BananaBaby: Musa spp. Anisotropic and Parallel Venation Biomimetic Neonatal Incubator Liner Preventing Hospital Acquired Infections (HAIs) in Developing Countries

Devarajan, Vedika (School: Redmond High School)

Globally, every 1 in 10 babies are born prematurely, their lives dependent on neonatal incubators to maintain a high humidity environment and reduce water loss through their immature skin. However, humidity-induced condensation proliferates pathogenic bacteria, increasing infection risk by 26%. In developing countries, limited access to expensive condensation-inhibiting incubators necessitates manual wiping, raising contamination risk by 65% and contributing to high infant mortality. A Musa spp. leaf-imprinted incubator liner was investigated as a novel, low-cost method to redirect condensation. A polydimethylsiloxane mold was cast to capture the nanoscale structures of parallel venation that induce Musa leaf pressure gradients. Through molding, a crosslinked hydrophilic layer and epoxy hydrophobic layer (containing a Musa-derived antimicrobial agent) were cured and imprinted. The liner was characterized empirically via Young's equation and goniometer measurements, aqueously by measuring hydric retention under 90-95% humidity, and antimicrobially, upon E.coli K12 exposure. With an average 0.41g water uptake versus 8.39g control, the liner showed minimal mass retention, optimal saturation, and an 80% reduction in surface condensation. More sterilizations seemed to strengthen sodium alginate–calcium chloride bonding in the hydrophilic layer, enhancing saturation. Additionally, this activated the antimicrobial agent in the hydrophobic layer, nearing 0 colonies of E.coli growth versus 260 control colonies. This study is the first to apply Musa spp. to passive neonatal condensation control. It offers potential uses in wound dressings and dialysis equipment, reduces reliance on manual wiping and expensive incubators, and facilitates safer care for premature infants worldwide.

Awards Won:

Third Award of $1,200

Non-Trivial Ventures: Non-Trivial Fellowship Scholarship