Project ID: 381

SR - Microbiology

John Wang

Using Resazurin Assays for Screening Herbal Extracts with Antimocrobial Activity on Oral Streptococcus mutans

Streptococcus (S.) mutans, a gram-positive, anaerobic bacterium, is a major contributor in the formation of dental caries. The effective way for prevention and treatment of dental caries is through antibiotics. However, reckless use of antibiotics has led to a rapid increase in bacterial resistance, creating an urgent need to develop novel antimicrobial agents against S. mutans. Plants are rich in potentially therapeutic compounds, making them promising candidates for developing alternative treatments. This study aimed to analyze the antibacterial properties of aqueous extracts from six plants on S. mutans. It was hypothesized that some aqueous herbal extracts of the plants would exhibit antimicrobial activity against S. mutans.

Aqueous herbal extracts of dried herbs were prepared by decoction, then sterilized and diluted in PBS (pH 7.4). S. mutans in Mueller Hinton broth with an OD600 of 0.0001 was used in Resazurin assays on 96-well plates. The minimum inhibitory concentrations (MIC) were determined based on color change and the half maximal inhibitory concentrations (IC50) were estimated by non-linear curve fitting with fluorescence signals.

The extracts of green tea, peppermint and thyme exhibited dose-dependent inhibitions on S. mutans growth, with MICs of 0.5%, 1%, 1%, and IC50s of 0.21%, 0.40%, 0.43%, respectively. Significant additive/synergistic effects between the three extracts were observed even at low concentrations.

The results demonstrate that herbal extracts contain compounds directly inhibiting S. mutans. The findings indicate that alternative treatments to dental caries can be developed from aqueous herbal extracts.

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SR - Microbiology

Hafsah Kazi

The Impact of Gut Bacteria and Beta Amyloid on Yeast Cells

Beta Amyloid is a protein that can accumulate in the brain, playing a central role in creating plaques that block communication between neurons contributing to Alzheimer's. However, new research presented at the Alzheimer's Research UK conference suggests a strong link between gut bacteria and cognitive disruption in the brain. Studies have shown that gut bacteria may play a more important role in contributing to the accumulation of beta amyloid plaques that cause Alzheimer's and dementia.

The purpose of this experiment is to investigate the complex relationship between gut bacteria and beta amyloid. To test whether certain natural remedies like walnuts and probiotics can lower protein levels in the brain. Based on conducted research it is hypothesized that the gut bacteria will decrease the levels of Beta amyloid (B42) in the yeast compared to the samples grown in the absence of gut bacteria and that the walnut treatment will be more effective than probiotics to enhance the protection of the yeast cells.

To conduct this experiment, yeast cultures will be treated with the different variations of solutions. The control (yeast cells), yeast with gut bacteria, yeast with BA42, yeast with probiotics, and yeast with the walnut extract. After 24 hours, the viability of the cells will be tested by measuring the number of CFUs in a growth.

After conducting my experiment, my results show that my hypothesis was proven incorrect. Instead of decreasing and eliminating the beta amyloid, the gut bacteria increased the protein concentration and decreased the cell viability. This discovery shows that there is a correlation between beta amyloid and gut bacteria. However, further research is required to prove, or disprove, the correlation as a causation. The natural remedies like walnut increased the cell viability and lowered the protein concentration. On the other hand, the probiotics decrease the cell viability and showed high protein concentration in the results

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SR - Microbiology

Kara Fan

A Self-Disinfecting Nanomaterial for Future Space Travel

A big challenge of long term space travel and habitation is bacteria proliferation in the spacecraft and space station. Bacteria form threatening biofilms that jeopardize equipment and the health of astronauts. Strict quarantine, antibiotics coating, and cleaning procedures were ineffective in preventing biofilm contamination. In this study, I created nanomaterials that can inhibit bacterial growth without the use of water and cleaning chemicals. The antibacterial mechanisms of the nanomaterials were analyzed by comparing how polymer polarity affects bacterial growth. I hypothesized that polar polymers with nanopillars prevented more bacteria growth than nonpolar polymers. Nanopillars were fabricated on two polar polymers, polymethyl methacrylate (PMMA) and polycarbonate (PC), and two nonpolar polymers, cyclic olefin copolymer (COC) and high-density polyethylene (HPDE) via hot embossing nanoimprint lithography. Raman spectroscopy indicated that imprinting nanopillars changed the surface chemistries of the polymers. Pseudomonas (PAO1) bacteria were incubated on each surface and biofilm growth was visualized with scanning electron microscopy. The colony forming units of PAO1 growth were measured. I discovered that polar nanopillar polymers significantly prevented bacteria growth compared to the control (67% to 83% decrease in bacteria on nanopillars) while nonpolar polymers did not prevent bacteria growth (20% to 30% increase in bacteria on nanopillars). The results suggest that electrostatic interactions between polar nanopillar surfaces and bacterial membrane proteins yield high antibacterial effects. Therefore, this innovative nanomaterial could prevent biofilm buildup in microgravity environments and microbial contamination of spacecraft and Advanced Life Support (ALS) modules.