

# Spray Evaporation System for Dehydrating Mustard Seed Extract

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# Objective

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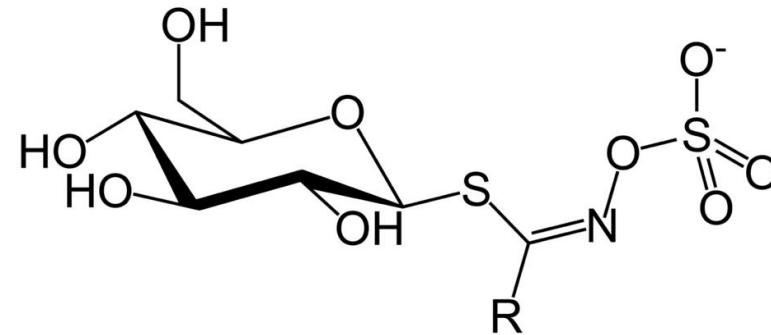
This project aims to create a flash evaporation system to dehydrate mustard seed extract, a byproduct from creating biodiesel that can then be used as an pesticide. The current drying process uses a freeze-drying method, which is inefficient. Our goal is to reduce this drying time by half, reducing a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



# Value Proposition

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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

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- 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

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- 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

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- 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

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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

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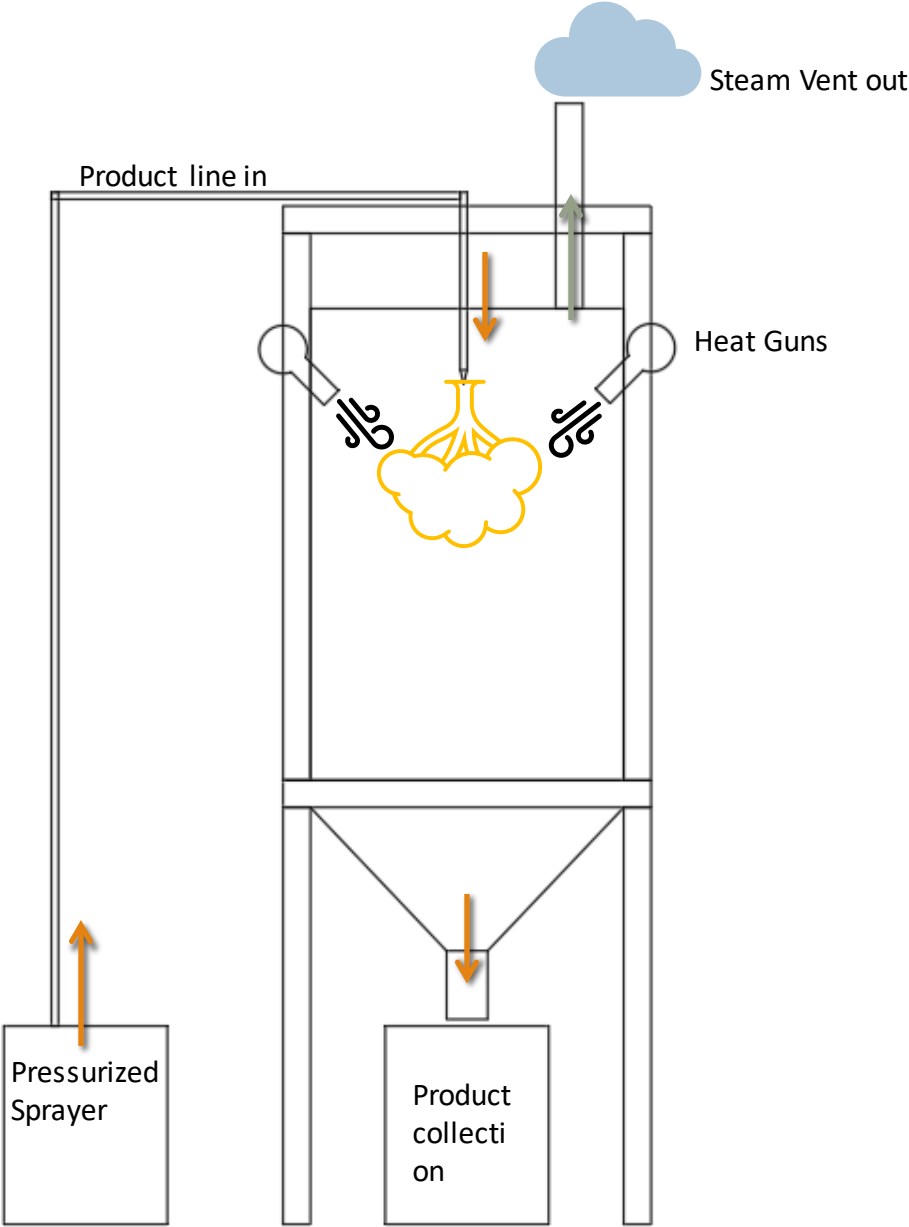
## 5 Gallon Portable Stainless Steel Tank Sprayer

- 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

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- 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													
		Mar					Apr				May				
Task Description	2/6	3/5	3/12	3/19	3/26	4/2	4/9	4/16	4/23	4/30	5/7	5/14	5/21	5/28	
Budget															
Poster															
Personal Logbook															
Project Portfolio															
Wikipage															
Prototype - Create design															
Prototype - Order parts															
Prototype - Build															
Prototype - Testing & Analysis															
Snapshot Days															
Design expo															
Project Final deliverables															

# Schedule

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**Capstone Project Budget Template - Fall/Spring**

Project: Dehydrating Mustard Extract

Last Updated **2/23/21**

Year									Item		
Expense Items	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total		
<b>Equipment/Tools:</b>									\$ -		
									\$ -		
									\$ -		
<b>Travel:</b>											
									\$ -		
									\$ -		
<b>Supplies / Parts / Services:</b>											
Bulk Line - Plastic Fastener			\$ 0.59						\$ 0.59		
V Tube - Plastic Tubing (3 ft)			\$ 1.96						\$ 1.96		
Bulls Eye Brass Nozzle			\$ 9.99						\$ 9.99		
Brass Coupler			\$ 7.99						\$ 7.99		
Brass Adapter			\$ 3.49						\$ 3.49		
Thread Seal Tape			\$ 1.39						\$ 1.39		
Check Valve									\$ -		
Different Nozzles (potentially)						\$ 18.00			\$ 18.00		
Heat Gun						\$ 289.00			\$ 289.00		
Control system						\$ 50			\$ 50.00		
Sprayer Tank						\$ 207.21			\$ 207.21		
Frame									\$ -		
Getting drum sandblasted						\$ 70			\$ 70.00		
										\$ 659.62	<b>Expenses Subtotal</b>
<b>Shop Usage (est. Hrs):</b>									Hours		
Welding/Cutting						8			8		
									-		
											<b>Graduate Student Support</b>
									\$ -		including fringe
									\$ -		<b>Shop Overhead</b>
									\$ 32.98		<b>University Overhead</b>
											5% of all expenses
									<b>\$ 692.60</b>	<b>\$ 1,000.00</b>	<b>\$ 307.40</b>
										Budget	Excess

# Budget

# Acknowledgements

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- Dr. Inna Popova, Sponsor
- Dr. Brian He, Instructor
- Kirk McKenzie, Mentor
- Bishal Bhattarai, Mentor