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Cultivation of two Wild Edible Oyster Mushrooms on Locally Available Substrates under Konkan Region of Maharashtra, India

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Abstract
It is a proven fact that small scale mushroom cultivation is gaining momentum as a subsidiary agri-business all over the country. Among all the mushrooms cultivated in India, oyster mushroom cultivation has reached to every nook and corner of the country due to its ability to thrive well in the diverse environmental conditions all over the country and capability to degrade all sorts of crop residues and lignin cellulose rich weed flora. Oyster mushroom cultivation requires minimum skill as well as meager financial investment. Two wild edible oyster mushroom species, one each of white and pink were collected from Dapoli (Dist. Ratnagiri, Maharashtra) which were growing on dead decaying mango tree trunk. They were brought into pure culture and master spawn and commercial spawn was prepared. It was decided to cultivate them on different locally available substrates like paddy straw, one local weed grown on barren land called Kasheda (Coix-*Lacryma Jobi*), Nagali straw, Sugarcane bagasse and saw dust. The yield was compared with each other.

Keywords: Oyster mushroom, konkan, local wild species, cultivation, local substrates.

1. Introduction

Oyster mushrooms are lignicolous in habit i.e., in nature, they are found growing on dead barks of perennial trees or rotting logs of wood especially in tropical forests but some species are also found in temperate regions. Oyster mushrooms are the most suitable fungal species to produce, without composting, protein-rich food from various agro-wastes or forest wastes.

The commonly cultivated species worldwide, include, tree oysters (P. ostreatus), gray oyster mushrooms (P. sajor-caju), abalone mushrooms (P. cystidiosus), white oyster mushrooms (P. florida), golden oyster mushrooms (P. citrinopileatus), the pink oyster mushroom (P. eous), and P. sapidus -the black oyster mushroom (Sanchez, 2010) [12].

The biological efficiency of a cultivated oyster mushroom is dependent on the factors such as mushroom species, substrate as well as optimum temperature and humidity during substrate colonization and fruit body formation. The climatic conditions of Konkan Region are very suitable for cultivation of oyster mushrooms. Hence the investigation was attempted to standardize cultivation technology of two local, wild, edible oyster mushrooms for assaying biological efficiency of wild mushrooms on different local substrates.

2. Materials and Methods

The oyster mushroom sporocarps growing on wood barks in the wild were collected in paper bags. It was brought to the laboratory. Collected samples were cleaned with a brush, washed with tap water and then rinsed with distilled sterile water to remove the extraneous material. Such cleaned sporocarps were cut into two halves with a transverse cut by using a sterilized blade. Then 4-5 small bits of tissues at the junction of pileus and stipe were cut with a sterilized blade and placed in 0.1 per cent Gentamycin solution for 30 seconds. In order to use dry bits for culturing, the bits were placed on sterile blotting paper for 2 minutes. Such dried bits were aseptically transferred to sterilized medium in Petri plates containing sterile PDA. The inoculated plates were

incubated at 26±˚C. Pure culture was maintained on PDA slants.

The slants with profuse mycelial growth were preserved in refrigerator for further studies. This culture was used for preparation of master spawn by following standard procedure. Prepared spawn was utilized for cultivation. In order to assess the biological efficiency of wild edible oyster mushrooms, substrates like paddy straw, finger millet straw, Kasheda grass (Coix lacryma-jobi), sugarcane bagasse and saw dust were used. Standard methodology of substrate pasteurization, bed preparation was followed.

Substrates were chopped into 5-7cm pieces. Required quantity of substrates was weighed on electronic balance. The substrates were transferred to gunny bags and soaked for 18 hours in 100 ppm formaldehyde solution. Excess water in the substrate was drained off by placing the gunny bags on a clean, cemented platform with desirable slope. The substrates were removed from the gunny bag and allowed to air dry by spreading it on a clean and disinfected platform in order to retain 60% moisture in each substrate.

Polypropylene bags of the size 24 X 18 "(LXB) were used for bed preparation. These bags were disinfected by dipping in sanitizer solution to remove the dust particles if any. These bags were filled by placing 5-6 alternate layers of the substrate and grain spawn. Spawn was used @ 2 per cent on wet weight basis of the substrate. Each bag thus filled was plugged with cotton to provide proper aeration during spawn run. Mushroom beds were then stacked on iron angel shelves in spawn run room. Complete darkness and temperature around 25-300C was maintained in this room till completion of spawn run. Beds with full white mycelial growth were opened and transferred to the cropping room on wooden hangers. In cropping room, about 25-300 C temperature and 85-90 per cent relative humidity was maintained.

The humidity in the cropping room was maintained within a range of 85-90 per cent with the help of mist blowers which were run for 5-10 minutes 4-5 times a day. Five replications were maintained per species. The experiment was laid in Completely Randomized Design (CRD).

3. Results

Assaying Biological Efficiency of Wild Mushroom on Different Local Substrates

Five locally available substrates like paddy straw, ragi straw, Kasheda grass, sugarcane bagasse and saw dust were used to evaluate the best suitable substrate for cultivation of wild edible oyster mushrooms in the region.

a) Wild White Oyster Mushroom

The data presented in Table-1 revealed that, the minimum period was required to colonize local grass kasheda (22 days) followed by paddy straw (25 days) and ragi straw (27 days) respectively. They were followed by sugarcane bagasse and saw dust. Sugarcane bagasse required 29 days for complete mycelial growth. The maximum period (32 days) was required for complete colonization of saw dust.

Early emergence of pin heads occurred on local grass kasheda (3 days) followed by paddy straw (5 days) and ragi straw (5 days) respectively. They were followed by sugarcane bagasse (8 days). Delayed pin head formation was observed on saw dust where pin heads appeared 9 days after opening of the beds. In case of wild white oyster mushroom the overall spawn run period ranged between 22-32 days and pin head initiation period between 3-9 days after opening of beds.

The maximum biological efficiency was recorded on paddy straw (83.60%) which was subsequently followed by kasheda grass (72.00), ragi straw (37.30%); sugarcane bagasse (23.34%) and saw dust (4.40%) respectively.

The data in the Table 1 indicates that the biological efficiency of wild white oyster mushroom on saw dust was negligible and therefore this substrate is unsuitable for oyster mushroom cultivation.

It is clear from the results of this experiment that in respect of time required for complete mycelial growth, period of pin head initiation and biological efficiency, paddy straw was the best substrate followed by kasheda grass for cultivation of wild white oyster mushroom.

Table 1: Biological efficiency of wild white oyster mushroom on locally available substrates

Tr. No.	Substrate	Spawn run period (Days)	Pin head formation days	Yield per 1 kg dry substrate (gm)*	B.E (%)
T_1	Paddy straw	25	5	836.00	83.60
T_2	Ragi straw	27	5	373.00	37.30
T_3	Local Grass (*Kasheda*)	22	3	720.00	72.00
T_4	Sugarcane bagasse	29	8	233.40	23.34
T_5	Saw dust	32	9	44.00	4.40
SEm ±				2.3726	
CD at 5%				7.1517	
CD at 1%				9.8872	
CV%				2.1505	

*mean of three replications

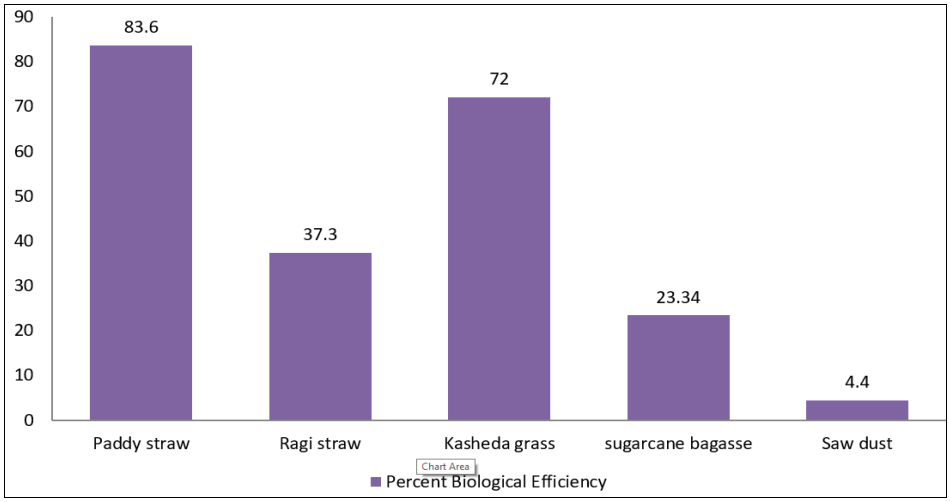

Fig 1: Biological efficiency of wild white oyster mushroom on locally available substrates

b) Wild Pink Oyster Mushroom

The data presented in Table-2 revealed that, the minimum period was required to colonize kasheda grass (23 days) followed by paddy straw (24 days) and ragi straw (27 days) respectively. They were followed by sugarcane bagasse and saw dust. Sugarcane bagasse required 29 days for complete mycelial growth. The maximum period (31 days) was required for complete colonization of saw dust.

Early emergence of pin heads occurred on paddy straw (4 days) followed by kasheda (6 days) and ragi straw (6 days) respectively. They were followed by sugarcane bagasse (7 days) and saw dust (11 days). Delayed pin head formation was observed on saw dust where pin heads appeared 11 days after opening of the beds. In case of wild pink oyster mushroom the overall spawn period ranged between 23-31 days and pin head initiation period between 4-11 days after opening of beds.

The maximum biological efficiency was recorded on paddy straw (83.40%) which was followed by kasheda grass (70.15%), ragi straw (36.65%); sugarcane bagasse (23.15%) and saw dust (6.00%) respectively.

The data in the Table 2 indicates that the biological efficiency of wild pink oyster mushroom on saw dust was very meager as compared to paddy straw and kasheda grass.

It is clear from the results of this experiment that in respect of time required for complete mycelial growth, period of pin head initiation and biological efficiency, paddy straw was the best substrate followed by kasheda grass for cultivation of wild pink oyster mushroom. However, saw dust is not at all suitable for cultivation of this mushroom.

Table 2: Biological efficiency of wild pink oyster mushroom on locally available substrates

Tr. No.	Substrate	Spawn run period (Days)	Pin head formation days	Yield per 1 kg dry substrate (gm)	B.E (%)
T_1	Paddy straw	24	4	834.00	83.40
T_2	Ragi straw	27	6	366.50	36.65
T_3	Local Grass (*Kasheda*)	23	6	701.50	70.15
T_4	Sugarcane bagasse	29	7	231.50	23.15
T_5	Saw dust	31	11	60.00	6.00
SEm ±				2.14573	
CD at 5%				6.46793	
CD at 1%				8.94187	
CV%				1.95645	

*mean of three replications

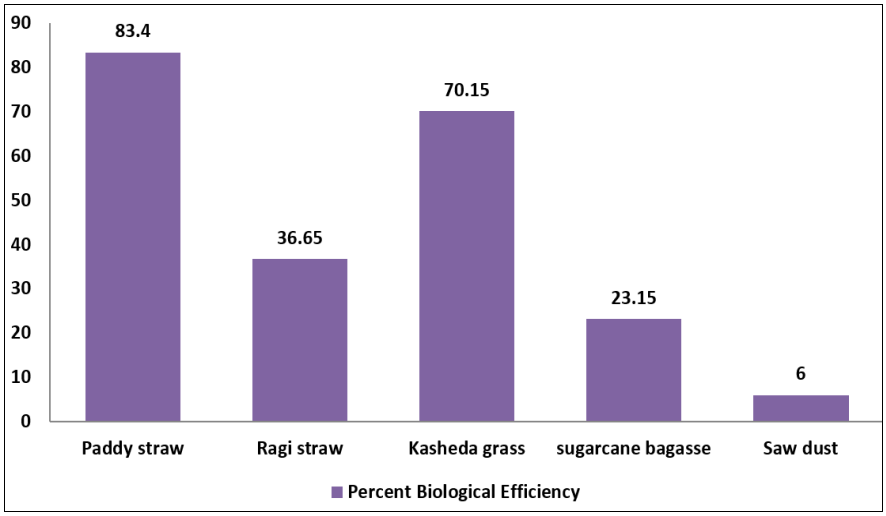

Fig 2: Biological efficiency of wild pink oyster mushroom on locally available substrates

3. Discussion

While assessing the biological efficiency of two wild oyster mushrooms, five substrates paddy straw, ragi straw, kasheda grass (Coix lacrima-jobi), sugarcane bagasse and saw dust were evaluated. The maximum biological efficiency of wild white as well as pink oyster mushroom was recorded on paddy straw (white- 83.6%, pink- 83.4%) followed by that on kasheda (white- 72%, pink- 70.15%). Proportionate amounts of lignin, cellulose and hemicellulose in paddy straw might have played an important role in performance of the mushrooms under study Karnawadi (2006) [7]. Superiority of paddy straw as compared to many other substrates such as wheat straw, black gram, mustard waste, chickpea straw, lantana camera, sugarcane bagasse, waste cotton, coconut coir, sunflower stalk etc. for cultivation of different oyster mushrooms has been reported by many workers (Iqbal *et al*. 2005, Das and Mukherjee 2007, Kumari *et al*. 2008, Amin *et al*. 2010, Pani 2011) [11].

Borkar *et al*. (2012) [2] also reported that paddy straw is better than wheat straw for cultivation of P. pulmonarius.

In case of ragi straw, the BE of both the species was considerably low (white- 37.3%, pink- 36.65.%) than the former two substrates. Ragi straw and sugarcane bagasse recorded less than 50% biological efficiency. Saw dust proved to be the most unsuitable substrate. Jegadeesh *et al*. (2018) reported 119% biological efficiency of P. djamor var. roseus on ragi straw substrate. Kimenju *et al*. (2009) [8] also compared the BE of P. ostreatus on many straw substrates and reported 85% BE on ragi straw substrate. Both these findings are contradictory to the results of present study. The difference in biological efficiency on the same straw substrate may be due to the difference in the cultivated species or may be due to the variety of the crop. Sugarcane bagasse is also an agricultural waste which is disposed by using as a cattle feed or by burning. However it's a good substrate for oyster mushrooms. In the present study it was used as one of the substrate but the biological efficiency of both the wild mushrooms under study ranged between 23.15-23.34%. This imply that it is not advisable to cultivate these mushrooms on sugarcane bagasse. Borkar *et al*. (2014) recorded 59.33 per cent biological efficiency of P. pulmonarius on sugarcane bagasse while Dey *et al*. (2008) reported 82.8 per BE of P. sajor-caju on this substrate. Both these findings are contradictory to the results of this study. The reason for low BE of both the wild oyster mushrooms on this substrate may be due to their inability to degrade lignin and cellulose contents in the bagasse. According to Membrillo *et al*. (2010), lignin and cellulose are preferentially degraded in smallest particles, while hemicellulose breakdown reaches its peak in medium size particles. The size of bagasse bits used as the substrate was 7-8 cm which did not favor higher lignases and cellulases synthesis which consequently resulted in drastic reduction in the yield. Even though shortest period for colonization and pin head formation was observed in kasheda grass it failed to record higher biological efficiency. The reason for early colonization and pin head formation may be attributed due to chemical composition of the kasheda grass but the reason for decreased biological efficiency could not be ascertained. However, use of kasheda grass (Coix lacrima-jobi) for cultivation of oyster mushroom is a significant outcome of the present study.

Saw dust was the poorest performer among the five substrates used in the study. Generally the saw dust is composed of high complex cellulose, lignin, hemicelluloses, and minor amounts (5–10%) of extraneous materials (Horisawa *et al*., 1999) [4]. Both the wild mushrooms recorded less than 10 per cent BE on this substrate. Pathmashini *et al*. (2008) [10] reported 30.76% BE of P. ostreatus on saw dust substrate while Khan *et al* (2012) used the saw dust of Bombex cieba, mango, Pinus wallichiana and Acacia nilotica for cultivation of P. flabellatus and concluded that, among the four saw dust substrates Acacia nilotica (BE-70.56%) was the best. These findings are paradoxical to the results of present study. The reason for poor yield in saw dust may be due to following reasons. The particle size of saw dust is very less. Even after proper air drying of the chemically sterilized substrate some moisture is retained in the particles. Therefore, the mycelial growth was in patches and not filamentous as in case of other substrates. Secondly, the days required for completion of mycelial run were more than other substrates. The beds were brittle and not compact. This was accompanied by improper aeration and due to this; the conversion secondary mycelium into tertiary mycelium essential for fruiting was hampered.

Conclusion

Five locally available substrates such as paddy straw, ragi straw, local weed kasheda grass (Coix lacryma-jobi), sugarcane bagasse and saw dust were evaluated for their suitability as a substrate, for cultivation of wild edible oyster mushrooms. Out of these substrates paddy straw was found to be the best substrate with highest biological efficiency, followed by kasheda grass and ragi straw. Sugarcane bagasse and saw dust were found inferior for the cultivation of these wild edible oyster mushrooms.

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