KáktosPatch: Monitoring Necrosis in Carnegiea gigantea (Saguaro Cactus) Using an Engineered Smart Bandage and Mobile Application

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Carnegiea gigantea (Saguaro cactus) plays a significant role both ecologically and culturally in the Sonoran Desert region of Arizona. However, this magnificent and unique cactus species faces pathological problems caused by various microbes, which contribute to necrotic rot that could eventually lead to the cactus's demise. This project aims to investigate the mechanisms of necrotic rot progression caused by different bacterial species found in saguaro cactus rot and find alternative solutions to preventing the progression of the rot. Four sites in the Tonto National Forest were identified for collecting bacterial samples from the necrotic rots found on saguaro cacti. The samples were then analyzed using 16S rRNA sequencing to identify the bacterial species or strains present in the rots. Twenty-seven bacterial isolates were identified and classified as primary rot-causing, opportunistic, and decomposer species. The progression of rot in the saguaro cactus was then inferred using the profile of the bacterial species that were identified. In terms of the antimicrobial activity of allicin, it was assessed through the Kirby-Bauer disk diffusion method using E.coli and B. subtilis as surrogate organisms. These represent both gram-positive (B. subtilis) and gram-negative (E.coli) bacteria. It was found that higher allicin concentrations (0.5–1.0 g/mL) produced inhibition zones greater than 16 mm. This indicates great antimicrobial properties. Additionally, a mobile application was developed to classify rot stages through CIE L*a*b* colorimetric analysis. This project integrates molecular identification, natural antimicrobial testing, and app-based color detection and offers a sustainable and accessible approach for monitoring Saguaro cactus rot.

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