

Problem Statement

Watermelon lacks sugar and flavor needed to make a quality wine product. A standard process for making watermelon wine does not currently exist.

Objectives

1. Design a standard process for making watermelon wine for a student operated business.
2. Develop optimal quality product using a zero discharge, minimum energy plant.

Background

Watermelon season in Indiana lasts from mid-July to mid-October [2]. On average, watermelon contains 8% sugar and 92% water [1]. The U.S. alcoholic beverage market is a \$211.6 billion industry [3]. Within this market, wine makes up about 15% of \$211.6 billion in retail sales dollars, a \$31.74 billion market [3].

Market Analysis

Strengths

- Availability of locally sourced fruit.
- Wine product designed to appeal to young women.
- Minimal waste.
- Minimal overhead cost.

Opportunities

- Wine sales growing each year, key growth among young women [4].
- Growing popularity of micro-breweries and wineries [5].
- Interest stated by consumers in the Lafayette area.

Weaknesses

- Juice production step of process must be seasonal.
- Small scale means little product availability.
- Barriers to entry: cost of equipment.

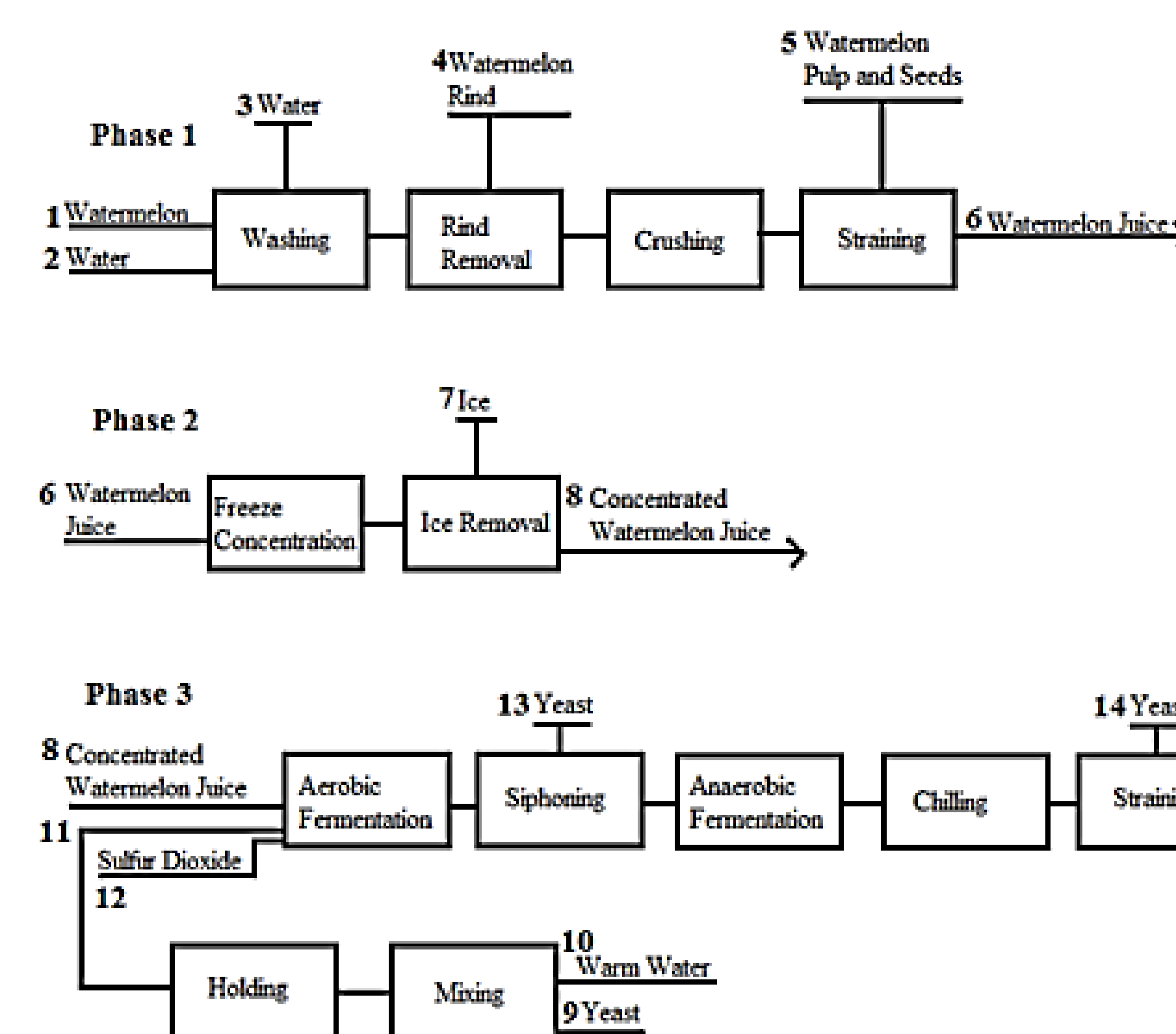
Threats

- Unknown brand with little brand loyalty.
- Obtaining a liquor license in West Lafayette.
- Competition in the marketplace.

Methods: Analysis of surveys and market research as well as interviews with local small wineries and breweries.

Final Design

Process Flow Chart



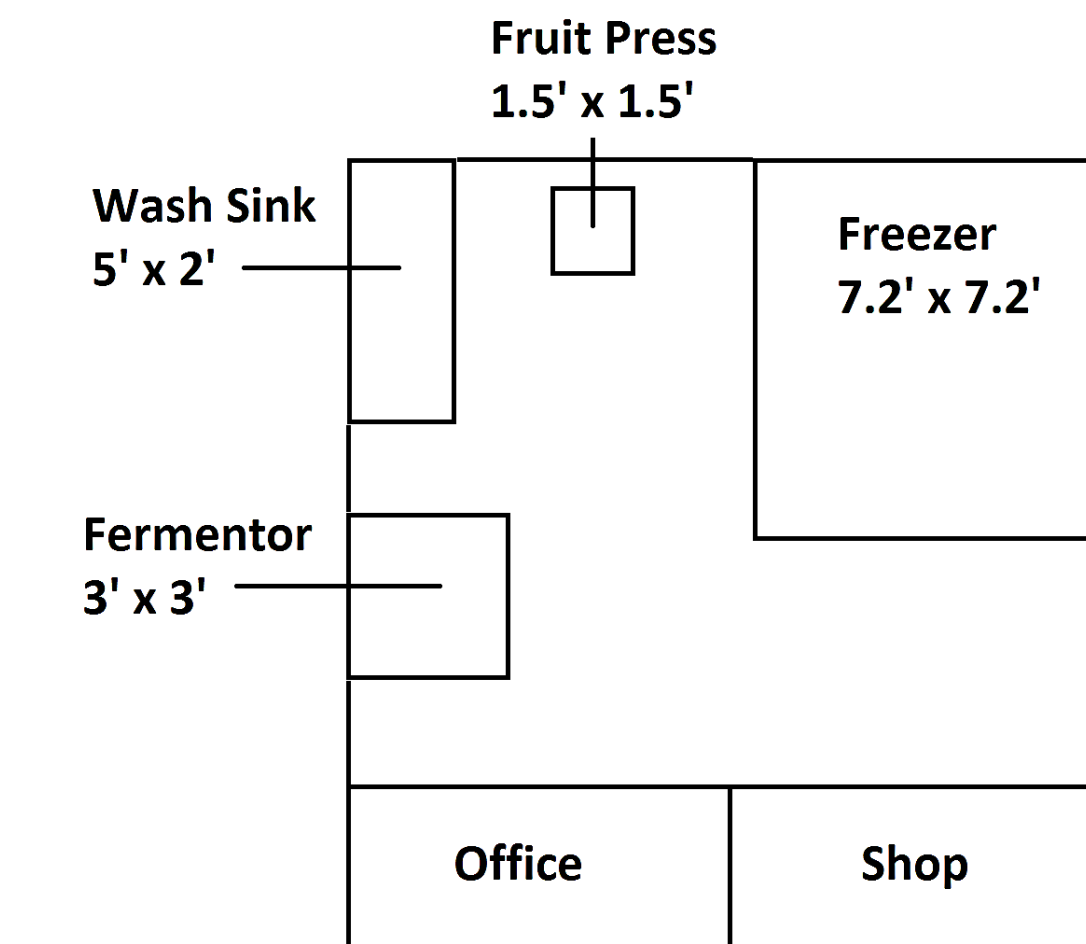
Timeline

Process	Time
Washing	1 min/watermelon
De-Rind	20 min/watermelon
Pressing	16 hr/batch
Freeze Concentration	14.5 hr/9 gal container
Fermentation	462 hr/cycle
Total Time	~ 493 hours/batch

Label



Floor Plan

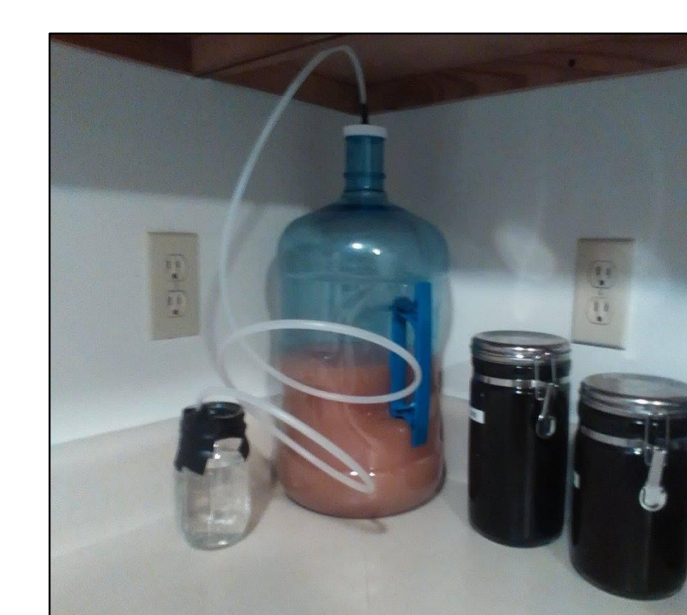


Key Experiment

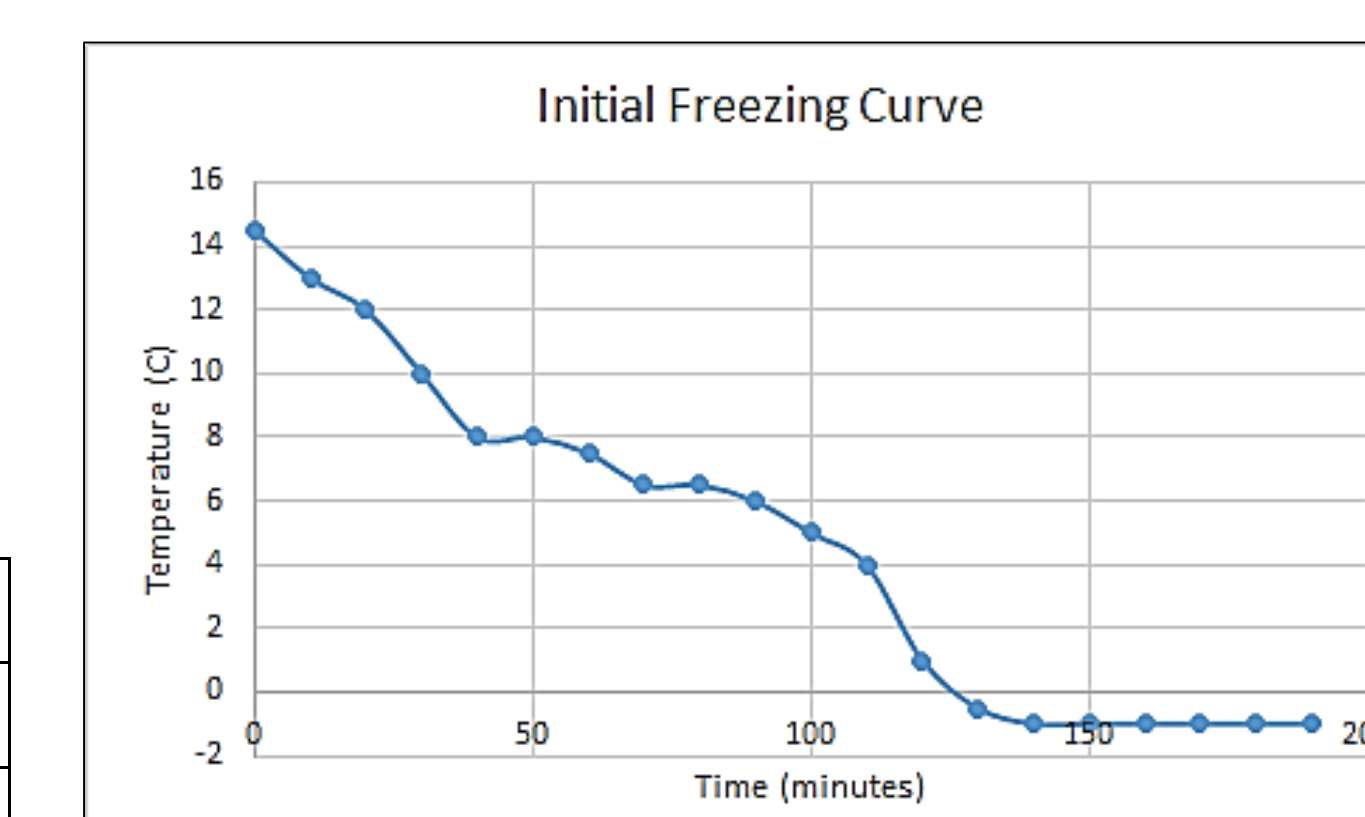
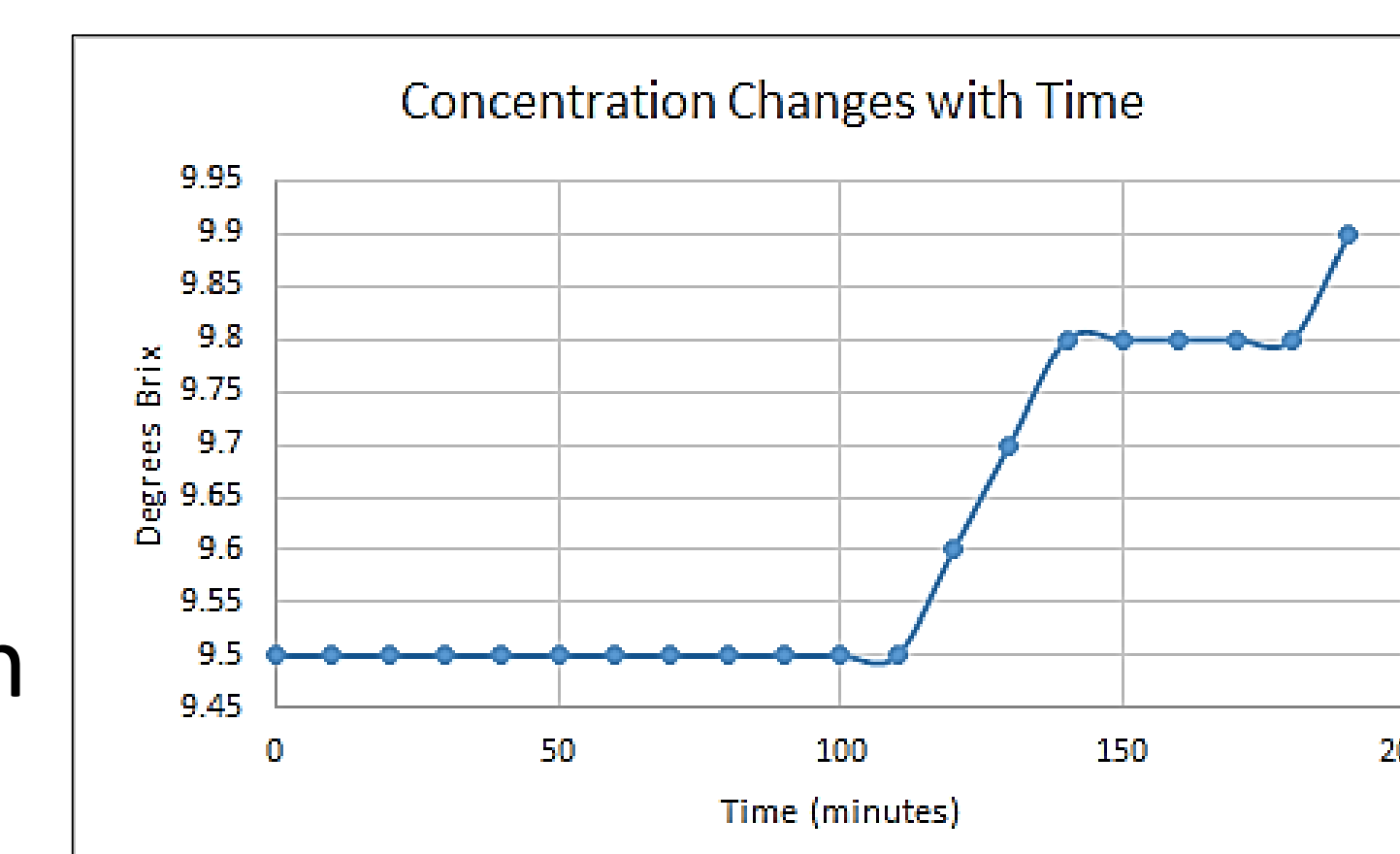
A small-scale experimental trial of the freeze concentration process was performed as a way to understand and compare the theoretical and practical aspects of the process. Data was collected throughout in order to later be extrapolated for future use in our student run winery.

Collected Data:

1. Freezing Patterns
2. Initial Freezing Temperature
3. Freezing Time



Initial Freezing Temperature of the Juice	-0.958°C
Freezing Temperature of the 20°Bx Juice	-2.257°C
Freezing Temperature of the 25°Bx Juice	-2.989°C
Freezing Temperature of the 30°Bx Juice	-3.816°C



Alternative Solutions

For each of the three main production steps (juice extraction, concentration, and fermentation), multiple methods were evaluated to determine the best options for our specific requirements.

Juice Extraction

	Option 1	Option 2	Option 3	Option 4
Washing	Bath Wash	Spray Wash	Manual	Bristle Washer
Rind Removal	Peeler	Hollower	Manual	-
Straining	Hydraulic Press	Continuous Filter Press	Plate Press	-

Concentration

	Option 1	Option 2	Option 3
Concentration	Freeze Concentration	Evaporation	Filtration
Ice Removal	Screening	Pressing	Centrifugation

Fermentation

	Option 1	Option 2
Aerobic Fermentation	Batch	Continuous
Excess Yeast Removal	Siphoning	Filtration
Anaerobic Fermentation	Batch	Continuous
Chilling	Refrigeration	Freezing
Filtration	Column	Plate

*Bolted options were chosen as the final methods.

Economic Analysis

Annual Cost (\$)/Year	
Watermelon	\$ 7,680.00
Yeast	\$ -
Labor	\$ 4,728.00
Distillery License	\$ 750.00
Water	\$ 9.69
Electricity	\$ 2,095.10
Cleaner	\$ 267.58
Sulfur Dioxide	\$ 27.30
Bottling	\$ 605.60
Total	\$ 16,163.27

Equipment Cost (\$)

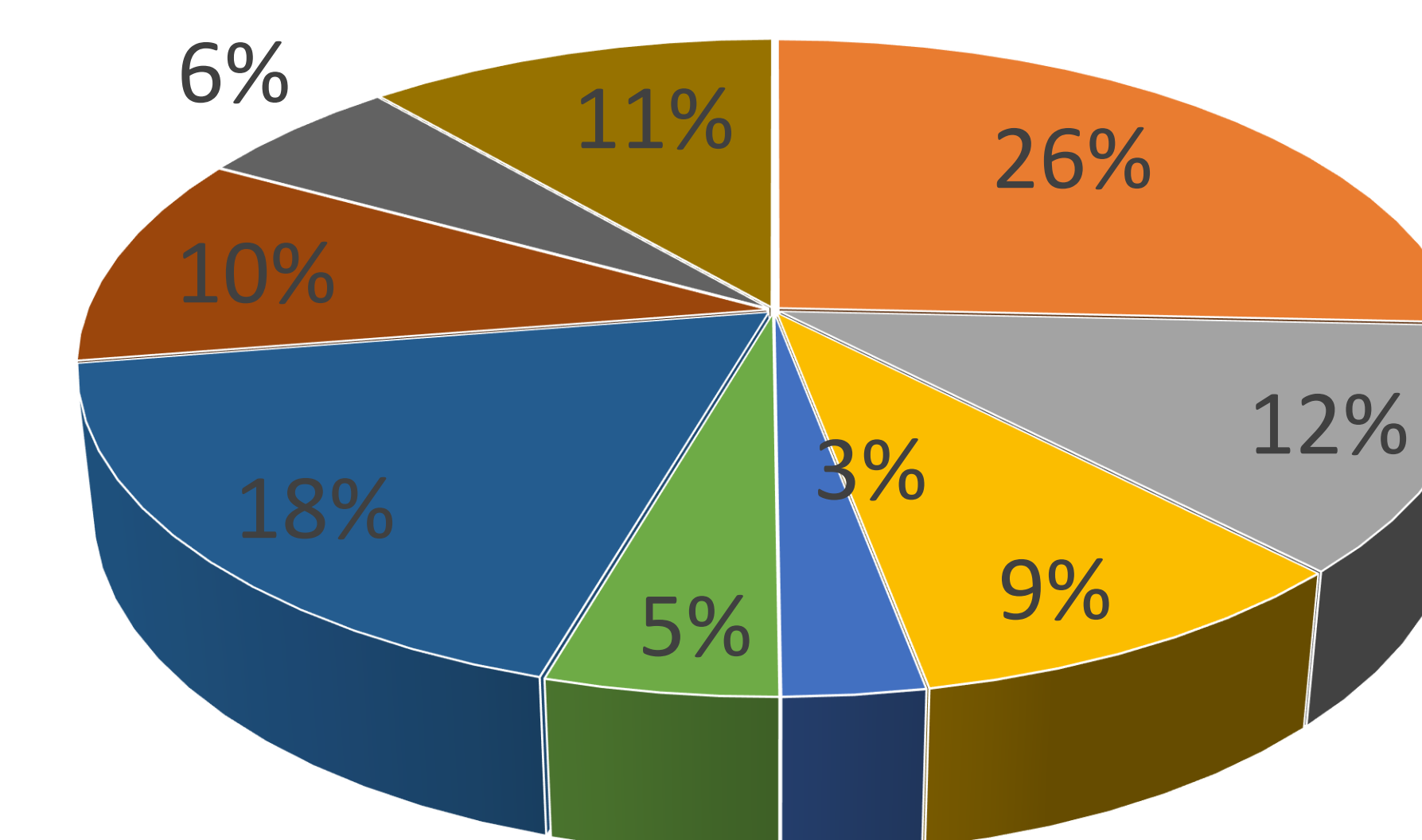
3 Basin Sink	\$ 650.00
Walk-in refrigerator	\$ 4,000.00
Hand Wine Press	\$ 225.00
Fermentation Tank 1	\$ 2,150.00
Fermentation Tank 2	\$ 2,150.00
Filter System	\$ 184.44
Wine Bottle Filler	\$ 424.99
Label Applicator	\$ 499.00
Total	\$ 10,283.43

Summary

Rev.	\$ 18,927.00/yr	ROI	17%
Cost	\$ 16,163.27/yr	TCI	\$40,000
Profit	\$ 2,763.73/yr	PP	23 yr

Total Capital Investment

- Equipment Cost
- Installation
- Instrumentation
- Electrical Systems
- Buildings
- Service Facilities
- Construction Expenses
- Contractors
- Contingency



Calculations performed w/ production of 300 gal/year sold at \$12.50/bottle.

Global/Societal Impact

- Low waste process.
- Provide on-campus jobs that allow Purdue students to gain valuable hands-on experience.

Works Cited

1. "Composition of Watermelon." *Internet Symposium on food Allergens*. (2001) 3 (3): 153-158.
2. Indiana State Department of Agriculture. "Indiana Fruits and Vegetable Harvest Calendar."
3. "Alcoholic Beverage Market Overview In The United States." *Park Street Imports*.
4. Thatch, Liz. "Trends in the US Wine Industry for 2014." *Wordpress*. 26 March 2014. Web.
5. Number of Breweries and Brewpubs in U.S." *Brewers Association*.

- Dr. Okos (Instructor)
- Coleen Riley (T.A.)

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