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# Effect of Different Substrates for Higher Bioefficiency of Mushrooms

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**A B S T R A C T**

Different substrates for the production of different oyster (*Pleurotus eoeus, Pleurotus florida*, *Pleurotus sajor-caju*, *Hypsizygous ulmarious*) mushrooms was studied. Substrates *viz.* maize stover, maize rind, maize sheath or cob sheath and paddy straw as control were evaluated as substrates. Further, these maize crop byproducts combinations with paddy straw were studied for mushroom production. Among the different maize crop byproducts used for the cultivation of oyster mushroom, 50 % paddy straw+50 % maize sheath or cob sheath gave the highest yield (593g/bag) and bioefficiency (90.95 %). Among different varieties of oyster mushrooms *Pleurotus eoeus* was found to be the best variety to grow on 50 % Paddy straw + 50 % Maize cob sheath as substrate for mushroom production.

## Introduction

Millions of tones of agro wastes – maize stalk, sugarcane trash, other cereal trash to name a few are generated every year in India. Significant quantities of these are either burnt, causing environmental pollution or left in field to be accumulated for long time to undergo very slow degradation.

Sugarcane grown in millions of hectares generates large quantities of trash which is usually burnt in the field. Apart from this Ragi and Maize generate huge quantities of left over straw after grain harvest.

All these wastes warrant an efficient utilization or recycling. Particularly maize is grown over a large area in the state warrants an efficient utilization of its stalk. Mushrooms are the fruiting bodies of fungi, rich in protein and known for their nutritional and medicinal value.

Growing mushrooms on cereal straw wastes results in production of nutrient rich food and helps in an efficient management of straw. Since mushroom fungi are known for their lignin, cellulose and hemicelluloses degradation activities.

Oyster and milky mushrooms are suited for growing in Karnataka. Oyster mushroom different species lke *Pleurotus florida, Pleurotus eous, Hypsizygus ulmaris* and milky mushroom (*Calocybe indica*) need screening on different substrate combinations, for better bioefficiency of the mushrooms.

## Materials and Methods

### Spawn production

Spawn is a medium through which the mycelium of a fruiting culture has grown and which serves as the inoculum for the substrate in mushroom cultivation (Chang and Miles, 1989) which is used for oyster mushroom (*Pleurotus eous, Pleurotus florida* and *Pleurotus sajor-caju, Hypsizygous ulmarious,)* cultivation was prepared by following standard procedure (Krishnamoorthy,1981).

### Following different varieties of oyster mushroom and milky mushroom cultivars were mass multiplied

1. *Pleurotus eoeus*
2. *Pleurotus sajor caju*
3. *Pleurotus florida*
4. *Hypsizygous ulmarius*
5. *Calocybe indica*

### Rind spawn production

The procedure for rind spawn production is same as jowar spawn preparation. Here maize rind is used as a substrate for different species of oyster and milky mushroom spawn production.

### Preparation of substrate

Cultivation of oyster mushroom (*Pleurotus eous, Pleurotus florida, Pleurotus sajor-caju, Hypsizygous ulmarious,*) was carried out by following the method of Desai (1982). Maize crop byproducts and paddy straw was chopped to convenient length of about 6 to 10 cm. The substrate was soaked in fresh water for 10 hr in a container. After soaking the substrates, the excess water was drained off by spreading on a clean slab, so as to have 70-75 per cent moisture. The substrate was pasteurized using steam for 30 minutes at $85^0$ C in a closed chamber. The pasteurized substrate was spread on clean cement floor inside the room and allowed to cool to room temperature.

### Spawning and spawn running

Polythene bags of size 30 x 45 cm of 150-guage thickness were used for substrate filling. Hundred grams spawn of *Pleurotus eoeus, Pleurotus florida, Pleurotus sajor-caju and Hypsizygous ulmarious* were used for filling of each bag (2.5-3.0 kg substrates on wet bases) or 5 % of spawn on wet weight basis of substrate for layer spawning, leaving 6 to 7 cm gap at the top. The mouth of polythene bag was tied with a rubber band. Two to three small holes were made at the bottom of the bag and 5 to 6 holes all over the bag for drainage of excess water and for air exchange respectively. During spawn running humidity of 80-85 per cent was maintained in cropping room.

### Cropping

After complete growth of mycelium on the substrate, the polythene bags were cut open using by a blade. These opened 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 interval to maintain moisture. Buds developed into fruiting body. Finally fruiting bodies were harvested after attaining their maximum size and the fresh weight was recorded and the yield and bio efficiency was calculated.

### Estimation of bioefficiency

Fully matured fruiting bodies of oyster mushroom and elm mushroom were harvested prior to up curling of margin. Harvesting was done prior to watering and fresh weight was determined soon after. Bioefficiency of mushroom was calculated by using formula as

recommended by Chang and Miles (1989).

$$\text{Bioefficiency} = \frac{\text{Fresh weight of mushrooms}}{\text{Dry weight of substrate}} \times 100$$

## Estimation of moisture

Fresh samples were taken and dried in an oven at 60 ºC. After ensuring that the weight of the dry samples remained constant, the dried samples were weighed and this value was subtracted from the fresh weight of the sample to obtain the weight of the moisture.

$$\text{Moisture (\%)} = \frac{\text{Sample fresh weight (g)} - \text{sample dry weight (g)}}{\text{Sample Fresh weight (g)}} \times 100$$

## Statistical analysis

The data obtained was subjected to factorial completely randomized design statistical analysis (Littly and Hills, 1978).

## Result and Discussions

The rind spawn production is same as jowar spawn production but here the presence of large picies of rind that makes the less quantity of spawning material compare to the jowar spawn. If we apply the rind spawn to the mushroom growing substrates results in poor yield compare to jowar spawning method (Fig. 1).

The production of mushroom on different maize crop byproducts (Maize stover, Maize rind and Maize sheath) with using the different mushroom fungus species such as *Pleurotus eoeus, Pleurotus florida, Pleurotus sajor-caju, Hypsizygous ulmarious.* The obtained data is presented in table 1 and figure 4.

Mushroom yield (611.33g/bag) in interaction between *Pleurotus eoeus* and 100% paddy straw substrates gave the highest significant bioefficiency (97.76%) compare to the all maize crop byproducts and combination with paddy straw substrates. Among the maize crop byproducts 50% Maize sheath + 50% Paddy straw combination shows the significantly higher yield (593g/bag) and bioefficiency (90.95%) compare to the other maize crop byproducts (Fig. 3).

Mushroom yield (517g/bag) in interaction between *Pleurotus florida* and 100% paddy straw substrates yielded the higher bioefficiency (82.72%) compare to the all maize crop byproducts and combination with paddy straw as substrates. Among the maize crop byproducts 50% Maize sheath + 50% Paddy straw combination showed the significantly higher yield (510g/bag) and bioefficiency (86.69%) compare to the other maize crop byproducts.

Mushroom yield (515g/bag) in interaction between *Pleurotus sajor caju* and 50% paddy straw+ 50% sheath substrates gave higher bioefficiency (89.56%) compare to the all maize crop byproducts combination with paddy straw substrates and 100 % Paddy straw. But lowest yield (275g/bag) was found in the maize rind as substrates.

Mushroom yield (688 g/bag) in interaction between *Hypsizygous ulmarius* and 100% paddy straw substrates gave the higher

bioefficiency (110 %) compare to the all maize crop byproducts and combination with paddy straw substrates. Among the maize crop byproducts 50% Maize sheath + 50% Paddy straw combination shows significantly higher yield (400 g/bag) and bioefficiency (69.56 %) compare to the other maize crop byproducts.

Among the substrates and mushroom fungus sp. interactions 100% Paddy straw with *Hypsizygous ulmarius* shows the highest bioefficincy (110%) and yield (688g/bag), but the lowest yield ( 235g/bag) was found in the 100% maize stover as substrate for *Hypsizygous ulmarius* (Fig. 2).

Among the different sources of maize crop byproducts and paddy straw as substrate, the highest yield was found in the interactions of 100% Paddy straw with *Hypsizygous ulmarius* showed the highest bioefficincy (110%) and yield (688g/bag). The lowest significant yield (235g/bag) was found in the 100% maize stover with *Hypsizygous ulmarius.*

In different substrates the mushroom yield varied. This could be due to the nature and nutrient content of the substrates (Desai, 1982).

Before growing *Hypsizygous ulmarius* mushroom on different substrates the maximum Nitrogen (0.84%), Phosphorus (0.49%), Potassium (1.72%) content was recorded in paddy straw. Similar results were also reported by Kaul *et al.*, (1981) with paddy straw.

**Table.1** Yield and bioefficiency of different varieties of oyster mushrooms on different cereal crop substrates

| | ***P.e*** | | ***P.f*** | | ***P. sc*** | | ***H. u*** | |
|---|---|---|---|---|---|---|---|---|
| **Substrates** | Yield (g/bag) | B.E (%) | Yield (g/bag) | B.E (%) | Yield (g/bag) | B.E (%) | Yield (g/bag) | B.E (%) |
| 100% Paddy staw | 611.33 | 97.76 | 517 | 82.72 | 410 | 65.60 | 688 | 110.00 |
| 100% Maize straw | 325 | 52.00 | 345 | 55.20 | 345 | 55.20 | 235 | 37.60 |
| 100% Rind | 280 | 40.00 | 275 | 39.20 | 275 | 39.20 | 255 | 36.40 |
| 100% Sheath | 300 | 60.00 | 350 | 70.00 | 350 | 70.00 | 285 | 57.00 |
| 50% Maize sheath + 50% Paddy straw | 593 | 90.95 | 510 | 86.69 | 515 | 89.56 | 400 | 69.56 |
| 50% Sheath + 50% Paddy straw | 491 | 78.56 | 445 | 72.80 | 495 | 72.80 | 375 | 60.00 |
| 50% Rind + 50% Paddy straw | 300 | 40.00 | 290 | 65.60 | 280 | 38.66 | 285 | 38.00 |

| | SEm | CD at 5% |
|---|---|---|
| A | 0.0048 | 0.0137 |
| B | 0.0064 | 0.0181 |
| A x B | 0.0128 | 0.0361 |

*P. e – Pleurotus eoeus,* *P. f – Pleurotus Florida,* *P. Sc – Pleurotus sajor-caju*
*H.u – Hypsizygous ulmarious,* B.E -Bioefficiency

Note: Data are mean value of three replications

**Fig.1** Rind spawn of different oyster mushroom varieties

Rind spawns

| Jowar spawn (*P.f*) | Rind spawn (*P.f*) |
|---|---|

| Jowar spawn (*H.u*) | Rind spawn (*H.u*) |
|---|---|

| Rind spawn (*S.c*) | Jowar spawn (*S.c*) |
|---|---|

| Rind spawn (*P.e*) | Jowar spawn (*P.e*) |
|---|---|

**Fig.2** Different substrates used for mushroom cultivation

**Fig.3** Growth of *Pleurotus eoeus* mushroom using rind spawn on maize cob sheath

100% maize cobsheath (Rind spawn)

100% maize cob sheath (Jowar spawn)

**Fig.4** Different oyster mushroom species growth on maize crop byproducts

100% paddy straw + (*p.e*)

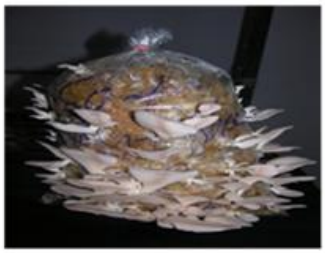
100% maize stover +*P.e*

100% sheath + (*p.e*)

100% Rind +(*P.e*)

100% paddy straw + (*p.e*)

50% maize stover+ 50% paddy straw + (*p.e*)



50% sheath +50% paddy straw +(*p.e*)

50%paddy straw +50% Rind +(*p.e*)

100% paddy straw + (*H.u)*

100% maize stover + (*H.u)*

100% paddy straw + (*P.f)*

50% paddy straw + 50% maize stover (*P.f)*

100% paddy straw +( P.sc)

100% sheath +( P.sc)

50% paddy straw + 50% maize straw (*P.sc)*

50% paddy straw + 50% sheath (*P.sc)*

Four agricultural wastes were mixed with date palm leaves at different ratios, with two supplements and three spawn rates were used. Wheat straw mixed with date palm at ratio of 25 (date palm): 75 (agro-waste) showed the best results in most of the parameters measured. Corn meal was superior over wheat bran as a supplement in all treatments (Kholoud *et al.,* 2014).

Frederick and co-workers in 2012 to other studied on seven substrates to test the mushroom production namely bean straw, saw dust, rice straw, maize cobs(Zea mays), wheat straw, sugarcane bagassse, banana leaves were tested for their suitability for production of indigenous *Pleurotus citinopipileatus.* Among the different substrate tested the maximum yield (397.71g/kg wt substrate) and biological efficiency of 148%were obtained from bean straw at spwn rate of 5% (Fredrick *et al.,* 2012).

In conclusion, different varieties of oyster mushrooms yield vary with the different substrates. Further Paddy straw is the best substrate followed by Paddy straw + Maize cob sheath for the cultivation of *Pleurotus eoeus* variety of oyster mushroom.

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