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Microbial Examination of Automated Teller Machine (ATM) in Owerri Imo State

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Abstract

This study assessed the microbial examination of Automated Teller Machine (ATM) in Owerri, Imo state. A total of five ATMs were selected from different locations within Owerri Municipal, Imo state was used for this study. Samples were collected from the key-pads and screens of the ATM devices outside banking hails with sterile cotton swabs soaked in physiologic saline. The swab stick was removed in an aseptic manner and corked properly immediately. These were transported to the laboratory inside a sealed plastic bag within 2 hours of collection. The results show the total heterotrophic bacteria county of ranged from 2.2'x 10^2 cfu/g - 2.9 x 10^2 cfu/g, the coliform bacterial counts ranged from 2.0 x 10^2 cfu/g - 3.1 x 10^2 cfu/g and total fungal count ranged from 1.1 x 10^2 cfu/g- 2.3 x 102 cfu/g. Bacterial isolated were Escheriches coli, Pseudoatomic specie., Klebsiella specie, and Staphylococcus aiireus. Prevenance of isolation of bacterial isolates shows that Staphylococcus specie [15(34.8)] were the prevalent isolates, followed by E. coli [10 (23.2)], Pseudomonas specie [9(20.9)] and KlebsieUa specie [9(20.9)]. A total of four fungi were isolated. These comprises of Aspergillus specie., Rhizopus specie, Penicillin specie, and Candida specie This study has revealed the presence of bacterial contamination on ATM keypads, with possible health challenges. The organisms isolated were Staphylococcus aureus, Escherichia coll, KlebsieUa specie, Pseudomonas aeruginosa, Asterius specie., Rhizopus specie, Penicillin specie, and Candida specie. Tf pathogens can be found on ATM keypads, it is easier to comprehend why there are enrphases on public health safety.

Keywords: Microbial examination; Automated teller machine Owerri

Introduction

Contamination of environmental objects and surfaces by microorganisms is a common phenomenon. The presence of viable pathogenic bacteria on inanimate objects has been reported by earlier researchers [1]. Several studies of the human environment have demonstrated contamination and coloration of inanimate objects such as door handles, plastics, faucets, phones, money, fabrics, plastics and other fomiles by bacteria which is also responsible for the spread of various bacterial infections [2]. Human hands have been shown to play a significant role in the transmission and cross contamination of microorganisms between environmental surfaces [3]. Furthermore, microorganisms found to contaminate of mites have been shown to persist on the surfaces for periods ranging from a few hours to several months, and have been detected and recovered from surfaces after routine conventional cleaning. The ability of inanimate objects to support viable microorganisms for a prolonged period of time is well documented [4] and such environmental surfaces and objects, especially those in close proximity with persons and frequently touched, poses a lot of threat to human health and is a cause for public concern. Examples of such inanimate objects in the environment that are currently in frequent contact with the hands are the keypads of an automated teller machine (ATM). Automatic teller machines (ATMs), also known as cash machines in the United States are the longest standing and most widely used form of computer driven public technology [5], with an estimated over 2.4 million units in use since their invention and use in the late 1960's, This wide usage has consequently led to regular and unrestricted sharing of interfaces among users. With the harboring of microorganisms acquired -from the human microflora or as transient organisms from the environment, and previous accounts of cross contamination of microorganisms [6]. it is readily

conceivable that pathogens could be transferred among users who share interfaces.

Materials and Methods

Sample area

Imo State is one of the 36 States of Nigeria, located in the southeast region of the country. Formed in 1976 when it split from the former Fast-Central State, Imo Slate is bordered by Abia Slate on the east, Delta Stale to the West, Anambra State on the north, and Rivers State to the south. The state capital, Owerri, is often described as the entertainment capital of Nigeria. Imo State is a predominantly Igbo speaking state, with Igbo people consenting an estimated 98% of the stales population. During the Nigerian Civil War (1967-1970), the present-day borders of Imo State were part of the Republic of Riafra, a secessionist state formed by Igbo nationalists. Secessionist sentiment remains commonplace in modern Imo State, with the Movement for the Actualization of the Sovereign State of Biafra (MASSOB) being headquartered in the district: of Okigwe

Sample Size

A total of live ATMs was selected from different locations in Imo State

Ethical Approval

Written permission was obtained from five (5) banking organizations including Zenith, United Bank of Africa, "First Bank of Nigeria, Access Bank and Stanbic Bank.

Eligibility of Subject

Inclusion Criteria

Samples were collected from the key-pads and screens of the ATM devices outside banking halls with sterile cotton swabs soaked in physiologic saline. The swab stick was removed in an aseptic manner and corked properly immediately. These were transported to the laboratory inside a sealed plastic bag within 2 hours of collection. All samples were transported to the laboratory as soon as possible without delay and was processed on the same clay of collection.

Media preparation

All the media used were prepared according to the manufacturer's guide. Mannitol Salt Agar (MSA), MaeConkey and Nutrient, agar plates were used for the isolation of bacteria and saboraud dextrose agar was used for isolation of fungi.

Identification of The Bacteria Isolates

Identification of pure colonies using morphological characteristics were based on morphological differences, colonies was isolated from their axenic culture. Petri-d is lies was divided into quadrants and sub culturing carried out by streaking. Colony morphology observations formed a major identifying criterion for bacteria. The characteristics observed include (circular, irregular, spreading), elevation (flat, slightly raised or markedly raised), pigmentation (red, white, pink, colorless), size (pinpoint, small, medium, large) and texture.

Gram Staining

Culture plates of bacteria, microscopes, wire loops, normal saline, Bunsen burners, timers, microscope slides, oil immersion, distilled water, crystal violet, and Ingol iodine. On a clean slide, a drop of sterile saline was added using a sterilized wire loop. The wire loop was flamed to red hot and allowed to cool, and then, a small number of cells from an isolated colony 24 hours on a culture plate was collected and mixed in a drop of saline and it was spread on the slide to make a thin, uniform smear. The smear was then allowed to air dry before they heal lead by carefully passing them over a Bunsen Burner flame six to eight times. Crystal violet was used to stain the smear for one minute, then it washed off with distilled water and drained, then it LugoPs iodine was added and was left on the smear for 1 minute, which was washed off gently with distilled water and drained. The slides were decolorized with acetone for 3 seconds by adding uniformly and quickly to the slide, it was washed off quickly with distilled water and then saffranin was added and after 1 minute it was washed off with distilled water. The slides were air dried and immersion oil was dropped on the smears and examined microscopically using x100 oil immersion objective of the microscope.

Identification of Bacteria Using Biochemical Methods

Indole Test

Kovac's reagent, peptone water, incubator, wire loop. The test organism was inoculated in sterilized tube containing peptone water broth, the solution was incubated aseptically at 37°C for 24-28 hours, then 0.5ml of Kovac's reagent was added to the broth. The result: was noted.

Methyl Red Test

MR.-VP medium (glucose broth), methyl red indicator, wire loop, incubator. By using a sterile wire loop, (The test organism was inoculated into the fresh, sterile prepared MR-VP medium and it was incubated at 37°C for 2-5 days. After incubation the broth was obtained from the incubator, 5 drops of 0.04% solution of alcoholic methyl red solution were added and mixed properly. Then the result was read and rioted,

Voges- Proskauer Test

MR-VP broth, alpha naphthol, 40% KOH, deionized water. A tube containing the MR/VP broth was inoculated with the pure culture of (he tests organism and was incubated at 35°C at 24 hours. Then 1.5mL of 5% alpha naphthol and 0.5mL of 40% KOH was added and mixed properly. The bottles were left to stand for 5 minutes for aeration. Changes were observed.

Oxidase Test

Oxidase reagent, bacterial cultures, Whatman No 2 filter paper, glass rod. A piece of filter paper was placed in a clean Petri-dish and 2-3 drops of freshly prepared oxidase reagents was added. Using a sterile loop, test bacterial was picked and smeared over a small area of the filler paper. The color change was examined after 10 seconds.

Catalase Test

Bacterial culture, H202, glass slide, test tubes, glass rod. A drop of 3% H202 was placed on the opposite ends of a clean grease free glass slide with the help of a dropper. A small portion of (her bacterial culture was transferred on the glass slide containing the H2O2 with a sterile glass rod. The sample was examined for immediate bubbling effervescence of 02.

Identification of Fungi Isolates

The growth pattern, pigmentation and size of colonies were recorded at the incubation period to aid identification of the organisms.

Use Slide Culture Method

The isolate was identified using cultural characteristics and morphology. With the help of sterile petri dishes, sterile filter paper was placed in each of the Petri dishes and 1ml of distilled water was added into the petri dish as sterile U shape glass rod was placed in each of the petri dish. Will) the help of inoculating needle, a cubelike shape of already prepared SDA was cut, four days to 1-week fungal growth was smeared by the four sides of the SDA using a sterile wire loop and a sterile cover slip was placed on the inoculums in the Petri dish. The plate was then covered and kept at room temperature for 4 to 7days as growth was observed daily before examination.

Cell Morphology of Fungi Isolate

A drop of lactophenol (LP) was placed on a clean microscopic slide The cover slip from the glass culture was gently removed and placed in the drop of lactophenol (LP) and also a drop of LP was dropped on the slide from the old culture as the media cultured on the slide was gently removed a sterile cover slip was placed on the slide and observe microscopically. It was first view at X10 to focus the lens well then X40 to get a clearer view.

Results

Table 1 shows the bacterial counts of each sample. The total heterotrophic bacteria count of ranged from 2.2 x 10^2 cfu/g -2.9 x 10^{2}" cfu/g, the coliform bacterial counts ranged from 2.0 x 10^2 cfu/g -3.1 x 10^2 cfu/g and total fungal count ranged from 1.1 x 10^2 cfu/g -2.3 x 10^{2}" cfu/g.

***Table 1**: Total Viable Consult of Bacteria Isolates.*

Total Viable Count (CFU/g)				
SN	**Sample**	**THC**	**TCC**	**TFC**
1	A	2.2 x 10^2	2.8 x 10^2	1.1 x 10^2
2	B	2.6 x 10^2	2.5 x 10^2	2.0 x 10^2
3	C	2.9 x 10^2	3.0 x 10^2	1.8 x 10^2
4	D	2.8 x 10^2	2.0 x 10^2	1.6 x 10^2
5	E	2.4 x 10^2	3.1 x 10^2	2.3 x 10^2

***Table 2**: Morphological and Biochemical identification of bacteria isolates.*

S/N	Morphology	Gramstaining	Catalase	Citrate	Indole	Methylred	Voges proskaeur	Oxidase	Motility	Suspected organism
1	Yellor, Glassy, Round, Coccie in cluster	+	+	+	-	+	+	+	-	*Staphylcococcus specie*
2	Greenish, Opague, Flat and Odour colony	-	+	+	-	-	-	+	+	*Pseudomonas specie*

3	Cream, Smoot, Irregular, Short rod in single colony	-	+	+	-	-	+	-	-	*Klebsiella specie*
4	Cream, Smooth, Irregular, Short rod	-	+	-	-	+	-	-	-	*Escherichia coli*

***Table 3**: Prevalence of Isolation of Bacterial Pathogens.*

Isolates	Frequency (%)
Escherichia coli	10(23.2)
Staphylococcus specie	15 (34.8)
Pseudomonas specie	9 (20.9)
Klebsiella specie	9(20.9)
Total	43 (100.0)

***Table 4:** Colonial and Morphological Features of the Fungi Isolates from A.T.M.*

S/N	Morphological characteristics	Microscopie characteristics	Probable organism
1	Compact, clusters of dark colony	Hyline conidiophores phylides borne on vesicles, clusters of dark walled conidia with spetate hyphae	*Aspergillus specie*
2	Cotton-like, white in color	Simple and form apical, globular sporangia that are supported and elevated by a column shapped columella	*Rhizopus specie*
3	The pigmentation was initially white and became green which later turned to pinkish with time. they were filamentous in texture	Spetate hyphae with simple a conidiospores and conidia were observed	*Penicillum specie*
4	Creamy colonies that are smooth, convex and with a yeasty odour	Budding spherical to elongated cells forming pesudmycelium	*Candida specie*

***Table 5:** Number and percentage of fungi species isolated from A.T.M.*

Isolates	Number of Isolate	Percentage
***Aspergillus* specie**	15	40.5%
***Candida* specie**	10	27.0%
***Pcniclllum* specie**	7	18.9%
***Rhizopus* specie**	5	13.5%
Total	**37**	**100%**

Keys

THBO - Total Heterotrophic Bacteria count
TCC =Total Coliform count
TSS = Total Salmonella Shigella
Sample A – Zenith bank
Sample B = UIJA
Sample C = First Bank of Nigeria
Sample D = Access Bunk
Sample E, - Stannic Bank

Morphological and Biochemical identification of bacteria isolates

Results from Table 2 shows the morphological appearances and biochemical properties of isolated bacteria. Bacterial isolated were Escherichia coli, Pseudomonas specie, Klebsiella specie, and Staphylococcus specie.

Prevalence of isolation of bacterial pathogens

Table 3 shows the prevalence of isolation of bacterial isolates from A.T.M. Of the 43 bacterial isolates obtained, Staphylococcus specie [15(34.8] were the prevalent: isolates, followed by K. coll ['10 (23.2)], Pscitcloinonas specie [9(20.9) and Klebsiella specie [9(20.9)]

Colloidal and Morphological features of the Fungi Isolates from A.T.M

Results as shown in table 4 shows the Colonial and microscopic morphology of isolated fungi associated with A.T.M. A total of four fungi were isolated. These comprises of Aspcrgilins spiecie, Rhlzopns specie, Penicillin specie, and Candida specie.

Number and percentage of fungi species isolated from A.T.M

Table 5 shows the number and percentage of fungi species isolated from A.T'.M, which revealed (hat Aspergillus sp. was the most common isolate ('-1-0.5%), followed by Candida specie. (27.0%), Petucillum specie. (18,9%), and Rhizopus specie (1 3.5%).

Discussion

ATM machines are one of the most commonly touched surfaces today. The study assessed the microbial contamination of shared surfaces on user hardware interface of five (5) commercial banks randomly scattered within Owerri, Imo state metropolis in south-east Nigeria. A total of 43 bacterial organisms comprising of four (4) difference species were isolated. The result obtained in (Table 2) showed that bacteria such as Staphylococcus aureus; Escherichia coli; Klebsilla specie; and Pseudomonas aeruginosa, were isolated from the Automated Teller Machine (ATM) located in Owerri, axis Imo State. This result is in agreement with the result obtained by [7,8]. The bacteria isolated from (his study can cause hand-to-mouth infections in man if hands are not sanitized after using the ATM. There is also a possibility of them causing nosocomial infections through medical personnel that used an ATM without thorough sanitation of hands used on ATM in the hospital and its environs as also reported by [9]. These findings are in agreement with the results obtained by [10].

The higher prevalence of Staphylococcus aureus (34.8%) obtained might probably be due to high concentration of ATM users S. aureus is a normal flora of (he skins. Although S. aureus is not always pathogenic, it is a common cause of skin infections such as abscesses, respiratory infections such as sinusitis and food poisoning. In addition, it can result to opportunistic infections. 'The Klebsiella pneumonia isolated could possibly expose the users of the ATMs in the study area to pneumonia if good hygiene practices (especially hand washing after using ATMs) are not adhered to by the users [4]. The statistically significant relationship between the bacterial isolates and the respective locations could be as a result of several factors such as, poor hygiene practices by ATM users, rainfall, wind and high concentration of users at ATM galleries. Similarly, it has been reported that the keypads of ATMs harbored more bacteria than the computer keypads and this may be due to (lie fact that, the}' are exposed to many users, environmental factors such as rain and climatic factors such as wind [11]. The result of this study is also similar with the results of bacterial contamination from obtained the surfaces of the metallic keypads of the ATMs located within Abakaliki metropolis [12]. The abundance of E. co/l an enteric bacterium is indicative of possible fecal contamination which could also be a pointer also to poor hygienic practices by ATM users [13]. The results of CITJ fungal enumeration is demonstrated in Table 4 Data about fungal contamination in ATMs were described in a few studies. The fungal contamination in this study included Aspergillus specie, Rhizopus specie, Penicillium specie and Candida specie. The Aspergillus genera were the most dominant followed by Candida specie (27.0%), Penicillium specie (18.9%), and Rhizopus specie (13.5%). Aspergillus specie, are widespread in nature because they produce many spores, have wide ecological tolerance, can easily spread through the atmosphere, and they can contaminate almost any kind of surface [14]. Penicillium species are common contaminants on various substrates and are known as potential mycotoxin producers. Opportunistic infections leading to mycotic keratitis, o to my co sis and endocarditis have been reported. Its spores and components in atmosphere entering from respiratory tract affect the human health and may cause allergic reactions. Rhizopus species is one of the factors of opportunistic fungal infection, as skin and mucous membranes allergies [15].

Conclusion

This study has revealed the presence of bacterial contamination on ATM keypads, with possible health. challenges. The organisms isolated were Staphylococcus aureus, Escherichia coli, Klebsiella specie, Pseudomonas aeruginosa, Aspergillus spp., Rhizopus specie, Penicillin specie, and Candida specie. If pathogens can be found on ATM keypads, it is easier to comprehend why there are emphases on public health safely. The need to combine technological innovation with safe and healthy use is therefore strongly advocated in the light of current findings. Therefore, this showcase a general responsibility to see that measures are adequately place to ensure that transfer of infections through ATMs is reduced to it barest minimum and if possible, it should be eradicated totally.

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