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Biofilms: Its Significance and Properties

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ABSTRACT

The biofilm plays an important role in antimicrobial resistance, as a reservoir for pathogenic organisms, device-related infections and in chronic diseases. Biofilms comprises of microbial cells and extracellular polymeric substances (EPS). Quorum sensing plays an important part in intercellular communication thereby facilitating biofilm formation. Hence a greater knowledge of biofilms is absolutely essential which could lead to novel operative biofilm control strategies and newer antimicrobials which could penetrate the barrier effectively resulting in good therapeutic outcomes.

Keywords: Biofilm, EPS

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INTRODUCTION

In aquatic locations bacteria are survive as multi-species communities attached to underwater surfaces [1,2]. Biofilm-producing bacteria growing on a surface are more resistant to antimicrobial agents than the same bacteria growing in a free state which leads to chronic and persistent infections [3-5]. A biofilm is defined as a community of microorganisms growing implanted in a self-produced environment of extracellular polymeric substances (EPS) which causes cell adhesion resulting in the formation of biofilm matrix. They are composed of polysaccharides, nucleic acids, lipophilic compounds and proteins [6,7]. It is found that biofilm formation is a well-controlled process involving three mechanisms which includes multiplication of attached cells, redistribution of motile surface-attached cells and recruitment of cells from the surrounding fluid. This depends on the substrate, environmental factors and ability of the organisms [2]. Some of the biological factors which facilitate biofilm formation include extent of EPS production, motility and growth rates of the bacteria, cell-to-cell signalling between the biofilm bacteria.

Mode of growth

Bacteria establish contact with the surface and initiate synthesis of substances for example, alginate production by *Pseudomonas aeruginosa.*

Initial adhesion of bacteria

Specific molecular docking mechanisms help in adhesion to living surfaces whereas non-specific hydrophobic interactions play a major role in initial adhesion between bacteria and non-living surfaces. On further growth, cell-to-cell adhesion on non-living surfaces are mediated by adhesins [*Staphylococcus epidermidis* produces a polysaccharide intercellular adhesin (PIA), *Bacillus* spores are the most adherent such as hydrophobic spores of *B. cereus*] [5, 8, 9] *P. fluorescens* being motile move along surfaces in a semi-attached state [10]. Among the fungi, the most commonly isolated from catheters, prosthesis, heart valves) is *Candida albicans.* The resistance of biofilm producing fungi to antifungal agents may also result from contact-induced expression of drug efflux genes [11].

Bacterial cell-to-cell communication

Bacteria possess the ability to communicate with another bacterial cell and to establish. Itself as collective groups with characteristics not demonstrated by individual cells [12]. Quorum sensing plays a vital role in biofilm formation [13]. The reasons for antimicrobial resistance are multifactorial [3]. They include de-activation of reactive oxidant radicles in the outer membrane of EPS, decreased permeation through the relatively thick biofilm, altered concentrations of pCO2, pO2, pH and enzymes produced within the biofilm.

It is thus understood that biofilms are complex resilient structures which poses the next challenge in medical microbiology for the development of novel antimicrobials.

REFERENCES

[1] O'Toole G, HB Kaplan and R Kolter. Annu Rev Microbiol 2000;54: 49-79.
[2] Stoodley P, K Sauer, DG Davies and JW Costerton. Annu Rev Microbiol 2002;56: 187-209.
[3] Costerton JW, PS Stewart and EP Greenberg. Science 1999;284: 1318-1322.
[4] Donlan RM and JW Costerton. Clin Microbiol Rev 2002;15: 167-193.
[5] Dunne WM Jr. Clin Microbiol Rev 2002;15: 155-166.
[6] Flemming H-C. Appl Microbiol Biotechnol 2002;59: 629-640.
[7] Neu TR, GDW Swerhone and JR Lawrence. Microbiol 2001;147: 299-313.
[8] Rupp, ME, PD Fey, C Heilmann and F Götz. J Infect Dis 2001;183: 1038-1042.
[9] Husmark U. 1993. Adhesion mechanisms of bacterial spores to solid surfaces. Ph.D. Thesis. Department of Food Science, Chalmers University of Technology, Göteborg, Sweden. 85 pp.
[10] Korber DR, JR Lawrence, HM Lappin-Scott and JW Costerton. 1995. Growth of microorganisms on surfaces, p. 15-45. In: Lappin-Scott HM and JW Costerton (Eds), Microbial biofilms, Plant and microbial biotechnology research series: 5, University Press, Cambridge, UK.
[11] Kumamoto CA. Curr Opin Microbiol 2002;5: 608-611.

[12] Greenberg EP. 1999. Quorum sensing in Gram-negative bacteria: acylhomoserine lactone signalling and cell-cell communication, p. 71-84. In: England R, G Hobbs, NJ Bainton and D McL Roberts (Eds), Microbial signalling and communication, Symposium 57 of the Society for General Microbiology, Cambridge University Press, Cambridge, UK.

[13] Davies DG, MR Parsek, JP Pearson, BH Iglewski, JW Costerton and EP Greenberg. Science 1998;280: 295-298.