How fast is a collective bacterial state established?

Bacteria in a biofilm colony have the capacity to monitor the size and growth conditions for the colony and modify their phenotypical behaviour to optimise attacks, defence, migration, etc. The quorum sensing systems controlling this involve production and sensing of diffusive signal molecules. Frequently, quorum sensing systems carry a positive feedback loop which produces a switch at a threshold size of the colony. This all-or-none switch can be beneficial to create a sudden attack, leaving a host little time to establish a defence. The reaction-diffusion system describing a basal quorum sensing loop involves production of signal molecules, diffusion of signal molecules, and detection of signal molecules. We study the ignition process in a numerical solution for a basal quorum sensor and demonstrate that even in a large colony the ignition travels through the whole colony in a less than a minute. The ignition of the positive feedback loop was examined in different approximations. As expected, in the exact calculation the ignition was found to be delayed compared to a calculation where the binding of signal molecules was quasistatic. The buffering of signal molecules is found to have little effect on the ignition process. Contrary to expectation, we find that the ignition does not start when the threshold is reached at the center-instead it allows for the threshold to be approached in the whole colony followed by an almost simultaneous ignition of the whole biofilm aggregate.

General information
Publication status: Published
Organisations: Department of Electrical Engineering, Biomedical Engineering, Technical University of Denmark
Contributors: Sørensen, M. L., Dahl, P., Sams, T.
Number of pages: 10
Publication date: 2017
Peer-reviewed: Yes

Publication information
Journal: P L o S One
Volume: 12
Issue number: 6
Article number: e0180199
ISSN (Print): 1932-6203
Ratings:
BFI (2017): BFI-level 1
Scopus rating (2017): CiteScore 3.01 SJR 1.164 SNIP 1.144
Web of Science (2017): Indexed yes
Original language: English
Electronic versions:
journal.pone.0180199.pdf
DOIs:
10.1371/journal.pone.0180199

Bibliographical note
© 2017 Sørensen et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
Source: Findit
Source ID: 2371692799
Research output: Contribution to journal › Journal article – Annual report year: 2017 › Research › peer-review