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Growth and Yield of *Hypsozygous ulmarius* Mushroom on Different Substrates Mixtures

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Paddy straw, ragi husk, ragi straw, groundnut shell, lawn grass and shredded paper were used as substrates for the cultivation of *Hypsozygous ulmarius* mushroom. Use of paddy straw + lawn grass showed significantly higher mushroom yield (538.33 g/ bag) and bio efficiency (111.81 %). Chemical analysis of N, P and K of substrates, viz., ragi husk, groundnut shell, lawn grass, shredded paper, ragi straw and paddy straw was carried out before and after growing mushroom. Before growing mushroom maximum nitrogen (0.84), phosphorus (0.49), potassium (1.72 %) content were recorded in paddy straw. After growing mushrooms the maximum nitrogen (1.64%) in ragi husk, phosphorus (0.49 %) in paddy straw, potassium (2.72 %) in ragi husk.

Key words: Oyster Mushroom, Substrate mixture, paddy straw.

Mushrooms are fruiting bodies of basidomycetes and some ascomycetes fungi, which are edible. Fleshy nature of mushroom and their nutritional value is responsible for its main attraction to human being as a source of food. Mushrooms and their products are used as delicacy and its consumption is rapidly increased as they have good taste, flavour and nutritive value. Its products can serve to improve the nutritional status and helps in alleviating protein deficiency. (Suresh Chandra *et al*, 2006). The mushroom production and productivity is gradually increasing every year. Presently Indian mushroom production is 2,50,000 tonnes per year and world mushroom production is 15 million tonnes per year, with 7% of growth rate per year (Anonymous, 2010).

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Hypsozygous species are efficient lignin degrading mushrooms, which belonging to Hymenomycetes of Basidiomycotina. *Hypsozygous ulmarius* commonly called as elm mushroom or Blue/black oyster mushroom. Cellulose rich organic substrates are found to be good for the cultivation of these mushrooms. Therefore the cellulose rich agricultural wastes or byproducts of agro industry like paddy straw, coir pith, sugarcane bagasse, wheat straw, banana leaves, hulled maize cobs etc., can be used as substrates for cultivation of *Hypsozygous species.*

MATERIALS AND METHODS

The laboratory experiment of mushroom cultivation was carried out in the Department of Agricultural Microbiology.

Mushroom cultures

The pure culture of *Hypsozygous ulmarius* was used from the mushroom laboratory

for the experiment, Department of Agricultural Microbiology, UAS, GKVK, Bengaluru.

Development of spawn

Spawn for mushroom cultivation was prepared by following the standard procedure of Krishnamoorthy (1981). For this purpose, uninfected, clean sorghum grains were washed in clean water three times and cooked, until the seed coat was just opened. The moisture content of half boiled grains was adjusted by air drying, to obtain around 50 to 55 %. This was followed by mixing with 2 % of calcium carbonate and 2 % of calcium sulphate. This mixture of sorghum seeds was filled into polypropylene bags of size 15 x 20 cm of 250 gauge. It was filled up to 2/3 capacity of the bags to have proper aeration and to enable easy handling. Mouth of the poly propylene bag was closed with rubber band so as to avoid entry of moisture upon sterilization. The bags were sterilized in an autoclave at 121^0C and 15 psi for 45 minutes. After sterilization the bags were cooled and inoculated with mushroom mother culture of *Hypsozygous ulmarius* and incubated at room temperature. Mushroom mycelium (cottony growth) covered the entire sorghum in the bag in about 10-12 days. After complete growth on substrate, spawn packets were used for further studies.

Substrate selection

Paddy straw, ragi husk, ragi straw, groundnut shell, lawn grass and shredded paper were used as a substrate for *Hypsozygous ulmarius* mushroom cultivation.

Preparation of substrate

Cultivation was carried out by following the method outlined by Desai (1982). Ragi husk, groundnut shell, ragi straw, lawn grass (Clipped grass) and shredded paper in pure and in combination with paddy straw were used for the cultivation of Hypsozygous *ulmarius* mushroom. Paddy straw and groundnut shell were soaked in water for 10 hrs in a container and the excess water is drained off and for the remaining other substrates water was sprinkled. The substrates were pasteurized using steam for 30 minutes at 85^0C in a closed chamber. The pasteurized substrate was spread on a clean cement floor inside the room and allowed to cool to room temperature.

Spawning and spawn running

Substrates were filled to polythene bag of size 30 cm x 45 cm of 150 gauge thickness. Hundred gram spawn of *Hypsozygous ulmarius* was used for filling of each bag or 5 % of spawn on wet weight basis of substrate for layer spawning, leaving 5 to 7 cm gap at the top and the mouth of the polythene bag was closed tightly with a rubber band. Three small holes were made at the bottom of the bag and 5 to 6 holes all over the bag for drainage and air exchange respectively. These bags were kept on racks in mushroom growing rooms. During spawn running humidity of 70-80 % was maintained in cropping room.

Cropping

After complete growth of mycelium on the substrate, bags were kept 15 cm apart on racks. Relative humidity was maintained at 80-85 % by spraying water in the rooms. Watering of the opened bags was done at regular intervals to maintain moisture whenever buds appeared. Buds developed into fruiting body. Finally, the fruiting bodies were harvested after attaining their maximum size and the fresh weight was recorded and the yield and bioefficiency of *Hypsozygous ulmarius* mushroom was calculated.

Estimation of Bio - efficiency

Fully matured fruiting bodies of oyster mushrooms were harvested prior to curling up at margin. Harvesting was done prior to watering and fresh weight was recorded soon after the harvest of mushroom. Further, each bag was allowed to stand for 3 croppings Bio-efficiency of *Hypsozygous ulmarius* mushroom was calculated by using the formula given by Chang and Miles (1989).

$$\text{Bio efficiency (\%)} = \frac{\text{Fresh weight of mushrooms}}{\text{Dry weight of substrate}} \times 100$$

Chemical analysis of substrates before growing mushroom

Chemical analysis N, P and K of substrates, viz., ragi husk, groundnut shell, lawn grass, shredded paper, ragi straw and paddy straw was carried out as detailed below.

Total Nitrogen

Total nitrogen content of the substrates before growing mushroom was estimated by micro kjeldhal method (Black, C. A, 1979).

Phosphorus

Phosphorus content of the substrates

before growing mushroom was estimated by vanbdomolybdate yellow colour method (Jackson, 1973).

Potassium

Potassium content of the substrates before growing mushroom was determined by using a flame photometer (Jackson, 1973).

Chemical analysis of mushroom spent substrates

Chemical analysis for N, P and K was carried out in mushroom spent substrates, viz., ragi husk, groundnut shell, lawn grass, shredded paper, ragi straw and paddy straw as detailed below.

Total Nitrogen

Total nitrogen content of the substrates after the mushroom cultivation was estimated by micro kjeldhal method (Black, C. A, 1979).

Phosphorus

Phosphorus content of the substrates after the mushroom cultivation was estimated by vanbdomolybdate yellow colour method (Jackson, 1973).

Potassium

Potassium content of the substrates after the mushroom cultivation was determined by using a flame photometer (Jackson, 1973).

RESULTS AND DISCUSSION

The yield and bio-efficiency of *Hypsozygous ulmarius* mushroom on different substrates. The Significantly higher yield of *Hypsozygous ulmarius* mushroom on different substrates were recorded in the substrate combination of paddy straw + lawn grass (538.33g/bag) followed by paddy straw (531.65g/bag) alone and the minimum (258.67g/bag) yield was recorded when shredded paper alone was used as substrate. Similarly, the maximum bio efficiency (111.81%) was recorded in the substrate combination of paddy

Table 1. Yield and bioefficiency of *Hypsozygous ulmarius* on different substrates

Substrates	Yield (g/bag)	Bioefficiency (%)
Paddy straw (Control)	531.65^{a}	106.69^{a}
Ragi straw	376.66^{cd}	84.56^{c}
Ragi husk	338.00^{d}	65.26^{d}
Groundnut shell	325.00^{d}	53.85^{e}
Lawn grass	368.33^{cd}	82.57^{c}
Shredded paper	258.67^{e}	46.04^{f}
Paddy straw + groundnut shell	421.66^{bc}	89.13^{bc}
Paddy straw + ragi husk	453.33^{b}	93.13^{b}
Paddy straw + lawn grass	538.33^{a}	111.81^{a}
Paddy straw + shredded paper	389.66^{c}	85.94^{c}
SEm ±	15.70	1.75
CD at 5 %	46.33	5.16

Table 2. Nitrogen, phosphorus, potassium content of substrates before growing of *Hypsozygous ulmarius* mushroom

Substrates	N (%)	P (%)	K (%)
Paddy straw (Control)	0.84	0.49	1.72
Ragi straw	0.66	0.25	1.45
Ragi husk	0.59	0.17	1.61
Groundnut shell	0.45	0.08	1.20
Lawn grass	0.62	0.18	1.37
Shredded paper	0.30	0.04	1.03

Table 3. Nitrogen, phosphorus, potassium content of substrates after growing of *Hypsozygous ulmarius* mushroom

Substrates	N (%)	P (%)	K (%)
Paddy straw (Control)	1.48	0.73	2.51
Ragi straw	1.12	0.30	2.25
Ragi husk	1.64	0.28	2.72
Groundnut shell	0.91	0.16	2.07
Lawn grass	1.14	0.29	2.31
Shredded paper	0.67	0.12	1.92

straw + lawn grass followed by paddy straw (106.69%) and the minimum bio efficiency (46.04%) was recorded when shredded paper alone was used as substrate (Table 1).

In different substrates the mushroom yield varied. This could be due to the nature and nutrient content of the substrate (Desai, 1982). The low yield and bioefficiency in shredded paper may be due to its poor nutrient content.

Before growing *Hypsozygous ulmarius* mushroom on different substrates the maximum nitrogen (0.84%), phosphorus (0.49%), potassium (1.72%) content was recorded in paddy straw. The minimum was found in shredded paper (Table 2). Similar results were also reported by Kaul *et al*. (1981) with paddy straw.

After growing *Hypsozygous ulmarius* mushroom on different substrates the maximum nitrogen (1.64 %) and potassium (2.72%) content were recorded in spent ragi husk, followed by in spent paddy straw and the minimum was recorded in spent shredded paper (Table 3). Results are in confirmation with the findings of Kurien *et al*. (1959), (1981), Nageswaran *et al*. (2003).

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