AHL-Based Quorum Sensing as a Focus for Inter-Species Bacterial Competition

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Cell density-dependent regulation of gene expression, or quorum sensing, via acyl-homoserine lactone (HSL) signal molecules is a widespread trait among *Proteobacteria*. Although quorum sensing has largely been studied for its role in regulating virulence in animal and plant pathogens, a growing number of species have been shown to also use quorum sensing to regulate production of antimicrobial toxins. This suggests a role for quorum sensing in mediating competition between bacterial species in environmental settings. We have demonstrated that the Gram-negative species, *Pseudomonas aeruginosa*, uses AHL-regulated functions to compete with other species in liquid co-culture. Intriguingly, numerous bacterial species with the capacity to degrade acyl-HSL signals have been identified, particularly in soil. We hypothesized that signal degradation, or "quorum quenching," provides a means for bacteria to prevent accumulation of quorum sensing regulated toxins by competing organisms. Overexpression in *Bacillus subtilis* of the acyl-HSL lactonase from *B. cereus* encoded by *aiiA* conferred the ability to degrade the signal molecules on *B. subtilis*. In rich medium co-cultures with *P. aeruginosa* or *Chromobacterium violaceum,* both of which regulate antimicrobial production by quorum sensing, *B. subtilis* overexpressing *aiiA* reached 10 to 100 fold higher population densities than the wt parent strain in similar cocultures. Although *P. aeruginosa* reached a similar cell density in cocultures with either *B. subtilis* strain, acyl-HSLs molecules were undetectable in cocultures with the *aiiA*-overexpressing strain. A *B. cereus* strain in which *aiiA* was eliminated by an in-frame deletion lost the capacity to degrade acyl-HSLs. This strain also exhibited reduced growth compared to the wt in competition with *P. aeruginosa* or *C. violaceum.* These results provide the first evidence that quorum quenching may contribute to bacterial competitiveness in the environment by interfering with signaling by competing species.