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Contamination of Coliforms in Different Paper Currency Notes of Bangladesh

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Abstract: To determine the degree of contamination of taka notes, samples of the notes circulating in different local markets and people of different professions in Khulna region of Bangladesh were collected. Coliforms, the indicator organisms in taka notes were determined by multiple tube method and identified with differential media and data were analyzed. About 80±5% of old two-taka notes were contaminated with total coliforms and 16±4% of notes were found contaminated with fecal coliforms. But comparatively newer two-taka notes showed that 43±3% were contaminated with total coliforms and 5±2% were with fecal coliforms, suggesting the notion that more handled taka notes were contaminated more intensely even by fecal coliforms. Ten taka notes also represented the same pattern of results as two-taka notes, indicating that taka notes may carry enteric pathogens. This study also revealed that porsaline paper notes were easily vulnerable to coliforms contamination whereas polymer paper notes were almost free from coliforms suggesting that polymer paper notes are safer to use than porsaline paper notes.

Key words: Contamination, total coliforms, fecal coliforms, taka notes

INTRODUCTION

Coliforms are Gram-negative, aerobic or facultative anaerobic, non-spore forming bacteria that ferment lactose with the production of acid and gas at 37°C within 24-48 h and belong to the family of enterobacteriaceae (Cappuccino and Sherman, 1999; Stanier *et al*., 1995; Tortora *et al*., 1995). The classical species of coliforms are *Escherichea coli* and *Enterobacter aerogenes* which are also known as fecal coliforms have relation to other pathogenic enteric bacteria such as *Salmonella*, *Shigella*, *Klebsiella*, *Proteus*, *Serratia* etc. that may cause dangerous fever, diarrhea and dysentery (Pelczar *et al*., 1998). Even members of coliforms are sometimes opportunistic to cause enteric diseases, urinary tract infections, wound infections and bacteraemia (Stanier *et al*., 1995). Most of the coliform bacteria grow best in dark, warm, moist environment with nutrient, but fecal coliforms have also the capability to grow at elevated temperatures (44-44.5°C) and associated with the fecal materials of warm-blooded animals (Pelczar *et al*., 1998).

Paper currency notes are susceptible to bacterial contamination during continuous handling from person to persons, storing them at contaminated polythine/ cotton/ leather bags at moist, sweaty and dark conditions, which are most favorable for the growth of coliforms as well as other pathogens (El-Dars and Hassan, 2005; Khin *et al*., 1989; Lavins *et al*., 2004; Pope *et al*., 2002). In addition, older paper notes provide with more space for bacterial accumulation, on the other hand, coins are less vulnerable to microorganisms and bacteria (El-Dars and Hassan, 2005). Currency notes are handled by all classes of people including even children and come to the contact of all and thus the contaminated notes may play roles in spreading of diseases by having meals without washing hands after handling of money notes or due to count paper notes by using saliva usually by the illiterate people in the rural area of Bangladesh.

In Bangladesh, generally people are not used to wash their hands after handling taka (name of Bangladesh currency) notes and all most people are not conscious about the fact that they may be affected by many dangerous diseases caused by pathogenic bacteria

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transmitted to them by handling of taka notes. The aim of the present study is to raise health consciousness in people during currency handling. In this research, we used taka notes made of porsaline paper and polymer paper to investigate the extant of contamination by coliforms that indicate the possible presence of other pathogenic bacteria. This paper reports the contamination of porsaline paper notes of Bangladesh by total and fecal coliforms.

MATERIALS AND METHODS

Sample collection: Two and Ten taka notes (old and comparatively newer) were collected aseptically in sterile polythine bags from three different markets of Khulna city (named as Gollamary Fish Market, Nirala Kacha Bazar and Duck Bangla Boro Bazar). Both types of taka notes were also collected from different occupational people such as farmer, shopkeeper, student, teacher, doctor and postman. This study was conducted from July, 2002 to February, 2003 in the Department of Biotechnology, Khulna University, Khulna, Bangladesh.

Identification of coliforms: In the presumptive test, each taka note was soaked in 5 mL sterile distilled water and vigorously agitated by vortex mixture for 5 min and then the water was added to 25 mL of sterile Brilliant Green Lactose Broth (BGLB) and mixed properly. Three aliquots (each of 10 mL) were transfer in sterile screw capped tube containing inverted Durham's tube occupied with BGLB and incubated at 37±1°C for 48 h. Formation of gas in Durham's tube was considered as the evidence for the positive presumptive test. In the confirmative test to identify the total coliforms, one loop of suspension from positive (presumptive) BGLB tubes was inoculated into sterile Eosin Methylene Blue (EMB) agar plates and incubated at 37±1°C for 24 h. Different centered and sheen colonies of coliforms were observed.

To identify the fecal coliforms by confirmative test, one loop of suspension from positive BGLB tubes was transferred to newly prepared BGLB tube and incubated at 44.5±1°C for 48 h. Gas production indicated presumptive fecal coliforms. One loop of suspension from positive BGLB tube was then inoculated into EMB plate and incubated at 37±1°C for 24 h and the cultural characteristics of fecal coliforms were observed in the plates.

In the completed test, typical colonies were selected on the EMB plates and inoculated in nutrient agar slants as well as in lactose broth media containing Durham's tubes. Following 18-24 h of incubation at 37°C, slant cultures were used to observe the morphologies (shape and sporolation) and Gram reactions by microscopic examination. The lactose broth was observed for the production of gas.

RESULTS AND DISCUSSION

Through the confirmative test, small colonies with dark black centers and greenish metallic sheen and large pinkish mucoid colonies with dark centers but with rarely metallic sheen were suggested as the characteristic colonies produced by *E. coli* and *Enterobacter aerogenes*, respectively (Pelczar *et al*., 1998). The characteristic colonies further produced gas in the completed test and were found as Gram-negative bacilli and non-sporolated and thus met the typical features of coliforms.

This study revealed that about 80% of thirty old two-taka notes made of porsaline paper were contaminated by total coliforms and near 20% of notes showed the presence of fecal coliforms (Table 1). However, 69% of fifteen old two-taka notes collected form different occupational people (materials and methods) were contaminated only with non-fecal coliforms (data not shown). These results explicated that taka notes circulated or handled in fish markets or Kacha Bazar is of high risk due to contamination even by fecal coliforms. In addition, absence of fecal coliforms in two-taka notes collected from different occupational people may be due to less number of samples under test. Comparatively newer two-taka notes collected from fish markets or Kacha Bazar showed that 40-45% of thirty samples were contaminated with the total coliforms and 3-7% were with fecal coliforms (Table 1), suggesting more handling of taka notes by many people made them more vulnerable to bacteria. Almost the same pattern of contamination rate was observed when old or newer ten-taka notes made of porsaline paper were used to investigate the presence of total and fecal coliforms (Table 2). However, total number of coliforms was higher in ten-taka notes compared to two-taka notes due to their additional area. On the other hand, ten taka notes made of polymer paper showed the absence of coliforms (Table 2). The reason may be the hydrophobic characteristic of polymer paper notes for which they cannot absorb moisture that is the prerequisite for bacterial accumulation and growth. Moreover, in Bangladesh, polymer taka notes have been introduced only a few years before and therefore, these were not more handled or circulated as the porsaline paper notes for being bacterial contamination, or polymer notes are not vulnerable to bacterial contamination at all.

Table 1: Contamination of coliforms in two-taka notes made of porsaline paper[a]

Type of sample	Location of sampling	% of taka notes contaminated with: Total coliforms	% of taka notes contaminated with: Fecal coliforms
Old[b]	Gollamary Fish market	87 (26)	20 (6)
	Nirala Kacha Bazar	80 (24)	13 (4)
	Duck Bangla Boro Bazar	77 (23)	17 (5)
Newer[b]	Gollamary Fish market	43 (13)	7 (2)
	Nirala Kacha Bazar	40 (12)	3 (1)
	Duck Bangla Boro Bazar	47 (14)	3 (1)

[a]Data are representative of triplicate experiments, [b]Total number of sample from individual location was 30, In parenthesis, number of taka notes contaminated is shown

Table 2: Contamination of coliforms in ten-taka notes[a]

Notes made of	Location of sampling	% of taka notes contaminated with: Total coliforms	% of taka notes contaminated with: Fecal coliforms
Porsaline[d]	Gollamary Fish market[b]	85 (17)	25 (5)
	Nirala Kacha Bazar[b]	85 (17)	20 (4)
	Duck Bangla Boro Bazar[b]	75 (15)	15 (3)
	Gollamary Fish market[c]	45 (9)	10 (2)
	Nirala Kacha Bazar[c]	35 (7)	5 (1)
	Duck Bangla Boro Bazar[c]	40 (8)	5 (1)
Polymer[d]	Gollamary Fish market[b]	5 (1)[e]	0
	Nirala Kacha Bazar[b]	0	0
	Duck Bangla Boro Bazar[b]	0	0
	Gollamary Fish market[c]	0	0
	Nirala Kacha Bazar[c]	0	0
	Duck Bangla Boro Bazar[c]	0	0

[a]Data are representative of triplicate experiments, [b]Old taka notes, [c]Newer taka notes, [d]Total number of sample from individual location was 20, [e]Contamination was observed only one set of experiments, In parenthesis, number of taka notes contaminated is shown

Contamination of taka notes by coliforms indicated the possible presence of pathogens such as *Salmonella*, *Shigella*, *Leptospira* etc because such enteric pathogens have relation with coliforms, the indicator organisms that are widely used in the bacteriological analysis of food, drinks, drinking water and so on (Pelczar *et al*., 1998; Madigan *et al*., 2000) and thereby, many epidemic diseases like diarrhea, cholera, dysentery and typhoid may be caused through taka notes in Bangladesh by food poisoning due to deficient in proper washing of hands after handling of taka, using of saliva during counting of money, taking of money in the mouth of children. This study helped to determine the extant of bacterial contamination of two types of paper money notes used in Bangladesh and in addition explicated the notion that the older porsaline paper notes were more dangerous due to excessive contamination than that of newer ones and moreover, polymer taka notes seemed to be safer than porsaline paper notes. Depending on the results of this study, one suggestion may be made to individuals to improve their personal health consciousness by washing hands after handling of money notes, allowing no baby to handle money notes and using no saliva during counting of paper money notes. Although Khulna city is a small part of Bangladesh and a small number of samples were used, it may draw a representative indication of the danger in handling of porsaline paper notes and as far we know, this is the first report on the bacterial contamination of currency notes of Bangladesh. However, further studies are necessary with more samples including foreign currencies to make a conclusive inference and to recommend any regulatory measures.

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