Journal of the Kalash Science, Volume-3, Number-1, 2015 : 9-14 ISSN : 2321-7634

Effect of different casing thickness on cropping period and yield performance for Milky mushroom (C*alocybe indica*)

A. K. Srivastava, Gopal Singh, Brajesh Kumar, Ramji Singh, Kamal Khilari
Department of Plant Pathology, S. V. P. University of Agriculture and Technology, Modipuram, Meerut -250110 (U.P.)

Accepted 28 January 2015

Abstract

Milky mushroom a popular mushroom was first time reported from India in 1976. It can be easily grown in temperature range of 25-35^{0}C with 75-85% relative humidity, therefore with respect to study was undertaken to assess the effect of different casing thickness for fruiting body yield in milky mushroom (*Calocybe indica*) strain APK-2 and CI-14. The experiment was conducted from 2013 to 2014 in Mushroom Laboratory, Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh in completely randomized design with eight treatment 0.30 cm/125 gm, 0.55 cm/225 gm, 0.80 cm/325 gm, 1.05 cm/425 gm, 1.30 cm/525 gm, 1.55 cm/625 gm, 1.80 cm/725 gm and 2.05 cm/825 gm with three replications were used. The parameters of casing thickness milky mushroom viz., day for pinhead formation, number of pinhead initiation, day for first harvesting, average weight of fruiting body (g/FB) and total yield (gm/kg dry straw) were analyzed in the crop room are interpreted.

Among the tested casing thickness, the 0.30 cm/125 g casing thickness took less period for pinhead formation (12.33 and 12.00 days) in Strain APK-2 & CI-14 and first harvesting (18.00 days) in Strain APK-2 with the thickness of 0.55/225 g cm and in CI-14 (18.00 days) with 0.30 cm/125 g thickness. Maximum numbers of pinhead initiation were showed with casing thickness of 1.05 cm/425 g from APK-2 (72.33/bag) and strain CI-14 (70.33/bag), respectively which was significantly superior to all the tested casing thickness. The maximum numbers of fruiting bodies were harvested from casing thickness 0.80 cm/325 gm (28.67/bag) in APK-2 and CI-4 strain (21.33) at 1.05 cm/42 5gm, respectively. Minimum numbers of fruiting bodies were harvested from strain APK-2 (14.00) and in CI-14 (15.00) at 2.05 cm/825 g. However, maximum average weight of fruit body was recorded significantly well with 2.05 cm/825 g casing thickness in APK-2 (34.82 g) and from strain CI-14 (33.94 g) with 1.30 cm/525 g, respectively. Whereas, maximum yield was recorded significantly well in casing thickness 1.55cm/625 gm from strains APK-2 and CI-14 (537.67g/kg and 523.00g/kg of dry substrate with 53.76% and 52.30% B.E.), whereas minimum yield (428.33g/kg and 370.33g/kg of dry substrate with 42.83% and 37.03% B.E.) with 0.30cm/125g casing thickness respectively.

Keywords: Milky mushroom, casing thickness, yield

Introduction

Mushrooms are the macro or larger fungi which possess fleshy, subfleshy fruiting bodies of fungi. Mushroom has been defined as “a macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous and large enough to be seen with naked eye and picked by hand” (Chang & Miles 1993). It is achlorophyllus fungal plant occurring seasonally all over the world in varies habitats with quiet different characters like shape, size, color appearance and edibility. They include edible, medicinal and poisonous species. However, originally, the word “mushroom” was used for the edible members of macro fungi and “toadstools” for poisonous ones of the “gill” macro fungi. Edible mushrooms once called the “food of the gods” and still treated as a garnish or delicacy can be taken regularly as part of the human diet or be treated as healthy food or as functional food. The extractable products from medicinal mushrooms, designed to supplement the human diet not as regular food, but as the enhancement of health and fitness, can be classified into the category of dietary supplements/mushroom nutraceuticals (Chang & Buswell 1996). Mushrooms are aptly called as vegetable meat or slimming foods.

Mushroom is known by various names like *Khumbhi, Gobarchatta, Bhumiphor* etc. in India. The Hindi term *Khumbhi* has been originated from Sanskrit word "*Ksumpa*". The local name "*Gobarchatta*" is assigned due to its habitat and chhatra like structure. Since some of its species come out by breaking the soil layer so it is also known as "*Bhumiphor*".

Out of about 2000 edible fleshy fungi, called mushrooms worldwide, 350 species belonging to 70 genera have been reported from India. Five genera (*Agaricus, Lentinula, Volvariella, Pleurotus* and *Auricularia*) contribute about 88% of the total world production during 1989-90 (Chang & Miles 1991). Button mushroom (*Agaricus bisporus*) is the most popular mushroom commercially cultivated all over the world until 1970's. Among these, an edible mushroom, milky mushroom (*Calocybe indica*) has become the focal point of exploitation in India. This mushroom was first reported from India (Purkayastha & Chandra 1974). Milky mushroom is robust, fleshy and milky white in color even after flattening. Hence, it has greater consumer attraction. As it grows in hot humid climate the mushroom is highly suitable for cultivation in the most of the plains of India. Milky mushroom is also known as "*Dudh Chhatta*" because of its milky white appearance and large sized sporophores or as "white summer mushroom" because of its tropical nature. Milky mushroom has become the third commercially grown mushroom in India after Button and Oyster. Therefore, milky mushroom is considered as a better proxy for oyster mushroom notably in tropical region with longer shelf life of 3-4 days. It is being cultivated in Karnataka, Tamil Nadu and Andhra Pradesh on a large scale (Krishnamoorty 2003).

World production and consumption of mushroom has increased at rapid rate, especially since the mid 1990s. Over a 15-year period (1997-2012), per capita consumption of mushrooms increased from about 1kg/year to over 4 kg/year (Royse 2014). Major exporting countries of fresh mushrooms are Netherlands, Poland, Ireland and Belgium. China is the main producer consumer, and exporter of preserved mushrooms with a market share of 41.82%, Netherlands (25.12%) and Spain (7.37 %). India ranks sixth with a market share of 4.43 %. The major importing countries of prepared and preserved mushrooms are Germany, USA and France while of fresh mushrooms is U.K, Germany, USA and France (Royse 2014). Mushroom production increased from approximately 1500 tonnes per annum in 1989 to 14,000 tonnes in 1999 and 38930 tonnes in 2009. Productivity of mushroom is increased from 8 kg/q in 1970 to 25-28 kg/q in 1997. In India, the total production of mushroom is about 41000 Metric Tons (FAO STAT 2014). Among the major share (80%) goes to button mushroom and that too by a single unit *i.e.* Agro Dutch, Lalru (Patiala), Punjab. In India state wise Punjab tops in the ranking for the production by contributing 20-25% of total production of mushroom followed by Uttrakhand and Haryana rest of the share (20%) goes to tropical mushrooms such as oyster, paddy straw and milky mushrooms.

Attempts on identification of potential strain and cultivation technology has been made till today but further research still needs to be carried out in the area such as, improvement in locally available casing materials. Therefore, experiments were conducted to explore the role of different casing thickness in the production and productivity of milky mushroom. Therefore, the present investigation effect of different casing thickness on cropping period and yield performance for milky mushroom (*Calocybe indica*).

Materials and Method

The experiments were conducted in Mushroom Laboratory, Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, which is situated on the western side of the Delhi-Dehradun high way NH-58 at a distance of 10.0 km away in the north of Meerut City.

In order to see the effect of different casing thickness on productivity of Milky mushroom, cultivation of *C. indica* strains namely APK-2 and CI-14. Casing consisting of Farm Yard Manure + Sand + Garden Soil (1:1:1 w/w) each two years old and treated with formalin (4%) solution and kept covered for 48 to 72 hrs, the different thickness of casing were tried with three replication of eight treatment such as 0.30 cm/125gm, 0.55 cm/225gm, 0.80 cm/325gm, 1.05 cm/425gm, 1.30 cm/525gm, 1.55 cm/625gm, 1.80 cm/725gm and 2.05 cm/825gm. Spawning and cultivation were same as given in cultivation technology. Observations were recorded as total yield (g/kg of dry substrate), days for pinhead formation (DFPF), days for first harvesting (DFFH), number of pinhead initiation (NOPI), number of fruiting bodies per bag (NOFB) and average weight of fruiting body (g/FB).

Cultivation technology

The substrate used for the crop room experiments was bright, good quality wheat straw which was soaked in a water tank chemically treated with Carbendazim 7.5 gm and formalin 100-120 ml/100lit of water for overnight (18 hrs) in the tank, so as to make it soft. The tank was covered with polythene sheet to prevent the evaporation of formalin. Thereafter, straw was taken out from the tank and spread on cemented floor treated with 2% formalin for 2 hrs to drain out excess of water. This is now ready to mix with spawn @ 6% of the wet weight of substrate. The mixing of spawn and wet substrate should be properly and through with at proper moisture and after spawning this mixture was filled in polythene bags at the rate 1.0 kg/bag. The upper portion of the polythene bags was folded and stapled. Thereafter, 8-10 small holes were made on polythene bags with the help of needle, to permit proper aeration during spawn run. These bags were placed in the dark mushroom crop room at relative humidity of 60-70% and temperature maintained 28±2 ^{0}C. After the full spawn run in the wheat straw, it becomes white compact mass covered with mycelial growth which was also sticking to the polythene bag after approximately three weeks. Some precautions should be taken under the cultivation technology has been given as under-

- Floor should be sterilized before spread the substrate.
- Moisture should be 60-65% maintained in substrate during the filling bags.
- Spawn should be pure not contaminated and spread properly in substrate and mixed properly. Recommended spawn dose should be applied.
- Hand should be washed with dettol or alcohol during the filling bags.

Casing

Casing means covering the top surface of bags after spawn run is over with pasteurized casing material in thickness of about 2-3 cm. Casing provides physical support, moisture and allows gases to escape from the substrate. Casing mixture is prepared by mixing of two years old FYM+VC+GS (1:1:1 w/w) and treated with formalin (4%) solution and kept covered for 48-72 hrs or is pasteurized in autoclave at 15lb psi for one hour. The pH of casing was maintained 7.8-8.9 using calcium carbonate and calcium sulphate. After treatment casing material is spread in uniform layer of 2-3 cm thickness and sprayed with solution of carbendazim and formaldehyde to saturation

level. Temperature 30-35^{0}C and R.H. 80-90% are maintained. It takes about 10 days for mycelium to reach on top of casing layer when fresh air is introduced while maintaining temperature and R.H. as above. Pin head initiation started after 12 ± 2 days of casing in the crop room.

Biological efficiency was calculated @ 1kg dry weight of wheat straw substrate per bag using the following formula:

$$\text{Biological efficiency (\%)} = \frac{\text{fresh weight of fruiting bodies}}{\text{dry weight of substrate}} \text{x100}$$

Results and Discussion

Among the tested casing thickness, the 0.30 cm/125g casing thickness took less period for pinhead formation (12.33 and 12.00 days) in Strain APK-2 & CI-14 and first harvesting (18.00 days) in Strain APK-2 with the thickness of 0.55/225g cm and in CI-14 (18.00 days) with 0.30 cm/125g. Maximum numbers of pinhead initiation were showed with casing thickness of 1.05 cm/425g from APK-2 (72.33/bag) and strain CI-14 (70.33/bag) respectively which was significantly superior to all the tested casing thickness. The maximum numbers of fruiting bodies were harvested from casing thickness 0.80 cm/325gm (28.67/bag) in APK-2 and CI-4 strain (21.33) at 1.05 cm/425gm, respectively. Minimum numbers of fruiting bodies were harvested from strain APK-2 (14.00) and in CI-14 (15.00) at 2.05 cm/825g. However, maximum average weight of fruit body was recorded significantly well with 2.05 cm/825g casing thickness in APK-2 (34.82g) and from strain CI-14 (33.94g) with 1.30cm/525g respectively. Whereas, maximum yield was recorded significantly well in casing thickness 1.55 cm/625gm from strains APK-2 and CI-14 (537.67g/kg and 523.00g/kg of dry substrate with 53.76% and 52.30% B.E.), whereas minimum yield (428.33g/kg and 370.33g/kg of dry substrate with 42.83% and 37.03% B.E.) with 0.30cm/125g casing thickness respectively.

Table 1 Effect of thickness of casing on cropping period and yield of *Calocybe indica* using APK-2 strain

SN	Casing thickness (gm/cm)	DFPF	DFFH	NOPI	NOFB	Yield (g/kg dry substrate)	Average weight (g/FB)	Biological efficiency (%)
1.	125g/.30cm	12.33	18.33	63.33	18.33	428.33	22.59	42.83
2.	225g/.55cm	13.67	18.00	61.00	16.67	480.33	25.91	48.03
3.	325g/.80cm	14.33	18.67	70.00	28.67	523.20	26.88	52.32
4.	425g/1.05cm	15.00	20.67	72.33	19.33	517.00	26.73	51.70
5.	525g/1.30cm	16.00	21.33	55.00	17.00	490.67	32.26	49.06
6.	625g/1.55cm	16.33	22.33	53.33	16.33	537.67	32.74	53.76
7.	725g/1.80cm	17.67	24.33	47.67	14.33	515.67	33.59	51.56
8.	825g/2.05cm	18.00	26.00	42.33	14.00	501.67	34.82	50.16
CD at 5%		2.570	2.760	2.806	2.469	33.369	2.497	-
SE (d)		1.202	1.291	1.312	1.155	15.606	1.168	-

Average of three replications

DFPF= Days for pinhead formation, DFFH= Days for first harvesting,

NOPI= Number of pinhead initiation, NOFB= Number of fruiting body

Table 2 Effect of thickness of casing on cropping period and yield of *Calocybe indica* using CI-14 strain

S N	Casing thickness (gm/cm)	DFPF	DFFH	NOPI	NOFB	Yield (g/kg dry substrate)	Average Weight (g/FB)	Biological efficiency (%)
1.	125g/.30cm	12.00	18.00	64.33	18.33	370.33	17.12	37.03
2.	225g/.55cm	12.33	19.33	55.00	19.67	398.33	22.01	39.83
3.	325g/.80cm	13.67	20.67	64.00	20.67	426.33	18.41	42.63
4.	425g/1.05cm	13.33	21.00	70.33	21.33	450.33	25.31	45.03
5.	525g/1.30cm	14.00	21.33	59.00	19.00	495.00	33.94	49.50
6.	625g/1.55cm	14.00	23.33	53.33	18.33	523.00	30.65	52.30
7.	725g/1.80cm	15.67	24.67	45.67	16.33	513.00	25.27	51.30
8.	825g/2.05cm	17.33	28.33	47.33	15.00	485.00	24.70	48.50
CD at 5%		2.364	2.760	2.520	2.960	26.815	2.388	-
SE (d)		1.106	1.291	1.179	1.384	12.541	1.117	-

Average of three replications
DFPF= Days for pinhead formation, DFFH= Days for first harvesting,
NOPI= Number of pinhead initiation, NOFB= Number of fruiting body

Similarly the result with the findings of Kumar (2013) noticed maximum numbers of pinhead formation were showed in casing thickness 1.25 cm/500 gm (57.67 and 59.33 per bag) followed by 1.5 cm/600 gm (53.67 and 57.67 per bag) in strains APK-2 and CI-9, respectively which was significantly superior to all the tested casing thickness while the minimum number of pinhead initiation were found in casing thickness 2.00 cm/800gm (44.00 and 45.33) in strains APK-2 and CI-9, respectively. Whereas, maximum yield was recorded significantly well in casing thickness 1.25 cm/500 gm from strains APK-2 and CI-9 (619.67 and 636.33 g/kg of dry substrate with 51.63 % and 53.02 % B.E.), respectively followed by (585.00 and 612.22 g/kg of dry substrate with 48.75 % and 51.02 % B.E.) in casing thickness 1.5 cm/600 gm from strains APK-2 and CI-9.

Statistical analysis of data

Data with appropriate transformations were analyzed with the help of analysis of variance table wherever required. The F value was tested and critical difference (CD) was calculated at 5% of significance under the programme of OPSTAT for comparing treatment means.

References

Chang, & Bushwell 1996. Functional properties of mushrooms. *Nut. Rev.*, **54:** 91-93.

Chang, S.T. & P.G. Miles 1991. Resent trends in world production of cultivated edible mushroom. *Mush. J.*, **50(4):** 15-17.

Chang, S.T. & P.G. Miles 1993. Mushroom biology a new discipline. *The Mycologist*, (UK).

FAOSTAT, 2014. Food and Agriculture Organisation and United Nations FAO STAT. http//faostat3.fao.org/home/index.html#Download.

Krishnamoorthy, A.S. 2003. Commercial prospects of milky mushroom (*Calocybe indica*) in the tropical plains in India. *In:* Current vistas in Mushroom Biology and Production **Edited by** R. C. Upadhyay, S. K. Singh & R. D. Rai, *Mushroom Society of India*, Pp. 131-135.

Kumar, A. 2013. Studies on Casing Material for Production of Milky Mushroom**.** M.Sc. thesis, Department of Plant Pathology, SVPUA&T, Meerut.

Purkayastha, R.P. & A. Chandra 1974. New species of edible mushroom from India. *Trans. Br. Mycol. Soc.*, **62:** 415-418.

Royse, D. J. 2014. A Glodal Prospects of High Five Mushroom. *8th International Conference on Mushroom Biology and Mushroom Products*,**1:** 1-6.