

Fermented Tomato Ketchup

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Problem Statement and Objective

Ketchup global popularity has increased the demand on different types of ketchup to adjust for different tastes around the world. The search for non-traditional, organic ketchups has been growing significantly. On the other hand, customers are concerned about sodium and high fructose corn syrup levels in their condiments. Ketchup is typically produced using tomatoes and high fructose corn syrup, and the need for a more healthful ketchup product is present.

Fermentation products are rich in digestive enzymes and probiotics that help reduce diseases like lactose intolerance and asthma, and increase the absorption of nutrients derived from food. The purpose of our project is to design an efficient model for the fermentation of a healthful fruit ketchup that optimizes product quality while minimizing production costs.

Alternative Solutions

- Waste:** use of seeds & skin
- Tomatoes:** storing of tomato paste
- Filtration:** mesh screen
- Bottle Sterilization:** high heat sterilization, Ethylene Oxide processing
- Packaging:** cans, bottles, jars

Constraints

- Price point:** High in order to profit
- Competitors:** Heinz, Hunts, Kissan, DelMonte
- Seasonal Growth:** Tomatoes do not grow year round in the U.S.

Business Plan

- Target Consumers:** Individuals, families, and restaurants
- Sales Platform:** Online retailers, farmers markets, company website
- Advertising:** Social media, company website, free sampling

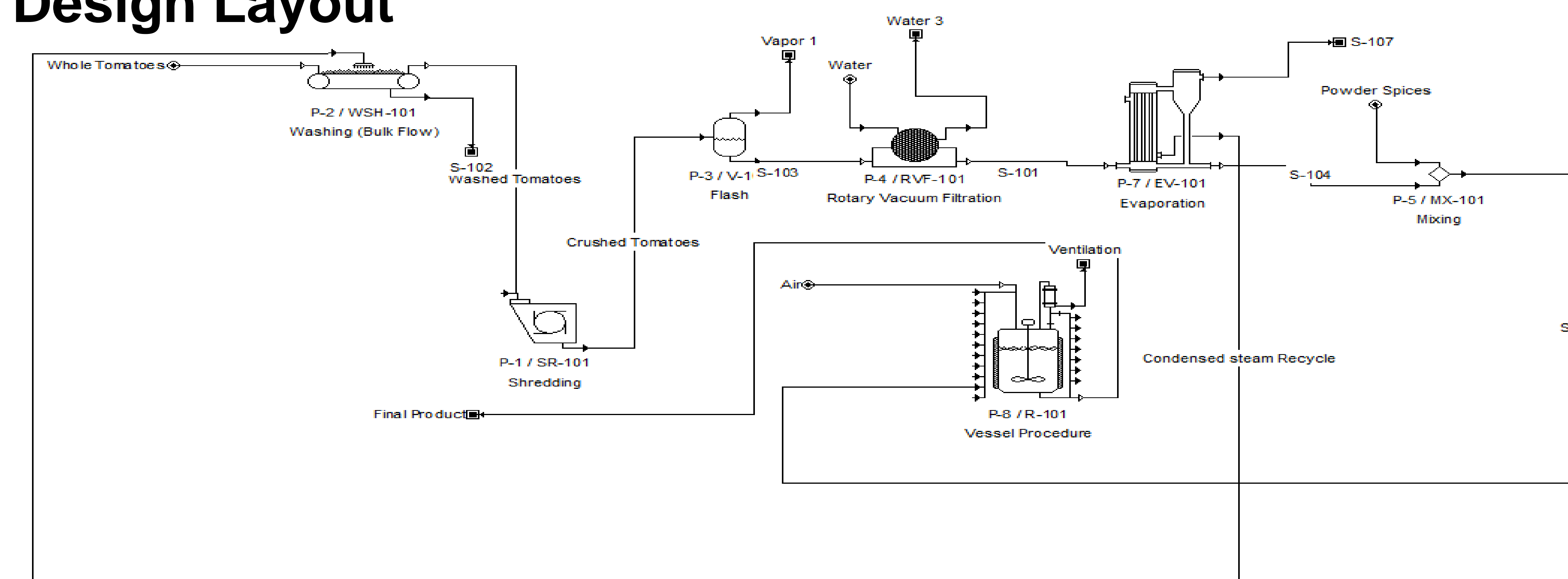
Equipment Cost

- Filtration System: \$5,449.19
- Mixing System: \$3,853.71
- Multiple Effect Evaporator: \$1,512
- Fermentation System: \$9,253.34
- Pumping: \$2,250
- Piping: \$1,562.30
- Total: \$23,880.95

Summary of Economics

- Total Direct Costs: \$56,120.23/yr
- Total Indirect Costs: \$30,090.38/yr
- Total Income: \$290,178.67/yr
- Total Product Cost: \$192,356.57/yr
- Total Capital Investment: \$120,121.18

Design Layout



Break-even Chart

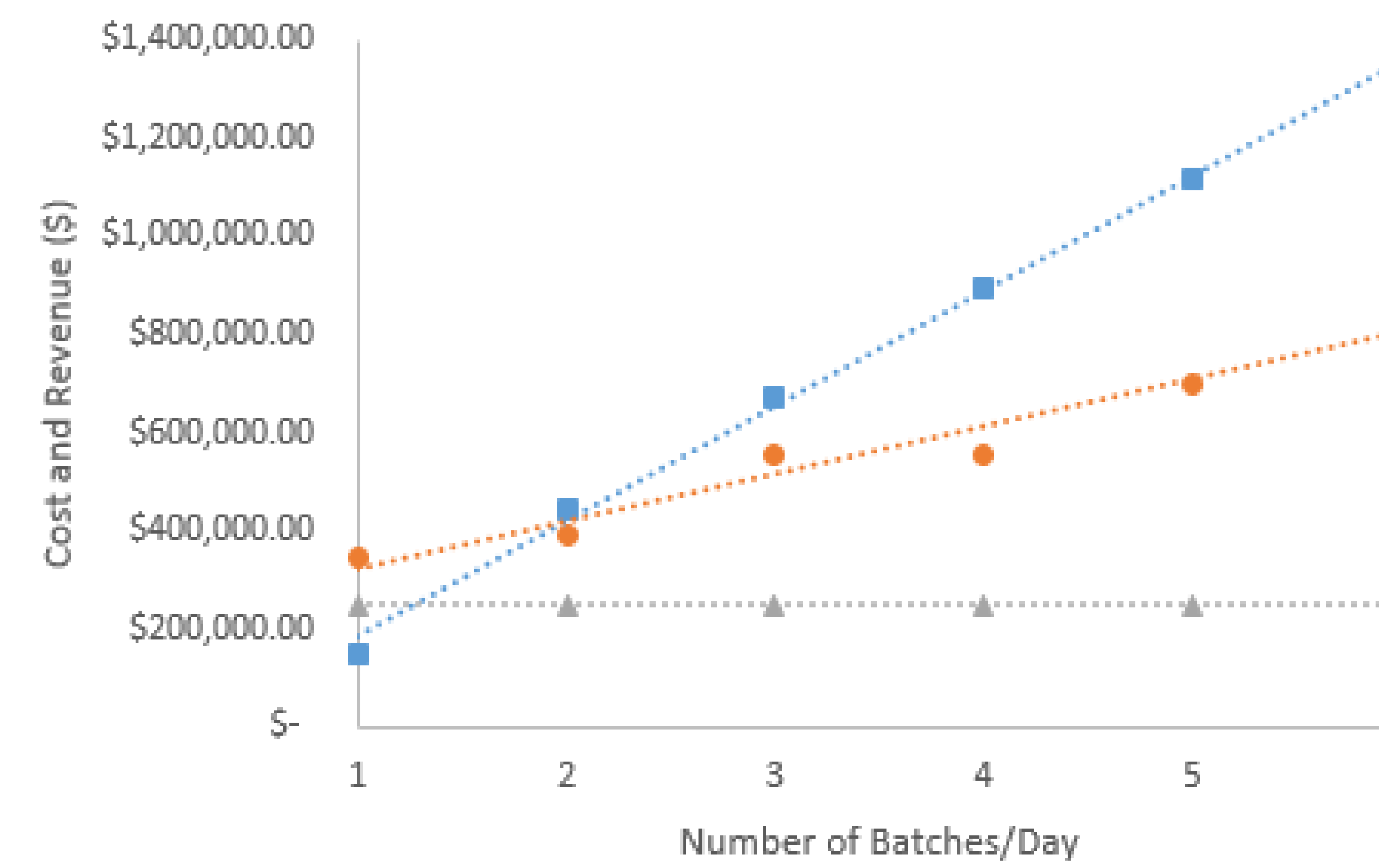


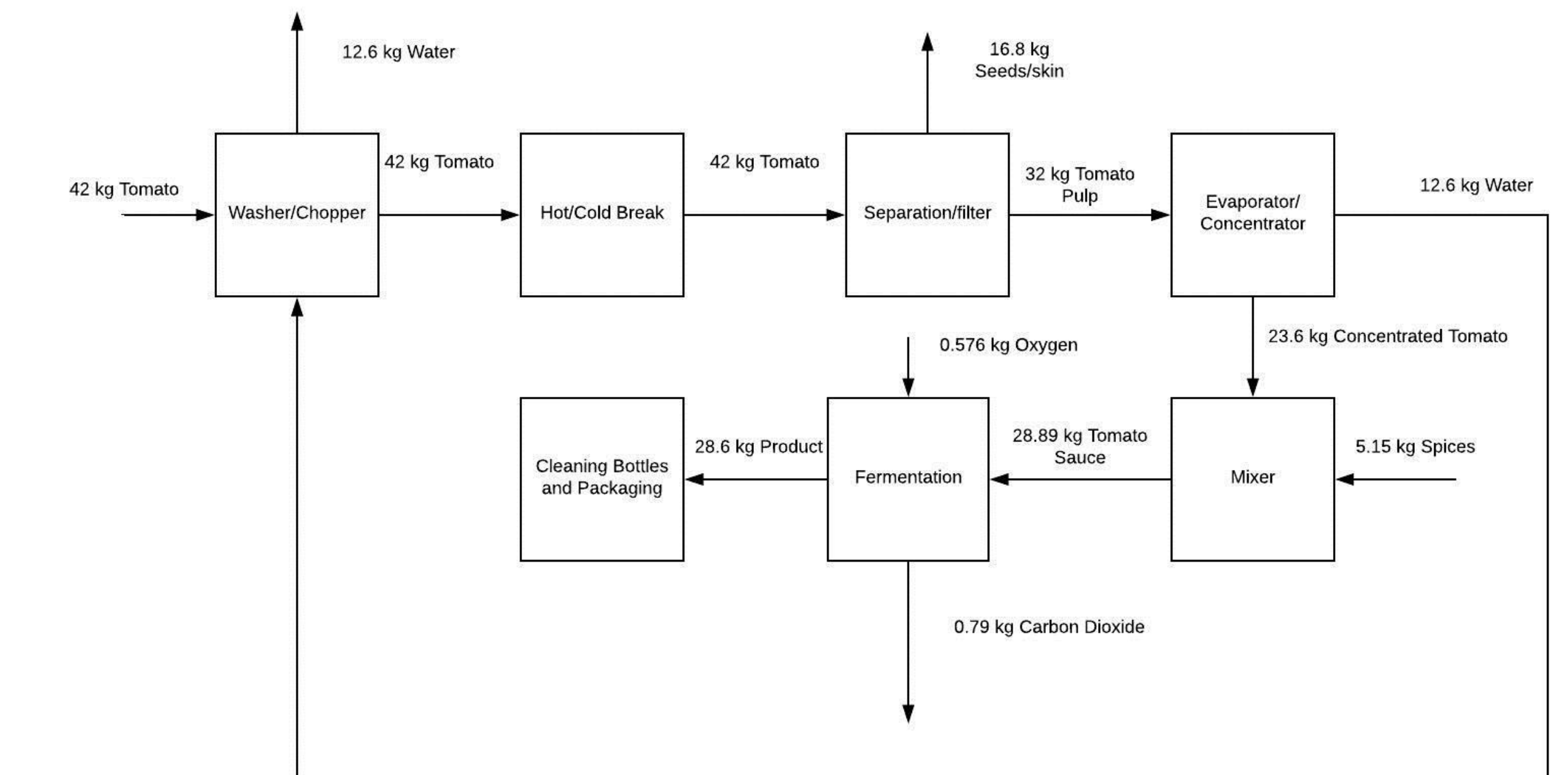
Figure: Break-even chart showing Fixed Costs (▲), Revenue (■), and Total Costs (●) based on number of batches per day. Breakeven point occurs at two batches per day.

Procedure

- Whole tomatoes enter system
- Tomatoes are washed and chopped
- Seeds and skin are filtered
- Excess water is evaporated to form tomato paste
- Excess water is condensed and recycled for use in the washing stage
- Spices are mixed in and cooked
- Fermentation of vinegar occurs
- Sterilized bottle packaging



Process Flow Diagram



- Production rate of 57.2 kg/day
- 2 batches/day
- 50,000 bottles/year
- 12 oz/bottle
- \$6.50/bottle



Summary of Lab Experiments

Variable	Relationship	Lower Limit	Upper Limit
A	Temperature in Boiler	75°C	100°C
B	Rate of Agitation	Low speed	High speed
C	Time in Fermenter	3 hours	6 hours

Varied parameters for taste optimization used in design of experiments.

Five people were selected to form a sensory panel in order to determine significant parameters. Product was tested for appearance, consistency, mouth feel, and flavor. A full factorial analysis was performed.

Impacts

Market: The ketchup market was valued around \$4.15 billion in 2015 and it is expected to grow to \$5.9 billion in the next 5 years.

Global/Societal Impact: Considering the large market and our contributions to it, it is of critical importance that we acknowledge our global and societal impact. We have looked into finding places or unit operations in the food processing chain where waste can be minimized and productivity increased with the help of sustainable solutions. In the future, we might aim to make changes to our system to add back the skins and seeds and reduce waste.