

Deciphering the structure-function relationship of an ABC transporter required for cell differentiation in the multicellular cyanobacterium *Anabaena* PCC 7120

Keywords

Cyanobacteria, Cell differentiation, Signaling, Structure, Transporter

Summary

Under nitrogen-limiting conditions, the multicellular and diazotrophic cyanobacterium *Anabaena* (Nostoc) PCC 7120 differentiate ~10% of its cells to become specialized nitrogen-fixing heterocysts. The decision to commit into terminal differentiated cells occurs ~13 h after the induction of differentiation. While the initiation of this process is rather well understood (1), the mechanisms that govern the transition to commitment and to maturation are yet to be elucidated. The progress of heterocyst differentiation beyond the initiation state is abolished in a mutant of the *hetC* gene that encodes a putative ABC transporter with a potential peptidase activity (2,3). Interestingly, the expression of several genes crucial for differentiation is impaired in the *hetC* mutant (3). How exactly HetC controls gene expression and heterocyst development and whether its transporter activity is involved are unknown. In this project, we aim at elucidating the structure-function relationship of HetC. For this, a multidisciplinary approach including genetics, biochemistry and structural biology will be used to answer the following questions: (i) is the transporter activity of HetC required for heterocyst formation? (ii) Does it act as a peptidase and if yes, what are the protein substrates? (iii) What are the signaling factors acting between HetC and gene transcription? The elucidation of the molecular mechanism by which a membrane protein regulates the fate of a differentiating cell in a multicellular prokaryote will be of great interest in the field of developmental biology.

- (1) Xu X., Risoul V., Byrne D., Champ S., Douzi B. and A. Latifi (2020) HetL, HetR and PatS form a reaction-diffusion system to control pattern formation in the cyanobacterium *Nostoc* PCC 7120. *Elife*.7;9:e59190
- (2) Khudyakov I, Wolk CP (1997) *hetC*, a gene coding for a protein similar to bacterial ABC protein exporters, is involved in early regulation of heterocyst differentiation in *Anabaena* sp. strain PCC 7120. *J Bacteriol.* 179(22):6971-8
- (3) Xu X, Wolk CP (2001) Role for *hetC* in the transition to a nondividing state during heterocyst differentiation in *Anabaena* sp. *J Bacteriol.* 183(1):393-6
- (4) Wang Y, Xu X (2005) Regulation by HetC of genes required for heterocyst differentiation and cell division in *Anabaena* sp. strain PCC 7120 *J Bacteriol.* 187(24):8489-93

The co-supervisors

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Locations

LCB, Campus Joseph Aiguier, Marseille, France

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Doctoral school

Life and Health Sciences (ED 62), Aix-Marseille université (<https://ecole-doctorale-62.univ-amu.fr/>)

Expected profile of the candidate

Master or engineer's degree in microbiology. The candidate should have a strong background in molecular microbiology and biochemistry. A training in structural biology would be an advantage.