World Academy of Science, Engineering and Technology
International Journal of Mathematical and Computational Sciences
Vol:14, No:12, 2020

Differential Survival Rates of Pseudomonas aeruginosa Strains on the Wings of Pantala flavescens

Authors : Banu Pradheepa Kamarajan, Muthusamy Ananthasubramanian

Abstract : Biofilm forming Pseudomonads occupy the top third position in causing hospital acquired infections. P. aeruginosa is notoriously known for its tendency to develop drug resistance. Major classes of drug such as β-lactams, aminoglycosides, quinolones, and polymyxins are found ineffective against multi-drug resistance Pseudomonas. To combat the infections, rather than administration of a single antibiotic, use of combinations (tobramycin and essential oils from plants and/or silver nanoparticles, chitosan, nitric oxide, cis-2-decenoic acid) in single formulation are suggested to control P. aeruginosa biofilms. Conventional techniques to prevent hospital-acquired implant infections such as coatings with antibiotics, controlled release of antibiotics from the implant material, contact-killing surfaces, coating the implants with functional DNase I and, coating with glycoside hydrolase are being followed. Coatings with bioactive components besides having limited shelf-life, require cold-chain and, are likely to fail when bacteria develop resistance. Recently identified nano-scale physical architectures on the insect wings are expected to have potential bactericidal property. Nanopillars are bactericidal to Staphylococcus aureus, Bacillus subtilis, K. pnuemoniae and few species of Pseudomonas. Our study aims to investigate the survival rate of biofilm forming Pseudomonas aeruginosa strain over non-biofilm forming strain on the nanopillar architecture of dragonfly (Pantala flavescens) wing. Dragonflies were collected near house-hold areas and, insect identification was carried out by the Department of Entomology, Tamilnadu Agricultural University, Coimbatore, India. Two strains of P. aeruginosa such as PAO1 (potent biofilm former) and MTCC 1688 (non-weak biofilm former) were tested against the glass coverslip (control) and wings of dragonfly (test) for 48 h. The wings/glass coverslips were incubated with bacterial suspension in 48-well plate. The plates were incubated at 37 °C under static condition. Bacterial attachment on the nanopillar architecture of the wing surface was visualized using FESEM. The survival rate of P. aeruginosa was tested using colony counting technique and flow cytometry at 0.5 h, 1 h, 2 h, 7 h, 24 h, and 48 h post-incubation. Cell death was analyzed using propidium iodide staining and DNA quantification. The results indicated that the survival rate of non-biofilm forming P. aeruginosa is 0.2 %, whilst that of biofilm former is 45 % on the dragonfly wings at the end of 48 h. The reduction in the survival rate of biofilm and non-biofilm forming P. aeruginosa was 20% and 40% respectively on the wings compared to the glass coverslip. In addition, Fourier Transformed Infrared Radiation was used to study the modification in the surface chemical composition of the wing during bacterial attachment and, post-sonication. This result indicated that the chemical moieties are not involved in the bactericidal property of nanopillars by the conserved characteristic peaks of chitin pre and post-sonication. The nanopillar architecture of the dragonfly wing efficiently deters the survival of non-biofilm forming P. aeruginosa, but not the biofilm forming strain. The study highlights the ability of biofilm formers to survive on wing architecture. Understanding this survival strategy will help in designing the architecture that combats the colonization of biofilm forming pathogens.

Keywords : biofilm, nanopillars, Pseudomonas aeruginosa, survival rate
Conference Title : ICSRD 2020 : International Conference on Scientific Research and Development
Conference Location : Chicago, United States
Conference Dates : December 12-13, 2020