Industrial Wax Ester Production Using Engineered Rhodococcus jostii

Group B1
Darien Grace, Daniel McClement, Rosemarie Nederend, Carissa Scholes, Emma Stanley, Taj Taggar, Carolina Trujillo, Riley Whittaker

1 Media Prep and Sterilization
Media components are mixed and sterilized prior to filling bioreactors.

2 Bioreactor
R. jostii grow to high cell densities and accumulate wax esters under nitrogen limitation inside the fed-batch bioreactor.

3 Concentration and Cell Lysis
A disc stack centrifuge is used to remove excess spent media.

4 Cell Debris Centrifuge
Bead mills lyse cells, releasing the intracellular product.

5 Centrifugal Contactors
Centrifugal contactors separate wax esters from the spent media using hexane as a solvent.

6 Hexane Evaporation
A flash drum separates the hexane solvent from the wax ester product.

Background
Jojoba is a land intensive source of wax esters
Wax esters are commonly used as emollients in shampoos, conditioners, skin ointments, and moisturizers
The jojoba oil market is expected to grow to $222.1 MM USD by 2025
Target production for this plant is 2,300 tonnes of wax esters per year, 10% of the 2025 jojoba oil market

A novel approach to wax ester production is using bacteria as a biocatalyst

Plant Layout and Location
Located in the State of Espirito Santo
Industrial area, easy access to utilities
4 km to Vitoria
12 km to port

Section 1: Media Preparation
Section 2: Bioreactors
Section 3: Biomass Slurry Tanks
Section 4: Cell Lysis and Centrifugation
Section 5: Hexane Separation

Economic Assessment
Total Operating Expenditure (OPEX)
- General Expenses 19%
- Plant Overhead Costs 5%
- Field Charges 19%
- OPEX $48.83MM USD

Total Capital Expenditure (CAPEX)
- Working Capital 15%
- Fees & Contingency 11%
- Indirect Plant Costs 14%
- Direct Production Costs 57%
- CAPEX $96.62MM USD

- Plant lifetime: 30 years
- Payback period: 9 years
- Revenue: $74.91MM USD/year
- Sale price to meet 12% MARR: $32.57/kg
- Uncertainty in market price