Isolation and Identification of Pathogenic Microorganisms From Automated Teller Machine Key Pads of Commercial Banks in Ibadan North

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Abstract

The automated teller machine (ATM) has been an important device in the banking sector and other financial institutions. The ATMs are visited everyday by millions of people for financial transactions. This machine is accessible to different people from different socio-economic levels. and hygiene status use the ATM daily and increase the chances of hand-borne transmission of microorganisms to the machine's surfaces. The ATMs might be potential areas for pathogen accumulation. The aim of this study therefore, was to isolate sand identify Bacteria on the keypads of selected ATM of 4 commercial bank in Ibadan north. Swab samples were taken from the keypads of the four ATMs. The swab sticks were immediately transferred to the laboratory. Isolation was done on nutrient agar, Eosine methylene blue agar (EMB) and Salmonella shigella agar (SSA) following bacteria. Standard microbiological procedures. Identification of microorganisms was done using colonial and microscopic. The results revealed that these machines that serve as cash dispensing device can be a potential disease dispensing machines as samples analyzed revealed bacterial isolates such as Salmonella s($2.0x10^{-4}$ cfu/mL bank with code X and Z had $1.0 x10^{-4}$ cfu/ml, most pathogens on characterization revealed the genus of the particular organisms Salmonella typhimurium which is the pathogen that causes typhoid disease and other enteric disorder.

Keywords: Automatic Teller Machine (ATM), Microorganism, Pathogen isolation , Bacteria, Typhoid

Isolement et Identification des Micro-Organismes Pathogenes A Partir des Claviers des Guichets Automatiques Bancaires des Banques Commerciales Au Nord d'Ibadan

Résumé

Le guichet automatique bancaire (GAB) a été un dispositif important dans le secteur bancaire et d'autres institutions financières. Les guichets automatiques sont visités chaque jour par des millions de personnes pour des transactions financières. Cette machine est accessible à différentes personnes de différents niveaux socio-économiques et l'état d'hygiène utilisent quotidiennement le guichet automatique et augmentent les risques de transmission manuelle de micro-organismes aux surfaces de la machine. Les guichets automatiques pourraient être des zones potentielles d'accumulation d'agents pathogènes. Le but de cette étude était donc d'isoler et d'identifier les bactéries sur les claviers des guichets automatiques sélectionnés de 4 banques commerciales au nord d'Ibadan. Des écouvillons ont été prélevés sur les claviers des quatre guichets automatiques. Les écouvillons ont été immédiatement transférés au laboratoire. L'isolement a été effectué sur de la gélose nutritive, de la gélose au bleu de méthylène éosine (BEM) et de la gélose Salmonella shigella (GSS) après les bactéries. Procédures microbiologiques standard. L'identification des micro-organismes a été faite à l'aide de colonies et de microscopie. Les résultats ont

révélé que ces machines qui servent de distributeurs de billets peuvent être des distributeurs potentiels de maladies, car les échantillons analysés ont révélé des isolats bactériens tels que Salmonella s (la banque de 2,0 x 10^{-4} ufc/mL avec le code X et Z avait 1,0 x 10^{-4} ufc/ ml, la plupart des agents pathogènes lors de la caractérisation ont révélé le genre des organismes particuliers Salmonella typhimurium qui est l'agent pathogène qui cause la maladie typhoïde et d'autres troubles entériques.

Mots-clés : Guichet automatique bancaire (GAB), Micro-organisme, Isolement de pathogènes, Bactéries, Typhoïde

عزل وتحديد الكائنات الدقيقة المسببة للأمراض من آلة الصراف الآلي الوسادات الرئيسية للبنوك التجارية في إبادان الشمالية

جامعة إبادان ، إبادان ، نيجيريا.

الملخص: تعتبر ماكينة الصرف الآلي (ATM) من الأجهزة المهمة في القطاع المصرفي والمؤسسات المالية الأخرى. يزور ملايين الأشخاص أجهزة الصراف الآلي يوميًا لإجراء معاملات مالية. هذه الآلة متاحة لأشخاص مختلفين من مختلف المستويات الاجتماعية والاقتصادية. والحالة الصحية تستخدم أجهزة الصراف الآلي يوميًا وتزيد من فرص انتقال الكائنات الدقيقة المحمولة يدويًا إلى أسطح الماكينة. قد تكون أجهزة الصراف الآلي مناطق محتملة لتراكم العوامل الممرضة. لذلك ، كان الهدف من هذه الدراسة هو عزل وتحديد البكتيريا على لوحات المفاتيح لأجهزة الصراف الآلي المختارة لأربعة بنوك تجارية في إبادان شمال. تم أخذ عينات المسحة من لوحات المفاتيح لأجهزة الصراف الآلي الأربعة. تم نقل أعواد المسحات على الفور إلى المختبر. تم العزل على أجار المغذيات ، Eosine methylene blue agar (EMB) و Salmonella shigella agar (SSA) التالية للبكتيريا. الإجراءات الميكروبيولوجية القياسية. تم التعرف على الكائنات الحية الدقيقة باستخدام المستعمرة والمجهرية. أظهرت النتائج أن هذه الآلات التي تعمل كجهاز صرف نقدي يمكن أن تكون آلات محتملة لتوزيع الأمراض حيث كشفت العينات التي تم تحليلها عن عزلات بكتيرية مثل Salmonella s (2.0x10-4 cfu / mL bank with code X and Z has 1.0 x10-4 cfu / مل ، كشفت معظم مسببات الأمراض عند التوصيف عن جنس الكائنات الحية المعينة Salmonella typhimurium وهو العامل الممرض الذي يسبب مرض التيفود والاضطرابات المعوية الأخرى.

الكلمات الرئيسية: آلة الصراف الأوتوماتيكية (ATM) ، الكائنات الحية الدقيقة ، عزل العوامل الممرضة ، البكتيريا ، التيفوئيد

Introduction

Automated Teller Machine or Automatic Teller Machine (ATM) is a computerized telecommunication device that enables customers of a financial institution to carry out financial transactions with ease without the need for a human clerk, cashier or bank teller (Odeyemi *et al*., 2018). By the 1960s, several teams around the world were working independently to devise a method for withdrawing cash from a bank after hours without committing a crime. The timeline for the advent and spread of the ATM is given below in 1960, an American named Luther George Simjian invented the Bankograph, a machine that allowed customers to deposit cash and checks into it. 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 (Adedeji, 2019). With the wide

acceptance and extended usage of ATMs across Nigeria, the electronic technologies are considered as sources of bacterial contamination due to public usage. However little report exists on the associated health risk in the use of ATM, this study provides more insight on the effect of microbial contamination and their adverse effect on health status. Microorganisms are forms of life that require magnification to see and resolve their structure. They include bacteria, yeasts, moulds, protozoa, algae, and rickettsia. Viruses are also included, although they cannot live or reproduce on their own. These cells may require magnification to be seen but when cultured on solid media that allow their growth and multiplication; they form visible colonies consisting of millions of cells. Microorganisms may be beneficial or disease causing (pathogenic) and need to be controlled in both cases (Aquino *et al*., 2019). 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 (Onuha and Fatokun, 2014). Microorganisms recovered from hands can be divided into two categories namely: resident and transient. The resident flora consists of microorganisms residing under the superficial cells of the stratum corneum and can also be found on the surface of the skin. Resident flora is less likely to be associated with infections. Transient flora colonizes superficial layers of the skin and is more amenable to removal by routine hand hygiene. Bacteria are single-celled, microscopic pathogens having different shapes, such as rods, spirals, or spheres. Bacteria are usually larger than viruses and have a nucleus containing DNA. They can live in any environment and reproduce rapidly after entering the host body. They release toxins that damage the tissues causing illness. Some bacteria are not pathogenic and support essential body functions. However, all of them are prokaryotes (they lack a nucleus). Bacteria is plural, bacterium is singular. This research is aimed at evaluating bacterial contaminants and their pathogenicity associated with Automated Teller Machines (ATMs) keypads in Ibadan, Oyo State, Nigeria.

Materials and Method

Swab samples from key pads of Four different Commercial Banks Automated Teller Machine (ATM) in Ibadan Local Government area of Nigeria were used in this experiment. The banks were labelled X, Y, Z, P to avoid legal inferences. Materials used for this study are Sterile swap stick, sterile water, conical flasks, sterile petri dish, Autoclave, Ethanol, Insulator, test tube, Eosine methylene Blue (EMB) Salmonella Shgella Agar. The sterile swap sticks were soaked in the sterile water and there after use to make a swap on the ATM machine enter key, which customers must press while using the machine. The swaps were soaked in 10mL of sterile water, for serial dilution process, to reduce the bacteria population, and moreover to prevent "Too numerous to count" isolate on the media (CFU/g).

Results and Discussion

The results of the assay on the isolation of the possible clinical isolates (pathogenic) from commercial banks Automated Teller Machine showed that *Salmonella sp* was present on bank X and Z ATM key pads. *Salmonella sp* coliform and pathogenic bacteria which produce salmonellosis is seen in two kinds of viz. Enteric fever which can be typhoid or paratyphoid and gastroenteritis which is non-

typhoidal. Typhoid fever is an acute, life-threatening febrile illness caused by the bacterium *Salmonella typhi and Paratyphi,* Salmonellosis is more prevalent in developing parts of the world in Africa, Asia, and South America. South Asia is at highest risk for infections, and there are estimated 20 million cases and 200,000 deaths worldwide each year (Crump *et al*., 2004).

Salmonella infections are usually acquired by ingestion of contaminated food or water. Once ingested, the organisms multiply in the small intestine over the period of 1-3 weeks, breech the intestinal wall, and spread to other organ systems and tissues. (Carlson *et al*., 2002)

Strains of Salmonella are pathogenic as they have the ability to invade, replicate and survive in human host cells, resulting in potentially fatal disease. Salmonella displays a remarkable characteristic during its invasion of non-phagocytic human host cells (Hansen *et al*. 2002) whereby it actually induces its own phagocytosis in order to gain access to the host cell. The remarkable genetics underlying this ingenious strategy is found in Salmonella pathogenicity islands (SPIs) is required for full typhoid pathogenesis and they (Coombes and others) gene clusters located at the large chromosomal DNA region and encoding for the structures involved in the invasion process (Grassl and Finlay 2008).

When the bacteria enter the digestive tract via contaminated water or food, they tend to penetrate the epithelial cells lining the intestinal wall. SPIs encode for type III secretion systems, multi-channel proteins that allow Salmonella to inject its effectors across the intestinal epithelial cell membrane into the cytoplasm. The bacterial effectors then activate the signal transduction pathway and trigger reconstruction of the actin cytoskeleton of the host cell, resulting in the outward extension or ruffle of the epithelial cell membrane to engulf the bacteria. The morphology of the membrane ruffle resembles the process of phagocytosis (Kobayashi *et al*. 2012).

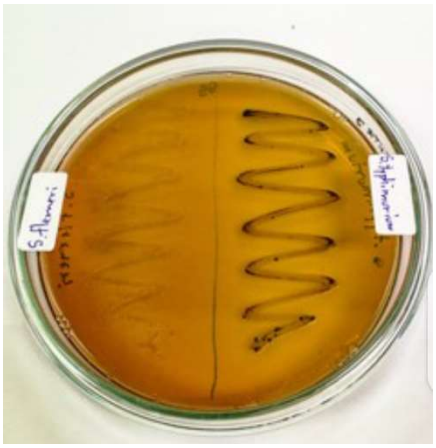

Figure1: Growth of Salmonella sp. on Salmonella Shigella Agar

Table 1: Shows the isolated bacteria obtained from the different swap gotten from commercial bank in Ibadan north, labeled as XYZP.

S/N	ISOLATES	X	Y	Z	P
1	*Salmonella sp*	+	-	+	-
2	*Esterichia coli*	-	-	-	-
3	*Bacillus sustils*	-	-	-	-
4	*Pseudomonas sp*	-	-	-	-
5	*Staphylococcus sp*	-	-	-	-

KEY: + Presence, - Negative,
X, Z, Y, and P Different commercial banks code

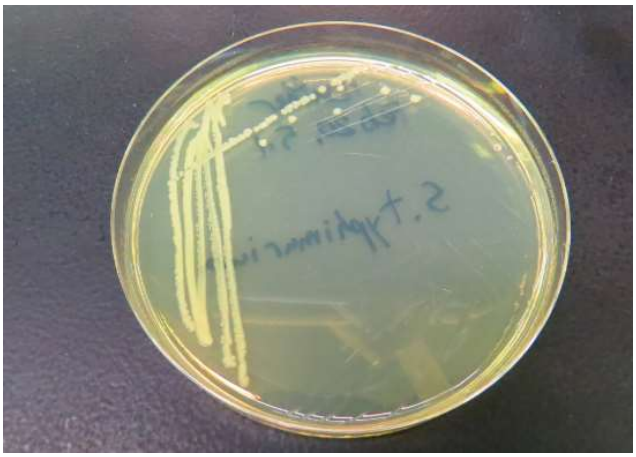

Figure 2: *Salmonella sp.* growth on Nutrient Agar

Table 2: Morphological characteristics of isolated Bacteria from the ATM key pads.

S/N	Isolate	Size	Colour	Marh	Testure	Gram stain	Pro org
1	*Salmonella sp*	Small	Creamy	Tntice	Smooth	Negative	*Salmonella*
2	*E. coli*	__	__	__	__	__	__
3	*Bacillius sp*	__	__	__	__	__	__
4	*Pseudomonas sp*	__	__	__	__	__	__
5	*Staphylococcus sp*	__	__	__	__	__	__

Table 2: Total colony count of bacteria.

S/N	Sample code	Total colony count
1	X	2.0X10-4cfu\ml
2	Y	__
3	Z	1.0X10-4cuf\ml
4	P	__

As reported in the figure 1 and tables above, two of the commercial bank labelled X and Z had Salmonella growth on them, of values ranging between $1.0x10^{-4}$ cfu/mL to 2.0 x 10-4 cfu/Ml. This indicates that they are source of the pathogen contraction. Diseases associated with this pathogen includes typhoid, enteric disorder , fever etc.

CONCLUSION

The deployment of ATMs by banks to meet customers demand and ease banking stress, so also it has some health effect on customers. Since accesses to ATMs are not specific to a particular user or group of people with same hygiene practices or financial status, as such, hundreds of people indiscriminately use it for that reason, customers with contaminated fingers easily contaminate the keypads, reverting in cross-contamination of users.

Bacteria isolated from this study is *Salmonella typhimurium* which was only confirmed in bank X ($2.0x10^{-4}$cfu\ml) at Y at the rate of ($1.0x10^{-4}$cfu\mL). This study shows 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, wind and high concentration of users at ATM galleries can also transmit pathogenic bacteria on the surface of the ATM key pads.

Salmonella typhi isolated from the study area of some commercial banks can cause diseases mainly typhoid and other related illness which is hazardous to human health, and most if the commercial bank customers are not swear of the what contamination may arise with the use of ATM and how to prevent and control. For instance, during the outbreak if covid 19 everyone one maintained proper hygiene practice e.g wearing of gloves when using public machine or items and the use of sanitizers to sanitize their hand after the use use of public facilities but all was abandoned after the outbreak subdue. It encouraging to keep proper hygiene practice to avoid infection such as bacteria, virus and other pathogenic infection.

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