Vitamin A Deficiency in Pregnant Women World-wide
Image of early Sumerian brewing techniques
VitaYeast
by JHU iGEM
Pathways

Vitamin A
Vitamin C
β-Carotene (pro-vitamin A)

- **crtE**
- **crtYB**
- **crtl**

- **Farnesyl Diphosphate**
- **Geranyl-Geranyl Diphosphate**
- **Phytoene**
- **Neurosporene**
- **Lycopene**
- **Beta-Carotene**

BBa_K530000
BBa_K530001
BBa_K530002
β-carotene autofluoresces green
L-Ascorbate (vitamin C)

GDP

- GDP-D-Man

GDP-L-Gal

- GDP

L-Gal-1-Phosphate

α-L-Gal-1-Phosphate

L-Gal-1,4-Lac

L-Ascorbate

GME

- VTC2

- VTC4

BBa_K530025

BBa_K530026

BBa_K530027

ARA1

ARA2

ALO1
QuantiYeast
Parts Characterization
**β-Carotene Purification and Spectrometry**

Graph showing the concentration of β-carotene per cell (μg) over time (hours) for different strains:
- WT
- crtE/YB/2I/tHMG1
- crtE/YB/I/tHMG1
- crtE/YB/2I
- crtE/YB/2I/tHMG1
\[ v = \frac{k_{\text{cat}} [E]_t [S]_t}{k_M + [S]_t} \]
OptiYeast
Simulation
Optimization
BTS1 and crtE are redundant, but crtE is more important.

Inhibition of GME by GDP does not strongly affect the model.
Fractional Nitrogen Allocation in an Optimal Beta-Carotene Pathway

Genes coding for metabolic enzymes:
- BTS1
- crtE
- crtYB
- crtI

Fractional Nitrogen Allocation in an Optimal L-Ascorbate Pathway

Genes coding for metabolic enzymes:
- GME
- VTC2
- VTC4
BBa_K530004
BBa_K530005
BBa_K530006
BBa_K530007
BBa_K530008
BBa_K530009
BBa_K530010
BBa_K530012
BBa_K530014
BBa_K530015
BBa_K530016
BBa_K530017
BBa_K530019
BBa_K530020
12 new vectors for yeast expression

<table>
<thead>
<tr>
<th>Types</th>
<th>Integrating</th>
<th>CEN/ARS</th>
<th>2-micron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Markers</td>
<td>HIS3</td>
<td>TRP1</td>
<td>LEU2</td>
</tr>
</tbody>
</table>
Reporters

- Beta-Carotene
- Lycopene
- Violacein
VitaBread
Baking with VitaYeast
Best Bread Machine Bread

Submitted By: SHECOOKS2
Photo By: LUBSY

Prep Time: 10 Minutes
Cook Time: 40 Minutes
Ready In: 3 Hours
Servings: 12

“This very easy-to-follow recipe promises to be foolproof. It makes a soft bread with a flaky crust.”

INGREDIENTS:
1 cup warm water (110 degrees F/45 degrees C) yeast
2 tablespoons white sugar 1/4 cup vegetable oil
1 (.25 ounce) package bread machine 3 cups bread flour
8000 OD of VitaYeast (0.28 oz) 1 teaspoon salt

DIRECTIONS:
1. Place the water, sugar and yeast in the pan of the bread machine. Let the yeast dissolve and foam for 10 minutes. Add the oil, flour and salt to the yeast. Select Basic or White Bread setting, and press Start.
HPLC results

$t_{Ret} = 17.7\text{ min}$
Human Practices

The real world
THIS RICE COULD SAVE A MILLION KIDS A YEAR

but protesters believe such genetically modified foods are bad for us and our planet. Here's why.
9. You are at the market buying bread for yourself or your family. Which of the following factors is most important to you when buying bread? Please rank the following factors in order of importance (1 = most important, 6 = least important).

☐ Cost
☐ Country of origin (where the ingredients came from)
☐ Nutritional content
☐ Genetic modification (if you were told which ingredients in the bread are genetically modified)
☐ Taste
☐ Availability (whether it will be available year round or not)
Accomplishments

• BioBricked and sequenced \( \beta \)-carotene and \( l \)-ascorbate pathways.
• BioBricked 8 promoters, 5 UTRs, and 12 yeast shuttle vectors.
• Utilized the LBS modeling language for the first time in iGEM.
• Optimized \( \beta \)-carotene and \( l \)-ascorbate production in silico.
• Submitted a survey on attitudes toward GM foods to our IRB.
More to Come

- **Characterize** the promoter and UTR library
- Attempt to achieve predicted optimum enzyme levels using our expression cassette library
- **Measure** enzyme expression levels and parameters to fit to the model
- Distribute GM foods survey at local markets
- Search for additional funding to continue research and deploy our work in the field
Special thanks to our advisors and mentors

Dr. Jef Boeke | Dr. Marc Ostermeier | Dr. Joel Bader | Dr. Mike Betenbaugh | Dr. Takanari Inoue
Dr. Deb Mathews | Dr. Patrick Cai | Dr. Leslie Mitchell | Dr. Giovanni Stracquadanio | Marty Taylor