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Yield performance and nutritional analysis of *Pleurotus* species on different agro wastes and vegetable wastes

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ABSTRACT

Mushroom cultivation is followed due to their delicious flavour and low calorific value. Oyster mushroom was cultivated on rice straw, *brassica* straw, cauliflower leaves, pea pod shell, soybean husk and on various combinations of paddy straw and aforementioned waste. *Pleurotus citrinopileatus* failed to grow on pea pod shell and cauliflower leaves when it was cultivate separately on these wastes. However, it grew very well on paddy straw in combination with other substrates. Yield and biological efficiency of *P. citrinopileatus* was seen better, when it grows on paddy straw mixed with other agro waste than paddy straw alone and also in case of nutrients. From different species of *Pleurotus*, *P.sajar-caju* have high biological efficiency than *P. sajar-caju* and *P. florida when cultivated on soybean husk*.

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INTRODUCTION

Mushroom with their grate varies of species, constituting a cost effective mean of both supplementing the nutrition to human kinds. Some species of mushroom are of industrial significance throughout the world (Change and Miles, 1991). In India majorly, *Agaricus bisporus*, *Pleurotus sajar-caju* are preferred for commercial cultivation.

The cultivation of mushroom serves as the most efficient and economically viable biotechnology for the conservation of lignocelluloses waste material to high quality of food and these well naturally open up new job opportunities especially in rural areas (Fasidi *et al*.,1993 and Hussain, 2001). Edible mushroom like *Agaricus* sp. and *Pleurotus osterus* are commercially produced and sold in Asia, America and Europe (Okhuoya *et al*., 1998).

Most of the edible fungi are saprophytic in nature. They utilize lignocellulosic complex as an energy source and for making their carbon skeleton. Oyster mushroom has strong enzyme profile, that breakdown these complex organic macromolecules to simple form and help to grow on a wide range of agricultural waste like cereal, millets, pulses, vegetables, fruit, cotton, palm, sugar crop waste and wood bi-product etc.

Nutritional attributes of the oyster mushroom is being increasingly realized in recent times. They are low in calories and high in protein, as compare to rice, wheat, cabbage and milk. Mushrooms are good source of vitamins including thiamine, riboflavin, niacin, biotin and ascorbic acids. The oyster mushroom is good source of minerals and rich in carbohydrate and fibres.

Various workers have reported nutritional and medicinal attributes of mushroom. But there is wide variation in the values reported for the same species by the different workers. The difference may be due to the variation in genetic makeup, substrate used, cultivation technology and condition at the stage of harvest as well as post harvest, which affect the composition.

In the present work, the oyster mushroom *Pleurotus citrinopileatus* was cultivated on different referable and agricultural wastes *viz.*, *Brassica* leaves, cauliflower leaves and pea pod shells alone and in combinations with paddy straw in different proportion.

MATERIAL AND METHODS

The pure culture of ***Pleurotus*** were procured from College of Agriculture, Pune, Maharashtra and maintained at temperature 25 ± 2 ^{0}C.

Preparation of spawn:

Spawn is referred as the vegetative mycelial growth of fungus, which is grown on cereal grains. Healthy, unbroken and bold wheat grains were well washed in tap water and then half boiled in water. After that, excess water was drained out from wheat grains followed by mixing of buffers $CaCO_3$ and $CaSO_4$ in 3:1 ratio. Then saline glass bottles were half filled with wheat grains and plugged with cotton. The bottles were sterilized at 121^{0}C temperature and 15 psi pressure for 40 min. and left for overnight. Inoculate the bottles by transferring pure culture and incubated in BOD incubator. Within 10-12 days entire grains are covered with whitish mycelial growth.

Preparation of substrate, spawning and cultivation:

The collected cauliflower leaves and pea pod shell were sundried, soaked in cold water for 8-10hrs and sterilized by steam sterilization method. These substrates alone as well as in various combinations with paddy straw, were used for experiment. Paddy straw and soybean husk were sterilized by hot water sterilization method for an hour and excess water was drained out. Paddy straw with vegetable wastes used in two combinations *i.e.* 70 per cent paddy straw + 30 per cent other wastes and 80 per cent paddy straw + 20 per cent other wastes. On the wet weight basis of substrate the beds were spawned @3 per cent and incubated in incubation room.

Biological efficiency:

The four bags of each substrate of *P. citrinopileatus* were kept for evolution of yield performance and biological efficiency in mushroom house under *in vivo* condition. The yield was expressed as of fresh fruit bodies produced per bag. Biological efficiency was calculated by following formula :

$$\text{Biological efficiency} = \frac{\text{Fresh weight of mushroom per bag (x)}}{\text{Dry weight of substrate per bag (y)}} \times 100$$

Moisture content:

It was carried out by picking fresh fruit body of *P. citrinopileatus* and dried in hot air oven at 60^{0}C. For 15 hours.

$$\text{Moisture content} = \frac{\text{(Fresh weight of mushroom - Dry weight of mushroom)}}{\text{Fresh weight of mushroom}} \times 100$$

Total yield:

Total yield was determined by taking the weight of mushroom obtained after 1st, 2nd and 3rd flush.

RESULTS AND DISCUSSION

When the *Pleurotus citrinopileatus* was cultivated alone on pea pod shell and cauliflower leaves, the mushroom failed to grow. On the other hand when it is cultivated on paddy straw alone and paddy straw with the combinations of vegetable wastes, the fructification took place. *Brassica* straw alone as well as in combination with paddy straw supported better growth. Yield of *Pleurotus citrinopileatus* on different agrowastes in various combinations and their biological efficiency are given in Table 1 and Fig. 1.

Yield and biological efficiency of *Pleurotus citrinopileatus* on 70 per cent paddy straw + 30 per cent other agrowastes were significantly higher than 80 per cent paddy straw + 20 per cent agrowastes combination. Paddy straw and vegetable wastes combination gave better result in terms of total yield and biological efficiency than paddy straw alone. In respect of fruit flush, first flush gave much more yield than second and subsequent flushes. There, is decrease in mushroom yield in the subsequent flushes.

The moisture content of fresh mushroom fruit bodies, grown on various substrates ranged from 86.86 to 89 per cent. *Brassica* Straw and pea pod shell with paddy straw in all combination showed similar moisture retention capacity (88%). The result of moisture is given in Table 2 and Fig. 2.

In the present investigation *Pleurotus citrinopilatus* failed to grow when cultivated alone on pea pod shells and cauliflower leaves. The probable reason is, the vegetable wastes when processed before cultivation, they hold large amount of water. Hence due to presence of excess water in the substrate and lack of proper aeration *Pleurotus* mycelia does not developed and spawn run as well as fructification fail to occur. Sing and Pandey (2002). On the other hand when these vegetable wastes are mixed with paddy straw, these shortcomings are overcome and spawn run and fructification take place. The result of yield performance (Table 1) indicates that the first flush of fruiting bodies gave maximum yield in comparison to second and subsequent flushes. The lowest yield recorded in last flush. Block *et al*.(1959) also reported higher yield of *P. ostreatus* in first flush while yield of second flush was two third of first flush and yield of third flush was two third of second flush. However, Change *et al*.(1998) Observed uniform distribution of fruit bodies of *P. sajarcaju* in all the four

Table 1: Yield and biological efficiency of *Pleurotus citrinopileatus* on different combinations of agrowastes

Substrates	Flush I (g/bag)	Flush II (g/bag)	Flush III (g/bag)	Flush IV (g/bag)	Total (g/bag)	B.E. (%)
100% PS	150	75	46	00	271	90.00
30%BS+70%PS	145	66	53	15	279	92.33
30%PP+70%PS	146	65	54	17	282	94.33
30%CF+70%PS	137	69	56	11	273	91.00
20%BS+80%PS	137	68	57	10	272	90.80
20%PP+80%PS	151	74	35	11	271	90.00
20%CF+80%PS	159	64	49	00	272	90.80

PS= Paddy straw, BS= Brassica straw, PP= Pea pod, CF= Cauliflower leaves, BE= Biological efficiency.

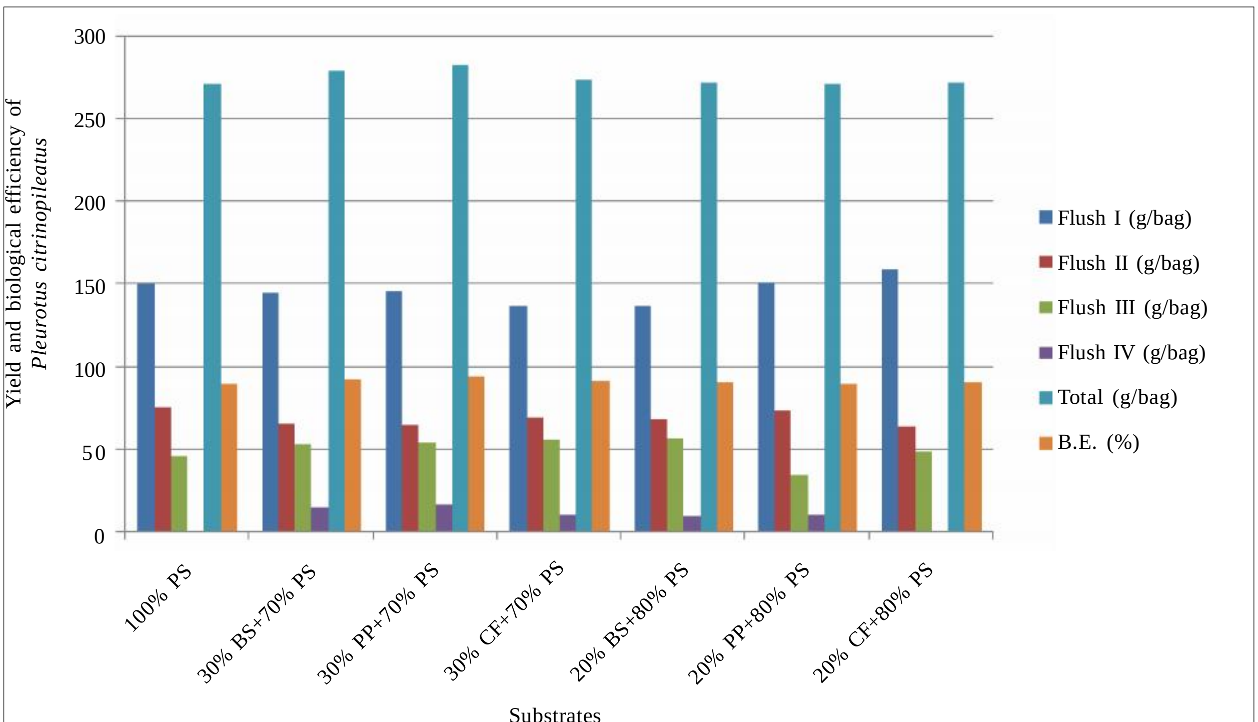

Fig. 1 : Yield and biological efficiency of *Pleurotus citrinopileatus* on different combinations of agrowastes

Table 2 : Moisture content of *Pleurotus citrinopilatus* on different combinations of agrowastes

Substrates	Moisture contents (%)
100% PS	89.00
30%BS+70%PS	88.00
30%PP+70%PS	88.00
30%CF+70%PS	87.05
20%BS+80%PS	88.04
20%PP+80%PS	86.86
20%CF+80%PS	86.86

PS= Paddy Straw, BS= Brassica Straw, PP= Pea Pod, CF= Cauliflower Leaves, BE= Biological Efficiency.

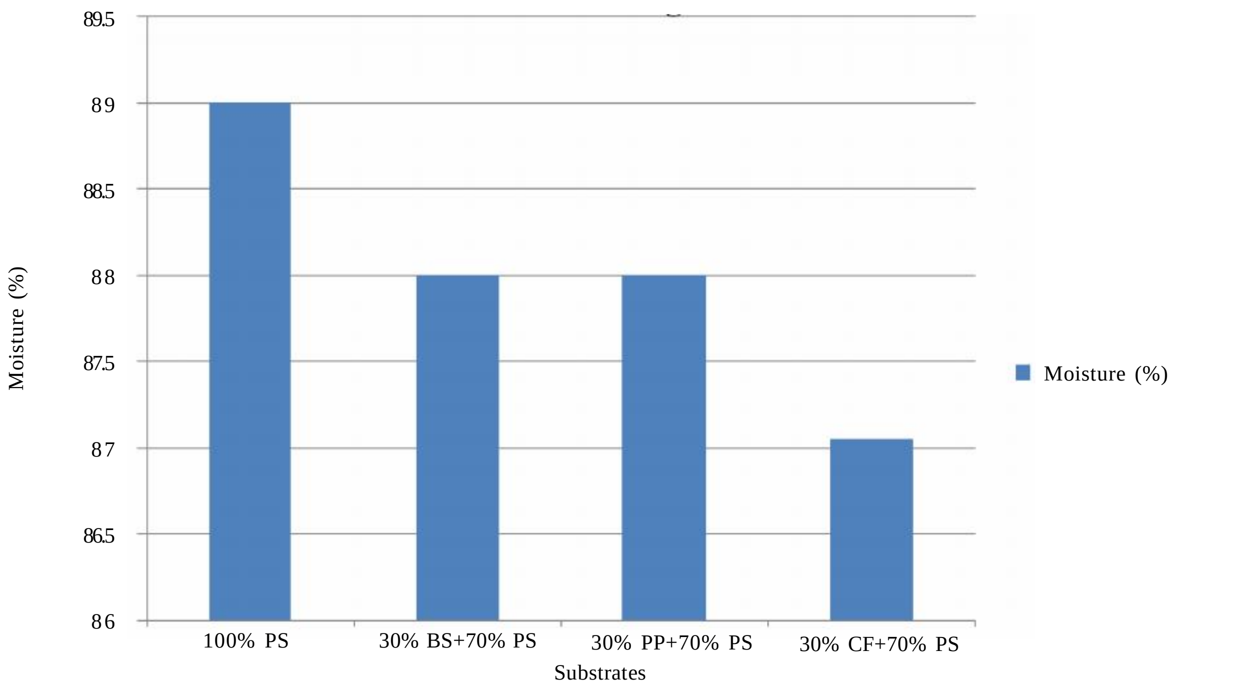

Fig. 2 : Moisture content of *Pleurotus citrinopilatus* on different combinations of agrowastes

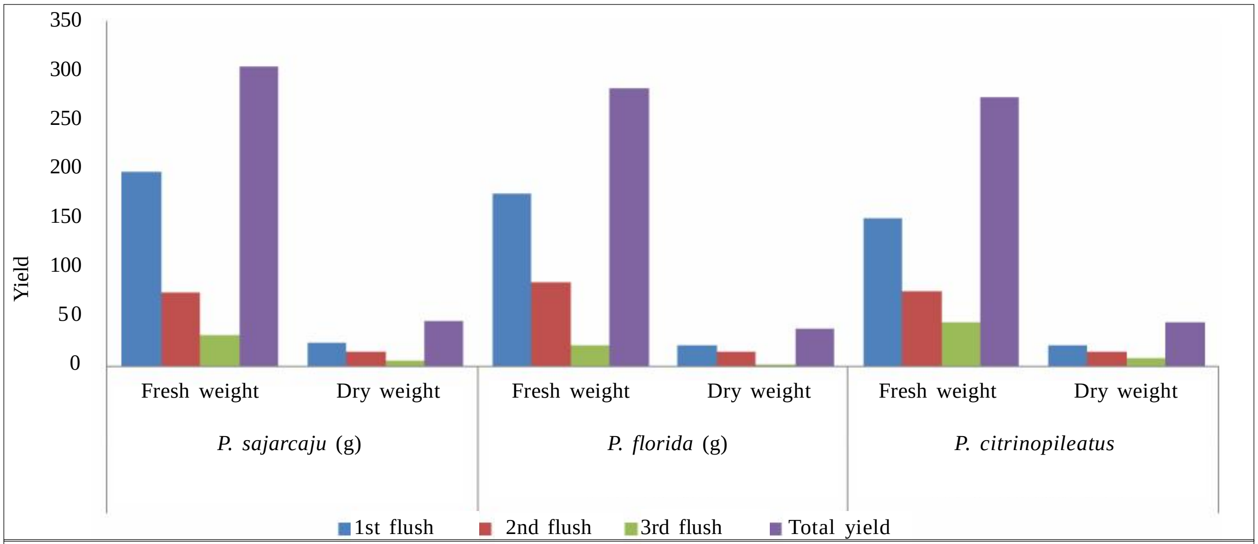

Fig. 3 : Total yield of different *Pleurotus* sp.

Table 3 : Total yield of different *Pleurotus* sp.

No.	*P. sajarcaju (g)*		*P. florida (g)*		*P. citrinopileatus*	
	Fresh weight	Dry weight	Fresh weight	Dry weight	Fresh weight	Dry weight
1st flush	197.00	25.05	174.88	22.03	150.00	21.69
2nd flush	74.55	15.11	85.00	15.01	77.01	14.91
3rd flush	32.01	6.01	22.02	2.11	45.04	9.17
Total yield	303.56	46.17	281.9	39.15	272.05	45.77

flushes on cotton waste, while they observed higher yield of first flush (46%) than second flush (29%), third flush (15%) and fourth flush (9%) 0n paddy straw. Bisaria *et al.* (1987) reported higher yield of *P. florida* in first flush than subsequent flushes on paddy and wheat straw.

In present work better yield and efficiency of *Pleurotus citrinopilatus* was seen when it was cultivated on paddy straw mixed with other agrowastes than paddy straw alone. This may be due to presence of various micro and macro elements present in the *brassica* straw, pea pod shell and cauliflower leaves, which could have promoted the growth of the mushroom and ultimately yield and biological efficiency.

Per cent Moisture content considerably influences the nutritional value of mushroom fruit bodies. In the present work the moisture content of mushroom have been found to be 86.86 per cent to 89 per cent. Crisan and Sands (1978) and Bano and Rajarathnaqm(1982) reported moisture content of fresh mushroom between 90 to 94 per cent. Singh and Pandey (2002) also reported that moisture content of *Pleurotus citrinopilatus* was between 87.84 per cent to 90 per cent.

Total yield of different species of *Pleurotus* was estimated on the basis of 500g of dry weight substrate used, by measuring the fresh and dry weight of fruit bodies. The results presented in Table 3 indicate that total yield of *Pleurotus sajar-caju* gives the highest yield in terms of fresh weight 303.56g and dry weight 46.17g as compared to *Pleurotus citrinopilatus* and *Pleurotus florida*.

Reports on cultivation of the oyster mushroom on similar by-product have manifested variable levels of biological efficiency. These variations mainly related to spawn rate, fungal species used and supplement added to the substrate (Mane *et al.*, 2007). Some of the evaluated B.E. of *Pleurotus* sp. on commonly used substrate of rice straw was 85.5 per cent (Mehta *et al.*, 1990), and on leguminous plants was 103.8 per cent (Sharma and Madan, 1993).

Conclusion :

The observations of present investigation suggested that, the edible mushroom *Pleurotus citrinopilatus* grown on paddy straw mixed with *brassica* straw, pea pod shell and cauliflower leaves gives fruit bodies. Besides, these substrates also support better yield performance and biological efficiency. Pea pod shell and cauliflower leaves used in the present investigation are generated from every households and markets in large quantities. These wastes can be utilized as resources for mushroom production with improved nutriceuticals. This can be used as an effective weapon against malnutrition particularly in those regions of the world where malnutrition related disease and death are common.

Also, in present study, all the species of *Pleurotus like Pleurotus citrinopilatus, Pleurotus florida, Pleurotus sajar-caju* gives better yield when cultivated on soybean husk. The *Pleurotus sajar-caju* shows the higher biological efficiency as compared to the other species.

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