Cologne Evolution Colloquium

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Rod-shaped bacteria control cell volume through the rate of surface-area growth

Bacteria contain a high total concentration of macromolecules. Such crowded environments can largely affect diffusion of and interaction with macromolecules. Steric hindrance limits diffusion and excluded volume effects promote association of macromolecules. Crowding clearly impacts the biochemical system and physiology of the cell. In a growing cell, the increase in volume needs to be matched with the increase in biomass in order to maintain its crowding. However, it is not understood how cells achieve this task.

Here, we used *Escherichia coli* and monitored dry-mass and cell dimensions using quantitative phase microscopy. Thus we are able to extract single cell dry-mass densities – a proxy for crowding. We found little variation in mass density among cells indicating a robust regulation between volume and mass. However, volume and dry-mass did not strictly grow at the same rate. Instead, we found cell surface and dry-mass to grow in proportion. Consequently, geometry dependent surface-to-volume changes during the cell-cycle led to variation in mass density. Similarly, mass density could transiently be modulated by changes in cell diameter, but eventually returned to old levels with surface-to-mass ratios transitioning to a new steady-state.

We conclude that crowding homeostasis is achieved indirectly by coupling the rate of cell-surface expansion to the rate of dry-mass growth and adaptation of surface-to-mass ratios to steady-state cell diameters. Further potential mechanisms for the control of surface expansion were investigated. Together, our experiments reveal important dependencies underlying crowding homeostasis.

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Hosted by Berenike Maier

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