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CULTIVATION AND YIELD PERFORMANCE OF MILKY MUSHROOM (*Calocybe indica*) FROM DIFFERENT AGRO-WASTES IN WEST BENGAL, INDIA

Selima Khatun[1]

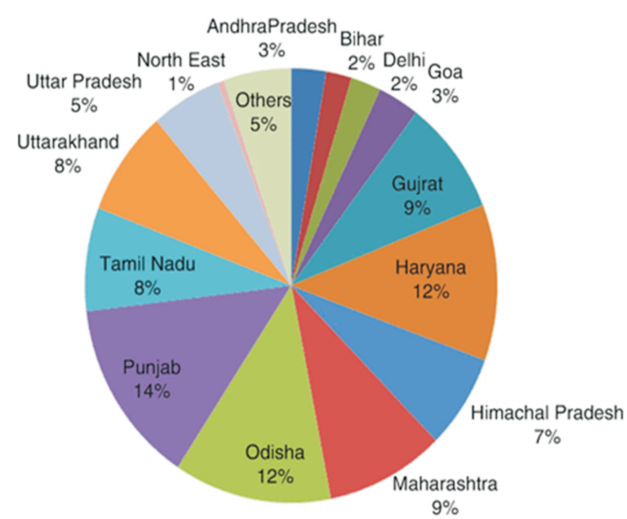
ABSTRACT

This study was conducted in the mushroom laboratory at Department of Botany at Government General Degree College, Singur during March 2024 to May 2024. Material used was *Calocybe indica* called as milky mushroom. The highest total yield obtained of *C. indica* in the month of May which was 5914 g kg^{-1} dry weight of substrates and the least total yield of *C. indica* was recorded in the month of March which was 2696 g kg^{-1} dry weight of substrates in rice straw than the wheat straw. The biological efficiency of this summer mushroom was found to be highest (591.4%) in the month of May in rice straw. The biological efficiency was found to be least (173.4) in the month of May in wheat straw. Rice straw was found superior for cultivation of milky mushrooms when compared with wheat straw. Integration of mushroom cultivation is definitely making the venture cost effective and profitable. If, it can be popularized among the rural people, it will enhance the livelihood and uplift the socio-economic condition of the area that could produce mushroom products from the different substrates (paddy and wheat straw) and help to dispose those substrates to save the environmental pollution.

(Key words: Milky mushroom, agro-wastes, rice straw, wheat straw, yield, biological efficiency)

INTRODUCTION

Calocybe indica is widely referred to as the milky mushroom because visually is appealing milky white fruit body. Milky mushrooms are excellent source of thiamine, riboflavin, nicotinic acid, pyridoxine, biotin and ascorbic acid. The rice straw is very appropriate for the white summer mushroom cultivation. Being Indian population vegetarian, eating of mushrooms would certainly enhance their diet indicates poor in proteins and minerals. Mushroom consumption can thus path a boon to growing children as well as their mothers (Barman *et al.,* 2018). Mushroom consumption has confirmed beneficial for the patients suffering from hypertension, high sugar and heart problems. *Calocybe indica* is a potentially new species to Indian mushroom growers, reported first time from West Bengal (Purkaystha and Chandra, 1974). Mature sporocarp consist of 4% soluble sugars, 2.9% starch and 7.43% ash (Barman *et al.,* 2015). The fruit body contains 12 amino acids, namely, alanine, aspartic acid, glutamine, glutamic acid, glycine hydroxyl proline, histidine, lysine, threonine, tryrosine, valine, arginine, and proline (Yadav *et al.,* 2021). Out of all amino acids glycine is predominant (10.8 g 100 g^{-1} protein). In addition to this, it has all the mineral salts required by human body such as potassium, sodium, phosphorus, iron and calcium (Sornprasert *et al*., 2022). Qasim *et al.* (2025) recorded 28% protein (dry weight basis) in milky mushroom. It is also reported that milky mushroom contains higher protein than button and oyster mushrooms (Krishnamoorthy *et al.,* 2000). Saranya *et al.* (2011) stated that the type of agro-substrates used for mushroom cultivation had highly subjective the adjacent work with antioxidants. Ragul (2013) reported that chitosan was found in the fruit bodies of *C. indica*. Good amount of minerals (Ca, K, Mg, Na, and P) and trace elements (Cu, Fe, Mn, and Zn) from milky white mushrooms were noted by Zahid *et al.* (2010). Sharma (2017) analyzed the status of global mushroom industry and the opportunities and challenges for development of mushroom entrepreneurship in India. *C. indica* is mainly found in West Bengal and also has been reported in plains of Tamil Nadu and Rajasthan



1. Asst. Professor, Dept. of Botany, Maulana Azad College, Kolkata-700013, West Bengal, India (Corresponding author)

(Krishnamoorthy, 2003). It has been commercially cultivated in south India like Tamil Nadu, Andhra Pradesh, and Karnataka and recently been cultivated in North India (Singh *et al.,* 2017). The agri-wastes made up of mainly of cellulose, hemicelluloses and lignin etc. Lignin fraction which is recalcitrant in nature, but in mushroom it possesses the specific type of hydrolytic enzyme system with capacity of utilizing lignin for fruit body production (Barman *et al.,* 2015). However during spawn run stage, mushroom hydrolyzes mainly the lignin, the hemicelluloses and produced milky mushroom (3%) in India (Sahu and Gupta, 2024). Utilization of agri wastes for production of milky mushroom has been explained by Kumar and Chandra (2013). Jahan and Singh (2019) stated that China was the highest creator and punter of mushrooms. This paper deals with the yield performance and biological efficiency of milky mushroom (*Calocybe indica*) in two different agro-substrates (rice and wheat) of West Bengal, India.

MATERIALS AND METHODS

The experiment was carried out in mushroom cultivation room, Department of Botany, Government General Degree College, Singur, Hooghly from March, 2024 to May, 2024. Wheat straw and paddy straw were used for cultivation of *C. indica*. Potato dextrose agar medium was used to grow mycelia at 35°C temperature. 6.5 to7 pH was maintained. 800 lux light intensity was given to grow mycelia.

Substrate preparation

The potential locally available lignocellulosic substrates such as wheat straw and paddy straw were selected for cultivation of *Calocybe indica*. Paddy straw and wheat straw were chopped and all substrate were cleaned with tap water separately. Rice straw harvested during previous season was collected from nearby village. All the substrates pre-soaked in cold water, and selected substrates were filled in metallic tank separately and treated with hot water 80-85 ºC for 30 minutes. After draining excess water, substrates straw was spread on sterilized surface to evaporate extra moisture approximately to 70% and after cooling the spawning was done.

Sterilization

Sterilization was done to kill of micro-organisms at temperature of 121°C and steamed at 15lbs pressure for 15-20 minutes.

Preparation of spawn bags

Wheat grain was commonly used for making spawn as it shows very good mycelium growth, wheat grains were thoroughly washed and soaked for 10-16 hours in water, and then sieved. After overnight soaking, 2 kg of grains were taken in a vessel with 4l of water and it was boiled for about 15-20 minutes and allowed to cool for 15 minutes, water was drained and the spawn was dried in black poly-paper. 20 g of gypsum ($CaSO_4.2H_2O$) was added with 60 g of ground limestone ($CaCO_3$) and mixed well to prevent agglomeration and the pH was maintained at 6.8-7.The grain was packed into the polypropylene bags of 200 x 300 mm size. One bag contains 250 g of the prepared grain and was packed tightly. The packed bags were then autoclaved at a temperature of 121°C at 15lbs pressure for 15 minutes. After sterilization, the bags were cooled and inoculated with fresh mother culture. Then, these were incubated in an incubator at 28±2°C for mycelium growth. It takes 2-3 weeks for complete spread of mycelium and the whole bag turns into white.

Inoculation

Spawn was added to the polythene bags in the size of 30 x 60 cm in the ratio of 250 grams for every 5 kilograms of wet substrate.

Incubation

The mushroom bags were moved to a dark room having temperature of 25-30^{0}C with 80% relative humidity (RH). After about 21 days, the substrate was colonized and the bags were used for casing.

Casing

The top of the bags was covered with pasteurized casing material to provide structural strength, moisture and allowed gasses to escape.

Cropping and harvesting

The mushrooms were harvested in three flush, and the entire cycle repeated 5 times to get mean ± standard error. The optimum temperature for cropping was maintained at 35-38°C with 85-90% relative humidity. Diffused light and ventilation were provided.

Fruiting

The fruit bodies were weighed immediately after harvest using electronic balance.

Yield and biological efficiency

The fruiting bodies harvested from polypropylene bags were recorded as total yield of mushrooms. The biological efficiency (B.E.) was calculated by the formula given in the ratio of fresh milky mushroom harvested (g)$^{-1}$ dry substrate (g) and expressed in percentage (%).

$$\text{B.E.} = \frac{\text{Fresh Weight of the Mushroom (g)}}{\text{Dry Weight of the Substrate (g)}} \times 100$$

RESULTS AND DISCUSSION

After about 13 days, the mycelium reached the top of the casing layer. Pinhead initiation was beginning at 4-7days after opening the bags. Within 5-7 days, fruiting bodies were begun to grow in the shape of needles and matured within a week.

The data collected from the month of March to May in the year 2024 are presented in Table 1 and Figure 1. The effect of substrate on growth and development of mushroom were analyzed for yield (g) and the biological efficiency. The highest total yield obtained in the month of May which was 5914 g kg^{-1} dry weight of substrates and the least total yield obtained in the month of March which was 2696 g kg^{-1} dry weight of substrates in rice straw than the wheat straw. Rice straw appeared to be the common and superior substrate for cultivation of milky mushrooms when compared to most other lingo cellulosic wastes (Petchimuthu *et al.,* 2020). Rice straw was the best substrate, followed by wheat straw (Mauriya *et al.,* 2020). Therefore, cellulose-rich organic substrates are suitable for cultivating mushrooms (Sahu and Gupta, 2024). The higher biological efficiency of *C. indica* was found in 1st flush in the month of May in paddy straw than the wheat straw. The total yield and biological efficiency of *C. indica* were gradually declined from 1st to 3rd flush. The present work also suggests that small scale mushroom farms or enterprises can maintain consistency in the supply of mushrooms between March to May by cultivating *Calocybe indica.* Cultivation of this mushroom is very simple and low-cost production technology, which gives consistent growth with high biological yield. The rice straw was the best substrate for the commercial cultivation of *Calocybe indica* (Sahu and Gupta, 2024). Integration of mushroom cultivation is definitely making the venture cost effective and profitable. If, it can be popularized among the rural people, it will enhance the livelihood and uplift the socio-economic condition of the area that could produce mushroom products from the different substrates (paddy and wheat straw) and help to dispose those substrates ultimately save the environmental pollution .

Figure 1. Milky mushroom cultivation in our laboratory: a) substrates, b) spwans, c) steam sterilization at autoclave, d) spwan spreading into the bed, e) hole the mushroom bed f) mushroom bed in dark chamber, g) mature fruit body, h) immature pinheads and mature fruit body

Table 1. Yield and biological efficiency (upto 3rd flushes) of *Calocybe indica* cultivated at their respective optimal temperature, pressure & humidity regimes between March to May, 2024 using different agro-wastes

Agro-wastes	Month of Observations	1st Flush (g)#	2st Flush (g)	3st Flush (g)	Total yield (g kg^{-1} dws*)	Biological efficiency (%)
Rice straw	March	1121±0.75	962±0.70	613±0.75	2696	269.6
	April	1687±2.59	1560±0.28	1304±0.25	4551	455.1
	May	2151±0.47	1975±1.93	1788±0.28	5914	591.4
Wheat straw	March	401±0.28	250±0.28	157±0.25	808	80.8
	April	610±0.47	451±1.19	301±0.25	1362	136.2
	May	762±10.3	570±9.12	402±1.08	1734	173.4

#Results are mean ± standard error, n=5. *dws dry weight of substrate

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