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Isolation and Identification of Pathogenic Bacteria and Fungi from Some Sudanese Banknote Currency

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Abstract: Sudanese banknotes in different values were critically evaluated to show the level of contamination with pathogenic microbes using standard techniques. The fungal genera *Trichophyton* sp., *Microsporum* sp., *Epidermophyton* sp., *Taenia* sp., *Aspergillus* sp. and *Saccharomyces* sp. were isolated and identified. The genera of bacteria that isolated were *Escherichia coli*, *Citrobacter* sp., *Klebsiella* sp., *Proteus* sp., *Bacillus* sp., *Corynebacterium* sp. and *Staphylococcus* sp. The potential of Sudanese currency notes to act as environmental vehicles for transmission of pathogenic fungi and bacteria was assessed. The lower values of banknotes were highly contaminated and there is a negative correlation between banknotes value and microbial contamination.

Key words: Banknote, currency, bacteria, fungi, microbial contamination, Sudan

INTRODUCTION

Money is very important to human life as it facilitates the needs and currency notes are vital for goods and services worldwide. Banknotes are used for every type of commerce from buying milk at local store to buying even drugs. Although, the paper notes of currency which is handled by a large number of people increase the possibility of acting as environmental vehicle for the transmission of potential pathogenic microorganisms i.e., bacteria and fungi.

So, the infected currency is identified as potential public health hazard as pathogen spread by circulating banknotes. Immunocompromised person stand the risk of acquiring opportunistic infection, through handling of contaminated currency. Opportunistic infection can occur when immune system is not function properly so bacteria and fungi are usually harmful and cause diseases (Bodsworth *et al*., 1990; Cheesbrough, 1991; Allen *et al*., 1972).

In literature there is a few data obtained from currency notes as result of microbial contamination. For example in Nigeria Emikpe and Oyero (2007) identified *Entrobacter* sp., *Staphylococcus* sp., *Citrobacter* sp., *Klebsiella* sp. and *Proteus* sp. as pathogenic bacteria resistant to tetracycline and cotrmoxazole and also sensitive to amoxoftine, gentamicin, nalidixic acid and ofloxacin. In USA, Peter Ender isolated *S. aurous*, *Klebsiella pneumoniae*, *Enterobacter* sp. and *Pseudomonas* sp. with a 72% sample contamination. In India, Venkatesh similarly isolated *S. aurous*, *Candida* sp. and *Aspergillus* sp. in currency note samples. In Pakistan, a co-operative study in Microbiology Department of Karachi University concluded that contacts with contaminated currency notes could cause diarrhea and urinary tract infection besides skin burn and septicemia infection. Their research findings emphasized the economic importance of banknotes as a source of microbial contamination.

In Sudan, there is no any documented data concerning the pathogenic fungi and bacteria which transmitted by currency notes therefore, the objectives of the present research work are to:

- Investigate whether Sudanese banknotes currency save as barriers for microbial contamination
- Highlight some environmental pollution due to currency microbial contamination
- Suggest some control measures to minimize contamination in Sudanese banknote currency

MATERIALS AND METHODS

Survey: Banknotes from different sources such as butchers, vegetable markets, fish markets and bus passengers were selected. The values of banknotes were 1, 2, 5, 10 and 20 Sudanese pounds which were collected randomly and put in sterile polyethylene bags. They were immediately transferred to the microbiology laboratory of

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El-Neelain University to apply all microbiological examinations for the different values of collected banknotes.

Preparation of samples: Values of banknotes were rinsed and soaked separately in normal saline or sterilized distilled water in 250 mL beaker for 24 h.

Inoculation in culture media: Streaking and swabbing were done with washed water using sterile loop and swab and inoculated onto Nutrient Agar (Play House 52, Wash Bary, U K) and Macconkey Agar (SHIV, India) to obtain bacterial isolation for 48 h incubation period at 37°C. While Sabroud Dextrose Agar (Play House 52, Wash Bary, UK) was used for fungal isolation for 1 week at 28°C.

Examination of culture media: Cultures in solid media were visually inspected for growth rate and colony characteristics.

Sub-culturing: Different colonies were sub-cultured on Nutrient Agar and Macconkey Agar and incubated similarly as before.

Identification of bacteria: Identification of bacteria was carried out using different tests as described by Cowan.

Identification of fungi: The growth of fungi on Sabaroud dextrose agar was examined critically after 1 week using prepared microscope slides. The prepared specimens were mounted on Lacto phenol cotton blue and identification of the fungal species was performed with aid of binocular compound microscope (40X) adopting the techniques used by Bruge *et al.* (1977).

RESULTS AND DISCUSSION

Microbiological methods which were adopted in this study indicated that various species of bacteria and fungi have been isolated from different Sudanese banknotes. The genera of isolated bacteria are the members of the family Enterobacteriaceae i.e., *Citrobacter frendii*, *Citrobacter koseri*, *Escherichia coli*, *Klebsiella ozaeni*, *Klebsiella pneumoniae*, Klebsiella *rhinosclrematis*, *Proteus vulgaris*, Shigella flexneria and *Shigella dysentery* which are shown in Table 1.

The identified gram positive bacteria were *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Staphylococcus saprophyticus* and spore-forming bacteria such as *Bacillus subtilis*, *Bacillus pemulus*, *Bacillus megaterium*, *Bacillus firmus*, *Corynbacterium haemolyticum*, *C. hafmainaii* and *Lactobacillus caserii* as shown in Table 2. Bacteria which isolated from different

Table 1: Laboratory tests for identification of gram's negative pathogenic bacteria isolated from some Sudanese currency notes

	Laboratory test												KIA			
Microorganisms	Gram	Motility	Catalase	Glucose	O\F	Indol	Citrate	MR	VP	Urea	Gas from glucose	Man-nitol	Slop	Butt.	H_2S	Gas
*Citrobacter freundi*i	-, Rod	+	+	+	F	+	+	-	+	+	+		y	y	-	+
Citrobacter koserii	-, Rod	+	-	+	F	+	+	+	-	-	+		y	R	-	-
Escherichia coli	-, Rod	-	+	+	F	+	-	+	-	-	+	+	y	Y	-	+
Klebsiella ozaeni	-, Rod	+	+	+	F	-	+	+	-	+w	+	+	y	y	-	+
Klebsiella pneumonae	-, Rod	+		+	F	-	+	-	+	-	+	+	y	y	-	+
Klebsiella rhinosclermatis	-, Rod	-	-	-	-	-	-	-	+	-	-	-	R	R	-	-
Shigella dysentery	-, Rod	-	-	-	-	-	-	+	-	-	-	+	R	R	-	-
Shigella flexneria	-, Rod	-	+	-	-	-	-	+	-	-	-	+	R	R	-	-
Protus vulgaris	-, Rod	+		-	-	+	+	-	+	+	-		R	y	+	+

*-=Negative,+ = positive, R = Red, Y = Yellow, O = Oxidation, F = Fermentation, MR = Methyl Red, VP = Voges Prosker, KIA = Kliger Iron Agar

Table 2: Laboratory tests for identification of gram's positive pathogenic bacteria isolated from some Sudanese currency notes*

	Laboratory test													KIA			
Microorganisms	Gram	Motility	Catalase	Glucose	O.F	Indol	Citrate	MR	VP	Urea	Gas from glucose	Man-nitol	DNAse	Slop	Butt.	H_2S	Gas
Bacillus firmus	+, Rod	-	+	+	f	-	-	+	-	-	+			y	y	-	+
B. megaterium	+, Rod (s.f)	+	+			-	+	+	-	-		+					
B. pemilus	+, Rod (s.f)	+	+			-	+	-	+	+							
B. subtilis	+, Rod (s.f)	+	+			-	+	-	+	-		+					
Corynebacterium haemlyticum	+, Rod	-	+	+	f	-	-	+	-	-	+			y	y	-	+
C. hofmannii	+, Rod	-	+	+	f	-	-	+	-	-	+			y	R	-	-
Lactobacillus caserii	+, Rod	-	-	+	f	-	-	+	-	-				y	R	-	-
Staphylococcus aureus	+, Cocci	-	+	+	f							+	+				
S. epidermidis	+, Cocci	-	+	+	f							-	-				
S. saprophyticus	+, Cocci	-	+	+	f							+	-				

* - = Negative, + = Positive, R = Red, Y= Yellow, O.f = Oxidative fermentation, MR = Methyl Red, VP = Voges Proskaur, KIA = Kliger Iron Agar. (s.f) = spore-forming

Table 3: Identification of some pathogenic bacteria isolated from some Sudanese currency notes*

	Currency value (pound)				
Bacterial species	One	Two	Five	Ten	Twenty
Bacillus firmus	+	-	-	++	-
B. megaterium	-	-	+	-	-
B. pemilus	-	-	+	-	-
B. subtilis	+	++	-	-	-
Citrobacter freundii	+	-	-	-	+
C. koserii	+	-	-	-	-
Corynebacterium haemlyticum	+	-	-	-	-
C. hofmannii	+	-	-	-	-
Escherichia coli	+++	++	+	++	+
Klebsiella ozaeni	-	++	+	-	-
K. pneumonae	++	-	-	-	-
K. rhinosclermatis	-	-	-	-	+
Lactobacillus caserii	-	-	-	+	-
Protus vulgaris	+	-	-	-	-
Shigella dysentery	-	+	-	-	-
S. flexneria	-	+	+	-	-
Staphylococcus aureus	+++	++	++	+	++
S. epidermidis	+	+	-	++	-
S. saprophyticus	-	-	++	-	-
Control	-	-	-	-	-

*+ = low occurrence, ++ = medium occurrence, +++ = high occurrence

banknotes and showed high occurrence were *Staphylococcus auraus*, *E. coli*. While genera such as *Bacillus*, *Klebsiella*, *Citrobacter*, *Proteus*, *Shigella* were found in a limited colony numbers especially in banknotes value of 5, 10 and 20 pounds (Table 3).

The most predominant fungal species isolated were *Epidermophyton* sp. and *Saccharomyces* sp., those found abundant in banknote values of 1 and 2 Sudanese pounds. While species such as *Tinea* sp. and *Aspergillus* sp. were isolated from a very limited numbers of samples. The occurrence of some species such as *Microsporum* sp. is somewhat negligible and in a limited manner of prevalence with some percentage of <25%. Moreover, some species of the genus *Asprgillus* sp. are found very low as compared to the other isolated genera of fungi (Table 4).

From the present investigation, it was clearly observed that there is a negative correlation between value of banknotes decrease and increase in microorganisms that were found, regardless of the species found. Areas within Khartoum state are more contaminated with pathogenic fungi and bacteria because it is a capital city of the country and involve a large population which means more handling more frequent exchange of currency leading to more contamination. There were also a large number of pathogenic bacteria and fungi isolated from samples collected from fish markets. The bacteria isolated belong to Enterobacteriaceae family and this family is more frequency found in the air (air-borne) and was found also in large quantity in faces. This reflects that faucal pollution appears as a result of poor hygienic attitude in the community. Moreover, the genera of Enterobacteriaceae are usually hazardous

Table 4: Identification of pathogenic fungi isolated from some Sudanese currency notes*

	Currency value (pound)				
Fungal species	One	Two	Five	Ten	Twenty
Aspergillus flavus	+	-	-	-	-
A. fumigatus	-	+	-	-	-
A. niger	-	+	-	+	-
Epidermophyton sp.	+++	++	+	+	+
Microsporum sp.	++	+	+	+	+
Saccharomyces sp.	++++	++++	++	+	-
Tinea sp.	+++	+++	++	-	-
Trichophyton sp.	+++	+++	+	-	+
Control	-	-	-	-	-

* += low occurrence, ++ = medium occurrence, +++ = high occurrence

such as *Salmonella typhi* and *Shigella dysentery* that are pathogenic to human and animals. Furthermore, it was observed that high values of currency are less contaminated than a low values currency because a low values are more wide spread and exchangeable between people in population.

The results are closely related and similar to those obtained by Oyero in Nigeria who isolated *Enterobacter* sp., *Staphylococcus* sp., *Citrobacter* sp., *Klebsiella* sp. and *Proteus* sp. from different samples of Nigerian currency. Also from this investigation and others, we have reach to the point that Sudanese currency gives a positive appearance of some species of pathogenic bacteria and fungi due to the absence of antimicrobial agent in row material used for manufacture. We also found bacterial contamination in significant number of samples from fish markets which also indicated lack of hygienic attitude.

CONCLUSION

The results suggest that currency notes may be contaminated especially with bacteria and enteric microbes and may serve as a source of infection. Personal hygiene to reduce the risk of infection is recommended.

RECOMMENDATIONS

Therefore, a recommendation should be pointed out such as awareness of people is how to handle money emphasizing to reduce their hand contamination so reducing currency pollution; emphasis is to be stressed in the handling of banknotes by children so as to keep them safe from infectious diseases because they may enter all type of currency on their mouth; to develop banknotes manufacture by adding antimicrobial agents as a row material during processing; Re-sterilization of currency when it is dirty and return it back to reduce the risk of infection especially for children; plastic banknotes are strongly recommended and coin currency is sometimes needed.

REFERENCES

Allen, A.M., D. Taplin, J.A. Iowy and L. Twigy, 1972. Skin infection in Vietnamm. Mit. Med., 137: 295-301.

Bodsworth, N.J., D.A. Cooper, and B. Donovan, 1990. The influence of human immunodeficiency virus type 1 infection on the development of the hepatitis B virus carrier state. J. Infect. Dis., 163: 1138-1140.

Bruge H.P., W.R. Salomon, J.R. Boise, 1977. Comparative merits of eight popular media in aerometric studies of fungi. J. Allergy. Clin. Immunol., 60: 199-203.

Cheesbrough, M., 1991. Medical Laboratory Manual for Tropical Countries. Vol. 2: Microbiology. Butterworth-Heinemann Ltd., UK., pp: 496.

Emikpe, O.B. and O.G. Oyero, 2007. *In vitro* antibiotics sensetivity pattern of some bacteria isolated from Nigerian currency. Res. J. Biol. Sci., 2: 209-211.