Green Terpene: Sustainable production of terpenes by redesigning isoprene biosynthesis

Introduction

Terpenes are a class of molecules naturally produced by living organisms, in particular plants. Originally, terpenes were extracted with very low yields from plant tissues. Progresses in genetic and metabolic engineering allowed to achieve heterologous production of terpenes in bacteria: already at the beginning of this century amorphadiene, the precursor of the antimalarial drug artemisinin, has been heterologously expressed in *Escherichia coli* [1], giving birth to industrial uses of terpenes. Currently, they have many applications in the market like flavours, fragrances and medicals. The further improvements in the genetic engineering and cultivation techniques are opening scenarios for reduced production costs of terpenes, rising their interest as potential candidate for advanced bio-fuels [2].

Aim

Bio-production of terpenes as fuels has been achieved, but the current production system is not efficient enough to make the product competitive with oil-derived fuels.

Isobionics is a Dutch company that produces terpene fragrances and aromas. We are cooperating with them to improve terpene production in *Rhodobacter sphaeroides*, focusing on improving the redox balance and energetics of the terpene biosynthesis network.

Approach

Since the beginning of the PhD project, we developed parallel research lines: setting up a valid fermentation system for the Isobionics' production strain; designing a system able to determine its metabolic fluxes and implementing new genetic modification techniques. We are working for converging the data generated creating a metabolic model for our strain. Therefore, we will be able to address the first genetic modification steps in the bug, and we will monitor modifications in the metabolic pathways in our established fermentation system. An iterative approach of cultivation and metabolic engineering will enable us to generate a strain with improved terpene synthesis.

Synergies and contributions from different research areas (molecular biology, process technology, systems biology/bioinformatics) are highly appreciated, as the same as the will of working in a team.

Partners

Isobionics (http://www.isobionics.com/)

Thesis projects

Within this project there are various possibilities for doing a BSc or MSc thesis. If you are interested in doing a BSc or MSc thesis, feel free to contact me.

References

1. Pitera, D. J., Withers, S. T., Newman, J. D. & Keasling, J. D. Engineering a mevalonate pathway in Escherichia coli for production of terpenoids. *Nat. …* (2003). at <http://www.nature.com/nbt/journal/v21/n7/abs/nbt833.html>

2. Zhang, F., Cardayre, D. S. B. & Keasling, J. D. Microbial engineering for the production of advanced biofuels. *Nature* (2012). at <M:\My Documents\ReadCube Media\et al-2012-Nature.pdf>