

Objective

Develop a process to reuse as much of the waste in the gin-making process as possible.

Market Analysis

In 2023, 9 million 9-liter cases of gin were sold creating a revenue of \$1 billion for distillers, and it is predicted to continue to grow

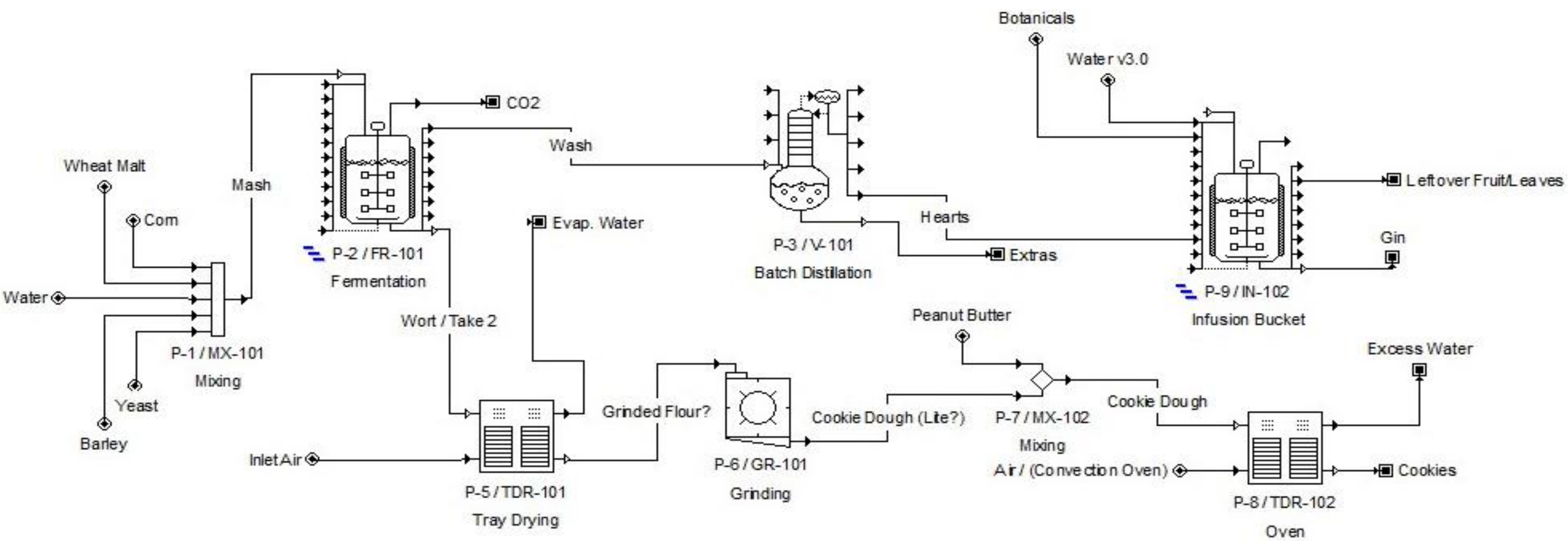
Design Considerations

- Flavor profile of cookies
- Why cookies and not animal feed
- Mash content
- Batch vs. Continuous

Corn and Indiana

Indiana ranked 5th among all states in production of corn for grain. To keep the gin process as sustainable and local as possible most of the gin is made up of flaked corn.

Process Diagram



Experiment Design & Results

Fermentation Time

- Alternating fermentation time (1-2 weeks) for optimal ethanol production and batch time
- 1 week in anaerobic conditions

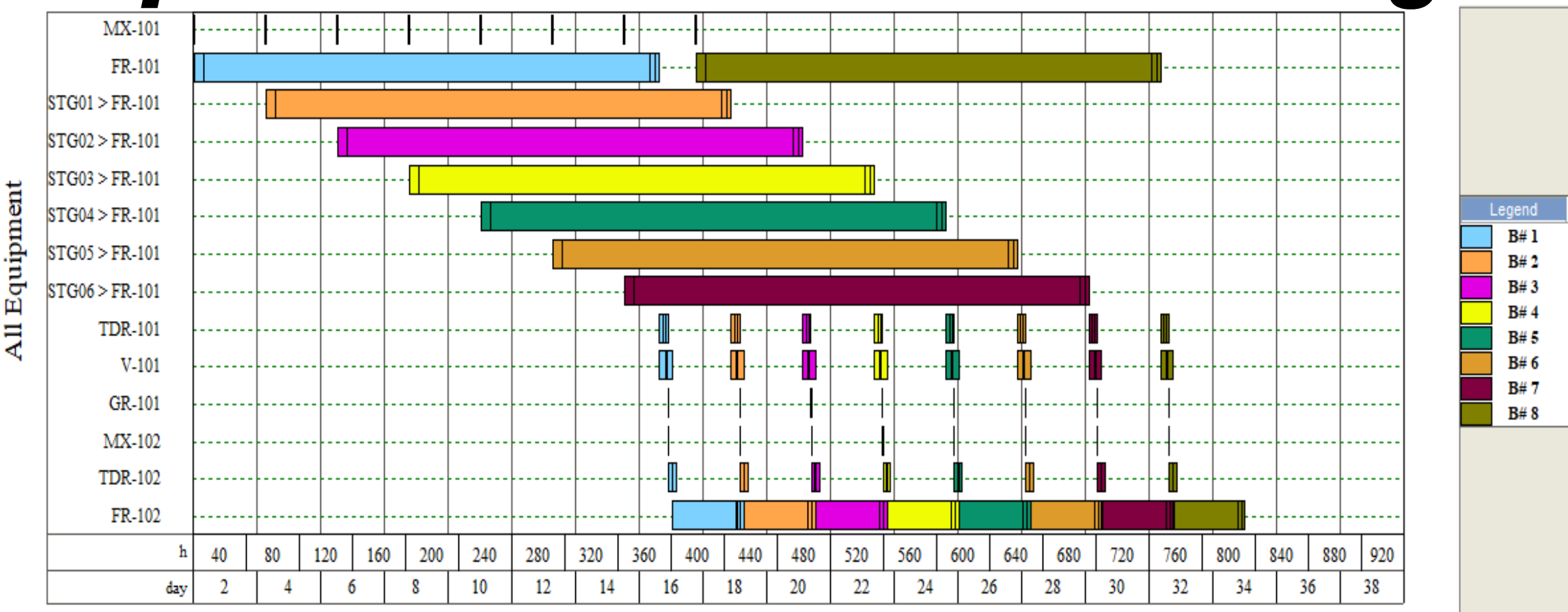
Water to Grain Ratio

- Adjusting water to grain-mixture ratio in mash
- 1:1.5 ideal for mash

Cookie Recipe

- Adjust ratio of spent grain to flour
- Addition of peanut butter for taste

Optimization and Scheduling



1. Mixing - Boil raw corn, wheat malt, Barley malt together to extract and soften the wort.

1. Fermentation - Combine wort with yeast in a sealed vessel with a bubbler so fermentation can occur.

1. Separation - Divide into wash liquid stream and wort solids stream after 1 week of fermentation.

Gin

4. Distillation - Wash stream split between ethanol stream and waste stream of acetone, methanol, ethyl acetone, and other waste.

5. Infusion - Boil ethanol with botanicals to produce high alcohol gin.

6. Dilution - add water to gin to obtain the final product.

Cookies

4. Tray Drying - Wort is spread thin, reducing moisture content.

5. Grinding - Dried mash is ground down into a flour-like consistency.

6. Mixing - Powder is combined with ingredients to produce a cookie dough.

7. Oven - Dough is heated to produce cookies.

Economic Analysis

Total Capital Investment	\$8,735,074.94
Total Production Cost	\$4,989,983.30
Cost / 750mL Bottle	\$38.87
Cost / 12 Cookies	\$9.99
Net Yearly Profit	\$989,998.26
Facility Output	265 batches/year

Sustainability

Cookies Production

- The spent grains were recycled into peanut butter cookies.
- Cookies will allow for a bigger profit margin than animal feed.
- In the US 30-40% of the food supply goes to waste. The cookies will help prevent the spent grains from adding to that number and making sure they are as delicious as possible, so people don't waste them.

Water Recovery

- Recovery of evaporated water and distillation waste for reuse

Future Considerations

- Utilizing vaporized heat created during distillation for a botanical greenhouse
- Experimenting with Infusion techniques
- Diversifying spent grains into dog treats
- Continuous system instead of a batch system
- Potential use for the methanol (heads) byproduct

