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Effect of Different Agro-Waste Substrates on Yield Performance of Oyster Mushroom (*Pleurotus sajor-caju*)

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ABSTRACT

Oyster mushroom (*Pleurotus sajor-caju (Fr.) Singer*) was cultivated on different agro-wastes *viz.,* wheat straw, black gram straw, maize straw, maize hulled cobs and okra straw and their combination in 1:1 proportion to determine the effect of these agro-wastes on different parameters such as spawn running, fruiting bodies formation pinhead formation, yield and biological efficiency (BE). Black gram straw+ wheat straw showed significantly highest yield (3.78kg/5kg straw) with 75.6 per cent BE and lesser time for spawn run (13.44 d) and pin head appearance (18.66 d) followed by maize dry leaves+ hulled cobs+ wheat straw (3.60kg/5kg straw) with 72.0 per cent BE and wheat straw resulted (3.45kg/5kg straw) yield with 69.0 per cent BE. Maize hulled cobs required 16.66 and 23.33 days time for spawn run and pin head appearance, respectively and resulted less yield (2.75kg/5kg straw) with 55.0 per cent BE. All the tested substrates were found suitable for the growth of *Pleurotus sajor-caju.*

Key Words: agro-wastes, biological efficiency, *Pleurotus sajor-caju*, yield.

INTRODUCTION

Oyster *Pleurotus sajor-caju* (Fr. Singer) is an edible mushroom represent basidiomycetous fungi, characterized by fruiting bodies with eccentric stalk attached to the pileus that opens like an oyster shell during morphogenesis. These mushrooms namely *Pleurotus* species are described as food delicacies because of their characteristic biting texture and flavor. It can be grown at temperature ranging from 20 to 30^0 C and 80-90% RH. The best growing season is from March/April to September/ October and in the lower regions from September/ October to March/April. *P. sajor caju* is rich source of proteins, carbohydrates, minerals & vitamins. Mushroom contains digestible proteins (10-40%), carbohydrates (3-21%), dietary fiber (3-3.5%), on dry weight basis which is higher than those of vegetables and fruits and of superior quality (Mallavadhani *et al*, 2006). High potassium to sodium ratio contain in *Pleurotus* species helps to cure patients suffering from hypertension and heart diseases. Mushroom as an excellent food source to alleviate malnutrition in developing countries due to their flavor, texture, nutritional value and high productivity per unit area (Eswaran *et al*, 2000). Bioconversion of lignocellulosic residues through cultivation of *Pleurotus* species offers an opportunity to utilize renewable resources in the production of edible protein rich food that will sustain food security for people in developing countries (Sanchez *et al*, 2002). Mushroom production gives additional or alternative income to farmers looking for a value added product and a way to supplement farm income while making use of byproducts from other crops. Therefore, present investigations were undertaken with a view to find the feasibility of utilizing several locally available lignocellulosic by products as potential substrates for the cultivation of oyster mushroom and determination of their optimum yield.

MATERIALS AND METHODS

The different substrates selected for cultivation of oyster mushroom were wheat straw (*Triticum aestivum*) black gram straw (*Vigna mungo*), maize (stem, leaves, cobs) straw (*Zea mays*), okra straw

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(*Abelmoschus esculentus*). All the substrates were dried and cut into 3-4cm long pieces except wheat straw. The maize cobs were crushed into small pieces and all the substrates were soaked in water for 8-10 hr in cemented pond to obtained 70-75 per cent moisture level. All the substrates were sterilized by boiling method where the substrates were boiled for one hour at 70-75°C, stalked on the steep cemented floor so as to remove the excessive moisture from the substrates to get 65-75 per cent moisture level. The substrates were cooled up to room temperature (25°C). A local method was developed for determination of moisture in which moisture was determined by pressing a handful mixture. If there was no water runoff and the material stayed in form indicates that the moisture content was around 65 per cent.

Five kilogram of each substrate was filled in transparent polythene bag (30x45cm) and seeded with 150g of *P. sajor-caju*. The pinholes at 10-12cm distance were also done in the bags with help of sterilized led pencil in 2 per cent formaldehyde solution. The bags were incubated in dark cropping room where ambient temperature ranged between 22-28$\pm$1^{0}C. The humidity 80–90 per cent of the room was maintained by spraying of water twice a day on the floor covered with jute bags. After complete colonization of substrate polythene was removed and bags were put on the bamboo made structure for fruiting. The humidity of the bags was accomplished by spraying of water on them twice a day. The experiment was laid out in complete randomized design (CRD) with three replications and five treatments. Time was recorded in days for the completion of growth of mycelium on substrates, appearance of pinheads and maturity of fruiting bodies in different treatments. The data on average values of observations were also recorded for the yield, number of fruit bodies. Biological efficiency of mushroom on fresh weight basis was calculated by using formula given by Chang and Miles (1989).

$$\text{Biological efficiency (\%)} = \frac{\text{Yield of fruiting body (g)}}{\text{Total weight of substrate used (g)}} \times 100$$

RESULTS AND DISCUSSION

The three phases of mushroom cultivation *i.e.,* spawn running, pinheads formation and fruiting bodies require proper temperature and humidity. Temperature 22$\pm$28 and 80-90 per cent humidity showed good results.

Spawn running

It was evident (Table 1) that the time taken to colonize the substrates was 2-3 wk after spawning. Maximum duration of spawn run was recorded on okra straw (18.22d) followed by maize straw (17.66d) and wheat straw (17.33d). Among all the test substrate combinations, least duration for spawn run was taken by blackgram starw+ wheat straw (13.44 d) whereas black gram straw alone taken 16.33 d. Similar studies were also undertaken by Asraf *et al* (2013) on cotton, wheat and rice straw and observed fastest (minimum number of days) spawn running, primordial initiation, harvesting stage, maximum number of fruiting bodies and maximum yield on cotton waste.

Pinhead formation

The pinhead formation is the second stage of mycelia during cultivation of mushroom. Small pinhead like structures were observed, these pinhead were formed 3-9 d after spawn running (Table1). The data revealed that maximum duration was taken by the maize stem straw for the pinhead formation (8.78d) followed by blackgram straw (7.92d) whereas in combined treatments, maize dry leaves+ maize hulled cobes+ wheat straw took only 2.77 d for primordial formation followed by maize hulled cobes+ wheat straw (3.67d) and wheat straw alone took (4.33d). Our results corroborated with Ahmed (1986) who stated that *Pleurotus ostreatus* completed spawn running in 17-20 days on different substrates and the time for pinhead formation was noted as 23-27d. These findings are conformity with Quimio (1978) who reported that fruit bodies appeared within 3-4 wk after inoculation of spawn.

Fruiting bodies formation

The fruiting bodies appeared 3-7 d after pinhead

Table 1. Days taken for completion of spawn running, fruit bodies formation and pinhead formation of *P. sajor-caju* on different agro-wastes.

Substrate	Spawn running (days)	Pinhead formation (days)	Fruiting bodies formation (days)	Number of fruit bodies (Average)
Black gram straw	16.33	24.22	26.66	28.45
Maize stem straw	17.66	26.44	27.33	24.54
Maize hulled cobs	16.66	23.33	26.77	26.14
Okra straw	18.22	25.33	31.44	23.33
Black gram straw+ wheat straw	13.44	18.66	23.33	32.66
Maize straw + wheat straw	16.67	24.66	26.65	30.55
Maize dry leaves+ wheat straw	14.33	19.33	21.69	26.22
Maize hulled cobs + wheat straw	15.66	19.33	22.66	29.33
Okra straw + wheat straw	16.66	23.66	26.22	28.33
Maize dry leaves+ hulled cobs+ wheat straw	15.67	18.44	22.21	35.66
Wheat straw (Check)	17.33	21.66	28.33	26.33
CD (0.05%)	2.09	2.21	3.45	3.22

formation and took 18-28 da= later after inoculation of spawn (Table1). Sharma and Jandaik (1981) reported that *P. sajor-caju* cultivation on wheat straw took 32 d for the first harvest. Similar results were reported by Chandra *et al* (2013) who observed faster colonization (22.80d), primordial initiation (29 d) and first harvest in maize stalk with rice bran followed by pea waste and rice bran.

Average number of fruit bodies ranged between 23.33-35.66 d in three flushes (Table1). Highest number of fruit bodies (35.66) were produced by maize dry leaves+ hulled cobs+ wheat straw followed by black gram straw+ wheat straw (32.66), maize straw + wheat straw (30.55), maize hulled cobs + wheat straw (29.33) and black gram straw (28.45) whereas least number of fruit bodies (23.33) were harvested from okra straw. Similar studies were also reported by Tupathar and Judhao (2006). Asraf *et al* (2013) reported that cotton waste produced maximum number of fruit bodies 4.33 ± 0.42 followed by wheat straw (3.80 ± 0.30) and rice straw (3.53 ± 0.24).

Yield of oyster mushroom

The crop was harvested in three flushes where maximum yield was obtained in first flush than the second and third flush. The results obtained (Table 2) showed that out of five substrates evaluated for their potential to produce sporophores of *P. sajor-caju*, black gram straw+ wheat straw supported 9.56 per cent higher yield as compared to wheat straw as check. The significantly highest yield of mushroom was recorded on black gram straw+ wheat straw (3.78kg) and Maize dry leaves+ hulled cobs+ wheat straw (3.60kg) followed by wheat straw (3.45kg). The mushroom yield obtained in case of black gram straw was 3.30kg whereas with okra and maize straw it was 3.10 and 2.82 kg, respectively. Other substrates have also proved to be the promising substrates for the cultivation of oyster. Mane *et al* (2007) grew *P. sajor caju* in several agro-industrial residues *viz.,* cotton processing residue, wheat straw, soy straw, pea stalk and peanut stalk. Tupatkar and Jadhao (2006) conducted the similar studies on different substrates including wheat straw, paddy

straw, soybean stalks and reported that paddy straw (613 g/kg of dry straw) followed by soybean straw (557 g/ kg of dry straw) and combination of soybean straw plus wheat straw 1:1 w/w (508 g/kg of straw) gave optimum yield. The lower performance and yield of different agricultural wastes might be due to low lignolytic and cellulolytic activity. However, high and significant performance of other substrates ensures the possibilities of utilizing the locally available substrates for *Pleurotus sajor- caju* cultivation.

Biological Efficiency

Considerable variation was found in yield of oyster mushroom using different substrates. The biological efficiency was calculated on the dry weight basis of the substrate. It was evident that the substrates, black gram straw+ wheat straw showed best biological efficiency (75.6%) followed by maize dry leaves+ hulled cobs+ wheat straw (72.0%), wheat straw (69.0%), black gram straw (66.0%) and maize straw + wheat straw (65.8%). Similar results were reported with *P. sajor-caju* by Dias *et al* (2003). Patil (2012) reported faster mycelial growth and highest yield (348.13 g per 25 cm × 15 cm bag) with 87.03 per cent BE from maize stalk with rice bran and second best yield (299.53 g) with 74.88 per cent BE was recorded from pea residue with rice bran. Dehariya and Vyas (2013) reported that among all the combinations soybean straw + wheat straw showed significantly highest yield (with 87.3 per cent B.E.) and soybean straw + saw dust showed significantly lesser yield (43.8% B.E). *Pleurotus sajor- caju* was found to utilize all the agricultural wastes and were observed suitable for spawn run, yield and biological efficiency (Das *et al,* 2000).

CONCLUSION

It was evident from the study that different substrates significantly affected the number of primordia and fruiting bodies, and the amount of fresh weight or yield of oyster mushroom. The highest number of primordia and fruiting bodies and the amount of fresh weight was obtained with black gram straw+ wheat straw in all flushes whereas, the lowest with maize straw alone. However high and significant performance of other substrates ensures the possibilities of utilizing the locally available agricultural wastes for *Pleurotus sajor- caju* cultivation.

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