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Evaluation of different substrates and supplements for growth and yield of paddy straw mushroom (*Volvariella volvaceae*)

MD Mijan Hossain**Abstract**

The present investigation was carried out to know the suitable substrates for cultivation of paddy straw mushroom (*Volvariella volvaceae*) using different agro wastes such as paddy straw, banana leaves, deenanath grass, maize stalks & leaves, paddy straw + maize stalks (1:1), paddy straw + banana leaves (1:1) and paddy straw + deenanath grass (1:1). Highest yield and biological efficiency was obtained from paddy straw followed by paddy + maize stalks substrates (1:1), paddy+ banana substrates (1:1), respectively. Minimum yield was obtained from deenanath grass. In order to find out best supplements, five different supplements such as wheat flour, chickpea grain powder, maize flour, rice bran and rice flour were used on paddy straw. Among different supplements, highest yield and biological efficiency was obtained from chickpea powder, followed by wheat flour, maize flour used on paddy straw substrate, respectively. Minimum yield was obtained from control bed.

Keywords: Paddy straw mushroom, *Volvariella volvaceae*, substrates, yield, supplements

Introduction

Mushrooms are fruiting bodies of flesh fungi which can be seen with naked eyes and picked up by hands (Chang and Miles, 1992) [5]. In India, white button (*Agaricus bisporus*), Oyster (*Pleurotus* spp.), Paddy straw (*Volvariella volvaceae*) and milky (*Calocybe indica*) mushrooms are commercially cultivated. Paddy straw mushroom is the third most important mushroom cultivated in the world. Paddy straw mushroom belongs to the phylum basidiomycota, order agaricales and family pluteaceae (Singer, 1961) [12]. It is grown in warmer climatic condition. It can be grown within temperature range of 25-35°C and relative humidity of 75 to 80 per cent. Paddy straw mushroom is important for its taste, flavor, medicinal and nutritional value. Mushrooms contain good quantity of Vitamin C, Vitamin D, B-complex, minerals and proteins [Caglarirmak, 2007] [3]. Mushrooms are good diet for patients suffering from heart diseases and diabetes (Randive, 2012) [11]. Mushroom cultivation is an important profitable agribusiness which provides employment opportunity to rural women. Paddy straw mushroom grows very fast which can be harvested within two weeks of bed preparation. Demand for mushroom is increasing day by day in Odisha. Agro-climatic situations in Odisha is best suited for cultivation of paddy straw mushroom.

Paddy is the main crop grown in Odisha. So, farmers can utilize paddy straw for cultivation of straw mushroom due to its availability locally in abundance at cheaper rates. Paddy straw mushrooms are efficient lignin degraders which can be grown on different agricultural wastes. Some of these agricultural wastes include banana leaves, rice bran, wheat bran, sugarcane baggage, wheat and rice straw, cotton wastes etc. (Tripathy, 1999; Canga and Peeraly, 1995; Maurya et al 2016) [14, 4, 9]. Biological efficiency of straw mushroom in Odisha is about at 10 per cent which is low. So, it is very much essential to conduct research on paddy straw mushroom for increasing its biological efficiency. As mushroom yield is influenced by substrates and supplements used, the present investigation was carried out to find out the best substrate and supplements for yield enhancement of straw mushroom.

Materials and Methods**Isolation and maintenance of pure culture of *V. volvaceae***

Pure culture of *V. volvaceae* was obtained from fresh fruiting body by tissue culture method (Jonathan et al, 2009) [8]. Pure culture of the paddy straw mushroom was maintained in potato dextrose agar medium. Sub culturing was done in every 15 days. One week old pure culture of the fungus was used for mother spawn preparation.

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Spawn preparation

Healthy, undamaged wheat seeds were collected, washed thoroughly in tap water and soaked overnight in water. Then grains were boiled till they become soft, drained off excess water and mixed with calcium carbonate at the rate of 2% by the grain weight. The grains were filled into glucose bottle, plugged with non-absorbent cotton and sterilized in autoclave at 15 lb psi for 30 min at 121 °C. After sterilization, grains were inoculated with pure culture of *V. volvaceae* maintained on PDA and incubated at 25 °C until the mycelium fully covered the grains (Modified method of Michael *et al.*, 2011) [10].

Preparation of different substrates for cultivation

This experiment was conducted during rainy season in the year 2023 at Department of Plant Pathology, College of Agriculture, Chiplima, Sambalpur. Bed was prepared as described by Maurya *et al* (2016) [9] with slight modification. Different substrates such as paddy straw, banana leaves, deenanath grass (*Pennisatum pedicellatum*), paddy straw + maize stalks & leaves (1:1), paddy straw + banana leaves (1:1) and paddy straw + deenanath grass (1:1) were used for this experiment. Different agro wastes such as paddy straw, banana leaves, deenanath grass and maize stalks & leaves free from infestation were freshly collected from students' plot, College of Agriculture, Chiplima and used as cultivation substrate. Paddy straw and other substrates were made into bundles of 45 cm length. The bundles were soaked in a solution containing 10 g carbendazim in 100 liter of water for about six hours. Bundles were removed from water tank and drained off excess water and about 60 percent moisture in the substrate was maintained. Four soaked bundles were kept on one side lengthwise close to each other on a raised platform of bamboo structure. Then small quantity of spawn was placed 3 to 4 inches inside the margin leaving a space of 5 cm from each other. Then small quantity of gram powder (Besan) was sprinkled over the spawn bits. Four bundles of each substrate were placed in opposite direction of the first layer in criss-cross manner to prepare second layer. Spawn and gram powder were placed in the same way as mentioned above. Third layer was prepared by putting another four bundles of the substrate in the opposite direction of second layer. Then spawn and gram powder were sprinkled over the third layer. Another two bundles of straw were placed in opposite direction of third layer to cover the spawn. Ten kg of dry substrate was used for preparation of one bed. Beds were then covered with transparent polythene sheet for maintaining high relative humidity (80 percent) and optimum temperature (28 to 32°C) for mycelial growth and pinhead formation. When pinhead was emerged, polythene cover was removed. Watering was done as and when required to make the beds moist. First flush was harvested 14 days after bed preparation. Time required for completion of spawn run, pin head and fruiting body formation was recorded. Total yield of mushroom fruiting body from each bed was recorded immediately after harvest. Biological efficiency was calculated by dividing average yield of mushroom per bed by dry weight of substrate.

$$\text{Biological efficiency} = \frac{\text{Fresh weight (g) of mushrooms harvested}}{\text{Dry weight (g) of substrate}} \times 100$$

Effect of supplements on yield

Different supplements such as chickpea powder, wheat flour, maize flour, rice bran and rice flour were used for testing their ability to contribute towards yield of paddy straw mushroom. In the control bed, no supplement was added in the paddy straw. Twenty five grams of each supplement were used over spawn bits for each bed of paddy straw. 10 kg dry paddy straw was used as a substrate for each bed. Three replications were maintained for each treatment.

Results and Discussions

Effect of substrates on spawn running, pin head and fruiting body formation

Different substrates were used to assess the growth and yield of paddy straw mushroom. Time required for completion of spawn run, pin head emergence and fruiting body formation are presented in Table 1. The data reveals that spawn run period varied on different substrates ranged between 8.1 to 12.2 days. Spawn run period was lowest in paddy straw (8.1 days) followed by paddy +maize stalks & leaves substrates (1:1) (8.5 days), maize stalks & leaves (10.2 days), respectively. Longest spawn run period was observed in banana leaves (12.2 days). Almost similar results were obtained by Maurya *et al*, 2016 [9] who reported spawn run period in *V. volvaceae* varied from 9 to 13 days in different substrates. Pin head emergence was fastest in paddy straw (10.2 days) followed by paddy + maize stalks & leaves (1:1) (11 days), maize stalks & leaves (13.1 days), respectively. Pinhead emergence was slowest in paddy + banana (1:1) (15.1 days) substrates. Paddy straw took minimum time (12.2 days) for fruiting body formation, followed by paddy+ maize stalks & leaves (1:1 ratio) (12.7 days), maize stalks & leaves (16.1 days), respectively. Banana leaves took maximum time (18.8 days) for fruiting body formation. Almost similar results were found by Jana *et al*, 2022 [6] who studied time required for spawn run period, pin head emergence and fruiting body formation by paddy straw mushroom using different agro wastes such as paddy straw, pea straw, cotton waste and wheat straw. They reported spawn run period ranged between 6 to 10 days, pin head emergence period ranged between 10 to 13 days and time required for first harvest ranged between 12 to 17 days.

Effect of various substrates on yield

Different agro-wastes such as paddy straw, banana leaves, deenanath grass, maize stalks and leaves, paddy straw in combination with other substrates such as paddy + banana leaves (1:1), paddy + deenanath grass (1:1), paddy + maize stalks & leaves (1:1) were used to assess the yield and biological efficiency of different substrates to support the growth and yield of paddy straw mushroom and data are presented in Table 2. The results showed that maximum yield (848.0 g) was obtained from paddy straw followed by paddy + maize stalks & leaves substrates (1:1) (701.0 g), paddy+ banana substrates (1:1) (650.0 g), respectively. Minimum yield (446.0 g) was obtained from deenanath grass. Highest biological efficiency was recorded in paddy straw (8.48%) followed by paddy + maize stalks & leaves substrates (1:1) (7.01%), paddy+ banana substrates (1:1) (6.50%). Lowest biological efficiency was recorded in deenanath grass (4.46%). Paddy straw was found most suitable substrate for cultivation of *V. volvaceae*. Similar results were also reported by Biswas, 2014 [1]. He cultivated paddy straw mushroom on

different agro wastes such as, paddy straw, wheat straw + paddy straw 1:1, water hyacinth + paddy straw 1:1, maize straw + paddy straw 1:1, mustard straw + paddy straw 1:1 and observed maximum yield in paddy straw followed by maize straw + paddy straw 1:1, banana leaf + paddy straw 1:1, respectively. Our findings also supports the data of Jiskani et al, 2004 who obtained maximum yield from paddy straw in *V. volvaceae*. Thiribhuvanamala et al, 2012^[13] reported that banana wastes and maize stubbles/ trash when combined with paddy straw, yield of *V. volvaceae* was reduced which is contradictory to our results.

Effect of various supplements on yield

In order to determine effect of different supplements on yield of paddy straw mushroom, different supplements were tested on paddy straw and data are presented in Table 3. Results showed that all the supplements differed significantly in producing yield of mushroom over control. Among different supplements, highest yield was obtained from chickpea

powder (860.0 g), followed by wheat flour (755.0 g), maize flour (715.0 g), respectively. Minimum yield (610.0 g) was obtained from control bed. Highest biological efficiency was obtained in the paddy straw substrate supplemented with chickpea powder (8.60%), followed by wheat flour (7.55%), maize flour (7.15%), respectively. Lowest biological efficiency (6.10%) was recorded in control bed. Jana et al, 2022^[6] studied effect of five different supplements viz., rice bran, wheat bran, chickpea grain powder, pea powder, pigeon pea grain powder on yield of *V. volvaceae* on paddy straw. They obtained maximum yield from the substrate using rice bran followed by wheat bran, chick pea powder, pigeon pea powder and pea powder, respectively. Biswas and Layak, 2014^[2] tested different supplements such as rice bran, rice flour, wheat bran, wheat flour, red gram powder on paddy straw and obtained highest yield and biological efficiency from the substrate supplemented with red gram powder followed by rice flour, rice bran, wheat flour and wheat bran, respectively.

Table 1: Days for completion of spawn run, pin head emergence and fruiting body formation by *V. volvaceae* on different substrates

Substrate	Spawn running (days)	Pinhead emergence (days)	Fruiting body formation (days)
Paddy straw	8.1	10.2	12.2
Banana leaves	12.2	16.0	18.8
Maize stalks and leaves	10.2	13.1	16.1
Deenanath grass	11.5	14.6	17.9
Paddy + maize stalks & leaves (1:1)	8.5	11.0	12.7
Paddy + banana (1:1)	11.2	15.1	18.4
Paddy + deenanath grass (1:1)	11.0	13.5	16.8
SEm±	0.35	0.39	0.52
CD at 5% level	0.62	0.66	1.57

All the observations are average of three replications

Table 2: Yield and biological efficiency of *V. volvaceae* on different substrates

Substrates	Yield* (g) per 10 kg of dry substrate	Biological efficiency%
Paddy straw	848.00	8.48
Banana leaves	580.00	5.80
Maize stalks & leaves	625.00	6.25
Deenanath grass	446.00	4.46
Paddy + maize stalks & leaves (1:1)	701.00	7.01
Paddy + banana (1:1)	650.00	6.50
Paddy + deenanath grass (1:1)	501.00	5.01
SEm±	7.71	
CD at 5% level	23.38	

*Average of three replications

Table 3: Effect of different supplements on yield and biological efficiency of *V. volvaceae*

Substrates	Yield* (g) per 10 kg of dry substrate	Biological efficiency%
Wheat flour	755.00	7.55
Maize flour	715.00	7.15
Chickpea grain powder	860.00	8.60
Rice bran	680.00	6.80
Rice flour	650.00	6.50
Control	610.00	6.10
SEm±	9.57	
CD at 5% level	29.48	

*Average of three replications

Conclusion

In this study, it was observed that paddy straw was the best substrate among different substrates tested and chickpea powder was the best supplement among five different supplements tested to enhance the yield of paddy straw mushroom. So, paddy straw substrate supplemented with

chickpea powder can be used for commercial cultivation of paddy straw mushroom in increasing productivity.

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