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CURRENCY NOTES PATHOGENS AND THEIR ANTIBIOTIC RESISTANCE PATTERN

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ABSTRACT: Currency contaminated by microbes might act as fomite playing an important role in the transmission of microorganisms and also in the spread of drug resistant strains in the community. The objective of the present study is bacteriological analysis of the currency notes circulating in meat market of Nagpur city. Total 60 samples of currency notes of denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were collected from vegetable market. The cultures from the collected currency notes yielded 123 isolates representing 6 different types of bacterial species. Identification showed an active participation of these six species in descending order of percentage as Escherichia coli 33.33%, Staphylococcus aureus 27.64%, Pseudomonas spp. 19.51%, Salmonella spp., 13.82%, Proteus spp. 4.07% and Enterobacter spp. 1.63%. Antibiotic resistance profile showed organism wise variation in resistance pattern. It was concluded that the currency notes circulating in meat market of Nagpur city may serve as a vehicle for the transmission of potentially pathogenic microorganisms. This may play a significant role in the transmission of various diseases. The lower denomination currency notes appeared to be more highly contaminated with bacterial pathogens than higher denomination currencies. The mutilated currency notes had the highest prevalence of bacterial contamination (93.5%) than the non-mutilated currency notes (6.5%). It supports the finding that non-mutilated currency notes are particularly dangerous.

Key Words: Nagpur meat market, Mutilated and Non-mutilated currency notes, Contamination, Bacterial Pathogens, Antibiotic Resistance Pattern

INTRODUCTION:

Currency contaminated by microbes act as fomite playing an important role in the transmission of microorganisms and also in the spread of drug resistant strains in the community (Pope et al., 2002; Singh et al., 2002). Paper currency can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placements on dirty surface, by pathogenic microorganisms is of much public health concern as they can be sources of transmitting pathogens.

Studies in different parts of the world have reported high rates of microbial contamination of currency notes in circulation (Abrams and Waterman, 1972; Goktas and Oktay, 1992; El-Dars and Hassan, 2005; Lamichhane et al., 2009). A study in Bangladesh reported that *Escherichia coli, Klebsiella, Staphylococcus aureus, Salmonella spp.*, Bacillus *spp.* and *Pseudomonas spp.* were recovered from paper currency notes of vegetable market in Bangladesh (Ahmed et al., 2010). Rote et al., (2010) conducted a study to evaluate currency samples of different denominations from different occupational groups for isolation of microbial contaminant includes butchers, food sellers, students, beggars, vegetable sellers, petrol pump, book sellers, grocery shops, banks and cobblers. Saadabi et al., (2010) isolated and identified the pathogenic bacteria and fungi from Sudanese banknote currency. Alwakeel and Nasser (2011) made a survey of the bacterial and fungal contamination of paper money samples in Riyadh, Saudi Arabia. Dehghani et al., (2011) evaluated the degree of contamination of Iranian currency.

The data regarding the bacteriological contamination of currency is scanty and a recent medical literature search revealed only a few studies on this topic. Moreover the bacteriological study on currency notes circulating from meat markets and antibiotic resistance profile is the main aim of the study. Because it helps to investigate the likelihood of bacterial contamination of currency notes and this study can also provide the basis for raise health consciousness in people during currency handling.

MATERIALS AND METHODS:

Paper currency notes: A total of 60 samples of currency notes having denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were obtained from meat market of Nagpur. The samples were graded using appearance and degree of dirtiness as mutilated and non-mutilated currency notes. Five mutilated and five non-mutilated currency notes of each denomination were collected. Out of 60 currency notes 30 were mutilated and 30 non-mutilated.

Sample Collection: Meat sellers handling the notes were

asked to deposit them in sterile polythene bags. The samples were then transported immediately to the microbiology laboratory for bacteriological analysis. They were compensated with other currency of same denomination.

Isolation and Identification of Bacteria: A sterile cotton swab was dipped in the sterile physiological saline and rubbed on both the surfaces of currency note. The swab was inoculated in 5 ml of sterile nutrient broth and incubated for 6-8 hours at 370C. Thereafter the broth cultures were plated on Mannitol Salt Agar, MacConkey Agar and Cetrimide Agar. The plates were incubated at 370C for 24 hours. After incubation the isolated colonies were identified on the basis of morphological, cultural and biochemical characteristics (Collee and Marr, 1996) and results were compared with Bergeys's Manual of Determinative Bacteriology, 9th edition.

Antibiotic Sensitivity Test: All the confirmed bacterial pathogens were subsequently tested for antibiotic sensitivity patterns by disk diffusion method on Mueller Hinton agar. The antibiotic discs used in the study were categorized into 3 different sets of 10 different discs in each set obtained from Hi-media Laboratories Pvt. Ltd. Mumbai (Table 1 a,b). Finally, the zone size of inhibition was recorded in mm (Bauer et al., 1966) and results were interpretated as per Clinical and Laboratory Standards Institute (CLSI) guidelines (CLSI, 2007).

RESULTS AND DISCUSSION:

The present study revealed the extent and the level of contamination of Nagpur paper money with pathogenic microorganisms. A total of 60 currency notes of denominations Rs. 5, Rs. 10, Rs. 20, Rs. 50, Rs. 100 and Rs. 500 were collected from meat market.

Contamination of Bacterial Pathogens on Currency Notes:

The cultures from the collected currency notes yielded 123 isolates representing selected 6 different types of bacterial species. Identification showed the active participation of these six species in descending order of percentage as Escherichia coli 33.33%, Staphylococcus aureus 27.64%, Pseudomonas spp. 19.51%, Salmonella spp., 13.82%, Proteus spp. 4.07% and Enterobacter spp. 1.63% (Table 2). The results showed the prevalence of pathogenic microorganisms isolated from currency notes of meat market. The study was in accordance with Ahmed et al., (2010) who showed that the microorganisms isolated from currency notes of meat market in Nigeria were *Escherichia coli* 63.63%, *Salmonella spp.*, 18.18%, *Pseudomonas spp.* and *Staphylococcus aureus* 9.09% each.

Staphylococcus aureus Contamination:

In the present study, the isolation of Gram positive as well as Gram negative bacteria from currency notes confirmed that currency might be playing an important role as a vector in the transmission of pathogenic bacteria in the community. The presence of Staphylococcus aureus on paper money could have been due to rubbing off or may be surfing from a skin flake. Pathogenic Staphylococci harbored either by an asymptomatic carriers or a person with a disease which can be spread by hands or expelled from the respiratory tract (Saeed and Rasheed, 2011). Though Staphylococcus aureus is the normal flora of the skin and mucous membranes, its high incidence has clinical significance and it is considered as a well-recognized pathogen. A number of studies have documented the clinical significance of Staphylococcus aureus as a causative agent of urinary tract infections (Tessema et al., 2007). Staphylococcus aureus have also been reported to cause conjunctivitis (Everitt et al., 2006). Furthermore, Staphylococcus aureus is also associated with toxic shock syndrome, skin infections and respiratory tract infections (Miller et al., 2007; Yamaguchi et al., 2006).

Enterobacteriaceae Family Members' Contamination:

The presence of the members of Enterobacteriaceae family revealed the poor sanitary condition of the environment as well as poor personal hygiene practices observed by most of the people surveyed. The presence of Salmonella spp. is an indicator of poor hygiene and sanitation standards. Among the pathogenic bacteria isolated, Escherichia coli is a virulent organism that can cause urinary tract infections, community-acquired pneumonia, bacteremia, sepsis etc. (Chang et al., 2006; Sun et al., 2006; Jayaseelan et al., 2007). Proteus spp. is also a causative agent of cystitis and pyelonephritis in patients with urinary catheters or structural abnormalities of the urinary tract (Grude et al., 2001).

Pseudomonas spp. Contamination:

Pseudomonas spp. is one of the principle agent of bacteremia, soft tissue infections, conjunctivitis, endophthalmitis, pneumonia, meningitis, brain abscess, infections in burns, cystic fibrosis, endocarditis, wound infection and otitis media (Armour et al., 2007; Damas et

al., 2007; Valle et al., 2007). Pseudomonas spp. is pathogenic when introduced into areas devoid of normal defences e.g., when mucus membrane and skin are disrupted by direct tissue damage. The organism attaches to and colonizes the mucus membrane or skin, invades locally and produces systemic disease (wounds and meningitis) (Yazah et al., 2012).

Bacterial Contamination on Mutilated and Non-mutilated Currency Notes:

The study revealed a significant association between bacterial contamination and the type and condition of the currency with high rate of contamination on mutilated currency notes than non-mutilated currency notes. The mutilated currency notes had the highest prevalence of bacterial contamination (93.5%) than the non-mutilated currency notes (6.5%). It supports the finding that non-mutilated currency notes are particularly dangerous (Table 2). This finding has very important health and economic implications, especially in underdeveloped and developing tropical nations of the world (Siddique, 2003). The presence of mutilated currency notes and failure to consistently withdraw them from circulation are common phenomena in many parts of the country. The climatic and environmental conditions of the tropics favor the thriving of many pathogenic microorganisms, and in the face of underdevelopment, inadequate water and sanitation, crowded living conditions, lack of access to health care, and low levels of education, a greater proportion of the populace, particularly the poor, become highly susceptible to infection and disease (Podhajny, 2004). The persistence of mutilated currency notes in active circulation could elevate their contributory role in transmission of some pathogens, thereby constituting potential public health hazard.

Denominationwise Bacterial Contamination on Currency Notes:

The study reported here found relatively more prevalence of bacteria among lower denomination notes; presumably as a result of a higher rate of handling and hand-to-hand exchange (Lamichhane et al., 2009). The results showed that currency notes of lower denominations Rs. 5 (17.07%), Rs. 10 (26.02%), Rs. 20 and Rs. 50 (21.95% each) had more contamination of pathogens than the currency notes of higher denominations Rs.100 (9.76%) and Rs. 500 (3.25% each). These lower denomination paper money are used frequently for different normal daily activities. Higher denominations are not used as frequently as lower denominations (Ahmed et al., 2010).

Antibiotic Resistance Profile of Currency Note's Pathogens:

Antibiotic resistance profile showed organism wise variation in resistance pattern. Staphylococcus aureus (34) was highly resistant to Ampicillin (32), Penicillin G (33), Methicillin (29) and Oxacillin (29). Out of 24 Pseudomonas spp., all 24 were found to be sensitive to Aztreonam, Carbenicillin (14), Ciprofloxacin (17), Gentamicin (18), Imipenem (19), Piperacillin (22), Piperacillin/Tazobactam (24), Ticarcillin (21) and Tobramycin (22) (Table 3a). Escherichia coli (41) was resistant to Cephalexin (35), Ciprofloxacin (32), Gatifloxacin (38), Levofloxacin (34), Nalidixic acid (35), Norfloxacin (35) and Ofloxacin (36). Enterobacter spp. (2) was resistant to Ciprofloxacin (2), Levofloxacin (2), Nalidixic acid (2), Norfloxacin (2) and Ofloxacin (2). Proteus spp. (5) was resistant to Cephalexin (3), Nalidixic acid (5) and Norfloxacin (3). Salmonella spp. (17) was found to be resistant to Nalidixic acid (17) (Table 3b). The low susceptibility (that is, higher resistance) of the isolates to the common and cheap antibiotics is not surprising as these drugs are more commonly abused or misused leading to development of resistance. The higher susceptibility to other antibiotics suggests the use of relatively costly antibiotics which are not easily affordable to permit abuse/misuse (Alwakeel and Nasser, 2011).

The results of the study reported here suggest that paper currency recovered from meat market were found to be contaminated with bacterial pathogens. Meat sellers' way of exchanging the currency notes was just touching the goods like meat and then exchanging the notes by the same people. This may play a significant role in the transmission of various diseases. This scenario is a major concern especially in respect of the health status of the population. Therefore handling of paper currency deserves special attention. Depending on the results of this study, one suggestion may be made to peoples to improve their personal health consciousness by washing hands after handling the currency notes, taking no foods even snacks after touching money notes, avoiding using saliva during counting of paper currency notes, avoiding baby to handle the currency notes.

Furthermore, regular disinfection of the currency notes be carried out by the banks; regular withdrawal of mutilated notes should be put in place by the authorities; public enlightment campaigns on non-mutilated (good)

money handling practices should be done and lastly more similar study should be carried out on a continuous basis in order to build a global information network on money hygiene being in mind the public health implications of contaminated currency notes.

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