

SENIOR CAPSTONE/ SENIOR DESIGN EXPERIENCE

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Brie Reinvented: A Sustainable Future with *Penicillium biforme*

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OBJECTIVE

- Design a sustainable, artisanal Brie cheese production process
- Explore the use of *Penicillium biforme* as an alternative mold
- Address the genetic vulnerability of traditional strains

BACKGROUND

Market Size

The global cheese market was valued at \$172.6 billion in 2023, projected to reach \$222 billion by 2033, driven by increasing demand for artisanal/specialty cheeses (Bharatrao Lomate & Deshmukh, 2017)

Target Consumer

Those interested in authentic, artisanal foods, sustainability, and premium gourmet cheese experiences.

Industry Challenge

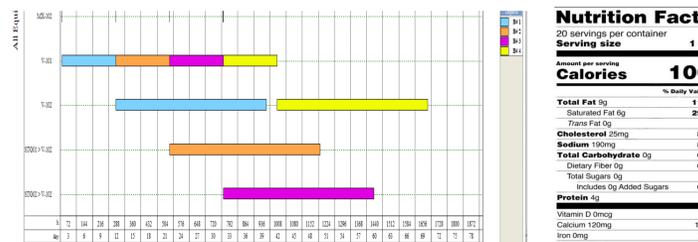
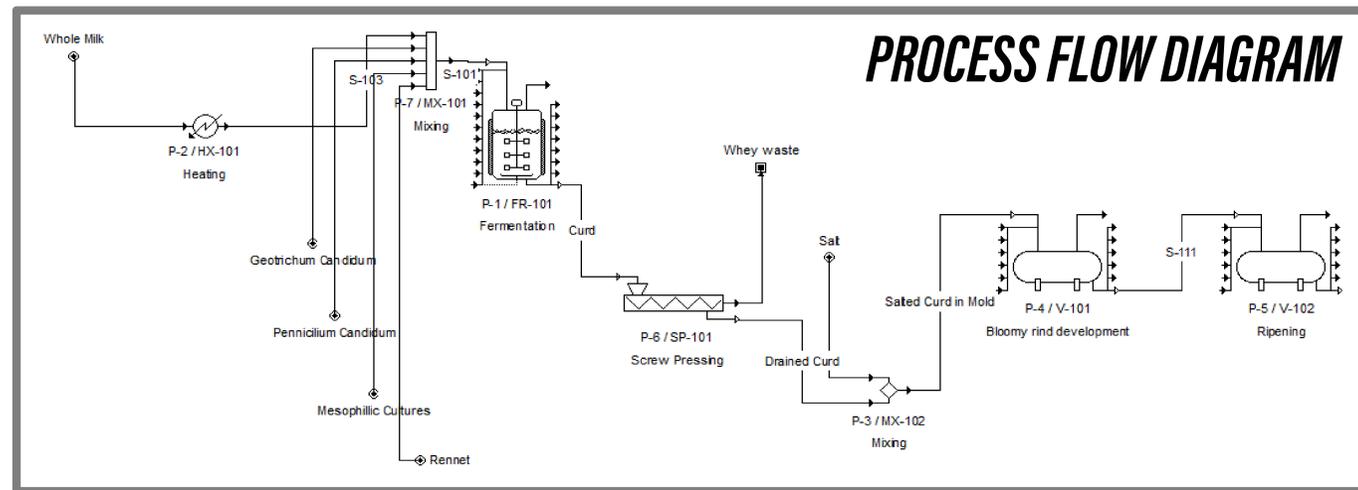
Brie production relies on a genetically uniform mold strain, making the industry vulnerable to pathogen outbreaks and environmental shifts.

PRODUCT OVERVIEW

- A Brie cheese product consisting of pasteurized cow's milk(whole), salt, and a white mold
- *Penicillium candidum* is traditionally used, however this strain is genetically at risk. The chosen alternative in the Brie is *Penicillium biforme* due to its flavor, texture, and white rind formation

OPTIMIZATION

Pasteurization (HTST)	• 72 °C for 15 seconds
Coagulation	• pH: 6.5 • 31 °C for 60 minutes • Rennet Concentration: 0.0013 g/L
Molding/Shaping	• Pneumatic pressing system • 0.3 bar
Ripening	• 14.2°C • 92% Relative Humidity



UNIT OPERATIONS

Unit Operation	Utilization
Pasteurization	Milk is heated to eliminate harmful bacteria
Coagulation	Curd formation occurs from the addition of rennet
Molding/Shaping	Curds are placed in molds to form shape
Ripening	Cheese is aged to develop flavor and texture

ECONOMIC RESULTS

Financial Component	Value
Total Capital Investment	\$588,132.83
Total Production Cost	\$392,223.17
Cost/Batch	\$1,002.23
Cost/Unit	\$1.57

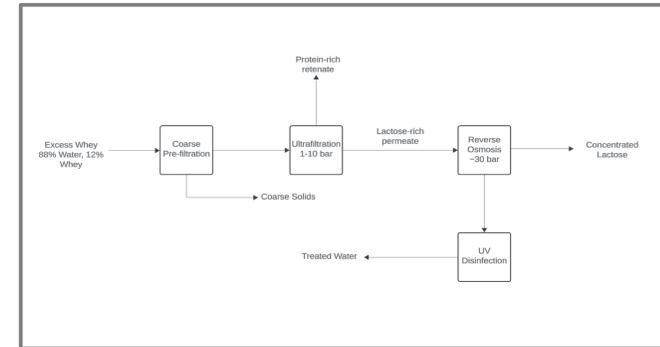
EXPERIMENTAL DESIGN

- **Pasteurization**
 - Eliminate pathogenic and spoilage microorganisms
 - HTST
- **Fermentation**
 - Milk inoculated with mesophilic culture, *Geotrichum candidum*, and *Penicillium biforme*
- **Coagulation**
 - Enzymatic curd formation using veal calf rennet.
 - Target pH: 6.3
- **Molding, Pressing and Draining**
 - Curds shaped into wheels and drained naturally in molds
 - 22-24°C
- **Ripening**
 - Aged at 14.2°C and 92% humidity for 2-6 weeks
 - Regular flipping and airflow promote uniform surface mold development

Final Product: The amount of rennet was varied experimentally to optimize consistency and creaminess

Ingredients Used: Whole Milk, *Geotrichum candidum*, Mesophilic Culture, *Penicillium biforme*, Cheese Salt, Veal Calf Rennet

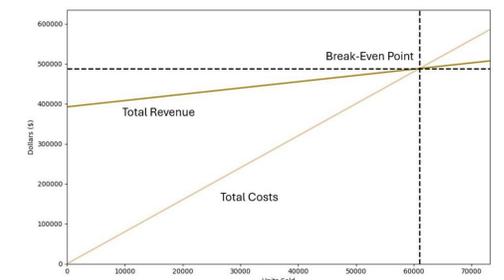
WHEY TREATMENT



BYPRODUCT RECOVERY

Whey byproducts contain compounds such as protein, lactose, and organic nutrients. The system can recover these components using ultrafiltration, lactose crystallization, and biological processing. These strategies transform waste into high-value products, supporting zero-waste goals and enhancing economic sustainability.

FINANCIAL PLAN



Break-Even Point occurs at the sale of 59,998 Units

FUTURE RECOMMENDATIONS

Flavor Enhancement	Test additional mold strains to modify the flavor profile
Texture Enhancement	Adjust ripening and aging times to change texture
Quantify Strain Effect	Analyze microbial dynamics throughout production process to determine effect of different mold strains

Instructor: Dr. Martin Okos
Advisor: Daniel Hauersperger

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