Only connect! Septal junctions and multicellularity in filamentous cyanobacteria

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Septal junction complexes are tube-like protein structures that link the cells of filamentous cyanobacteria, enabling the diffusion of smaller molecules and ions between the cytoplasms of neighbouring cells in the filament. They are functionally analogous to the gap junction connexons that link mammalian cells, although the protein components are unrelated and the cyanobacterial structures must be more complex because they span not only the plasma membrane but also the periplasm and the peptidoglycan cell wall. Similar structures seem to be present in all filamentous cyanobacteria, and in multiple cell types in the *Nostocales*. I will give an overview of progress in determining the function, composition and structure of septal junctions, in collaboration especially with the groups of Enrique Flores (Sevilla) and Iris Maldener (Tübingen). We started by developing a method to visualise and quantify the intercellular exchange of molecules using Fluorescence Recovery after Photobleaching with fluorescent tracer molecules loaded into the cytoplasm (1,2). Intercellular molecular exchange via the septal junctions appears to be crucial for all aspects of multicellularity in filamentous cyanobacteria, including:

a. Metabolic co-operativity: metabolite exchange between heterocysts and vegetative cells.

b. Pattern formation: the signalling that sets up the spacing of developing heterocysts during adaptation to diazotrophy.

c. Co-ordinated multicellular behaviour: signalling for rapid switches in motility in hormogonia.

References

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