Pentose fermentation

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Pentose fermentation

- Microorganisms dissolve pentose using their enzyme
- Production of bio-ethanol
Why is pentose fermentation important?

-A shortage of petroleum/natural gases have sparked more interest in using renewable biomass resources for fuel.

-Ethanol produced from sugar fermentation

-Pentose = significant portion of total fermentable sugars

Current Research:

● Alternative fuel sources

● Microorganisms capable of making biofuels (Ethanol)
Pentose

- General term for 5 carbon sugars
- Monosaccharide aka “Carbohydrate”
- Used to make various ethanols
- Formula $C_5H_{10}O_5$
What is metabolic engineering?

- Using a cell's function for output
- Pinpoint parts of the cell that constrain production of products
- Optimizing cell conditions to output a desired substance
- Desired substance: Various bio-ethanols
Why bio-fuels?

- Cost efficient
- Renewable
- Eco-friendly
- Economical
Microorganism capable of producing bioethanol

- Various yeast strains
- *S. cerevisiae*
- *Escherichia coli*
- *Klebsiella oxytoca*
- + dozens of other strains
*Escherichia coli*

- **Mass** production of ethanol is possible
- Ability to metabolize different pentose compounds natively
- Very high experimental yield
- Different strains with different yields
Phenotype TCS083/pLOI297

- Very effective at synthesizing ethanol
- Can utilize xylose and glucose
- Not found in the wild
- Currently patented (US20100255553)
- 91% ethanol yield from pentose sugars
- Strain with highest yield
S. Cerevisiae

- The most well established yeast for ethanolic fermentation
  - Yeast/Bacteria:
    - superior resistance to hydrolysate inhibitors
    - better growth in low pH
    - less nutritional requirements
- It does not naturally metabolize xylose (pentose sugars)
  - Introduce metabolic pathways/sugar transport proteins

Research:
- Metabolically engineered to enhance ethanol production:
  - Replacing native P. Stipitis with mutation (xylose reductase) improved fermentative capabilities
Conclusion/ Future Research

Challenges:

- simultaneous co-fermentation of hexose/pentose sugars
- Increase byproduct formation

Future:

- minimize the co-fermentation of sugars and byproduct formation
  - S. Cerevisiae: development of a strain engineered to express pentose metabolising proteins from fungi living on decaying plant material
- Increase inhibitor tolerance


- http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2446564/


- http://www.journalagent.com/tjb/pdfs/TJB_40_1_74_80.pdf