

MUSHROOM CULTIVATION - A WASTE TO WEALTH VENTURE

SEM VI General

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3-12

Introduction

13

Objective

14 -
27Materials
and Methods

28

Results

29

Conclusion

30

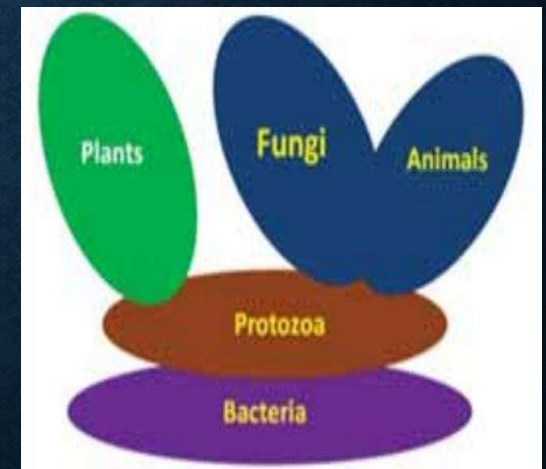
References

INTRODUCTION:-

What is mushroom?

Humans have been collecting and consuming mushrooms since long time ago but their cultivation is a recent development. The mushrooms appearing in the lawns, around heaps of compost and in the fields, on wooden logs, etc. after the rains and wondered that what are these and how they have come.

Mushrooms were earlier considered as plants. Now these are classified into separate kingdom because these are neither plant nor animals. During evolution plants evolved from lower organisms, after that the fungi and animals got separated. Plants make their own food whereas animal and fungi depends upon other organisms. Cell wall of mushroom is different from plant and animals. These character and their method of nutrition , growth and reproduction helps scientists to classify them into a different kingdom.



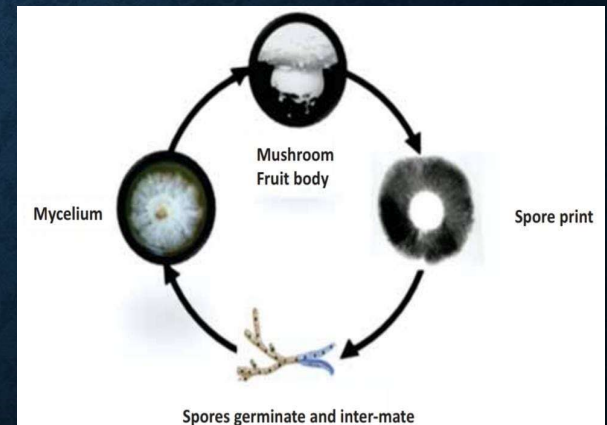
Mushrooms are members of the fungi kingdom. Unlike higher plants, mushrooms do not have chlorophyll which helps plants to use water & carbon dioxide from earth and energy from the sun to make their own food. As mushroom cannot produce their own food, these depend on higher plants for food. Mushrooms obtain nutrients from organic materials like straw, dead wood, manure, dung, etc.

For most part of the life the fungi exist as thread like structure in the soil, wood etc. In fact one cubic centimeter of soil can have up to 8 miles long thread of fungi. The microscopic threads are called mycelium. These threads unit to form small structures that grow into structures with a cap and stalk, that is, mushroom. Thus mushrooms are nothing but the fruiting bodies of fungi. These fruiting bodies produce spores that help in spread of the fungus. You must have seen black mass of spores wherever fungi grow-on bread pieces, wet wooden pieces or even clothes left unattended for longtime.

It is inferred that all fungi are not mushrooms. We also eat many fungi other than mushrooms. For example, any fermented food has yeast and yeast is a fungus not a mushroom.



Varities of Mushroom that are cultivated and consumed



Life cycle of mushroom-the mushroom fruit body produces spores, that germinate, mate and the mycelium spreads in the soil or wood, etc. During proper season the mycelium turns into fruiting bodies.

Types of mushroom:-

There are large number of fungi in the world. An estimate is that there are 1.5 million fungi. However, we have not been able to study all and scientists have studied only 1.1 lakh fungi out of which 14000 are mushrooms. All mushrooms are not edible. some are even poisonous. Out of these only 3000 have been considered to be truly edible. However, it is not possible to cultivate all of these. Despite all the efforts it has been possible to cultivate only about 200 species out of which 60-70 are cultivated commercially and about 10 are cultivated on industrial scale.

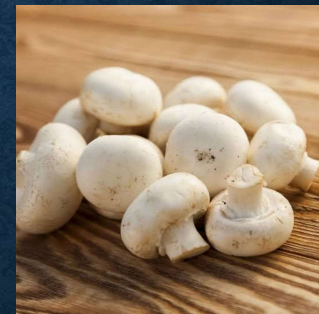
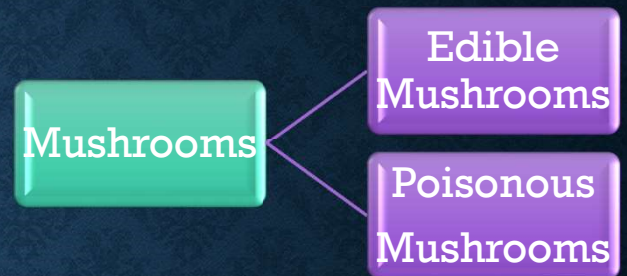
❖ Edible Mushroom:- Edible mushrooms are the fleshy and edible fruit bodies of several species of macro fungi (fungi which bear fruiting structures that are large enough to be seen with the naked eye). They can appear either below ground (hypogeous) or above ground (epigeous) where they may be picked by hand. Edibility may be defined by criteria that include absence of poisonous effects on humans and desirable taste and aroma. Edible mushrooms are consumed for their nutritional and culinary value.

Examples:- *Agaricus bisporus* (Button Mushroom)

Volvariella volvacea (Paddy straw Mushroom)

Pleurotus ostreatus (Oyster Mushroom)

Calocybe indica (Milky White Mushroom) etc.



❖ Poisonous Mushroom:-

Although, certain varieties of edible mushrooms offer innumerable health benefits, a few others are lethal to the extent of causing death and allergic reactions. Mushroom poisoning refers to harmful effects from ingestion of toxic substances present in a mushroom.

Examples:-*Amanita phalloides*(Death Cap)

Conocybe filaris / *Pholiotina rugosa*

Galerina marginata (Autumn Skullcap)

Cortinarius rubellus (Web caps)

Amanita virosa (Destroying Angels)

Podostroma cornu-damae (Poison Fire coral)

Lepiota brunneoincarnata (Deadly Dapperling) etc.



Amanita phalloides



Conocybe filaris



Galerina marginata



Cortinarius rubellus



Lepiota brunneoincarnata

NUTRITIONAL AND MEDICINAL VALUES OF MUSHROOM:-

Nutritional Values:-

The nutritional value of edible mushroom is affected by numerous factors such as species, stage of development and environmental conditions. Also, edible mushrooms are a good source of some vitamins such as thiamin, riboflavin, niacin, biotin and vitamin C, in some cases, beta-carotene etc. The digestible carbohydrate profile of mushroom includes starches, pentoses, hexoses, disaccharides, amino sugars, sugar alcohols and sugar acids. Presence of minerals: P, Na, K, is at a high level. But Fe and Ca are present at low levels. It is important to note that the fungus can also accumulate heavy metals such as: Ni, Cu, Zn, Mn, Cr, Co, Se, and the most important contaminants are: Pb, Hg and Cd.

- Mushrooms do not have cholesterol. Instead, they have ergosterol that acts as a precursor for Vit-D synthesis in human body. The protein content of edible mushrooms is usually high, but varies greatly. 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). Nutritive values of different mushroom are given in Table.

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

Courtesy: Stamets, 2005 (*A.bisporous*, *P. sajor-caju*, *Lentinula edodes*), FAO, 1972 (*Pleurotus ostreatus*, *V. volvaceae*), Doshi and Sharma, 1995 (*Calocybe indica*), Crison and Sand, 1978 (*Flammulina velutipes* and *Auricularia spp*).

Medicinal Values:-

Since thousands of years, edible fungi have been revered for their immense health benefits and extensively used in folk medicine. Specific biochemical compounds in mushrooms are responsible for improving human health in many ways. These bioactive compounds include polysaccharides, tri-terpenoids, low molecular weight proteins, glycoproteins and immunomodulating compounds.

1. Good For Heart:- 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.

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. Thus it is most preferable food for people striving to shed their extra weight.

3. Prevents Cancer:- Compounds restricting tumor activity are found in some mushrooms but only a limited number have undergone clinical trials.

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.

Mushroom	Compounds	Medicinal properties	Courtesy
<i>Ganoderma lucidum</i>	Ganoderic acid	Augments immune system	Lin and Zhang, 2004
		Liver protection	Wang et al., 2007
	Beta-glucan	Antibiotic properties Inhibits cholesterol synthesis	Moradali et al., 2006 Komoda et al., 1989
<i>Lentinula edodes</i>	Eritadenine	Lower cholesterol	Enman et al., 2007
	Lentinan	Anti-cancer agent	
<i>A. bisporous</i>	Lectins	Enhance insulin secretion	Ahmad, 1984
<i>P. sajor-caju</i>	Lovastatin	Lower cholesterol	Gunde and Cimerman, 1995
<i>G. frondosa</i>	Polysaccharide	Increases insulin secretion	Horio and Ohtsuri, 2001
	Lectins	Decrease blood glucose	
<i>Auricularia auricula</i>	Acidic polysaccharides	Decrease blood glucose	Yuan et al., 1998
<i>Flammulina velutipes</i>	Ergothioneine	Antioxidant	Bao (2008)
	Proflamin	Anti cancer activity	Ikekawa et al., 1985
<i>Trametes versicolor</i>	Polysaccharide-K (Kresin)	Decrease immune system depression	Coles and Toth, 2005
<i>Cordyceps sinensis</i>	Cordycepin	Cure lung infections	Li et al., 2006
		Hypoglycemic activity	Ko et al., 2009
		Cellular health properties Anti-depressant activity	Nishizawa et al., 2007

Medicinal values of some important mushrooms

CULTIVATION OF MUSHROOM:-

Why we cultivate mushroom??

Mushroom cultivation has different aspects. Mushroom cultivation is not only a source for nutritious protein-rich food, it can also contribute to the production of effective medicinal products. Another significant aspect of mushroom cultivation is to help reduce pollutants in the environment. The bioconversion of lignocellulosic biomass to food and useful products has had a significant impact on national and regional pollution levels and will continue to increase. Bioremediation uses mushroom mycelia to remove and break down contaminants and will eventually absorb the pollutants (biosorption process), presenting another influential role of mushrooms in the ecosystem

Advantages of Mushroom Cultivation

1. Mushroom cultivation is waste converted to wealth because mushrooms, unlike other crops, is unique and raw materials are readily available and cheap.
2. In this cultivation you need little or no capital to start a mushroom farm, all inputs are mainly agricultural wastes – sawdust, rice bran, wheat bran, corn cob, water hyacinth, cotton waste, millet, cocoa waste and guinea corn waste etc.
3. Mushroom doesn't need direct sunlight to survive. what you need is- a wasteland, a structure (known as cropping house), hose with sprinkler or watering can, sawdust in colonized bags. These are the basic things that's why any mushroom farmer will need to start a mushroom farm.

4. The common financial problems of rural communities are partly solved because the corporation can extend some production inputs on credit.
5. Technical assistance to mushroom-producers can be extended with more dispatch than by government departments.
6. Possible production of all year around
7. Marketing problems associated with a highly perishable product like mushrooms are solved because the corporation buys all the product right on the farms.

Ease of Mushroom cultivation(Outdoor and Indoor):-

Outdoor Cultivation:-

1. In many senses, growing mushrooms outdoors is ideal because the forest (or any shady environment with good humidity and air flow) creates the ideal conditions for fruiting without the need for any climate control on the part of the farmer.
2. The main limit with forest or outdoor cultivation is that only the log-grown shiitake can be grown consistently enough to yield mushrooms on a weekly basis, a necessary part of the supply chain for a farm business.
3. We can't expect mushroom for marketing throughout the year because the outdoor cultivation is completely season dependent.



Outdoor Cultivation Of
paddy straw Mushroom

Indoor Cultivation:-

1. Apart from greens and herbs ,mushrooms can be produced in locations with minimal infrastructure and capital to start and sustain production in indoor system.

2. In indoor cultivation we have to control temperature, humidity, light, and air flow etc. which is not possible to maintain naturally in outdoor cultivation. It is the main benefit to cultivate mushroom at indoor.

3. A big advantage of indoor production is that systems can be adapted to work in a wide range of abandoned and underutilized farm infrastructure including barns, outbuildings, high tunnels, and storage facilities.

4. In an urban environment, basements, shipping containers, and warehouse spaces can be easily retrofitted for production.

5. This positions mushrooms to be a system that is accessible to both rural and urban farms and those farmers with limited capital and access to other resources for start-up.

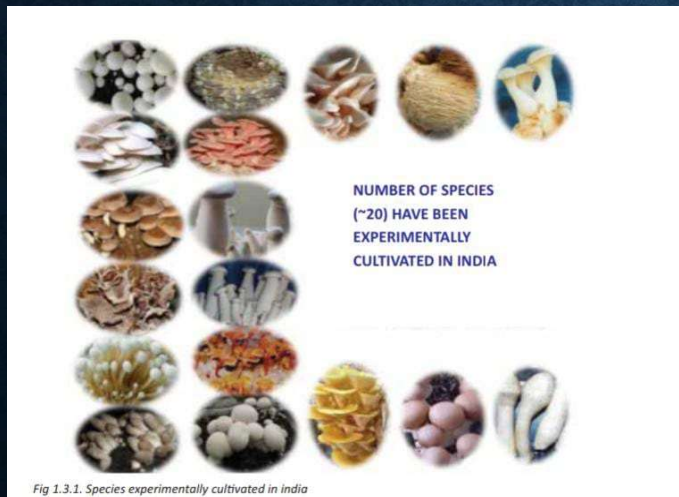
➤ From the above discussion it can be inferred that indoor cultivation is very useful than outdoor cultivation and there is no requirement of agricultural land in indoor cultivation.



TYPES OF MUSHROOM CULTIVATED IN INDIA:-

Mushroom production in the country started in the 70s but growth rate, both in terms of productivity as well as production has been phenomenal. Today commercially grown species are button and oyster mushrooms, followed by other tropical mushrooms like paddy straw mushroom, milky mushroom etc. The concentrated areas of production in India are the temperate regions for the button mushroom, tropical and sub-tropical regions for oyster, milky, paddy straw and other tropical mushrooms.

Two to three crops of Button Mushroom are grown seasonally in temperate regions with manure adjustments of temperature in the growing rooms; while one crop of Button Mushroom is raised in north Western planes of India seasonally. Oyster, paddy straw and Milky Mushrooms are grown seasonally in the tropical / sub-Tropical areas from April to October. The areas where this mushrooms are popularly grown are Odisha, Maharashtra, Tamil-Nadu, Kerala, Andhra Pradesh, Karnataka and North Eastern region of India.



Climate	Mushroom suitable for cultivation	
Temperate (10-20°C)	Button mushroom	Oyster mushroom
	Winter mushroom	Shiitake
Sub-tropical (20-30°C)	Summer button Oyster (Summer species)	
	Wood ear mushroom	Shiitake (summer variety)
Tropical (30-40°C)	Milky mushroom	Paddy straw mushroom

OBJECTIVE:-

1. Mushroom proteins usually have a complete essential amino acid profile, which may cover the dietetic requirements, as well as may have certain economic advantages as compared to animal and plant sources. Therefore Mushroom is used to produce protein-rich food for family consumption.
2. Mushrooms are thought to protect against breast and other hormone-related cancers because they inhibit an enzyme called aromatase, which produces estrogen. Therefore we don't have to produce estrogen commercially so much and the cost of cancer inhibiting medicine will drop down. All mushrooms contain beta glucans, which have been found to help fight inflammation and aid the immune system. Mushroom contain antioxidants as Selenium, Vitamin C, Choline etc. which help the body for eliminating free radicals.
3. To aware people, How to differentiate between edible and non edible Mushroom and the importance of mushroom in daily food.
4. We can train people how to cultivate mushroom, therefore it will become a profitable source of income to them.
5. The Mushroom cultivation will benefit economically. We can empower women of rural areas that she can become economically independent. Not only that unemployed youth can cultivate mushrooms, it will be profitable.

MATERIALS AND METHODS:-

There are different kinds of edible mushrooms in India and worldwide. Among of them there are three mushrooms named Oyster mushroom, Button mushroom and paddy straw mushroom are mostly cultivated. These types of mushrooms have different species but we will restrict our discussion on *Pleurotus sajor-caju*, *Agaricus bisporus* and *Volvariella volvacea* accordingly.

Cultivation Of *Pleurotus sajor-caju*(Oyster mushroom)

Materials:-

- ❑ Thatched hut/polythene chamber/mud or pucca house.
- ❑ Dry wheat straw or other Argo waste-100kg
- ❑ Spawn bottles
- ❑ Polythene bag 1 kg
- ❑ Water sprayer

Methods:-

- 1.Spawning:-**
- 1.The 20-30 days old grain spawn is best for spawning. The old spawn approximately 3-6 months can stored at room temperature (20-30 C).
 - 2.It forms very dense mat like structures due to mycelium aggregation and sometimes young pinheads and fruit bodies start developing in the spawn bottle itself. The spawning must be done in a pre-fumigated room (48 hrs. with 2% formaldehyde).

Process of Substrate preparation:-Substrate was soaked in 100 litre of water containing 3 gm Bavistin, 3 gm calcium carbonate and 120 ml formaldehyde for 18 hours as suggested by Vijay and Sohi (1987). After sterilization the excess water was drained off by spreading the straw on the sloppy cemented floor till the moisture content of straw declined to 65-70 per cent. The 60% moisture content in the straw was judged by taking a handful of straw and squeezing tightly.

3. The spawn should be mixed with 2 to 3% of the wet weight of the substrate. One bottle of contamination free spawn of 300 g is enough for 10-12 kg of wet substrate or 2.8 to 3 kg of dry substrate weight.

4. The spawn can be mixed thoroughly or mixed in layers wise, because in mixing method the quantity of spawn increased. Spawned substrates should be filled in polythene bags (60 x 45 cm) of 125-150 gauge thickness. Ten to 16 small holes (0.5-1.0 cm diameter) should be made on all sides specially 2-4 holes in the bottom for leach out excess water.

5. The perforated bags give superior and early crop (4-6 days) than non-perforated bags because of accumulation of high CO_2 which inhibits fruiting. The empty fruit packing cartons or wooden boxes for filling substrate. Polythene sheets of 200 to 300 gauge breadth of 1.25 x 1.25 m are spread in rectangular wooden or metal box.

6. Spawned wheat substrate is filled and the polythene sheet is folded from all the four sides to make a compressed rectangular box. It should be tightly pressed and tied with a nylon rope.

7. The bags are incubated as such and after mycelium growth polythene sheet is removed.

2. Cropping:- 1. The spawned bags or blocks are kept in incubation room for mycelial growth. Spawned bags should be kept on a raised platform or shelves or can be hanged in cropping room for mycelial colonization of the substrate.

2. Although mycelial growth the bags are not to be opened or no aeration is needed. Likewise, there is no need for any high relative humidity, so no water should be sprayed.



3.Previously the mycelium has fully colonized the spawned substrate and forms thick mycelial mat it is ready for fruiting.

4.Those bags become contaminate with mould may be discarded while bags with patchy mycelial growth may be left for few more days to complete the mycelial growth.

5.In case of oyster mushroom cultivation no need to casing material on it. All bundles, cubes or blocks are set on wooden shelves with a minimum space of 15-20 cm between every bag in the tier.

3. Harvesting:- **1.**The mushrooms should always be harvested before spraying water.

2.The right stage for picking can be judged by the shape and size of fruiting body. In young mushrooms the edge of the cap is thick and cap margin is enrolled while the caps of mature mushroom become flat and inward curling starts.

3.After harvesting lower portion of the stalk with adhering debris must be cut using a knife. Stipe is kept short or almost nonexistent because it is hard and not liked by many consumers.

4.Fresh mushrooms should be filled in perforated polythene bags for selling in market. They can also be sun dried by spreading thinly on a cotton cloth in bright sunlight or diffused light. The dried produce with 2-4% moisture can be stored for 3 to 4 months after sealing well.



Cultivation Of *Agaricus bisporus* (Button mushroom)

Materials:-

- ☐ Spawn.
- ☐ wheat/paddy straw.
- ☐ wooden trays.
- ☐ chemicals.

Substrate Preparation:-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 1 kg. of mushroom, 220 g. of dry substrate materials are required.

Methods:-

- ☐ **Spawn Production:-**Spawn is produced from fruiting culture / stocks of selected strains of mushrooms under sterile conditions. Stock culture may be produced in the lab or may be obtained from other reputed sources. Fruiting culture is mainly imported from various places including foreign sources which give higher yield than Indian strains and the spawn is produced in the lab. The spawn should be of good quality in terms of flavor, texture and size apart from having potential for high yield and longer shelf life.
- ☐ **Method Of Composting:-** 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 1 kg. of mushroom, 220 g. of dry substrate materials are required. It is recommended that each ton of compost should contain 6.6 kg. nitrogen, 2.0 kg. phosphate and 5.0 kg. of potassium (N:P:K- 33:10.25). Using this we can produce compost. The compost can be prepared in two methods - (1) **Short Method** , (2)**Long Method**.

(1) Short Method of composting:-

(a) During the first phase of compost preparation, paddy straw is placed in layers and sufficient water is added to the stack along with fertilizers, wheat bran, molasses etc.

(b) The whole thing is mixed thoroughly with the straw and made into a stack (almost 5 feet high, 5 feet wide and of any length can be made with the help of wooden boards). The stack is turned and again watered on the second day.

(c) On the fourth day the stack is again turned for the second time by adding gypsum and watered.

(d) The third and final turning is given on the twelfth day when the colour of the compost changes into dark brown and it starts emitting a strong smell of ammonia.

(e) The second phase is the pasteurization phase.

(f) The compost prepared as a result of microbe mediated fermentation process needs to be pasteurized in order to kill undesirable microbes and competitors and to convert ammonia into microbial protein.

(g) The whole process is carried out inside a steaming room where an air temperature of 60°C is maintained for 4 hours.

(h) The compost finally obtained should be granular in structure with 70% moisture content and pH 7.5.

(i) It should have a dark brown colour, sweet unobnoxious smell and free from ammonia, insects and nematodes. After the process is complete, the substrate is cooled down to 25°C .



Wetting of the Straw



Low Stack of Wetted Straw



Mixing of Ingredients



Making of Pile



Compost piles



Pasteurization of Compost

(2) Long Method of composting:-

(a) The long method of composting is usually practiced in areas where facilities for steam pasteurization is not available.

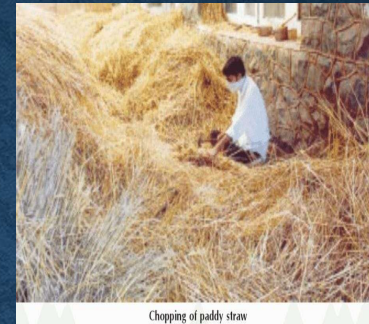
(b) In this method, the first turning is given about six days after preparation of the substrate for composting.

(c) The second turning is given on the tenth day followed by third one on the thirteenth day when gypsum is added.

(d) The fourth, fifth and sixth turnings are given on the sixteenth, nineteenth and twenty-second day.

(e) On the twenty-fifth day the seventh turning is given by adding 10% BHC (125 g.) and the eighth turning is given on the twenty-eighth day after which it is checked whether there is any smell of ammonia present in the compost.

(f) The compost is ready for spawning only if it doesn't have any smell of ammonia; otherwise a few more turnings are given at an interval of three days till there is no smell of ammonia.



❑ Spawning:-

The process of mixing spawn with compost is called spawning. The different methods followed for spawning are given below;

- (a) **Spot Spawning:** Lumps of spawn are planted in 5 cm. deep holes made in the compost at a distance of 20-25 cm. The holes are later covered with compost.
- (b) **Surface Spawning:** The spawn is evenly spread in the top layer of the compost and then mixed to a depth of 3-5 cm. The top portion is covered with a thin layer of compost.
- (c) **Layer Spawning:** About 3-4 layers of spawn mixed with compost are prepared which is again covered with a thin layer of compost like in surface spawning.

The spawn is mixed through the whole mass of compost at the rate of 7.5 ml./ kg. compost or 500 to 750 g./ 100 kg. compost (0.5 to 0.75%).

❑ Spawn Running:-

- (a) After the spawning process is over, the compost is filled in polythene bags (90x90 cm., 150 gauge thick having a capacity of 20-25 kg. per bag) / trays (mostly wooden trays 1x1/2 m. accommodating 20-30 kg. compost) / shelves which are either covered with a newspaper sheet or polythene.
- (b) The temperature maintained in cropping room is $23 \pm 2^{\circ}\text{C}$ and higher temperature detracts growth of the spawn and temperature below that specified results in slower spawn run. The relative humidity should be around 90% and a higher than normal CO_2 concentration would be beneficial.



Spawn of white button mushroom



Spawning and filling of compost in polythene bags

❑ Casing and Fruiting: -

Casing: - (a) The compost beds after complete spawn run should be covered with a layer of soil (casing) about 3-4 cm. thick to induce fruiting. The casing material should be high porous, water holding capacity and the pH should range between 7-7.5. Peat moss is best material for it. In India, the mixtures like garden loam soil and sand (4:1); decomposed cow dung and loam soil (1:1) and spent compost sand and lime are commonly used .

(b) The casing soil before application should be either pasteurized (at 66-70°C or sterilized 7-8 hours), treated with formaldehyde (2%) and Bavistin (75 ppm.)/Steam sterilized. The treatment needs to be done at least 15 days before the material is used for casing. After casing is done the temperature of the room is again maintained at 23-28°C and relative humidity of 85-90% for another 8-10 days. Low CO₂ concentration is favourable for reproductive growth at this stage.

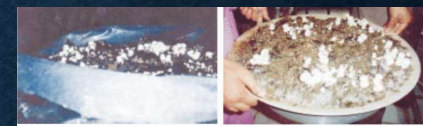
Fruiting: - The maintained temperature (initially $23 \pm 2^\circ\text{C}$ for about a week and then $16 \pm 2^\circ\text{C}$), moisture (2-3 light sprays per day), humidity (above 85%), CO₂ concentration (0.08-0.15 %) the fruit body starts to appear as pin heads and develop into button stage.



Peat



Casing soil (Mixing peat and garden soil)



Mushroom crop in polythene bags



Mushroom crop in aluminum trays



Mushroom crop baskets



Mushroom crop in plastic trays kept on shelves in a well ventilated hit room

Materials:-

- ☐ Spawn
- ☐ Bricks
- ☐ Bamboo Frame
- ☐ Paddy Straw
- ☐ Loose Straw
- ☐ Powder Of gram/arhar
- ☐ Seeds
- ☐ Water source
- ☐ Transparent Polythene sheet
- ☐ Shade
- ☐ Thermometer

Substrate Preparation:-

Preparation of uniform straw bundles by cutting from ends (45 cm long × 10 cm wide)

Soaking in clean water mixed with 2.0 % CaCO_3 (12-18 hours)

Taking out of straw bundles and draining of excess water

Preparation of bed by placing 4-5 bundles side by side in first layer, putting spawn at 7-8 spots, followed by covering each spot with some gram powder

Putting 2nd layer of bundles over 1st layer, and repeating of the process of putting spawn and gram powder.

Putting of 3-4 layers like this. For one bed of 7-8 kg straw, about 200 g spawn and 150 g red gram powder is used

Covering of bundles with polythene sheet for maintaining requisite humidity (80-85%) and temperature (30-35°C)

It will take about 8-10 days for complete spread of mycelium in the straw

Methods:-

1.Spawning:-

- ❑ The pure mycelial culture of this mushroom can be obtained from any authorized agency or it can be raised by tissue culture method, single spore culture technique or by multi spore culture technique.
- ❑ The culture of this mushroom cannot be kept at low temperature and should be maintained at 17-20°C or above.
- ❑ The spawn of this mushroom can be prepared on a number of substrates like grains, straw, used tea waste, cotton waste, etc. Procedure for making of the spawn is same as for other mushrooms, except for temperature for incubation.
- ❑ After inoculation, the bags are incubated at 32-35°C. It takes only 5-7 days for complete colonization of the substrate. Spawn of this mushroom should be used as fresh, and if needed should be stored at 15-20 °C, maximum for one month.



Tissue Culture of spawn



Stacking

2.Cultivation procedure :-

Paddy straw is used for preparing bed for cultivating *Volvariella volvacea* (paddy straw mushroom). Mushroom bed works as a bedding material for spawn and mushroom. It is a thick layer of paddy straw. **Step by step procedure for preparation of mushroom bed is as follow:-**

- ❑ Start the procedure at evening.
- ❑ Cut the paddy straw (dried rice stalk) into 1 – 1.5 feet long pieces.
- ❑ Make 1-2 feet thick layer in square shape.



Knots Of Paddy Straw

- ❑ Make 1-2 feet thick layer in square shape.
- ❑ Wrap and tie the straw to make it a bundle.
- ❑ Place all the bundles inside water tank.
- ❑ 3/4 part of water tank should be stuffed with bundles.
- ❑ Fill the tank with fresh and clean water.
- ❑ The level of water should always be kept over from last layer of bundle.
- ❑ Pour 2% of formalin in water tank.
- ❑ Let paddy straw be saturated overnight. 12-13 hrs.
- ❑ Open the Outlet Of Water tank in Early morning after 12 hrs. so, that the water goes out.

3. Bed Preparation & Cropping:-

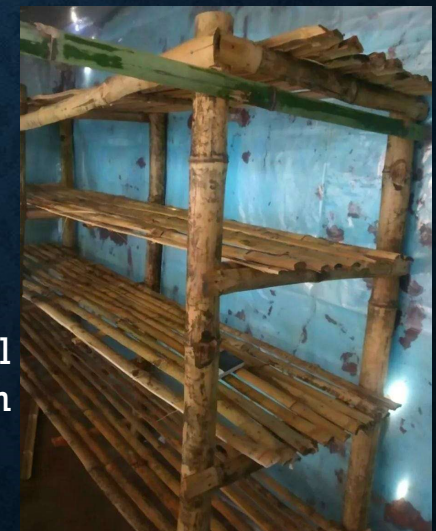
- ❑ The cultivation of paddy straw mushroom can be done in a thatched house and also under the shade of a tree. Fresh , disease free paddy straw is the ideal substrate .Ten to fifteen kg paddy straw is necessary for preparing one bed. In recent years, it is cultivated inside plastic film houses to maintain the temperature of around 25 -35 ° C and relative humidity of 75-80 %.

a. Paddy Straw bundle method:-

- ❑ Prepare a raised platform of about 1 m in length and 0.75 m in breadth with a deal wood flanks and keep it over a support on bamboo frame by arranging bricks on all four corners.
- ❑ The paddy straw is bundled into to weigh about kg each.
- ❑ Soak the straw bundles in water for 12-18 hr.



Wetting of Paddy straw



- ❑ Ten bundles are taken out and drain the excess water
- ❑ Place the bundles over the platform with their butt end on one side.
- ❑ Build the second layer by placing the butt end towards the other direction. (These 8 bundles make one layer of bed)
- ❑ Place a small quantity of spawn 8-12 cm inside the margin at an interval of 10-15 cm all along the periphery.
- ❑ Apply a spoonful of coarsely powdered gram/dhal powder before placing spawn.
- ❑ Place the straw bundles at right angles to the previous layer in criss-cross fashion to make the third layer.
- ❑ Place the straw bundles with opposite butt ends to make fourth layer.
- ❑ Spawn this layer as stated above.
- ❑ Place another layer of straw bundles over this and do not apply spawn.
- ❑ Pressure the bed to make it as compact as possible and cover it with a transparent polythene sheet.
- ❑ Keep the beds undisturbed for a few days.
- ❖ mushrooms start appearing from all sides in 6-10 days as tiny buttons, which can be harvested in another 4-5 days. The harvesting is to be done at the button stage itself, since the opened sporocarp will be more fibrous. Usually, 1-2 kg of mushroom can be harvested from 10 kg substrate.



b. Paddy straw twist method:-

❖ Instead of bundled straw, twisted paddy straw can also be used for cultivation.

- ❑ Make the straw into twists of about 5-8 m long and 5-10 cm diameter.
- ❑ Immerse the twists in water for 12 hr.
- ❑ Take out the straw and drain the excess water.
- ❑ Place the place them lengthwise over a platform on a zigzag manner.
- ❑ Place a second over this in an opposite direction. (This forms the first layer of the bed)
- ❑ Sprinkle the coarsely powdered dhal/ gram and place small bits of spawn all along the periphery as above.
- ❑ Build another layer as described above and spawn the layer.
- ❑ Build up 4-5 layers and spawn as usual.
- ❑ Compact the bed by pressing and cover it with a polythene sheet.

4. Care and Maintenance:-

- ❑ Uncover the mushroom bed after 4-7 days.
- ❑ Maintain the required level of humidity without damaging mycelium growth.
- ❑ Use hazara (water can for irrigation) to spray water.
- ❑ Apply pest control measures against rat.



5.Harvesting:- Mushroom can be harvested after 4-7 days of mycelium growth. It should be harvested while fruiting body is still round shaped. 8-10 kg of yield can be achieved from 1 kg of spawn.

6.Preservation:-

Paddy Straw Mushroom is very delicate; so it is consumed in fresh condition. The autolysis of Paddy straw mushroom occurs in 4 degree Celsius, therefore it is conserved in 10-20 degree Celsius. If we have to import the mushroom in various country, at first it dried after putting in saline water and thereafter it are put in cardboard boxes.

7.Precautions:-

- ☐ Don't contaminate the span.
- ☐ Try to keep moist the bundle of paddy straw.
- ☐ Apply fresh air for proper growth and development of mycelium.
- ☐ Use grain free paddy straw to avoid rat attack.
- ☐ Use water cans for light watering.
- ☐ Do not apply water directly over developed mycelium; it can destroy the fungus body.
- ☐ Growing media should be free from harmful micro-organism.



RESULTS:-

Name Of Mushroom	Required Dry Substrate Weight(S)(Kg)	Produced Mushroom Weight(M)(Kg)	Yield Of Mushroom(Y) In percentage $Y=\{(M/S)*100\}\%$
Oyster Mushroom	1	1 – 1.5 (King Oyster)	(100 - 150)
		0.9 – 1.4 (Lions Mane)	(90 - 140)
		0.8 – 1.2 (Reishi)	(80 - 120)
		1.0 – 2.0 (Shittake)	(100 - 200)
Button Mushroom	0.220	1	454.4%
Paddy Straw Mushroom	10	4-9	(40 - 90)%

CONCLUSION:-

- ❖ The conclusion of this Project is that Mushroom farming is a very profitable business. No need of large area of land for this farming. For this farming Raw materials are available everywhere.
- ❖ We use Agricultural waste (e.g. Rice bran , Wheat Bran , Paddy straw etc.) and horticultural waste (e.g. skin of fruits, Bagasse etc.) and animal waste (cow dung) for Mushroom Cultivation. Therefore we can manage the wastes .
- ❖ The above written wastes don't have any commercial value , but we can utilize it for production of Mushroom which is high source of various important amino acids and nutrients. It is easily available in shopping mall and stores, so we can include mushroom in our regular diet at least twice in a week and it is a good source of proteins for vegetarians also. So it's a wealth which can be produced from wastes.
- ❖ If we manage this wastes by mushroom cultivation in a large scale (e.g. industries, self dependendent organisations in rural areas) many young people can get a job so their and our economy can be boosted also.
- ❖ As the waste is managed in a controlled manner in Mushroom Production , the environmental pollution will become less . Because we see that paddy and many straws are burnt in field , which causes heavy air pollution (e.g. At winter the smog of Delhi happen for many time). We can reduce the pollution by managing wastes.
- ❖ During the Pandemic Covid 19 Mushroom is given to patients and doctors advise it to consume for boosting immunity.

In this project , I have discussed how we cultivate Mushroom and how we can create **wealth (Mushroom) From waste. I hope it will be fruitful to other guys for enhancing techniques for them in future.**

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THANK YOU