*, *Escherichia coli*, *Bacillus spp.*, *Pseudomonas spp.*, and fungal species like *Aspergillus* and *Penicillium* on currency notes and coins. These microorganisms may spread from contaminated currency to human hands and subsequently to food, water, or other surfaces, increasing the risk of infections and cross-contamination. (Kuria et al., 2009)

The present study focuses on the isolation and identification of microorganisms present on Indian currency notes and coins collected from different public places. This study helps in understanding the microbial contamination associated with currency handling and highlights the importance of proper hygiene practices to reduce the spread of infectious microorganisms.

2. Methodolgy

2.1 Sample collection

Samples were collected from different sources of bus conductor, vegetable market, milk parlour, glocery shops . Samples were collected in sterile polythene bags using Nitrile gloves (Snehalatha et al., 2016). Samples collected were carried to the lab within 24 hours for further processing. Four different denomination that includes Rs 2, Rs 5, Rs 10, Rs 20 (notes and coins of two each) were collected. (Hosen et al., 2006).

Figure 1. Indian currency notes and coins used for the isolation and identification of microorganisms from circulating currency.





Table 1. Details of Indian currency samples collected from vegetable markets, grocery shops, milk parlours, and public bus conductors for microbiological examination.

Locations	Rs 10 Note	Rs 20 Note	Rs 2 Coin	Rs 5 Coin
Local vegetable market	2	2	2	2
Local grocery shop	2	2	2	2
Public bus conductor	2	2	2	2
Milk parlour	2	2	2	2

2.2 Isolation of microorganism present on Indian currency

For bacteria cotton swab moistened with sterile physiological saline was used to save both side of currency notes and coins. This swab was streaked onto the nutrient agar plates and prepare a loan culture on the nutrient agar plates. These plates are incubated at 37°C for 24 hours for isolated colonies. From nutrient Agar colonies were subculture on macconkey agar and incubator at 37 ° C for 24 hours. Mainly Macconkey Agar was used to differentiate the microbes due to lactose fermentation (Neel R .2012) and the examined for bacterial growth according to standard protocol describe previously. (Cheese rough,2000).

For fungi, Cotton swag moistened with sterile physiological saline was used to swab both sides of the currency notes and coins. The swab was inoculated into the Saboudard's Dextrose Agar (SDA) plates and incubated for 3-4 days at room temperature. (Onion et al.,1981).

2.3 Identification of isolated microorganism

Identification of bacteria - The isolated bacteria were examined microscopically by using gram staining procedure for referred to a gram Positive bacteria or gram negative bacteria. (Brown et al.,2005). For biochemical identification, the colonies were taken from macconkey agar for negative test bacteria. Then the colonies were subjected to biochemical test which include catalyst, coagulase and oxidase test for identification of bacteria. These test were carried out according to (Forbes et al.,2002). The organism were identified based on the biochemical characteristics and colony morphology.

Identification of fungi- The isolated colonies were subjected to Lacto phenol cotton blue (LPCB) test. The fungal species were identified with the help of microscope (Neel et al., 2012). Then the colonies were identified based on the colony morphology and lacto phenol cotton blue methods and other standard protocol. (Sangeeta et al., 2016).

3. Result

A total of 32 Indian currency samples, including ₹10 notes, ₹20 notes, ₹2 coins, and ₹5 coins, were collected from various public locations such as vegetable markets, grocery shops, milk parlours, and public bus conductors. Two samples of each denomination were obtained from every location and subjected to microbiological analysis to assess the extent of microbial contamination.

Following incubation on nutrient agar medium, all currency samples exhibited microbial growth, indicating that both notes and coins were contaminated with microorganisms. However, the degree of contamination varied among the different denominations and sources. Currency notes showed a comparatively higher microbial load than coins, which may be attributed to their porous surface and frequent circulation among individuals. Among the samples analyzed, ₹10 and ₹20 notes collected from vegetable markets and public transport sources exhibited the highest levels of bacterial growth, suggesting extensive handling and exposure



to unhygienic conditions. Although microbial contamination was also detected on coins, the number of colonies observed was relatively lower than that recorded on paper currency.

Morphological examination of the colonies revealed considerable diversity in colony characteristics, including variations in size, shape, pigmentation, and texture. Circular, irregular, creamy-white, yellowish, and translucent colonies were observed on the culture plates. Gram staining analysis confirmed the presence of both Gram-positive and Gram-negative bacterial isolates.

Further identification of the isolates was carried out using biochemical tests, including catalase, coagulase, and oxidase assays. Based on colony morphology, microscopic examination, Gram staining characteristics, and biochemical test results, the predominant bacterial species identified were *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*.

Among the bacterial isolates, *Staphylococcus aureus* was the most frequently detected organism on currency notes, indicating its widespread occurrence on frequently handled surfaces. *Escherichia coli* was predominantly isolated from samples collected from public handling environments, suggesting possible fecal contamination resulting from inadequate hygiene practices. *Pseudomonas aeruginosa* was recovered from a limited number of highly exposed samples, particularly those associated with moist and unhygienic conditions. Similar observations have been reported by Basavarajappa et al. (2005), Prasai et al. (2008), and Akoachere et al. (2014), who documented the presence of potentially pathogenic microorganisms on circulating currency.

The findings of the present study demonstrate that Indian currency notes and coins serve as potential reservoirs and vehicles for the transmission of pathogenic microorganisms. Continuous circulation, repeated handling, and poor hygienic practices contribute significantly to microbial contamination of currency. The high levels of contamination observed on frequently exchanged notes highlight the importance of maintaining proper hand hygiene and increasing public awareness regarding safe currency-handling practices. These findings are consistent with earlier studies conducted by Vriesekoop et al. (2010) and Umeh et al. (2007), which emphasized the role of currency in the dissemination of infectious microorganisms and associated public health risks.

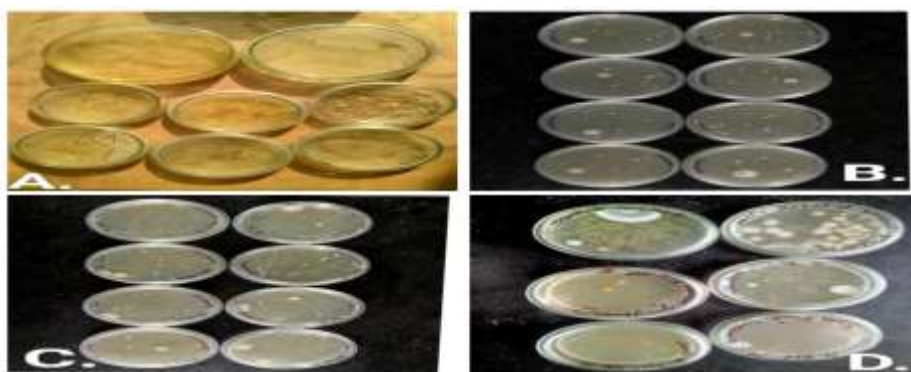


Figure 2. Representative nutrient agar plates showing microbial contamination associated with Indian currency samples collected from various public locations. (A) Uninoculated control plates prior to sample inoculation. (B) Bacterial colonies isolated from currency samples obtained from public bus conductors. (C) Moderate microbial growth observed in samples collected from milk parlours. (D) Heavy mixed microbial growth, including bacterial and fungal colonies, detected in currency samples collected from vegetable markets and grocery shops.

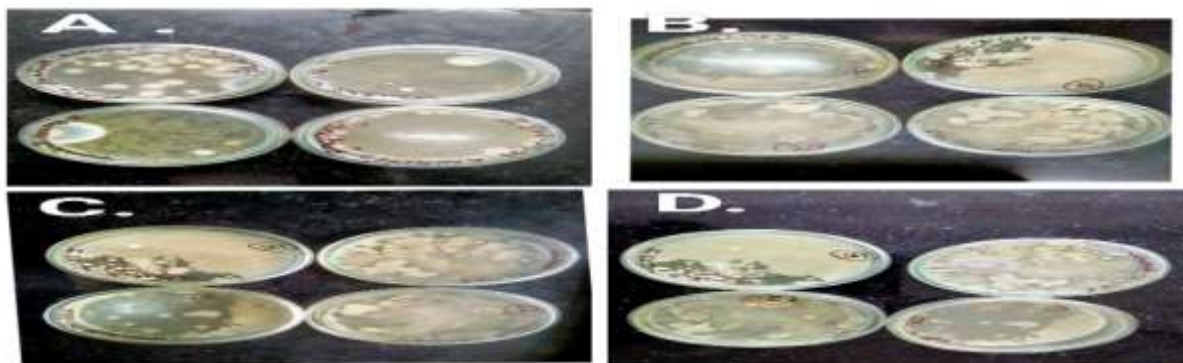


Figure 3. Growth characteristics of microorganisms isolated from Indian currency samples on nutrient agar medium. (A) Abundant microbial growth with multiple colony morphotypes. (B) High-density mixed microbial colonies indicating extensive contamination. (C) Moderate to heavy bacterial growth with clearly distinguishable colony characteristics. (D) Diverse microbial populations displaying variations in colony size, morphology, and growth pattern.



Figure 4. Catalase-negative reaction showing the absence of bubble formation after the addition of hydrogen peroxide. **Figure 5.** Catalase-positive reaction showing oxygen bubble formation due to the decomposition of hydrogen peroxide by the catalase enzyme.

The catalase test was performed to differentiate bacterial isolates based on their ability to produce the enzyme catalase, which decomposes hydrogen peroxide into water and oxygen. The test serves as an important biochemical tool for the preliminary identification of bacterial species isolated from contaminated currency samples. As shown in **Figure 4**, certain bacterial isolates did not produce visible effervescence following the addition of hydrogen peroxide, indicating a **catalase-negative reaction**. The absence of bubble formation suggests that these isolates lack the catalase enzyme and are therefore unable to break down hydrogen peroxide. Such reactions are characteristic of several bacterial genera that do not possess catalase activity. In contrast, **Figure 5** illustrates **catalase-positive reactions**, where immediate bubble formation was observed upon the addition of hydrogen peroxide. The release of oxygen bubbles confirms the presence of catalase enzyme in the bacterial cells. Catalase-positive reactions were observed in several isolates recovered from currency samples and were useful in distinguishing potential species such as *Staphylococcus aureus* and *Bacillus* spp. from catalase-negative organisms. The catalase test, together with colony morphology, Gram staining, and other biochemical assays, contributed significantly to the identification and characterization of bacterial isolates present on Indian currency notes and coins.



The coagulase test was performed to differentiate coagulase-producing bacteria from non-coagulase-producing isolates. This biochemical test is particularly useful for the identification of *Staphylococcus aureus*, a clinically significant pathogen commonly associated with human skin and mucosal surfaces. As shown in **Figure 6A**, several bacterial isolates exhibited a **coagulase-positive reaction**, characterized by visible clot formation or agglutination in the test suspension. The formation of clumps indicates the production of the enzyme coagulase, which converts fibrinogen into fibrin. Coagulase-positive isolates were presumptively identified as *Staphylococcus aureus*. In contrast, **Figure 6B** shows **coagulase-negative reactions**, where no clotting or agglutination was observed. These isolates lacked the ability to produce the coagulase enzyme and therefore remained uniformly suspended. Coagulase-negative reactions were observed among isolates such as *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Bacillus cereus*. The coagulase test, together with Gram staining, colony morphology, and other biochemical assays, aided in the accurate identification of bacterial isolates recovered from Indian currency notes and coins. The predominance of coagulase-positive *Staphylococcus aureus* among the isolates highlights the potential public health risk associated with handling contaminated currency.

Organism	Gram Reaction	Cell Shape
<i>Staphylococcus aureus</i>	Gram Positive	Cocci (Clusters)
<i>Escherichia coli</i>	Gram Negative	Rod
<i>Pseudomonas aeruginosa</i>	Gram Negative	Rod
<i>Bacillus subtilis</i>	Gram Positive	Rod
<i>Bacillus cereus</i>	Gram Positive	Rod

Table 2 Morphological and Microscopic Characteristics of Identified Bacterial Isolates

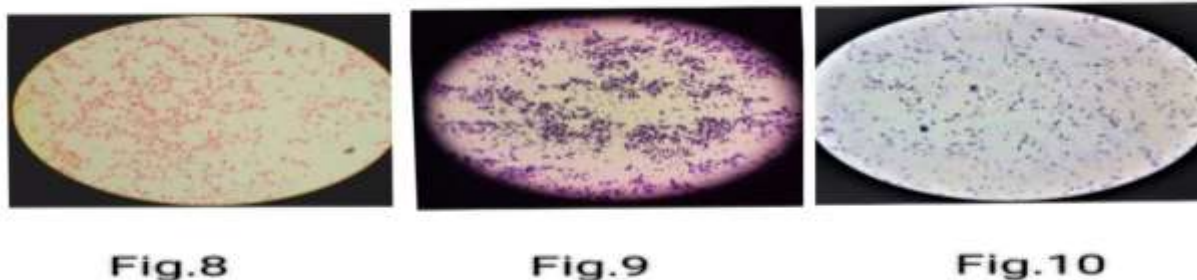


Fig.8

Fig.9

Fig.10



Microscopic examination of Gram-stained bacterial isolates was carried out to determine their cellular morphology and Gram reaction. The observations obtained were used in conjunction with colony characteristics and biochemical test results for the identification of bacterial species isolated from Indian currency samples. As shown in **Figure 8**, the isolate identified as *Escherichia coli* appeared as **Gram-negative short rod-shaped cells (bacilli)**, distributed singly or in small groups. The characteristic pink coloration observed after Gram staining confirmed its Gram-negative nature. **Figure 9** shows the microscopic appearance of *Staphylococcus aureus*, which was observed as **Gram-positive cocci arranged in irregular grape-like clusters**. The purple coloration retained by the cells following Gram staining confirmed its Gram-positive nature. This organism was among the most frequently isolated bacteria recovered from the currency samples. The isolate identified as *Bacillus subtilis* is presented in **Figure 10**. Microscopically, the organism appeared as **Gram-positive rod-shaped cells**, occurring singly or in chains. The cells retained the crystal violet stain, appearing purple under the microscope, which is characteristic of Gram-positive bacteria. The microscopic characteristics observed in Figures 8–10 were consistent with standard descriptions of these bacterial species and supported their identification based on morphological and biochemical analyses.

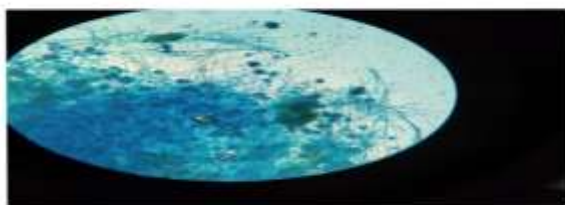


Fig.11

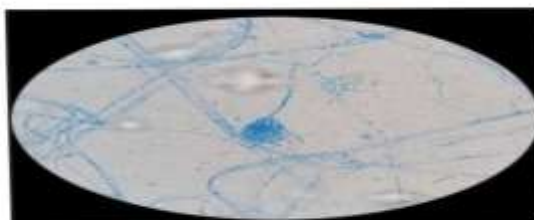


Fig.12

Microscopic examination of fungal isolates was performed to identify the fungal contaminants recovered from Indian currency samples. The identification was based on characteristic morphological features, including hyphal structure, spore arrangement, and conidiophore morphology. As shown in **Figure 11**, the isolate was identified as *Aspergillus* spp. based on the presence of septate hyphae and characteristic conidial structures. The fungal mycelium appeared well-developed, with branching hyphae and dense spore-bearing structures typical of the genus *Aspergillus*. This fungus is commonly found in environmental sources and may contaminate frequently handled surfaces exposed to dust and moisture. **Figure 12** shows the microscopic morphology of *Penicillium* spp. The isolate exhibited septate hyphae with branched conidiophores bearing chains of conidia. The characteristic brush-like appearance of the conidiophores is a distinguishing feature of *Penicillium* species and aided in its identification. The presence of *Aspergillus* spp. and *Penicillium* spp. on circulating currency indicates that paper notes and coins can serve as reservoirs for environmental fungal contaminants. These findings suggest that prolonged circulation and repeated handling of currency may facilitate the accumulation and dissemination of fungal spores. The microscopic observations were consistent with standard taxonomic descriptions and supported the identification of the fungal isolates obtained during the study.



CONTAMINATION COMPARISON ON ₹2 COIN, ₹5 COIN, ₹10 NOTE & ₹20 NOTE



Figure 13 illustrates the comparative levels of microbial contamination detected on different Indian currency denominations, including ₹2 coins, ₹5 coins, ₹10 notes, and ₹20 notes. The results indicate that currency notes exhibited a higher degree of microbial contamination than coins. Among the tested denominations, the **₹10 note showed the highest level of contamination (40%)**, followed by the **₹20 note (30%)**. The elevated contamination observed on paper currency may be attributed to its fibrous and porous surface, which provides favorable conditions for the attachment and survival of microorganisms. In addition, currency notes are frequently exchanged among individuals, increasing the likelihood of microbial transfer and accumulation. The **₹2 coin accounted for 20% of the total contamination**, while the **₹5 coin showed the lowest contamination level (10%)**. The relatively lower microbial load on coins may be due to their metallic composition and smoother surface, which are generally less conducive to microbial persistence than paper-based currency. Various groups of microorganisms were detected on the currency samples, including bacteria, fungi, and yeasts. The predominant bacterial isolates identified were *Staphylococcus aureus*, *Escherichia coli*, and *Pseudomonas aeruginosa*, while fungal contaminants included *Aspergillus* spp. and *Penicillium* spp. The presence of these microorganisms suggests that circulating currency can act as a reservoir for potentially pathogenic microbes and may contribute to the spread of infectious agents through frequent handling. Overall, the findings demonstrate that Indian currency notes, particularly lower-denomination notes that undergo frequent circulation, harbor higher levels of microbial contamination than coins, emphasizing the importance of proper hand hygiene and safe currency-handling practices.

4. Conclusion

The present study revealed that Indian currency notes and coins are contaminated with different types of microorganisms due to continuous handling and exposure to unhygienic environmental conditions. Currency samples collected from vegetable markets, grocery shops, public bus conductors, and milk parlours showed noticeable microbial growth on culture media. Different bacterial and fungal isolates were identified through morphological, microscopic, and biochemical characterization. The major bacterial isolates included *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Bacillus cereus*, while fungal isolates such as *Aspergillus niger*, *Penicillium*, and *Candida* were also observed. The findings



indicate that currency can act as a possible source for the transmission of pathogenic microorganisms and may contribute to public health risks through improper handling practices. Therefore, maintaining proper hand hygiene, avoiding unhygienic handling of money, and promoting clean transaction practices are important to reduce microbial contamination associated with Indian currency.

5. Discussion

The present study confirmed that Indian currency notes and coins are contaminated with various microorganisms due to frequent handling and exposure to different environmental conditions. All collected samples showed microbial growth, indicating that currency can serve as a potential carrier of microbes. Currency notes exhibited higher contamination than coins, likely because their porous surface provides favorable conditions for microbial survival.

Microbial contamination was highest on ₹10 and ₹20 notes collected from vegetable markets and public transport sources, reflecting frequent exchange and poor hygiene practices. The bacterial isolates identified included *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus* species, while fungal contamination was also observed on some samples. The presence of these microorganisms suggests contamination from human handling as well as environmental sources.

These findings highlight the public health importance of contaminated currency as a potential source of microbial transmission. Improved hand hygiene, public awareness, and increased use of digital payment methods may help reduce the spread of microorganisms through currency handling.

References

1. Ahmed, M. S. U., et al. (2010). Evaluation of microbial contamination of paper currency notes. *Advances in Biological Research*, 4(5)
2. Ahmed, M. S. U., Parveen, S., Nasreen, T., & Feroza, B. (2010). Evaluation of the microbial contamination of Bangladeshi paper currency notes. *Bangladesh Journal of Scientific and Industrial Research*, 45(3)
3. Akoachere, J. F. T. K., Gaele, N., Dilonga, H. M., & Nkuo-Akenji, T. (2014). Public health implications of microbial contamination of currency handled by food vendors in Cameroon. *BMC Research Notes*, 7
4. Alemu, A. (2014). Microbial contamination of currency notes and coins in circulation: A potential public health hazard. *Biomedicine and Biotechnology*, 2(3)
5. Basavarajappa, K. G., Rao, P. N., & Suresh, K. (2005). Study of bacterial, fungal, and parasitic contamination of currency notes in circulation. *Indian Journal of Pathology and Microbiology*, 48(2)
6. Brown et al. (2005). *Benson's Microbiological Applications: Laboratory Manual in General Microbiology*. 9th Edition. McGraw-Hill Publishing Company, New York
7. Forbes et al. (2002). *Bailey and Scott's Diagnostic Microbiology*. 11th Edition. Mosby Publications, St. Louis, USA
8. Goktas, P., & Oktay, G. (1992). Bacteriological examination of paper money. *Journal of International Medical Research*, 20(2)
9. Hosen et al. (2006). Contamination of currency notes by pathogenic bacteria and fungi and their public health significance. *Journal of Environmental Health*, 68(7)
10. Kuria, J. K., et al. (2009). Profile of bacteria and fungi on money coins. *East African Medical Journal*, 86(4)
11. Neel et al. (2012). Isolation and characterization of microorganisms associated with currency notes. *Journal of Pharmacy and Biological Sciences*, 2(6)



12. Neel, R. (2012). Isolation of pathogenic microorganisms from contaminated paper currency notes in circulation from different market places in Korogwe and Mombo towns in Tanzania. *Journal of Microbiology and Biotechnology Research*, 2(3)
13. Onion et al. (1981). Microbial contamination of paper currency and its role in disease transmission. *Applied and Environmental Microbiology*, 41(1)
14. Prasai, T., Yami, K. D., Joshi, D. R., & Lekhak, B. (2008). Microbial load on paper/polymer currency and coins. *Nepal Journal of Science and Technology*, 9
15. Sangeeta et al. (2016). Microbial contamination of Indian currency notes in circulation and their health hazards. *International Journal of Scientific Research*, 5(4)
16. Snehalatha et al. (2016). Isolation and identification of microorganisms from Indian currency notes and coins collected from different sources. *International Journal of Current Microbiology and Applied Sciences*, 5(8)
17. Tagoe, D. N. A., & Baidoo, S. E. (2011). Bacterial contamination of Ghanaian currency notes from various food vendors. *Internet Journal of Microbiology*, 8(2)
18. Umeh, E. U., Juluku, J. U., & Ichor, T. (2007). Microbial contamination of Nigerian currency notes in circulation. *Research Journal of Environmental Sciences*, 1(6)
19. Vriesekoop, F., et al. (2010). Dirty money: Investigation into the hygiene status of currencies. *Foodborne Pathogens and Disease*, 7(12)
20. Vriesekoop, F., Russell, C., Alvarez-Mayorga, B., Aidoo, K., Yuan, Q., Scannell, A., & Beumer, R. (2010). Dirty money: An investigation into the hygiene status of some of the world's currencies as obtained from food outlets. *Foodborne Pathogens and Disease*, 7(12)