Course- Mushroom Cultivation Technology (ELP)

Course code- EL-AGP 803

Practical Manual

THE NEOTIA UNIVERSITY

ज्ञानम् आत्म प्रदीपाय

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CONTENT

INTRODUCTION TO MUSHROOM

Objective: To familiarize the students with Mushroom

Definition –

Mushrooms are macro fungi with characteristic fruiting bodies which are large enough to be seen with naked eyes and picked by hands. During its growth, a mushroom can decompose organic materials and absorb nutrients from it. Mushrooms can be a good source of protein which contains all the essential amino acids. Mushrooms are also high in fibre, rich in vitamins, and low in cholesterol. Mushrooms are commonly used for various dishes in different shapes and forms.

Systemic position of Mushroom –

Kingdom: Fungi.

Sub-Kingdom: Dikarya.

Division: Basidiomycota.

Subdivisions: Agaricomycotina**.**

Class: Agaricomycetes.

Order: Agaricales

Family: Agaricaceae

What Are the Parts of a Mushroom?

There are two main parts to a mushroom fungus; An above-ground **fruiting body** or sporophore and the underground **mycelium**.

Mycelium –

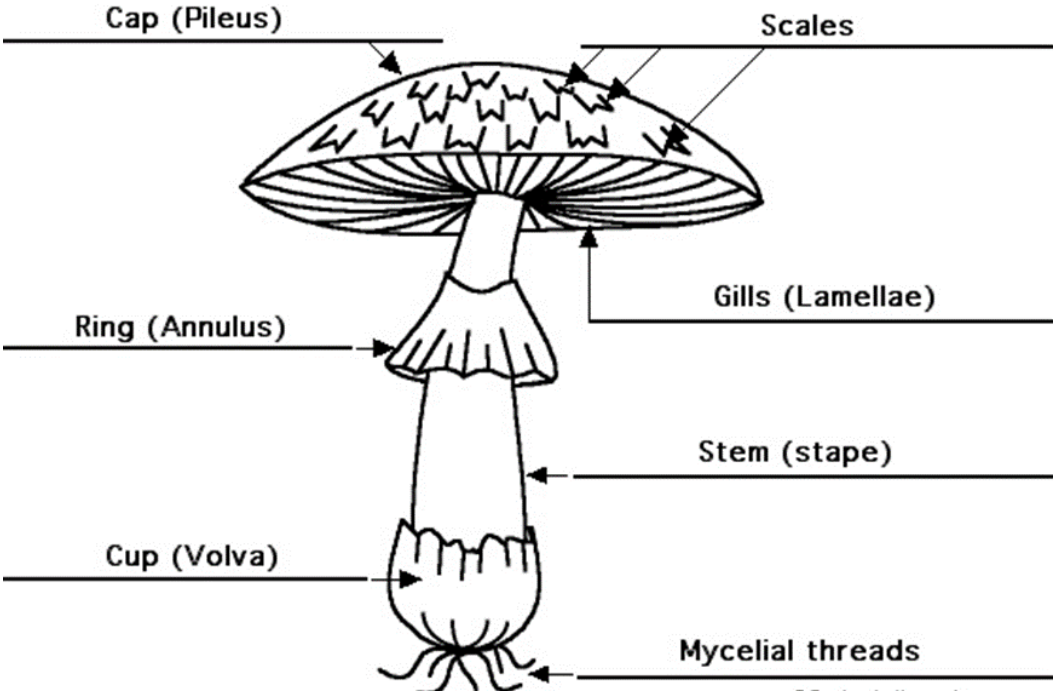
Mycelium forms the underground part of the fungus that we seldom see. It's a vast, complex network of cells that form thin fibers, like plant roots, and spread under the forest floor in search of nutrients. When a mushroom spore lands in a spot with ideal growing conditions, it germinates. Producing thread-like filaments called hyphae that grow, interconnect and form mycelium. Extensive networks of mycelium spread over large distances underground and connect fungi to each other. Mushrooms don't have chlorophyll like plants for food production. Instead, the mycelium grows by absorbing nutrients from dead and decaying organic matter. Mycelium lives for many years and may remain dormant for several seasons until conditions are perfect for fruiting. Mycelium's only goal is to reproduce and keep its species going. To do this, it grows mushrooms that produce and distribute spores.

Fruiting Body –

The umbrella-shaped body of a mushroom that we recognize is the fruit of a much larger underground fungus. They're called fruiting bodies or sporophores and are the fleshy, sometimes edible, part of the

fungus. The fruiting body usually grows above the ground or on the surface of a host. Its purpose is to produce and distribute spores so the fungus can reproduce.

Parts of a Mushroom and Their Functions: -



A. Cap –

The cap of the mushroom is the topmost part and gives the fungi its umbrella-like shape. It can be flat, conical or spherical and have a wide range of textures and colors. The caps' color and texture don't only vary by species. They also change depending on the stage of development of the mushroom. The shape of the cap also changes throughout the development of the mushroom. The cap contains the spore-producing surface of the mushroom, made up of gills, pores or teeth. The technical name for a mushroom cap is a pileus.

Function:

The function of the cap is to protect the spore-producing surface. It does this in the same way that an umbrella would protect you from rain or the heat of the sun.

B. Gills –

The gills are thin, paper-like structures layered side by side that often hang from the underside of the cap. Gills come in various colors and have distinct features, making them useful for species identification.

Not all mushrooms have gills. Some, like porcinis, have pores. These are tiny, tightly packed tubes that resemble a sponge. Others, like lion's mane, have teeth or needles instead of gills. Gills also called lamellae.

Function:

The purpose of the gills is to hold the spores, the microscopic "seeds" of a mushroom.

C. Spores –

Mushroom spores are microscopic, unicellular reproductive cells produced in the gills. Most spores are shades of white, brown, pink or black, but there are also some mushrooms with orange, green and yellow spores. Some scientists use the color, size and shape of spores to identify fungi. A mushroom spore is like a seed in that it contains all the genetic material required to grow new mushrooms. At the end of the mushroom growth cycle, mushrooms release their spores. Wind, water, animals or humans then disperse them. The spores need to land in a warm, moist, shaded area to germinate.

Function:

The spore of a mushroom contains all of the necessary materials to form a new fungus. When the spores of a mushroom are released, they may travel a certain distance before they land. The single cell then sends out hyphae to help establish the fungus and gather food.

D. Ring –

A ring of tissue is sometimes found on a mushroom stem. It's the remaining part of a partial veil. A partial veil is a thin piece of tissue that provides an extra layer of protection for the gills when the mushroom is young. Rings vary considerably and may be thick and prominent or thin and cobweb-like. People use the ring type, position and shape for the identification and classification of mushrooms.

Function:

The partial veil, which becomes the annulus or ring on the stalk in the mature mushroom, is a swath of tissue that covers and protects the gills of the fruiting body while it is developing.

E. Stem –

The stem or stipe supports the cap and elevates it above the ground. The function of a stem is to assist with the dispersal of the spores. In the wild, many mushrooms use the wind or animals to scatter their spores. Thus, the cap and gills need to be high enough from the ground for the mushroom to effectively release its spores into the wind or onto passing animals. The size, shape and texture of the stem play a role in identifying mushrooms. Some mushrooms have no stems at all. While others, like oyster mushrooms, have gills that extend down the sides of the stem.

Function:

The stem or stipe supports the cap and elevates it above the ground. The function of a stem is to assist with the dispersal of the spores.

F. Volva –

The volva or universal veil is a layer of tissue that protects the immature mushrooms of some species as they grow out of the ground. As the mushroom matures, it breaks through the universal veil, leaving the bottom part of the veil at the base of the stalk. The remnants create a cup-like shape at the stem's base. The volva is very important when identifying mushrooms in the wild.

Function:

In mycology, a volva is a cup-like structure at the base of a mushroom that is a remnant of the universal veil, or the remains of the peridium that encloses the immature fruit bodies of gasteroid fungi.

G. Mycelium –

Mycelium is a web-like structure made up of long hyphae fibers that are often white or cream. The mycelium, as a whole, is the non-reproductive, vegetative part of the mushroom found in soil or other organic matter. The mycelium grows outwards to look for water and other nutrients. It then transports these to the fruiting body or mushroom so it can mature and release spores. Mycelium plays a vital role in nature as it aids the decomposition of plant material and provides food for many soil invertebrates.

Function:

Mycelium extends the area in which a mushroom or fruiting body can acquire nutrients.

H. Hyphae –

The hyphae are the microscopic, thread-like filaments or tubes that interconnect and grow to form the web-like mycelium or body of a fungus. The function of the hyphae is to absorb nutrients from the environment and transport them to other parts of the fungus.

Function:

Hyphae perform a variety of functions in fungi. They contain the cytoplasm or cell sap, including the nuclei containing genetic material. Hyphae absorb nutrients from the environment and transport them to other parts of the thallus.

PRACTICAL 1: VIABLE SPAWN PRODUCTION OF OYSTER MUSHROOM

Objective: To know the production technology of Spawn (mushroom seed) by using the fruiting body of Oyster mushroom.

Sterilization technique in laboratories for mushroom spawn production requires avoiding any contamination like the appearance of unwanted microorganism and to provide safety for the user. Therefore, mushroom laboratory equipment and sterilization techniques are two major tasks for mushroom spawn production and yielding of quality crops.

Materials required: As the spawn is a vital part of mushroom cultivation and it is produced through laboratory practices so the major requirements of spawn and laboratory accessories are tabulated below:

1. **Autoclave** is required for the sterilization of culture media.
2. **Hot air oven** is required for the sterilization of glassware.
3. **The Laminar air flow cabinet** is needed for isolation and multiplication of pure culture and spawn inoculation.
4. **BOD incubator** is needed to keep the pure cultures and master culture at a specific temperature (28°~1°C)
5. **Refrigerator** which is often required for short term reservation of the mycelial culture of mushrooms.
6. **Boiling Pan or boiling kettle** for boiling the grains and for preparation of media.
7. **Gas** can be installed on a stove or steam line for boiling of wheat grain and preparation of media.
8. **Chemicals:** Potato dextrose agar (PDA media), calcium carbonate, calcium sulphate, alcohol, spirit, Mercury chloride, chloramphenicol (antibiotic), formaldehyde.
9. **Other items:** glass material, inoculation needle (hook type), chemicals for media preparation, polypropylene bags, absorbent and non-absorbent cotton, rubber band, spirit lamp, stove, water sprayer, and paper.
10. Apart from the above mentioned items the Steel racks in the incubation room, exhaust fan, test tube, petri plate etc. are required.

The major requirements for a spawn production laboratory are autoclave BOD incubator, laminar flow, digital balance, hot air flow, glass apparatus, petri dish, culture tube, conical flax, measuring cylinder and polybag

Mushroom Spawn Production Technology:

Spawn is an important vital part of mushroom cultivation. Spawn preparation is the major laboratory practice for mushroom production. Artificial propagating material is vital for cultivation. This artificial propagating material is produced on substrates in well-equipped laboratory practice. This artificial seed of mushroom is generally referred to as a spawn.

Spawn is maybe defined as synthetic grain supported medium that is impregnated with mycelia of a pure culture of the chosen micro fungal stain which are used as inoculums for initiating fruit body production as mushroom. In more simple form which is defined as medium impregnated with mycelia that serves as the seed for mushroom cultivation.

Culture Media:

Culture is important for culturing the fungal and bacterial strains. Culture media is also known as growth media. The culture media provides the entire nutritional requirement to the microbial stain for their growth. There are several media used for fungal culture. The compositions and method of popularly known used media is PDA media.

Method of media preparation: PDA media is the most recommended and widely used media for growing fungi. In the preparation of PDA, potatoes (20g) are washed. Peeling and slicing into small pieces. Then it is boiled in 100 ml distilled water until potatoes become soft enough but not overcooked. The straining of the extract in a glass container is followed by restoring volume of 100 ml. The addition of 2g dextrose and 2 g of agar is made by stirring occasionally until the agar is dissolved completely. Addition should be made while boiling the water. The prepared media is transferred into 25 ml culture tubes, or 250 ml conical flasks followed by plugging with non-absorbent cotton. Then it is wrapped with brown paper. Then the flask and test tubes were sterilized at 121˚C 15 psi for 15 to 20 minutes using an autoclave. Then slants are prepared by placing sterilized media containing tubes on the table in a slanting position for the next 24 hours for cooling.

Fungal Culture:

Fungal mycelia which are artificial cultured onto a media of slant under laboratory practice are called as fungal culture. Fungal mycelia culture is generally prepared on the slant or Petri plate through pouring of plate from stab with inoculation of spores on the mass of the cell of fungi aseptically under the laminar airflow cabinet.

STEP-I: ISOLATION OF FUNGAL CULTURE

Procedure:

Tissue Culture Technique:

Young basidiocarp (fruiting body) is cleaned with sterilized distilled water and dipped into 0.1% Mercury chloride or 2.5% sodium hydrochloride solution for 30 seconds to 1 minute under the laminar air flow chamber. Then it is split open longitudinally and little mycelial bits are cut carefully from the caller region (junction of cap and stipe portion) with the help of a sterilized cold knife. Doing this care should be taken that it doesn't touch the inner surface of the mushroom fruiting body. These bits are then washed in sterilized water three times to remove mercury chloride and place these tissue pieces in blotting paper to show the excess water. After that it is placed in PDA media on the petri plate. The petri plates are incubated in BOD at 25°~2° C or 27°~1°C for 10-15 days.

Observation:

Conclusion:

STEP-II: PREPARATION OF MOTHER SPAWN

Spawn media:

Spawn for mushroom production can be prepared by using any kind of cereal grains as substrates or media. The most common cereal grains used in spawn preparation include rice, wheat, maize, jowar, bajra, and agriculture waste (rice straw, saw dust etc.). Cereal grains used in spawn preparation should be free from disease, insect damage, and should not be broken and old. The cereal- based substrates are good for spawn production for several edible mushrooms.

Procedure of Spawn Medium Preparation:

The cereal grains to be used as substrate for spawn preparation are thoroughly watched 3 to 4 times in sufficient water to remove soil debris, straw particles and undesirable seeds of grasses, weeds etc. 100 kg of cereal grains are weighed and soaked in water for 20 to 30 minute and then boiled in a container for 20 to 25 minutes. Excess water of the boiled grains is drained off by spreading on a sieve, the grains are left as such a few hours on the sieve so that the water on the surface gets removed through evaporation. Now the grains are mixed with gypsum and chalk powder so that the pH of the grains can be achieved around 7 to 7.8 and don't form clamps. Different people use different ratios of gypsum and chalk powder for mixing. However, the best result is achieved by using gypsum (120 grams per 5 kg cereal grain) and chalk powder (40 grams per 5 kg cereal grain). First gypsum and chalk powder are separately mixed and then thoroughly mixed with the grain. This mixing should be done on a smooth surface with hands wearing gloves. Now about 250 gram prepared cereal grain substrate is filled with a milk bottle or polypropylene bags up to 2/3rd volume and plugged with non-absorbent cotton.

The flask is covered with aluminium foil and these bottles are placed in an Autoclave. For cooling, these autoclaved bottles are left in room for 24 hours. After cooling the autoclave bottles are kept in a laminar air flow chamber under UV tubes for 20 to 30 minutes. A piece of mycelium of pure culture is grown in Petri plates on media aseptically inoculated to these bottles. And these inoculated bottles are placed in BOD chamber. The spawn gets ready in 15 to 20 days with white cottony mycelium grown on grain-supported media. This spawn is obtained from pure culture and is referred to as the mother spawn. Once the fully colonized mother spawn is obtained, bottles can be used for inoculating the commercial spawn bags after 2 to 3 weeks.

Observation:

Conclusion:

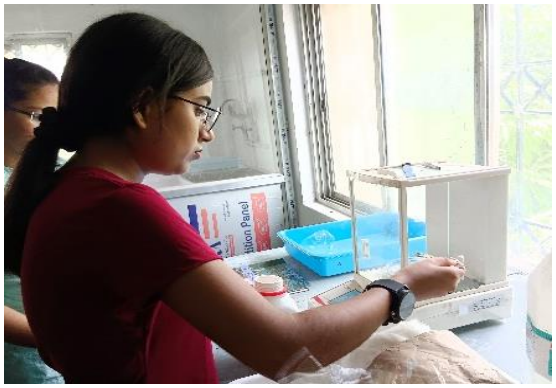
STEP-III: PREPARATION OF COMMERCIAL SPAWN

Procedure of Multiplication of Spawn:

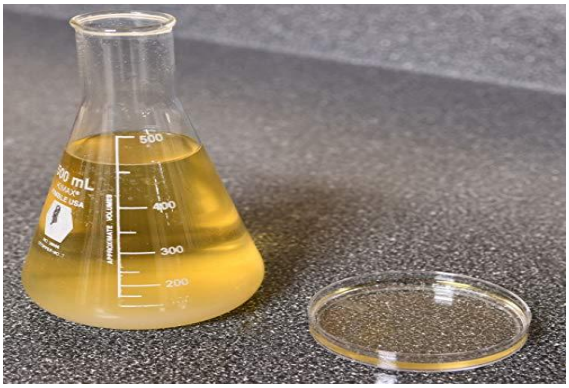
Polypropylene bags are generally being used for commercial spawn production. After filling the grains into the polypropylene bags, they are plugged with non-absorbent cotton and wrapped with Aluminium foil. The bags filled with grains are then sterilized in an autoclave. Autoclaved bags are shaken well before making inoculation, so that the water droplets accumulated inside the gas get absorbed by the grains. The sterilized bags are kept in the laminar air flow chamber under a UV tube for 20 to 30 minutes. About 10 gram of master spawn is used to inoculate each commercial spawn bag under aseptic condition and one bottle of master spawn is sufficient to inoculate 20-25 commercial spawn bags. After inoculation, the inoculated bags are again shaken so that the inoculums are well mixed with the media. Then following successful inoculation bags are kept in the incubation room. During incubation, bags are regularly examined for mould infestation and if any bags get contaminated it should be removed immediately to avoid more contamination. Normally it takes 15 to 20 days for maturation of spawn with white cottony mycelial mat. Fully colonized bag should be kept in a cold room for future use.

Observation:

Conclusion:

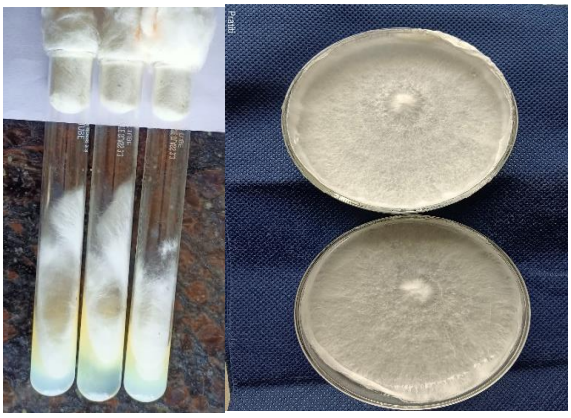


Weighing of media powder in weighing balance



PDA Media

Isolation of Mushroom



Pure culture of Mushroom

Boiling of wheat grain for preparation of Spawn

Mixing of gypsum and chalk powder with boiled grain

Mother Spawn of Mushroom

Commercial Spawn of Mushroom

Spawn Production Technology

PRACTICAL 2: CULTIVATION TECHNIQUE OF OYSTER MUSHROOM

Objective: To know the cultivation technology of Oyster mushroom.

Oyster mushroom (*Pleurotus* sp.) belonging to Class Basidiomycetes and Family Agaricaceae popularly known as 'dhingri' in India and grows naturally in the temperate and tropical forests on dead and decaying wooden logs or sometimes on dying trunks of deciduous or coniferous woods. It may also grow on decaying organic matter. It is one of the most suitable fungal organisms for producing protein rich food from variousAgro-wastes or forest wastes without composting.

Materials required: Paddy straw, spawn, boti, big bucket (50 liters), korai, polythene bags (35x45 cm), scissor, sprayer, knife etc.

Oyster mushroom cultivation process on Agro waste has the following major steps

1. **Mushroom Spawn:**

Mushrooms spawn is a vital part of mushroom cultivation. It is the artificial seed of macro fungi used for initiation of fungal fruiting body formation which is called as mushroom cultivation. Mushrooms spawn can be collected from authorized spawn suppliers or maybe produced in laboratory.

2. **Mushroom Bed:**

Substrates: - Substrate is the major raw material of mushroom bed for mushroom cultivation. Any lignocellulosic agro waste can be used as substrate or medium for mushroom cultivation with pasteurization. Agro waste like paddy straw, sugar cane trash, maize straw and banana leaves are the major common available substrate of Oyster mushroom in West Bengal, lndia.

3. **Bed Preparation technique:**

The Agro waste such as paddy straw, waste paper, saw dust, maize straw and wheat straw are used for mushroom cultivation. Agro waste are chopped (2-3 cm pieces) and soaked in water, pasteurized, cooled and excess water is drained off. The polythene bags (35x45 cm) were filled up with Substrates and multilayered technique is adopted for spawning. Each bag is filled up with 1.5 kg of dry substrate and 200g of Spawn with multilayered technique. After complete layering packets are wrapped with rubber band and make perforated with needle all over the surface to allow free exchange of gases. Now mushroom bed is ready to incubate.

4. **Incubation:**

Then mushroom beds are incubated in mushroom cropping house, so it is called as Cottage cultivation, where the temperature and humidity are maintained around 25°C and 80-90% respectively. The spawn run was completed within 20 to 25 days with white cottony mycelium growth. Then polythene sheets are tear-off carefully to expose mycelia mat on the substrate. The beds are then sprayed with water regularly to moisten. Formation of fruit bodies as pinheads is appeared within 3-4 days. Next another 3-4 days pinhead is matured to fruiting body i.e. mushroom.

5. **Harvesting of Crops:**

Macro fungal fruit body i.e. mushroom is harvesting gently pulling or twisting the fruit body from substrate clock wise or anti clock wise with hand application. It will take another few days for the second and third flush.

Chopping the paddy straw (3-4 cm)

Chopped paddy straw fill in gunny bags

Soaking in water for 12 hrs

Doing pasteurization (80-85^{O} C)

Drying of paddy straw under the sunlight

Bagging of paddy straw with spawn

Tie the poly bag and make tiny holes randomly around the poly bag then plugging them with absorbent cotton

Fruiting body of Oyster Mushroom

Advantages of *Pleurotus* sp. cultivation:

- It grows on wide range of easily available agricultural wastes.
- It can grow in wide range of temperatures from 17-30 ^{O} **C.**
- Its conversion rate i.e. percentage of fresh mushroom production from the dry substrate is very high i.e. Biological efficiency (BE) is up to 100%
- It is less susceptible to disease and moulds than other mushrooms.
- Faster growth rate and easy cropping.
- Cost of production is low as it does not require costly infrastructure facilities.
- Most suitable venture for rural areas and can create self-employment.

Limitations of *Pleurotus* sp. cultivation:

- Spore allergy to certain people.
- Limited consumer demand in some parts of the country.

Yield and biological efficiency:

Observation on period of spawn run, appearance of pinhead, maturation of fruiting bodies are recorded up to third flush. Fresh weight of mature fruit bodies are also recorded upto third flush to calculate the total yield and corresponding biological efficiency. Biological efficiency (B.E.) is determined by the ratio of fresh weight (g) of mushroom upto third flush to dry weight of (g) of substrate and express as percentage.

$$\textbf{Biological efficiency (B.E.)} = \frac{\textbf{Fresh weight (g) of mushrooms harvested} \times 100}{\textbf{Dry weight (g) of substrate}}$$

Observation: Yield performance of *Pleurotus* sp. on substrate:

Substrate	Yield			Total yield	Biological efficiency
	1st Flush	2nd Flush	3rd Flush		

Preparation of balance sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for mushroom produce.

Observation: Calculate the cost of cultivation, Net profit and calculation of B: C ratio.

Sl. No.	Items	Specification	Operational justification	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Substrate					
2.	Polythene bag					

3.	Mushroom spawn					
4.	Rent of mushroom house or space (own land)					
5.	Infrastructure					
6.	Cost of water and electricity					
7.	Chemicals					
8.	Cost of labour (own labour)					
9.	Packaging and marketing					
10.	Miscellaneous					
Total cost of cultivation (Rs.)						
Yield (Kg)						
Net profit (Rs.)						
B:C ratio						

Yield per bag-

Price per kg-

Conclusion:

PRACTICAL 3: VIABLE SPAWN PRODUCTION OF PADDY STRAW MUSHROOM

Objective: To know the production technology of Spawn (mushroom seed) by using the fruiting body of Paddy straw mushroom.

Materials and Procedure:

Required materials and production technology have already described in practical 1.

Observation:

Conclusion:

PRACTICAL 4: CULTIVATION TECHNIQUE OF PADDY STRAW MUSHROOM

Objective: To know the cultivation technology of Paddy straw mushroom.

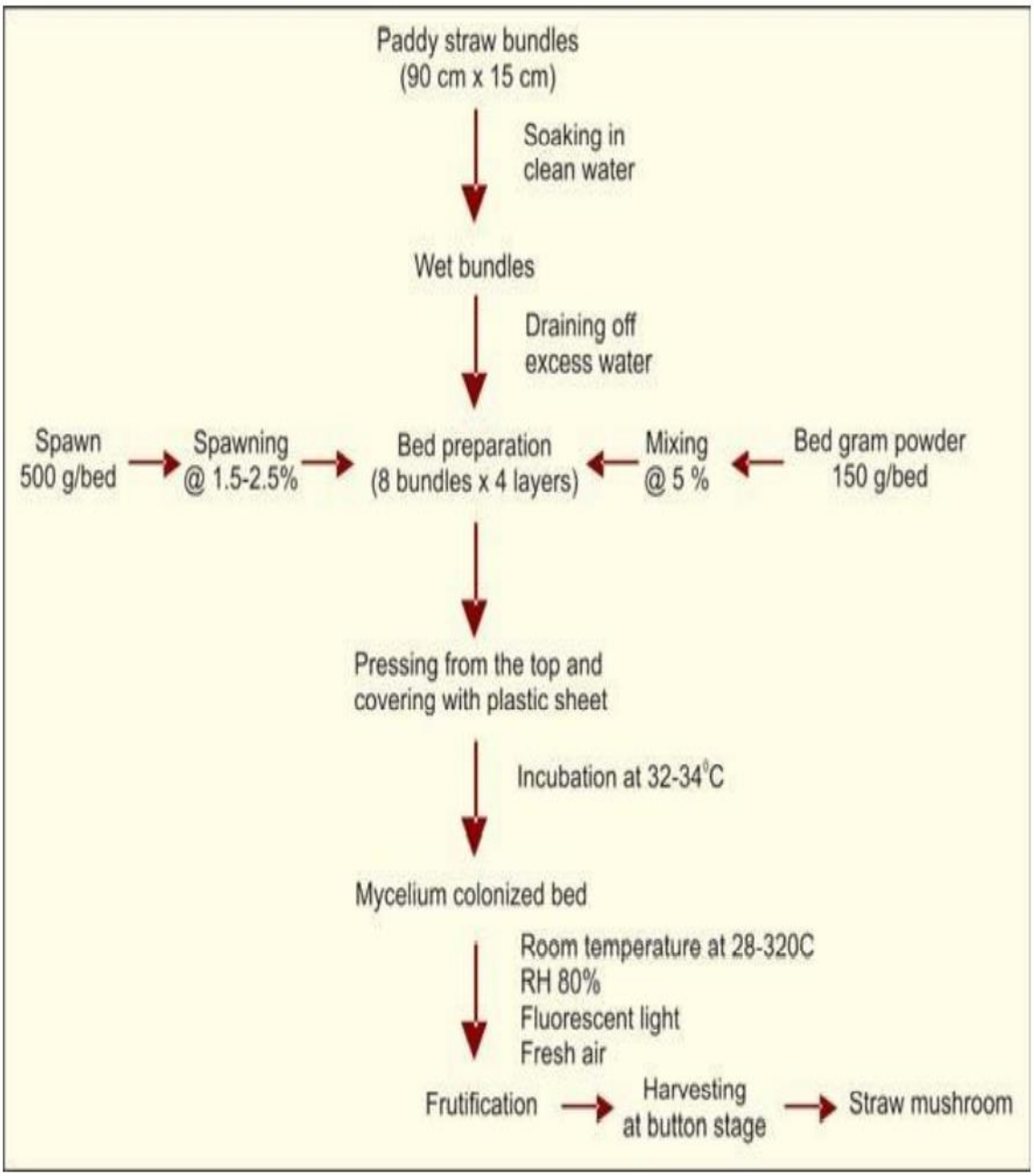
The paddy straw mushroom is having good combinations of all attributes like flavour, aroma, delicacy, high content of protein and vitamins and minerals, because of which, the acceptability of this mushroom is no way less than much popular white button mushroom. Mushrooms, also called 'white vegetables' or 'boneless vegetarian meat'.

Materials required: Paddy straw, spawn, boti, polythene sheet, racks, red gram powder, scissor, sprayer, knife etc.

Production Technology:

Different steps involved in this method are as follow: -

- Prepare paddy straw bundles of 0.5 kg (80-95 cm long & 12-15 cm wide) preferably from hand threshed paddy.
- Immerse the bundles in water which is mixed with lime (200gm in 100 lit water) for 12-18 hours in a cemented water tank.
- Drain out excess water by placing bundles on raised bamboo or cemented platform.
- Make first layer by placing 4 bundles side by side and another four bundles similarly but from the opposite side forming one layer of eight bunds.
- Prepare second, third & fourth layer by intermittent spawning between the layers.
- Spawn the entire surface of different layers of the beds leaving margin of 12-15 cm from edges at a space of 5 cm apart.
- Sprinkle red gram powder over the spawned surface.
- Use 200 g spawn and 150 g of red gram powder for a bed of 12 kg paddy straw.
- Press beds from the top and cover with clean polythene sheet for maintaining requisite humidity (80-85%) and temperature (30-35 °C).
- Remove the polythene sheet after 7-8 days and maintain a temperature of 28-32 °C with 80% humidity.
- Mushroom will start appearing after 4-5 days of sheet removal and will continue for next 15-20 days.
- After crop harvest the left over substrate can be converted in to manure for its use in the fields.



Flowchart of Paddy straw mushroom production technology

Cutting of Paddy straw

Drying of Paddy straw bundles

Preparation of mushroom bed

Covering the bed by polythene sheet

Mycelial growth from mushroom bed

Fruiting body of Paddy straw mushroom

Harvesting of mushrooms:

The straw mushroom is harvested before the volva breaks or just after rupture. These stages are called as the button and egg stages. This mushroom grows at high temperature and moisture thus grows fast. So for harvesting of straw mushroom at good condition it has to be harvested twice or thrice in a day (morning, noon & afternoon). This mushroom usually takes 9-10 days from spawning to harvest of first crop and the first flush normally exist for 3 days, which constitute about 70 to 90% of the expected mushroom yield. The intervening period of 3 to 5 days require thorough watering and maintaining of optimum conditions inside the rooms. The next flush will again survive for 2-3 days and yields less mushroom than the first flush. The second flush added only 10 to 30% of the total crop. On reaching the harvestable size, the fruiting bodies should be carefully separated from the beds/substrate base by lifting & shaking slightly left or right and then twisting them off. The mushrooms should not be cut off by knives or scissors from the base of the stalk, because the stalks left behind on the bed/substrate will rot and will be attacked by pests and moulds, which in turn will destroy the mushroom bed.

Advantages of *Volvariella* sp. cultivation:

- Paddy straw mushrooms are cultivated indoors and do not require arable land.
- Paddy straw mushroom is a short-duration crop with high yield per unit time.
- Paddy straw mushrooms are valued not only as nutritious and delicious food but these also possess medicinal properties including anti-cancer and anti-HIV activities.

Limitations of *Volvariella* sp. cultivation:

- Paddy straw mushrooms are highly perishable vegetable crop with less than two to three days of storability. Presently, more than 85 per cent of the total mushroom production in the country is of button mushroom. There is less diversification with respect to mushroom species as well as mushroom products.
- Inadequate implementation and follow-up of institute-village linkage programmed for effective transfer of mushroom production technology.

Observation: Yield performance of *Pleurotus* sp. on substrate:

Substrate	Yield		Total yield	Biological efficiency
	1st Flush	2nd Flush		

Preparation of balance sheet

Objective: To learn the process of calculation of cost of production.

Procedure: Collect all the data related to all inputs required, cost of labour, collection of data and market study for mushroom produce.

Observation: Calculate the cost of cultivation, Net profit and calculation of B: C ratio.

Sl. No.	Items	Specification	Operational justification	Quantity	Rate (Rs.)	Amount (Rs.)
1.	Substrate					
2.	Racks					
3.	Mushroom spawn					
4.	Red gram powder					
5.	Rent of mushroom house or space (own land)					
6.	Cost of water and electricity					
7.	Chemicals					
8.	Cost of labour (own labour)					
9.	Packaging and marketing					
10.	Miscellaneous					
Total cost of cultivation (Rs.)						
Yield (Kg)						
Net profit (Rs.)						
B:C ratio						

Yield per bed-

Price per kg-

Conclusion:

PRACTICAL 5: BY-PRODUCT FROM MUSHROOM

A. PREPARATION OF MUSHROOM PICKLE

Objective: - To know the processing and preservation technology of small scale mushroom pickle production.

Under our conditions, especially in rural area, it may not be possible to do canning of mushrooms. A locally accepted alternative is to make pickle. In fact, some mushrooms like milky mushroom are more accepted as pickle than as fresh product. Pickling of mushrooms is an easy home scale process for preservation of mushrooms to a value-added product of high market acceptability.

Materials required: For 1 kg mushroom you need various spices viz., turmeric powder (20g), black mustard seed powder (35g), red chilli powder (10g), cumin seed powder (1.5 g), carom seed (10 g), nigella seed (kalonji) (10 g), fennel seed powder (1.5 g), salt (90 g) and mustard oil (200 ml). You may also use Acetic acid (upto 100 ml) and sodium benzoate within the permitted limits as preservatives. This pickle can be stored up to one year in the airtight bottles.

Procedure:

1. One kg mushrooms are washed in 0.03 to 0.05% KMS solution and then blanched for 5 min at 85°C.
2. The blanched mushrooms are washed in cold water 2-3 times and the excess water is drained off.
3. Mushrooms are cut in halves or quarters according to the size.
4. Then the mushrooms are subjected to salt curing process, in which 20 g sodium chloride per kg of mushroom is added and kept overnight. The excess water that oozes-out of mushroom is removed on the next day.
5. Mushrooms are allowed to dry for 2-3 hours and spices, salt and preservatives are mixed to the desired taste and quality of mushroom pickle.
6. We add heated mustard oil from the top to the mixture and blend with both hands, leave overnight for imbibing of spices and flavour development, fill in plastic/glass jars and again top-fill with mustard oil, close the caps and seal the jars and store pickle at shaded ambient place.

Given below is another recipe for making sweet-sour pickle of mushroom:

Sweet-sour/mixed mushroom pickle-

Materials required: Mushrooms- 250 g, Onion- 50 g, Ginger- 25 g , Garlic- 2-3 cloves , Mustard oil- 100 g, Salt- 1 spoon, Red chilies- 1/2 spoon, Garam masala- 1/2 spoon, Jaggery- 100 g, Vinegar /acetic acid- 3 cup/ 1 spoon, Mustard seeds- 10 g

Procedure:

1. Wash the mushroom and cut into small pieces.

2. Cut ginger, onion garlic into fine pieces.

3. Grind the mustard seeds coarsely.

4. Make a mixture of Jaggery and vinegar.

5. Heat the mustard oil and fry the mushrooms, keep fried mushrooms to one side.

6. Fry onion ginger, garlic till light brown.

7. To this add fried mushrooms and solution of jaggery and vinegar.

8. Then add mustard powder, chillies, salt and garam masala. Mix well and keep in sun for 2-3 days.

Conclusion:

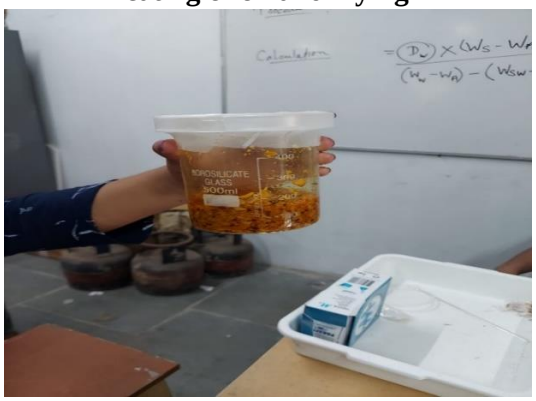
Washing and Cutting

Mixing of ingredients

Heating of oil and frying

Heating of oil and frying

Mixing of all ingredients



Final Product

B. PREPARATION OF MUSHROOM POWDER

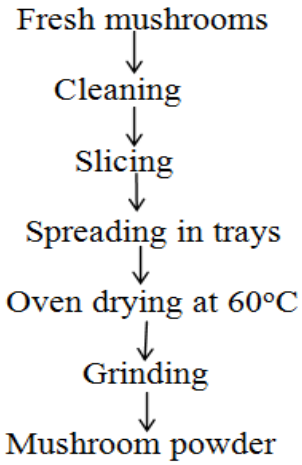
Objective: - To produce fine mushroom powder for the formulation of confectionary or ready to eat product.

As you are aware that drying is one of the most important methods to decrease the water content of the produce. The dried produce can be further utilized for preparing a number of value-added products. Button mushroom cannot be easily sundried. However, mushrooms like oyster, shiitake, wood ear mushroom, etc can be easily sundried. Besides sun drying, mushrooms can be dried in cabinet dryers at a drying temperature of 55-60ºC which gives dehydrated final product of lower moisture content with longer shelf life and better quality.

Mushrooms have about 90% water and hence after drying these become very light. Care has to be taken while sun-drying. Mushrooms should be dried in dust free area and in containers where these don't get dispersed with wind. Additional advantage of sun drying is the increase in Vitamin D content in the mushroom. Mushrooms having open gills should be firstly dried with gill side upwards preferably in shade and then dried in sun. You may use solar based heater. But it is important to monitor the temperature of drying. Temperature above 60°C is not desirable as it leads to charring of sugars, loss of flavour and also decrease in rehydrability (that is gain of weight on rehydration of the dry product). You may powder the dried mushrooms and use it to make various products. Up to 10% powder can be added to flour that may be used to make biscuits, bread, cake or any other bakery product.

Procedure: -

1. Fresh mushrooms are cleaned and cut into slices (about 3 mm thickness).
2. Drying is carried out at 60°C for 8 hr in a tray drier.
3. Afterwards dried mushroom sample are ground separately in an electric grinder/ mortal pestle.
4. Grounded mushroom powder then sifted through an 80-mesh screen to obtain fine powders.
5. The obtained powder is then cooled and hygienically packed and stored in airtight container for further use.



Conclusion:

Weighing of Mushroom

Drying of Mushroom

Grinding of dry Mushroom

Fine Mushroom powder