PURDUE UNIVERSITY

CAPSTONE/DESIGN EXPERIENCE 2017

High Fiber Nutrition Drink

Agricultural & Biological ENGINEERING

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Goals and Objectives

Goal: To create a high fiber nutritional drink to meet the needs of the average adult in a market lacking such products.

Objectives:
- Provide higher amounts of fiber and protein than competitors
- Provide easy way for consumers in 18 - 24 age demographic to meet nutrition requirements

Motivation:
- Dietary fiber intake reduces risk of stroke, hypertension, diabetes, etc.
- Most individuals in America consume less than half their recommended levels of dietary fiber

Market and Market Size

- Purdue students, West Lafayette, Lafayette, and Indianapolis (1 million)
- The target demographic is primarily millennials, ages 18 - 24
- Millennials are largest group of consumers with 26% of population
- The 18 - 24 age demographic consumes more smoothie type drinks than any other demographic
- Beverage consumption data shows a 5.1% increase in nutritional drink sales between 2014 – 2015

Constraints

- Competitors: Odwalla, Evolutions Fresh, Kombucha, Ensure, Boost
- Consumer preferences in IN
- Processing Time
- Availability of fresh ingredients

Impact and Sustainability

- Spent grain makes up 85% of beer brewing byproducts
- Average water consumption during brewing is 5 - 6 L/beer
- Encourage consumption of nutrient dense food in a high obesity state

Prototype Analysis

Parameters: Mixing speed, consistency, ingredient amounts, and taste

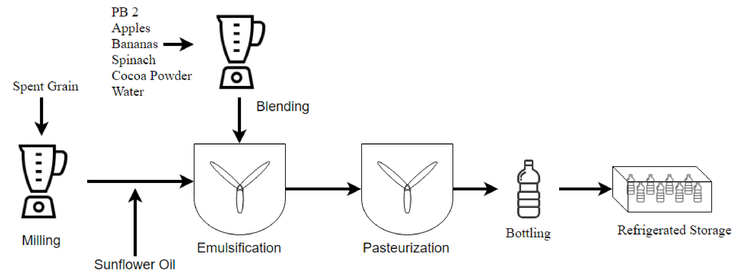
Observations: spinach particles, color, and semi-stable emulsion

Product Recipe

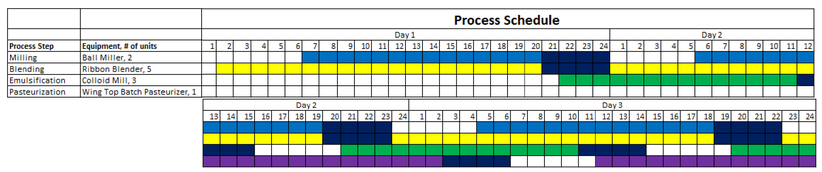
Ingredient	Functionality	Amount per Batch (lbs)
Apples	Flavor/Nutrition	552
Bananas	Flavor/Nutrition	552
Spinach	Nutrition	165
Cocoa Powder	Flavor	11
Water	Reduce Viscosity	2,370
PB2	Flavor/Protein	165
Spent Grain	Fiber	88
Oil	Emulsifier	552

For a serving size of 8 fluid ounces, we meet 33% of the daily recommended amount of fiber and 24% of the daily recommended amount of protein for an adult female.

Process Flow



Schedule



Processing Requirements

	Amount	Unit
Produce/Powder Inputs	1,202	lbs
Spent Grain Input	88	lbs
Cycle Time	2	days
Wastes	300	lbs/batch
Water Req. for Product	75	L
Water Req. for Processing	1,000	L
Thermal Load	2,522.32	MJ
Monthly Production	150,000	bottles

Alternatives

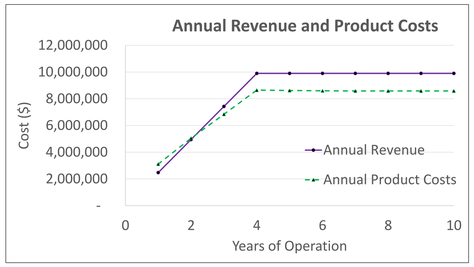
1. Drying spent grain was considered, but was deemed a waste of energy
2. Blending/Milling: food processor, blender
3. Emulsification: high pressure homogenizer
4. Pasteurization: UV, pulse light treatment, high speed pressure

Economic Analysis

Annual Production	Cost, $
Manufacturing Costs	**6,487,500**
A. Direct Production Costs	5,190,000
1. Raw Materials	2,595,000
2. Operating Labor	865,000
3. Direct Supervisory and Clerical Labor	86,500
4. Utilities	1,470,500
5. Maintenance and Repairs	113,033
6. Operating Supplies	16,955
7. Laboratory Charges	129,750
8. Patents and Royalties	0
B. Fixed Charges	865,000
1. Depreciation	141,292
2. Local Taxes	58,989
3. Insurance	17,697
4. Rent	480,000
5. Financing	166,724
C. Plant Overhead Costs	432,500
General Expenses	**2,162,500**
A. Administrative Costs	173,000
B. Distribution and Marketing Costs	432,500
C. Research and Development Costs	432,500
Total Product Cost	**8,650,000**

Entity	Cost, $
Direct Costs	
1. Purchased Equipment Delivered	280,898
2. Purchased Equipment Installed	126,404
3. Instrumentation and Controls	73,033
4.Piping	87,078
5. Electrical Systems	28,090
6. Buildings	81,460
7. Yard Improvements	33,708
8. Service Facilities	154,494
Total Direct Plant Cost	848,312
Indirect Costs	
1. Engineering and Supervision	89,887
2. Construction Expenses	95,505
3. Legal Expenses	11,236
4. Contractor's Fee	53,371
5. Contingency	103,932
Total Indirect Plant Costs	353,931
Fixed Capital Investment	**1,179,772**
1. Working Capital	210,674
Total Capital Investment	**1,412,917**

Years of Operation	Production Capacity	Annual Revenue	Annual Product Costs	Annual Cash Flow	ROI
1	25%	2,475,000	3,112,310	-372,960	-26.4%
2	50%	4,950,000	5,044,817	12,694	0.9%
3	75%	7,425,000	6,840,470	439,405	31.1%
4	100%	9,900,000	8,644,618	863,567	61.1%
5	100%	9,900,000	8,617,483	871,707	61.7%
6	100%	9,900,000	8,595,657	878,255	62.2%



Costs Per Bottle	Cost, $
Production Cost	4.73
Sale Price	5.50
Profit	0.77

Equipment	Cost, $
Blending	34,182
Milling	13,673
Emulsification	36,193
Pasteurization	46,850
Packaging	150,000
Total Equipment Costs	280,898

Future Work

- Determine most effective plant location for market
- Create and implement public marketing strategies
- Research additives to alter the finished appearance
- Lower production costs
- Continue to evaluate process for bottlenecks and areas of improvement
- Profitability of differently sized finished products
- Develop defined roles for managerial positions

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