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RESEARCH ARTICLE

Growth Parameters of *Pleurotus ostreatus* (Jacq. Fr.) Kumm Cultivation Using Paddy Straw as a Substrate

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ABSTRACT

Pleurotus ostreatus (Jacq. Fr.) Kumm are large, oyster-shell shaped edible mushroom which can be easily identified by their grey white, oyster shell shaped cap which is attached to a thick, firm stalk. They are nutritionally rich contain good amount of vitamin C, niacin, riboflavin, thiamin and cobalamin. They have high oleic acid and linoleic acid content. They also contain lovastatin and pleuran. Hence, oyster mushroom exhibit anti-atherosclerotic, hypo-glycemic, anti-oxidant, anti-cancer and immuno-modulatory properties. *P. ostreatus* (Jacq. Fr.) Kumm is one of the commonly sought wild mushrooms and paddy straw is mainly used as a substrate for its cultivation. Mycelial growth is a preliminary step that creates suitable internal conditions for fruiting. Thus, out-standing growth of mycelium is a vital factor in mushroom cultivation. In the present study, *P. ostreatus* (Jacq. Fr.) Kumm cultivation was carried out using paddy straw as a substrate. Spawning was done in layers in polythene bags (24 ×16 inch). All the 10 spawned bags were arranged in a dark cropping room on raised platform for mycelium colonization of substrate. Suitable temperature (~28°C) and relative humidity (~80%) were maintained during incubation. Harvesting of mushrooms was carried out before the margin starts folding inwards. Observations such as days for spawn run, days for pinhead formation and first harvest, number of primordia, total weight and total yield of mushroom were measured in the study. It took 23.50 ± 1.27 days for spawn run and 27-31 days for pinhead. First harvest of fruiting bodies was done after the ~4th day of the pinhead formation. Total 224 primordia were noted up to the day of the first harvest from ten bags. The fruiting bodies were harvested into three flushes and total yield after 38 days of incubation was ~4.48 kg.

Keywords: Mushroom, *Pleurotus ostreatus* (Jacq. Fr.) Kumm, Spawn, Fruiting body

INTRODUCTION

The fungi kingdom is separate from plants, animals and bacteria. Fungi are the eukaryotic, achlorophyllus organisms having absorptive mode of nutrition. They are of two types, yeast and mould. Yeast is a unicellular and round shaped organism. It forms smooth and circular colonies. Reproduction in yeast, generally occur by budding and smaller number of yeasts produced by binary fission. On the other hand, mould is multicellular having filamentous structure called hyphae. It forms colorful colonies having wooly texture. Reproduction of moulds occur sexually and asexually using spores. As per the classification, the fungi kingdom is composed of seven phyla namely, Ascomycota, Basidiomycota, Blastocladiomycota, Chytridiomycota, Glomeromycota, Microsporidia and Neocallimastigomycota (Afonso *et al*., 2021). Among these, Ascomycota and Basidiomycota are considered as main phyla within the subkingdom Dikarya. They have an unique intermediate stage called dikaryon in which two nuclei remain as such separate in the cell when two hyphae fuse. All the members of the basidiomycota are filamentous except yeast. They are characterized by club-shaped fruiting bodies called basidia. The basidium produces specialized sexual spores called basidiospores. Mushrooms are the macrofungi generally classified under the phylum Basidiomycota, division Eumycota, subdivision Basidiomycotina and class Hymenomycetes *(Ukwuru et al*., 2018).

They may be edible or poisonous. Poisonous mushrooms are popularly known as toadstools. The simple mushroom has umbrella shaped fruiting body containing spores. These spores fall on the substratum, germinate under suitable conditions and grow as mycelium strands in all directions. As it grows further, a stem is produced and later cap begins to open up like an umbrella tearing away the delicate veil. Inside the cap, gills (lamellae) are developed that resemble the spokes of a wheel. The gills become dark colored as spores appear on them. When spores become mature, the cap of the mushroom begins to flatten out and the spores are eventually released to the ground in millions (Ahmad and Khan, 2010). Among edible mushrooms, button mushroom ranked first in the world for cultivation. In recent times, oyster mushroom is also gaining popularity and rank second in world production (Royse *et al*., 2017). Oyster mushrooms also referred as *Pleurotus* and known as '*Dhingri*' in India. The '*Pleura*' is a Greek word which means lateral, particularly referring to the lateral position of the stem in relation to the cap. Species of the genus *Pleurotus* are well known for their broad adaptability under different agro-climatic conditions and most attractive for commercial scale production due to simple and ease way of cultivation. In the present work, cultivation of *P. ostreatus* (Jacq. Fr.) Kumm was carried out using paddy straw as a substrate. Parameters such as days for spawn run, days for pinhead formation and first harvest, number of primordia, total weight and total yield of mushroom were measured in the study.

MATERIALS AND METHODS

Substrate Preparation : The substrate (paddy straw) was chopped into small pieces (~2.00 inches length). Further, it was soaked in water treated with formalin (500.00 ppm) and carbendazim (75.00 ppm) for 14-18 h. After soaking, removal of water from the substrate was carried out to the extent that it contains ~68-70% moisture. Then the substrate was used for spawning.

Spawning : Spawning was done in layers using spawn of *P. ostreatus* (5%) as per wet weight of the substrate prepared. Spawn was mixed after each layer of paddy straw (4.00 cm thickness) in Polythene bags (24 x 16 inch) having holes at distance of 10.00 cm. Holes were used for diffusion of gases and heat generated inside the bags. Then, mouth of each bag was tied with a thread (Dhakal et al., 2020). Total ten bags were prepared in the study.

Incubation: Spawned bags were arranged in a dark cropping room on raised platform for mycelium colonization of substrate. Suitable temperature (~28°C) and relative humidity (≥ 80%) were maintained for incubation. Darkness was maintained in room during spawn run period (Sharma *et al*., 2013). Total number of days required to cover the paddy straw substrate bags with mycelium growth was recorded as a spawn run period.

Fruiting Body Induction : The bags were slightly tapered from inside and pulled from the sealed cover to expose the substrate for primordial initiation. The colonized substrate bags kept 15.00 cm apart from each other at 25-32°C temperature and 80% relative humidity. The watering was done two times daily. During pinhead formation, aeration was provided after each watering by opening the windows and doors for 3 h, every day. So that the surface of the pinhead became dry. Pinhead emergence is an important factor in mushroom cultivation. Mycelia come together and indicate the initial stage of fruiting bodies formation is called as pinhead stage. Days required for the pinhead formation and for first harvest were monitored. Further, the number of primordia was recorded as total numbers of pinheads per bag.

Cropping and Harvesting : Primordia when developed in to mature fruiting bodies and before their margins start folding inwards, harvesting of mushrooms was carried out. Total yield of harvested mushroom was measured by

totaling of the mushrooms obtained per bag in grams. Further, biological efficiency of mushroom cultivation was measured using following formula,

$$\text{Biological efficiency } (\%) = \frac{\text{Total weight of fruiting bodies}}{\text{Dry weight of the substrate}} \times 100$$

RESULTS AND DISCUSSION

Cultivation of *P. ostreatus* (Jacq. Fr.) Kumm

Days for Spawn Run

P. ostreatus (Jacq. Fr.) Kumm cultivation was done in ten different bags. The mycelium fully covered the substrate in the bag was considered as completion of spawn run. The data obtained during cultivation of *P. ostreatus* (Jacq. Fr.) Kumm revealed that spawn run required 23.50 ± 1.27 days. Dhakal et al. (2020) reported that spawn run of *P. ostreatus* (Jacq. Fr.) Kumm on rice straw substrate taken 30.75 days. Further, days require to complete the spawn run varies with different substrates used ranged from 17 to 30 days.

Days for Pinhead Formation and First Harvest

Pinhead formation was observed for 27-31 days of incubation in the ten bags selected for the study. In seven out of ten bags, initial pinhead formation was observed on 27th day of the incubation. In one of the study it is reported that pinhead formation on various substrates occurred between 26.40 to 31.60 days of incubation (Sharma *et al*., 2013). Tsegaye and Tefera (2017) reported that most of the experimental bags took 3 to 5 days from primordial formation for maturation of mushroom fruiting body. In the present study, first harvest of mushroom was performed on 31 – 34th day of incubation.

The Number of Primordia

The numbers of primordia were noted from the day of first pinhead formation to the day of first harvest in all ten bags and the result obtained is shown in the Table 1. Total 224 primordia were noted up to the day of the first harvest from all the bags. Similar kind of observation was noted by Dey et al. (2008). They reported 209 primordia from paddy straw substrate.

The fruiting bodies were harvested into three flushes and weighed. Total yield was measured after all the three flushes were harvested. Total yield of harvested mushroom from all three flushes after 38 days of incubation was ~4.48 kg (Table 2). All the stages of mushroom growth are shown in Figure 1.

Biological Efficiency

There are several reports available in which biological efficiency of oyster mushroom yield are reported using different substrates. In the present study, the biological efficiency of the oyster mushroom obtained from rice straw was 89.52%. High yield of mushroom obtained using paddy straw was because of easier way of getting sugar from cellulosic substances (Ponmurugan et al., 2007). Substrate rich in cellulose, sucrose and nitrogen and easily available to mushroom supports better yield and, substrates rich in substances like lignin which are not easily degradable affect the yield (Das and Mukherjee, 2007; Taurachand, 2004; Yildiz et al., 2002)

CONCLUSION

P. ostreatus is rich source of nutrition with medicinal properties. In the present study, growth parameters of oyster mushroom cultivation were studied using paddy straw as a substrate. Spawning was done in layers into ten plastic bags with appropriate care. It took 23.50 ± 1.27 days for spawn run, 27-31 days for pinhead formation and 31-34 days for first harvest, respectively. Total fruiting bodies were harvested into three flushes, which was ~4.48 kg with 89.52 % biological efficiency. The growth parameters studied in the present work are very much important for commercial scale cultivation of mushroom with higher production and short time.

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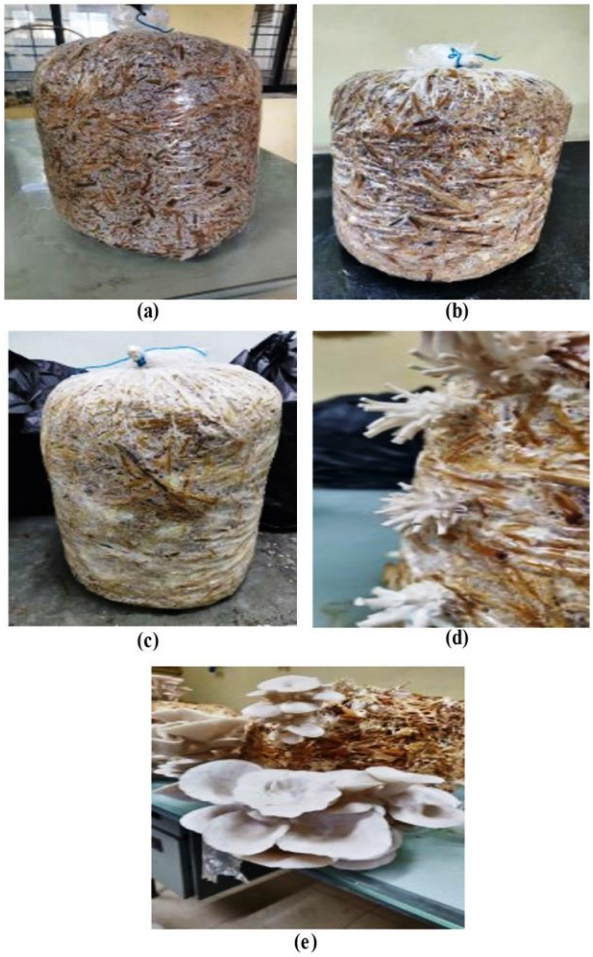

Figure 1: (a) 0 day of incubation, (b) 15th day of incubation, (c) 27th day of incubation, (d) Primordial stage, (e) Harvesting

Table 1: Number of primordia per bag

Days after incubation	Number of primordia in individual bag										
	Bag1	**Bag2**	**Bag3**	**Bag4**	**Bag5**	**Bag6**	**Bag7**	**Bag8**	**Bag9**	**Bag10**	**Average primordia**
27	0.00	5.00	2.00	0.00	0.00	10.00	5.00	5.00	6.00	8.00	4.10
28	9.00	10.00	5.00	2.00	0.00	18.00	10.00	6.00	7.00	8.00	7.50
29	21.00	17.00	10.00	6.00	0.00	30.00	15.00	6.00	8.00	10.00	12.30
30	31.00	22.00	12.00	15.00	6.00	38.00	22.00	10.00	10.00	12.00	17.80
31	36.00	24.00	15.00	30.00	22.00	40.00	24.00	10.00	10.00	13.00	22.40
Total	97.00	78.00	44.00	53.00	28.00	136.00	76.00	37.00	41.00	51.00	64.10

Table 2: Weight of fruiting bodies (g) per bag harvested into three flushes

Bags	Day of fruiting body harvest		
	31st	34th	38th
1	212.00	153.00	89.00
2	210.00	165.00	84.00
3	205.00	147.00	95.00
4	203.00	142.00	88.00
5	199.00	156.00	101.00
6	194.00	143.00	98.00
7	195.00	157.00	105.00
8	189.00	164.00	86.00
9	188.00	167.00	90.00
10	181.00	176.00	94.00
Grand Total (4476.00 g) (123123) (4476.00 g)	1976.00	1570.00	930.00
Average	**197.60 ± 10.05**	**157.00 ± 11.12**	**93.00 ± 6.82**