Cultivation Practices of Milky Mushroom

Suresh Kumar[1]* and N.L. Meena[2]

[1]Department of Plant Pathology, Rajasthan College of Agriculture

[2]Maharana Pratap University of Agriculture and Technology, Udaipur

Corresponding Author: drskg8888@gmail.com

Introduction

The first report on wild occurrence of Calocybe indica, commonly called "Dudh Chatta" means ("Milky white mushroom") originated from India. Its milky white color and robust nature are appealing to consumers (Fig. 1). In nature, milky white mushrooms are seen grown on humus rich soil in agricultural fields or along the roadside in tropical and subtropical parts of India, especially in the plains of Tamil Nadu (South Indian State) and in Rajasthan (located in the western edge of India). These mushrooms can be grown between the months of May and August, which normally coincides with sufficient showers after a prolonged dry spell. Since this mushrooms is morphologically similar to Agaricus bisporus (Button mushroom), it has been quite popular in southern Indian states and slowly getting popular in other countries (China, Malaysia, and Singapore). Cultivation of milky mushroom has become popular in Tamil Nadu, A.P. and Karnataka where the temperature prevails more than 25-30°C. This is tropical mushroom next to paddy straw.

Small scale mushroom growers prefer to grow this tropical mushroom due to the following reasons: (1) Ideally suited to warm humid climate (30-38°C and 80 to 85% humidity), (2) Its longer shelf life without any refrigeration (can be stored up to 7 days at room temperature), (3) Retains fresh look and does not turn brown or dark black like that of button mushrooms, (4) Lesser contamination due to competitor molds and insects during crop production under controlled conditions, (5) Infrastructure needed to grow this mushroom is very much affordable and cost of production is comparatively low, which means industrial production could be attractive and (6) Has a short crop cycle (7-8 weeks) and good biological efficiency of 140% (140 kg fresh mushroom/100 kg dry substrate).

Milky mushroom (*Calocybe indica*) can be grown on wide range of substrates as in case of oyster mushroom. It can be grown on substrates containing lignin, cellulose and hemicelluloses. Substrate should be fresh and dry. Substrates exposed to rain or harvested premature (green color) are prone to various weed molds which may result in failure of the crop.

Substrate and substrate preparation

It can be grown on any agricultural waste which have good amount of lignin, cellulose and hemicelluloses like straw of paddy, wheat, ragi, maize/bajra/cotton stalks and leaves, sugarcane leaves and bagasse, cotton and jute wastes, dehulled maize cobs, tea/coffee waste etc. However cereal straw (paddy/wheat) easily available in abundance, is being widely

used. Straw is chopped in small pieces (2-4 cm size) and soaked in fresh water for 8-16 hours. This period can be reduced when pasteurization is to be done by steam. Main purpose of soaking is to saturate the substrate with water. It is easier to soak if straw is filled in gunny bag and dipped in water. The substrate can be treated in various ways as follows:

Steam pasteurization

Wet straw is filled inside insulated room either in perforated shelves or in wooden trays. Steam is released under pressure from a boiler and temperature inside the room substrate is raised to 65°C and maintained for 5-6 hours. Air inside the room should be circulated to have uniform temperature in the substrate.

Hot water treatment

Water is boiled in wide mouth container and chopped wet straw filled in gunny bag is submersed in hot water for 40 minutes at 80-90°C to achieve pasteurization. Drain excess water and cooled the substrate to room temp. for spawning. This is very popular method particularly with small growers.

Chemical sterilization

Ninety liters of water is taken in a rust proof drum (preferably of galvanized sheet) or G.I. tub of 200 liters capacity. Ten to twelve kg of wheat straw is slowly steeped in water. In another plastic bucket, carbendazim 7.5 g and 125 ml formaldehyde (40%) is dissolved in 10 liters of water and slowly poured on the already soaked wheat straw. Straw is pressed and covered with a polythene sheet. After 15 to 18 hour the straw is taken out and excess water drained. One can use a larger container or cemented tank of 1000-2000 liters for soaking more straw. The chemicals to be added can be calculated accordingly. The remaining solution can be used once again for chemical sterilization of straw without any further addition of chemicals. Some of the farmers fill the pre wetted substrate in nylon net bags and press these bags in to the cemented tank containing chemical solution. This makes the process of taking out of substrate easier.

Sterilization/Autoclaving

Substrate is filled in polypropylene bags (35x45cm, holding 2-3 kg wet substrate) and sterilized in an autoclave at 15 lb psi for 1 hour. Once pasteurization/sterilization is over, straw bags should be shifted to spawning room for cooling and spawning.

Spawn and Spawning

Sorghum or wheat grains were found to be the best substrates for *C. indica* spawn production. During preparation of the spawn culture, these substrates are half cooked in water for about 30 min and the excess water is usually drained before the grains are slightly air-dried and mixed thoroughly with 2 % calcium carbonate. This wet substrate is then transferred to autoclavable polypropylene bags (usually 30 × 12 cm), which should filled up to 75% volume and sterilized at 20±2 lb psi for 90 minutes. After cooling to ambient temperature, the bags should be aseptically inoculated with the mushroom mycelia, closed and incubated at 30°C temperature. After 15 to 20 days of incubation, complete colonization of the substrate by the mushroom mycelia will be observed, meaning that they can be used for culture bed inoculation. The age of spawn is an important factor that influences the flushing pattern and yield of milky white mushroom. An interesting study developed by Pani who prepared spawns with wheat grains and stored for different periods (14-60 days), revealed that the best milky white mushroom yields were obtained using 21 day old spawn. Prolonged storage of spawn reduced the productivity and total yield.

The rate of mixing spawn to the prepared substrate should be 4 - 5 % of weight of wet straw, means 40-50 kg. Spawn is sufficient for

spawning 1000 kg compost. If lower rate of spawning is done then lower spawn run will be observed i.e., the duration of spawn run period will be increased while higher rate of spawning will lead to rise in temperature of the substrate which adversely affect the spawn run. Therefore the rate of spawning must be accurate.

Colonization of the substrate by mushroom mycelium is known as spawn run. In case of milky mushroom, complete spawn run may takes about 20 days. After that the bags are ready for casing.

Method of Spawning

Spawning is the inoculation of the culture into the substrate or compost. It is the actual planting of the spawn and requires much care depending on the species of mushroom and the technology being applied. However, there are several techniques of introduction of mushroom to substrate. It can be done by any of the following two methods:

Thorough method: Mixing of whole quantity of substrate with required amount of spawn thoroughly and then filled in the polythene bags or trays.

Layer method of spawning: It is the method of filling bags making layers of substrate and spawn i.e., fill some quantity of prepared substrate and then sprinkle spawn over it and then fill some quantity of substrate and then sprinkle some spawn. Thus fill the bag or tray with prepared substrate and spawn making different layers.

Spawned substrate is filled in polythene bags (35x45 cm size) of 125-150 gauze thickness. After filling cover the filled bags with polythene by tying the mouth of bag with rubber band or sutali. Then these bags are shifted to crop room for spawn run and 25-30^{o}C temperature with 80% RH and darkness in the crop room is maintained for the faster spawn run.

Casing

Casing is an important agronomic practice in the cultivation of any humicolous mushroom (that grows on soil) and milky white mushroom is not an exception. Casing was found to be an absolute requirement for proper fructification in *C. Indica* because it triggers off the change of mycelium from vegetative to reproductive phase. Compact casing interfaces impede the diffusion of harmful metabolic gases on mushroom bed surface. Thus accumulation of high concentrations of carbon dioxide in the soil during fructification usually results in yield depression. The qualities of casing soil are – (1) It should have a high water holding capacity, (2) It should retain a good air space ratio to facilitate gaseous exchange i.e., good porosity, (3) Ihe pH of such soil must be neutral to alkaline, and (4) It should be nutritionally poor.

Casing mixtures: Different formulations of casing mixtures can be used for the cultivation of milky mushroom e.g.

- Mixture of 2 years old FYM and 2 years old spent compost (1:1by volume).
- Garden soil and sand mixture (4:1 by volume).
- Decomposed FYM and loam soil (1:1 by volume).
- Peat soil, sand, biogas slurry, farm yard manure and coir pith compost.
- Partially steamed clay loam soil.

It is considered that casing prepared using clay loam soil generate maximum yields and a higher number of buttons than other media. In sandy soil and farm yard manure, the fungus took more than 10 days for the production of pinheads and attained harvesting maturity. In clay loam soil and peat, the buttons appeared almost 2 days earlier when compared to all other casing media tried. Interestingly, the clay loam soil had the quality to absorb moisture

quickly and release it slowly. In this soil, less water was needed to maintain the required moisture level and a delay in spraying did not lead to the total drying of bed surface. Using vermi-compost as casing substrate was also reported with limited success. In addition to its composition, pH, EC, water holding capacity, porosity and bulk density of casing mixture are some of the important factors to be considered while selecting substrates for casing.

Sterilization/Pasteurization of Casing mixtures

Casing soil is treated either by steam at 65-70oC for 6-8 hours or by drenching with formaldehyde or formalin (40%) @ 3 liters in 40 liters of water per m3 casing soil. The pH of casing soil can be adjusted between 7-8 (with the addition of chalk powder, calcium carbonate) about a week in advance of casing. Solution should be enough to saturate the soil. It is covered with polythene sheet to avoid escape of chemicals and at an interval of 2 days soil is turned so that at the time of casing soil is free from formalin fumes. Steam sterilized casing soil produced better yield than the chemically treated with formalin or using heat sterilization.

Casing application

Unfold the bags and its top is made uniform by ruffling the top surface of the substrate. Casing material is spread in uniform layer of 4-5cm thickness. Water spraying should be done immediately after casing application to make the casing wet. Temperatures 32-35°C and RH 80-90% are maintained in the crop room. Case run take about 9-10 days.

Crop Management, Harvesting and Packing

It takes about 10 days for mycelium to reach on top of the casing layer when fresh air is introduced while maintaining temperature and R.H. as above. Light should be provided for long time (10-12 hours daily). The changes thus made in the environment, result in the initiation of fruiting bodies within 3-5 days in the form of needle shaped pin heads which will mature in about a week.

Crop management

A. During substrate preparation

Substrate is a major source of weed molds and disease causing organisms. Hence substrate should be chopped and soaked at a distance from bag filling/spawn running and cropping areas. The worker chopping straw should not be involved in bag filling and spawning without taking a bath and change of cloth.

B. During the bag filing, spawning and Spawn running stage

(i) Bag filling and spawning room should be sprayed with formaldehyde (1%) twice in a week. Persons doing the process should take a bath and change the cloth before the job. There should not be much air movement in the room. For large scale production it is advisable to have Hepa filtered air circulation. Spawn running rooms should be sprayed as given below:

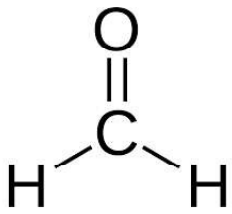
(ii) Formaldehyde 0.5% (5ml/litre of water) once a week.

(iii) Malathion 0.1% (1 ml/litre of water) once in a week. Rooms should be protected from the rates and flies by providing iron frames and nylon net on windows.

C. During casing and cropping:

At the time of casing bags open the top surface spray carbendazim (1 gm) + formaldehyde (5ml) in 1 liter of water, do casing and repeat it on casing soil and inside the room and again after a week. It should not be sprayed on mushrooms. Malathion (0.1%) should be sprayed in the evening or next day to protect from flies. It should not be sprayed on mushrooms. If any patch of mold (it may be green/blue/brown) is noticed do spot

treatment with formaldehyde (4%, 40 ml/liter) soaked cotton by touching it on and around the spot. This will kill the mould. Before removal of bags spray formaldehyde (2%) to dispose off spent substrate away from the farm.



D. Water management :

This is very important for a good and healthy crop. During rainy season controlled watering is required and watering once may be enough. During summer watering twice may be sufficient to maintain the required RH and moisture of the substrate. During such period one can use mist sprayer 3-4 times and frequently check the moisture of the casing by touching. Watering should also be adjusted to maintain RH inside the cropping room.

Harvesting and Packing

After 9-10 days of casing, pinheads start emerging out which will be ready to harvest within 3-5 days. Mushrooms 7-8 cm diam. are harvested with the help of Thumb and first two fingers by holding the fruit body, twisting it and pulling out from the bag. It should be done before watering the bags. After harvesting, cut the lower most portion of the stipe with the help of sharp knife to remove the soil adhered on it and then packing should be done. Packing can be done as per the market demand in packets of either 200 gm, 250 gm, 500 gm or one kg bags. However, if growers have to send the product to any processing unit for the making of value added products then bulk packing can also be done. Packing should be done in perforated polythene/polypropylene bags for marketing.

Spent Mushroom Substrate

The SMS of milky mushrooms has not been studied much as the cultivation of this mushroom has remained confined to only a few pockets of Southern peninsular regions of India only. As the substrate and the methodology used for substrate production are similar to that of *Pleurotus spp*. so it can be presumed that the physical properties of this SMS will be similar to that of SMS from oyster mushroom. The biochemical properties, which more depend upon the species used for cultivation, are bound to vary from specie to specie. Even with respect to its utility for cultivation of other mushrooms, for vermi composting, bioremediation, bio control of diseases and insect pests of crop plants, bio fuel production and composting for manure preparation has not been studied much. Considering the physical structure and bulk of SMS from milky mushrooms there are possibilities that it can found uses in bio fuel production that includes extraction of enzymes for their use in bio-ethanol production and their use in heat generation and composting for manure preparation.

Conclusion

Cultivated mushrooms have now become popular all over the world. There are over 200 genera of macro-fungi which contain species of use to people. Twelve species are commonly grown for food or medicinal purposes, across tropical and temperate zones, including the Common mushroom (*Agaricus*), Shiitake (*Lentinus*), Oyster (*Pleurotus*), Straw (*Volvariella*), Lion's Head or PomPom (*Hericium*), Ear (*Auricularis*), *Ganoderma* (Reishi), Maitake (*Grifolafrondosa*), Winter (*Flammulina*), White jelly (*Tremella*), Nameko (*Pholiota*), and Shaggy Mane mushrooms (*Coprinus*). Commercial markets are dominated by *Agaricusbisporus, Lentinulaedodes* and *Pleurotus*sp., which represent three quarters of mushrooms

cultivated globally. Mushrooms provide a high protein and low caloric diet and can thus be recommended to heart patients. They also contain all the essential amino-acid required by an adult. Small scale mushroom growers prefer to grow this tropical mushroom due to the following reasons: (1) ideally suited to warm humid climate (30-38ºC and 80 to 85% humidity), (2) its longer shelf life without any refrigeration (can be stored up to 7 days at room temperature), (3) retains fresh look and does not turn brown or dark black like that of button mushrooms, (4) lesser contamination due to competitor molds and insects during crop production under controlled conditions, (5) infrastructure needed to grow this mushroom is very much affordable and cost of production is comparatively low, which means industrial production could be attractive, and (6) has a short crop cycle (7-8 weeks) and good biological efficiency of 140% (140 kg fresh mushroom/100 kg dry substrate).

References

- Ainsworth, G.C. (1976). Introduction to the history of mycology. Cambridge University Press, Cambridge, UK.
- Chang, S. T. & Miles, P. G. (1992). Mushroom biology-a new discipline. *The Mycologist*, 6:64–65.
- María, E.V.; Talía, H. and Octavio, P. (2015).Edible Mushrooms: Improving Human Health and Promoting Quality Life. *International Journal of Microbiology*.1-14.
- Marshall, E. and Nair, N. 2009. Make Money by Growing Mushrooms; Food and Agriculture Organization of the United Nations (FAO): Roma, Italy.

❖❖