

Converting tree nut byproducts into gourmet mushrooms and mulches

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Mushrooms are the fruitbodies of fungi



Mushroom mycelium grows in a substrate (in this case hardwood sawdust) to break down nutrients and eventually forms fruitbodies.

Gourmet Mushrooms

Oyster



Lion Mane



Shiitake



- They are delicious, nutritious with medicinal values.
- Most need hardwood substrates to grow.
- Taiwan faces deforestation problems because of its mass mushroom growing farm/industry.

California produces millions of tons of nutshells from nut farms



Can we use them to grow mushrooms as a substitute of sawdust?

Similar composition of woody nut shells and hardwood sawdust

The hardwood sawdust content of Cellulose: 41.58%, Hemicellulose: 32.81 % Lignin: 33.56 %. (Ehmad et al 2016)

The main chemical constituents of cellulose, hemicellulose and lignin in almond shells account for 38.48%, 28.82% and 29.54%, respectively. (Materials (Basel). 2018 Sep; 11(9): 1782. Wang et.al)

Pistachio shells contain 60.62 wt% cellulose, 12.80 wt% acid insoluble lignin, 2.44 wt% hexane soluble extractives (Açıklan et al., 2012 #161)

We use a bag system to do experiments for growing mushrooms from nutshells because it can be scaled up for automation of large production



Conditions tested:

**nutshell types, size of breakdown particles,
water content in bags**

Supplement: wheat or rice bran for nitrogen

Different strains of mushrooms with different shells

Speed of mycelium growth, mushroom yield measured



Environmental Benefit by Converting Nutshells to Mushrooms

Biowaste:Nutshells



**Mushroom Mycelium
Powerful Decomposer**



**Gourmet Mushrooms
to Feed People**



**Substrate Use as
Mulch
Save water
Prevent weeds
Enrich soil**

Findings and Recommendations for Future Farmers

Almond shells are prone to be broken into fine particles, which make the bags too compact for mycelium to invade. Adding some coarse materials such as wood shavings will help.

Pistachio shells have poor absorbance of water (33% saturation point). To achieve 55-60% water content for maximal mushroom growth, some wood sawdust will be needed. Coastal Fir sawdust seems to work fine.

Wheat or rice bran (10% to 15%) needs to be added as nitrogen supplement for a good mushroom yield.

Pistachio shells are a great substrate for Lion's Mane mushrooms.

The mushrooms grown from nutshells taste the same as those from sawdust.

