A study of Bacterial Contamination of Ghanaian Currency Notes in Circulation

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Citation

D Tagoe, S Baidoo, I Dadzie, D Ahator. *A study of Bacterial Contamination of Ghanaian Currency Notes in Circulation*. The Internet Journal of Microbiology. 2009 Volume 8 Number 2.

Abstract

The study aimed at determining the presence, type and nature of bacterial contamination of Ghanaian currency notes in circulation. One hundred currency notes of different denominations were randomly collected from sellers on the major streets and markets of the Cape Coast Metropolis into sterile paper bags, shaken in universal bottles with 10ml sterile buffered peptone water, removed and the resulting peptone water incubated overnight and later sub-cultured onto Blood agar, MacConkey, Cysteine Lactose Electrolyte Deficient (CLED) and incubated at 37C for 24hours. Colonial Morphology, Gram Reactions and Biochemical tests were used for identification of isolates. All 100 samples collected were contaminated with one or more bacteria representing 100% contamination. A total of 107 bacteria isolates were obtained from the 100 samples made up of 13 different bacteria species. Bacteria isolated from the notes include Coagulase negative Staphylococci (23.4%), Staphylococci aureus (8.4%), Escherichia coli (5.6%), Bacillus species (23.4%), Klebsiella species (5.6%), Enterobacter species (2.8%), Enterococci species (10.3%), and Proteus species (8.4%) among others. The One Ghana Cedi and Twenty Ghana Cedi notes had more bacteria isolated than their number sampled (43 out of 40) and (25 out of 20) respectively. Although the number of species isolated increased with sample numbers, all the denominations were contaminated with Coagulase Negative Staphylococci and Bacillus species. Four non-circulated notes of each denomination used as controls had no bacteria growth. This work seeks to confirm bacterial contamination of everyday currency and also introduces the nature and levels of contamination of the Ghanaian currency.

INTRODUCTION

The possibility that currency notes might act as environmental vehicles or formites for the transmission of potential microorganism was suggested in the 1970s (Abrams & Waterman, 1972). The use of paper currency for every type of commerce is hard on the currency, with the lower-denomination notes receiving the most handling because they are exchanged frequently (Gadsby, 1998; Ogbu and Uneke, 2007). These means money which may get contaminated during production, storage, after production, and during use are always in circulation (Hugo et al., 1983). Confirmation of contamination of money by drugs has been detected in the United States and United Kingdom (Ritter, 1997; Jenkins, 2001, Thompson, 2002). Contamination from the skin, anal region, wounds, nasal secretions and aerosols generated by sneezing and coughing are potential sources of transfer of microorganisms to currency notes during handling (Mackintosh and Hoffman, 1984).

Numerous research on currency in several countries indicated bacterial contamination. A study by Hosen et al., (2002) in Bangladesh revealed coliform contamination of 80% of thirty old two-taka notes, Pope et al., 2002, isolated pathogenic or potentially pathogenic organisms from 94% of one-dollar bills, Basavarajappa et al., (2005) found 96 out of 100 currencies contaminated with bacteria (K. pneumoniae, E. coli, S. aureus, Pseudomonas species and S. Typhi), fungal and protozoa and Umeh et al., in 2007, revealed that 89.8% of Nigerian currency notes in circulation within the University of Agriculture, Makurdi Campus has microbial contamination. The Ghanaian currency like any other being used in the world is exposed to the potential of bacterial contamination. Thus this present study seeks to introduce the nature, type and level of contamination of the Ghanaian currency in circulation.

MATERIAL AND METHODS

Samples and Sampling: The study samples were collected based on the level of usage and thus circulation. This was made up of 40 One Ghana Cedi notes (GH¢ 1), 25 Five Ghana Cedi notes (GH¢ 5), 20 Ten Ghana Cedi notes (GH¢ 10), 10 Twenty Ghana Cedi (GH¢ 20) notes and 5 Fifty

Ghana Cedi notes (GH¢ 50) collected randomly from sellers on the major streets and markets of the Cape Coast Metropolis into sterile paper bags between September, 2009 to March, 2010 and transported to the Laboratory of the Department of Laboratory Technology, University of Cape Coast for bacteriological analysis on the same day. Four currency notes of each denomination and not in circulation obtained from the Central Bank were used as control samples.

Culture and Isolation of Bacteria: Each currency note was aseptically transferred into individual universal bottles containing 10 ml of sterile buffered peptone water and the bottle vigorously shaken for 2 minutes. The currency is removed and the resulting peptone water solution served as a test sample and incubated for 24hours at of 37°C. The incubated test sample was then cultured onto Blood agar, MacConkey and Cysteine Lactose Electrolyte Deficient (CLED). The plates were incubated aerobically overnight in an incubator at 37C. Pure cultures were obtained by sub-culturing distinct colonies. Control samples underwent the same processes.

Identification of Isolates: Pure isolated colonies were identified using their Morphology, Gram reaction as well as biochemical techniques such as the Indole Catalase, Coagulase, Oxidase, Urease, Catalase test and Triple sugar iron tests (sugar fermentation and gas production).

Statistical Analysis: Data from study was analyzed descriptively using SPSS 16.0 software.

RESULTS

All 100 samples analysed were contaminated with various species of bacterial representing 100% contamination (Table: 1). A total of 107 bacterial isolates were obtained from the 100 samples analysed whilst all 20 samples not in circulation were negative for any bacterial isolate. Bacteria isolated from the notes were Coagulase Negative Staphylococci (23.4%), Staphylococci aureus (8.4%), -hemolytic Streptococci (3.7%), -hemolytic Streptococci (3.7%), E. coli (5.6%), Yersinia species (2.8%), Bacillus species (23.4%), Klebsiella species (5.6%), Shigella species (0.9%), Enterobacter species (2.8%), Enterococci species (10.3%), Listeria monocytogenes (0.9%) and Proteus species (8.4%), (Table: 1). Coagulase Negative Staphylococci and Bacillus species were both the highest isolates and also present on all the currency whilst Listeria Monocytogenes and Shigella species were the least isolated (Table: 2) being isolated one time each on different currencies.

Figure 1

Table: 1 The Type and the Numbers of Bacteria Isolated on the various Currencies

Bacterial Isolates	GH¢1 (40)	GH¢5 (25)	GH¢10 (20)	GH¢20 (10)	GH¢50 (5)	Percentages (%)
Coagulase Negative Staphylococci	8	6	8	2	1	23.4
Staphylococci aureus	5	1	1	2	0	8.4
α-hemolytic Streptococci	1	1	1	0	1	3.7
β-hemolytic Streptococci	3	0	1	0	0	3.7
Escherichia coli	4	0	2	0	0	5.6
Yersinia species	1	1	0	1	0	2.8
Bacillus species	8	7	4	3	3	23.4
Klebsiella species	4	2	0	0	0	5.6
Shigella species	0	1	0	0	0	0.9
Enterobacter species	2	1	0	0	0	2.8
Enterococci	3	4	3	1	0	10.3
Listeria monocytogenes	0	0	1	0	0	0.9
Proteus species	4	1	3	1	0	8.4
Total	**43**	**25**	**24**	**10**	**5**	**100**

Figure 2

Table 2: Percentage Bacteria Isolate from all Samples

Bacterial Isolates	GH¢1 (%)	GH¢5 (%)	GH¢10 (%)	GH¢20 (%)	GH¢50 (%)
Coagulase Negative Staphylococci	18.6	24	33.3	20	20
Staphylococci aureus	11.6	4	4.2	20	0
α-hemolytic Streptococci	2.3	4	4.2	0	20
β-hemolytic Streptococci	7	0	4.2	0	0
Escherichia coli	9.3	0	8.3	0	0
Yersinia species	2.3	4	0	10	0
Bacillus species	18.6	28	16.6	30	60
Klebsiella species	9.3	8	0	0	0
Shigella species	0	4	0	0	0
Enterobacter species	4.7	4	0	0	0
Enterococci	7	16	12.5	10	0
Listeria monocytogenes	0	0	4.2	0	0
Proteus species	9.3	4	12.5	10	0
Total	**100**	**100**	**100**	**100**	**100**

DISCUSSION

Bacterial, Viral, Fungal and Parasitic contamination of various currencies all over the world has been confirmed by several researchers such as Khin et al., (1989), Veevers,

(2006), Zarei et al. (2009) and Vaghmare et al., (2010). In this present study the 100% contamination of the currency confirms other research findings about bacterial contamination of currencies in circulation as well as introduces a new level of contamination although other researchers have detected contamination levels of 80% (Hosen et al., (2002), 90% (Bosh and Steyn (1997), 94% (Pope et al., (2002) and 96% (Igumbor et al., (2007). The Bank of Ghana in 2007, noted the several unhygienic conditions (butchers with bloody fingers, the artisan with dirty-dusty and oily fingers, the teacher with chalky and inky fingers, the street-food vendor with wetly-oily fingers, etc) receiving or picking the Ghanaian currency notes without any hygienic intervention (Bank of Ghana, 2007). The high levels of Coagulase Negative Staphylococci (23.4%) and Bacillus species (23.4%) confirmed earlier works by Goktas and Oktay, (1992) isolating 63.3% Staphylococcus epidermidis and 91% Bacillus species from 120 currency notes. Singh et al., (2002) predominantly isolated Bacillus species as the major contaminant on currencies studied. The widely accepted Ghanaian attitude of applying saliva to fingers while counting the currency notes, biting off corners of banknotes, sticking banknotes in braziers and even squeezing all serves as potential routes of exposure to these bacteria.

Bacteria isolated from the currency notes include Coagulase Negative Staphylococci, Staphylococci aureus, -hemolytic Streptococci, -hemolytic Streptococci, Escherichia coli, Yersinia species, Bacillus species, Klebsiella species, Shigella species, Enterobacter species, Enterococci species, Listeria monocytogenes and Proteus species. These corresponds to more than 90% of isolates from other researchers (Asikong et al., 2007; Oyero and Emikpe, 2007; Umeh et al., 2007 and Zarei et al., 2009). This indicated that, currency which is handled by large numbers of people, under a variety of personal and environmental conditions, can be a source of infection. Even though, it may be almost impossible to trace the source of infection, coins and currency notes may carry potentially pathogenic organisms and serve as formites in the transmission of infection (Singh et al., 2002). Folding or crumpling of banknotes creates pouches or crevices which could harbour dust particles and microorganisms some of which may grow or remain in a quiescent stage for long periods until they find suitable environments to grow and multiply (Bank of Ghana, 2007). Studies however have shown that there is no statistically significant association between physical condition and the bacterial contamination of currency notes (Zarei et al., in 2009) which places all currencies in circulation as potential public health hazards and immunocompromised persons stand the risk of acquiring opportunistic infections through handling of contaminated currency (Igumbor et al., 2007).

Scientific information on the contamination of the Ghanaian currency notes, the Ghana Cedi (GH¢), by microbial agents since its introduction in July 2007 is absent (Bank of Ghana, 2007). This study has determined the presence, type and nature of bacterial contamination of Ghanaian currency notes in circulation and will serve as a yard-stick to subsequent research work on other contamination parameters.

ACKNOWLEDGEMENT

We recognized the invaluable contributions of the technical staff of the Department of Laboratory Technology in bringing this manuscript into fruition.

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