Isolation and Identification of Bacteria on Automated Teller Machines (ATMs) in Makurdi Metropolis

Awua Yuana[1, *], Tsekaa Emmanuel Terkimbi[1], Atu Bernard Ortwer[1], Adikwu Peter[1], Gberikon Grace Mwuese[2], Odo Joel Inya[2]

[1]Department of Biological Sciences, Benue State University, Makurdi, Nigeria

[2]Department of Microbiology, College of Sciences, Federal University of Agriculture, Makurdi, Nigeria

Email address:

yuanaawua@gmail.com (A. Yuana)

[*]Corresponding author

Abstract: The automated teller machine (ATM) has been an important device in the banking sector and other financial institutions. The aim of this study was to isolate and identify Bacteria on the keypads of selected Automated Teller Machines (ATMs) in Makurdi metropolis. Swab sticks soaked with sterile normal saline were used to collect specimens from the keypads of the ATMs. The swab sticks were immediately transferred to the laboratory of Microbiology in the Department of Biological Science, Benue State University Makurdi. The collected samples were pooled into different tubes containing sterile normal saline and was agitated for 5minutes. This was further inoculated using the spread plate technique. The keypads of fifty (50) ATMs from five different locations in Makurdi were examined for bacterial contamination. The bacteria isolated from this study were, *Staphylococcus aureus* with a prevalence of (41.6%), *Escherichia coli* (34.4%) and *Klebsiella pneumoniae* (24.0%) on the keypads of the ATMs. There was a statistically significant relationship between the bacterial isolates and the respective locations (X^2=72.96; df=8; p=0.000). This result gives the impression that ATMs could be a potential "pathogen city". Therefore, adequate personal hygiene and regular routine cleaning of these machines bythe bank's authorities is recommended.

Keywords: Automated Teller Machine (ATM), Bacteria, Contamination and Makurdi

1. Introduction

The automated teller machine (ATM) is a self-service machine that dispenses cash and performs some human teller functions like balance enquiry, bills payment, mini statements and dispense of cash which is its major function. ATM transactions are carried out through the use of debit/credit cards which enable the card holders to access and carry out banking transactions without a teller. Different people from different socio-economic levels and hygienic status use the ATM daily and this increases the chances of hand-borne transmission of microorganisms to the machine surfaces. One of the most common routes for the spread of many infectious agents in the environment can either be direct or indirect contact on hands or on inanimate objects also known as hand-borne transmissions. Pathogens transmitted via the hands, serve as a serious factor in the spread of diseases [1, 10].

Microbes are found on surfaces that require contact with human hands like computer keyboards, door handles, mobile phones and elevator buttons which serve as microbial reservoirs. [8, 5]. Many factors have been attributed or shown to influence the bacterial transfer between surfaces, the source and destination surface features, bacterial species involved, moisture levels, pressure and friction between the contact surfaces and inoculums size on surfaces [4]. Many bacterial, fungal and viral pathogens can survive on inanimate objects for

several months and such pathogens could cause epidemic infections [1, 5].

Studies have shown that there is heavy contamination of parts of ATMs due to contact with customer's hands such as the keypads and screens. ATMs might serve as potential areas for pathogen accumulation and they might have a role in microbial transmission in the community. The wide acceptance of electronic banking technology has created new environmental challenges on publicly used electronics and technological devices. It provides an avenue for high human dermal contact which could be a source of contamination or infection and pose a health hazard to man.

2. Materials and Methods

2.1. Study Area

Makurdi is a city found in Benue Nigeria. It is located 7.73 latitude and 8.52 longitudes and it is situated at elevation 104 meters above sea level, [8].

2.2. Sampling Site

The study area covered some selected ATMs located within Makurdi town. A total of fifty (50) swabbed samples were obtained from five (5) different locations within Makurdi town. These locations were: Wadata Area, Wurukum (Bank Road), High Level, Benue State University and Northbank.
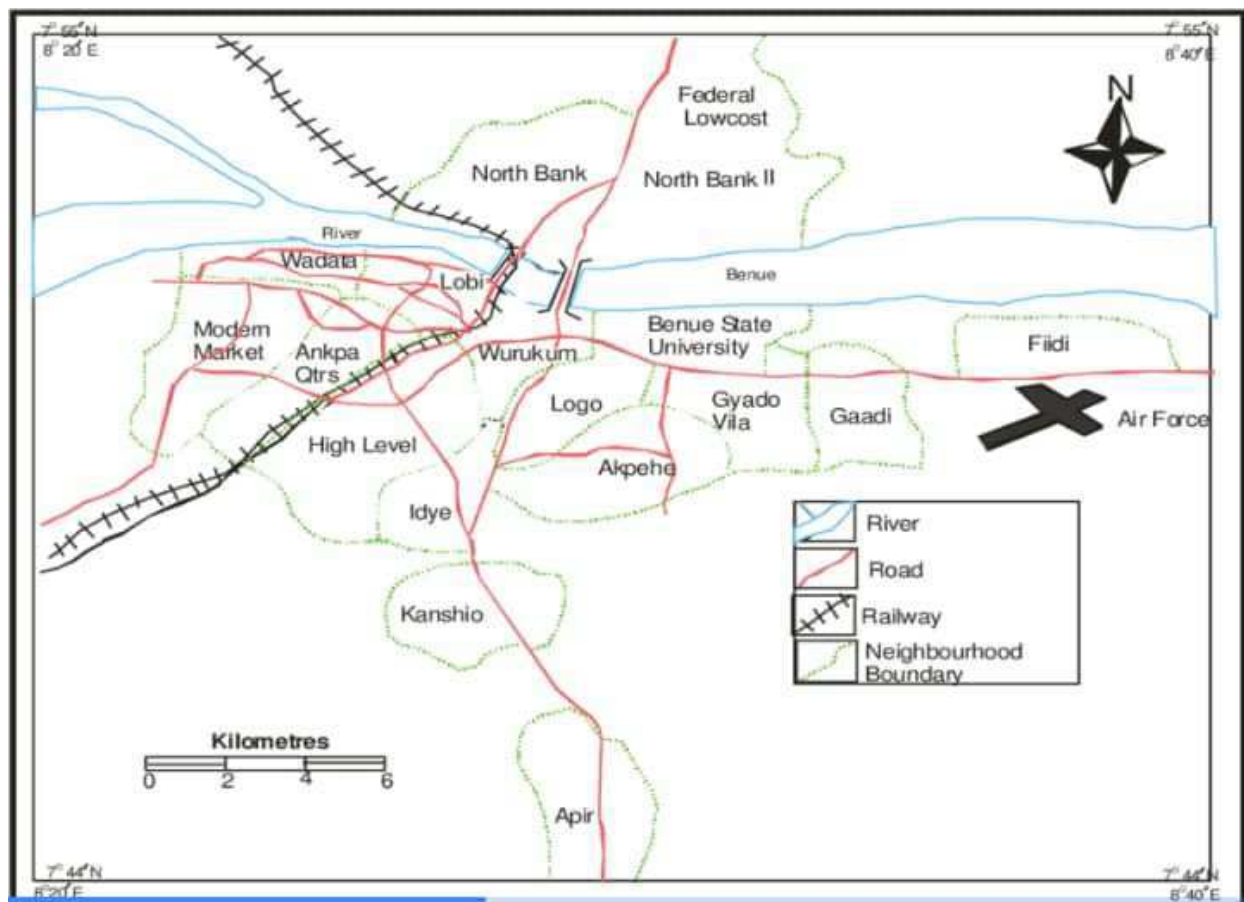

Figure 1. Map ofMakurdi Town Showing the Location of ATMs.

2.3. Isolation and Identification of Bacteria

The method described by [2] was used. The swab sticks bearing the samples from each location were dipped into a test tube containing a sterile normal saline and was agitated for 5minutes before inoculums were collected from there and cultured by spread plate technique on manitol salt agar, eosin methylene blue agar, macConkey agar and salmonella shigella agar.

Characterization and identification of isolates was done on the basis of cultural appearance of organisms, colonial morphology, differential and selective media, and biochemical tests [3].

2.4. Biochemical Tests

The biochemical tests were carried out to differentiate types of bacterial species.

2.5. Data Analysis

The data obtained from the study was subjected tostatistical package of social science (SPSS) version 21.0 using descriptive statistics such as percentages and chi-square.

3. Results

From five (5) different locations spanning major areas within Makurdi metropolis, fifty (50) samples were collected for analysis. Bacterial species were isolated, ranging from *Escherichia coli, Staphylococcus aureus* and *Klebsiella pneumoniae* across locations. In Bank road (Wurukum) 39 Bacteria colonies (E. *coli* 7, *Staphylococcus. aureus* 21 and *Klebsiella pneumoniae* 11) were counted. In High Level 43 Bacteria colonies (*Escherichia coli 3, Staphylococcus aureus 35 and Klebsiella pneumoniae 5*) were counted. In Benue State University, 86 Bacteria colonies (*Escherichia coli 31, Staphylococcus aureus 47 and Klebsiella pneumoniae 8*) were counted, in Modern Market/Wadata 92 Bacteria colonies (*Escherichia coli 42, Staphylococcus aureus 17 and Klebsiella pneumoniae 33*) were counted and North-Bank 74 Bacteria colonies (*Escherichia coli 32, Staphylococcus aureus 19 and Klebsiella pneumoniae 23*) were counted making a total of 334 bacterial counts (Table 1).

The number of bacterial species isolated in total were three, of the total 334 bacteria colonies counted, *Escherichia coli* had a prevalence of 115 (34.4%), *Staphylococcus aureus* had the highest of *149* (41.6%) and Klebsiella *spp.* had the least 80 (24.0%) (Figure 3).

The result of the Chi-square (x^2) analysis showed that there was a statistically significant relationship between the bacteria isolates and the respective locations (x^2 =72.96; DF=8; p=0.000) as shown in Table 2.

Table 1. Percentage occurrence of bacteria isolated from different ATM locations.

Number of isolates (%)				
Location	No. Sampled	*E. coli*	*S. aureus*	*K. pneumoniae*
Bank Road, Wurukum	10	7 (18)	21 (54)	11 (28.2)
High Level	10	3 (7)	35 (81.4)	5 (11.6)
Benue State University	10	31 (36)	47 (54.7)	8 (14.3)
Modern Market	10	42 (47)	17 (18.5)	33 (35.9)
North Bank	10	32 (43)	19 (25.7)	23 (31.1)
Total	50	115	139	80

Table 2. Distribution of isolates from different locations.

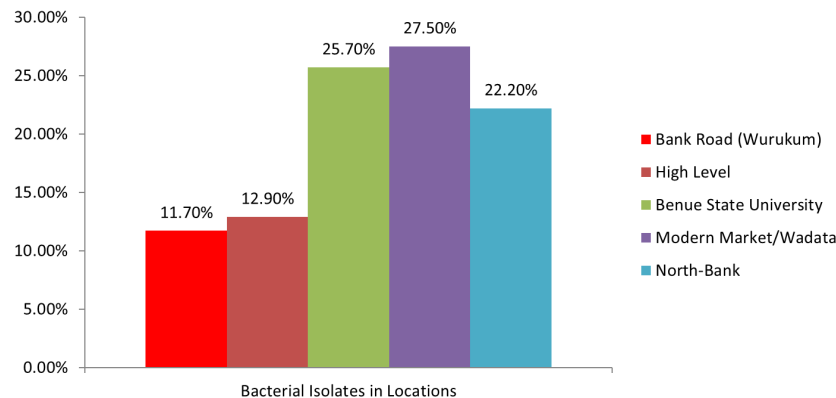| Location ofATMs	*Escherichia coli*	*Staphylococcus aureus*	*Klebsiella pneumonia*
Bank road (Wurukum)	7	21	11
High level	3	35	5
Benue state university	31	47	8
Modern market/ Wadata	42	17	33
North bank	32	19	23

x^2=72.96; df=8; p=0.000.

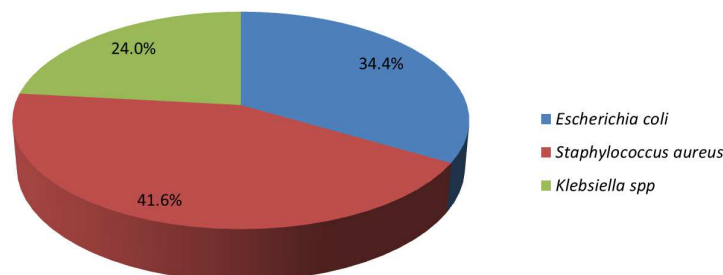*Figure 2. Prevalence of percentage occurrence of Organisms isolated from different studyLocation.*

Figure 3. Percentage prevalence of bacteria isolated.

Table 3. Colonial morphology and biochemical characterization of isolates.

Organisms			
Test	*Escherichia coli*	*Staphylococcus aureus*	*K. pneumoniae*
Indole	+	-	-
Catalase	-	+	-
Citrate utilization	-	-	+
Coagulase		+	
Gram reaction	-	+	-
Colony appearance	Green metallic	yellow colonies	pinkish colonies

Key:+ positive
- Negative.

4. Discussion

Pathogenic bacteria such as *Escherichia coli, Staphylococcus aureus* and *Klebsiella pneumoniae* were isolated from the Automated Teller Machines (ATMs) located in Wadata / Modern market, High level, North bank, Bank road and Benue State University within Makurdi metropolis. The bacteria isolated from this 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 [6]. These findings are in agreement with the results obtained by [5] and [3].

The higher prevalence of *Staphylococcus aureus* (41.6%) obtained might probably be due to high concentration of ATM users at ATM galleries since *S. aureus* is a normal flora of the skin. 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 [5]. In addition, it can result to opportunistic infections.

The higher prevalence of E. coli in Wadata / Modern market (47%) as compared to North Bank (43%) might be due to poor hygiene practices coupled with unsanitized hands after leaving the toilets [6].

The *Klebsiella pneumoniae* isolated especially in wadata / modern market 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 [7]. The statistical 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, [2] reported that the keypads of ATMs harbored more bacteria than the computer keypads and this may be due to the fact that, they are exposed to many users, environmental factors such as rain and climatic factors such as wind. 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 [6]. The abundance of *E. coli* an enteric bacterium is indicative of possible fecal contamination which could also be a pointer also to poor hygienic practices by ATM users [5].

5. Conclusion

In conclusion, bacteria isolated from this study were *Escherichia coli* (34.4%), *Staphylococcus aureus* (41.6%) *and Klebsiella pneumoniae* (24.0%). There is a highly significant relationship between the bacterial isolates and the respective locations which may amount to several factors such as, poor hygiene practices by ATM users, rain fall, wind and high concentration of users at ATM galleries.

References

[1] Adedeji, A. B. (2019). A Study Investigating Bacterial Colonization on Automated Teller Machines in Ibadan Metropolis, South-West Nigeria. *Acta Scientific Pharmaceutical Sciences,* 3 (6): 119-132.

[2] Agu, R. C., Osondu-Ayanwu, C. and Nwachukwu, A. A. (2018). Isolation and identification of Microorganisms associated with automated teller Machines in Calabar metropolis. *Journal of Advances in Biology and Biotechnology,* 18 (3): 1-7.

[3] Mbajiuka, S. C. (2015). Isolation and Identification of microorgansism, associated with the use of automated teller machine (ATM) in Michael Okpara University of agriculture, Umudike (MOUAU) and its Environs. *World* Journal *of pharmaceutical Research,* 4 (8): 85-89.

[4] Nagajothi, J. (2015). Study of Prevalence of Microbial Contamination with its Antibiotic Resistance Pattern in Automated Teller Machine in and around Puducherry, India. *Journal of Earth Environment and Health Sciences,* 1 (1): 27-3.

[5] Nwankwo, E. O. and Offiah J. C. (2016). Bacterial Contamination of User Interface of Automated Teller Machines (ATM) of Various Banks in Umuahia Metropolis, Abia State, Nigeria. *International Journal of Tropical Disease & Health,* 13 (3): 1-9.

[6] Nworie, O., Mbaba, M., Chukwudi, A., Oko, I., Chukwudum, S. O., Agah, V. M. and Ekuma, U. O. (2012). Antibiogram of bacteria Isolated from automated teller machines within Abakaliki Metropolis. *American Journal of Infectious Disease,* 8 (4): 168-174.

[7] Okoro, J., Oloninefa, S. D., Ojonigu, A. F. and Sani, M. (2018). Assessment of some selected automated teller Machines In Kaduna Metropolis for Pathogenic Bacteria Contamination, *British Journal of Environmental Sciences.* 6 (1): 19-35.

[8]   Onuoha, S. C. and Fatokun, K. (2014). Bacterial contamination and public health risk associated with the use of banks automated teller machines (ATMs) in Ebonyi State, Nigeria. *Journal of Public Health Research,* 2 (2): 46-50.

[9]   Tarun, M. (2014). Drugs and Diseases. Medscape. Transfer efficiency of Gram positive bacteria, Gram negative bacteria and phages. *Journal of Applied Microbiology*, 93: 585-592.

[10]   Tekerekoglu, M. S. (2013). ''Bacteria found on Banks automated teller machines (ATMs)''. *African Journal of Microbiology Research,* 7 (16): 1619-1621.

[11]   Wikipedia., 2009. "Benue State, Nigeria", Retrieved from hpp/en.wikipedia.org/wiki/Benue-State.