Density Dependent Signaling in the Model Eukaryote Chlamydomonas reinhardtii

Shah, Pooja (School: West Shore Junior/Senior High School)

Bacteria frequently couple specific phenotypes to cell density through the exchange of low-molecular weight chemical signals. This phenomenon is known as quorum sensing (QS) and allows these microorganisms to restrict specific phenotypes to the cell densities where they are most effective. This coordination of bacterial behavior plays crucial roles in swarming, virulence factor production, biofilm formation, and more. This underscores the importance of the QS phenomenon in microbial ecology as well as host-microbial associations. Similar population-wide coordination of behaviors has been observed in other eukaryotic microorganisms such as fungi. This suggests that QS may be a relatively common occurrence among both prokaryotic and eukaryotic microorganisms. Therefore, it was hypothesized that unicellular algae motility is also a population-dependent phenotypic response which could result in the alga swimming speed to increase over a period of 96 hours. In this study, the density dependent phenotype motility was investigated in unicellular algae Chlamydomonas reinhardtii. A density dependent increase in the overall velocity of the cells in the cultures was observed; supporting the hypothesis of the presence of a QS mediated process. The data and results provide evidence for the existence of quorum sensing in a unicellular alga. Evidence for a QS circuit in this model system for unicellular eukaryotes suggests a broader distribution of density-dependent phenotypic regulation among microorganisms, fundamentally altering our understanding of how the microbiome develops and is maintained. These findings have potential implications to microbial ecology and human health, as well as the evolution of cell-cell signaling.

Awards Won: