Elucidating Growth Coupling of Metabolites in *E. coli* and Characterizing Modularity

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**Objective**

**Project Goal**
- The goal of this project is to design a modular (chassis) cell that will increase efficiency of rapid engineering strain design.
- This can be accomplished in a design, build, test, & validation process.

**Background Knowledge**
- Metabolism is a systematic network of chemical reactions that drive the transformation of chemical energy to fuel cellular activity.

- This would result in optimal economic and sustainable practices of chemical production and synthesis.

**Current Limitations**
- The current limitation in industrializing biology is the amount of time needed to optimize the production pathways within cells for bulk chemical production.
- Altering DNA elements in a piecewise fashion is a laborious process that the modular cell theory would resolve.

**Modularity & Chassis Cell Concept**
- Modularity focuses on designing a cellular framework that is auxotrophic, meaning the cell cannot support cellular growth and long term function.
- In theory, the modular cell can be coupled with an engineered production module.

**Methodology**

**Introduction**

**Methodology**
- Step 1: Design
  - ModCell2 & Multiobjective Strain Design
  - Metabolic flux calculations predict production module products
  - PLacO1 promoter has universal properties in *E. coli*
- Step 2: Build
  - Lactate Construct
- Step 3: Validate
  - Hypothesis: Optimal modular cells will grow the fastest
  - The growth of cells will be measured using a spectrophotometer to record the turbidity of the culture
  - HPLC will be used to measure the yield, productivity and titer of the product.
- Step 4: Test
  - Isolate optimal cell strain via serial inoculation

**Results**

**Discussion**

**Implications of Experiment Design**
- K12: Growth possible without Product Synthesis
- EcoHSCT0401 + pHS0238: Growth coupled with product synthesis

**Future Directions**
- Focus on growth coupling of higher order alcohols like isobutanol and butanol
- Investigate other competent cells like BL21 which are engineered for better expression levels.

**Conclusion**
- Demonstrating modularity insinuates that there exists a baseline cellular framework from which all types of cellular processes and chemicals can be produced.
- This would make chemical synthesis more universal and robust.

**References**


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