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MICROBIOLOGICAL ASSESSMENT OF OFFICE EQUIPMENT AND SURFACES IN SOME OFFICES AT FEDERAL POLYTECHNIC ADO EKITI, EKITI STATE, NIGERIA

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ABSTRACT

Office equipment such as computers, photocopiers, printers, scanners and smartphones have been used almost every day in homes and offices. This study was carried out to reveal the microbial colonization of the surface of these equipment, especially the keyboards and press buttons. A total of 250 office equipment, which included 50 computers, 50 photocopiers, 50 scanners, 50 smartphones and 50 printers were examined for microbial contamination from selected offices in Federal Polytechnic Ado Ekiti. The result showed that computers were infected by 21%, photocopiers by 20%, scanners by 20%, smartphones by 18% and printers by 21%. The highest rate of contamination was by E. coli on computers, least was by Micrococcus sp. The highest rate of contamination was by Staphylococcus sp. on smartphones, Staph. sp. was also the highest on printers. Almost all the keyboards were contaminated by one or different microorganisms.

***Keywords**: Equipment, Computers, Microorganisms, Instruments, Keyboard, Contamination.*

INTRODUCTION

This work involves the microbial assessment of office equipment and their surfaces. Office equipment are those materials or instruments that are useful in an office to perform various duties or operations. These equipment are usually essential, and durable goods that are useful in managing and conducting office duties. Some of these equipment are computers and related devices, they are fundamental to modern offices. In the category of computers are desk top computers, laptop, monitor printers, keyboard, mice and servers. Furniture, this include desks, chairs, filing cabinets, conference tables, cubicles and others that can provide good working environment. Office supplies; items of this category include pens, papers, staplers etc. Communication gadgets: These can include cell phones. Other equipment include photo copiers, fax machines, scanners, shredders, projectors and so on. (Bures *et al*., 2001; Michael *et al*., 2001; Dogan *et al.*, 2008). Microorganisms are ubiquitous, they can be found on every environments, such as air, water, soil, food, human body even on solid objects like office equipment like computer, scanner, photocopier and others. All the equipment that have surfaces, keyboards and even door handles can easily harbor microorganisms (Renolds *et al.*, 2005).

Some gram -positive and gram -negative organisms are viable under various environmental conditions. Some of these microbes are very infectious at very low doses. These microbes can survive for hours or weeks on surfaces such as door handles or even computer keyboards (Renolds *et al*., 2005 & Anderson and Palombo 2009). Bacteria can easily

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colonize the surface of computer keyboards, photocopiers, smart phones, scanners (Sinclair *et al.*, 2011). Some microorganisms like *Staphylococcus sp., Enterococci sp., Streptococci sp. Even Eschericia coli* have been found to survive in dry environmental conditions. Infectious dose of some of these pathogens may mistakenly be transferred to the mouth after handling (Rusin *et al.*, 2002; Soltan Dallal *et al.*, 2010). Some office workers that operate the computers recently were screened on their hands and even their mobile phones were discovered to be contaminated with different types of microorganisms.

The aim of this study is to create awareness to office workers that office equipment and surfaces can harbor bacteria on them.

MATERIALS AND METHODS

Materials:

Fifty (50) pieces of computer keyboards, photocopiers, scanners and smartphones were selected from different offices in Federal Polytechnic Ado Ekiti, Ekiti State Nigeria. A total of 200 swabs were used on the above -mentioned number of equipment.

Samples Collection:

Samples were collected on computer keyboards, photocopier buttons, scanner press buttons and smart phones keyboards. The moistened swab sticks were rubbed several times on the surface of computer keyboards as well as the photocopier press buttons, likewise the moistened swab was rubbed on scanner press buttons and smart phone keyboards.

Methods:

CULTURE MEDIA PREPARATION:
The culture media used in this research are MacConkey and Nutrient agar, these agar were prepared according to the manufacturers' instructions and sterilized by autoclaving at 121 ^{O}C for 15 minutes.

SERIAL DILUTION:
The swab sticks were quickly analyzed by preparing serial dilution of the individual swab stick using distilled water or ringer solution. These serially diluted samples from the swab sticks were plated out on sterilized culture media of Nutrient and Mac Conkey agars. The Mac Conkey agar was used for coliform bacteria and Nutrient agar was used for other bacteria that are not coliform. The plates were incubated for 24 hours at 37 ^{O}C or for 48 hours at 37 ^{O}C for bacteria organisms and 72 hours at 27 ^{O}C for fungi organisms. At the end of incubation, the colonies were counted and expressed as cfu/mL of the sample.

OBSERVATION AND CHARACTERIZATION OF THE ISOLATES:

MORPHOLOGICAL OBSERVATION:
The cultured plates were observed for the developed colonies and their arrangement.

Microbial Count: This was done to know the microbial load of each equipment, the incubated cultured plates were counted, after which counts were recorded for every sample accordingly.

Grams staining: Slides were prepared by cleaning with water and soap, then, a drop of distilled water was placed on the slide. An inoculum was picked from the cultured plate with a sterile inoculating loop and smeared on the drop of distilled water on the slide, different stains; crystal violet,

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grams iodine, ethanol and safranin were used respectively to flood the smear. All the stain were allowed to stay for 1 minute except ethanol that stayed for only 30 seconds.

Motility Test: This test was done to show the organisms that are motile and the ones that are non motile. The test was done using hanging drop method.

Other tests such as Catalase, Coagulase, Oxidase, Starch hydrolysis, Citrate were performed.

SUBCULTURE FOR PURE CULTURE:
Pure cultures of the colonies were obtained by sub-culturing the colonies on fresh nutrient agar. Identification tests such as gram-staining technique, motility test, catalase, coagulase, fermentative test and other biochemical tests were used for the identification of the isolates.

RESULTS AND DISCUSSION:
The bacterial and fungal counts on the equipment surfaces examined were presented on tables 1 and 2, ranged from 1.8 x 10^4 cfu/mL to 3.4 x 10^4 cfu/mL under 24 hours of incubation at 37 ^{O}C and 2.1 x 10^4 cfu/mL to 3.3 x 10^4 cfu/mL under 48 hours of incubation at 37 ^{O}C for bacteria. And for fungal counts ranged from 1.2 x 10^4 cfu/mL to 2.1 x 10^4 cfu/mL under 48 hours of incubation at 27 ^{O}C and 2.6 x 10^4 cfu/mL to 3.1 x 10^4 cfu/mL under 72 hours of incubation at 27 ^{O}C.

Table 1. Bacterial count on the office equipment examined are presented on table 1.

	24 hrs. cfu/mL		48 hrs. cfc/mL	
Samples	TBC	CFC	TBC	CFC
A	3.1 x 10^4	1.8 x 10^4	2.8 x 10^4	2.1 x 10^4
B	2.6 x 10^4	2.0 x 10^4	2.4 x 10^4	2.4 x 10^4
C	2.5 x 10^4	2.2 x 10^4	2.8 x 10^4	2.7 x 10^4
D	3.0 x 10^4	2.6 x 10^4	3.2 x 10^4	2.8 x 10^4
E	2.8 x 10^4	2.5 x 10^4	2.7 x 10^4	3.0 x 10^4

Key: A = Computer keyboard, B = Photocopier button, C = Scanner button, D = Smartphone keyboard and E = Printer keyboard.
TBC = Total bacterial count, CFC = Coliform count

Table 2. The fungal count on the examined equipment are presented on table 2.

Samples	cfu/ml 48 hours	cfu/ml 72 hours
A	1.2 x10^4	2.4 x 10^4
B	1.5 x 10^4	2.6 x 10^4
C	1.8 x 10^4	2.8 x 10^4
D	2.1 x 10^4	3.0 x 10^4
E	2.3 x 10^4	3.2 x 10^4

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Table 3: Characterization and Identification of Bacterial and fungal isolates

Isolates	Gram s	Motil.	Oxida.	Catala.	Coagula.	Starch hydr.	Citra.	Indol	Lact.	Glu.	Suspected organism
a	+ve	-ve	-ve	+ve	+ve	+ve	+ve	-ve	-ve	+ve	*Staph auriculan*
b	+ve	-ve	-ve	+ve	+ve	+ve	+ve	-ve	-ve	-ve	*S. aureus*
c	+ve	-ve	-ve	+ve	-ve	+ve	-ve	-ve	-ve	+ve	*Aeromon*
d	+ve	-ve	+ve	+ve	-ve	+ve	-ve	-ve	-ve	+ve	*Micrococ*
e	-ve	+ve	+ve	+ve	-ve	+ve	+ve	-ve	-ve	+ve	*Pseudomo*
f	-ve	+ve	+ve	+ve	-ve	+ve	+ve	+ve	-ve	+ve	*E. coli*
g	+ve	-ve	+ve	-ve	-ve	-ve	-ve	-ve	+ve	+ve	*Yeast*

Table 4: Frequency table of microorganisms isolated from office equipment examined.

Samples	Staphylococcus sp.	Aeromonas	Micrococcus	Pseudomonas	E. coli	Yeast	Total
Computers	25	15	15	20	35	10	120
Photocopiers	20	15	15	15	25	20	110
Scanners	15	10	20	25	20	20	110
Smartphones	40	15	20	20	20	20	103
Printers	30	10	20	20	20	20	120
Total	130	65	80	85	118	85	563

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CONCLUSION & RECOMMEDATION:

CONCLUSION:

In conclusion, the result of this work showed that almost all the equipment used for this research had microbial contaminations. It could be assumed that those equipment and some other surfaces can be seen as vehicles for spreading infections and disease among the users of the equipment.

RECOMMENDATION:

In this aspect, I can recommend that every person that want to operate any equipment should wear a hand glove before operating, to avoid transmission of infection.

DISCUSSION

This study showed that high level of contamination were found on the office equipment that were examined in the Federal Polytechnic, Ado Ekiti.

The hands of human beings are major sources of microbial contamination on office equipment. Human beings act as vehicles that transmit microorganisms to the surfaces include the keyboards of computer and other office equipment. High bacterial loads were detected on the surfaces of all the equipment examined from the selected offices. Some operators of these equipment do not clean their hands, some operators or processors of the equipment have wounds and carbuncles on their fingers, some pathogenic microorganisms will find their ways from the wounds to the keyboards (Afunwa *et al*., 2018).

Table 1 of this result showed the microbial count based on 24 hours of incubation and 48 hours of incubation for Total Bacterial Count (TBC) cfu/mL, and Coliform Count (CFC) cfu/mL. The highest count of 3.2 x 10^4 TBC on smart-phone for 48 hours cfu/mL and 3.0 x10^4 cfu/mL TBC for 24 hours cfu/mL. The count on computer keyboard at 24 hours incubation was 3.1 x 10^4 cfu/mL and the least count of all was 1.8 x 10^4 cfu/mL coliform count on computer keyboard, this was in agreement with the report of Steffen *et al*., 2008. Table 2 showed the result of fungal count, based on 48 hours and 72 hours incubation. The highest count was 3.2 x 10^4 cfu/mL at 72 hours on printer and the least count was 1.2 x 10^4 cfu/mL on computer keyboard, The result was in accordance to reports of Bensch *et al*., 2012 and Afunwa *et al*., 2018.

The ability of microorganisms to survive on plastic materials is another thing that enhanced the survival of some of these organisms to grow on most of these office equipment especially computer keyboards. Rutala and David (2004).

Many different bacterial species were found to coexist on the surface of office equipment and on the hands of the users or operators. Surfaces of office equipment are found to harbor a community of bacteria with varying virulence and pathogenicity, as well increasing the risk of infection and severity of infections (Oluduro *et al.*, 2011)

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