Engineering cyanobacteria for high-level photosynthetic production of terpenes

Cyanobacteria are widely-diverse highly-abundant photosynthetic organisms that can be manipulated to produce chemicals (biofuels and medicinal products) from solar energy, CO_2 and water (marine or fresh). Among chemicals, the large family of terpenes (also termed terpenoïds or isoprenoïds) is of particular interest. Terpenes are volatile odorous compounds used in the production of essential oils (apple, lemon, orange, pine, *etc*), disinfectants and drugs. Furthermore, many terpenes, in having a great energy density and a low temperature viscosity, can be blended with petroleum-based fuels to turn them into aircraft fuels.
So far, a few papers report the engineering of one cyanobacterium for a low and transient production of one terpene. Thus, one cannot predict which cyanobacterium should be chosen (why?) and engineered (how?) for the production of a particular terpene (their properties influence their production).
Consequently, we have used our expertise in the biology and genetics of cyanobacteria to engineer four model cyanobacteria (each endowed with specific advantages), for the photoproduction of four terpenes of interest. We have shown that our terpene producers are genetically stable, and we are currently analyzing the influence of the growth conditions (light, carbon and nitrogen availabilities) on the level of terpene production. Also, to optimize the production we will manipulate a few genes to increase the flux of carbon towards terpene production. We seek a highly motived student to participate to this work.

Selected publications

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K. Narainsamy, S. Farci, E. Braun, C. Junot, C. Cassier-Chauvat, and F. Chauvat. 2016. Oxidative-stress detoxification and signalling in cyanobacteria: the crucial glutathione synthesis pathway supports the production of ergothioneine and ophthalmate. Mol. Microbiol. 100: 15-24. doi: 10.1111/mmi.13296

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