Biofuel production by metabolic engineering

Isobutanol synthesis using Saccharomyces Cerevisiae

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Introduction

Biomass is the organic matter generated by vegetables and some algae from atmospheric CO_2, water and light energy in a process called Photosynthesis. It has great value as a fuel because biomass can make renewable energy, as it does not increase atmospheric CO_2. Nowadays biofuels represents about 10-14% of global energetic supply, and its use is higher every day.

The conversion of biomass to fuel can be done by few ways, based in thermo-chemicals or bio-chemical methods. Resulting fuels can be solid, liquid or gaseous.

Energy production from biomass

Types of Biomass

There are some properties that can be attractive for a fuel-production crop like great yield or low growth requirements. However, one of the most important criteria is based on the possibility that the vegetable can be used in alimentation, since creating biofuel-destined crops reduce available ground to crops designed to nourishment.

According to the crop used, there are three kinds of biofuel:

- **1st Generation:** use of edible vegetables.
- **2nd Generation:** use of non-eatable residues from edible vegetables, like leaves or stems.
- **3th Generation:** use of inedible vegetables.

Conversion Technologies

Conclusions

Biofuels are good candidates to substitute fossil fuels, not only nowadays but also in the future. Production of these is turning into a very promising research field at industrial level.

References

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Biofuel synthesis: isobutanol

Despite the fact that ethanol has major production, isobutanol presents some advantages which make it a very promising candidate.

	Ethanol	Isobutanol
Energy Density (MJ/kg)	29.7	36.1
Energy yield from Glucose (%)	97.6	95.4
Higroscopicity	High	Low
Corrosivity	High	Low
Biofuel Generation	1st, mostly	2nd
Average octave number	116	110

Cell factory microorganism selection

Saccharomyces Cerevisiae is used because of its inherent properties:

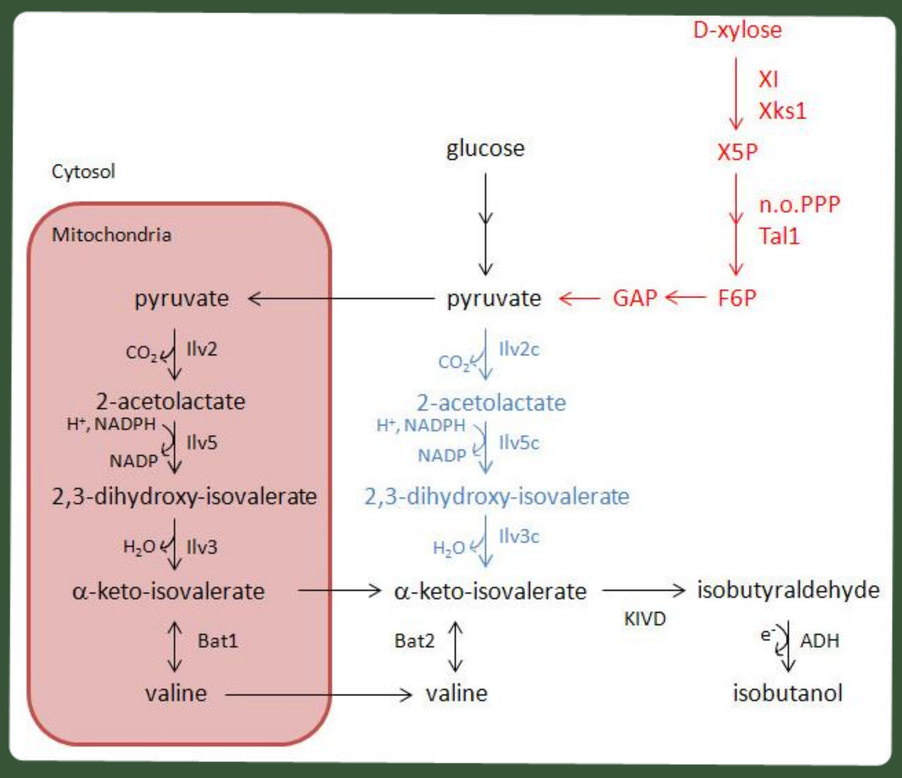
- Tolerance to high alcohol concentrations; great capacity to produce bioalcohol.
- It has an homologue isobutanol synthesis pathway.
- High robustness under industrial conditions.
- It is easy to use by the fact that it is highly characterized.

Biomass selection

Corn fiber has a great potential as fermentation substrate to produce isobutanol:

- Rich in lignocelluloses, that can be used as substrate, even in inedible parts like leaves or stems.
- High cultivated crop because of its high agro-economic value; its harvest generates lots of non-eatable residues that can be used to make biofuel.

Biotransformation



S.Cerevisiae produces isobutanol through Ehrlich Pathway. There are some ways to optimize this process:

- Construction of an artificial pathway for valine in the cytosol.
- Improve pyruvate pool, for example, enabling a new metabolic pathway that allows using xylose as substrate instead of glucose.