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Commentary

# Note on Cell Signaling in Single Celled-Organisms

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## DESCRIPTION

Cell signaling allows cells in multicellular organisms to coordinate their activities, ensuring that tissues, organs, and organ systems to function appropriately. The cells in unicellular organisms require cell-signaling pathways to communicate with one another. These cells may not be part of the same organism, but they belong to the same population. These organisms also require mechanisms to communicate individually or collectively. Bacteria utilize chemical signals to determine population density and adjust their activity accordingly, whereas yeast use chemical signals to select partners.

### Bacterial quorum sensing

The regulation of gene expression in response to changes in cell population density is known as quorum sensing. Auto-inducers are chemical signal molecules produced and released by quorum sensing bacteria which increase in concentration as cell density increases. When a minimum threshold stimulatory concentration of an auto-inducer is detected, gene expression changes.

Quorum sensing communication circuits are used by both Gram-positive and Gram-negative bacteria to regulate a wide range of physiological processes such as symbiosis, virulence, competence, conjugation, antibiotic production, motility, sporulation, and biofilm development, etc. Recently, many bacteria have been found to engage in quorum sensing, a type of cell-cell communication.

### Quorum sensing in symbiosis

Quorum sensing was first discovered in *Aliivibrio fischeri*, a bacterium that has a symbiotic connection with the Hawaiian bobtail squid. Light organ is present in the squid in which colonies of *A. fischeri* are formed. The squid feeds the bacteria, and the microorganisms emit light in return. The bacteria's luminescence prevents the squid from creating a shadow, so that it won't be visible to predators swimming beneath. They glow when *A. fischeri* bacteria are inside a squid's light organ, but not when they're free in the water. Researchers discovered that bacteria utilize quorum sensing to choose when to emit bioluminescence. Chemical reactions that generate light would be a metabolic waste for alone bacterium in the open ocean, as they provide no benefit without a squid host. When a large number of bacteria are packed within a light organ, the bacteria helps to keep their squid host safe from predators.

### Biofilms

Biofilms are formed when microorganisms cling to surfaces. These adherent cells become embedded in an extracellular matrix composed of Extracellular Polymeric Components (EPSs). The EPS components are often a polymeric agglomeration of extracellular polysaccharides, proteins, lipids, and DNA produced by the cells within the biofilm.

Biofilms have been found to be implicated in a wide range of microbial infections in the body, accounting for up to 80% of all infections. Bacterial biofilms have been shown to impair cutaneous wound healing and diminish topical antibacterial efficacy in the healing or treating of infected skin wounds.

The bacteria *S. aureus* can infect the skin and lungs, causing skin infections and pneumonia. Furthermore, *S. aureus* biofilm infections network is important in preventing immune cells like macrophages from removing and killing bacterial cells. Furthermore, bacteria that create biofilms, such as *S. aureus*, develop intrinsic resistance to antimicrobial peptides which prevents the pathogen from being inhibited and allows it to survive.

### Signaling in yeasts

It is regulated by quorum signals, which are tiny diffusible molecules that influence gene expression *via* signal transduction pathways. *Saccharomyces cerevisiae* and *Candida albicans* have been the most investigated yeast species for quorum sensing.
The primary quorum sensing molecules (QSMs) in *S. cerevisiae* are 2-phenylethanol, tyrosol, tryptophol and in *C. albicans* are farnesol and tyrosol.

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