Cultivation of Pleurotus ostreatus (oyster mushrooms) for In-Situ Resource Utilization on the Moon

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Background

As astronauts plan missions further away from Earth for longer periods of time, strategies must be developed to sustain their presence without requiring constant resupply. As highlighted by the Artemis mission, the Moon is the first stop for deep space exploration and the first opportunity to demonstrate in-situ resource utilization (ISRU) science and technology. Fungi are critical to the Earth's microbiome and are gaining prominence for terrestrial, and space, food production, material development, and waste reduction strategies that support sustainable and circular systems.

Research Objective

This study investigates the interaction between blue oyster mushroom mycelium and lunar regolith simulant and calculates the biological efficiency of eight different bulk substrates.

$$Biological\ Efficiency = \frac{total\ fresh\ mushroom\ weight}{(total\ dry\ substrate\ weight + dry\ spawn\ weight)} \times 100$$

Substrate Dry Mass (lbs)	In-Situ Material (Lunar Simulant)	Carbon Source (Hardwood Pellets)	Nitrogen Source (Soy Hulls)
0.8	20%	40%	40%
0.8	30%	45%	45%
0.8	40%	30%	30%
0.8	50%	25%	25%
0.8	60%	20%	20%
0.8	70%	15%	15%
0.8	0%	50%	50%
2.0	0%	50%	50%

*Note that each substrate was hydrated to 60% with reverse osmosis water; in total there were seven 2 lb blocks and one 5 lb block

Methodology

Four grain jars were inoculated with a commercially bought strain of blue oyster mushroom liquid culture and were allowed to incubate at 68 $°F$ for 29 days. The four jars were separated into two categories, one with strong mycelium colonization and one with weaker mycelium colonization.

Strong Colonization:

Weaker Colonization:

After the eight substrate bags were prepared and sterilized in an autoclave at 250 $°F$ for two hours, ~0.5 pounds of grain spawn were added into each bag from both strong and weak grain jars.

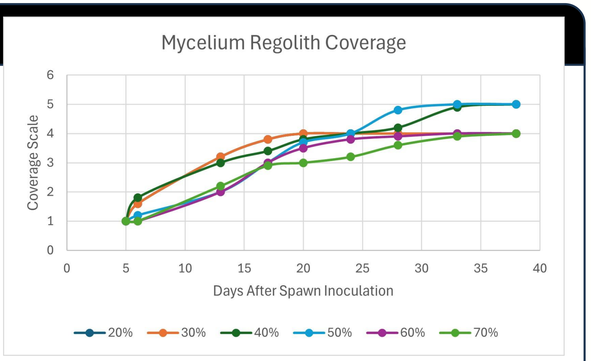
The bottom of the bags (where the regolith settled) were analyzed and rated on mycelium coverage. The following scale was used to determine a trend for each bag with regolith.

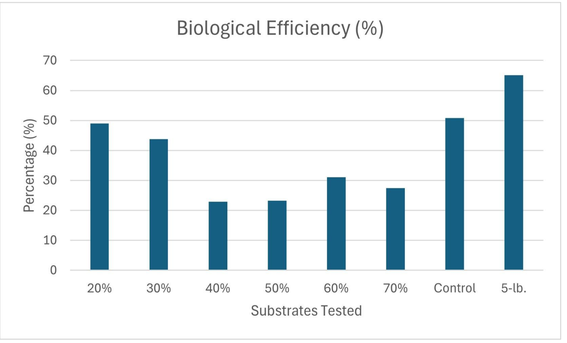
Scale:

	1	2	3	4	5
					
Coverage:	**0-5%**	**6-30%**	**31-69%**	**70-94%**	**95-100%**

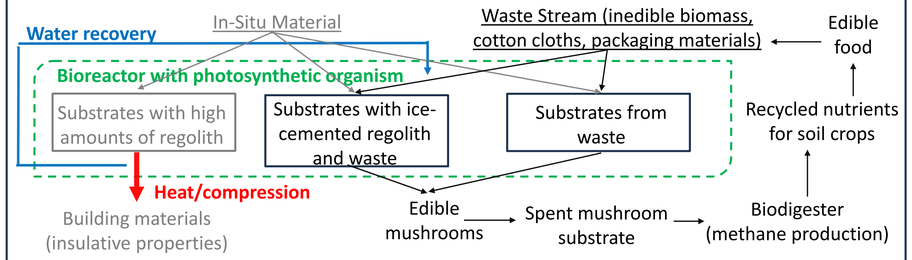
The mycelium colonized the bulk substrates at 68 $°F$. When the substrates showed signs of fruiting, cuts were made into the bags, and they were placed in a fruiting chamber with a relative humidity of 80% and constant airflow. Each substrate was allowed two harvest cycles; the mushrooms were then weighed and dried.

Results





Future Applications



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