World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:15, No:12, 2021

Assessment of Biofilm Production Capacity of Industrially Important Bacteria under Electroinductive Conditions

Authors : Omolola Ojetayo, Emmanuel Garuba, Obinna Ajunwa, Abiodun A. Onilude

Abstract : Introduction: Biofilm is a functional community of microorganisms that are associated with a surface or an interface. These adherent cells become embedded within an extracellular matrix composed of polymeric substances, i.e., biofilms refer to biological deposits consisting of both microbes and their extracellular products on biotic and abiotic surfaces. Despite their detrimental effects in medicine, biofilms as natural cell immobilization have found several applications in biotechnology, such as in the treatment of wastewater, bioremediation and biodegradation, desulfurization of gas, and conversion of agro-derived materials into alcohols and organic acids. The means of enhancing immobilized cells have been chemical-inductive, and this affects the medium composition and final product. Physical factors including electrical, magnetic, and electromagnetic flux have shown potential for enhancing biofilms depending on the bacterial species, nature, and intensity of emitted signals, the duration of exposure, and substratum used. However, the concept of cell immobilisation by electrical and magnetic induction is still underexplored. Methods: To assess the effects of physical factors on biofilm formation, six American typed culture collection (Acetobacter aceti ATCC15973, Pseudomonas aeruginosa ATCC9027, Serratia marcescens ATCC14756, Gluconobacter oxydans ATCC19357, Rhodobacter sphaeroides ATCC17023, and Bacillus subtilis ATCC6633) were used. Standard culture techniques for bacterial cells were adopted. Natural autoimmobilisation potentials of test bacteria were carried out by simple biofilms ring formation on tubes, while crystal violet binding assay techniques were adopted in the characterisation of biofilm quantity. Electroinduction of bacterial cells by direct current (DC) application in cell broth, static magnetic field exposure, and electromagnetic flux were carried out, and autoimmobilisation of cells in a biofilm pattern was determined on various substrata tested, including wood, glass, steel, polyvinylchloride (PVC) and polyethylene terephthalate. Biot Savart law was used in quantifying magnetic field intensity, and statistical analyses of data obtained were carried out using the analyses of variance (ANOVA) as well as other statistical tools. Results: Biofilm formation by the selected test bacteria was enhanced by the physical factors applied. Electromagnetic induction had the greatest effect on biofilm formation, with magnetic induction producing the least effect across all substrata used. Microbial cell-cell communication could be a possible means via which physical signals affected the cells in a polarisable manner. Conclusion: The enhancement of biofilm formation by bacteria using physical factors has shown that their inherent capability as a cell immobilization method can be further optimised for industrial applications. A possible relationship between the presence of voltage-dependent channels, mechanosensitive channels, and bacterial biofilms could shed more light on this phenomenon.

Keywords : bacteria, biofilm, cell immobilization, electromagnetic induction, substrata
Conference Title : ICMDBA 2021 : International Conference on Microbial Diversity for Biotechnological Applications
Conference Location : New York, United States
Conference Dates : December 09-10, 2021