

Objective

To create a zero-waste process that utilizes apple pomace waste from hard apple cider to create fruit leather.

Background

Market Analysis

- USD 14.67 billion in 2022 and is expected to grow at a CAGR of 7.2% (Grand View Research, 2023).
- In 2024, canned cider sales grew by 19%. (Hoptown Handles, 2024).

Target Consumer

- Young Adults looking for healthy portable snacks.
- Health-conscious Adults looking to try a new craft beverage made sustainably.

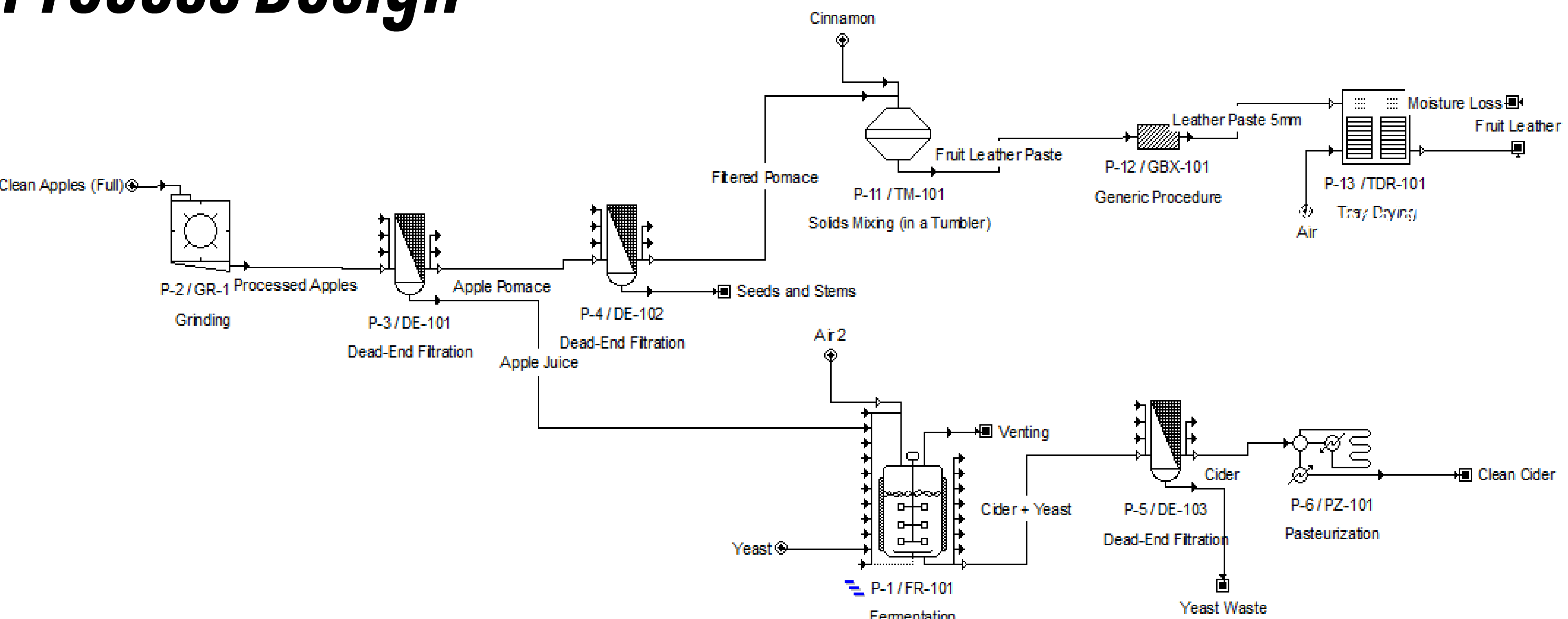
Competitors

- That's It, Annie's Fruit Snacks, Stretch Island Fruit Co.
- Angry Orchard (owned by Boston Beer Company), Bold Rock, Heineken.

Environmental Impacts

- Globally, 40-50% of fruits and vegetables are wasted during production (Despoudi et al., 2021).
- Pomace makes up 10-35% of an apple and is usually discarded (Sostaric et al., 2023).
- Biomass contributes to 20-50% of global greenhouse emissions (Sial et al., 2024).

Process Design



	Fermentation	Dehydration	Pasteurization
Chosen type	Stainless Steel	Tray	LTLT
Alternative type	Barrells	Microwave	HTST
Optimization parameter	ABV %	Temperature	Temperature and Time
Optimized value	22°C \$35,000	78°C \$91,941	71°C 6.17 mins

Economic Analysis

Total Capital Investment	\$8,294,470
Total product cost	\$2.08/kg of Cider \$2.37/kg of Fruit Leather
Product Produced	94,000 L of Cider/ Year 240,000 Kg of Leather / Year
DCFR	25.6%

Plant Design

- Waste water treatment
 - Closed circuit water cycle in pasteurizer
- Plant layout optimization
 - Shorten flow distances in piping

Future Work

- Improve texture and color of fruit leather
- Test alternative uses of apple pomace
- Add new flavor profiles to Cider

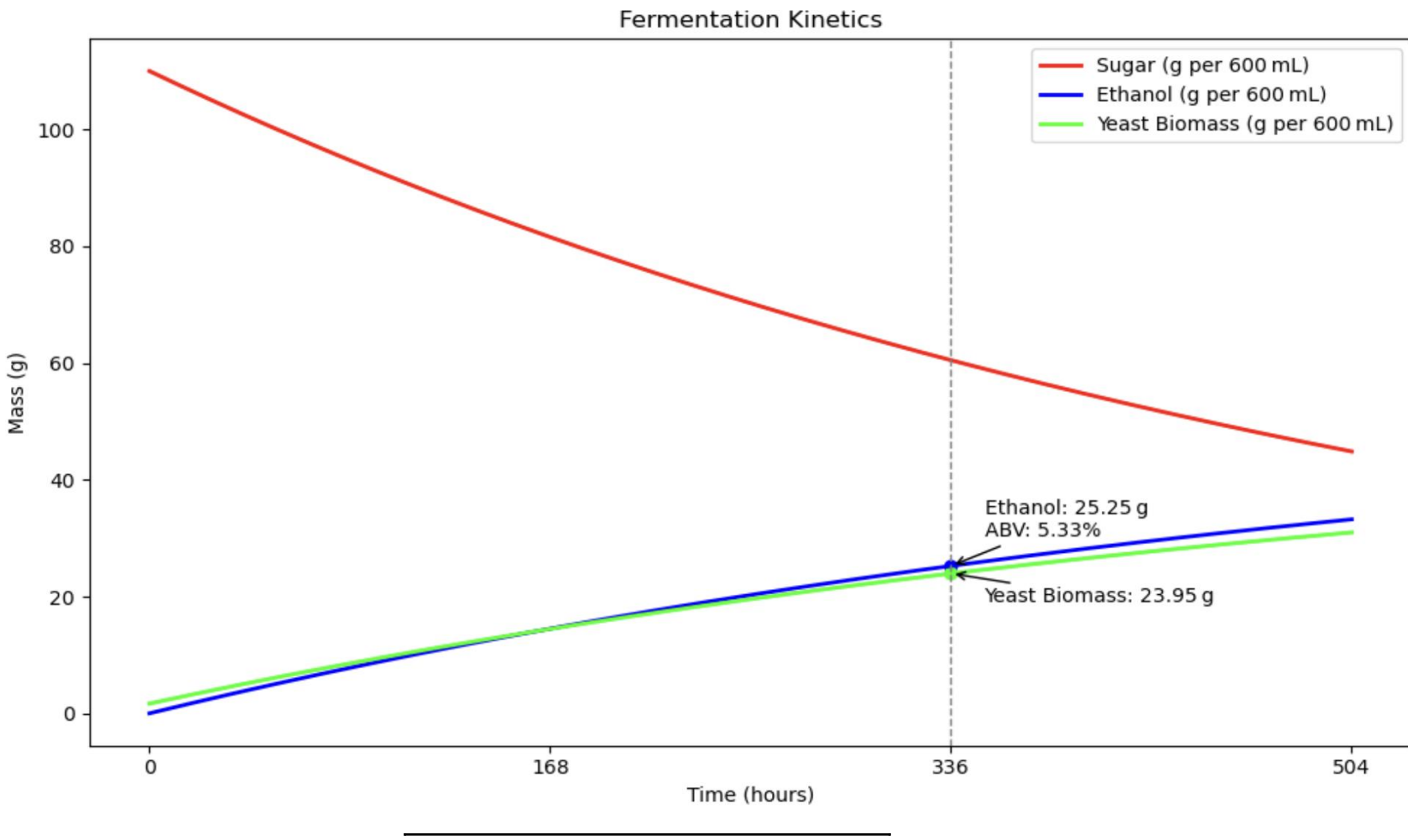
Experimental Design

Cider Production

- Process and juice apples:** Wash, cut, remove seeds and stems. Place apple slices in juicer.
- Activate and add yeast:** Heat 0.26g yeast and 2.6 mL of water at 35-37°C for 20 min.
- Anaerobic Fermentation:** Ferment at room temp for 2 weeks.
- Filtration:** Filter through a cheese cloth.
- Pasteurize:** Boil in water until cider is at 140°C for one min.

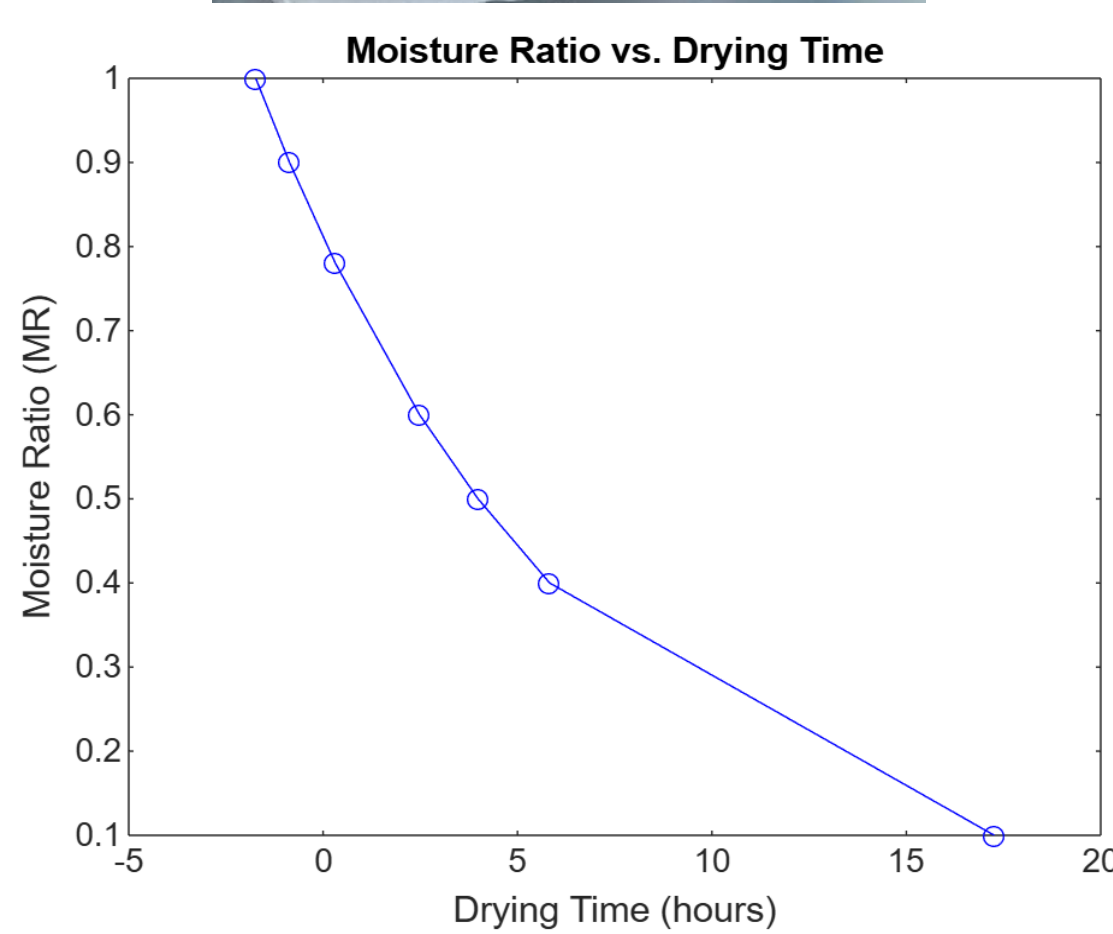
Experimentation

Apple variety (**Honeycrisp**, Granny Smith, Fuji)
Fermentation length (4 weeks, 3 weeks, **2 weeks**)



Fruit Leather Production

- Process and juice apples:** Wash, cut, remove seeds and stems. Place apple slices in juicer
- Collect pomace:** Remove leftover apple pomace from juicing.
- Blend pomace with additives:** Blend apple pomace with cinnamon until smooth paste is formed.
- Dehydrate:** In oven at 77°C for 12 hours



Experimentation

Dehydrator type (**Oven**, tray dehydrator)

*Dehydration time and temperature varied with type