

Impact of the different casing material on the yield of *Calocybe indica* in polyethylene bag and bed system

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ABSTRACT

Milky Mushroom (*Calocybe indica*) is well known for its nutritional value, longer shelf life and ability to grow in warm and humid climatic conditions. Casing material plays an important role in its fructification and yield determination. The present study explored the impact of the different casing material on the biological efficiency (BE) of the *Calocybe indica*. A total of six types of casing material treated with thorough formaldehyde, steam and autoclaving were used during the study. The cultivation was done in the poly-ethylene (PE) bag and bed system. Maximum BE was observed in the garden soil+sand (75:25) casing material. However, the BE obtained was at par with all the pasteurization treatment i.e. tunnel pasteurization, autoclaving and formalin treatment. Also formalin treated - Farmyard manure (FYM) + sand (75:25) as casing material resulted at par BE (54.3-56.3%). The lowest BE was observed in the coir pith casing material (32.3%). Seeing recent government restrictions on single use plastics and environmental hazards due to use of polyethylene bags, this study also explored the cultivation of the *C. indica* in the bed system with two types of casing material prepared through tunnel pasteurization. The significantly similar BE was observed in FYM+ coir pith (80:20) and garden soil+ sand (75:25) casing material in the bed system also. In the treatment where no casing material was used, mass pinning and inability of the fruit body maturation in PE bag system was observed. In bed system, the fruit body matured with curved stipe and low yield obtained (BE-28.5%) in absence of casing.

Keywords: *Calocybe indica*, Biological Efficiency, Casing Material, Bed system

Mushroom is one of the major crops, which can overcome the nutritional and food security problem. Beside this, growing ability of the mushroom on the different agricultural wastes can help in the avoiding the negative environmental impact. To feed the increasing population with limited agricultural land, mushroom is a crop, which does not require agricultural land and well known as landless venture. *Calocybe indica* is commonly known as Milky mushroom and suitable for the tropical climate of

Malaysia, Singapore, China, Africa and India. It is well known for the adaptability towards the warm and humid climate and longer shelf life. This milky white mushroom have pleasant chewy texture and comparable with the button mushroom in terms of flavor. Its robust nature of the fruit body is attractive feature for the consumers (Subbiah and Balan, 2015). The required temperature of 25-35°C for the mushroom is very much suitable for most of the parts of India (Sharma *et al.*, 2020). This mushroom is

enriched with essential amino acids, minerals, fiber and different vitamins viz. thiamine, nicotinic acid, riboflavin, biotin, ascorbic acid and pyridoxine (Breeneet al., 1990; Mallavadhani et al., 2006; Alam et al., 2008).

Casing is a key factor to determine the crop yield and essential for the cultivation of *C. indica* (Subramanian and Shanmugasundaram, 2015). Highly compact casing hamper the process of diffusion of harmful metabolic gases and led to increased concentration of carbon dioxide (CO₂) ultimately affecting the fruit body formation and yield (MacCanna 1983; Subbiah and Balan, 2015). Moreover, thickness of the casing is also one of the crucial factors to get the maximum mushroom yield. Thickness of 2-2.5 cm was reported to be most suitable to obtain the maximum yield in *C. indica* (Pani, 2012; Subramanian and Shanmugasundaram, 2015). Moreover, polyethylene (PE) bags are generally used for the commercial cultivation of the *C. indica* (Bokariaet al., 2014).

Here, we have analyzed the yield of *C. indica* by utilizing the different casing material in PE bag system. In addition, the bed system was also explored for the cultivation of the *C. indica*.

MATERIALS AND METHODS

Germplasm

DMR Milky-985(DMRO-985) released strain of the *C. indica* from ICAR-Directorate of Mushroom Reaearch, Solan (Sharma et al., 2020) was used to analyze the impact of casing material on the crop yield. The culture of *C. indica* strain DMRO-985 was obtained from the culture banks of ICAR-Directorate of Mushroom Research (ICAR-DMR), Solan, India. Further, this strain was sub-cultured on Malt extract agar medium (Hi-Media, India) followed by incubation at 32°C for the growth of culture and stored at 15-18 °C temperature till further use.

Spawn preparation and cultivation trial

The spawn of *C. indica* was prepared as described by the Sharma and Kumar (2011 a). Wheat straw was used as substrate to cultivate the *C. indica*. The methodology of substrate preparation and spawning was adopted from Sharma and Kumar (2011 b). Briefly, after wetting the wheat straw substrate on first day, calcium carbonate (1%) was mixed followed by the stack formation (4 foot height) on the next day. Further, the substrate was subjected to tunnel pasteurization at 62-65 °C for 6 hours followed by layer spawning @ 5% on wet weight basis. The substrate was filled in PE bags of size 21 x 18 inch (5 kg) and shifted to cropping room. Room temperature was maintained at 32±2 °C for spawn run for 25±1 days. Casing layer (2.3±1cm) was laid after completion of the spawn run and temperature (32±2 °C) and humidity of 80-85% was maintained for the fruiting. The biological efficiency (BE) was calculated as follows:

$$BE (\%) = (\text{Fresh weight of the fruit body} / \text{Dry weight of the substrate}) \times 100$$

Casing material preparation

A total of six casing material combinations were used during the study and three different treatments i.e. tunnel pasteurization, formalin treatment and autoclaving were used for different combinations. Tunnel pasteurization of casing materials at 62-65 °C for 6 hours was performed for the farmyard manure (FYM)+coir pith (80:20); Spent Mushroom Substrate of button mushroom (SMS)+FYM (50:50); Garden soil+Sand (75:25) and Coir pith alone. Formalin (2%) was used to prepare the Garden soil+sand (75:25), FYM+sand (75:25), SMS of button mushroom alone as casing material. The formalin (LOBA Chemie, India) was sprayed in the casing material after wetting and covered with poly-ethylene sheet for 16-18 hours and applied as casing in the PE bags. Autoclave method was also used for Garden soil+sand (75:25)

casing material by autoclaving at 121°C temperature, 15psi pressure for 2 hours.

Cultivation trial in the bed system

Tunnel pasteurized wheat straw substrate was used to prepare the bed (height 13-15cm) in the racks. Further, layer spawning was performed at 5% on wet weight basis. The beds were covered with polyethylene sheet to maintain the temperature and moisture content of the bed for spawn run at 32±2°C for 25±1 days. A temperature 32±2°C was maintained

for the cultivation. The polyethylene sheets were removed from the bed after the completion of spawn run and 2.3±1cm thick tunnel pasteurized casing material was applied.

RESULTS AND DISCUSSION

Effect of the different casing material in the PE bag system

Casing is general agronomic practice for the commercial cultivation of the *C. indica*. It helps in



Fig. 1. Evaluation of the *Calocybe indica* on the different casing material. FC: FYM +coirpith (80:20); SF : Spent Mushroom Substrate of button mushroom (SMS)+FYM (50:50) ; SS: Garden soil +Sand (75:25); C: Coir pith; FTG :Formalin treated-Garden soil+sand (75:25);FFS: Formalin treated-FYM+ sand (75:25); FSMS: Formalin treated-SMS; A: Autoclaved Garden soil + Sand (75:25); WC: without casing

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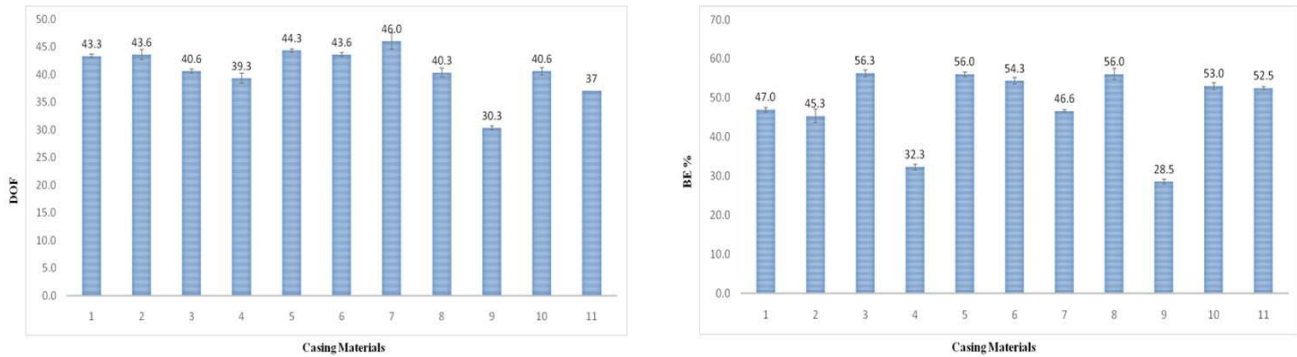


Fig. 2. Days of the first harvest (DOF) and biological efficiency (BE) of the *C. indica* on the different casing materials in PE bag and bed system. In PE bag system: 1. FYM +coir pith (80:20); 2. Spent Mushroom Substrate of button mushroom (SMS) +FYM (50:50); 3. Garden soil+sand (75:25); 4. Coir pith prepared by tunnel pasteurization; 5. Formalin treated-Garden soil+sand (75:25); 6. Formalintreated-FYM+ sand (75:25); 7. Formalin treated-SMS; 8. Autoclaved garden soil +sand (75:25). In bed system:9. Without casing; 10. Garden soil+sand (75:25) and 11. FYM +coir pith (80:20) prepared by tunnel pasteurization.

the stimulation of the fruit body and transition from the vegetative to reproductive phase (Pardo *et al.*, 2004). Subramanian and Shanmugasundaram (2015) studied the effect of casing thickness in *C. indica* and observed the thickness of the 2.5 cm was appropriate for the optimum yield. Pani (2012) found 2 cm thickness suitable to maximize the yield. In this study we have used the casing thickness of 2.3 ± 1 cm for the cultivation both in bag and bed system of cultivation. Sardar *et al.* (2020) analyzed the effect of peat moss, loam soil and SMS on milky mushroom yield and reported the maximum yield in peat moss followed by loam soil. Maximum yield (54.3-56.3%)

of was observed in garden soil+sand (75:25) irrespective of the method of pasteurization. At par yield was also obtained in formalin treated-FYM+ sand (75:25). The minimum yield was observed in coir pith casing (32.3 %) (Fig. 1 and 2). The morphological parameters viz. pileus size, stipe length-width and average fruit body weight was found similar in all the casing material. Minimum first harvest period was observed in the coir pith casing material (39.3 days) while the maximum days of the first harvest was in formalin treated SMS of the button mushroom (46 days). In *Agaricus bisporus* (Button mushroom), maximum yield was reported in the steam sterilized



Without casing

Garden Soil + Sand (75:25)

FYM + Coir Pith (80:20)

Fig. 3. Cultivation of the *Calocybe indica* in the bed system with and without casing material

casing as compare with formalin treated and heat sterilized casing material (Singh *et al.*, 2007). In our study, we have observed the similar yield in the steam (tunnel) pasteurized formalin and autoclaved garden soil + sand (75:25) as casing material.

Evaluation of the *C. indica* in the bed system

The cultivation of the *C. indica* in the bed indicates at par yield in the both casing material i.e. FYM+coir pith (52.5% BE) and garden soil+sand (53.0 % BE) casing material. The minimum days of the first harvest was observed in the FYM+coir pith casing (37 days) followed by the garden soil+sand casing material (40.6 days) (Fig. 2 and Fig. 3). In this study, effect of no casing material in cultivation of *C. indica* was also observed in PE bag (Fig. 1) and bed system (Fig. 3). In PE bag, large number of pinhead appeared but does not mature in to fruit body. While in the bed system 28.5% BE was observed without application of casing. Curved stipe was observed in absence of casing material (Fig. 3). The BE was less in the bed system as compare with PE bag system after using the same casing material.

CONCLUSIONS

The present study explored the utilization of the different casing material and its impact on the yield of *C. indica*. Beside this, here we have also demonstrated the bed system cultivation method for the *C. indica*. The findings of the present study will be very helpful to the *C. indica* mushroom growers to utilize the different available casing material as well as cultivation in the bed system.

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