Reinventing the Catheter: Inhibiting UTIs by Creating a Novel Material Integrated with Castanea sativa to Inhibit Quorum Sensing among Nosocomial Infection Causing Bacteria

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150 million UTIs occur annually, amounting to over $6 billion in expenditures. Of these, over 80% are associated with the use of urinary catheters. Staphylococcus epidermidis bacteria are one of the most common causes of nosocomial infections and UTIs. S. epidermidis communicate through quorum sensing, the production and release of autoinducers that trigger different behaviors contributing to the incidence of UTIs. The purpose of this project is to create a cost-effective antimicrobial catheter that inhibits UTIs without facilitating bacterial resistance using Castanea sativa leaves, which are known to inhibit quorum sensing amongst Staphylococcus bacteria. Multiple groups of catheter material were created using Polydimethylsiloxane(PDMS): PDMS, PDMS+25% C. sativa, PDMS+50% C. sativa, PDMS+75% C. sativa, PDMS+100% C. sativa, and PDMS+silver. “Catheters” were then incubated at 37°C in 5:1 urine:bacteria solution, modeling UTI incidence. Surface areas of viable/non-viable biofilms were calculated/analyzed using fluorescence staining, ImageJ. Kruskal-Wallis testing was also performed. Upon analysis, it was determined that material integrated with 75% and 100% Castanea sativa leaf extract have the greatest potential to be used as a cost-effective infection inhibiting component in medical devices. 75% and 100% extract significantly decreased the average percent biofilm formation from the plain control by 90.20% and 97.72% respectively. Both had the same effect as the silver nano-powder material did. This suggests C. sativa has great potential to be utilized in medical devices susceptible to Staphylococcus. C. sativa is over 800x cheaper than silver nano-powder, a common component in current medical devices, and bacteria have no detectable resistance to it.

Awards Won:

Second Award of $2,000