In situ localization and quantification of surfactins in a Bacillus subtilis swarming community by imaging mass spectrometry

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Surfactins are a family of heptacyclopeptides in which the C-terminal carbonyl is linked with the -hydroxy group of a fatty acid acylating the N-terminal function of a glutamic acid residue. The fatty acyl chain is 12-16 carbon atoms long. These compounds, which are secreted by the Gram-positive bacterium Bacillus subtilis in stationary phase in liquid cultures, play an important role in swarming communities on the surface of agar media in the formation of dendritic patterns. TOF secondary ion MS (TOF-SIMS) imaging was used to map surfactins within 16-17 h swarming patterns, with a 2 m spatial resolution. Surfactins were mainly located in the central mother colony (the site of initial inoculation), in a ring surrounding the pattern and along the edges of the dendrites. In the mother colony and the interior of the dendrites, surfactins with shorter chain lengths are present, whereas in the ring surrounding the swarm community and between dendrites, surfactins with longer fatty acyl chain lengths were found. A quantitative analysis by MALDI-TOF MS showed a concentration gradient of surfactin from the mother colony to the periphery. The concentration of surfactin was 400 pmol/mL in the mother colony and 10 pmol/mL at the base of the dendrites, decreasing to 2 pmol/mL at their tips.

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