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Media optimization of oyster mushroom cultivation and to increase its nutritive value

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ABSTRACT

Cultivation of oyster mushroom - *Pleurotus eous, Pleurotus florida, Pleurotus sajor-caju* on different substrate viz., fairy castle, bunny ears, dharba, khetki, sugarcane bagasse, coconut coir, dry pseudostem, lotus leaves against in straw (as control). The experiment was laid out with eight different substrate's (1 kg per bag) which were arranged in the ground. *P.eous, P.sajor-caju, P.florida* showed highest yield in substrate (44.43%, 41.72%, 48.08% BE respectively) than in straw (37.04%, 35.09%, 36.10% BE respectively). In substrate, *P.eous* showed highest ash (1.13%) content, lipid (1.75%) content and carbohydrate (7.15%), then in *P.florida* showed highest moisture (91.20%) content and in *P.sajor-caju* showed highest protein (5.12%) content and energy (64.43%) value.

KEY WORDS: Oyster mushroom, eight different substrates, yield, Nutritive analysis.

1. INTRODUCTION

Mushrooms are also known as vegetarian's meat and its rich in proteins, minerals, and vitamins. Mushroom proteins that contains all the nine essential amino acids required for human body and it's considered to be intermediate between animals and vegetables (Kakon, 2012). Genus *Pleurotus* spp. looks oyster like shape so it's called oyster mushroom which belongs to a family Tricholomataceae and in India it called as Dhengri. Mushroom production increased highly through grain bran supplementation of substrate which has previously been shown. This is due to increases the nutritional content in the substrate especially balancing the carbon and nitrogen (Onyango, 2012). Recent analysis has proved that 200g of mushroom which efficiently replace 100g of meat as a protein source which is a 30% diet of the world population (Jozef Poppe, 2004). Oyster mushrooms contains folic acid that helps to cure anemia and it also contains alkaline ash and high fiber content that inhibits hyperacidity, constipation and cholesterol. Oyster mushroom cultivation is becoming popular due to its abilities to utilize various lignocelluloses and to grow at a wide range of temperatures. *Pleurotus* species has enzyme in agriculture wastes and industrial by-product which capable of utilizing complex organic compounds (Mary Josephine, 2014). These mushrooms has lignocelluloses solid state decomposing types of white rot fungi. The presence of lignocellulolytic enzyme that converts any agro waste that contains cellulose and lignin into carbohydrates such as glucose, which used as energy source for fungi (Isrori, 2011).

Since food production and value addition of waste is the most important issue in the agro and food processing industry, the aim of this study is to investigate the effect of different agro-waste by-product substrates namely Agave tequilana (khetki), Cereus tetragonus (Fairy Castle), Cocos nucifera (Coconut), Imperata cylindrica (Dharba), Musa paradisiaca (Banana), Nillumbik nucifera (Lotus), Opuntina microdasys (Bunny ears), Saccharum edule (sugarcane) in *Pleurotus sp.* Such as *P.eous, P.sajor-caju, P.florida* against Paddy straw (as control).

2. MATERIALS AND METHODS

The experiment was carried out at the Mushroom Culture House (MCH), Cell Biology laboratory of the Department of Biotechnology, Vel Tech High Tech Dr.RR Dr.SR Engineering College, Chennai, India during December 2014 to May 2015. The method for cultivating oyster mushroom as follows:

2.1. Procurement of Spawn: *Pleurotus florida, Pleurotus sajor-caju, Pleurotus eous* (fruiting body) were collected from Tamil Nadu Agriculture University at Anna Nagar. Spawn was prepared by standard method.

2.2. Substrate Preparation: The material on which the mycelium of the mushroom grows is called substrate. The listed eight Agro-waste substrates are collected and dried under direct sun until it is completely dried. After the substrates are completely dried they are cut into small pieces (< 3 cm) and are soaked in excess water tub for overnight. This is done to remove dust particles adhering to the substrates. Then surplus water is drained off and allowed to air dry.

The next step is mixing the substrates. Mixing is important for the moisture distribution. The correct amount of water should be available everywhere in the substrate. After mixing the moisture content should be 60-65%. To check whether the substrate is with moist enough squeeze tests is done. Just a few drops of water should be released with some pressure is acceptable. This procedure is same for straw.

Next autoclave the mixed substrates and straw seperately at 121°C for 90 mins. The aim of the heat treatment is to kill competing microorganisms and get rid of soluble nutrients.

2.3. Substrate Packing: The substrates should have cooled down to 25-30°C. The spawn of 3-8% of the weight of the substrates can be filled in each layer of substrate. Spawn of 30 grams is added to one kilogram of substrate. The bags are packed into three layers.

2.4. Cultivation conditions: The spawed bags were subsequently placed in the dark incubator room at 20 - 22° C and 65 - 70% relative humidity until completion of spawn running. After completion of spawn running the temperature and relative humidity was changed to 19 to 20° C and 80 - 90% RH, respectively. The bags were removed and water was sprayed for maintaining moisture in the spawned substrate as well as in straw.

2.5. Growth & Colonization of Mycelium: During spawn run stage the mycelium will grow through the substrates as well as in straw (as control). In *P. eous* (Day 7), *P. sajor-caju* (Day 12), *P. florida* (Day 15) the Colonization of mycelium growth were seen in substrate. But in straw, the colonization of mycelium growth of *P.eous* (Day 9), *P.sajor-caju* (Day 15), *P. florida* (Day18) were seen. The span run time is different for each species and depends on the strain used and the temperature.

2.6. Budding: Open the bag as soon as mycelium has covered the substrate completely. It takes three days to four days after opening the bags before the primordial mushrooms will form. After mycelium growth, Primordial growth on substrate in *P.eous* (Day 10), *P. sajor-caju* (Day 17), *P. florida* (Day 23). But in straw, the Primordial growth of *P. eous* (Day 12), *Pleurotus sajor-caju* (Day 17) *Pleurotus florida* (Day 26).

2.7. Fruiting: Open the bag as soon as mycelium has covered the substrate completely. After budding the fruiting in substrate took *P. eous* (Day 13), *P. sajor-caju* (Day 20), *P. florida* (Day 27) but the fruiting in straw took *Pleurotus eous* (Day 15), *P. sajor-caju* (Day 23), *P.florida* (Day 30).

2.8. Harvesting: The mushrooms are ready for harvesting in five days or two to three days. It will take another five to nine days for the second flush. In substrate, it took *P. eous* (Day 15) and the weight it is of 282.32 g/ kg, *P.sajor-caju* (Day 20) and the weight it is of 264.76 g/ kg, *P. florida* (Day 27) and the weight it is of 287.92 g/ kg but in straw, it took *P. eous* (Day 17) and the weight it is of 226.39 g/kg, *P. sajor-caju* (Day 23) and the weight it is of 209.12 g/kg, *P. florida* (Day 30) and the weight it is of 245.67 g/kg.

3. RESULTS AND DISCUSSIONS

3.1. Yield Analysis: Total weight of all fruiting bodies harvested from two flushes is measured as total yield of mushroom. The biological efficiency (yield of mushroom per kg of substrate on dry weight basis) was calculated by the formula from the standard method.

$$Biological\ efficiency = \frac{Fresh\ weight\ of\ mushroom}{Dry\ weight\ of\ substrate} \times 100$$

Table.1.Effect of substrate on yield on *Pleurotus* sp.

Species	Yield (g/kg dry substrate)			
	Flush I	Flush II	Total	B.E %
Pleurotus eous	282.32	162.03	444.35	44.43
Pleurotus sajor-caju	264.76	152.45	417.21	41.72
Pleurotus florida	287.92	192.67	480.89	48.08

Table.2.Effect of straw on yield on *Pleurotus* sp.

Species	Yield (g/kg dry straw)			
	Flush I	Flush II	Total	B.E %
Pleurotus eous	226.39	144.09	370.48	37.04
Pleurotus sajor-caju	209.12	141.85	350.97	35.09
Pleurotus florida	245.67	115.39	361.06	36.10

The results reveal the yield, biological efficiency (B.E) of the *P. eous*, *P. sajor-caju*, *P.florida* on different agro waste (Table 1) and on straw (Table 2). Significantly maximum yield of *P.florida* was obtained on when it was cultivated on Argo waste (480.89 gm/kg of substrate) with 48.08 % B.E. Similar results were reported with *Pleurotus* sp. by Patil (2012). Below the graphs are shown.

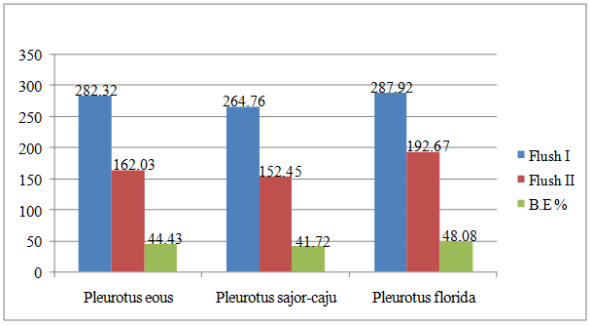

Figure.1.Effect of substrate on yield of *Pleurotus* sp

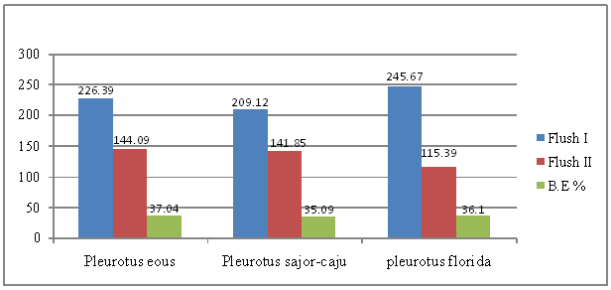

Figure.2.Effect of straw on yield of *Pleurotus* sp

3.2. Nutritional Analysis: The samples were analysed for chemical composition (moisture, proteins, fat, carbohydrates and ash) using the standard AOAC procedures (AOAC, 1995). The nutrient content that present in oyster mushroom in substrate and in straw that tabulated below.

Table.3.Nutrient content in subsrate in *Pleurotus* species

Nutrient name	*P.eous*	*P.sajor-caju*	*P.florida*
Moisture %	84.95	87.75	91.20
Proteins %	5.02	5.12	3.55
Fat %	1.75	0.73	1.38
Carbohydrates %	7.15	5.73	3.027
Ash %	1.13	0.986	0.843
Energy (Kcal/100g)	64.43	46.615	3.027

Table4. Nutrient content in straw in *Pleurotus* species

Nutrient name	*P.eous*	*P.sajor-caju*	*P.florida*
Moisture %	85.21	89.27	90.40
Proteins %	3.95	2.965	3.004
Fat %	1.80	2.965	1.42
Carbohydrates %	8.27	5.414	4.992
Ash %	0.77	0.72	0.734
Energy (Kcal/100g)	65.08	48.706	44.764

Moisture content of *P.florida* was found maximum (91.2) that shown in Table .3 which cultivated in the Agro waste substrates, followed by *P.florida* that cultivated in straw (90.4) but least was found in *P. eous* (84.95). These results are conformed to the finding of Patil (2012).

Mineral content (Ash) of *Pleurotus eous* was found maximum (1.13%) which cultivated in the Agro waste substrates, followed by on *P.sajor-caju* (0.986%). While least was found on *Pleurotus sajor-caju* cultivated on straw (0.72%). Observed values of ash content are in accordance with the study of Bonatti (2004).

Protein content of *Pleurotus sajor-caju* was found maximum (5.12) when cultivated on Agro waste substrates, followed by on *P.eous* (5.02) but least were found on *Pleurotus sajor-caju* cultivated in straw (2.965). The content of protein was similarly reported in similar studies (Syed Abrar Ahmed, 2009).

Fat content of *Pleurotus sajor-caju* was found maximum (2.965) when cultivated on Agro waste substrates, followed by on *P.eous* (1.8). While least was found on *Pleurotus sajor-caju* cultivated on straw (0.73). The content of fat was similarly reported in similar studies (Syed Abrar Ahmed, 2009).

Carbohydrate content of *Pleurotus eous* was found maximum (8.27) when cultivated on straw, followed by on *P.eous* (7.15) when cultivated on substrates. While least was found on *Pleurotus florida* cultivated on substrates (3.027). The content of carbohydrates was similar as reported in similar studies (Syed Abrar Ahmed, 2009). Amount of energy of *Pleurotus eous* was found maximum (65.08) when cultivated on straw, followed by on *P.eous* cultivated on agro-waste substrates (64.43). While least was found on *Pleurotus florida* (38.735). These results are conformed to the finding of Patil (2012).

4. CONCLUSION

Oyster mushroom presents a promising potential for treatment of eight substrate of agro –wastes. Eight different agro-waste such as khetki, Fairy Castle, Coconut coir, Dharba, Banana, Lotus, Bunny ears, sugarcane were used as oyster mushroom substrate and they increased the mushroom yield and those eight substrates are better mushroom substrate compare to the straw. *P.eous*, *P.sajor-caju*, *P.florida* showed highest yield in substrate (44.43%, 41.72%, 48.08% BE respectively) than in straw (37.04%, 35.09%, 36.10% BE respectively). In substrate, *P.eous* showed highest ash (1.13%) content, lipid (1.75%) content and carbohydrate (7.15%), then in *P.florida* showed highest moisture (91.20%) content and in *P.sajor-caju* showed highest protein (5.12%) content and energy (64.43%) value and it concluded that used eight different substrates gives high yield than compared to straw. It also produces

nutritious mushroom and offer economic incentives for agribusiness and develop new enterprises. Therefore, the mushroom cultivation may produce food products from different eight substrates and help to dispose them in the ecofriendly manner. Further studies have shown a link between consuming *Pleurotus* sp. And a lowering of cholesterol levels, no doubt due to the statins they produce. Hopefully future research will reveal exactly how much to eat to get these effects. As for cancer, research shows a possible anti-tumor effect from polysaccharides in oysters. A polysaccharide is a complex carbohydrate made up of smaller sugar molecules. Specific polysaccharides as beta D-glucans (pleuran), are suspected to stimulate the immune system to fight cancer. Studies are ongoing into the effects of the pleuran for cancer treatment eventually in the laboratory animals.

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