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UTILIZATION OF EMPTY FRUIT BUNCH OF OIL PALM AS ALTERNATE SUBSTRATE FOR THE CULTIVATION OF MUSHROOM

***Kavitha, B., G. Rajannan and P. Jothimani**
Department of Environmental Sciences,
Tamil Nadu Agricultural University, Coimbatore-3
E-mail: kavithaphd2008@gmail.com (**Corresponding Author*)

Abstracts: An experiment was conducted to find out the possibilities of utilizing Empty fruit bunches (EFB) of palm oil industry solid waste for mushroom cultivation. Oyster mushroom (*Pleurotus florida*) was grown on paddy straw and Empty fruit bunch with different ratios. Among the different treatments, Empty fruit bunch alone at 100 per cent gave maximum mycelial cover on 7^{th} day, first yield on 22^{nd} day and recorded a maximum total yield of 1.40 kg bag^{-1}. The protein, moisture and ash contents of the mushroom ranged from 23.1, 93.8 and 93.3 per cent, respectively in different treatments. The total yield of mushroom grown on EFB was higher than the yield on paddy straw. Hence the shredded EFB could be a best alternative substrate for mushroom cultivation.
Keywords: Palm oil industry solid waste, Empty Fruit Bunch, Substrate, Mushroom Cultivation.

Introduction

In the process of extracting these oils, 4.3 million tonnes of palm kernel shell, 10.7 million tonnes of palm pressed fibres (PPF), 17.4 million tonnes of empty fruit bunch (EPF) and 53.1 million tonnes of palm oil mill effluent (POME) are generated (Yacob , 2008). In practice the palm kernel shell and palm pressed fibres are used as fuels to generate steam and electricity for the palm oil mills. The empty fruit bunch are either incinerated or applied to the field. These practices create environmental pollution problems as incineration and boiler emit gases with particulates such as tar and soot droplets of 20-100 microns and a dust load of about 3000 to 4000 mg/nm (Igwe and Onyegbado, 2007) and indiscriminate dumping of EFB causes additional methane emission into the atmosphere.

Bioconversion of wastes into organic manure is of great interest for productive use of wastes and their recycling through agricultural usages. An alternative is using the Empty fruit bunches as substrate for mushroom cultivation. Cultivation of mushroom in developing countries has become attractive for many reasons. One of the most interesting would be that they are grown on agricultural wastes. It enables to acquire substrates at low price or even for

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free of cost and to conserve environment by recycling of wastes. Most of all, oyster mushrooms *i.e.*, *Pleurotus* sp. can utilize various kinds of substrates for its growth. The Empty fruit bunches are one of the palm oil industry wastes, which can be used for mushroom cultivation. These biomasses from palm oil mills contain cellulose, hemicelluloses and lignin.

Pleurotus ostreatus or oyster mushroom is an organism with the ability to bio converts various lignocelluloses materials as substrates (Zadrazil and Dube, 1992). This capability of the oyster mushroom is due to the presence of its lignocellulolytic enzymes, also named fibrolytic enzymes, including: xylanases, cellulases, and laccases (Sun *et al.,* 2004) which help it to convert cellulose and lignin into useful carbohydrates such as glucose that can be used as an energy source for the fungi (Baysal *et al.,* 2003). A wide range of plant waste, such as sawdust, paddy straw, bagasse, cornstalks, waste cotton, stalks and leaves of bananas, can all be used for *Pleurotus* mushroom production without a requirement for costly processing methods and enrichment materials (Chang *et al.,* 2003). Any agricultural waste that contains cellulose and lignin is a possible substrate for growing this fungus. However, Stajic *et al*. (2006) describes that lignocellulolytic enzymes production by *Pleurotus ostreatus* depends strongly on the strain, substrate composition and conditions of cultivation. Enzyme actions on the substrate depend upon the physical properties of the materials including the crystalline or amorphous nature, accessible area, surface area, porosity and mainly particle size (Pandey, 2003 and Viniegra-González *et al.,* 2003). Hence the present investigation was undertaken to explore the possibilities of utilizing palm oil industry solid waste for recycling of EFB for growing edible mushroom.

Materials and Methods

Cultivation of oyster mushroom

An experiment was conducted to find out the possibilities of utilizing Empty fruit bunches (EFB) of palm oil industry solid waste for mushroom cultivation. The oyster mushroom cultivation was conducted in the mushroom shed of the Mushroom Research and Training Centre, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore to assess the suitability of Empty fruit bunches as alternate substrate for mushroom cultivation.

Treatments details

T_1 – 100 % EFB

T_2 – 80 % EFB + 20 % Paddy straw

T_3 – 60 % EFB + 40 % Paddy straw

T_4 – 40 % EFB + 60 % Paddy straw

T_5 – 20 % EFB + 80 % Paddy straw

T_6 – 50 % EFB + 50 % Paddy straw

T_7- 100 % Paddy straw

Preparation of mushroom beds

Beds were prepared by following the polybags method described by Baskaran *et al*. (1978). Empty fruit bunch (EFB) and paddy straw were cut into three to five cm long bits and soaked in water for 4 h and excess water was drained. Straw and fibre were then boiled for 60 min., excess water was drained, shade dried to optimum moisture level of 50 per cent and used for the preparation of beds. Polythene bags of 100 gauge thickness and 60 x 30 cm size were taken and two holes of one cm diameter were made in the center of the bag to ensure aeration. The bottom of the polybags was tied with thread to provide a flat circular bottom to the mushroom beds.

For each bed, 600 g chopped sterilized straw and 150 g spawn were used. For all the treatments the paddy straw and Empty fruit bunch were used at various ratio as given in the treatment details. The straw bits were uniformly placed at the bottom of the polythene bags to a height of five cm followed by Empty fruit bunch two cm according to the treatments. Spawn was sprinkled over the entire surface of the straw followed by Empty fruit bunch and a second layer of straw was laid over the first layer to a height of 10 cm which was also spawned. Similarly, the third and fourth layers were also laid. Finally the fourth layer was covered with bits of straw to a height of five cm and tied to form a compact mass. The bags were then kept for spawn to grow and sporophores production under ambient temperature and relative humidity regimes of 25 to 27°C and 85 to 93 per cent respectively.

Storage of mushroom beds and observations

Mushroom beds were stored in thatched shed using a new method *viz.,* hanging rope system. In the present study, only one shed was utilized, instead of separate shed for spawn running and cropping. Observations on mycelial cover in the beds, number of days taken to cover the entire bed, total yield and quality parameters such as protein, moisture and ash contents were recorded.

Results and Discussion

Mycelial growth and yield of mushroom on different substrate ratio

The mycelia cover the beds of Empty fruit bunch within 7 days of the inoculation of mushroom (Table 1). However, in the treatment with paddy straw alone, the mycelial growth was observed only on the 16th day. Similarly, the first yield was obtained in Empty fruit bunch alone on 22nd day. The maximum yield of 1.40 kg was recorded in the treatment of Empty fruit bunch alone (T_1). The duration of the bed was also high in T_1 (Empty fruit bunch alone) when compared to other treatments. The treatment Empty fruit bunch alone (T_1) exhibited more number of fruiting body. The size of the pileus and pigment production was also comparatively more in the treatment T_1 (Empty fruit bunch alone), indicating better suitability of EFB for mushroom cultivation

These results were in agreement with the finding of Tan (1981), who reported that the spawn running took 7-21 days and fruiting bodies appeared after 2-3 days. Number of fruiting bodies, the caps of oyster mushroom was also counted in three flushes. Isikhuemhen and Okhuoya (1998) who reported that variation in mushroom yield in different substrates could be attributed to the difference in nutrient content, C/N ratio, phenolic compounds, and nature of lingo-cellulose complex. They also reported the higher production of fruit bodies by pleurotus tuber-rerium on oil palm mesocarp fibre when compared to coconut fruit fibre. Manu-Tawainh and Martin (1986) reported that the yield of mushroom is determined to a larger extent on the chemical composition of the substrate.

Qualitative study on mushroom

The protein content showed significant difference among the treatments with the highest value in T_3 (60 per cent EFB + 40 per cent paddy straw; 23.1 per cent) and the lowest value was recorded in T_7 (50 per cent EFB + 50 per cent paddy straw; 17.9 per cent). The maximum moisture content of the mushroom was observed in T_4 (40 per cent EFB + 60 per cent paddy straw; 93.8 per cent), followed by T_6 (paddy straw alone; 93.2 per cent. The ash content showed significant difference among the treatments with the highest value of 93.3 percent in T_5 (20 per cent EFB + 80 per cent paddy straw) and the lowest value was recorded in T_4 (40 per cent EFB + 60 per cent paddy straw; 83.1 per cent) (Table 2). The results are in confirmation with the findings of Bano and Rajarathnam (1982) who reported that the mushroom produced from different usufructs of coconut had protein content in the range of 18.07 to 29.31 per cent. Prabhu and Shetty (1991) also reported that the nutritive value of mushrooms varied based on substrate selection. These results are in confirmation with the findings of Rai *et al.* (2003) who reported that the mushroom contained 90 per cent of moisture and 80- 90 per cent of ash.

Table 1. Growth characteristics and yield of mushroom on different substrate ratio

Treatments	Mycelia to cover the beds (days)	First yield (th day)	Total yield (kg)	Duration (days)
T_1	7	22	1.40	45
T_2	8	23	0.71	41
T_3	14	27	0.70	38
T_4	18	30	0.34	37
T_5	20	27	0.29	35
T_6	17	30	0.58	40
T_7	16	26	1.10	43
SEd	**0.122**	**0.883**	**0.034**	**0.653**
CD (0.05)	**0.263**	**1.894**	**0.073**	**1.400**

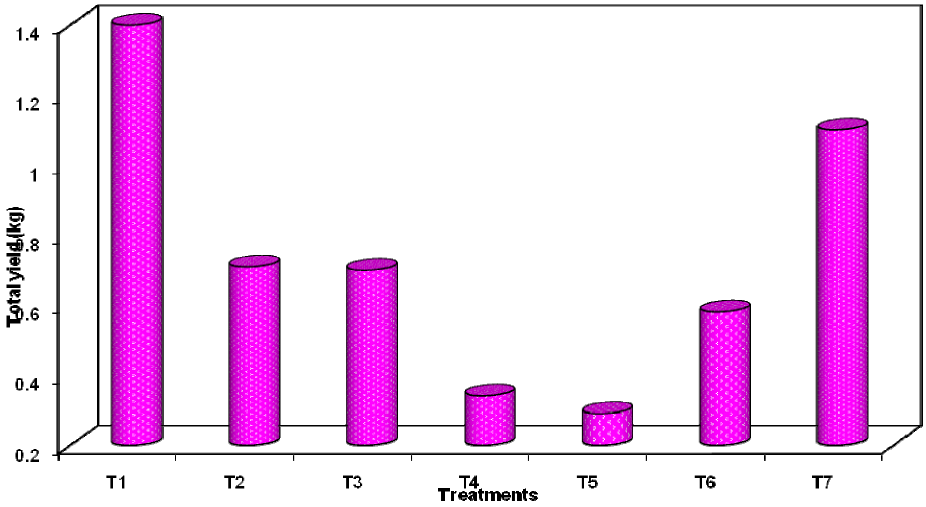
(Value represent mean of three replications)

Table 2. Qualitative study on mushroom (protein, moisture and ash content)

Treatments	Protein (%)	Moisture (%)	Ash (%)
T_1	19.3	90.4	89.2
T_2	22.5	91.4	83.6
T_3	23.1	89.6	86.4
T_4	18.8	93.8	83.1
T_5	21.2	90.8	93.3
T_6	19.5	93.2	85.3
T_7	17.9	93.0	87.3
SEd	**0.3336**	**3.0671**	**3.5718**
CD (0.05)	**0.7156**	**6.5789**	**7.6617**

(Value represent mean of three replications)

Fig. 1. Yield of mushroom



T1 – 100 % Empty Fruit Bunch (EFB) ; T2 – 80 % EFB + 20 % Paddy Straw (PS) ; T3 – 60 % EFB + 40 % PS ; T4 – 40 % EFB + 60 % PS ;

Fig 2. Mushroom bunches on EFB (100 %)

Conclusion

From this research, shredded empty fruit bunch and paddy straw applied in this study show potential as viable substrates for mushroom cultivation either alone or in combinations of both as substrate for the cultivation of *Pleurotus florida.* With optimum use of the biomass generated from the palm oil mills, it will not only solve the environmental pollution problem but it can also offer a promising way to convert low quality biomasses into a valuable high protein food.

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