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Research Article

Combating oral biofilms in Nigerian schoolchildren: a synergistic approach using Macrosphyra longistyla extracts and titanium-ferrite nanoparticles

Bekämpfung oraler Biofilme bei Nigerianischen Schulkindern: ein synergistischer Ansatz unter Verwendung von Macrosphyra longistyla-Extrakten und Titan-Ferrit-Nanopartikeln

Abstract

Introduction: The burden of infectious and non-infectious debilitating diseases of oral etiology is common in developing countries. The pathogenicity of oral infectious diseases is believed to be exacerbated by the uncontrolled progression of biofilm-producing bacteria. In contemporary research endeavours, there is a proposition to utilize anti-infective compounds in the control of biofilm-induced infections. This research was carried out to isolate and control biofilm-producing bacteria using anti-infective nanoparticles and a plant extract.

Methods: Biofilm-producing bacteria were isolated and characterized using microbiological techniques and next-generation sequencing. Antimicrobial susceptibility testing and minimum inhibitory concentration were determined using titanium ferrite (TF) coupled with *Macrosphyra longistyla* plant extracts. Bioactive antimicrobials were analyzed by Fourier-transform Infrared (FTIR) spectroscopy. The surface morphology was determined using a scanning electron microscope (SEM), and toxicological properties were characterized on adult Wistar rats.

Results: Biofilm-producing bacteria isolated and sequenced in this study are *Pseudomonas aeruginosa, Aeromonas caviae, Proteus mirabilis* and *Serratia marcescens*.

The plant extracts coupled with nanoparticles were found to be more bioactive against the biofilm producers than either the plant extracts or the nanoparticles alone. The MICs observed here showed these complexes to be more bioactive against the pathogens in lower concentrations compared to that observed in similar studies.

FTIR revealed that the bands at around 3,000–2,800 cm^{-1} correspond to C–H stretching vibrations. The bands at around 1,700–1,600 cm^{-1} corresponded to C=O stretching vibrations. The bands at around 1,500–1,400 cm^{-1} corresponded to N–H bending vibrations. The presence of these functional groups suggests that *Macrosphyra longistyla* doped with TF nanoparticles (MSLNP) is a complex compound that contains a variety of different chemical groups.

Histology revealed no significant derangements observed in the histoarchitecture of experimental groups. This suggests that the compound shows potential as antimicrobial therapy in battling bacterial oral biofilms. It is recommended that the compound undergo further testing in the drug design process.

Keywords: biofilm-producing bacteria, Pseudomonas aeruginosa, Aeromonas caviae, Proteus mirabilis, Serratia marcescens, Macrosphyra longistyla nanoparticle complex, minimum inhibitory concentration

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