SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE
2024

BrewBa Alcoholic Boba

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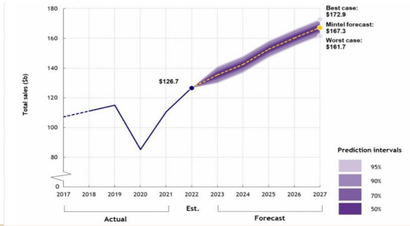
Objective

To develop a procedure for creating honey-wine popping boba and to design optimized product processes that minimizes waste and maximize profits.

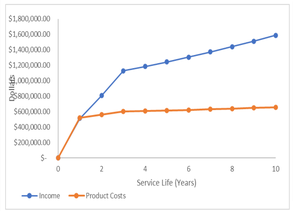
Market Analysis

- There is a growing global trend of at-home alcohol consumption.
- 126.7 billion dollars were spent on Alcohol in the United states in 2022, and this number is forecasted to increase by 50 billion in the next 5 years.
- 38% of the United States population is in the target age for the product, and of those, 39% state that they have the disposable income to purchase alcoholic products regularly. This equates to a market demand of roughly 45 million BrewBa pearls per year.



Finance

Cost, Sales, and Investment Metrics Summarized For Ten Years



TPC	Year	Breakeven Production Rate (kg/yr)
$ --	0	0.00
$ 520,736	1	12365
$ 558,360	2	11776
$ 599,583	3	11216
$ 606,797	4	10681
$ 614,372	5	10173
$ 622,325	6	9688
$ 630,676	7	9227
$ 639,445	8	8788
$ 648,652	9	8369
$ 658,319	10	7971

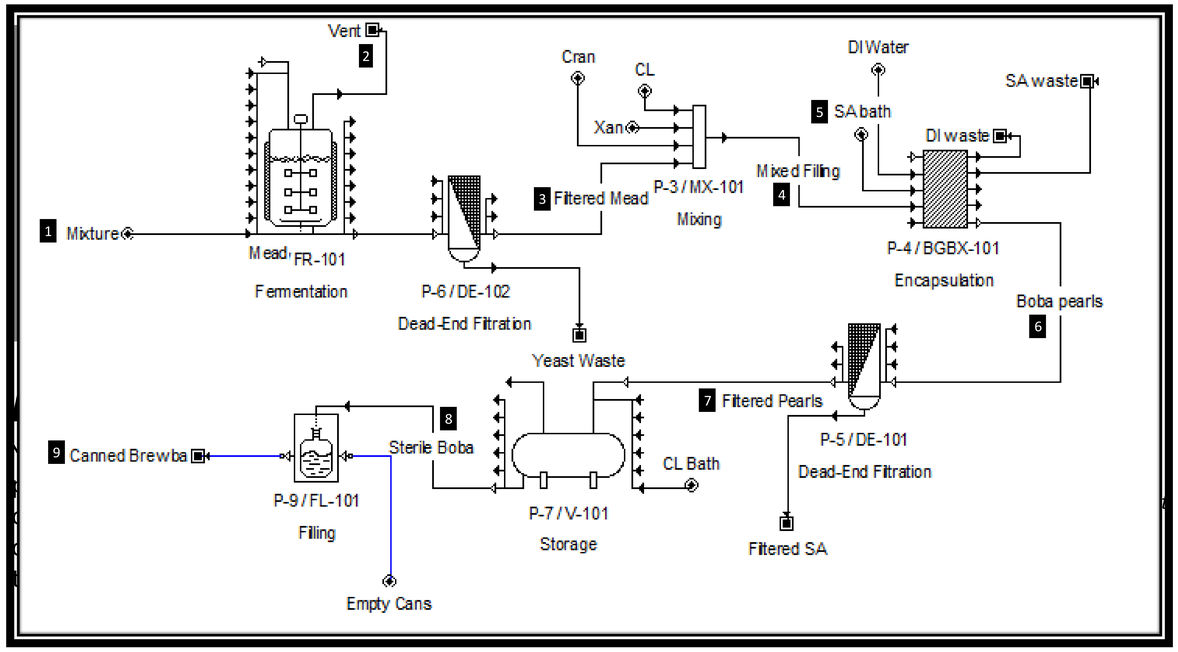
Component	Value
Total Capital Investment	$ 1,631,910.19
Total Product Cost	$ 6,099,265.47
Net Profit	$ 4,248,970.39
Break Even	Year 2

Minimized Waste

Brewba prioritizes ecological stewardship and production efficiency by:

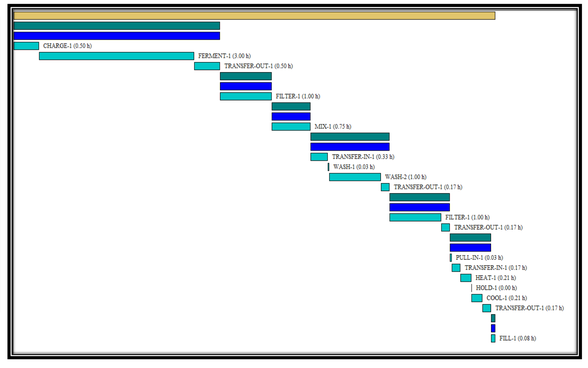
- **Filter cleaning and reuse**
- **Employing raw material recycle streams**
- **Using Energy Efficient Equipment**

Fun fact: Wine filters can be recycled with reverse washing to clear the filtrate cake!



Process Highlights Key

1. Mixture – Yeast (0.06%), Honey (67.5%), Water (32.4%), DAP (0.01%)
2. Vent – Carbon Dioxide (100%)
3. Filtered Mead – Water (82.9%), Ethanol (11.3%), Carbohydrates (5.1%), Ash (0.6%)
4. Mixed Filling – Mead (78%), Cranberry Juice (19.5%), Xanthan Gum (0.6%), Calcium Lactate (1.9%)
5. Sodium Alginate bath – Sodium Alginate (2.0%), DI Water (98.0%)
6. BrewBa pearls – Encapsulated mixed filling and washed with DI
7. Filtered pearls – SA particulate removed
8. Stored pearls – Stored in CL bath to stabilize gel layer
9. Canned Brewba – Sterilized with steam in cans (334 pearls/can)

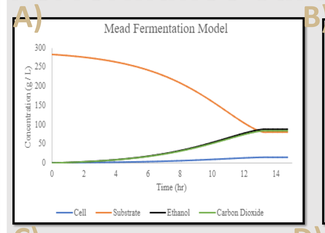


Optimization/Alternatives

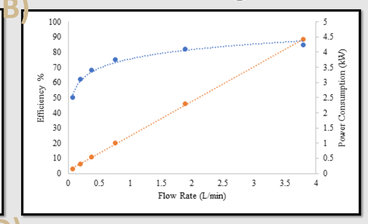
Fermentation	Filtration	Mixing	Encapsulation	Sterilization
Optimized process: • Anerobic fermentation – perfect for low-maintenance brewing. Ferments for 7 weeks. Goals: • Capture carbon • Zero power usage Alternatives: • Aerobic fermentation • Conical tank	Optimized process: • Vacuum filtration – a series of pore filters from large to small are used to remove particulate from mead. Process time is Goals • Minimize energy usage for vacuum • Prevent waste from spoilage Alternatives: • Membrane filtration • Crossflow filtration	Optimized process: • Propeller agitator – compatible with low RPM and low viscosity fluids. Mixing time is 45 minutes. Goals • Optimize energy usage with mixing speed and time Alternatives: • Jet Mixer • Static Mixer • Vacuum Mixer	Optimized process: • Reverse spherification – alcohol can only be encapsulated by reverse procedure. Process time is 5 minutes. Goals • Minimize waste with recycling baths Alternatives: • Electrostatic Sprayer • Spherification • Microfluidic channels	Optimized process: • Sterilization – machinery cans BrewBa pearls and sterilizes with steam. Cans and sterilizes 80 can/min. Goals • Minimize energy needed with steam Alternatives: • Pasteurization • Freezing

Performance Curves and Design

A)



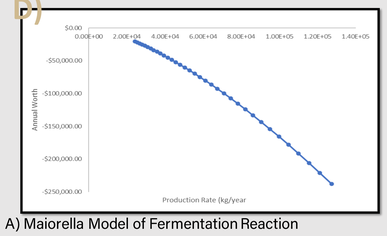
B)



C)

Table 3: Energy Requirement Calculations	
Operations	Total Energy (KW)
Agitated Vessel	9.71
Pumps for Sterilized Mead	0.69
Pumps for Cranberry Concentrate	0.32
Pumps for Intermediate Product to Encapsulation	1.08
Total Overall	11.81

D)



A) Maiorella Model of Fermentation Reaction

B) Performance Curve Measuring Linear Power Consumption against Logarithmic Efficiency

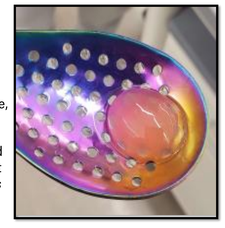
C) Component Energy Requirements by Process

D) Annual Worth vs Production Rate

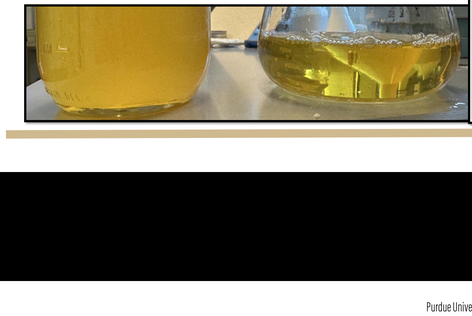
Product

BrewBa popping boba pearls are created with a technique called reverse spherification. A mixture with calcium lactate is dropped in a bath containing sodium alginate. The calcium ions inside the mixture react with sodium alginate, creating calcium alginate. This forms a gel-like layer around the material and holds the liquid inside.

Fermentation of mead is done with the yeast strain *Saccharomyces cerevisiae.* Honey, water, and DAP are added to a large container that is sealed and stored in a dark area. This will induce anerobic fermentation. Filtration is a largely important step in the process. All remaining yeast must be removed from the mead before it is processed into a BrewBa pearl. Filtration is done with a large wine filter followed by a 2.5 micron filter with a vacuum.



Nutritional Label



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