

Synergistic Antimicrobial Activity of Marine Macro Algae *Sargassum crassifolium*, *Ulva fasciata*, *Dictyota spp.* and *Valoniopsis pachynema* against Multi-Drug-Resistant Bacteria

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The emergence of multi-drug-resistant (MDR) bacteria presents serious public health threats, underscoring the urgent need for novel antimicrobial agents. Due to the side effects of prolonged antibiotic use, marine algae rich in naturally occurring bioactive compounds, may have the potential for treatment displacing synthetic medicines. The present study aimed to determine the synergistic antimicrobial activity of selected four extracts (n=4) of algae plants *Sargassum Crassifolium*, *Ulva Fasciata*, *Dictyota spp.* and *Valoniopsis Pachynema* against six (n=6) clinical isolates, *Staphylococcus aureus*, *Enterobacter*, *Escherichia coli*, *Proteus*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa*. Four different crude seaweed extracts of each variant (Ethanol, Methanol, Chloroform, and Acetone) were isolated using both the Soxhlet and Shaking incubator. Upon the extraction of phytochemicals, crude extracts of each evaporated organic solvent were DMSO-diluted and subjected to antimicrobial susceptibility testing (AST) via well diffusion method. Inhibition zone diameter (mm) was measured following CLSI guidelines. The statistical analysis was obtained via SPSS V23.0. (95%, P<0.05) The crude extracts isolated from the Soxhlet extractor showed the highest sensitivity (std. 10.633, mean 67.33). Ethanol crude extractions of all four species showed weak to moderate activity (7-10mm). The synergism of ethanol and methanol extracts showed the highest sensitivity against all MDR bacterial strains (>15mm) while Chloroform in synergism with other solvents had low antibacterial activity (<7mm). *Staphylococcus aureus* revealed significant susceptibility (p=0.02) compared to other microorganisms, while *Klebsiella pneumonia* showed the significant highest resistance (p=0.001) to synergism of Ethanol and Methanol solvents. This highlights marine algae as potential sources for combating resistant bacteria.

Keywords: *marine macro-algae, multi-drug resistant bacteria, synergistic antimicrobial activity*