Spreading of surfactants on gels.

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We are interested in the "swarming", i.e. fast migration of bacteria on a surface, that can lead to the formation of a “biofilm”. Remarkably, on a synthetic surface, Bacillus subtilis is able to form within a few hours reproducible dendritic structures, highly connected. This expanding community forms initially a monolayer, before to exhibits successive waves of migration with possibly terraces formation. These waves seem to involve both a “classical” swimming by using flagella, but also the emission of a surfactant called surfactine. Several authors believe that surface tension modifications are used by this organism to help its propagation.

We have conducted experiments of spreading of surfactine on a agar gel, and developed a visualization system that allows us to follow the evolution of the free surface. In our conditions, a drop of surfactine deposited on the gel is progressively absorbed by this one, while a circular front of surfactine developes and progressively invades the whole surface. We are studying the propagation of this front and comparing its typical properties with those of true bacterial colonies formed in the same conditions, varying the parameters (surfactine concentration, gel mechanical properties). The front propagation velocity seems to be poorly dependent of the surfactine concentration but strongly dependent of the gel connectivity. Our observations also reveal the complexity of the interaction between bacteria layers, surfactant gradients and the disordered surface of the gel.

This work is part of a program involving collaborations with biologists (S. Séror, Microbiology Orsay), other physicists (Y. Couder and G. Grégoire, MSC Paris 7, M. Plapp, Ecole Polytechnique), and mathematicists (B. Perthame, ENS Paris).

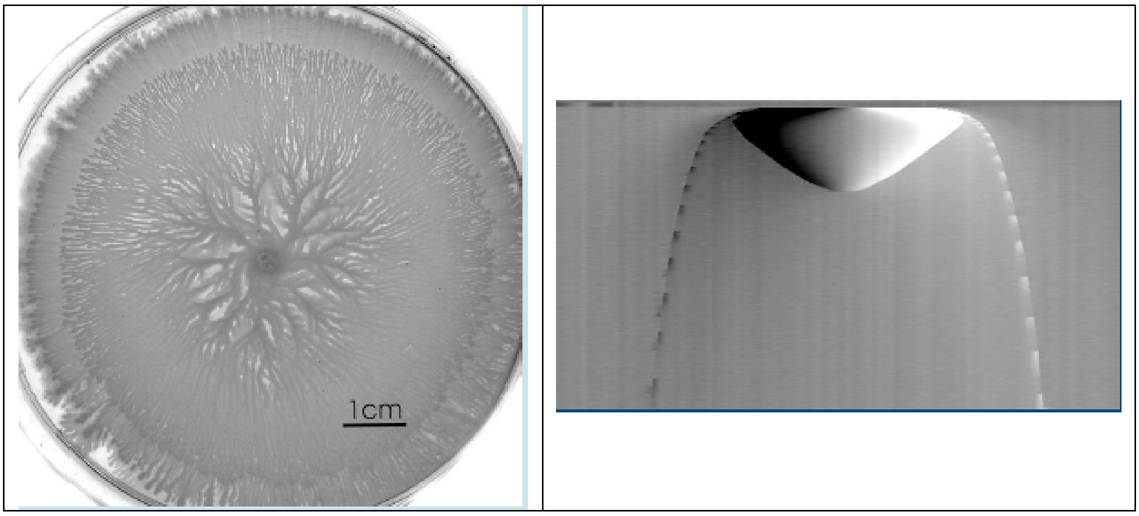

***Figure**: On the left a typical example of bacterial colony at a late stage of growth on a nutritive gel. On the right, propagation of a surfactine front starting from a drop deposited on the same gel. The grey level is representative of the local slope of the free surface. Time is running towards the bottom and the radial distance is plotted horizontally. The triangular shape at the top represents the disappearance of the drop, swallowed by the gel.*