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Microbiological And Physicochemical Properties of Toilet and Bathroom Walls in Male and Female Hostels in University of Port Harcourt, Nigeria

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Abstract- ***This study investigated the microbiological and physicochemical properties of toilet and bathroom walls in male and female hostels at the University of Port Harcourt. A total of twenty-four (24) wall swab samples were collected from selected hostel bathrooms and toilets and analyzed using standard microbiological techniques. Samples were cultured on Nutrient agar, EMB agar, and Potato Dextrose Agar for the isolation and identification of bacterial and fungal organisms. Physicochemical parameters of the sampled surfaces were also determined to assess conditions favoring microbial survival and colonization. Results revealed the presence of potential pathogenic bacteria including Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis. Fungal isolates identified included Aspergillus sp., Penicillium sp., and Rhizopus sp. Staphylococcus aureus was the most prevalent organism, particularly on male hostel walls, while higher isolate counts were generally recorded in toilet walls than bathroom walls. The presence of these microorganisms suggests contamination from human activities, aerosol dispersion during flushing, and poor hygienic practices. Findings indicate that hostel toilet and bathroom walls can serve as reservoirs for opportunistic pathogens with potential public health implications. The study therefore emphasizes the need for regular cleaning, proper disinfection practices, and improved hygiene awareness within university hostels.***

I. INTRODUCTION

Microorganisms are regarded to be very diverse in nature and thus are found everywhere in our environment on both living and nonliving things, human not excluded. Microorganism are also microscopic organisms known to be found everywhere in the Universe and could either be pathogenic or non-pathogenic (Abiose, 2019). Microorganism are known to have affinities for human skin, mouth, gut, bathing water on bathroom and toilet walls not excluded (Flores *et al.,* 2015). Toilet according to Sampson *et al.* (2019) is described as a receptacle into which both solid and liquid waste of human origin, in the form of urine and excreta are discharged. Sampson *et al*. (2019) described public toilet as a facility used by numerous groups of persons in a public setting or environment. Physiochemical properties of walls for survivability and colonization of microorganisms largely depends on various physicochemical properties of substrata, such as net surface charge, surface critical surface tension, surface wettability, and surface molecular topography for growth and attachment on surfaces for manipulation (Wiencek and Fletcher, 1997). This survivability mode of microorganism is applicable to the walls of bathroom and toilet due to their moist nature therefore favoring the growth (Bok and Johansson, 2020). Toilet and bathroom facilities are tools that play an essential role in disease transmission (Litinov *et al.,* 2010). Large number of microorganisms such as bacteria and viruses have been reportedly found in toilet bowl and bathrooms walls due to continual flushing and sprinkling of water (Best *et al.,* 2012). The adsorption of microorganisms to porcelain surfaces of toilet and bathroom bowls and walls, with gradual elution occurring after each flush is a high possibility of contracting infection such as gastroenteritis (Humphries and Linscott, 2015), hepatitis (Paya, 2001) and urinary tract infections (Behzadi *et al.,* 2010) from aerosols created in bathroom and toilet (Barker and Jones, 2005).

II. MATERIALS AND METHOD

Sample Site

This study was carried out in University of Port Harcourt, Rivers state. Rivers states lies between Latitude 4’’30˚N and 5’’45˚N approximately longitude 6’’30˚E of the Greenwich meridian.

Sample collection

A total of twelve (24) swab samples were collected in two (2) batches of twelve (12) from bathrooms and

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toilet in two (2) hostels used by students of University of Port Harcourt. For Batch A, three (3) male hostel bathroom wall surfaces were scrapped and three (3) toilet wall surface was also scrapped. In all, six total (6) samples were collected from male bathroom and toilet surface wall but were however duplicated for physiochemical and microbiological analysis for the research study making up a total twelve (12) samples obtained. Samples were taken from walls of bathrooms and toilet walls excluding washed bathrooms and parts of bathroom walls with soap lather because of the bactericidal effect of soaps and disinfectants on the microorganisms.

Post Sample Collection

Six of the swab sticks to be used for microbiological analysis were placed in containers containing 1ml peptone water, the other six (6) used for physicochemical analysis were placed in containers containing 1ml of distilled water. After each sample were collected, the swab sticks were reinserted back into the containers to make a solution. For batch B, the process was repeated in a female hostel, three (3) bathroom walls surface, and three (3) toilet walls surface were sampled. The sampled materials were also duplicated for physiological and microbiological analysis. The samples were sent to the laboratory immediately after collection for microbiological and physicochemical analysis.

Microbiological Analysis

Microbiological analysis of samples was conducted using standard culture, staining, and biochemical techniques for the isolation and identification of microorganisms. Samples were serially diluted and plated on Nutrient agar, Eosin Methylene Blue (EMB) agar, and Potato Dextrose Agar (PDA) using the spread plate method.

III. RESULTS

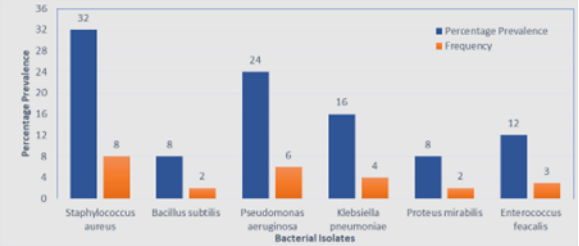

Figure 1: Frequency and % prevalence of bacteria isolated in bathroom and toilet walls of male and female hostels in university of Port Harcourt.

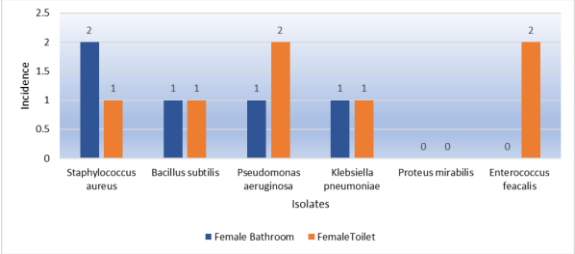

Figure 2: Total incidence of isolates in Female toilet and bathrooms.

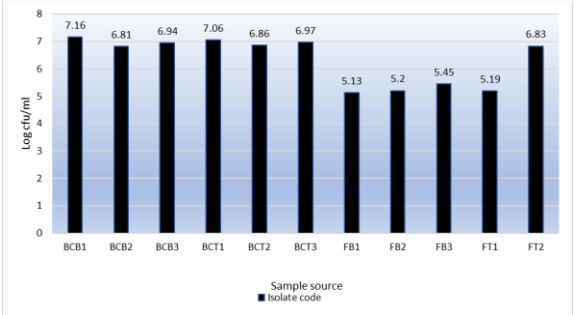

Figure 3: Log(cfu/ml) of the bacteria count in each sample

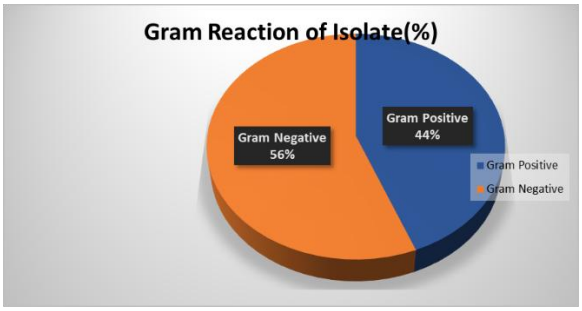

Figure 4: Percentage of gram positive and gram-negative isolates

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IV. DISCUSSION

The presence of *Staphylococcus aureus*, *Bacillius* sp, *Pseudomonas aeruginosa*, *Proteus mirablis*, *Klebsiella pneumoniae, Penicillium* sp, *Aspergillus* sp and *Rhizopus* sp infer contamination by fecal matter, suggesting poor hygienic practices and the settling of suspended microorganisms in the air after flushing of water closet systems without covering the lid (Gajanan and Singh, 2013). The presence of *Pseudomonas aeruginosa* a predominant soil bacterium suggest transmission from toilet floor surfaces brought in from foot wears, and settling dust suspensions (Ajayi and Ekozien, 2014). Considerable aforementioned numbers of bacteria and fungi were shown to remain on the walls of the result obtained in this study. Ogba and Obia (2020) detected the presence of *Staphylococcus aureus* on bathroom walls and toilet walls in their study which is in alignment with this present study. These organisms detected could persist for as long as seventeen days on the wall. However, the findings of Ogba and Obia (2020) obtained *Escherichia coli* as the most prevalent of the microorganism in their study compared to this present study where *Staphylococcus aureus* was recorded as the highest prevalence micro-organisms. The result of Ogba and Obia (2020) compare favorably to this present finding because this microbiological isolation was carried out in a hostel. The high number of isolates recorded in this present finding may be due to high number of users and lack of proper safety measures in the hostel. Also, the high prevalence occurrence of *Staphylococcus aureus* may be due to shedding of skin flora of users who are making use of the bathroom and toilets. In terms of occurrence of frequency of isolates in male bathroom and toilet walls, the present findings revealed that the male bathroom recorded *Staphyloccous aureus* as the most occurring bacteria followed *by Pseudomonas aeruginosa* and *Klebsiella pneumonia* tied on the same level with *P. aeruginosa.* The result obtained for the male toilet walls shows that *S. aureus, P aeruginosa* and *K pneumonia* recorded the highest occurring rate at the same level while *P. mirabillis* and *E.feacalis* were obtained and also tied at the same level of occurrence. The final result of the incidence rate shows that *Proteus mirabilis* was tied at the same rate with *Enterococcus feacalis.* The result however shows that mores isolates were recorded in the toilet than bathroom walls. Based on the incidence rate of isolates recorded in the female bathroom and toilet walls, the result of this study shows that *Staphyloccous aureus, Pseudomonas aeruginosa* and *Enterococcus feacalis* recorded the highest incidence of isolates in the female bathroom and toilet walls. However, the result of the study made it clear that the female bathroom walls recorded high number of *S. aureus* compared to other isolates of the like of *Bacillus subtilis, Pseudomonas aeruginosa, Klebsieela pneumonia* and *Enterococcus feacalis* all tied at the same level. For the female toilet walls, *P. aeruginosa* and *E. feacalis* recorded the highest number of isolates which are at the same level compared to the likes of *B.subtilis, S. aureus,* and *K.pneumoniae* which are also at the same rate of isolated level. The result of Chris and Adrian (2011) also conforms to this present study where it was detected that any bacteria present on ceramic tiles are usually just hanging out on the surface and will dry out or die when the surface dries out compared to that of concrete walls found in most bathroom walls. This present finding conforms to that of Okoronkwo *et al.* (2016) on hostel walls where *Bacillus* sp, one of the isolated micro-organisms from this study was obtained in their study. Also, in conformity with this present finding is the result obtained by Abiose (2019) where *Staphylococcus aureus* and *Kleibsella* were all isolated from both bathroom and toilet walls in a public University. The result of Ejim *et al.* (2016) compared favorably to this present study, where bacteria organisms of *Staphylococcus aureus* and *Bacillus* sp were isolated from a public toilet and bathroom walls. The distribution of isolated species on these walls could be attributed to splashing of water on the walls during bathing and flushing of toilets subsequently leading to a buildup of these micro-organisms Alonge *et al.* (2019) study also conforms to this study where *Pseudomonas aeruginosa*, *Proteus mirabilis,* and *Kleibsella* were all isolated and was attributed to lack of proper hygiene.

CONCLUSION

In view of the above findings and discussion, the following conclusions were made.

- Public toilet and bathroom walls can harbour considerable number of bacterial organisms which are potential pathogens.

- There is a possibility of contracting infections from bathrooms and toilets walls which are usually perceived to be a place for cleansing
- Bacterial and fungi isolated from the surface of the public toilets and bathroom walls can be a threat to the user's health since they are known opportunistic pathogens.

RECOMMENDATIONS

The following recommendations are hereby made from this study;

- Public toilet and bathroom walls within the University environment should be cleansed and disinfected at frequent intervals.
- Regular water supply is germane to achieving proper usage and cleaning of the toilets so as to reduce soiling the walls.
- Both the users and the cleaners should be enlightened about the presence and implication of been infected with these microscopic living cells.

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