Pak. J. Bot., 44(1): 399-402, 2012.

IMPACT OF SAWDUST USING VARIOUS WOODS FOR EFFECTIVE CULTIVATION OF OYSTER MUSHROOM

NASIR AHMAD KHAN[1], M. AJMAL[1], M. INAM UL HAQ[3], NAZIR JAVED[1], M. ASIF ALI[2], RANA BINYAMIN[1] AND SAJID ALEEM KHAN[1]

[1] Department of Plant Pathology, University of Agriculture, Faisalabad,Pakistan
[2]Institute of Horticulture Sciences, University of Agriculture, Faisalabad.
[3] Department of Plant Pathology,Arid Agriculture University,Rawalpindi,Pakistan
**Corresponding author E-mail: nasir_8914@yahoo.com*

Abstract

Sawdust of different woods which included Kikar,Mango,Simbal and Kail used as substrates were investigated for cultivation of Oyster mushroom. The maximum linear mycelial growth after 5, 10 and 15 days respectively were observed on Kikar (*Acacia nilotica*). The minimum linear mycelial growth after 5, 10 and 15 days respectively were observed on kail (*Pinus wallichiana)*.*Pleurotus* species artificially cultivated worldwide especially in South East Asia, India, Europe and Africa.Oyster mushroom showed relatively more linear mycelial growth in control treatment of cotton waste as compared to other substrates.The data regarding 25%, 50%, 75%, 100% of spawn running of *Pleurotus ostreatus*,the significantly effective substrate was sawdust of Kikar followed by the other substrates.It was observed that *Pleurotus ostreatus* gave the maximum yield in the first flush followed by second and third flush.The maximum yield was obtained on Kikar sawdust 282.2gm followed by Mango sawdust 257.7gm, mixed sawdust 233gm, Simbal sawdust 216.5gm and Kail 200.5gm.Oyster mushroom showed relatively more yield on control treatment of cotton waste as compared to other substrates. The maximum biological efficiency was obtained in kikar sawdust which was 70.56 %. The lowest biological efficiency was obtained in kail sawdust which was 50.12 %. Among all substrates, sawdust of Kikar proved the best substrates for the effective cultivation of Oyster mushroom.

Introduction

Mushrooms of *Pleurotus* spp., commonly called as Oyster mushrooms (Jacq.Fr.) *Quel. var. vulgaris*'. Mushrooms are being recognized as important food items from ancient times. Their usage is being increased day by day .Although the history of mushroom cultivation is very recent and its consumption is increasing rapidly. They are the second most popular mushrooms after button mushroom all over the world (Adejoye *et al.*, 2006). Mushrooms, a highly priced delicacy for more than two thousand years, are now consumed by many people in Pakistan. Mushrooms cultivation is profitable agribusiness and *P. ostreatus* is an edible mushroom having excellent flavor and taste. Mushroom production is small but important industry in many countries. Mushrooms could become an important additions to farmers looking for a value added product and way to supplement farm income while making use by products or co products from other crops. Wood saw dust, hulls, straw, stalk and paper will all support mushroom growth. The growths of diverse type of mushrooms require different type of substrates and availability of varied type of materials may dictate which type is used (Shah *et al*, 2004). Oyster mushrooms are ideally suitable for cultivation under both temperate and tropical climatic conditions oyster mushrooms are cultivated and harvested all over the year (Amin *et al*, 2007). Culture of Oyster mushroom is becoming popular throughout the world because of abilities to grow at a wide range of temperatures and to utilize various lignocelluloses. *Pleurotus* species have extensive enzyme systems capable of utilizing complex organic compounds that occur as agricultural wastes and industrial by-products. These mushrooms are also found to be one of the most efficient lignocelluloses solid state decomposing types of white rot fungi ((Baysal *et al*., 2003). Thus, many agricultural and industrial wastes can be utilized as substrates for production of *Pleurotus* species (Zadrazil & Brunnert, 1981).*Pleurotus* species are popular and widely cultivated throughout the world mostly in Asia and Europe owing to their simple and low cost production technology and higher biological efficiency (Mane *et al.*, 2007). Its present production is approximately 1.5 million tons in the world. Every year 90 tons of mushrooms are exported to Europe from Pakistan (Shah *et al*., 2004).*Pleurotus* species are efficient lignin degraders which can grow on wide variety of agricultural wastes with broad adaptability to varied agro-climatic conditions (Jandaik & Goyal, 1995). Sawdust and sugarcane bagasse were the best substrates for growing of Oyster Mushroom than other agro-based substrates (Ahmed,1998).The Present work was undertaken to find the best sawdust among others as substrate for effective cultivation of Oyster mushroom.

Material and Methods

Collection of sawdust: Sawdust of different woods Kikar (*Acacia nilotica*), Mango (*Magnifera indica*),Simbal (*Bombax cieba*) and Kail (*Pinus wallichiana)* were collected from wood market at Jhang Road, Faisalabad. The cotton waste was collected from textile industry and rice barn was collected from local market, Faisalabad.

Preparation of substrates: The substrates Kikar (*Acacia nilotica*),Mango (*Magnifera indica*), Simbal (*Bombax cieba*) and Kail (*Pinus wallichiana)* were wetted thoroughly and stacked on a cemented floor separately. pH was measured before mixing lime in each substrate with the help of pH electrode dip into the paste which was

prepared in distilled water. pH recorded of Kikar, Mango, Simbal and Kail were 5.6, 6.9, 7.54 and 5.1 respectively. Lime was added at the rate of 2%,1% and 2% in Kikar, Mango and Kail respectively.After mixing lime again pH was measured of Kikar, Mango, Simbal and Kail were 7.22, 7.43, 7.54 and 7.18 respectively. Rice bran and Urea were added as a supplement. Saw dust was fermented for 18 days. A local method was developed for determination of moisture. In this method moisture was determined by passing a handful mixture. If there was no water run off and the material stayed in that form, it indicates that the moisture content was around 65%. The size of Polyethylene bag was 3 X 6" was filled with prepared substrates @ 400 gm with 4 replications of each substrate and their mouth were plugged by rubber band tightly. Treatments with four replications were made by the following substrates and that are given below:

T_0 Control substrate (cotton waste)
T_1 Sawdust kikar (*Acacia nilotica*)
T_2 Sawdust mango (*Magnifera indica*)
T_3 Sawdust simbal (*Bombax cieba*)
T_4 Sawdust kail (*Pinus wallichiana)*
T_5 Combination of kikar, mango, simbal and kail sawdust

Spawning of bags: The only one exotic strain of Oyster mushroom i.e. *Pleurotus (flabellatus) djamor (R-22)* was used for its effective cultivation. Spawn was prepared on Sorghum grain and 5gm spawn per bag was used for all treatments and replications. The inoculated packets were again plugged. The inoculated packets were kept on iron rack in an incubation room at room temperature (25°C - 30°C) and relative humidity 65-70%.After the completion of spawn running bags were transferred into growing room on iron rack.

Recording of Data: In test tube the linear mycelial growth on different substrates was recorded in days.

Days for completion of spawn running: Time was recorded in days for the completion of 25%, 50%, 75% and 100% growth of mycelium on substrates in polypropylene bags.

Yield and biological efficiency: Total weight of all the fruiting bodies harvested from all the three pickings were measured as total yield of mushroom. The biological efficiency was calculated by the following formula Chang *et al*., (1981).

$$\text{B.E. (\%)} = \frac{\text{Fresh weight of mushroom}}{\text{Dry weight of substrate}} \times 100$$

Results and Discussions

Linear mycelial growth (mm) in days on sawdust (substrate) of different woods for Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **production:** The Linear mycelial growth (mm) data in test tube (5, 10 and 15 days after inoculation) of exotic strain of Oyster mushroom i.e., *Pleurotus (flabellatus) djamor* (R-22) was recorded in different substrates. The maximum linear mycelial growth observed was 33.75 and 52.5mm after 5,10 and 15 days respectively on kikar (*Acacia nilotica*). The minimum linear mycelial growth observed was 7.5 mm,17.5mm and 37.5mm after 5,10 and 15 days respectively on Kail (*Pinus wallichiana)*.Oyster mushroom showed relatively more linear growth on cotton waste as compared to other substrates (Table 1). Elhami & Ansari (2008) recorded the maximum and minimum mycelium growth rate on corn and millet substrate respectively and between various species, the maximum and minimum mycelium growth rate was in *Florida* and *Ostreatus* species respectively. Cruz *et al*., (1999) observed that the loss of dry matter decreased from 16.9 to 8.5% as the oat straw fraction (lignin and cellulose source) was increased from 0.55 to 0.80 (g g^{-1} mixture, dry basis). The utilization of mixture and response surface methodologies was useful approach to evaluate the relationship between substrate composition and mycelial development of *Pleurotus ostreatus*.

Table 1. Effect of different substrates on linear mycelial growth in test tubes for Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **production.**

Substrates/Treatment	Linear mycelial growth (mm) in days		
	5 days	10 days	15 days
Control (Cotton waste)	18.75 a	4 2.00 a	54.75a
Sawdust (Simbal)	9.25 d	25.75e	41.75d
Sawdust (Mango)	16.00 b	31.50c	50.50b
Sawdust (Kail)	7.50 e	17.50 f	37.50e
Sawdust (Kikar)	18.00 a	33.75b	52.50b
Mixed sawdust	12.50 c	29.75d	44.25c

Means sharing similar letter in a column are statistically non-significant ($p>0.05$). Small letters represent comparison among interaction means.

Spawn running on sawdust of different woods: Kikar took 10.5 days for one fourth,18.5 days for half, 23 days for three fourth and 26.5 days for full spawn running For one fourth, 36.75 days for half, 41.50 days for three fourth and 45 days for full spawn running of Kail. *Pleurotus ostratus* showed relatively least days for the completion of 25%, 50%, 75% and 100% spawn running on control treatment (cotton waste).It is evident from the result that from these substrates the best one was kikar, second best was mango, third one was mixed sawdust, fourth one was simbal and last one was kail (Table 2). Obodai (2002) studied the spawn run period on compost bags for the strains of *Pleurotus* species which ranged from 40-48 days. Tan (1981) reported cotton waste as a substrate for the cultivation of *Pleurotus ostreatus* and other species of *Pleurotus* took 3 weeks for spawn running completion. As well as *Pleurotus ostreatus* took 34 days for completion of spawn running on saw dust as reported by Sopit, (2006). Ahmad (1981) studied that *Pleurotus ostreatus* completed spawn running in 19-20 days, on different substrates. Shah *et al.*, (2004) reported that spawn running took 2 weeks for its completion on sawdust.

Table 2. Phases of spawn running (in days) using sawdust of different woods for Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **production.**

Substrate/treatment	Phases of Spawn running (in days)			
	25%	50%	75%	100%
Control (cotton waste)	7.25a	13.50a	18.00a	21.25a
Sawdust (Simbal)	22.00e	33.25e	38.50e	42.25e
Sawdust (Mango)	14.50c	23.00c	28.00c	31.50c
Sawdust (Kail)	25.00f	36.75f	41.50f	45.00f
Sawdust (Kikar)	10.50b	18.50b	23.00b	26.50b
Mixed sawdust	17.25d	27.25d	31.75d	35.25d

Means sharing similar letter in a column are statistically non-significant (p>0.05). Small letters represent comparison among interaction means.

Yield of Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **on sawdust of different woods:** The maximum yield was obtained on kikar (282.2gm) followed by mango (257.7gm), mixed sawdust (233gm) simbal (216.5gm) and kail (200.5gm). The lowest yield was obtained in kail sawdust (200.5gm). Oyster mushroom showed relatively more yield on cotton waste as compared to other substrates (Table 3). Obodai *et al*.,(2003) observed that the yield of mushroom on the different substrates were183.1, 151.8, 111.5, 87.8, 49.5, 23.3, 13.0 and 0.0 g a composted sawdust of Triplochiton scleroxylon, rice straw, banana leaves, maize stover, corn husk, rice husk, fresh sawdust, and elephant grass, respectively Nunez *et al*., (2002) observed the total period of cultivation ranged between 53-64 days. Seven of the 10 substrates showed three production flushes whereas the other three substrates exhibited only two flushes. Nasreen *et al.,* (2009) studied three lignocellulosic substrates (*Cedrus deodara, Abies pindrow* and *Populous ciliata*) used for the cultivation of *Pleurotus ostreatus* and 2-3 flushes were obtained from these substrates. Islam *et al*., (2009) found maximum yield per packet with Mango sawdust (150 gm) followed by Mahogony (148 gm), Shiris (146 gm), Kadom (136 gm), Jam (114 gm), Jackfruit (97 gm) and Coconut sawdust (83 gm). The lowest yield was observed in Coconut sawdust (83 gm). Quimio (1976) reported that *Pleurotus ostreatus* found to best one when cultivated on sawdust.

Table 3. Total yield of oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **on sawdust of different woods.**

Substrate/treatment	Yield in three flushes (gm)			Total yield (gm)
	1st Flush	2nd Flush	3rd Flush	
Control (Cotton waste)	115a	96.10a	85.15a	296.25a
Sawdust (Simbal)	85.05e	69.15e	62.05e	216.50e
Sawdust (Mango)	104.35c	88.25c	75.15c	257.75c
Sawdust (Kail)	75.30f	66.15f	59.05f	200.50f
Sawdust (Kikar)	109.15b	92.05b	81.05b	282.25b
Mixed sawdust	95d	75d	63d	233.00d

Means sharing similar letter in a column are statistically non-significant (p>0.05). Small letters represent comparison among interaction means

Biological effecincy of Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **on saw dust of different woods:** The maximum biological efficiency was obtained on kikar which was (70.56 %).The lowest biological efficiency was obtained on kail sawdust which was (50.12 %). Oyster mushroom showed relatively more biological efficiency on cotton waste as compared to other substrates (Table 4). Moonmoon *et al., (*2010) studied king Oyster mushroom *Pleurotus eryngii* on saw dust and rice straw in Bangladesh and found that saw dust showed the highest biological efficiency (73.5%) than other strains. Obodai *et al.,* (2003) reported the biological efficiency on composted sawdust of *Triplochiton scleroxylon*, rice straw, banana leaves, maize stover, corn husk, rice husk, fresh sawdust, and elephant grass. The biological efficiency ranged from 61.0% for composted sawdust to 0.0% for elephant grass Nunez *et al.,* (2002) found that the biological efficiency of the studied substrates varied from 106.2 to 50.8 % of *Pleurotus ostreatus* H9.

Table 4. Biological effecincy of Oyster mushroom *Pleurotus (flabellatus) djamor* (R-22) **on sawdust of different woods.**

Substrate/treatment	Total yield of three flushes (gm)	Biological effecincy %
Control (cotton waste)	296.25	74.63a
Sawdust (Simbal)	216.50	54.12e
Sawdust (Mango)	257.75	64.43c
Sawdust (Kail)	200.50	50.12f
Sawdust (Kikar)	282.25	70.56b
Mixed sawdust	233.00	58.25d

Means sharing similar letter in a column are statistically non-significant (p>0.05). Small letters represent comparison among interaction means

References

Adejoye, O.D., B.C. Adebayo-Tayo, A.A. Ogunjobi, O.A. Olaoye and F.I. Fadahunsi. 2006. Effect of carbon, nitrogen and mineral sources on growth of *Pleurotus florida*, a Nigeria edible mushroom. *African J. Biotechnology*, 5: 1355-1359.

Ahmed, S. 1998. *Performance of different substrates on the growth and yield of oyster mushroom Pleurotus sajorcaju (Fr.) Sing*. M.S. thesis, Department of Horticulture. Institute of postgraduate studies in Agriculture, Salna,Gazipur, Banglades.

Amin, S.M.R., C.S. Nirod, M. Moonmoon, J. Khandaker and M. Rahman. 2007. Officer's Training Manual. National Mushroom Development and Extension Centre, Savar, Dhaka, Bangladesh. pp. 7-17.

Baysal, E., H. Peker, M. Kemal and A. Temiz. 2003. Cultivation of oyster mushroom on waster paper with some added supplementary materials. *Bioresour. Technol*., 89: 95-97.

Chang, S.T., O.W. Lau and K.Y. Cho. 1981 . The cultivation and nutritive value of *Pleurotus sojar-caju. Europ. J. Appl. Mic. & Bio.*, 12: 58-62.

Cruz, O.S., G.S.Castaneda, J.L.P. Hach, M.G.R. Rojas and E.F. Torres. 1999. Effect of substrate composition on the mycelial growth of *Pleurotus ostreatus*. An analysis by mixture and response surface methodologies. *Process Biochem*., 35: 127-133.

Elhami, B. and N.A. Ansari. 2008. Effect of substrates of spawn production on mycelium growth of Oyster mushroom species. *J.of Bio. Sci*., 8: 474-477.

Islam, M.Z., M.H. Rahman and F. Hafiz. 2009. Cultivation of Oyster mushroom (*Pleurotus flabellatus*) on different substrates. *Int. J. Sustain. Crop Prod*., 4(1): 45-48.

Jandaik, C.L. and S.P. Goyal. 1995. Farm and farming of oyster mushroom (*Pleurotus* sp). In: *Mushroom Production Technology*. (Eds.): R.P. Singh and H.S. Chaube. G.B. Pant Univ. Agril. and Tech., Pantnagar India, 72-78.

Mane, V.P., S.S. Patil, A.A. Syed and M.M.V. Baig. 2007. Bioconversion of low quality lignocellulosic agricultural waste into edible protein by *Pleurotus sajor-caju* (Fr.) Singer. *Journal of Zhejiang University of Science*, 8(10): 745-751.

Moonmoon, M.M., N.Uddin, S. Ahmed, N.J. Shelly and M.A. Khan. 2010. Cultivation of different strains of king oyster mushroom (Pleurotus eryngii) on saw dust and SSrice straw in Bangladesh. *Saudi J. of Bio. Sci*., 17: 341-345.

Nasreen, Z., R. Bajwa, T. Kausar, S. Baig, N. Habib and M.B. Bhatti. 2008. Productivity of *Pleurotus ostreatus* under solid state fermentation on lignocellulosic substrates. *Mycopath*, 6: 51-56.

Nunez, J.P. and C.G. Mendoza. 2002. Submerged fermentation of lignocellulosic wastes under moderate temperature conditions for oyster mushroom growing substrates. *Mushroom Biology and Mushroom Products*, 5: 545-549.

Obodai, M. and K.A. Vowotor. 2002. Performance of different strains of *Pleurotus*.

Obodai, M., J. Cleland-Okine and K.A. Vowotor. 2003. Comparative study on the growth and yield of *Pleurotus ostreatus* mushroom on different lignocellulosic by-products. *J. Ind. Microbiol. Biotechnol*., 30: 146-149.

Quimio, T.H. 1976. Culturing Ganoderma the *Pleurotus* way. *Mushroom Newsletter for Tropics*, 6(4): 12-13.

Shah, Z.A., M. Ashraf and Ch. Ishtiq. 2004. Comparative study on cultivation and yield performance of oyster mushroom (*Pleurotus ostreatus*) on different substrates (Wheat straw, Leaves, saw dust). *Pak. J. Nutri*., 3: 158-160.

Sopit, V. 2006. Oyster mushroom cultivation on different cellulosic substrates. *Res. J. Agri. & Bio. Sci*., 2(6): 548-551.

Tan, K.K. 1981. Cotton waste is a good substrate for cultivation of *Pleurotus ostreatus*. The Oyster mushroom. *Mushroom science*. 11: 705-710.

Zadrazil, F. and F. Brunnert. 1981. Investigation of physical parameters important for the solid state fermentation of straw by white rot fungi. *Eur. J. Appl. Microbiol. Biotechnol*., 11: 183-188.

(Received for publication 17 January 2011)