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RESEARCH ARTICLE

Prevalence of Pathogenic Bacteria from Contaminated Yemeni Currency Notes in Taiz City

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ABSTRACT:

Pathogenic bacteria responsible for the causation of many common diseases have been identified on currency notes. The present investigation was carried out on one hundred currency notes of all the denominations (50, 100, 250, 500 and 1000RY), obtained from different occupational mainly bus drivers, hawker street, vegetable vendor, restaurants and butchers and fish seller groups in Taiz city, Yemen. Identification and characterization revealed active participation of the following species of organisms in the ascending order of percentage as E. coli(50.28 %), Staphylococci aureus(14.04 %), Klebsiellasp(4.39 %), proteus(4.39 %), salmonella(1.25 %), shigella(0.72 %), Coagulase negative staphylococcus(0.60 %), pseudomonas(0.50 %), beta haemolytic streptococcus(0.30 %), spore forming gram positive bacilli(0.30%) and alpha haemolytic streptococcus(0.10%). The study suggested that yemeni currency notes is commonly contaminated with pathogenic microorganisms and this contamination may play a significant role in the transmission of potentially harmful microorganisms or different diseases such as cholera, diarrhea, skin infections and also poses antibiotic resistant, so great care should be taken during handling of money and the preparation and handling of food to avoid cross contamination.

KEYWORDS: Prevalence of pathogenic bacteria isolated from Yemeni currency notes.

INTRODUCTION:

The environment plays important role in transmission of microbial agents to humans, with many environmental materials serving as vehicles [1]. Microorganisms are found in almost everywhere in our environment. Some microorganisms are useful but some are pathogenic. Currency note is widely exchanged for goods and services in most countries worldwide. Currencies note are extensively used and each currency is exchanged many times during the time it circulates. Currency on which pathogenic microorganisms might survive represents an often overlooked reservoir for enteric disease [2].

Paper Currency, can be contaminated by droplets during coughing, sneezing, touching with previously contaminated hands or other materials and placement on dirty surface.

Paper currency is commonly handled by various categories of people during transaction [3]. Contamination of objects by pathogenic microorganisms is of much public health concern as contaminated materials can be sources of transmitting pathogens. Paper money, therefore presents a particular risk to public health, since communicable diseases can spread through contact with foinites [4-9]. Although paper money is impregnated with disinfectants to inhibit microorganisms, pathogens are isolated from paper currency notes and coins [10].

Studies in different parts of the world have reported high rates of microbial contamination of currency notes in circulation [11,12]. The microorganisms implicated included members of the family Enterobacteriaceae, Mycobacterium tuberculosis, Vibrio cholerae, and Bacillus species. Staphylococcus sp. Micrococcus sp. and Coiynebacterium sp. Most likely contaminants of paper money are environmental organisms such as Gram- positive flora (especially Bacillus

Table1:Currency denomination with relation with occupational groups.

Currency denominations	50 RY	100RY	250RY	500RY	1000RY
No of currency(N)	20	20	20	20	20
Occupational Group	Bus drivers	Hawker street	Vegetable vendor	Restaurants	Buchers and Fish seller

Table 2:Percentage prevalence of different bacterial types per denomination of currency note

Currency denominations	50RY	100RY	250RY	500RY	1000RY	Total
<i>Staphylococci aureus</i>	18.3	20.68	18.62	12.6	0	14.04
<i>E. coli</i>	58.4	49.2	66.7	42.61	34.5	50.28
<i>Coagulase negative staphylococcus</i>	0.74	0	0.91	1.38	0	0.60
<i>Klebsiella</i>	2.1	0.47	9.51	6.36	3.5	4.39
<i>Salmonella</i>	0.61	0	5.64	0	0	1.25
<i>Beta haemolytic streptococcus</i>	0	0.54	0	0.9	0	0.30
<i>shigella</i>	3.6	0	0	0	0	0.72
<i>Spore forming gram positive bacilli</i>	0.69	0	0.72	0	0	0.30
<i>Proteus</i>	0	6.8	2.5	0	0.99	2.1
<i>Pseudomonas</i>	0	0.7	1.82	0	0	0.50
<i>Alpha haemolytic streptococcus</i>	0	0.12	0.21	0	0	0.10
Rate of contamination						74.58

Microbial contamination of paper money is not only confined to developing nations. Several studies from the United States reported contamination of coins and paper bills and the identification revealed the presence of pathogenic microbes like staphylococcus aureus, E. coli, klebsiellaenterobacter [13,14]. Another survey isolated total of 93 different types of bacteria belonging to the species staphylococcus, Streptococcus, Enterobacter, Acinetobacter, Pseudomonas, Bacillus, Diptheroids, Klebsiella pneumoniae and E. vuluneris [15].

The aim of this study therefore was to determine the level of bacterial contamination of the currency notes in circulation in Taiz city, so as to determine whether or not the notes constitute a potential source of disease spread. Taiz city was selected for the current study as it represents a typical Yemenis population of the South part of the country. And no study yet in this regards.

MATERIAL AND METHOD:

Sample collection:

This study was carried out during the period from November 2013 to December 2014, the whole sample size was 125 YR notes, samples were collected from different categories in Taiz city, which the currency notes of 50 obtained from bus drivers, 100 obtained from street hawkers, 250 obtained from vegetable vendor, 500 obtained from restaurant and 1000 obtained from fish seller and butchers.

Persons handling the money were asked to deposit the currency in a sterile polythene bag, after being compensated with other currency of same value. Samples that collected were labeled (serial number, source and date of collection) and taken to the bacteriology laboratory for analysis.

Isolation and identification of bacteria:

The origin samples for each currency were cultured on blood agar, macConkey agar, salmonella, shigella agar, mannitol salt agar. After incubation at 37 C° for 24 hr. the colonies were identified by colony characteristics, gram staining, and according to the result of gram stain, the

biochemical test were used which are catalase, coagulase, motility, indoleurea, kliger iron agar, citrate utilization and oxidase. To guide us to the genus of isolated bacteria.

RESULTS:

Out of the 100 currency notes of five different denominations which collected from different sites as shown in table 1. The present study revealed the extent and the level of microbial contamination of Yemeni currency notes. The cultures from the collected Yemeni currency notes shown eleven different types of bacterial species. Identification showed the active participation of these species in descending order as *E. coli* (50.28%), *Staphylococci aureus* (14.04%), *Klebsiella* spp (4.39%), *proteus* (4.39%), *salmonella* (1.25%), *shigella* (0.72%), *Coagulase negative staphylococcus* (0.60%), *pseudomonas* (0.50%), beta haemolytic *streptococcus* (0.30%), spore forming gram positive bacilli (0.30%) and alpha haemolytic *streptococcus* (0.10%) as shown in table 2.

DISCUSSION:

The present study revealed the extent and the level of contamination of Yemeni currency notes with pathogenic microorganisms. Table 2 shows the prevalence of pathogenic microorganisms isolated from the Yemeni currency notes from 50 RY to 1000RY, from different occupational groups mainly bus drivers, hawker street, vegetable vendor, restaurants and butchers and fish seller groups. The results showed in table 2 indicated that all the currency denominations groups had microbial contamination.

The study reported here found relatively less prevalence of microbial contamination among higher denomination notes presumably that may due to improper hand washing after using the toilet, counting paper notes using saliva, coughing and sneezing on hands then exchanging money, and placement or storage of paper notes on dirty surfaces. Microbes are then transferred from one contaminated note to other notes. Most people are not used to washing their hands after handling money.

In the present study shown that 74.58% of currency note was contaminated with varieties of microorganism table2. These findings are similar to the results of other studies such as Umeh et al, 2007[16] who found that eighty-nine percent of Nigerian Naira notes studied were contaminated with bacteria. Ninety-four percent of US one dollar bills had bacterial contamination and $80 \pm 5\%$ of old two- Taka notes in Bangladesh had (coliform) bacteria contamination [17].

Rocha-Gómez et al. [18] found that Out of the 70 peso banknotes, 48 (69%) to be contaminated in Mexico while Pope et al. [15] revealed that pathogenic or potentially pathogenic organisms were isolated from 94% of One-dollar bills survey.

Our results revealed that the more isolated bacteria were *E. coli* and *S. aureus* followed by *Klebsiella* spp, *proteus* spps, *salmonella* spp, *shigella*, *Coagulase negative staphylococcus*, *pseudomonas*, *beta haemolytic streptococcus* and *alpha haemolytic streptococcus*.

Smaller study have done by Mohammed RafiqKhan el al 2013 [19] who showed the active participation of these species in descending order as *Escherichia coli*, *Bacillus* spp, *Klebsiella* spp, *Staphylococcus aureus*, *Salmonella* spp and *Pseudomonas* spp. However Goktas and Oktay (1992) [20] found similar result as present investigation. They isolated aerobic spore forming bacilli (91%), *Staphylococcus epidermidis* (63.3%), *Staphylococcus aureus* (4.2%), *Enterococcus* (24.1%), *alpha hemolytic streptococcus* (4.1%), *Streptococcus pneumonia* (1.7%), *Corynebacterium* (7.5%), *Lactobacilli* (10.8%), *Klebsiella pneumoniae* (31.7%), *Enterobacter* (19.2%), *E. coli* (17.5%), *Proteus* (1.7%), *Pseudomonas aeruginosa* (0.8%), *Shigella flexneri* (0.8%) from paper money samples of one hundred twenty currency notes.

In the present study found that *E. coli*, was the highest isolated bacterium which indicates the presence of fecal contamination via cross-contamination with raw products or poor personal hygiene. Such finding is in line with what has been reported that currency banknotes are contaminated with enteropathogens [21]. Furthermore, the results explain the notion that currency banknotes act as a potential source of enteric diseases. For instance, all *Salmonella* are pathogenic to some degree, causing salmonellosis. Species of *Shigella* are responsible for bacillary dysentery. *Klebsiella* species occasionally causes a serious form of pneumonia in humans. Some species of *Proteus* are implicated in many infections of the urinary tract. *Staphylococcus* species produces many toxins responsible for toxic shock syndrome. Regarding the *E. coli*, this group of bacteria is a primary cause of traveler's diarrhea [22,23].

In the present study found that the second common pathogenic isolated from currency notes was *Staphylococci aureus* table2. The presence of pathogenic *staphylococci aureus* on money was expected because *S. aureus* carriers

and diseased persons are common in the population [24]. Simple nose rubbing, coughing or sneezing could cause contamination of the notes [25]. Paper currency has recently been identified as a mode of transmission of community-acquired *S. aureus* in [26].

Our study have been isolated enteric bacteria such as *Klebsiella* spp and *Pseudomonas* spp table2. Enteric bacteria, *Klebsiella* spp, *E. coli* and *Pseudomonas* spp, have been common isolates on paper currency in several studies [27,28]. *Klebsiella* spp and *E. coli* are coliform bacteria, indicating fecal contamination. This reflects poor personal [29]. However, *Klebsiella* spp also causes respiratory infections that contribute to its presence through droplet infection.

In the present study found that coagulase-negative Staphylococci and *Shigella* were common isolated bacteria in Yemeni currency notes. The isolation of coagulase-negative Staphylococci on the currency notes could have been contamination from the normal skin flora [30] and from the soil [31]. Moreover *Shigella* species are common causes of food-borne and water-borne illnesses worldwide [32]. The isolation of *Shigella* species and *S. aureus* from the currency notes and the fact that some food vendors serve food with their hands and also handle currency notes as they sell to their patrons, currency notes contaminated with pathogenic microorganisms such as *Shigella* species and *S. aureus* may cross contaminate the food and may cause food-borne illness [33].

Other species isolated from the Yemeni currency notes included: *Coagulase negative staphylococcus*, *pseudomonas*, *beta haemolytic streptococcus*, *spore forming gram positive bacilli* and *alpha haemolytic streptococcus*.

Similar study has been done by Janardan et al., (2009) [34] in their study isolated bacteria from Nepal currency notes. The microorganisms were *Coagulase negative staphylococcus*, *alpha-hemolytic Streptococcus*, *Enterobacter* spp, *Acinetobacter* spp, *non-aeruginosa* spp of *Pseudomonas*, *bacillus* spp, *Alcaligenes* spp, *diphtheroids*, and *Escherichia vulneris*, which do not typically cause infections in healthy people rather they were known to cause significant infections in those with depressed immune systems, including those infected with HIV, undergoing cancer chemotherapy, or taking other medications that depress the immune system. Those bacteria may also cause infection in hospitalized patients.

CONCLUSION:

This study found out that Yemeni currency notes is commonly contaminated with pathogenic bacteria and this contamination may play a significant role in the transmission of different diseases. We therefore advocate a greater sensitivity in the handling of money. The general awareness about the possibility of acquiring infection while applying saliva on fingers for counting currency notes; and

practicing good personal hygiene should be created in the public. Personal hygiene to reduce risk of infection is recommended especially for those who simultaneously handle food and money. Dirty and mutilated notes should be withdrawn from circulation from time to time. The practice of keeping money in brassieres, handkerchiefs and in shoes should be discouraged.

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