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ORIGINAL ARTICLE

Cultivation of different strains of king oyster mushroom (*Pleurotus eryngii*) on saw dust and rice straw in Bangladesh

Mahbuba Moonmoon, Md. Nazim Uddin, Saleh Ahmed, Nasrat Jahan Shelly, Md. Asaduzzaman Khan *

National Mushroom Development and Extension Centre, Savar, Dhaka 1340, Bangladesh

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Abstract *Pleurotus eryngii* is a popular mushroom due to its excellent consistency of cap and stem, culinary qualities and longer shelf life. In Bangladesh, where *Pleurotus* mushrooms are very popular, *P. eryngii* may take position among the consumers, but currently this mushroom is not cultivated in large scale there. In this study, 3 strains of *P. eryngii* such as Pe-1 (native to Bangladesh), Pe-2 (germplasm collected from China) and Pe-3 (germplasm collected from Japan) were cultivated on saw dust and rice straw and their growth and yield parameters were investigated. Pe-1 on saw dust showed the highest biological yield and efficiency (73.5%) than other strains. Also, the mycelium run rate and number of fruiting bodies were higher in Pe-1 than other two strains. The quality of mushroom strains was near about similar. On saw dust, the yield and efficiency were better than those cultivated on rice straw, however, on straw; the mushroom fruiting bodies were larger in size. This study shows the prospects of *P. eryngii* cultivation in Bangladesh and suggests further study in controlled environment for higher yield and production.

1. Introduction

The oyster mushrooms (*Pleurotus* spp.) are in the third place after the white button and shiitake among the world mushroom production (Gyorfi and Hajdu, 2007). King oyster mushroom (*Pleurotus eryngii*) belongs to the family of oyster mushrooms, which is edible, basidiomycetic and saprophytic (Lewinsohn et al., 2002). It is considered as the best one of all *Pleurotus* species due to its excellent consistency of cap and stem, culinary qualities and longest shelf life than any other oyster mushroom (Yildiz et al., 2002). In the recent year, *P. eryngii* has been commercially cultivated in China, Japan and Taiwan because its excellent texture and flavor attract consumers (Eguchi et al., 1999; Peng, 1996, 1998; Royse, 1999).

* Corresponding author. Present address: Department of Biochemistry, School of Biological Science and Technology, Central South University, Changsha, Hunan 410013, China. Tel.: +86 15243646146.
E-mail address: asadkhanbmj@yahoo.com (M.A. Khan).

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Many strains of *P. eryngii* are available in the world, which are extensively cultivated. Different strains of king oyster mushroom response differently to different substrates, supplements, supplementation amount and environmental factors in the aspects of mycelium run, average yield and quality (Visscher, 1989). It can easily and successfully be cultivated on wheat and rice straw, cotton waste and sawdust (Jiskani, 1999). In Bangladesh, three strains of *P. eryngii* like Pe-1 (native), Pe-2 (germplasm collected from China) and Pe-3 (germplasm collected from Japan) have been cultivated on a small scale since last two years. The temperature range required for cultivation of these strains is 12–17 °C for fruiting body development. Although *P. ostreatus*, *P. florida* and *P. sajor-caju* are widely cultivated all over the year, but widely cultivation of *P. eryngii* is so difficult without controlled condition, because the average temperature of Bangladesh is higher and even in winter season, it is about 18 °C.

In Bangladesh, sawdust and rice straw are widely used as the main substrate for mushroom cultivation. But still no work has been done to find out the suitability of these locally available lignocellulosic wastes for the cultivation of *P. eryngii* and also to find out the most cost compatible strains in this environmental condition. If the growing technology will be developed and temperature may be control, that can make this strain most demanded out of all *Pleurotus* spp. due to its excellent texture and shelf life (Szili and Vessey, 1980). So, to identify the best strain of king oyster mushroom that can be most suitable for culture conditions in Bangladesh in case of sawdust and rice straw substrate, was the main aim of this investigation.

2. Methods and materials

2.1. Strain of king oyster mushroom

Three strains of *P. eryngii* such as Pe-1 (native to Bangladesh), Pe-2 (collected strain from China) and Pe-3 (collected strain from Japan) were used in this investigation.

2.2. Culture preparation

Pure cultures of different strains were prepared on malt extract agar (MEA) medium. The inoculated Petri dishes were incubated in the growth chamber at 25 ± 2 °C in the dark for about ten days. This culture was used for inoculation of mother culture after completion of the mycelium. Medium of mother culture was prepared by mixing sawdust and wheat bran at the ratio of 2:1 and 0.2% calcium carbonate. The moisture level of the mixture was maintained at 65%. Polypropylene bags of 25 × 17 cm size were filled with 250 g of the mixture and packed tightly. The neck was plugged with cotton and covered with brown paper and tied with a rubber band. The packets were sterilized in an autoclave for 1 h at 121 °C under 1 kg/cm^2 pressure. The *P. eryngii* inoculated packets were placed on a rack in the laboratory at 25 ± 2 °C temperature for incubation. The substrate of the mother culture was colonized by the growth of mycelium within 15–20 days after inoculation. The fully colonized packets were used for spawning.

2.3. Spawn preparation

Two different substrates namely, sawdust (SD) and rice straw (RS) were used as culture media. In case of SD, sun dried SD, wheat bran and rice husk were mixed together at 176 g, 88 g and 11 g, respectively for each 550 g substrate. Water was added to adjust moisture content at 65% and $CaCO_3$ was mixed at the rate of 0.2% of the mixture. Substrate mixture was filled into autoclavable polypropylene plastic bottles (900 ml) and a hole of about 2/3 deep of the volume of the bottle was made for space to put the inoculums. The bottles were sterilized at 121 °C for 1 h under 1 kg/cm^2 pressure. After cooling down to room temperature the sterilized bottles were inoculated with the mother culture of the selected strains to be tested separately. In case of RS substrate, dried RS was chopped into 2–4 cm length and placed in hot water. After half an hour the burner was stopped and this straw was kept to cool. After cooling, the straw was spread on the polypropylene sheet for removal of excess water. Then the polypropylene bags were filled with substrate of 500 g. During bagging the packets were inoculated separately with the mother culture of selected strains to be tasted. These inoculated bottles and bags were incubated in a dark room at 25 ± 2 °C temperature for mycelium growth.

2.4. Cropping and harvesting

After completion of mycelial growth, the bottles of sawdust were uncapped and soaked in water for 3–5 min. But the spawn bags of rice straw were opened by square shaped (1″ × 1″) cut on the different place in a culture house. The temperature, relative humidity and light were maintained at 13–22 °C, 70–85% and about 180–250 lux, respectively. Carbon dioxide concentration was not monitored and controlled instrumentally. Mushroom were harvested when the mushroom cap surface were flat to slightly up-rolled at the cap margins. One flush of mushroom in each bottle or bag was harvested. The yield of mushrooms and their different quality parameters were recorded regularly.

2.5. Statistical analysis

The experiment was done completely randomized design with 10 replications ($n = 10$). Data was analyzed and graph was constructed by statistical program, SPSS-12.0 and Microsoft Excel.

3. Results

The growth and yield pattern of the *P. eryngii* strains cultivated on saw dust (SD) and rice straw (RS) is shown in Table 1. When *P. eryngii* strains were cultivated on SD, the highest mycelium run rate (MRR) was observed for Pe-1 (0.57 cm/day) which was significantly different ($P \leqslant 0.05$) from MRR of Pe-2 (0.32 cm/day) and Pe-3 (0.36 cm/day). Similarly, on RS, the MRR of Pe-1 (0.50 cm/day) was significantly different ($P \leqslant 0.05$) from MRR of Pe-2 (0.30 cm/day) and Pe-3 (0.31 cm/day). MRR for each strain was slightly lower on RS than SD, but this was not significant.

Number of primordia varied from 3.7 to 4.5 among the strains on two substrates but the variation was not significant at $P \leqslant 0.05$. On SD, the highest number of primordial initiation (NPI) was observed for Pe-2 (4.5), which was followed by Pe-1 (4.25) and Pe-3 (3.75). On RS, similar trend was observed: 4.0 for Pe-2, 3.79 for Pe-1 and 3.7 for Pe-3.