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POTENTIAL RISK OF HANDLING NIGERIAN CURRENCY NOTES

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ABSTRACT
A lot of people loss their life every year in Nigeria due to the transmittance of diseases by different kind of pathogenic microorganisms. The use of Currency notes could be one of the major sources of transmittance of such diseases that provides platform for the growth of such pathogenic microorganisms. The research work aimed at isolation and identification of microorganisms that are present on Nigerian currency notes and to check if Nigerian currency Notes are disease carriers. Nigerian currency notes of different denominations were collected from; bankers, beggars, market women and bus conductors in different cities of Lagos, Onitsha, Enugu and Abakaliki. The samples collected were analyzed for microbial contaminants. The results indicated the presences of bacteria and fungi. The bacteria isolated were Streptococcus species, *Staphylococcus aureus, Eschericha coli* and Bacillus species. The fungi isolated were *Aspergilus niger, Aspergilus flavus* and Rhizopus species. Most of these isolated micro organisms are pathogenic to man. The currencies used by beggers were found to be extremely contaminated with various pathogenic microorganisms followed by the currency used by hawkers and market women. Therefore, adequate care must be taken by those handling these currencies and public awareness of using paper currency in circulation became essential for the safety in human health.

KEY WORDS: Microorganisms, Infections, Pathogens, Currency notes, Nigerian.

INTRODUCTION

A classic characteristic of human parasitic and bacterial agents is the evolution of routes for transmission to susceptible hosts. The environment plays a critical role in transmission to humans, with many environmental materials serving as vehicles (Anderson and May, 1991; Struthers and Westran, 2003). Microbial contaminants may be transmitted, either directly, through hand-to-hand contact, or indirectly via food or other inanimate objects. These routes of transmission are of great importance in the health of many populations in developing countries, where the frequency of infection is a general indication of local hygiene and environmental sanitation levels (Cooper, 1991).

The possibility that currency notes might act as environmental vehicles for the transmission of potential pathogenic microorganisms was suggested in 1970s (Abrams and Waterman, 1972). Paper currency is widely exchanged for goods and services in countries worldwide. It is used for every type of commerce, from buying maggi at a local store to trafficking in sex and drugs. All this trade is in hard currency, with lower - denomination notes receiving the most handling because they are exchanged many times (Gadsby, 1998). Paper currency provides a large surface area as a breeding ground for pathogens (Podhajny, 2004).

Money on which pathogenic microorganisms might survive represents an often over looked reservoir for enteric disease (Michaels, 2002). In most parts of the developed world, there is a popular belief that the simultaneous handling of food and money contributes to the incidence of food - related public health incidents (FSA, 2000). Over the last two decades, the observed data indicated that simultaneous handling indeed was a cause of sporadic food borne - illness and survival of pathogens Nepal Journal of Science and Technology 10 (2009) 161-166on currency notes in Turkey (Goktas and Oktay, 1992), United States (News 1998, Jiang & Doyle 1999, Pope *et al.,*2002), Australia (FSA 2000), India (Singh *et al.,*2002), Egypt (El-Dars and Hassan, 2005), China (Xu *et al.,*2005), and Myanmar (Khin Nwe *et al.,*1989). An investigation carried out in 1997 that involved swabbing and culturing from various coins and paper money randomly collected from doctors, laboratory staff, and other employees at a New York hospital resulted to the recovery of many pathogenic microorganisms (News, 1998; FSA, 2000). The possibility of currency contamination with microorganisms has also been observed among food handlers. An assessment of the public health risk associated with the simultaneous handling of food and money in the food industry in Australia (Brady, 2000) showed the presence of Staphylococci on the money surface. This suggested that without hygienic intervention, human occupational activities, especially those involving simultaneous money handling, could introduce the risk of cross - contamination to foods (FSA, 2000). With a number of infectious intestinal diseases, a low dose of the infectious agent is capable of causing illness. Failure of food service workers to adequately sanitize hands or use food - handling tools (tongs, spoons, utensils or bakery/serving papers) between the handling of money and the serving of food could put food service patrons at risk (Michaels, 2002). Publications regarding the degree to which paper money is contaminated with bacteria are few (Abrams, 1972; Khin Nwe *et al.,*1989; Goktas and Oktay 1992; Jiang & Doyle,

1999; Michaels 2002; Pope 2002; Singh *et al.,*2002; El-Dars and Hassan 2005; Xu *et al*., 2005). Scientific information on the contamination of money by microbial agents is lacking in most developing countries. This dearth of information may have contributed to the absence of public health policies or legislation on currency usage, handling, and circulation in the countries like Nigeria. United States and Australia have fostered a higher level of public awareness about the potential for currency contamination by microorganisms (News, 1998; Jiang and Doyle, 1999; FSA, 2000; Michaels, 2002; Pope et al., 2002). In the United States, a whole division of the Department of Treasury deals with what is termed "mutilated currency," and the Department Web Site boasts many examples of beleaguered, burned, buried, water-damaged money (Siddique, 2003). An aspect of food service that frequently causes comment, is the way a food handler prepares the food, takes money for the purchase, returns change to the customer, and then prepares food for the next customer. Anything that gets on hands can get on money. To date no outbreak of food borne and other illness have been associated with infection from money. However, evidences for the presence of pathogenic bacteria on currency frinforces the need for strict adherence to hygienic practices among money handlers who also handle food and water (Prasai *et al.,*2008). The study reported here, therefore, was designed to add to the limited body of literature on microbial contamination of currency notes and to address growing community concerns about the risks associated with microbial contamination and handling of money worldwide.

Money is any medium of exchange which is generally accepted in payment for good, service and debt without any particular consideration of the position of the person in payment (Okeke, 1994; El – Dars et al., 2005). Since money goes in contact with man and his environment where microorganisms also inhabit, there is every possibility that microorganisms can thrive on money.

The paper therefore deals with isolation and identification of microorganisms that are present on Nigerian currency notes and to check if Nigerian currency notes are disease carriers.

MATERIALS AND METHODS

Sources of experimental materials

A total of 250 samples of different denominations which include N5, 10, 20, 50, 100, 200 and 500 were collected from different sources such as Beggers, Market women, Hawkers, Bus conductors and Bankers in different locations such as Aba, Onitsha, Enugu and Abakaliki in January, 2010.

Isolation of microorganisms

The samples of the currency notes were soaked into a sterile normal saline solution contained in a beaker and allowed to stand for ten minutes. After the time interval the money were removed using a sterile forcept. The solution washed out from the money was then diluted serially into five folds. From the fifth tube, about 0.1ml of the solution was collected using a sterile pipette and pour plated on nutrient agar medium. This was done for all the samples using different petri dish and pipettes. The plates were incubated at 37^{o}c for 24 hours. And between 24 and 48 hours and observed under the microscope for bacteria and fungi isolated spread plate method on sabouraus dextrose agar, incubated for 48 and 72 hours and observed for colony formation.

Colony count

Viable colonies seen on the plates were counted and recorded against the source from which the samples were collected.

Pure culture preparation

Each observed colony was transferred using a sterilize wire loop into appropriate medium and incubated. These sub-cultured plates were then used in the identification and characterization of the organisms.

Identification and characterization of the organisms

All the isolated organisms were identified and characterized using the grain staining reaction, motility test and biochemical characteristics while the fungi isolated were equally identified by observing their morphological characteristics and comparing it with standard organism.

RESULTS

From the analysis of the 250 samples 0f the Nigerian currency notes collected, it was established that bacteria and fungi were present on the notes. The overview of the isolates is shown in tables 1 and 2.'

DISCUSION

The isolation of bacterial and fungal agents from currency notes in the study reported here confirmed that currency might be a vector playing an important role in the transmission of pathogenic microorganisms in the community. Bacterial agents that can contaminate currency notes, for example, some strains of *Streptococcus* and *Staphylococcus*, are known to have developed resistance to conventional antibiotics (WHO 2000).

Microorganisms are found distributed in every environment where plants and animals exist (Postage, 1992; Food Science Austria, 2000). It is not surprising that Microorganisms were isolated from the samples of Nigeria currency notes investigated. The isolated bacteria were *Streptococcus* specie, *Escherichia coli, and Bacillus* specie *and Staphylococcus aureus.*

Streptococcus specie is a normal flora of the nose, stomach and skin (Draser and Barrow, 1985; Gwatkin, 2000) and is a group of Gram positive bacteria. Many strain of this specie have been implicated in infectious diseases of human. Examples include; celluliter, crysipselas, necrotizing facilities, scarlet fever sore throat, Streptococcal pneumonia etc. most of these diseases were leading causes of morbidity and mortality (Deuren *et al., 2000).*

TABLE 2: characteristics and identity of bacteria isolated from Nigerian currency notes

Samnple code	Colony Characteristics	Ccell morphology	Gram Reaction	Motility Test	Coagulas Test	Catalas Test	Methyl red Test	Urease Test	Lactose Fermentation	Glucose Fermentation	Sucrose fermentation	Organism
SA1- SA	yellow to cream round in shape	cocci in Cluster	+ve	-ve	+ve	+ve	-ve		+ve	-ve	+ve	*Staph. Aureus*
EC1 – EC	mucoid and pink colonies	short rod Cluster	-ve	+ve	-ve	-ve	+ve	-ve	+ve	+ve		*E. coli*
ST1 – ST	Colourless shiny and mucoid in	cocci	+ve	-ve	-ve	-ve						Strept. Species
BA1 – BA	milkish white rod shape	short chain Cylindrical Rod	+ve	-ve	-ve	+ve	-ve		+ve	-ve	-ve	Bacillus specie

Key: +ve : Positive, -ve: Negative

TABLE 3: characteristics and identify of fungi isolated from Nigeria currency notes

S/No	Colony characteristics	Texture	Elevation of colony	Shape and arrangement	Septate	Organism	Organism
1	black with yellow submerged pigment	Granular	Flat	spherial unicellular unbranched chain	Septate	*Aspergilus niger*	*Aspergilus niger*
2	yellow green	Granular	Flat	shape and arrangement spherial unicellular unbranched chain	Septate	*Aspergilus flavus*	*Aspergilus flavus*
3	black white sporargiospore (white cotton like mycelium)	Fruity	Raised	unicellular duster	Septate	Rhizopus species	Rhizopus species

TABLE 3: colony count

S/No	Sample source	Number of examination	Cfu/ml
1	Banks	50	1.0×10^{-5}
2	Beggers	50	2.4×10^{-5}
3	market women	50	1.6×10^{-5}
4	Hawkers	50	1.8×10^{-5}
5	bus conductors	50	1.5×10^{-5}

From the above table, a total of 250 samples were analyzed from five different sources, 50 samples from each source and the colony count was tabulated.

Escherichia coli is an inhabitant of human/animal intestines. The organism comes to the environment through fecal contamination (Gutrant and Boback, 1991; Singh *et al*., 2002). This is a lactose fermenting, Gram negative enterobacterium. It is an almost universal member of the normal internal flora of human (and a number of other animals) and 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 specie: This organism is known to produce endospores and is widespread in the environment (Nester *et al.*, 1995) and is an aerobic or factitively anaerobic. They tolerate extremes of heart and dryness, the presence of 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).*

Staphylococcus aureus is among the important bacteria that cause disease in humans. 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 haboured 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. However, it should be emphasized that Staphylococcal disease, for the most part occurs in people whose defensive mechanisms have been compromised, such as those in the hospital (Schacher *et al*., 1998), Staphylococcus aureus also causes Staphylococcal food poisoning (Siddique, 2003). When *Staphylococcus aureus* becomes established in hair follicle, tissue necrosis results (Prescott *et al*., 2002).

From table 3, fungi isolated were *Aspergilus niger*, *Aspergilus flavus* and *Rhizopus specie.* Fungi species are known to be distributed in every environment (Prescott et al., 2002; Janardan, *et al.,* 2009). They thrive on money usually when the money is kept in a damped environment. Review of the isolates as disease pathogens of man.

Aspergilus specie*:* this is of the genus molds. It is a major toxin producer and produce a wide spread infection referred to as Aspergillosis. It also causes bronchial pulmonary and skin leisure. Inhalation of large number of the spores can sometimes cause acute pneumonia. The fungus can also colonize cavities in the lung (due to inhaled tuberculosis or other condition producing a fungus ball). In patient with AIDS or other cases, *Aspergillus* species invade all parts of the body and cause death (Campbell and Steward, 1980; Khin *et al.,* 1989).

Rhizopus specie is a common mold not pathogenic but may cause mucormycosis (News, 1998). Although, no data is available on the infections acquired directly from money. The Nigeria currency notes may be responsible for the occurrence, spread and maintenance of the above mentioned disease in human populace.

This study revealed a significant association between bacterial and fungal contamination and the condition of the currency, with higher rates of micobial contamination on the dirty/mutilated notes ie currency used by beggers. This finding has very important health and economic implications, especially in underdeveloped and developing tropical nations of the world and particularly in Asia and Africa (Siddique 2003). 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 (Anderson 1991, Gwatkin 2000). Risk of infection is increased several fold when objects that change hands at a high frequency, such as currency notes, are contaminated with microbes. The risk is by no means restricted to residents of the country in question; it might even be greater for expatriates, tourists, and visitors from other countries, who may not be immune to the pathogens.

In Nigeria, poor-currency-handling culture is widespread, and there is indiscriminate abuse of currency notes. A great majority of the populace does not carry money in wallets, and squeezing of currency notes is a common occurrence. Women, especially among the unenlightened, often place money underneath their brassieres, while men place theirs in their socks. These activities not only enhance currency contamination but may also increase the risk of infection from contaminated notes. The situation is further compounded by the inability of the Nigeria government *to* consistently withdraw old, worn-out, and mutilated notes from circulation. The presence of damaged currency notes and the failure to consistently withdraw them from circulation are common phenomena in many parts of Africa and Asia (Gadsby, 1998; Podhajny 2004). The persistence of damaged or terribly mutilated notes in active circulation

could elevate their contributory role in transmission of some pathogens, thereby constituting potential public health hazard. Different species of bacteria isolated on this study are similar to those studied by Khin Nwe and co-workers (1989) in Rangoon, Myanmar; Goktas and Oktay (1992) in Turkey; and Pope and co-workers (2002) in Ohio. All of these researchers strongly suggested that money plays a role in the transmission of antibiotic-resistant and potentially harmful bacterial agents.

The study reported here found relatively more prevalence of bacteria among lower-denomination notes, hand-to-hand exchange (Gadsby 1998). The results did not suggest that any one denomination was particularly susceptible to or protected against contamination, since pathogens were found on all denominations of the currency notes and were absent only on the mint notes from banks. Siddique (2003) reported that a foreign bank wins business by guaranteeing its customers with a steady supply of fresh, new currency notes in Bangladesh. This practice may not guarantee the absence of microbial contamination, but it could minimizethe risk of currency-associated infection.

The plate count done on the investigated samples as shown on table 4 indicated that beggers have the highest colony with 2.4 $x10^{-5,}$ followed by hawkers with 1.8 $x10^{-5}$ market women1.6 $x10^{-5}$, bus conductors 1.5 $x10^{-5}$and bankers 1.0 $x10^{-5}$. The highest count on samples collected from beggers may be attributed to the nature of environment they stay where they come in contact with microorganisms. The lowest count on samples collected from bankers may be because the samples have been stored for sometimes leading to the death of some of the microorganisms.

A significant association was established between contamination and sources of currency (Beggers, Hawkers, Market women, Bus conductors and Bankers in this study), with the highest levels of contamination found among currency notes from Beggers, followed by Hawkers to Market women. Khin and co-authors (1989) isolated high levels of enteric pathogens from paper- Nepal Journal of Science and Technology 10 (2009) 161-166 money samples obtained from butchers and fish mongers in a local market in Rangoon, Myanmar. In most developing countries, including Nigeria, sanitation facilities at slaughterhouses and meat markets are grossly inadequate, resulting in very poor environmental sanitation, thus enhancing cross contamination from simultaneous handling of money and animal products. Major cities in Nigeria, as in other developing countries, are witnessing an influx of child labors. Most of these individuals searching for the unskilled job especially hanging on the doors of the three wheelers or microbuses and buses and live under severely unhygienic conditions, appear sick, and sometimes have putrefying sores on their bodies. It was not surprising that currency notes obtained from them were highly contaminated.

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