The Structural Diversity of Cell-Cell signals in Bacteria

Diversidad estructural de las señales célula-célula en las bacterias

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Abstract

A major mechanism of cell-cell communication in bacteria involves the synthesis, release, and detection of diffusible signal molecules. Bacteria can utilise such systems to monitor their population density (the process of quorum sensing) and/or their confinement in particular environmental niches and to activate in consequence specific population-wide alterations in gene expression and bacterial behaviour. Cell-cell signalling thus allows a colony or group of organisms to behave in a co-ordinated fashion to regulate processes contributing to virulence, antibiotic production, biofilm formation, and other developmental programs. The signal molecules are often referred to as autoinducers, a term coined to reflect their activity in influencing the behaviour of the producing organism. The autoinducer signal molecules produced by bacteria are structurally diverse. Many Gram-negative bacteria use *N*-acyl homoserine lactones (*N*-AHL) as signals, although other fatty acid derivatives such as *cis*-unsaturated fatty acids are also found. In contrast, many Gram-positive bacteria use amino acids or modified peptides as signal molecules. Fatty acid derivatives are however also found as signal molecules in Gram-positive bacteria, (for example the γ-butyrolactones of *Streptomyces* spp.) whereas cyclic dipeptides are found as signals in Gram-negative organisms. Both Gram-positive and Gram-negative bacteria use isomers of methyl-2,3,3,4-tetrahydroxytetrahydrofuran (the AI-2 autoinducer) as signals. Signal molecules belonging to further structural classes such as indoles, quinolones and (S)-3-hydroxytridecan-4-one have also been described. The molecular bases of the synthesis and perception of a number of these molecules and details of the signal transduction pathways have now been determined. I will give an overview of this structural diversity of signals and the potential of signal detection for bacterial diagnostics.

Keywords: Cell-Cell signals, bacterial diagnostics, biofilm, autoinducers