Study and engineering of bacterial microcompartment hexameric shell proteins for the design of a platform for synthetic biology.

Lucie Barthe, Luis Garcia-Alles, Delphine Dessaux, Jeremy Esque, Sophie Barbe

Study and engineering of bacterial microcompartment hexameric shell proteins for the design of a platform for synthetic biology

Lucie Barthe * [1], Luis Garcia-Alles [1], Delphine Dessaux [2], Jérémy Esque [2], Sophie Barbe [2]

[1] I2M - Ingénierie moleculaire et metabolique – Toulouse Biotechnology Institute – France
[2] CIMES - Catalysis and Enzyme Molecular Engineering – Toulouse Biotechnology Institute – France

Bacterial microcompartments (BMC) are proteinaceous structures naturally found in some bacteria. They enclose diverse metabolic pathways such as the degradation of ethanolamine in the Eut BMC, degradation of propanediol in the Pdu BMC or the fixation of atmospheric carbon in the Carboxysome (Chowdhury, 2014).
The shell of BMC is composed of 3 protein groups of: monomers assembling as an hexamer (BMC-H) composed of a Pfam00936 domain, those assembling as trimer (BMC-T) and composed of 2 fused Pfam00936 domain, both forming the facets and edges of the BMC and monomers composed of a Pfam03319 domain, assembling as a pentamer (BMC-P) and forming the vertices of the BMC.

BMC-H have generally several homologs per BMC genetic locus. Recently our team has shown that those homologs could form heterohexamers (Garcia Alles, 2019). Our aim is now to design a protein platform on the basis of an heterohexamer where enzymes belonging to a metabolic pathway of interest could be grafted on and spatially organized to increase enzymatic efficiency. In order to do so, we have studied natural heterohexamer formation in *Klebsiella pneumoniae*. Also, to increase our knowledge and the diversity of available heterohexamers to create such platform, we studied AI-designed hexamers.

Reference :

Chowdhury C, Sinha S, Chun S, Yeates TO & Bobik TA. Diverse bacterial microcompartment organelles. 2014 Microbiol Mol Biol Rev; 78(3): 438-68
Garcia-Alles LF, Root K, Maveyraud L, Aubry N, Lesniewska E, Mourey L, Zenobi R & Truan G. Occurrence and stability of hetero-hexamer associations formed by β-carboxysome CcmK shell components. 2019 PLoS One; 14(10): e0223877

Keywords: Bacterial microcompartment, protein platform, heterohexamer, modelling

*Speaker