Saponin Surfactants: Novel Extraction of Environment Friendly Natural Saponins, and Their Effect on Bacterial Inhibition and Plant Histology

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The widespread use of synthetic surfactants in household detergents pose major environmental risks due to chemical persistence of non-biodegradable petrochemicals in ecosystems. However, Sapindus mukorossi (soap nuts), offer a natural alternative, as the pericarp is rich in triterpenoid saponins, which mimic the amphiphilic chemical structure of surfactants in detergents. The project objective was to develop a novel, eco-friendly non-toxic saponin extract, as an alternative to detergents. Saponins were extracted using maceration, and vanillin-sulfuric acid assay was used to quantify Total Saponin Content (TSC) and saponin percent yield using different solvents. Antibacterial activities of saponins for gram-positive (Bacillus subtilis) and gram-negative (Escherichia coli K12) bacteria was determined using Kirby Bauer Disk Diffusion Method. Plant histology and phenotype changes were observed in kale and lettuce (leaves and roots) using saponin extract greywater, commercial detergent greywater and water control. Saponin extraction using aqueous-ethanol solution (50% v:v) was the most effective solvent (Tukey's Test post-hoc, $p<0.01$) for TSC and saponin percent yield; when compared with pure water, 80% ethanol and 100% ethanol. Saponin extract exhibited antibacterial properties against gram-positive Bacillus subtilis at concentrations of 12.5, 25, 50, 100 mg/ml. Lettuce and kale plants irrigated with saponin greywater and control exhibited similar plant histology, whereas commercial detergent greywater caused phytotoxicity (cell necrosis). Therefore, optimizing saponin extraction from s.mukorossi, with promising antibacterial properties and positive plant histology, offers the saponin extract as a novel, sustainable and eco-friendly alternative to conventional detergents.

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