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HEALTH IMPLICATIONS OF THE BACTERIAL LOAD OF COMPUTER KEYBOARDS

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ABSTRACT

Between April and May 2005, some selected computer keyboards in Bayero University, Kano, Nigeria were bacteriologically examined to evaluate the load and types of bacterial organisms associated with them. Eighty (80) computer keyboards were randomly sampled and analysed using surface carpeting method. Aerobic mesophilic bacterial count ranged between the highest of 2.37 x 10^2 cfu/m^2 and the lowest of 1.09 x 10^2 cfu/m^2. Characterization of the bacterial isolates using cultural, morphological and biochemical methods revealed the presence of seven bacterial genera namely: *Corynebacterium, Klebsiella, Listeria, Pseudomonas, Shigella, Staphlococcus* and *Streptococcus.* Generally, *Staphylococcus aureus* was the most isolated {43(58.1%)} while *Corynebacterium* species and *K. pneumoniae* were the least, each with 1(1.4%) occurrence rate. Statistically, there was a significant difference between sites ($P<0.05$) as it relates to the recovery of the bacteria. The implications of the results have been discussed in relation to human health and productivity. Suggestions have been made on how to improve the situation.

Keywords: Bacterial count, prevalence, computer, keyboard, health.

INTRODUCTION

Development in science and technology brings about the utilization of computers in almost all working places in both developed and under-developed countries of the world. This reduces the complexity of most works in many sectors such as hospitals, business centers, educational institutions and military sectors, to mention but a few (Collen, 2005). However, computer keyboards became an issue of concern particularly in recent years as they have been reported as potential carriers and transmitters of disease-causing microorganisms (Collen, 2005; Sharri *et al*., 2001; Garba, 2002). In addition, computer keyboards have been reported as agents of cross contamination (Michael, 2002), a phenomenon that occurs when people spread germs from one surface to another by simple touch (Mohammed *et al*., 2005; Rogo and Kawo, 2005). Disease commonly spread by means of fomites such as computers includes the common cold, cold sores, conjunctivitis, giardiasis, impetigo, meningitis, pinworm disease, diarrhoea and pneumonia, to mention but a few. Bacteria such as *E. coli, Shigella dysentriae, Streptococcus pneumoniae, Klebsiella pneumoniae* and *Corynebacterium dipthriae* cause

diarrhea, dysentery, pneumonia and whooping cough respectively while *Staphylococcus aureus* has been reported as responsible agent of food poisoning and intoxication (Food and Agricultural Organization, FAO. 1979; Center for Disease Control and Prevention, CDCP, 1992). Being patronized by unascertained persons sanitary-wise, computer keyboards could be regarded among the commonly touched items that could harbour large numbers of germs (Garba, 2002), hence the authors' interests in the present study. Furthermore, no study has been reported so far in this part of the country (northern Nigeria) on the microbiology of computer keyboards; in fact, this is a pioneer work on this subject in Kano State. It was aimed at quantitative and qualitative bacteriological assessment of computer keyboards with a view to assessing the level of contamination so as to establish the relevance of computer keyboards in the epidemiology of microbial infections. Suggestion on how to remedy the situation are made.

MATERIALS AND METHODS

Samples collection

Samples collections sites included the Center for Information Technology (CIT) laboratories (site I). business centers (site II), students' computer laboratories (site III) and the departmental offices (Site IV) all within and around the Bayero University, Kano, Nigeria. Samples were collected from the computer keyboards by aseptic swabbing technique. Here, a sterile swab stick was carefully unsealed and pre-moistened with sterile buffered peptone water (BPW) by dipping the tip of the swab into the container of the BPW. The pre-mostened swab stick was then used to swab the surface of the keyboards. The swab stick was sealed back into its sterile case and labelled. Samples were collected under aseptic conditions and immediately taken to laboratory for analysis (Baker and Silverton, 1985).

Inoculation of samples

The samples were inoculated onto Nutrient (Biotech, UK) plates using carpeting method. The plates were incubated at 35^0C for 18-24 hours after which the enumeration of aerobic mesophilic bacteria was carried out using standard plate count method (Baker and Silverton, 1985). On the other hand, selective and differential growth media were also inoculated and incubated at 35^0C for 18-24 hours after which the bacterial isolates obtained were subjected to further identification using cultural, morphological and standard biochemical tests (Cheesbrough, 1984).

Cultural, morphological and biochemical characterization of the isolates

This was carried out according to the method of Cheesbrough (1984). Here, colony appearance, haemolysis, hydrogen gas production and motility were observed and noted while Gram's stain was carried out to ascertain the morphology and Gram's reaction behaviour of the isolates. In addition, the following biochemical tests were carried out: catalase, oxidase, coagulase, citrate, urease and triple sugar iron tests.

Statistical analysis

Although the enumeration of aerobic mesophilic bacteria suggested that there were effects of sample collection sites on their abundance and distribution, it was however, grossly inadequate as a tool, to show to what degree the sites differ from each

other. It was also equally important to know whether such a difference is of any statistical significance. Consequently, recourse was taken to the comparison of the several sample means and variances otherwise known as analysis of variance (Singha, 2002).

RESULTS AND DISCUSSION

The results of the study are presented in Tables 1 and 2. Generally, site III had the highest bacterial count of 2.37 x 10^2 cfu/m^2 while site IV had the least {(1.09 x 10^2 cfu/m^2)}. The reasons for this might be that the site III, which comprise of departmental students' computer laboratories, are probably more frequently patronized than those of other departmental office, which are basically meant for only staff members; those having a restricted patronization. Table 2 shows that a total of seventy-four (74) bacterial isolates were recovered from the four sample collection sites. The cultural, morphological and biochemical properties of these isolates showed that they belonged to seven bacterial general namely: *Corynebacterium, Klebsiella, Listeria, Pseudomonas, Shigella, Staphylococcus* and *Streptococcus*. Site III had the highest bacterial isolates of 20(20.7%) while site IV harbored the least {14(18.9%)}. Generally, *Staphlococcus aureus* was the most isolated (43(58.1%)} while *Corynebacterium* species and *K. pneumoniae* were the least, each with 1 (1.4%) occurrence rate. Statistical analysis of the results indicated a significant difference between the sites ($P<0.05$). The high occurrence rate of *S. aureus* could be traced to the fact that it is abundant in human body especially as a normal flora of the skin. It is also reported to contribute 40 -50% nasal carriers in humans (Oghini and Omu, 1986; Uabol-Egbenni, 2003; Onukwubiri, 2005). In addition, *S. aureus* could elaborate mycotoxins in foods, which are dangerous to human and other animal health (Grundy and Grundy, 1974; Ogbini and Omu, 1986; Uabol-Egbenni, 2003). On the other hand, the low occurrence of *K. pneumoniae* might be associated with the fact this bacterium is present in respiratory tract and faeces of about 5% of normal individuals (Cheesbrough, 1984). Thus, these microorganisms could have come in contact with the computer keyboards, through soil, clothing, food and/or hands of users (Ogbini and Omu, 1986; Uabol-Egbenni, 2003 Mohammed *et al.,* 2005; Rogo and Kawo, 2005). Some of these microorganisms are potential disease agents. For example, *S.aureus* has been known to be responsible for food intoxication and poisoning (Turk et al., 1983; Wieneke *et al.,* 1993) while *Corynebacterium* species, *Listeria* species, *K. pneumoniae, P. aeruginosa, Shigella* species and *S. pneumoniae* are variously responsible for respiratory and skin infections, enteritis, meningitis, stomach disorders and sinusis (Cruickshank *et al.,* 1980; Collen, 2005; Garba, 2002). In other words, the computer keyboards act as vehicles for transmissible bacterial diseases and infections (Lucas and Gilles, 1984).

Table 1: Bacterial load (cfu/m2) of the computer keyboards

Sample site I	Sample site II	Sample site III	Sample site IV
2.81×10^2	6.90×10^1	1.07×10^2	2.12×10^2
1.93×10^2	1.03×10^2	5.20×10^1	1.09×10^2
1.24×10^2	5.04×10^2	3.11×10^2	1.13×10^2
1.16×10^2	3.12×10^2	3.25×10^2	1.52×10^2
2.14×10^2	4.01×10^2	1.81×10^2	No growth
9.70×10^1	2.06×10^2	1.27×10^2	No growth
1.16×10^2	1.97×10^2	1.74×10^2	8.70×10^1
1.84×10^2	1.02×10^2	4.01×10^2	2.73×10^2
2.03×10^2	1.09×10^2	4.11×10^2	No growth
2.11×10^2	2.62×10^2	1.93×10^2	2.04×10^2
5.60×10^1	1.91×10^2	1.74×10^2	8.40×10^1
2.17×10^2	2.78×10^2	2.13×10^2	No growth
7.20×10^1	3.05×10^2	3.01×10^2	No growth
9.70×10^1	3.02×10^2	4.01×10^2	1.78×10^2
1.34×10^2	4.01×10^2	2.05×10^2	1.06×10^2
4.01×10^1	1.90×10^1	2.08×10^2	2.11×10^2
1.01×10^2	2.00×10^1	1.67×10^2	9.10×10^1
3.51×10^2	1.40×10^1	1.81×10^2	2.40×10^2
1.06×10^2	2.90×10^1	2.03×10^2	1.10×10^2
2.53×10^2	2.02×10^2	4.00×10^2	No growth
Mean = 1.58×10^2	Mean = 2.01×10^2	Mean = 2.37×10^2	Mean = 1.09×10^2

Table 2: Prevalence of bacterial isolated (n =80) from the computer keyboards (figures in parentheses are percentages)

Bacterial Isolate	Site I	Site II	Site III	Site IV	Total
Corynebacterium species	1(1.3)	0(0.0)	0(0.0)	0(0.0)	1(1.4)
Klebsiella pneumoniae	0(0.0)	0(0.0)	0(0.0)	1(1.3)	1(1.4)
Listeria species	6(7.5)	6(7.5)	1(1.3)	5(6.3)	18(24.3)
Pseudomonas aeruginosa	2(2.5)	0(0.0)	0(0.0)	0(0.0)	2(2.7)
Shigella species	1(1.3)	2(2.5)	0(0.0)	0(0.0)	3(4.1)
Staphylococcus aureaus	9(11.3)	10(12.5)	19(23.8)	5(6.3)	43(58.1)
Streptococcus pneumoniae	2(2.5)	1(1.3)	0(0.0)	3(3.8)	6(8.1)
Total	21(28.4)	19(25.7)	20(27.0)	14(18.9)	74(100)

CONCLUSION AND RECOMMENDATION

The result obtained in this study encourage further studies in the isolation and identification of other microorganisms associated with computers. This will help to better understand the incidence of microorganisms and enable the users to take adequate measures in stopping the spread of infections through computers. Finally, adequate hand cleaning before and after use of computers should be strictly observed and, computer keyboards should be disinfected thoroughly after every day's working hours so as to reduce changes of infections.

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