Spray Evaporation System for Dehydrating Mustard Seed Extract

Objective

This project aims to create a flash evaporation system to dehydrate mustard seed extract, a byproduct from creating biodiesel that can then be used as an pesticide. The current drying process uses a freeze-drying method, which is inefficient. Our goal is to reduce this drying time by half, reducing a significant bottleneck in the lab's biopesticide production.



Value Proposition

Mustard seeds contain glucosinolates, a compound which contributes to the plants defense against pests. Extractions of this compound would provide an organic alternative to pesticides. A shelf stable powder can be extracted as a byproduct of mustard seed-based biodiesel production.



Background

- Mustard plants produce many useful chemical products
- •Oils that can be processed into biodiesel and glucosinolates-they show promise on being used as biopesticides
- Drying methods available
- Drum dry, freeze dry, and spray dry
- Freeze drying currently takes three days for a 10-gallon batch

Key Product Requirements

- •End product should be at least 50% dry
- •Reduce drying time by half
- •No large drop in glucosinolate yields caused by thermal degradation
- •No use of chemicals to aide with drying due to end product being used in organic farming
- •Can handle up to 10 gallons of product a day

Key System Components



THE HEATING CHAMBER

THE HEAT SOURCE



THE SPRAY SYSTEM

The Heating Chamber

- •55 gallon aluminum drum
 - Reusing a drum from Dr. He's Lab
- •80/20 frame
 - Using leftover framing from the workshop

•Reusing materials saves nearly \$500



The Heat Source

Two 14.5 Amp Corded Heavy-Duty Master Heat Guns

- Avg. Air flow of 3400 FPM and volume of 27 CFM
- Up to 649*C/1200*



The Spray System

5 Gallon Portable Stainless Steel Tank Sprayer

- Can be pressurized up to 125 PSI using any compressed air supply
- Can handle small particle solutions

Replaces the need for a full pump system



Prototype Drawing



Risks and solutions

Incomplete drying of extract powder

- Reduce spray flow or increase temperature
- Adjustable nozzle height
- •Spray nozzle potentially getting clogged
- •Heating chamber needs insulation
 - To provide safety to operator
 - Maintain chamber at desired temperature during operation
- •Potential Fumes
 - Steam vent will be tested for potential hazardous fumes to user
 - First tests will be outside

Capstone Project Schedule - Fall-Spring															
		2021													
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Budget

Acknowledgements

- •Dr. Inna Popova, Sponsor
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- •Kirk McKenzie, Mentor
- •Bishal Bhattarai, Mentor