Oilseed Rape straw for Cultivation of Oyster Mushroom

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ABSTRACT

Oyster mushroom [*Pleurotus ostreatus* var. *sajor caju* (Fr.) Singer] cultivation can play an important role in managing organic waste. It can be cultivated on a wide rang of substrates containing lignin and cellulose. Oyster mushroom was grown on five substrates: Rise straw (*Oryza sativa* L. var. Alikazemi), Rise straw + Oilseed Rape straw (*Brassica napus* var. Hyola 401) (75:25 dw /dw), Rise straw + Oilseed Rape straw (50:50 dw /dw), Rise straw + Oilseed Rape straw (25:75 dw /dw) and Oilseed Rape straw alone. Oilseed Rape straw alone and Rise straw + Oilseed Rape straw (25:75 dw /dw) were best for fruit body production of *P. ostreatus*. Time to fruiting for *P. ostreatus* was also shorter on Oilseed Rape straw. Protein content of the fruit bodies obtained from Oilseed Rape straw was higher than those from other substrates. Using Oilseed Rape straw as a substrate appears to be suitable for oyster mushroom production.

KEYWORDS. *Pleurotus ostreatus*, organic waste, oilseed Rape, rice straw, protein, fruit body

INTRODUCTION

Oyster mushroom [*Pleurotus ostreatus* var. *sajor caju* (Fr.) Singer] cultivation has increased during the last decade (Chang, 1999; Royse, 2002). This mushroom accounted for 14.2% of the total world production of edible mushrooms produced in 1997 (Chang, 1999). Although commonly grown on pasteurized wheat (*Triticum vulgare* Vill.) or rice (*Oryza sativa* L.) straw, oyster mushroom can be cultivated on a wide variety of substrates containing lignin and cellulose. Oyster mushroom cultivation can play an important role in managing and recycling of organic wastes as an alternative to other methods of disposal (Nirmalendu and Mukherjee, 2007).

Oyster mushrooms can also produce fruiting bodies on goose grass (*Eleucine coracana* Gaertn.), kikuyu grass (*Pennisetum typhoides* S. & H**.**) straw; sorghum (*Sorghum vulgare* Pers.) and maize stem (*Zea mays* L.) (Bano et al., 1987; Goswami et al., 1987), as well as on wood and sawdust of poplar (*Populus robusta* Bartr.), oak (*Quercus leucotrichopora* L.), horse chestnut (*Aesculus indica* Colebr.), *Acasia* sp. (Pant et al., 1987), chopped banana [*Musa paradisiaca* subsp. *sapientum* (L.) Kuntze] pseudostem (Singh and Tandon, 1987), cotton (*Gossypium* sp.) stalk, pea **(***Pisum satium* L.) shells (Philippoussis et al., 2001; Zervakis et al., 2001), and straw of some species of wild plants including: *Leonotis* sp., *Sida acuta* Burm, *Parthenium argentatum* Gray, *Ageratum conyzoides* L., *Cassia sophera* L., *Tephrosia purpurea* (Linn.) Pers., and *Lantana camara* L. (Nirmalendu and Mukherjee, 2007). The substrate used depends on its availability in a specific region. Rice is an important agriculture crop in northern parts of Iran which is a staple food for many Iranians. Oilseed Rape as a second crop is increased recently after rice harvesting in this region. Oilseed Rape straw is considered to be waste and is disposed of by burning. This project was undertaken to determine if Oilseed Rape straw can be used as an alternative to the common straws such as rice and other gramineae straw as a substrates for cultivation of oyster mushroom.

MATERIALS AND METHODS

Oyster mushroom spawn was purchased from Keshtpashohan Laboratory in Tehran, Iran. The substrates were: 1) Rise straw (*Oryza sativa* L. var. Alikazemi), 2)

Rise straw + Oilseed Rape (*Brassica napus* L. var. Hyola 401) straw (75:25 dw /dw), 3) Rise straw + Oilseed Rape straw (50:50 dw /dw), 4) Rise straw + Oilseed Rape straw (25:75 dw /dw) and 5) Oilseed Rape straw. Rice and Oilseed Rape straws were obtained locally, and had been stored approximately 6 and 2 months respectively. Both straws were chopped into small pieces (1–2 cm), weighed and soaked in water during overnight. Extra water present in the substrates was drained and the substrates were spread on clean blotting paper and air dried for 15 min to remove excess water. Substrates were pasteurized by boiling for 30 min in water.

A sample of each substrate was weighed before and after drying in an oven at 60^{o}C for 2 days to determine dry mater content. Total nitrogen, potassium, and ash (%) were measured (Table 1). Amounts of substrates (3,000 g) with 85% moisture were mixed with 10% spawn (ww/ww). Inoculated substrates were placed in 50 × 35 cm polythene bags. Bags were tightly closed and pin holes (1/100 cm^2) made through the bags for drainage. They were kept in a spawn running room at 25±1°C in the dark until primordia formed. After primordial formation, large holes were made in the polythene bags to allow normal development of fruiting bodies. Bags were kept at 22±1°C with a 12 hr photoperiod (1,500–2,000 lux) and 85–90% relative humidity. Adequate ventilation was provided to prevent increased CO_2 concentration in the room**.** Mushrooms were manually harvested three days after primordia initiation.

Biological efficiencies (BE) were calculated from ratios of weight (kg) of fresh mushrooms harvested·kg^{-1} to dry weight of substrates. Total nitrogen and protein were determined in samples of 0.5 g dry weight by the Kjeldhal method using concentrated H_2SO_4, K_2SO_4 and $CuSO_4$ to digest the sample and Phosphorus by spectrometry. Total C was determined by oxidation with potassium dichromate and titration of excess dichromate with ammonium ferrosulfate (Kalembasa and Jenkinson 1973).

Electrolytic conductivity (EC) was determined in the effluent and in a saturated solution (Rhoades et al. 1989). A completely randomized experimental design with 15 replications was used. Data were analyzed using SAS (ver. 9.00, SAS, Inc., Cary, N.C.). The Tukey-test was performed to separate means.

RESULTS AND DISCUSSION

Oilseed Rape straw added to substrate increase EC, N and C content in substrate and decrease P, K and ash in substrate (Table 1). Substrate affected time to primordial initiation and biological efficiency of mushroom production (Table 2). Primordia were formed most rapidly on Oilseed Rape straw alone in first flush but in second and third flushes Oilseed Rape straw increase primordial initiation. Biological efficiency was affected by treatment (Table 2). In the first flush of production, biological efficiency was better for fruiting bodies on Oilseed Rape straw alone and Oilseed Rape straw + rice straw (75:25). Biological efficiency was generally lowest when the substrate was Oilseed Rape straw in second and third flushes.

Substrate affected dry matter, ash, protein, potassium and phosphorous content, (Table 3). The lowest levels of dry matter, ash, potassium and phosphorous were obtained from fruiting bodies developed from spawn grown on Oilseed Rape straw alone. Protein concentration in fruiting bodies was highest when mushrooms were cultivated on Oilseed Rape straw. Protein content of fruiting bodies produced on Oilseed Rape straw alone and its mixtures with rice straw was better than from rice straw alone. There was a tendency of K, P, Dry matter and Ash levels for fruit bodies to be highest when the substrate was mixed with rice and Oilseed Rape straws and lowest when Oilseed Rape straw was alone. Fruiting bodies produced on rice straw obtained also the highest level of potassium, while those produced on Oilseed Rape straw.

Production of Oyster mushroom on biological waste substrates can be a highly efficient method for producing protein-rich food. It appears that Oilseed Rape straw mixed with rice straw can be used successfully as a substrate to benefit some aspects of oyster mushroom cultivation. It should be determined if concentrations of the components of the Oilseed Rape straw are at optimum levels for use in a substrate. Production on Oilseed Rape straw alone did not always produce the highest nutrient content in the mushroom. It remains to be determined why mixing Oilseed Rape straw with rice straw produced beneficial results regarding biological efficiency, but this was not the case as regards nutrient content of the mushrooms which was benefited by the presence of Oilseed Rape straw.

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TABLE 1. Some characteristics measured in substrates.

Substrate	PH	EC (µs/cm)	P (mg/100 g DM)	K (mg/100 g DM)	Ash (%)	C (%)	N (%)	C/N (%)
Rice straw	6.54	3.60	84.2	809.5	4.5	55.39	0.804	68.89
Rice straw+ Oilseed Rape straw (75:25 dry wt /dry wt)	6.54	3.74	74.6	803.0	4.4	55.63	0.820	67.84
Rice straw+Oilseed Rape straw (50:50 dry wt /dry wt)	6.58	3.98	68.2	780.3	4.2	55.68	0.822	67.73
Rise straw+ Oilseed Rape straw (25:75 dry wt /dry wt)	6.58	4.00	66.6	778.4	3.9	55.89	0.828	67.50
Oilseed Rape straw	6.58	4.05	57.0	762.5	3.8	55.97	0.830	67.43

TABLE 2. Effect of substrate on days to primordial initiation and biological efficiency of *P. ostreatus*

Substrate	Days to primordial initiation			Biological efficiency ^{Z}			
	First flush	Second flush	Third flush	First flush	Second flush	Third flush	Total
Rice straw	28.25^{a}	13.25^{c}	14.25^{b}	567.01^{d}	236.07^{a}	108.80^{a}	911.88^{c}
Rice straw+Oilseed Rape straw (75:25 dry wt /dry wt)	24.50^{b}	14.25^{c}	14.50^{b}	588.08^{c}	233.20^{ab}	108.60^{a}	929.88^{b}
Rice straw+Oilseed Rape straw (50:50 dry wt /dry wt)	22.75^{c}	17.00^{b}	14.75^{b}	602.52^{b}	228.91^{ab}	105.22^{ab}	936.65^{b}
Rise straw+Oilseed Rape straw (25:75 dry wt /dry wt)	21.00^{d}	20.25^{a}	16.25^{a}	630.00^{a}	228.11^{ab}	102.04^{b}	960.15^{a}
Oilseed Rape straw	20.50^{d}	20.75^{a}	16.75^{a}	632.33^{a}	224.73^{b}	99.80^{b}	956.87^{a}

^{Z} defined as g fresh weight·kg^{-1} dry substrate. ^{Y} values in a column followed by the same letter are not significantly different, *P*≤0.01, Tukey test.

TABLE 3. Effect of substrate on nutritive qualities of Oyster mushroom.

Substrate	DM (%)	Ash (%)	Protein (% DM)	K (mg/100 g DM)	P (mg/100 g DM)
Rice straw	7.99[az]	6.38[a]	18.53[e]	2826.75[a]	952.25[a]
Rice straw+Oilseed Rape straw (75:25 dry wt /dry wt)	7.98[a]	6.26[ab]	18.76[d]	2447.50[b]	931.00[b]
Rice straw+Oilseed Rape straw (50:50 dry wt /dry wt)	7.93[a]	4.14[b]	19.52[c]	2698.75[b]	917.50[c]
Rise straw+Oilseed Rape straw (25:75 dry wt /dry wt)	7.82[ab]	6.11[b]	20.00[b]	2611.75[c]	895.25[d]
Oilseed Rape straw	7.52[b]	5.92[c]	20.27[a]	2583.00[c]	837.75[e]

[Z] values in a column followed by the same letter are not significantly different, $P \leq 0.01$, Tukey test.

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