SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE
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Mycelium-Composite Packaging Materials

Avery Dorsch, Edson Ko Bautista, Jessica Wandling, Rylee Porter
[1]Biological Engineering; [2]Biological Engineering;
[3]Biological Engineering; [4]Biological Engineering

PURDUE UNIVERSITY
Agricultural and Biological Engineering

Objective

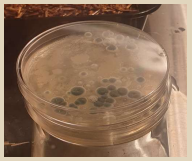
Driven by the COVID-19 pandemic and the explosive rise of e-commerce, there is a growing need for single use packaging. Our goal with this project is to create a feasible substitute for plastic packaging through the production of a mycelium-composite material.

Our process is designed to minimize waste and maximize energy efficiency while producing 100,000 kilograms of product each year.

Experimentation

Goals

- Pasteurization: Determine appropriate temperature & time
- Mixing: Vary mixing ratios
- Incubation: Determine ideal conditions for growth
- Drying: Find parameters to stop mycelium growth



Procedure

1. Wash agricultural substrate with water and cut
1. Heat the substrate to pasteurize
2. Mix fungi, substrate, and water in 8:17:75 ratio
3. Incubate mixture for 10 days
4. Dry resulting product

A Greening Industry

Younger generations are increasingly aware of how their choices as consumers impact the environment. In this regard, the demand for 'green' alternatives to single-use plastics is growing. The market for biodegradable packaging is expected to expand from 88 billion dollars to 169 billion dollars by 2032.

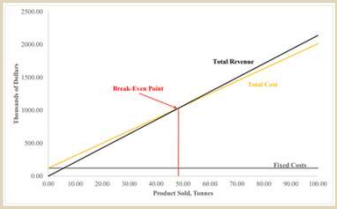
Light & Compostable

Mycelium is the rooting structure of mushrooms, which spreads throughout the substrate to create a durable web-like structure that can then be dried and used as packaging material. Not only is the subsequent material light, but it can be thrown out after use; safely decomposing in your own backyard!

Grifola frondosa, Hen of the Woods

Business Plan

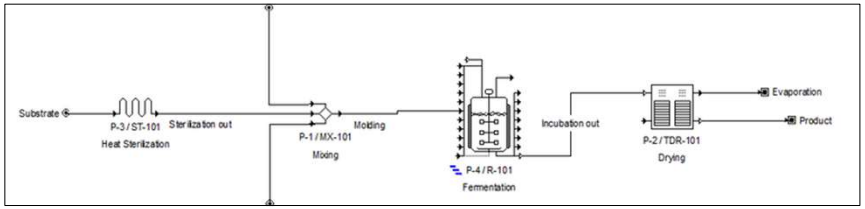
Break-Even Point Analysis

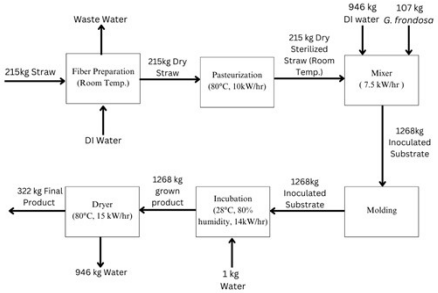


Break-Even sales occur at 49,000 kg of product during a typical year at full production.

The cost of the plant's equipment will total to $223,823, the value of which is expected to depreciate over the plant's expected lifetime of 10 years. At year one the total cost of production per kilogram of product is 18.37$. To meet a minimum ROI of 0.15 in year one, the price of the product is set at 19.40$ per kilogram of product.

Process Overview





Sterilization

- Eliminate competing micro-organisms
- 1 hour processing time
- 80°C

Mixing

- Mix substrate, fungi, and water
- 5 minutes mixing time
- 25 rpm

Incubation:

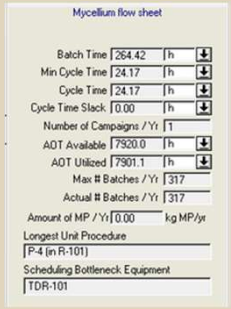
- Facilitate mycelium growth
- 10 day incubation period
- 28°C
- 80% humidity

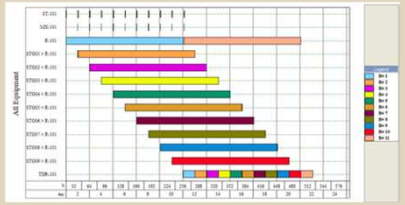
Drying

- Stop mycelium growth by removing water
- 1 day drying time
- 80°C

Scheduling

- One large fermenter is used for multi-batch operations. The dryer is ran semi-continuously with a 1 day trying time.
- 317 batches can be run each year. Each batch produces 322 kg of product.





Optimization & Controls

- Pasteurization: Temperature sensor to provide feedback & control processing time
- Mixing: Rpm sensor to provide feedback
- Incubation: Core probe used to determine temperature and humidity feedback control system
- Drying: Core moisture probe to provide feedback

Future Improvements

- Use a non-continuous air flow incubator
- Test drying time
- Use a better fiber prep system
- Test a wider variety of fungi species

Acknowledgments
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All outside data, research, and assumptions have been documented and cited throughout the product's development.