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Research Article

A Comparative Study of Microbes Associated with Earphones used Among University Students of Michael Okpara University of Agriculture Umudike, Abia State, Nigeria

Kelechi M Ukaegbu-Obi*, Nwankwo I U, Itaman V O and Ihemeje E O

Department of Microbiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria

***Corresponding Author:** Kelechi M Ukaegbu-Obi, Department of Microbiology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

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Abstract

Microbial growth associated with earphones used among students of Michael Okpara University of Agriculture, Umudike, Abia State was investigated. A total of 50 earphones were randomly selected for microbial analyses from 25 frequent student users (Group A) and 25 other non-frequent student users (Group B). The samples were analysed using standard microbiological methods. The bacteria isolated from the earphones were α-haemolytic Streptococci, *Bacillus* spp., coagulase-negative Staphylococci, *Escherichia coli*, *Proteus* spp., and *Staphylococcus aureus*. The fungi isolated were *Aspergillus* spp., *Mucor* spp. and *Rhizopus* spp. The distribution of the microbial isolates among the ear phones include; *Staph. aureus* 12 (24%), α-haemolytic Streptococci, 12 (24%), *Bacillus* spp. 10 (20%), Coagulase-negative Staphylococci (COANS) 6 (12%), *Escherichia coli* 3 (6%), *Proteus* spp. 2 (4%), *Aspergillus* spp. 6 (12%), *Rhizopus* spp. 5 (10%) and *Mucor* spp. 2 (4%). Statistical analysis showed a significant difference ($P < 0.05$) between the mean occurrence values of the isolates from the two groups. Comparing the occurrence values of the isolates from the two groups of earphone users, the study concluded that microbial growth does increase with frequent and continuous use of earphones in relation to the non-frequent use of earphones. The significantly higher occurrence values of the isolates in group A, when compared to those of Group B are indicative of a positive relationship between microbial frequency and duration of use of earphones. Thus, regular cleaning of ear phones with disinfectants before and after each usage is recommended to help reduce the microbial load of earphones and their potential as regards being fomites in the transfer of pathogenic microorganisms to the ear, to help prevent the incidence of otitis media and other ear infections amongst the earphone users.

Keywords: Microbes; Earphones; Ear Infections; Otitis Media; Students; Comparative Study; Nigeria

Introduction

Currently, there is an increase in the use of earphones among young adults and a high rate of sharing among students [1]. Several studies of the human environment have demonstrated colonization and contamination of objects such as earphones, door handles, faucets, phones, money, fabrics and plastics [2]. People come into daily contact with all sorts of fomites, with an increasing rate of bacterial and fungal infection [3].

Wearing headphones or earplugs has been suggested as a possible predisposing factor for external ear canal infection since their use can increase the temperature and humidity of the canal, create the potential for skin abrasion and provide a vehicle for the introduction of organisms into the canal skin [4].

The external auditory canal normally harbors many bacterial colonies which form the normal commensal bacterial flora of the ear. They are predominantly non-pathogenic and mostly aerobic, which include Staphylococci (like *Staphylococcus auricularis, Staphylococcus epidermidis, Staphylococcus capitis* and occasionally Staphylococcus aureus), Coryneforms like *Turicella otitidis* [5], alpha hemolytic streptococcus [1] and *Pseudomonas aeruginosa* [6].

Noise exposure among adolescents in the Western world is primarily caused by behaviour based on voluntary participation in leisure-time activities that often include music exposure [7,8]. Studies in Scandinavia, Germany, the USA and China have concluded that approximately 12–15% of children, adolescents and young adults may be affected by hearing loss caused by leisure-time noise exposure [9]. One of the previous studies in this field has reported an increase in hearing problems in younger people. Another problem arises when people use earphones not only for listening to music, but also for eliminating the surrounding noise in bed to sleep at night or in transportation systems such as bus and metro train [10].

There are some problems that can be caused by using such devices. They are: hearing loss/hearing complications; while using earphones, the sound reaches directly the ears and can lead to complications in hearing. Ideally, one should not use earphones continuously for more than 15 minutes [11]. Others are sensation of pain in ears, harmful effects on the brain, [10] ear infections which can be caused by individuals sharing the earphone and music player devices with each other [12].

Documented studies on the consequences of prolonged use of the earphone among adolescents and young adults are rarely found in the literature [10]. A very few studies have been conducted on earphones as means of spreading microbes that can lead to ear infections in Nigeria.

Thus the aim of this study was to compare the microbial growth associated with the use of earphones used among students and evaluate the potential role of these earphones as vectors of pathogenic microorganisms among students of Michael Okpara University of Agriculture Umudike, Abia state, Nigeria.

Materials and Methods

Study area

Michael Okpara University of Agriculture is a Federal University in Umudike, Abia State, Nigeria. The Institution is located in the Agricultural Training and Research city of Umudike, about 10 kilometers from Umuahia (capital of Abia State), Nigeria.

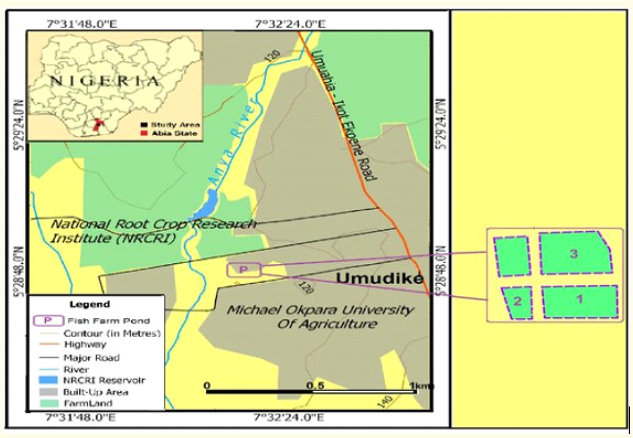

Figure 1: Map of Study area, Michael Okpara University of Agriculture, Umudike, Abia state

Sample Collection

Michael Okpara University of Agriculture is a Federal University in Umudike, Abia State, Nigeria. The Institution is located in the Agricultural Training and Research city of Umudike, about 10 kilometers from Umuahia (capital of Abia State), Nigeria.

Sample preparation

All the samples were analyzed within 1-2 hours of collection. The swab specimens were inoculated aseptically by streaking on the Nutrient agar and Sabouraud Dextrose agar for microbial growth.

Microbiological Analyses

Isolation of microbial isolates

The plates were incubated aerobically for 24 hours at 37°C for the bacterial isolates, and for 72-120 hours at room temperature for the fungal isolates. The discrete colonies that grew were sub-cultured on a freshly prepared Nutrient agar and Sabouraud Dextrose agar respectively to obtain pure cultures.

Characterization and identification of bacterial isolates

The bacterial isolates were examined for colonial morphology, cell micro morphology and biochemical characteristics as described by Ukaegbu-Obi., *et al.* [13]. Confirmatory identities of the bacteria were made using the Bergey's Manual of Determinative Bacteriology as described by Holt., *et al.* [14].

Characterization and identification of fungal isolates

Fungal isolates were characterised and identified using the colonial morphology, microscopic characteristics, slide culture techniques and slide mount of each isolate in lactophenol-cotton as described by Oyeleke and Manga 2008 [15] and Mailafia., *et al.* [16].

Statistical analysis

T-test was used to compare the mean occurrence values of the different isolates obtained from the ear phones of the two different groups of ear phone users.

Results and Discussion

The comparative study carried out on microbes associated with earphones used among students in Michael Okpara University gave the following results:

Isolates	Occurrence in Group A	Occurrence in Group B	Total
Escherichia coli	2	1	3
Coagulase negative Staphylococci	2	4	6
Proteus spp.	1	1	2
α-haemolytic Streptococci	6	6	12
Bacillus spp.	8	2	10
S. aureus.	7	5	12
Rhizopus spp.	2	3	5
Aspergillus spp.	2	4	6
Mucor spp.	-	2	2
Total occurrence	30	28	58

Table 1: Occurrence of the isolates in the sampled earphones.

Key: Group A: Frequent ear phone users; Group B: non-frequent ear phone users

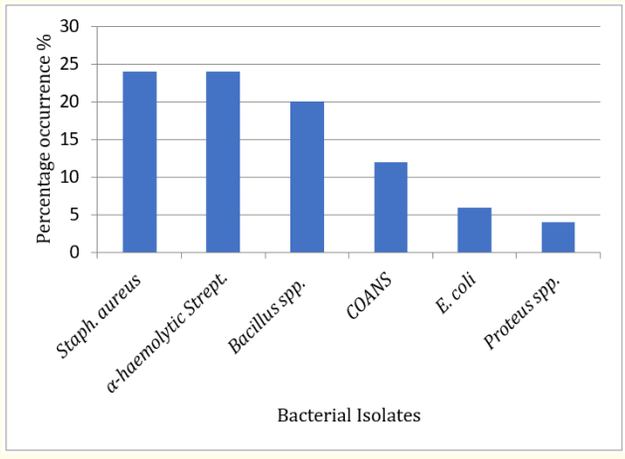

Figure 2: Percentage occurrence of bacterial isolates from the earphones.

Earphone usage among the students has been increased in the last few years. Similar to headphones or earplugs, the use of earphones could have a possible predisposing factor for external ear infections. This is because its continuous use can cause the increase of temperature and humidity of the canal and earlobes which get covered by the earphone thus creating the potential for skin abrasion, and provide a vehicle for the introduction of organisms into the canal skin as well [17]. The local pressure exerted by the device can also be an additional factor.

This study investigates the microbial growth associated with earphones used among students of Michael Okpara University of Agriculture, Umudike, Abia State. The bacteria isolated from the earphones were α-haemolytic Streptococci, *Bacillus* spp., coagulase-negative Staphylococci, *Escherichia coli*, *Proteus* spp., and *Staphylococcus* aureus. The fungal isolates were *Aspergillus* spp., *Mucor* spp. and *Rhizopus* spp.

Amongst the microbial isolates, bacteria had higher occurrence as shown in figure 2. *Staphylococcus aureus* and α-haemolytic Streptococci were the most predominant organisms with 24% occurrence respectively isolated on all the earphones. The result is in agreement with the findings of Oludoro., *et al*. who reported *S. aureus* (35.8%) as the frequent bacterial contaminant of electronic hardware interfaces in Ife [18]. Staphylococcus aureus is a major component of the normal flora of the skin and nostrils, it can be easily discharged by several human activities including sneezing, talking and contact with moist skin [19-21]; which can cause infections [22,23]. *Streptococcus sanguinis* and α-haemolytic *Streptococcus* can be considered as normal inhabitants of the human oral cavity [24].

Bacillus spp. was detected in 20% of the samples; its presence could be attributed to the fact that Bacillus spp are predominant in nature with spores that are able to resist environmental changes. This finding is in agreement with the findings of Nwankwo and Offiah who reported that Bacillus spp. was found to be among the predominant organisms from user hardware interfaces [25].

Coagulase-negative Staphylococci (COANS) was detected in 6 out of the 50 samples with a percentage occurrence of 12%. Although coagulase-negative *Staphylococcus, Staphylococcus aureus* and *Streptococcus pneumoniae* are the most common bacteria isolated from the external ear canal of healthy people [26], they can also become pathogenic if the conditions become congenial.

Escherichia coli was detected in 3 out of the 50 earphone samples with percentage occurrence of 6%. The presence of E. coli can be indicative of a faecal contamination, which can result in community-acquired infections and disease outbreak.

Proteus spp. was detected in 2 out of the 50 earphone samples with 4% percentage occurrence. It causes about 7% of community acquired urinary tract infections [27].

Figure 3 showed the fungal isolates with *Aspergillus* spp. being the most predominant among the fungal isolates with 12% percentage occurrence rate. *Rhizopus* spp. was detected in 5 out of the 50 samples with 10% percentage occurrence rate, while *Mucor* spp. was detected in 2 out of the 50 samples with a percentage occurrence of 4%. The presence of *Bacillus* and the moulds could be as a result of the prevalence of their spores in the environment, making it very easy for them to colonize the ear phones.

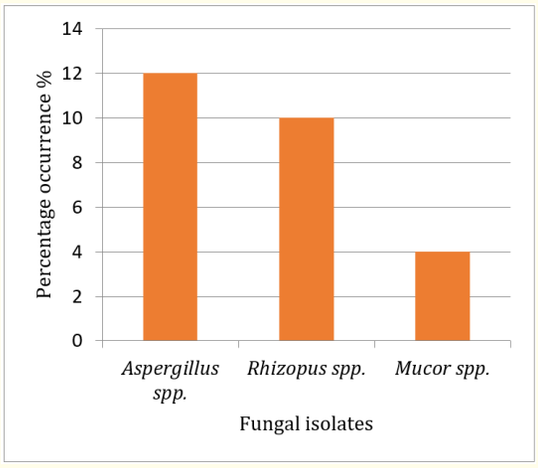

Figure 3: Percentage occurrence of fungal isolates from the earphones.

The increase in the number of microbial strains recovered in the devices may be due to the acquisition of new strains from the ear canal, the skin flora and the environment. Cheaper quality or improper use may give rise to abrasion, leading to breakage of the skin which might be a portal of infection [17]. The centers of Disease Control and Prevention (CDC) guidelines for Environmental Infection Control in Health-care facilities recommends periodic disinfection after cleaning instruments and surfaces that often come into contact with the hands, such as computer keyboards and mice, as defined by the infection control committee [28].

The percentage occurrence of the microbial isolates between the two groups of earphone users is shown in figures 4 and 5.

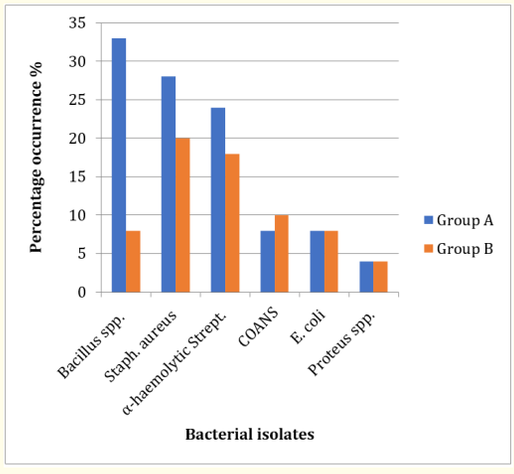

Figure 4: Percentage occurrence of the bacterial isolates from the two groups of earphone users.

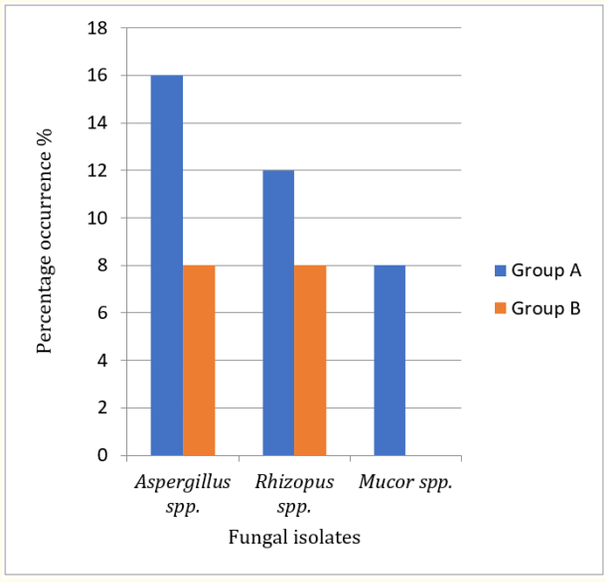

Figure 5: Percentage occurrence of the fungal isolates from the two groups of earphone users.

The bacterial percentage occurrence for the two groups – frequent (Group A) and non-frequent (Group B) users (Figure 4) showed that for the frequent ear phone users *Bacillus* had the highest percentage occurrence of 33% while for the non-frequent users 8%. *Staph. aureus* followed with occurrence of 28% for the frequent users and 20% for the non-frequent users. α-haemolytic Streptococcus was next 24% occurrence for frequent users and 18% for non-frequent users. Coagulase-negative Staphylococci had a lower percentage occurrence of 8% among frequent users than non-frequent users that had higher percentage occurrence of 10%. *E. coli* and *Proteus* spp. had the same Percentage occurrence between the two groups with 8% and 4% respectively.

Figure 5 showed the fungal isolates percentage occurrence between the two groups. All the fungal isolates had a higher percentage occurrence among frequent users than the non-frequent users. *Aspergillus* spp. had 16% for frequent users and 8% for non-frequent users. *Rhizopus* spp. had 12% for frequent users and 8% for non-frequent users. *Mucor* spp. had 8% for frequent users and 0% for non-frequent users.

The statistical analysis carried out showed a significant difference between the mean occurrence values of the isolates obtained from the two groups of ear earphone users. The significantly higher microbial growth in Group A indicates a positive relationship between microbial growth, frequency and duration of use of earphones. The incidence of greater colonization with continuous and regular use of earphones is a significant finding of this study, which

shows that infrequent and intermittent use may reduce colonization rate, probably contributing to less incidence of otitis externa; the result of this study is in agreement with the findings of Mukhopadhyay., *et al*. [17].

In group B, it is unlikely that the increase in microbial numbers can be explained only by multiplication of microbes. A more logical explanation is that the increase is induced by the outpouring of the resident organisms from the deeper skin layers and the sweat sebaceous glands, a process facilitated by heat and increased humidity that occur during normal physical activity as well as by tight occlusion of the ear by listening apparatus.

During the course of the study, it was discovered that the rate of routine cleaning of earphones among students was low as shown in figure 6; 86% of the students did not have the habit of cleaning their phones; the 14% who cleaned their earphones, used only a dry cloth for the purpose of cleaning and never used disinfectants. Out of the 15%, it was also discovered that only 2% cleaned their earphones regularly, and the rest of the students reported that they cleaned their earphones either once a week or on non-stipulated occasional basis.

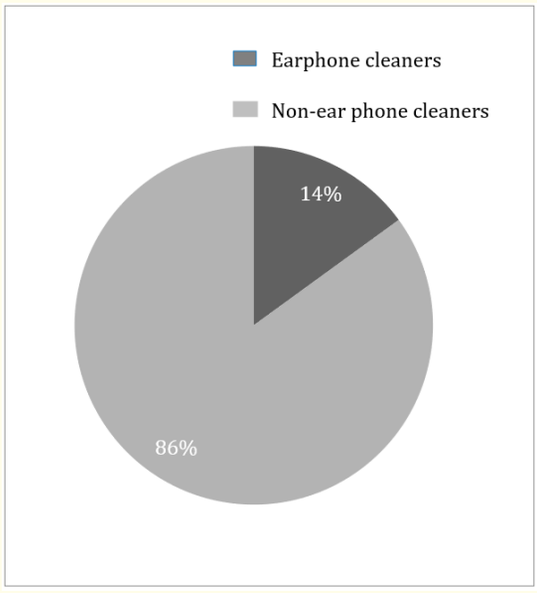

Figure 6: Cleaning practice observed amongst the earphone users.

Conclusion

Microbial transfer does increase with frequent and continuous use, and the chance of it being transferred is high when people tend to share earphones while listening to music. This may increase the chances of otitis media as well, especially if there is any abrasion in the external ear. The cleansing of the earphones with disinfectant can be adopted to prevent transmission of colonization flora from one person to another when earphones are exchanged. It is suggested therefore not to share earphones or to share with caution, like cleaning it before giving it to or taking it from someone else. Long usage of earphones without cleaning should be avoided.

Conflict of Interest

The authors declare that no conflict of interest exists.

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