



Occurrence of pathogens on paper currency of Bangladesh and their public health importance

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ABSTRACT

Bangladesh currency notes (Taka) were surveyed for microbial contaminations under this study. This study was carried out with one hundred paper currency notes collected from different occupational groups in Savar area. The old and dirty currency notes were selected as the chance of getting contaminants is high. The improper use of currency notes can play vital role in the transmission of diseases caused by the pathogens present on it. Our goals were to isolate and identify microorganisms present on currency notes and to observe their resistance pattern against common antibiotics. The currency notes of different values were collected from street hawkers, rickshaw pullers, bus conductors, beggars, shops in market, and different occupational groups in Savar area. The samples were analyzed for microbial contaminants. This study indicated that the presence of 5 bacterial *Bacillus* sp. (69%), *Streptococcus* sp. (7%), *Staphylococcus aureus* (15%), *Pseudomonas* sp. (6%), and *Escherichia coli* (3%) in the currencies. The all isolated bacteria were only found sensitive against gentamycin and ciprofloxacin was found active against *Streptococcus*, *Pseudomonas* and *Escherichia coli*. These isolated microorganisms from currency notes are highly pathogenic to human. Our study suggested that Bangladesh paper currency notes are commonly contaminated with pathogenic microorganisms and improper use of these currencies may play potential role in transmission of pathogens responsible for different diseases in human. Care should be taken during handling of currency notes and creating awareness among people to minimize the diseases or infections transmitted by the currencies.

Key words: currency, taka, microorganism Bangladesh

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INTRODUCTION

Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce. Accumulated data over the past two decades indicates simultaneous handling of paper currency and food is related to sporadic food borne illness (Brady and Kelly, 2000; Michaels, 2002). The paper/polymer currency notes and coins may harbor various deadly pathogenic microorganisms and represent a universal medium for the survival and transmission of bacteria in the environment and among humans (Xu *et al.* 2005; Brady & Kelly, 2000). Money is handled by persons of varying health and hygienic standards and is stored under

varying environmental and personal hygienic conditions that constitute a reservoir and source of various bacteria (Pomperayer & Gaylarde 2000). According to El-Dars and Hassan (2005) paper currency offers a larger surface area as a breeding ground for pathogens. Microbes may persist on it for longer periods. The older the paper note the more accumulation of microbes occurs which causes allergic responses. Lower-denomination notes receive the most handling because they are exchanged more often. Microbial contaminants may be transmitted either directly through hand-to-hand contact, or indirectly via food, water or other inanimate objects. These routes of transmission are of great public health importance in developing countries. Research has shown that

contaminated fomites or surfaces play a key role in the spread of bacterial infections with antimicrobial resistance (Hota 2004). Antimicrobial resistance is a global phenomenon that has resulted in high morbidity and mortality as a result of treatment failures and increased health care costs (Laxminarayan and Malan, 2007). In the hands of bus conductors and fish and meat sellers, currency notes become literally pestilent. Studies on the contamination of money with microbial agents is lacking in most developing countries. Therefore the present study was undertaken with the aims at investigating the status of bacterial contamination of currency note of Bangladesh. The study was designed to collect paper currencies from different sources in order to identify pathogens present on them and to determine their response against common antibacterial leading to assessment of the risks associated with microbial contamination from handling money in Bangladesh.

MATERIALS AND METHODS

Sample collection

The study was conducted during the period from April, 2011 to May, 2012 in Savar region of Dhaka. The samples were collected aseptically from grocery shops, canteens, vegetable shops, meat shops, paan shops, conductors of buses, minibuses and mini buses and different occupational group of Savar area. A total of hundred pieces of currency paper were randomly collected from persons of each category. The individual was requested to drop paper money into a sterile plastic packet. The packet was promptly sealed and the individual was given back another currency paper of same amount as replacement. The packets were immediately transported to the laboratory at the Department of Microbiology, Gono Bishwabidyalay, (University) Ashulia, Savar, Dhaka, Bangladesh for microbial analysis.

Isolation and identification of organisms

Nutrient Broth, nutrient agar, MacConkey agar, TCBS (thiosulfate citrate bile salts sucrose) agar, cetrimide agar and blood agar were used for isolation and identification of bacterial isolates.

Each paper currency was placed in 100 ml sterile distilled water in a beaker and agitates with sterile forceps and allowed to stand for ten minute. After the time interval the paper currency were removed using a sterile forceps and remaining washing water solution was used for inoculum. About 1ml of the inoculum was placed into nutrient broth using a sterile pipette and incubated for 6-8 hours at 37° C. Then the broth cultures were plated on differential media, nutrient agar media and incubated over-night at 37°C. From nutrient agar media the cultures were inoculated on selective media namely MacConkey agar, TCBS agar, blood agar, cetrimide agar. The plates were incubated at 35°C - 37°C overnight. The suspected colonies were sub-cultured. Bacterial colonies in each medium were then characterized on the basis of staining colonial, cellular morphology, and biochemical characteristics using standard microbiological technique (Barrow and Feltham, 1993)

Antibiotic susceptibility test (AST)

The susceptibility assay was performed on Mueller–Hinton agar plates using 6 different antibiotics (Biotech Lab UK), including penicillin (PEN) (10 units), erythromycin (ERY) (15 µg), ciprofloxacin (CP) (30 µg), gentamycin (GEN) (30 µg), amoxicillin (AM) (30 µg) and ampicillin (AMP) (30µg) (Hi Media, India).

RESULTS AND DISCUSSION

A total of 100 paper currency samples were analyzed in this study. All the currency samples showed substantial numbers of bacterial colonies. A total of 5 different species of bacteria were isolated (table 1). The most frequently isolated bacteria species include gram positive *Bacillus spp* (68%), *Staphylococcus aureus* (16%), *Streptococcus spp* (7%), *Pseudomonas spp* (6%), and *Escherichia coli* (3%). The colonies of the *Staphylococcus aureus* on blood agar media showed large, round, golden-yellow. *Escherichia coli* showed lactose fermentation on Mac Conkey agar media. *Pseudomonas spp.* showed blue green and yellow green colonies produce on cetrimide agar plate, *Bacillus spp* represents golden colony on nutrient agar plate (plate 1-4).



Plate 1
Culture of *Pseudomonas* in cetrimide agar plate showing pale yellow by the presence of green pigmentation



Plate 4
Growth of *Bacillus* spp represents golden colony on nutrient agar plate

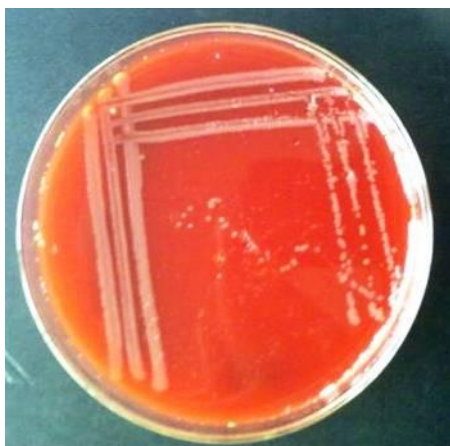


Plate 2
Growth of staphylococcus aureus show large golden colony on blood agar media



Plate 3
Growth of *Escherichia coli* shows lactose fermentation on Mac Conkey agar media

Microorganisms are found distributed in every environment where plants and animals exist (Food Science Austria, 2000). The bacteria identifies from Bangladeshi paper currencies were *Streptococcus* spp, *Escherichia coli*, and *Bacillus cereus*, *Pseudomonas* sp and *Staphylococcus aureus*. *Streptococcus species* is a normal flora of the nose, stomach and skin (Drasar and Barrow, 1985; Gwatkin, 2000) and is a member of gram positive bacteria. Many strain of this species have been implicated in infectious diseases of human. *Escherichia coli* (gram negative enterobacterium are an inhabitant of human/animal intestines. The organism comes to the environment through fecal contamination (Singh et al., 2002). *Escherichia coli* is known to cause life threatening epidemic gastroenteritis in infants; certain strains also cause gastroenteritis in adults, notably as the agents responsible for many cases of traveler's diarrhea. These organisms also have been implicated in bloody diarrhea (Black, 1991).

Bacillus species are known to produce endospores and is widespread in the environment (Nester et al., 1995) and is an aerobic or facultatively anaerobic bacteria. They are resistance to extremes of heat, dryness, disinfectants and radiation (Struthers and Westran, 2003). Some members cause serious infectious disease. e.g *bacillus anthracis* causes anthrax disease and is usually severe in wound infections and often fatal if spores are inhaled (Ballows et al., 1991).

Table 1
Biochemical and carbohydrate fermentation test of isolated organisms

No of samples	16	3	6	7	68
Motility	-	+	-	±	+
Catalase	+	+	+	+	+
Oxidase	±	±	+	±	±
Lactose	AG	AG	-	± AG	±
Sucrose	AG	A+	-	± AG	A
Citrate	±	-	+	±	+
TSI	A/A	± A/A	K/N	± K/A	± K/A
Indole	±	+	±	-	-
MR	-	+	-	±	-
VP	-	-	-		±
Nitrate	+	+	+	+	±
Urease	-	-	-	+	-
Interpretation	<i>Staphylococcus aureus</i>	<i>Escherichia coli</i>	<i>Pseudomonas</i> sp	<i>Streptococcus</i> sp	<i>Bacillus cereus</i>

(AG) yellow slant, bubble=glucose fermentation, gas production only; (K/A) yellow butt, red slant = ferments glucose only; (A/A yellow butt and slant) = ferments glucose + lactose and/or sucrose; (K/K) red but and slant = non-fermenter of all 3 sugars; (A) yellow slant, glucose fermentation; (K/N) red slant, no change

Table 2
Antimicrobial susceptibility pattern of the bacterial isolates

Name of organisms	Penicillin	Ampicilin	Amoxicilin	Erythromycin	Ciprofloxacin	Gentamycin
<i>Bacillus spp</i>	R	R	R	R	R	S
<i>Staphylococcus aureus</i>	R	R	R	R	R	S
<i>Streptococcus spp</i>	R	R	R	R	S	S
<i>Pseudomonas spp</i>	R	R	R	R	S	S
<i>Escherichia coli</i>	R	R	R	R	S	S

R= Resistance; S= Sensitive

Staphylococcus aureus is another important bacteria that cause diseases in human. They are normal inhabitant of the upper respiratory tract, skin, intestine and vagina. This bacteria cause various supportive or pus forming diseases such as boils, folliculitis, scalded- skin syndrome etc (Siddique, 2003). *Staphylococcus aureus* is being harboured by either asymptomatic carrier or a person with the disease and can be spread by hands, expelled from the respiratory tract, or transported in or on animate objects. It can produce disease in almost every organ and tissue of the body. When *Staphylococcus aureus*

becomes established in hair follicle, tissue necrosis results (Prescott et al., 2002).

In conclusion the present study clearly demonstrated that Bangladesh paper currency is commonly contaminated with pathogenic bacteria. This may play significant role in the transmission of various diseases as shown in this study. The study thereafter suggests that people should improve their personal health consciousness by washing hands after handling any currencies, taking no foods even snakes, avoiding the use of saliva during counting of paper currencies and

keep away their babies from handling or touching the currencies.

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