Antibiogram of Oral Isolates as a Panacea for Oral Health Among Students of Delta State University, Abraka Campus

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Abstract

Oral diseases, driven primarily by bacterial pathogens, represent a pressing public health concern globally and especially in developing countries. This study explores the bacterial composition of the oral cavity and evaluates the antibiogram of oral isolates obtained from undergraduate students at Delta State University, Abraka. A total of 30 oral swab samples were collected and analyzed using microbiological and biochemical techniques. The bacterial isolates identified include *Pseudomonas spp.* (64.38%), *Aeromonas spp.* (19.18%), *Proteus spp.* (13.70%), and *Staphylococcus aureus* (2.74%). Antibiotic susceptibility testing was conducted using the Kirby-Bauer disk diffusion method against 12 commonly prescribed antibiotics. The isolates exhibited high resistance, especially to Ampiclox, Cefuroxime, and Ceftriaxone/Sulbactam, while Ofloxacin, Levofloxacin, and Nitrofurantoin were relatively effective. This study highlights the need for evidence-based antibiotic prescription and calls for public health strategies that incorporate antibiogram data in oral healthcare.

Keywords: Oral microbiota, Antibiogram, Antibiotic resistance, *Pseudomonas* spp., Oral health

1. Introduction

Oral health is a fundamental component of general health and quality of life, encompassing the well-being of the teeth, gums, and entire oral-facial system. Oral infections, which arise due to the imbalance of the diverse microbial flora in the oral cavity, can lead to systemic complications if left untreated (Hajishengallis et al 2021). The oral microbiome includes over 700 microbial species, many of which coexist in biofilms and contribute to dental caries, periodontitis, and other diseases (Hathaway-Schrader et al., 2021). The World Health Organization (WHO, 2022) estimates that over 3.5 billion people suffer from oral diseases globally, with a majority residing in low- and middle-income countries. One of the major concerns in managing these conditions is the increasing resistance to antibiotics. The inappropriate use of antibiotics in dental settings has led to a surge in multidrug-resistant organisms, emphasizing the need for antibiogram-guided therapy (Menon et al., 2019). An antibiogram is a laboratory-generated profile of the susceptibility of a bacterial isolate to a panel of antibiotics. It is a crucial surveillance tool that aids in the selection of the most appropriate empirical treatment and helps in monitoring resistance trends (CDC, 2019). The growing problem of antibiotic resistance presents a serious challenge in the treatment of oral infections. To address this, it is essential to understand the susceptibility patterns of bacteria found in the oral cavity. This knowledge allows for the selection of the most effective antibiotics and helps prevent the misuse of broad-spectrum drugs. An antibiogram, a chart showing how sensitive oral bacteria are to various antibiotics, is a vital tool for guiding treatment decisions in oral health care (Wenzler, 2024).

Despite growing concerns about rising dental problems, there is limited data on the extent of dental consultations and associated antibiotic use. Additionally, poor hygiene practices, such as nail biting, can introduce harmful bacteria particularly enteric bacteria into the oral cavity, leading to infections (Zaatour, 2021). Because oral health is closely linked to overall health, early detection and treatment of oral infections can help prevent or manage more serious systemic conditions. Therefore, identifying the types of bacteria present in the mouth and studying their resistance patterns through an antibiogram can provide a foundation for more effective prevention and treatment strategies (Gaji et al., 2022). Furthermore, young people should be educated about the health risks associated with poor oral hygiene and unsafe oral sexual practices, which can lead to the spread of infections. This study aims to provide up-to-date information that will guide clinicians in choosing the most appropriate antibiotics and inform public health efforts aimed at preventing oral diseases.

2. Materials and Methods

Study Area and Population The research was conducted among students residing in medical hostels, Delta State University, Abraka. A total of 30 students aged 18 to 24 years were randomly selected. All participants provided informed consent prior to sample collection.

Sample Collection and Microbiological Analysis Oral swab samples were collected before morning oral hygiene routines. The swabs were immediately transported to the Pharmaceutical Microbiology Laboratory for analysis. Samples were inoculated onto Nutrient Agar, MacConkey Agar, Mannitol Salt Agar, and Cetrimide Agar and incubated at 37°C for 24 hours.

Biochemical Identification Isolates were identified based on colony morphology and biochemical tests including catalase, coagulase, oxidase, urease, motility, indole, citrate utilization, hydrogen sulfide production, and carbohydrate fermentation profiles as described by Oghenemaro et al 2018

Antibiotic Susceptibility Testing The Kirby-Bauer disk diffusion method was used on Mueller-Hinton Agar. Twelve antibiotics were tested, including Amoxicillin-Clavulanate, Levofloxacin, Cefotaxime, Imipenem, Ofloxacin, Gentamycin, Nalidixic Acid, Nitrofurantoin, Cefuroxime, Ampiclox, Ceftriaxone/Sulbactam, and Cefixime. Results were interpreted using CLSI standards.

Data Analysis Data were analyzed using SPSS version 22.0. Categorical data were expressed as frequencies and percentages, while inhibition zone diameters were analyzed using ANOVA. A p-value <0.05 was considered statistically significant.

3. Results

The microbial profile showed that *Pseudomonas spp.* was the most frequently isolated organism (64.38%), followed by *Aeromonas spp.* (19.18%), *Proteus spp.* (13.70%), and *Staphylococcus* *aureus* (2.74%). Most isolates demonstrated high resistance to multiple antibiotics. Ofloxacin, Levofloxacin, and Nitrofurantoin were the most effective drugs across the tested isolates. The antibiogram showed resistance patterns consistent with literature on environmental exposure and waterborne pathogens (Mark Welch et al., 2020; Lu et al., 2022).

Prevalence of Microorganisms

The result revealed that Pseudomonas spp was mostly represented in the swap samples (Figure 1).

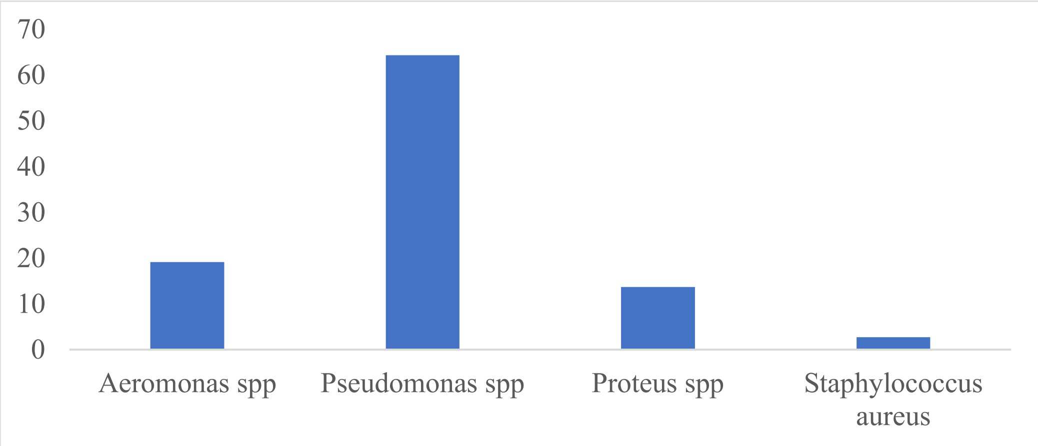

Figure 1: Prevalence of Microorganisms in swap samples

The microorganisms were mostly resistant to the antibiotics used and the comparison was significantly different for NA and CRO ($p < 0.05$)

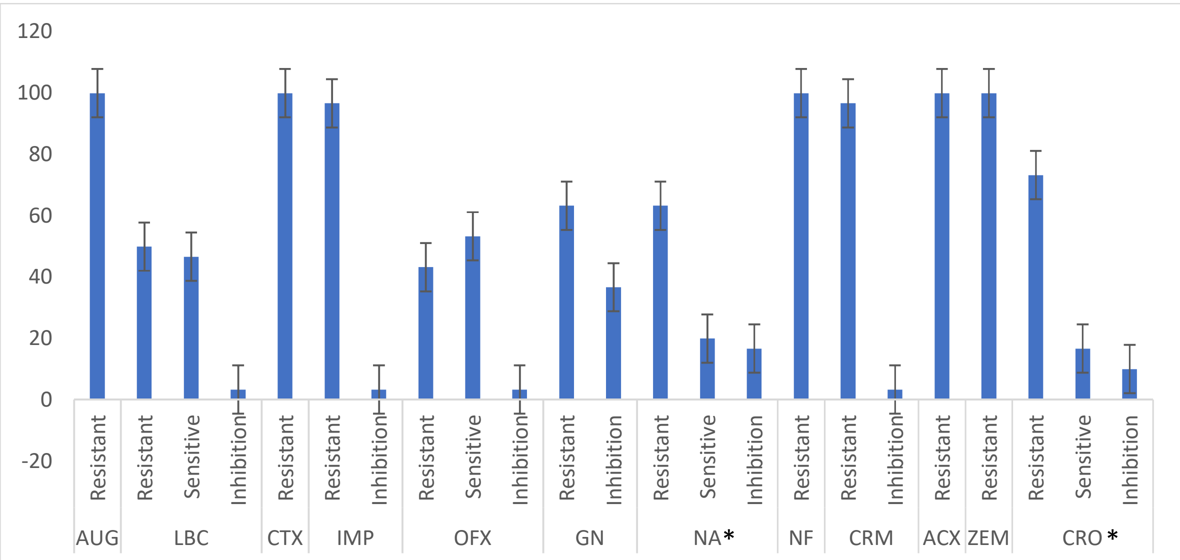

Figure 2: Susceptibility Pattern of Microorganisms to Antibiotics used

*$P < 0.05$ compared to other antibiotics

Table 1: Microbial Isolates and their Frequency of Occurrence

Organism	Frequency	%Frequency
Pseudomonas spp	47	64.38
Aeromonas spp	14	19.18
Proteus spp	10	13.70
Staphylococcus aureus	2	2.74

5. Discussion

Oral health is a critical component of overall well-being, yet it is frequently compromised by microbial infections, particularly in regions with inadequate access to clean water and poor hygienic practices. The escalating challenge of managing oral infections is largely attributable to the growing incidence of antibiotic resistance, which emphasizes the importance of evidence-based interventions such as antibiogram-guided therapy (Majumda et al., 2020; Adomi et al., 2025).

In the present study, four major bacterial species were isolated from oral swab samples: *Pseudomonas spp.* (64.38%), *Aeromonas spp.* (19.18%), *Proteus spp.* (13.70%), and *Staphylococcus aureus* (2.74%). The predominance of *Pseudomonas spp.* is consistent with findings by Ozuaduche et al. (2025), who linked its presence in the oral cavity to environmental reservoirs, particularly untreated water and poorly maintained infrastructures. *Pseudomonas aeruginosa*, in particular, is well-documented for its ability to form biofilms, enhancing its resistance to both antimicrobial agents and environmental stressors (Lu et al., 2021).

The detection of *Aeromonas spp.* and *Proteus spp.*, both Gram-negative organisms typically found in aquatic and terrestrial habitats, suggests possible exposure to contaminated water sources used for oral hygiene or domestic activities (Moreira et al., 2025). Although *Aeromonas spp.* generally exhibits lower resistance profiles than *Pseudomonas spp.*, emerging resistance to beta-lactam antibiotics remains a growing concern (Mark Welch et al., 2020).

Staphylococcus aureus, though the least frequently isolated organism in this study, is a clinically important pathogen associated with both oral and systemic infections. Its low prevalence may be attributable to reduced environmental resilience compared to Gram-negative bacteria. This observation aligns with data from Nagi et al. (2020), who reported considerable variability in oral colonization by *S. aureus* across diverse populations. Notably, resistance to multiple antibiotics, including methicillin, among *S. aureus* isolates is consistent with global concerns surrounding methicillin-resistant *Staphylococcus aureus* (MRSA) in oral health (Mukim et al., 2024).

The microbial profile observed in this study corroborates findings from Enitan et al. (2022), who reported similar patterns among dental clinic patients in Nigeria. These results reinforce the need for localized microbial surveillance and the use of antibiogram data to inform antibiotic selection.

6. Recommendations

1. Routine screening of the oral microbiota should be incorporated into student health programs.
2. Empirical antibiotic prescriptions should be guided by antibiogram profiles to improve treatment efficacy and reduce resistance.
3. Access to safe drinking water, regular sanitation of water storage facilities, and improved hygiene practices are essential to prevent microbial colonization.
4. Health education programs should be introduced to raise awareness among students about oral hygiene and the dangers of antibiotic misuse.

7. Conclusion

This study underscores the importance of antibiogram profiling in monitoring antimicrobial resistance trends among oral bacterial isolates. The dominance of antibiotic-resistant strains particularly *Pseudomonas spp.* poses a significant public health concern in resource-limited settings. Integrating antibiogram surveillance into routine dental and public health interventions can promote more rational antibiotic use and help mitigate the rise of resistant pathogens, ultimately enhancing treatment outcomes and protecting community health.

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