

# SENIOR CAPSTONE/ SENIOR DESIGN EXPERIENCE

2024

# PERI-MENOPAUSE GUMMIES

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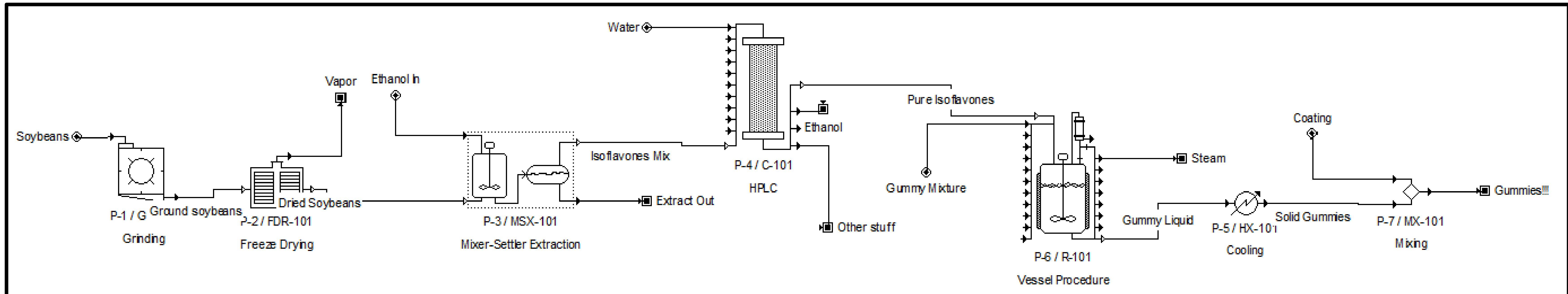
<sup>1</sup>Biological Engineering



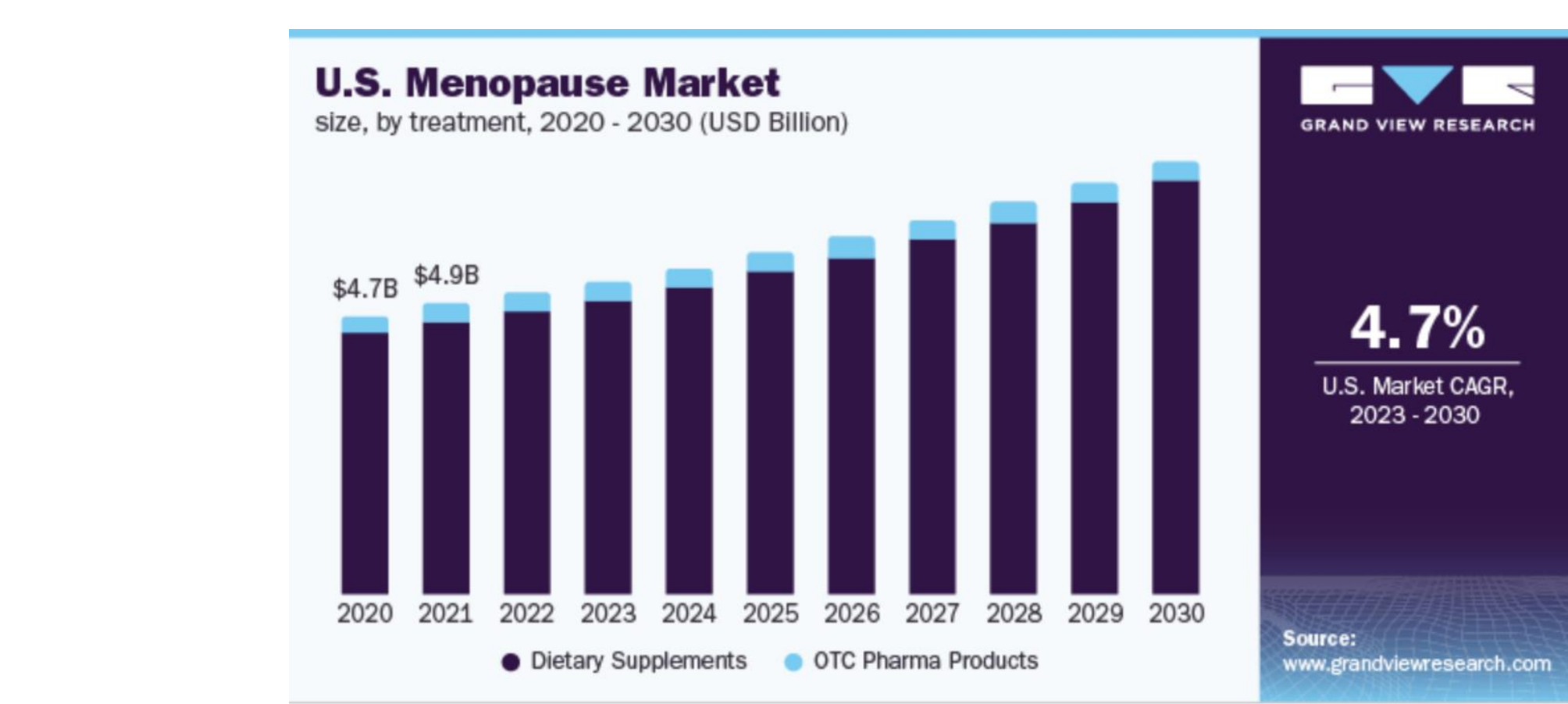
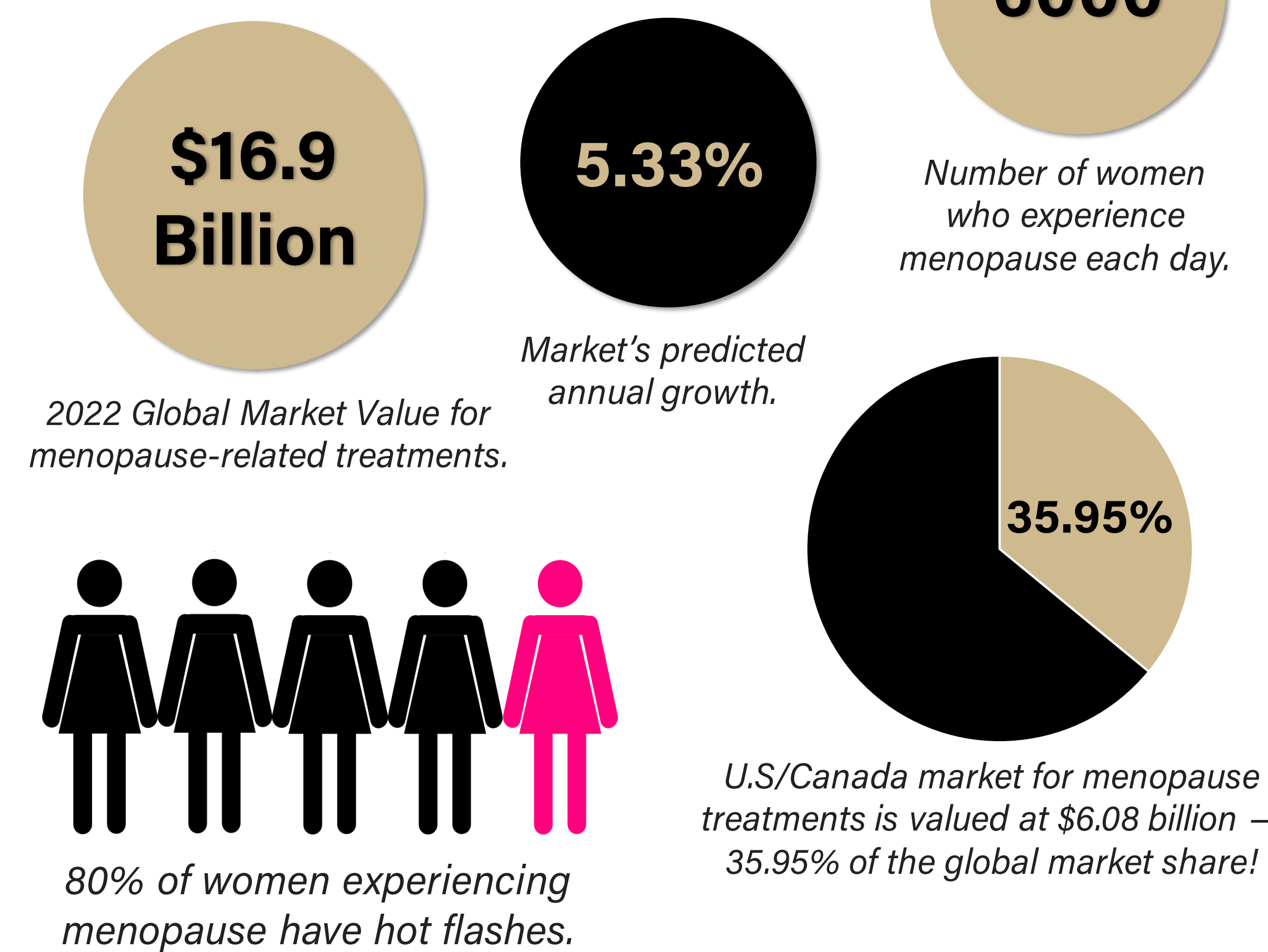
Agricultural and Biological Engineering

## OBJECTIVE

To create a functional process for the large-scale production of menopause gummies using soybean-derived isoflavones that will result in a profitable business.



## MARKET TRENDS



Global Menopause and Market Share Report for 2020 to 2030.

## EXPERIMENTAL DESIGN

❖ **Base Ingredients:** fruit juice (apple & cranberry), thickening agent (agar agar/locust bean gum), isoflavones, sugar, glitter



### Process Details

- ❖ Mixing/Heating → 90 °C for 6.5 minutes
- ❖ Cooling → 32 °C for 25 minutes
- ❖ Coating → Citric acid/sugar

### Results

- ❖ Optimal texture using locust bean gum and agar agar
- ❖ 1:1 ratio apple to cranberry juice provides optimal flavor
- ❖ Isoflavone unable to be tested due to solvent and cost

### Menopause Gummies

Nutrition Facts	
30 servings per container	
Serving size 2 gummies (10g)	
<b>Amount Per Serving</b>	
<b>Calories</b>	<b>10</b>
<b>% Daily Value*</b>	
<b>Total Fat</b> 0g	<b>0%</b>
Saturated Fat 0g	0%
Trans Fat 0g	0%
<b>Cholesterol</b> 0mg	<b>0%</b>
<b>Sodium</b> 0mg	<b>0%</b>
<b>Total Carbohydrate</b> 3g	<b>1%</b>
Dietary Fiber 0g	0%
<b>Total Sugars</b> 3g	<b>0%</b>
Includes 2g Added Sugars <b>4%</b>	
<b>Protein</b> 0g	
Vitamin D 0mg	0%
Calcium 0mg	0%
Iron 0mg	0%
Potassium 10mg	0%

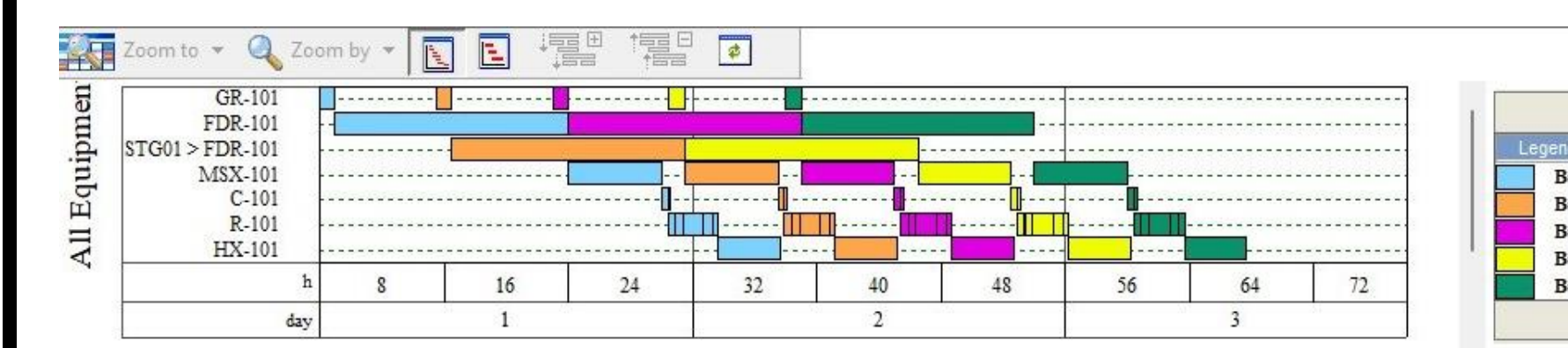
\*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

INGREDIENTS: CRANBERRY JUICE, UNSWEETENED, APPLE JUICE (WATER, APPLE JUICE CONCENTRATE, ASCORBIC ACID (VITAMIN D)), SUGAR, LOCUST BEAN GUM, AGAR POWDER, SOYBEAN ISOFLAVONES

## PROCESS DESIGN

### Design Considerations

ETHICAL	SOCIAL	ENVIRONMENTAL
<ul style="list-style-type: none"> <li>❖ Meets vegan diet needs</li> <li>❖ By-products as waste</li> <li>❖ Naturally-derived products</li> </ul>	<ul style="list-style-type: none"> <li>❖ Cost effective for all women</li> <li>❖ Testing among all demographics</li> <li>❖ Fair trade</li> <li>❖ Employment opportunities</li> </ul>	<ul style="list-style-type: none"> <li>❖ Deforestation for soybean harvesting</li> <li>❖ Reduce greenhouse gas emissions</li> <li>❖ Reduce water and energy usage</li> </ul>



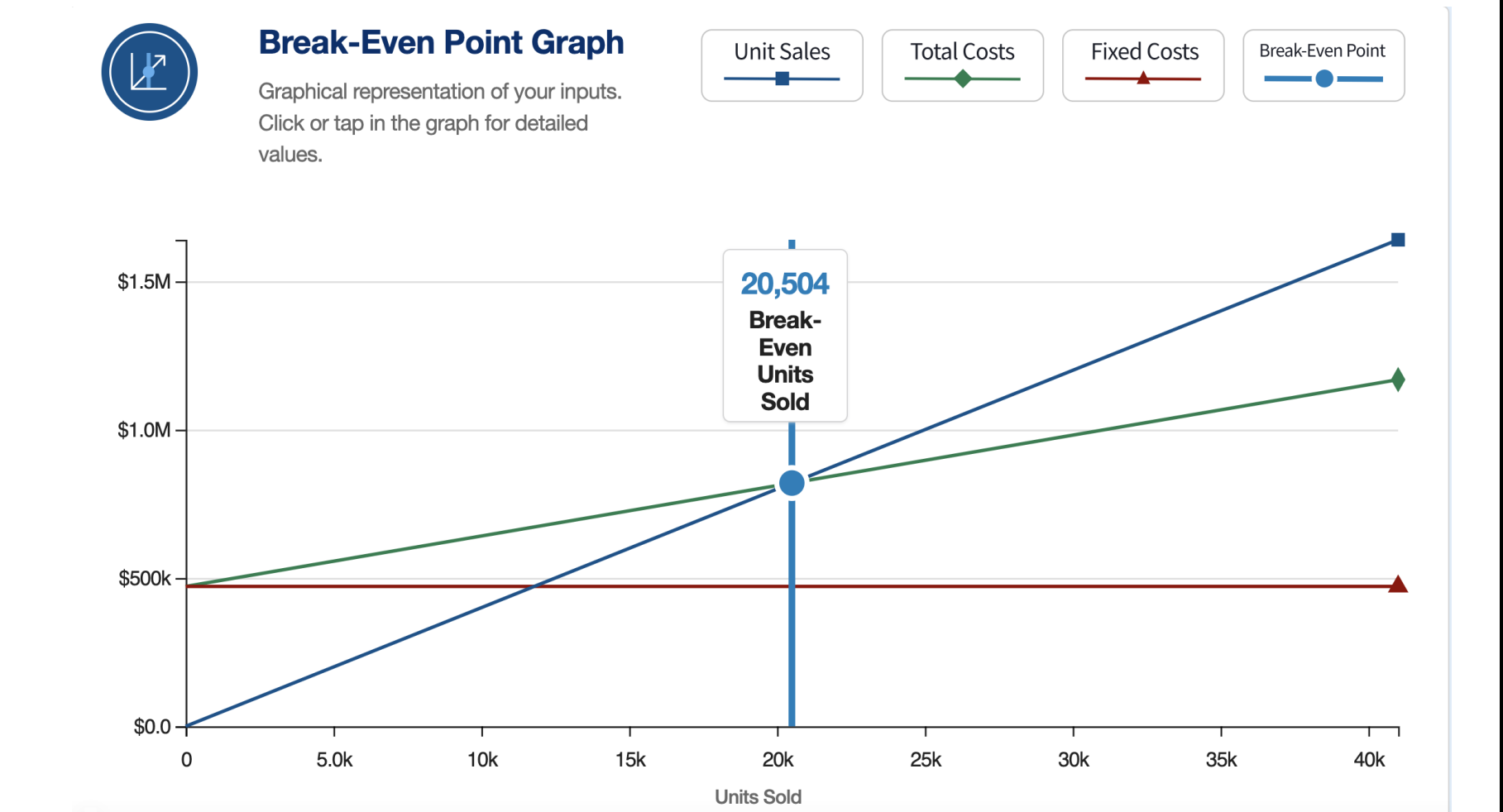
### Optimized Multiple Batch Schedule

The schedule above was calculated to maximize annual production in the plant, while reducing costs.  
 Single Batch Time: 30.86 hours  
 Single Batch Production: 985.79 kg/batch  
 Semi-Continuous Annual Batches: 615,130.95  
 Bottles per Batch: 4,107.46 bottles/ batch

### Equipment Selection and Optimization

Freeze-Drying	HPLC
<b>Design Parameters Considered:</b> <ol style="list-style-type: none"> <li>1. Prevent isoflavone-protein interactions</li> <li>2. Keep temperatures below</li> <li>3. Maximize isoflavone output</li> </ol>	<b>Design Parameters Considered:</b> <ol style="list-style-type: none"> <li>1. Accurate quality control</li> <li>2. Feasible for an industry setting</li> <li>3. Efficient method that minimizes energy costs</li> </ol>
Grinding	Mixing and Heating
<b>Design Parameters Considered:</b> <ol style="list-style-type: none"> <li>1. Increase surface area of soybean material</li> <li>2. Improve extraction efficiency</li> <li>3. Standardize isoflavone concentration</li> </ol>	<b>Design Parameters Considered:</b> <ol style="list-style-type: none"> <li>1. Achieves consistent quality</li> <li>2. Sterilizes product by heating to a temperature that prevents contamination</li> <li>3. Standardizes consistency</li> </ol>

## FINANCIAL DETAILS



**Total Capital Investment: \$13,760,000**  
**Operating Cost: \$90,277,000/year**  
**Total Annual Profit: \$12,095,824.77**  
**Total Annual Revenue: \$102,521,824.77**

## RECOMMENDATIONS

- Optimizing Texture**
  - ❖ Vary ratio of agar agar to locust bean gum
  - ❖ Different thickeners/gelling agents
- Reducing Sugar Levels**
  - ❖ Sugar alternatives:
    - Stevia
    - Monk fruit



Instructors: Dr. Martin R. Okos, Daniel Hauersperger  
 Acknowledgements: Amanda Limiac, Emily Aicher, Carol Weaver