MERIT RESEARCH JOURNALS
www.meritresearchjournals.org

Merit Research Journal of Agricultural Science and Soil Sciences (ISSN: 2350-2274) Vol. 2(2) pp. 032-037, February, 2014
Available online http://www.meritresearchjournals.org/asss/index.htm

Full Length Research Paper

Commercial production of Milky Mushroom (*Calocybe indica*)

[*1]Kanta Bokaria, [1]Siva Kumar Balsundram, [2]Indira Bhattarai and [2]Krishna Kaphle

[1]Department of Genetics and Plant Breeding, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur Nadia -700502- West Bengal, India.
[2]Institute of Agriculture and Animal Science, Rampur Campus, Tribhuvan University, Nepal.

***Corresponding Author Email: kkantabokria@rediffmail.com**

Abstract

Mushroom is now considered crucial component for food safety and security. The phytonutrients in mushroom are now sought after food items. Micro-economy and community engagement in mushroom cultivation is helping rural economy. Urban and semi urban cultivation is also gaining popularity for various edible plants including mushroom and *Calocybe indica* an edible mushroom, native to India was first described by Purkayastha and Chandra (1947). Its milky white colour and robust appearance is appealing to all and provided with easy, reliable, renewable method of growing, its popularity is bound to increase. In this work the first two authors worked to develop the model for easy production. Findings reveal that, cylindrical polythene bag beds of 15 x 30 cm size were found useful for commercial cultivation. Clay loam soil (pH 8.4) was found to be the best casting soil which recorded 388.0 g for mushrooms per bed. Incubating the beds after casing in a partially sunken 3 feet deep polythene chamber lined with high density sky blue coloured polythene sheet as roofing material was found to be effective. Inside this chamber temperature range was 30- 35°C, relative humidity of more than 85 percent and a light intensity of 1600 to 3200 lux at least for 6 h during day time was determined to be best suitable. Commercial production techniques for Milky mushroom, *Calocybe indica* recorded yield of 356.5 to 375.0 g of mushrooms per 250 g of paddy straw (dry weight) which accounts to 142.6 to 150.0 percent bio-efficiency. Substrates like maize stalks, sorghum stalks, vetiver grass and straw were also found to be suitable for growing Calocybe indica. However, paddy straw the commonly employed material showed relatively less yield. Substrate pre-treatment namely; steaming for 30 min. or soaking in hot water (80° C) for 60 min, are recommended for commercial purpose. While chemical substrate treatment (with Carbendazim 75 ppm + formalin 500 ppm for 16 h) was effective in viability and preservation. Mushroom grow competing and utilizing resources around it in special environment and their commercial conditions creation is importantly for science and society.

Keywords: Milky Mushroom (Calocybe indica), Appropriate Growing Method, Science and Society.

INTRODUCTION

Evolution of food culture have brought mushroom in the limelight. Its unique nutritional value and taste derived human understanding in civilized societies and compulsion/ethnic food (as wild and farm-grown), mushroom is becoming popular. Need to feed the booming billions (humans) in a sustainable way demand scientific intervention for optimum production. One major problem and irony of the planet is there is concern for food safety and security on one hand and huge loss from agricultural waste ~4,500 million tones/year. Out of which sub continent India alone produces about 1000 million tones of crop residues. Though, the major part of the crop residues is being used as fodder, rest is wasted in different ways. The crop residues constitute mainly of cellulose, hemicellulose and lignin. Attempts are underway to utilize them in production of biofuel but this is long way from being realized. Lignin fraction which is generally considered as recalcitrant in nature, does not find much takers, but in mushroom this fraction has remained as the material of choice as mushroom possesses the specific type of hydrolytic enzyme system with capacity of utilizing lignin for fruit body production. Mushroom being one of the cheapest sources of protein particularly for the vegetarian, it becomes imperative to produce more mushroom utilizing the local agro-waste to meet the protein need of the country. Out of different mushrooms that can be cultivated on lignin rich agricultural wastes, milky mushroom (*Calocybe indica*) is relatively new to the world of mushroom industry. This mushroom was first reported from West Bengal, India (Purakayasha, 1974) (Purkayastha, 1984-85; Pandey and Tewari, 1993). Even though attempts were made to grow C. Indica (Purkayastha and Nayak, 1981); Chakravarty et al., 1981; Doshi et al., 1989. Pandey and Tewari, 1993) only limited success was achieved in increasing the bio-efficiency and productivity of this mushroom. Krishnamoorthy et al. (1998) reported a high yielding strain of *Calocybe medica*, APK 2. It grows well at room temperature between 24°C – 27°C and can be cultivated even on unfermented materials. The advantages of this mushroom over other mushrooms are easy method of cultivation, less investment, very attractive fruiting body, pleasing milk white color, long shelf life, more nutritious and less time to grow. In general, mushroom cultivation is practiced using traditional raw materials whose availability often become limiting. In rural areas, plenty of agro-waste and organic materials are available, which often end up in waste thus contributing to the pollution woes. Recycling is the need of modern times and mushroom is an ideal candidate to harness its potentialities. Unique and rich nutritional status of Mushroom and growing demand for functional foods warrants innovative growing methods.

MATERIALS AND METHODS

Mushroom bed preparation

Beds were made in which each bed contained 0.5 kg of paddy straw (dry weight basis). Polyethylene bags of 60 x 30 cm size and 100 gauge thickness were used and cylindrical mushroom beds were prepared following layer methods of spawning. The rate of spawning was 5 per cent of wet weight of the substrate. The beds were incubated in semi dark spawn running rooms at about 30 to 32°C. After 10 to 12 days when the substrate was fully colonized by the fungus, the beds were cut horizontally into two equal halves and applied with the casing soil to about 2 cm height on the top of the open bed surface.

Selection of substrate

Different agro wastes were used as substrate, which were processed in hot water at 80 degree centigrade for suitable periods depending upon the quality of the material. In some material only steaming was done while in others chemicals was used like for paddy straw for processing. As boiling takes long time and does not give good result and it also makes the process costly the method of hot water treatment was found to be more suitable.

Preparation of casing soil

Clay loam with pH 8.to 8.5 was used to fill the mud posts after removing the clods. The moisture content of the soil was adjusted to 40 per cent by gravimetric method (Devadoss, 1971). The pots were covered with news papers and steamed in an autoclave at 110°C for 60 min. After 24 hrs when the soil was cool, it was used for casing. This soil was uniformly spread over the half cut spawn run beds. Regular spraying on the surface of the casing soil was done to maintain approximately 60 percent moisture on the bed surface.

Cultivation chamber

Cultivation chamber were constructed in a shaded place, partially sunken (three feet deep) chamber lined with sky blue colored high density polyethylene sheet as roofing

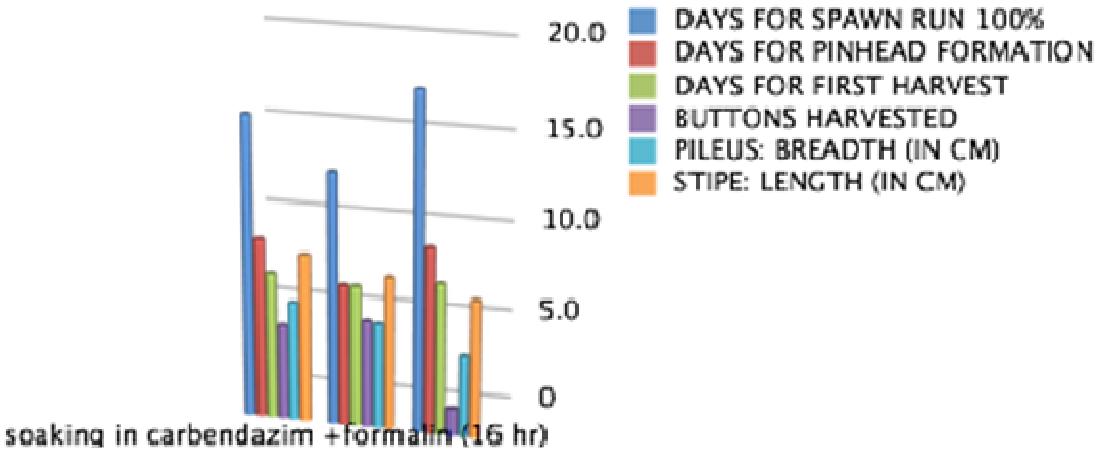

Figure 1. Provide Legend.

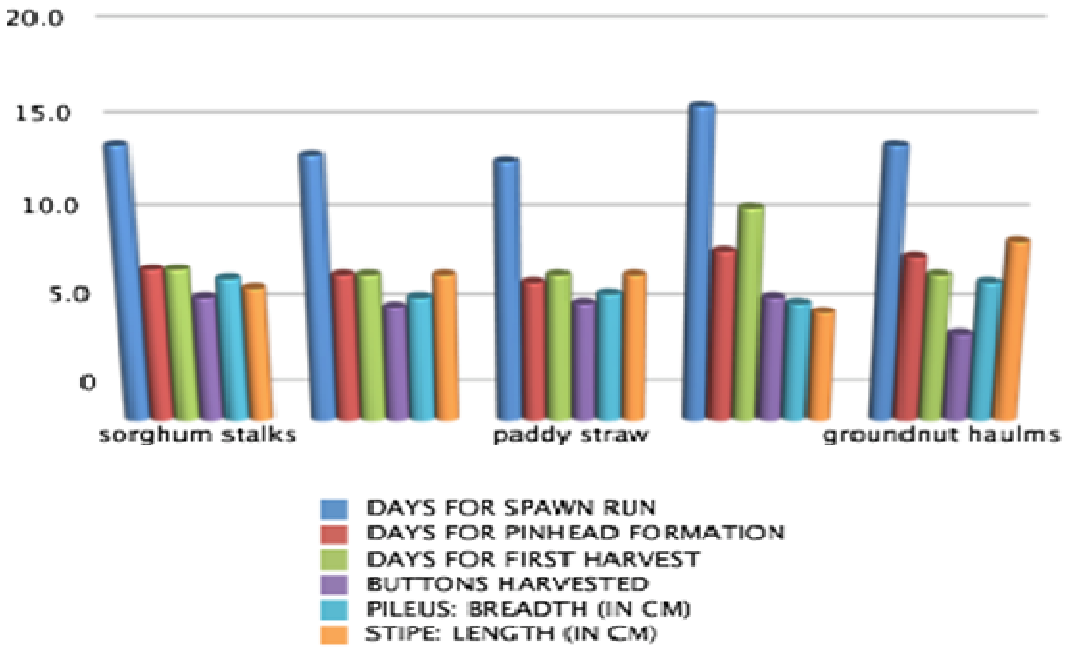

Figure 2. Provide Legend.

material. Beds after casing were incubated over racks in a chamber. The side walls of which were lined with hollow block bricks with enough ventilation for air exchange. The inside temperature range was 30 to 35°C and the relative humidity was more than 85 per cent. During day time approximately 1600 to 3200 flux intensity of light was available at least for 6 hrs inside the chamber. As it was found that at higher or lower light intensity the yield, size of pileus and stalk was affected.

Suitability of different substrates for cultivation

Paddy straw, sorghum stalks, sugarcane bagasse, palmarosa grass, vetiver grass, groundnut hulls, soybean hay, black gram hay and paddy straw compost were used as substrates for the cultivation trial. Paddy straw compost was prepared by long method of composting following IIHR formula (1986). All other substrates were processed in hot water (80°C). (Figures 1 and 2)

Table 1. Use of different substrates for growing.

	DAYS FOR SPAWN RUN	DAYS FOR PINHEAD FORMATION	DAYS FOR FIRST HARVEST	BUTTONS HARVESTED	PIELUS BREADTH (IN CM)	STIPE LENGTH (IN CM)
sorghum stalks	14.8	8.3	8.3	6.8	7.8	7.3
maize stalks	14.3	8	8	6.3	6.8	8
paddy straw	14	7.6	8	6.5	7	8
sugarcane bagassse	16.8	9.3	11.6	6.8	6.5	6
groundnut haulms	14.8	9	8	4.8	7.6	9.8

Table 2. Effect of pre treatment on milky mushroom.

	DAYS FOR SPAWN RUN 100%	DAYS FOR PINHEAD FORMATION	DAYS FOR FIRST HARVEST	BUTTONS HARVESTED	PILEUS: BREADTH (IN CM)	STIPE: LENGTH (IN CM)
soaking in carbendazim +formalin (16 hr)	16.5	9.8	8	5.2	6.5	9.2
soaking in water for 4hr + steaming 30 min	13.8	7.7	7.7	5.9	5.8	8.4
soaking in water for 4hr	18.5	10.2	8.3	1.5	4.5	7.6
CD (P=0.05)	1.23	1.40	N.S.	1.64	1.14	0.82

RESULTS AND DISCUSSION

Among the substrates (Table 1) paddy straw, maize stalk and sorghum stalk gave significant higher yields followed by sugarcane bagasse and groundnut hulls. Except in paddy straw compost, all other complete spawn run was achieved within 160 days. Physical and chemical state of substrates largely decide their suitability for mushroom growing. Poor growth and low yield of *Colocybe indica* in substrates could be related to the variation among the substrates in the bulk density, water holding capacity and improper gaseous exchange especially of harmful volatile compounds. Further, in dense solid substrates microbial heat or mycelium induced heat might not have dissipated to evaporation. Working with various types of *Agaricus* compost Wood and Smith (1987) also attributed similar reasons.

The substrate pre-treatment methods were compared, significantly increased yields were obtained in all the pre-treatment methods (99.0 to 108.3 per cent bio-efficiency) as compared to control as is illustrated in Table 2. Soaking in water for 4hrs was found to be more suitable and cost effective and easy but gave very less yield as compared to others. While soaking in water for 4 hrs followed by steaming for 30 minutes was found more suitable in all respects. However, the treatment did not vary much among themselves which could also be because of the lack of minute detail observation of variation thus demanding further investigation.

Beds prepared out of chemically tested paddy straw were frequently found contaminated by *Coprinus comatus* specially during spawn run. When the observations on the days for spawn run and days for pinhead formation were compared chemical treatment was found to be inferior to that of hot water treatment or steaming. This could be due to the presence of excess moisture in the substrate. Since paddy straw was soaked for 16 hrs in the fungicidal solution, the straw bits might have imbibed sufficiently more water. Suggestion can be made to shade dry the straw bits sufficiently for longer time in order to get the required moisture level in the substrates before bed preparation. This has resulted in the built up of excess humidity followed by dripping of water droplets on the bed surface inside the polyethylene bags at the time of spawn running. The straw bits inside polyethylene bags were found visibly wet. This wet condition of the bed surface likely contributed to the buildup of bacterial population which obviously competed with the mushroom mycelium resulting in delayed growth of the fungus. Tewari (2008) and Geetha (2009) also reported that the moisture content in paddy straw substrate increased with increase in soaking period.

Among the different soils (Table 3) used for casing, clay loam soil (pH 8.4) gave the maximum yield of 288.0 g of mushrooms per bed with more number buttons (7.9). Peat soil (pH 6.0) was the second best medium in terms of production. In the sandy soils fungus took more number of days for the production of pinheads (10.2 d) and they attained harvesting maturity only after 10.6 d. Thus, based on our finding it can be said that soils should

Table 3. Effect of pre treatment on milky mushroom.

	DAYS FOR SPAWN RUN 100%	DAYS FOR PINHEAD FORMATION	DAYS FOR FIRST HARVEST	BUTTONS HARVESTED	PILEUS: BREADTH (IN CM)	STIPE: LENGTH (IN CM)
FYM	7.6	10	9.2	4.4	5.2	6.6
CLAY LOAM	8.4	8.2	8.6	7.9	5.8	6.9
SAND	6.3	10.2	10.6	3.1	6	8
COMPOST	6.8	8.4	8.6	3.2	6.6	8
CD(P=0.05)	N.S.	1.2	1.41	0.88	N.S.	1.08

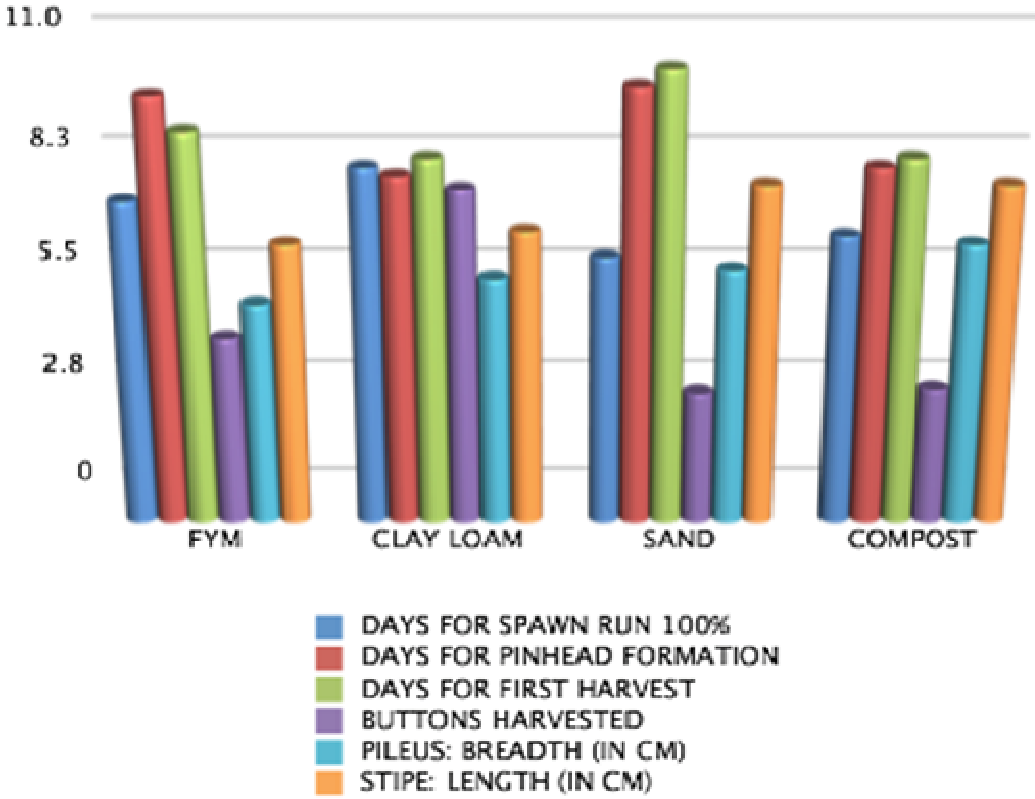

Figure 3. Provide Legend.

possess high water holding capacity, enough pore space, stable structure, low in soluble salts and electrical conductivity for better production. The casing soil should also be free from pre-decomposed vegetative matter and its pH should be neutral to alkaline. All these desirable attributes exactly matched with the clay loam soil (pH 8.4). Flegg (2007) reported that heavy clayey soils yielded better than other and the garden soil used contained the maximum clay content when compared to others. Interestingly, the clay loam soil had the quality to absorb the moisture quickly and release in addition in this soil less water was needed. (Figure 3)

ACKNOWLEDGEMENT

Authors are thankful to the Ministry of Science and Technology, Government of India, New Delhi For sanctioning Financial Assistance to the first author. The authors are thankful to Dr. Alok Mondal, Head, Depart-

ment of Plant Physiology and Nirmalendu Das from Department of Genetics and Plant Breeding Calcutta University for providing facilities and guidance for this work. Special thanks goes to Dr. H.B.Singh for providing this DST Project and Vardan Bokaria for helping in writing this paper and completing this project .

REFERENCES

Chakravarty DK, Sarkar BB, Kundu BM 1981. Cultivation of tropical edible mushroom Calocybe Indica. Curr. Sci., 50: 550.

Devadoss A (1971). Studies on the damping – Off of vegetables. M. Sc. (Ag.). Thesis submitted to Tamil Nadu Agricultural University, Combatore, India. P. 1234.

Doshi A, Sidana N, Chakravorti BP (1989). Cultivation of summer mushroom, *Calocybe indica* (P & C) in Rajasthan. Mush. Sci., 12:395-400.

Flegg PB (2007). How do your mushrooms grow? Mushroom J. 108: 401-409.

Geeta D (2009). Studies on Oyster mushroom (Pleurotus spp.) Ph. D Thesis submitted to Tamil Nadu Agricultural University, Combatore, India p. 253.

HHR (1986). Mushroom Cultivation, Extension Bulletin No. 8. Indian Institute of Horticultural Research, Hessaraghatta, Bangalore, India. P. 36.

Krishnamoorthy AS, Muthusamy M, Marimuthu T, Narasimhan V, Muthusankaranaraynman A (1998). Milky mushroom, APK 2. Bulletin on new mushroom variety release. Regional Research Station, TANU, Aruppukottai, India. P. 16.

Nagaraja AZN, Patwardhan MV (1978). Some aspects of the cultivation of Pleurotus flabellatus in India. Mushroom Sci. 10: 597-608.

Pandey M, Tewari RP (1993). Milky mushroom grown on paddy straw. The Hindu. Dec. 93 : 24.

Purkayastha RP (1984-85). cultivation of *Calocybe indica* P & C Indian J., Mush. 10-11 : 12-17.

Purkayastha RP, Chandra A (1974). New species of edible mushroom from India. Trans. Br. Mycol. Soc. 62 : 415-418.

Purkayastha RP, Nayak D (1979). A new method of cultivation of Calocybe indica. Taiwan Mush., 3: 14-18.

Singh RN, Bhandari TPS, Adikari K, Kanaujia JP (1992). Physico chemical parameres of casing soil in relation to yield of button mushroom (Agraicus brunnescens). Indian J. Mycol. Pl Pathol., 22: 160-164.

Sivaprakasam K (1980). Studies on the cultivation of Pleurotus sajor caju (Fr.) Singer. Ph. D Thesis submitted to Tamil Nadu Agricultural University, Coimbatore, India. P. 115.

Sivaprakasm TLK, Dandasamy TK (1978). Compact bag method – A new method for increasing the production of Pleurotus sajor caju. Indian J. Mush., 4: 10-12.

Smedron M (1983). Thoughts on casting. Mushroom J., 124 : 193-194.

Tewari RP (2008). Effect of soaking period and spawn dose on oyster mushroom production. In : Indian Mushroom (M. C. Nair et al. eds), KAU Press, Vellanikkara, Trinvananthapuram, India. Pp. 81-84.

Vijay B, Sohi HS (1987). Cultivation of oyster mushroom, H. S. P. sajor caju on chemical sterilized wheat straw. Mush J. Tropics 7:67-77.

Wood DA, Smith JE (1987). Mushroom cultivation. In: Essays in Agriculture and Food Microbiology (J. R. Norris and G. L. Pettipher eds.), John Willy & Sons Ltd., Chichestel. Pp. 309-343.

Zadrazil E (1978). Cultivation of Pleurootus. In: The Biology and Cultivation of Edible Mushrooms. (S. T. Chang and W. A. Hayes ed.). Acudemic Press, New York. Pp. 521-557.