Name(s)
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Project Number
S1610

Project Title
A Microbiome Approach to Treat Galactosemia, a Life Threatening Genetic Disorder

Abstract

Objectives/Goals
There are no drugs to treat galactosemia, a life-threatening genetic disease in which patients can't metabolize galactose, a sugar found in food. As a result, galactose builds up to toxic levels in the blood and organs causing serious brain and liver damage and intellectual impairment. The only approach to manage galactosemia is a highly restrictive low-galactose diet which is not sustainable overtime since most foods like milk, fruits, and vegetables contain galactose. Therefore, there is a need for a long-term cost-effective solution. The aim of this study was to develop a yeast strain able to detoxify galactose in the gut before its absorption by intestinal cells and its toxic accumulation in blood.

Methods/Materials
The galactose degradation capabilities of multiple yeast strains was evaluated by measuring (1) their growth kinetics on galactose containing medium and (2) the remaining galactose concentration in the spent medium using an enzymatic test. The performance of the lead candidate, designated Y10, was further improved by adaptive evolution. Its stability/survival rate to harsh gut environment was investigated by exposure to simulated gastric and simulated intestine fluids in presence of enzyme/low pH. Y10's ability to establish itself in the gut was evaluated by measuring its adherence to human intestinal cells.

Results
We successfully developed a yeast strain Y10 by adaptive evolution which can degrade galactose in the gut environment. Y10 degraded by 50% in just 2 hours the galactose present in milk, food with the highest amount of galactose (2.5 g/100 mL). Y10 survived simulated gastrointestinal conditions and it also exhibited adherence to human intestinal cells suggesting that it can establish itself where it needs to be most active. A dose of 10e9 CFU was estimated to be sufficient for delivery of viable and active yeast cells to the gastro-intestinal tract; this dose can be achieved with current oral delivery formulation technologies.

Conclusions/Discussion
Yeast strain Y10 developed in this study could potentially be used to treat patients allowing them to ingest a more normal galactose-containing diet and minimizing the onset of symptoms associated with galactosemia.

Summary Statement
I created an efficient yeast strain to detoxify galactose in food for patients with galactosemia.

Help Received
I designed the experiments and created the yeast strain. My Science Fair coordinator teacher, Mr. Haas, supported me with encouragement. I used a bench at the laboratory of Vetica Labs to perform the experiments. I connected with the Rare Science organization to network with the rare disease community.