Bioplastics: an alternative?
• Bioplastics are biodegradable polymers.
• Compared to conventional plastics based on petroleum, they are derived from renewable biomass sources.

Some plastic facts
• 280 million tons average amount of plastic produced each year, worldwide.
• 1 000 years: the typical life-span of a plastic bottle!
• Up to 450 years: time of degradation of plastic bags in the environment.

Beyond the lab
In Human Practices, we:
• Investigated public awareness on bioplastics & legislative restrictions on plastics.
• Presented our MOOC to high school students.
• Experimental PLA degradation as a skepticism exercise.
Banning plastics:
Focusing mainly on European & French legislations, we wondered how banning plastics would affect the market of bioplastics. We concluded that banning petroleum-based plastic may lead to a decrease of bioplastic prices.

Educational Survey: Is our public ready to use PLA?
Yes. If they had to choose between PLA and another petroleum-based product, 88.3% of our respondents would choose PLA.

Investigation on our project showed that development of new and efficient production processes would lead to costs reductions through economies of scales. We integrated it in our DIY Bioprocess.

Public Engagement: MOOC:
• High school presentations
• Bioplastics Survey and MOOC
• Crowdfunding campaign
• Improvement of iGEM Wikipedia pages

Together with GEM IONIS team, we organized the European Experience, an European iGEM Meet-Up allowing European teams to meet during one weekend in Paris for sharing ideas and learning about synthetic biology.

The European Experience

Bioprocess
Improving requires economical optimization of production. We presented a DIY Bioprocess consisting of:
• DIY continuous pump gas bioreactors
• DIY-PLA-Extruder and a DIY-roller for final storage

The plastic problem

Our solution: PLA bioproduction in P.putida
PLA: Poly-lactic acid
• Biodegradable polymer and thermoplastic
• Used for food packaging and for biomedical applications.

How? Using Pseudomonas putida as chassis

Before, Jung et al. [1] 2010 used E.coli
E.coli
K. subtilis
P.putida
Lactate production
Polymer formation

Enzymes allowing PLA synthesis: Pot and PhaC*

B. First, we cloned separately PhaC* and Pot on pSB1C3.
C. We would have cloned LDH in pSEVA231; transformed P. putida with 2 pSEVA; induced and expressed PLA.

To increase PLA yield, an evolved lactate dehydrogenase (D-LDH*)[2] allowed increasing quantity of precursor: lactate.

Cloning

Cloning plan:
• pSEVA are standardized plasmids, working well in (P.putida)
• pSEVA244: Expression of PhaC* and Pot, induced by IPTG
• pSEVA231: Expression of D-LDH*, induced by cyclosuccinate (C5H4O5)

We did Flux Balance Analysis (FBA) to study the metabolic pathway for PLA production and optimize yield.

FBA

We designed in silico regulation by using two systems:
• LIdR responsive promoters, as lactate biosensors.
• McbR pressible promoter, as feedback system.

We used two modeling types:
Rule-based model
Different transcription and translation rates change dynamics.
Optimal if low in LIdR

Electric circuit model
It integrates metabolic and gene expression levels. If solving it, PLA increases continuously while the rest reaches a balance.

InterLab
We participated in the InterLab, studying GFP expression for 3 devices in pSB1C3:
• J23101.B0034.E0040.B0015
• J23106.B0034.E0040.B0015
• J23117.B0034.E0040.B0015

Control: D0020 Control: D0040

Parts & Collabors.
Parts:
• BBa_K2042006: Pct gene
• BBa_K2042001: PhaC* gene
• BBa_K2042004: IPTG inducible promoter
• BBa_K2042006: CH inducible promoter

Collaborations:
• and more!

Dynamic regulation

FZPOEUMBC

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3. Silva-Rocha E.

References:

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