

Starvation-driven cell patterning: integrating lab experiments and mathematical modelling

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We present a reaction–diffusion model describing the interactions among cells, nutrients, and growth factors, aimed at capturing the emergence of starvation-driven cell pattern formation, a phenomenon recently observed in laboratory experiments under nutrient-limited growth conditions. Experiments and modelling were developed in parallel, enabling progressively more targeted experimental design while enhancing the biological realism of the model. This interdisciplinary feedback loop led to the formulation of new hypotheses and enabled the estimation of several key parameters. Numerical simulations show that the model reproduces pattern formation in both one- and two-dimensional spatial domains. To provide theoretical support for these findings, we performed a Turing instability analysis to investigate the potential for diffusion-driven instability. The analysis indicates that the observed patterns are not driven by chemotaxis; rather, they arise naturally under starvation conditions and display structural similarities to the Klausmeier model for vegetation pattern formation in semi-arid environments, suggesting the robustness of the underlying mechanism across biological scales.

Joint work with

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