

**Sem VI General
Botany Dissertation (DSE)
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Cultivation of mushroom – venture for food and income

SUBMITTED BY

SUBHRA MUKHERJEE

(UNIVERSITY ROLL – 180611610028)

SUPERVISED BY

DR. SUNITA BANDOPADHAY

DEPARTMENT OF BOTANY, MUC WOMEN'S COLLEGE , BURDWAN

THE UNIVERSITY OF BURDWAN

INTRODUCTION

What is mushroom



- ▶ Mushroom is a fungi producing a fleshy fruiting body , especially one consisting of a stalk with an umbrella cap .
- ▶ It has two part : cap like structure is known as PILEUS ,
attached with the thread like structure MYCELIA .
- ▶ Mycelia absorb nutrient From soil , it do not require sun light for their growth.

History of mushroom



- ▶ Cultivation of **mushroom** in western culture was first recorded in Paris ,france , around 1650 . Agaricus bisporus ,the quintessential “ shop **mushroom** “ , was first observed growing in melon crop compost.
- ▶ **1886** : some specimens of mushroom were grown by N.W. Newton and exhibited at the annual show of agriculture , horticulture society of india .
- ▶ **1886-87** : Dr. B.C. Roy of the Calcutta medical college carried out chemical analysis of the local mushroom prevalent in caves or mines .
- ▶ **1908** : A thorough search of edibles **mushrooms** was instituted by Sir David Rain .
- ▶ **1921** : bose was successful in culturing two agaricus on a sterilised dung media. Details of which were published in the Indian science Congress held at Nagpur during **1926.....**

TYPES OF MUSHROOM

(Approximately 14,000 species of mushroom are described)

- ▶ Mushrooms are undoubtedly, a connoisseur's gastronomic delight and quite healthy too. Mushrooms do not fall under the animal or plant variety but belong to the kingdom of fungi . With over a thousands types of mushrooms ,only a few of them have gained immense popularity. This is mainly due to the exotic flavour and taste besides their medicinal properties.
- ▶ There are two types of mushrooms – **Edible Mushroom**
Poisonous Mushroom

EDIBLE MUSHROOM

(there are over 50,000 species of mushroom , including molds and yeasts.)

- ▶ Edible mushrooms are consumed by human for their nutritional value and they are occasionally consumed for their supposed medicinal value .
- ▶ Edible may be defined by criteria that include absence of poisonous effect on humans and desirable taste and aroma .
- ▶ Edible mushrooms include many fungal species that are either harvested wild or cultivated .
- ▶ Examples :
 1. Button mushroom
 - ▶ 2. Shiitake(forest or oak) mushroom
 - ▶ 3. Oyster mushroom
 - ▶ 4. Porchini (cepe or bolete) mushroom
 - ▶ 5. Paddy straw Mushroom

BUTTON MUSHROOM



- ▶ **Scientific name : Agaricus bisporus**
- ▶ **A.bisporus** is an edible **basidiomycete** mushroom native to **grasslands** in **Europe** and **North America** . It has two colour states while immature – white and brown – both of which have various names, with additional names for the mature state.
- ▶ **When immature and white** , this mushroom may be known as **common mushroom, white mushroom , cultivated mushroom , champignon mushroom.**
- ▶ **When immature and brown** , it may be known variously as **Swiss brown mushroom, Crimini mushroom etc.**

OYSTER MUSHROOM



- ▶ **scientific name : Pleurotus ostreatus**
- ▶ Oyster mushrooms are beloved the world over for their delicate texture and mild , savory flavour.
- ▶ The mushroom typically have broad,thin , Oyster- or fan shaped caps and are white , gray , or tan with gills lining the underside.
- ▶ They are also known as pearl oyster mushrooms or tree oyster mushroom. They are more expensive than white button mushrooms but less so than rarer mushrooms like morals.
- ▶ Oyster mushroom is the rich source of protein, vitamin ,minarels , fibre and other antioxidants like selenium protect body cells from damage that lead to chronic disease and help to strengthen the immune system. Oyster mushroom is low in calories, fat free cholesterol free , gluten free and very low in sodium.

Paddy Straw Mushroom

Scientific name : *Volvariella volvacea*

It is a species of edible mushroom cultivated throughout East and South Asia and used extensively in asian cuisines. They are often available fresh in regions they are cultivated , but elsewhere are more frequently found canned or dried.

The mild flavoured , smooth textured mushroom has a pleasing appearance and the entire mushroom is edible .



SHIITAKE MUSHROOM



Scientific name : Lentinula edodes

- ▶ The **shiitake** is an edible mushroom Native to **East Asia** , which is cultivated and consumed in many East Asian countries.
- ▶ **Shiitake mushrooms** are easily recognisable for their brown , convex (umbrella-like) caps (grow between 2 and 4 inches) , off-white gills, and tan stems .
- ▶ It's often called the “ **Elixir of Life** “ and is also known as the “ **Fragrant mushroom** “ .

PORCHINI MUSHROOM

Season September - November



PER 100 GRAM:

Calories 20 cal Protein 3.6 g

Carbohydrates 0.5 g, total sugars: 0 g Fat 0.4 g

Dietary Fiber 7 g

- ▶ **Scientific name : *Boletus edulis***
- ▶ Porcini mushrooms, (also known as king bolete or cepe in french) are cultivated in europe , north america and part of asia.
- ▶ Porcini mushrooms are brown caped mushrooms with thick , white stalks. The caps can range in size form an inch to nearly a foot.
- ▶ Fresh porcini mushrooms are in season during the summer and fall .
- ▶ These mushrooms are low in calories but supply a good amount of iron , protein ,and fiber. They are also high in antioxidants and may reduce inflammation , improve digest health , promote weight loss.

MUSHROOM POISONING

- ▶ Also known as **mycetism** or **mycetismus**.
- ▶ Refers to harmful effects from ingestion of **toxic** substances present in a **mushroom** . These symptoms can vary from slight **gastrointestinal** discomfort to **death**.
- ▶ The **toxic** present are **secondary metabolites** produce by the **fungus** .
- ▶ **The most common reason** for this misidentification is close resemblance in terms of colour and general **morphology** of the toxic mushrooms species with edible species .

How to identify poisonous mushroom :

1. **Avoid picking mushrooms that are shape of an umbrella and has white rings around the stems.**
2. **Avoid mushrooms with red on the cap or stem .**
3. **When you cut the mushrooms it turns either green or purple .**
4. **Poisonous mushrooms have bad odour .**
5. **It tastes bitter**
6. **There is presence of scales on the cap .**

Examples of poisonous mushroom

- ▶ Deadly Dapperling (*Lepiota brunneoincarnata*)
- ▶ Destroying Angel (*Amanita verna*)
- ▶ Autumn Skullcap (*Galerina marginata*)
- ▶ Webcam mushroom (*Cortinarius rubellus*)
- ▶ Death cap (*Amanita phalloides*)



IMPORTANCE OF MUSHROOM NUTRITION



- ▶ Mushrooms are nature's **hidden treasure of nutrition** . But **are they really good for you ?** The answer is **yes!** For thousands of years , mushroom have been used in eastern medicine for their various health benefits .
- ▶ Earlier mushrooms were considered as an expensive vegetable and were preferred by affluent peoples for colinary purposes.
- ▶ Currently common populace also considers mushroom as a quality food due to it's health benefits.

Nutritional value of mushroom

- ▶ The nutritional value of mushroom is affected by numerous factors such as species, stage of development and environmental conditions. Mushrooms are rich in protein, dietary fiber, vitamins and minerals.
- ▶ The digestive carbohydrate profile of mushroom includes starches, pentoses, hexoses, disaccharides, amino sugars, sugar alcohols and sugar acids.
- ▶ The total carbohydrate content in mushroom varied from 26-82% on dry weight basis in different mushrooms. The crude fibre composition of the mushroom consist of partially digestible polysaccharides and chitin.
- ▶ Edible mushroom commonly have insignificant lipid level with higher proportion of polyunsaturated fatty acids. All these resulted in low calorific yield from mushroom foods. they have ergosterol that acts as a precursor for Vit- D synthesis in human body.
- ▶ The crude protein content of mushrooms varied from 12-35% depending upon the species. The free amino acids composition differs widely but in general they are rich in threonine and valine but deficient in sulphur containing amino acids (methionine and cysteine).

Nutritional value of mushroom

Table 1: Nutritive values of different mushrooms (dry weight basis g/100g)

Mushroom	Carbohydrate	Fibre	Protein	Fat	Ash	Energy k cal
<i>Agaricus bisporous</i>	46.17	20.90	33.48	3.10	5.70	499
<i>Pleurotus sajor-caju</i>	63.40	48.60	19.23	2.70	6.32	412
<i>Lentinula edodes</i>	47.60	28.80	32.93	3.73	5.20	387
<i>Pleurotus ostreatus</i>	57.60	8.70	30.40	2.20	9.80	265
<i>Vovarella volvaceae</i>	54.80	5.50	37.50	2.60	1.10	305
<i>Calocybe indica</i>	64.26	3.40	17.69	4.10	7.43	391
<i>Flammulina velutipes</i>	73.10	3.70	17.60	1.90	7.40	378
<i>Auricularia auricula</i>	82.80	19.80	4.20	8.30	4.70	351

- ▶ Mushrooms compromise about 80-90% of water , and 8-10% of fiber . In addition to these , mushroom is an excellent source of vitamin especially C and B (Folic acid , Thiamine , Riboflavine , and Niacin) .
- ▶ Minerals, potassium , sodium and phosphorus are higher in fruit bodies of mushroom . It also contains other essential minerals (cu , zn , mg) in traces but deficient in iron and calcium.

Table 2: Medicinal values of some important mushrooms

Mushroom	Compounds	Medicinal properties
<i>Ganoderma lucidum</i>	Ganoderic acid	Augments immune system Liver protection
	Beta-glucan	Antibiotic properties Inhibits cholesterol synthesis
<i>Lentinula edodes</i>	Eritadenine	Lower cholesterol
	Lentinan	Anti-cancer agent
<i>A. bisporous</i>	Lectins	Enhance insulin secretion
<i>P. sajor-caju</i>	Lovastatin	Lower cholesterol
<i>G. frondosa</i>	Polysaccharide	Increases insulin secretion
	Lectins	Decrease blood glucose
<i>Auricularia auricula</i>	Acidic polysaccharides	Decrease blood glucose
<i>Flammulina velutipes</i>	Ergothioneine	Antioxidant
	Proflamin	Anti cancer activity
<i>Trametes versicolor</i>	Polysaccharide-K (Kresin)	Decrease immune system depression
<i>Cordyceps sinensis</i>	Cordycepin	Cure lung infections Hypoglycemic activity Cellular health properties Anti-depressant activity

MEDICINAL VALUES OF MUSHROOM

1. Good for health

- ▶ The edible mushrooms have little fat with higher proportion of unsaturated fatty acids and absence of cholesterol and consequently It is the relevant choice for heart patients and treating cardiovascular diseases . Minimal sodium with rich potassium in mushroom enhances salt balance and maintaining blood circulation in human . Hence, mushrooms are suitable for people suffering from high blood pressure. Regular consumption of mushrooms like *Lentinula* , *pleurotus* sp were stern to decrease cholesterol levels.

2. Low calorie food

- ▶ The diabetic patients choose mushroom as an ideal food due to its low calorific value, no starch and little fat and sugars. The lean proteins present in mushrooms help to burn cholesterol in the body .

3. Prevents Cancer

Compounds restricting tumor activity are found in some mushrooms but only a limited numbers have undergone clinical trials .. All form of some edible mushrooms , and white button mushrooms in particular , can prevent the prostate and breast cancer . Fresh mushrooms are capable of arresting the action of 5-alpha-reductase and aromatase , chemicals responsible for growth of cancerous tumors . The drug known as Polysaccharide-K (kresin) , is isolated from *Trametes versicolor* which is used as a leading cancer drug . Some mushroom-derived polysaccharides have ability to reduce the side effects of radiotherapy and chemotherapy too. Such effects have been clinically validated in mushrooms like *Lentinula edodes* , *Trametes versicolor* , *Agaricus bisporus* and others.

4. Regulates digestive system

- ▶ The fermentable fiber as well as oligosaccharide from mushrooms acts as a prebiotics in intestine and therefore they anchor useful bacteria in the colon . This dietary fibre assists the digestion process and healthy functioning of bowel system .

5. Strengthens Immunity

- ▶ Mushrooms are capable of strengthening the immune system . A diverse collection of polysaccharides (beta- glucans) and minerals, isolated from Mushroom is responsible for upregulating the immune system. These compounds potentiate the host's innate (non-specific) and aquired (specific) Immune responses and activate all kind of immune cells .

Cultivation of mushroom

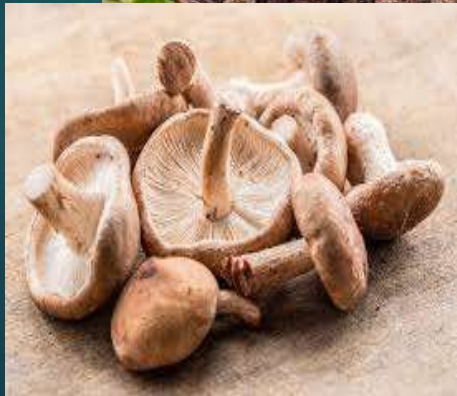
Advantages

1. Environment friendly.
2. Use agriculture waste as substrate.
3. Possible production all the year round.
4. Uses less capital.
5. Income and employment generator.
6. Mushrooms are rich in digestible essentials amino acids, rich protein, vitamins and minerals but low volume of high quality unsaturated fat and water-soluble carbohydrates.
7. Have high medicinal properties.
8. It constitutes one of the most promising resources for promoting rapid socio-economic development.

MUSHROOM CULTIVATED IN INDIA

- ▶ There are three sorts of Mushroom that are being cultivated in India, they are button mushroom, straw mushroom and oyster mushroom. Paddy straw mushrooms can develop in temperatures ranging from 35⁰ to 40⁰C. Button mushrooms grow at some point of winter. Oyster mushrooms are grown in the northern plains.

Pictures of cultivated mushroom all over world



OBJECTIVE

- ▶ To produce protein-rich food for family consumption.
- ▶ To produce herbal , medicinal food at low cost .
- ▶ To make people aware about the importance of consumption of mushroom.
- ▶ To get trained to become self-employed by cultivating Mushroom at pilot or commercial scale .
- ▶ To encourage empowerment of women and unemployed youth (especially from rural areas) .

Materials and methods (Button mushroom)

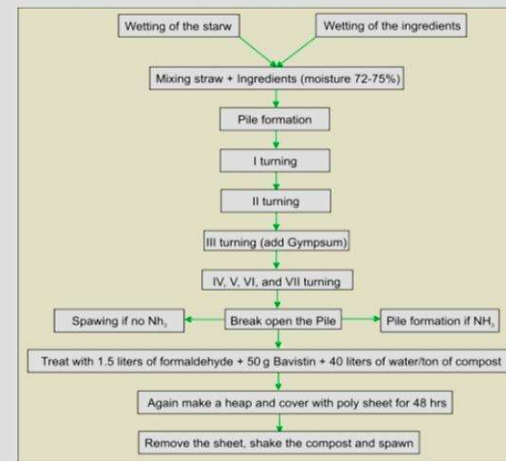
- ▶ **Materials :** The substrate on which Button mushroom grows is mainly prepared from a mixture of plant wastes (cereal straw/sugarcane bagasse etc.) , Salts (urea Superphosphate/gypsum etc.) , Supplements (rice bran /wheat bran) and water . In order to produce 1kg of mushroom , 220g of dry substrate materials are required.
- ▶ **Methods :** There are two types of methods of composting , Long method and short method . The distinction is based on the time taken for composting and the long method needs three to four weeks , while the short method requires only 12-15days , since the composting process is hastened by pasteurization. In the long method of composting , pasteurization is avoided , which will make the compost poor in quality and often gives variable yields .



Compost preparation

- ▶ **Long method** : The composting is done on a cement floor . It can be done in the open or under a roof , but sides are to keep open .

Flow chart of Long Method Composting



- ▶ **A) Natural compost** : This compost is traditionally prepared by using horse manure and the barn waste consisting of straw bedding of wheat or barley . These are taken in the proportion of 4:3 and this mixture , generally 100kg of chicken manure and 5kg of urea are added per tone of substrate. The manure is kept as heap of about one metre height and is regularly examined and turned repeatedly when it emits ammonia smell. This is done for every three – four days. Finally every tone 25kg of gypsum is added.

- ▶ **B) Artificial Compost :** Many formula are available and ingredients vto be used vary according to the locality and availability of materials. A widely used formula in India is given below :

Formula	Quantity
Wheat straw (chopped to 8-2- cm)	250 g
Wheat bran	25 kg
Ammonium sulphate of Calcium ammonium nitrate	4 kg
Urea	3 kg
Gypsum	20 kg

- ▶ Chopped wheat straw is spread over the floor and water is sprinkled thoroughly to wet the straw . Mix all the ingredients except gypsum. Finally the mixture stacked to height of one metre and compacted using wooden boards. This mixture is turned periodically on 5th , 10th , 14th , 18th , 22nd , and 26th day. The gypsum is added in two equal splits on the 14th day and 18th day . It is advisable to add nematicides like nemagon on the 22nd day , 40-50 ml per tone of substrate. In Mushroom houses where insect pests are also a problem , 10-15 ml of malathion is also added during gthe final turning and sufficient quantity of water is also added on the heap.

Short Method

- ▶ The short term compost involves two phases of operation , outdoors composting and steam pasteurization . The commonly used formula is given below .

Formula	Quantity
Chopped Wheat Straw	100 g
Chicken manure	400 kg
Barley	72 kg
Urea	14.5 kg
Gypsum	30 kg

- ▶ **Phase : 1 outdoor composting** : Barely and chicken manure are added to wheat straw and stacked after adding sufficient water to completely wet the same . The stack can be 3.3×2.5×1 m size . Turnings are given on the 2,4,6 and 8th days . The pH to be adjusted to 8.5 and the compost filled into trays for pasteurization.
- ▶ **Phase: 2 stream pasteurization** : Stram or dry heat is introduced to establish an aerobic fermentation and the temperature maintained between 52-60°C inside the compost. Usually it is done in a room well insulated where the trays are properly kept and after this all ventilators are closed and steam is introduced to raise the temperature to 52-54°C for four hr and afterwards fresh air is introduced and steam supply cut off.

Compost Production By Short Method



Wetting of the Straw



Low Stack of Watted Straw



Mixing of Ingredients



Making of Pile



Compost piles

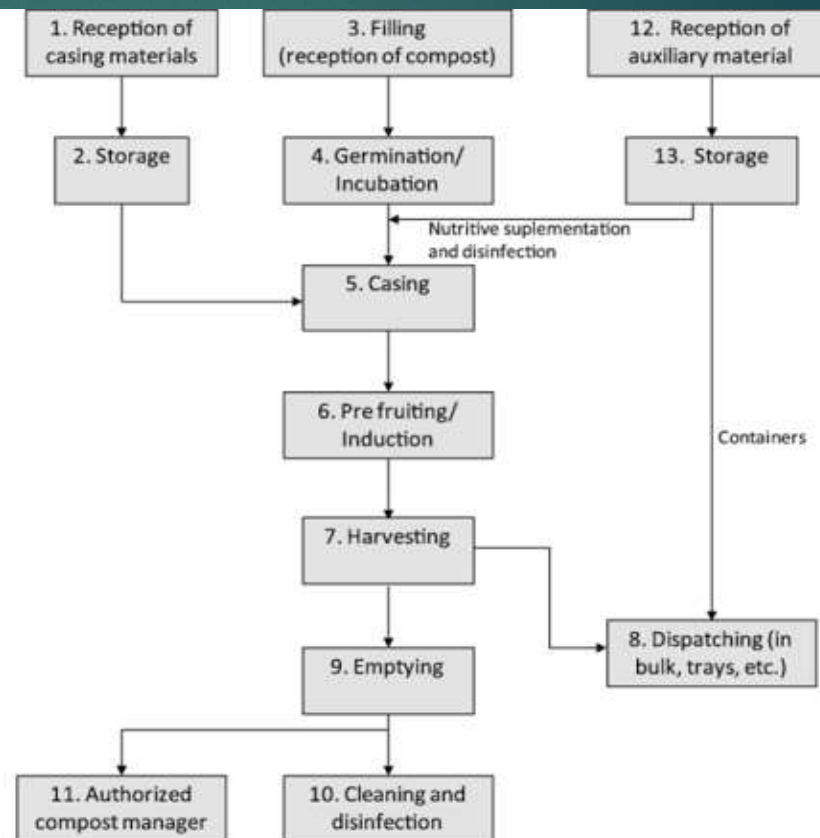


Pasteurization of Compost



Flow chart of button mushroom cultivation

Fig. 1 Flow chart of the mushroom cultivation line



Materials and methods (oyster mushroom)

- ▶ **Materials :** Straw (mostly paddy straw and wheat straw) Is the basic raw material which is used as substrate for Mushroom bed preparation . There are many different agricultural wastes , agro – industrial wastes or weeds which are used as low cost substrate for Mushroom bed preparation especially for oyster (pleurotus) Mushroom production . For example , maize straw , paddy husk , sugarcane bagasse , banana pseudostem , sugarcane trash , mustard stalks , various weeds such as water hyacinth.



Bed preparation for oyster mushroom

- ▶ The Cultivation of Oyster mushroom is usually carried out in transparent polythene covers . The size of the cover c60×30 cm , with a thickness of 80gauges.
- 1. Wash hands thoroughly with an antiseptic lotion.
- 2. Take polythene cover and tie the bottom end with a thread and turn it inwards.
- 3. Mix the dried straw thoroughly to get a uniform moisture level in all areas.
- 4. Take out well-grown bed spawn , squeeze thoroughly and divide in two halves .(two beds are prepared from single spawn bag).
- 5. Fill the straw to a height of 3” in the bottom of the polythene bag ; take a handful of spawn and sprinkle over the straw layer, concentrating more on the edges.
- 6. Fill the second layer of the straw to a height of 5” and spawn it as above.
- 7. Repeat this process to get 5 straw layer with spawn.
- 8. Gently press the bed and tie it tightly with a thread.
- 9. Put 6 ventilation holes randomly for ventilation as well as to remove excess moisture present inside the bed.

Bed preparation for oyster mushroom

10. Arrange the beds inside the thatched shed , (spawn running room) following the rack system or hanging system.

11. Maintain the temperature of 22-25°C and relative humidity of 85-90% inside the shed .

12. Observe the beds daily for contamination , if any . The contaminated beds should be removed and destroyed.

13. Similarly , observe regularly for the infestation of insect pests , flies , beetles, mites ,etc. If noticed, the pesticide like malathion should be sprayed Inside the shed 1ml per litre of water.

14. The fully spawn run beds can be shifted to cropping room for initiation of buttons.



Cutting the straw - 5 cm size



Soaking in cold water for 4-5hrs



Bed Spawn for inoculation of beds



Poly bag size: 60 x 30 cm, with a thickness of 80 gauge.



Strip one end with the thread



Fill the straw to a height of 3" in the bottom of polythene bag



sprinkle the spawn



Fill the second layer of the straw to a height of 5" and spawn



Repeat this process to get five straw layers with spawns



Gently press the bed and tie it tightly with a thread



Put 6 ventilation holes randomly

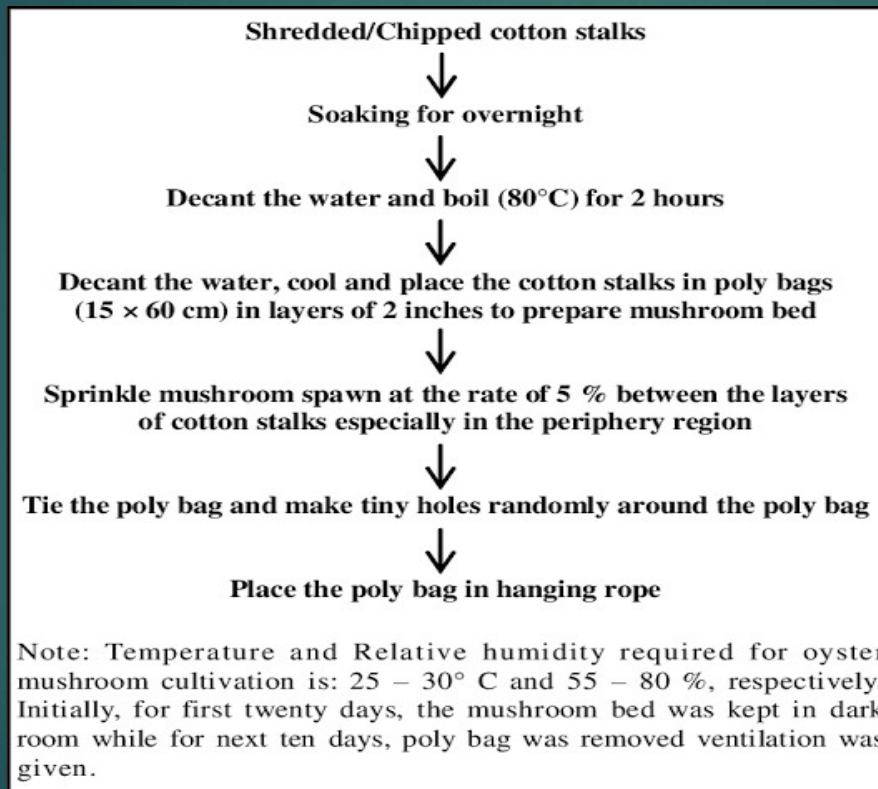


Labeling



Hanging rope system

Flow chart of Oyster Mushroom Cultivation



Materials and methods (Paddy Straw Mushroom)

Paddy straw is the most important thing in cultivation of *Volvoriella volvaceae*. It is a by-product of rice plant. It is known as Paira or Puaal in Hindi. Rice and straw are separated from each other after the harvesting of field crop. Straw of all paddy sp. Can be used for bedding material.

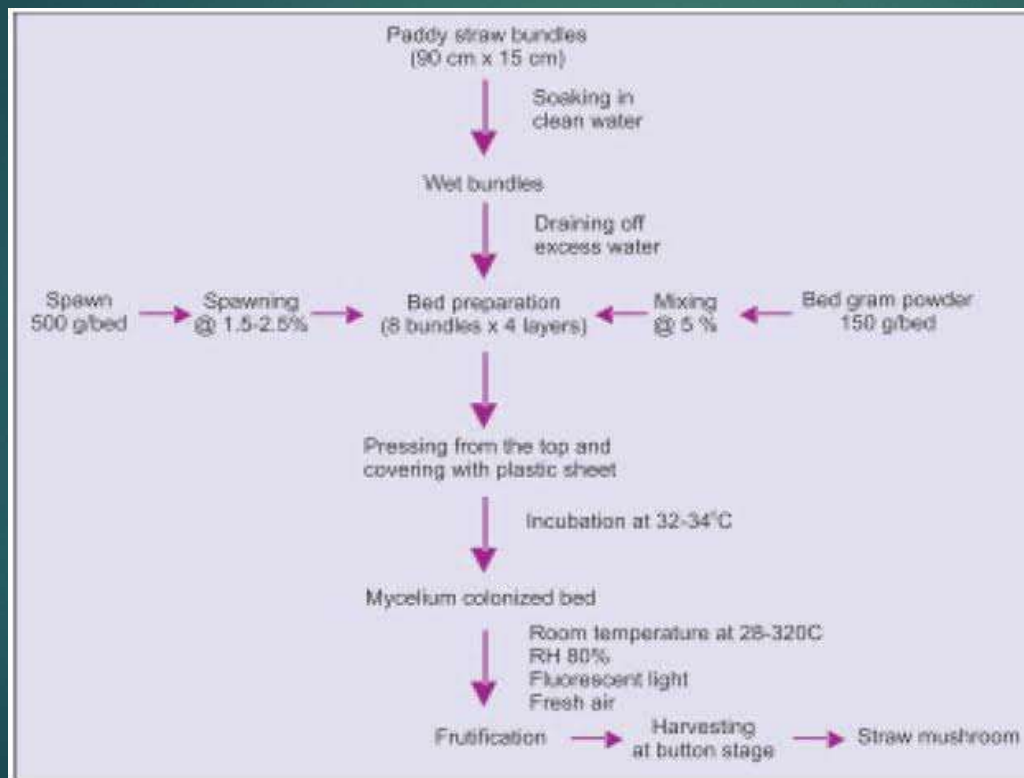


Bed preparation for Paddy Straw Mushroom



- ▶ In India, the Mushroom of this variety is grown on paddy straw. Well dried, long straws are tied together in bundle of 8-10 cm in diameter. They are then cut to uniform length of 70-80cm and soaked in water for 12-16 hours. Excess water is then allowed to drain off later.
- ▶ Four bundles from the soaked straw is placed on the frame . Another four bundles are placed but with the loose ends in the opposite direction. These eight bundles together make up the first layer of bedding. About 12cm away from the first layer , the grain spawn is scattered. Powdered gram or wheat/rice bran dusted all over the spawn. A second and third layer of 8 straw bundles are placed on the first layer and spawning again after every layer . The last fourth layer of straw bundles is placed and lightly pressed. Then the whole bed is covered with a transparent plastic sheet.

Flow chart of Paddy Straw Mushroom Cultivation



Result

▶ Different mushroom species yield differently. Some yield more while some yield less. If you see button mushroom, they give a total of 10 to 15 kg Mushroom yield per square foot. If you cultivate Mushroom in a 250 square foot, then the total yield is up to 2,500 – 3,750kgs .

▶ while the oyster mushroom which is the other

▶ er popular Mushroom variety yields a total of 12kg per square foot in India. The total oyster mushroom yield per square foot is 3000kgs.

▶ while if you see the cost of mushroom per kg, button sells for Rs. 120-150 . While the oyster mushroom is about Rs. 150.

▶ success in the Cultivation of paddy straw Mushroom depends on scale of farming and proper management practice.

▶ 8-10kg Mushroom can be produced from 1kg of mushroom spawn/seed.

▶ cost of 1kg Mushroom = 350-400INR

▶ so, profit margin will always high.

Yield performance of Oyster Mushroom cultivated on paddy straw

Oyster mushrooms	Substrate (1 kg, dws)	Yield* (g fresh weight mushroom/ kg dws)			Total yield (g/kg dws)
		1st flush	2nd flush	3rd flush	
<i>P. florida</i> (14-20 C)	RS	589.3	514.6	203.5	1,307.4
	RS + WH (1:1)	761.6	511	249.3	1,521.9
	RS + WH (1:2)	561.8	450	231	1,242.8
LSD at 5% level					
<i>P. citrinopileatus</i> (24-30 C)	RS	608.7	530.5	472.5	1,611.7
	RS + WH (1:1)	725.1	504.5	478.8	1,708.4
	RS + WH (1:2)	631.3	396.7	202.6	1,230.6
LSD at 5% level					
<i>P. pulmonarius</i> (20-26 C)	RS	589.8	450.2	236	1,276
	RS + WH (1:1)	684.9	561.2	278.8	1,524.9
	RS + WH (1:2)	598.8	457.5	225.2	1,281.5
LSD at 5% level					

Conclusion

- ▶ Mushroom production is an indoor activity using vertical space hence does not compete with agricultural land thus suited to small farmers , farm women and landless labourers .
- ▶ Many agricultural wastes can be utilized to produce quality food and organic manure in field crops. Besides Mushroom have high biological efficiency i.e. Conversion of dry substances into fresh mushroom.
- ▶ It can generate self employment , alleviate poverty and improve socio economic status of women and youth in rural areas .
- ▶ It can provide nutritional security particularly for poor people through incorporating Mushroom in their diet .
- ▶ Mushroom production training to the rural farm women in patna , bihar also showed an acceptance level of 61% as it aided to their economic empowerment along with increase in their knowledge regarding the intricacies of technology which would lead them to empower the next generation of farm women .

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Thank you .