Increased Utilization of Crude Glycerin from Biodiesel Production

Introduction
• Biodiesel production results in a large quantity of crude glycerol (glycerin) being produced [1].
• A large supply of crude glycerol with low demand has resulted in low prices (Figure 1). Crude glycerol is approximate $0.10/lb and feedstock price $0.28/lb. [2].
• Finding an efficient method for utilizing this readily available commodity is an intriguing opportunity for profit.

Background Information
• Glycerin market is heavily affected by biodiesel production.
• Refined glycerin (USP 99.7%) has greater demand, but refining is not cost-effective on a large scale [3].
• Glycerol thermally degrades before vaporizing. Vacuum distillation is a solution to this problem [3].

Constraints and Opportunities
• Opportunity: Convert crude glycerol directly to a product and bypass the purification process.
• A Glycerol-based biorefinery produces fuels and chemicals through microbial fermentation of crude glycerol [1].
• Constraint: Requires microbes (bacteria) that are tolerant to inhibitors in crude glycerol [1].

Potential Solutions
1) Ethanol Production
• Almost 40% is saved when produced from glycerol instead of corn-derived sugars (when considering feedstock demand and operational costs) [4].
• Different bacteria can be used such as Kluyvera cryocrescens S26 (natural) and Klebsiella pneumoniae (mutated) [1] [4].
• Depending on method, production levels of 21.5 to 27 g/L and productivities of 0.61 to 0.93 g/L/h can be reached [1] [4].

2) Citric Acid Production
• Certain yeast varieties, such as Yarrowia lipolytica, can perform citric-acid (CA) fermentation in batch fed fermenters.
• Citric-acid fermentation produces citric acid along with lesser amounts of byproducts (Isocitric acid, ICA) [7].
• The resulting product can be separated to provide pure citric acid.

Chosen Solution
Lipid Production
• Microalgal fermentation of glycerin from biodiesel production in batches shows a promising future for a continuous production [5].
• Lipids produced recycled into the biodiesel production process.
• S. Limacinum SR21, Chlorella Protothecoids, Cryptococcus curvatus [5] [6] [8].
• Can reach production levels of 60.7% to 73.3% g lipids/g glycerol [5] [6].
• C. Curvatus was unaffected by methanol concentration in the crude glycerin [8]; however, Lipid production with S. Limacinum is optimized with low methanol concentrations [6].

References