UNIT-IV: Skill Development: Mushroom Cultivation

1. **Introduction:** Nutritional and Medicinal value of edible mushroom; Poisonous mushroom. Edible mushroom: Volvariella volvacea, Plerotuscitrino pileatus, Agaricus bisporus
2. **Technology of Mushroom cultivation: Infrastructure:** Mushroom unit (Thatched house); **Tools:** Polythene bags, vessels, inoculation hook, inoculation loop, low cost stove, sievers, culture rack, water sprayer, tray, medium.
3. **Techniques:** Substrate, Preparation of Medium and spawn, sterilization, multiplication, bed preparation (Paddy-straw, sugarcane trash, banana leaves)

Nutritional and Medicinal Values of Mushrooms

Meeting the food demand for the increasing population from the limited land resource is a big challenge for our Indian democracy in this vulnerable climate change era. In addition to this, wide spread malnutrition and associated diseases are more common among the economically poor population. This compels us to search for cheap alternative quality nutritional sources for our huge population. Non green revolution otherwise referred as mushroom farming is one among the apt ways to meet this challenge because mushroom grow on wastes without requiring additional land besides its exceptional nutritional and medicinal properties.

Nutritional values of Mushrooms

Indian diet is primarily based on cereals (wheat, rice and maize), which is deficient in protein. Supplementation of mushroom recipe in Indian diet will bridge protein gap and improve the general health of socio-economically backward communities. Earlier mushrooms were considered as an expensive vegetable and were preferred by affluent peoples for culinary purposes. Currently common populace also considers mushroom as a quality food due to its health benefits.

Mushroom is considered to be a complete, health food and suitable for all age groups, child to aged people. 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 digestible 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 consists of partially digestible polysaccharides and chitin.

Edible mushrooms commonly have insignificant lipid level with higher proportion of polyunsaturated fatty acids. All these resulted in low calorific yield from mushroom foods. 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 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 theronine and valine but deficient in sulphur containing aminoacids (ethionine and cysteine). Nutritive values of different mushroom are given in Table 1.

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

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

Mushrooms comprise about eighty to ninety per cent of water, and eight to ten per cent of fiber. In addition to these, mushroom is an excellent source of vitamins especially C and B (Folic acid, Thiamine, Riboflavine and Niacin). Minerals viz., potassium, sodium and phosphorous are higher in fruit bodies of the mushroom. It also contains other essential minerals (Cu, Zn, Mg) in traces but deficient in iron and calcium.

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, glycoprotins and immunomodulating compounds. Hence mushrooms have been shown to promote immune function; boost health; lower the risk of cancer; inhibit tumor growth; help balancing blood sugar; ward off viruses, bacteria, and fungi; reduce inflammation; and support the body's detoxification mechanisms. Increasing recognition of mushrooms in complementing conventional medicines is also well known for fighting many diseases. Medicinal values of the some important mushroom are given in Table 2.

Table 2: Medicinal values of some important mushrooms

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

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. 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 spp* 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. 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. All forms of edible mushrooms, and white button mushrooms in particular, can prevent 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* (*Coriolus 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, Tramtes versicolor, Agaricus bisporous* and others.

4. Anti-aging property

The polysaccharides from mushrooms are potent scavengers of super oxide free radicals. These antioxidants prevent the action of free radicals in the body, consequently reducing the aging process. Ergothioneine is a specific antioxidant found in *Flammulina velutipes* and *Agaricus bisporus* which is necessary for healthy eyes, kidney, bone marrow, liver and skin.

5. 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.

6. 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 up-regulating the immune system. These compounds potentiate the host's innate (non-specific) and acquired (specific) immune responses and activate all kinds of immune cells.

Mushrooms, akin to plants, have a great potential for the production quality food. These are the source of bioactive metabolites and are a prolific resource for drugs. Knowledge advancement in biochemistry, biotechnology and molecular biology boosts application of mushrooms in medical sciences. From a holistic consideration, the edible mushrooms and its by-products may offer highly palatable, nutritious and healthy food besides its pharmacological benefits.

Still there are enough challenges ahead. Until now, how these products works is elusive and vast number of potential wild mushrooms are not explored. The utility of mycelia is paid little attention but it has tremendous potential, as it can be produced year around with defined standard. Knowledge on dose requirement, route and timing of administration, mechanism of action and site of activity is also lacking. Work is under progress in various laboratories across the world to validate these medicinal properties and isolation of new compounds. If these challenges are meet out in the coming days, mushroom industries will play a lead role in neutraceutical and pharmaceutical industries. The increasing awareness about high nutritional value accompanied by medicinal properties means that mushrooms are going to be important food item in coming days and at places may emerge as an alternate to non-vegetarian foods. Growing mushroom is economically and ecologically beneficial. Consuming mushroom is beneficial in every respect.

Poisonous Mushrooms

We have briefly discussed poisonous mushrooms when we covered the eating of wild mushrooms. It was difficult not to since eating wild mushrooms and mushroom poisoning seem to be closely related subjects. This is a rather important topic since mushrooms have apparently been gathered for eating throughout the world, for thousands of years, and it is also likely that during that time many people became ill or died when they inadvertently consumed poisonous mushrooms. Because some mushrooms were known to cause death when consumed.

Although only a few of the 70-80 species of poisonous mushrooms are actually fatal when ingested, many of these deadly fungi bear an unfortunate resemblance to edible species and are thus especially dangerous. Read on to learn more about these terrifyingly lethal mushrooms

Death Cap (*Amanita phalloides*)

Perhaps the deadliest of all mushrooms, the death cap is found throughout Europe and closely resembles edible straw mushrooms and caesar's mushrooms. Its heat-stable amatoxins withstand cooking temperatures and quickly damage cells throughout the body. Within 6 to 12 hours after consumption, violent abdominal pain, vomiting, and bloody diarrhea appear, causing rapid loss of fluid from the tissues and intense thirst. Signs of severe involvement of the liver, kidneys, and central nervous system soon follow, including a decrease in urinary output and a lowering of blood sugar. This condition leads to coma and death in more than 50 percent of the incidents. Notable deaths include Pope Clement VII, who died of accidental death cap poisoning in 1534, and possibly Roman Emperor Claudius in 54 CE.

Conocybe filaris

Conocybe filaris is an innocent-looking lawn mushroom that is especially common in the Pacific Northwest. Featuring the same mycotoxins as the death cap mushroom, *C. filaris* is potentially fatal if eaten. The onset of gastrointestinal symptoms often occurs 6-24 hours after the mushrooms were consumed, frequently leading to an initial misdiagnosis of food poisoning or the stomach flu. The patient may appear to recover, only to suffer from a life-threatening reappearance of the gastrointestinal distress, coupled with liver and kidney failure.

Webcaps (*Cortinarius* species)

The two species of webcap, the deadly webcap (*Cortinarius rubellus*) and the fool's webcap (*Cortinarius orellanus*), are very similar in appearance to both each other and to a number of edible varieties. These mushrooms feature a poison known as orellanin, which initially causes symptoms similar to the common flu. Orellanin has an insidiously long latency period and may take 2 days to 3 weeks to cause symptoms, often leading to a misdiagnosis. The toxin ultimately causes kidney failure and death if left untreated. In 2008, English author Nicholas Evans mistakenly collected and served webcap mushrooms to his relatives, resulting in hospitalization for four of them. He, his wife, and his brother-in-law all required kidney transplants as a result of the poisoning.

Autumn Skullcap (*Galerina marginata*)

Common throughout the Northern Hemisphere and parts of Australia, *Galerina marginata* is a gilled, wood-rotting mushroom with the same amatoxins as the death cap mushroom. Ingestion causes diarrhea, vomiting, hypothermia, and liver damage, and can result in death if left untreated. While it is not especially similar to edible species, several deaths and poisonings have been attributed to collectors mistaking the autumn skullcap for hallucinogenic *Psilocybe* mushrooms.

Destroying Angels (*Amanita* species)

The destroying angels are actually several species of all-white mushrooms in the genus *Amanita*. These incredibly toxic fungi are very similar in appearance to edible button mushrooms and the meadow mushrooms, and have been collected by mistake on numerous occassions. One of these species, *Amanita bisporigera*, is considered to be the most toxic North American mushroom. Symptoms take 5 to 24 hours to appear and include vomiting, delirium, convulsions, diarrhea, liver and kidney failure, and often lead to death.

Podostroma cornu-damae

This rare fungus is native to Asia and has been responsible for a number of fatalities in Japan and Korea. Its red fruiting bodies contain potent toxins known as trichothecene mycotoxins and can cause multiple organ failure in those unlucky enough to consume them. Symptoms of poisoning include stomach pain, peeling skin, hair loss, low blood pressure, liver necrosis, acute kidney failure, and result in death if left untreated.

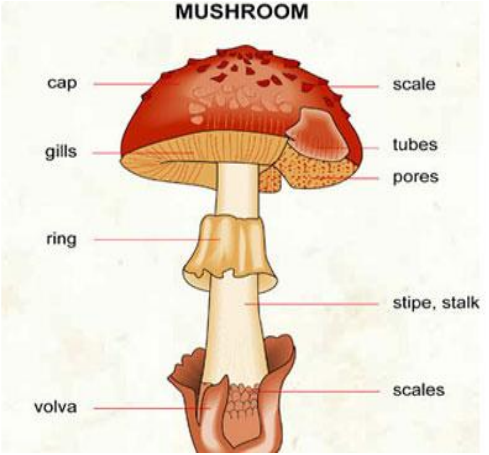
Deadly Dapperling
(*Lepiota brunneoincarnata*)

The deadly dapperling is a gilled mushroom known to contain amatoxins. Widely distributed throughout Europe and parts of Asia, the mushroom is fairly innocuous and has been mistaken for edible varieties, though poisonings are not very common. Accidental consumption leads to severe liver toxicity and can have lethal consequences if immediate treatment is not received.

Morphology of mushroom

Mushrooms can be defined as “a macro-fungus with distinctive fruiting bodies, epigeous or hypogeous, large enough to be seen with naked eyes and picked up by the hands”. The mushroom fruiting body may be umbrella like or of various other shapes, size and colour. Commonly it consists of a cap or pileus and a stalk or stipe but others have additional structures like veil or annulus, a cup or volva. Cap or pileus is the expanded portion of the carpophore (fruit body) which may be thick, fleshy, membranous or corky.

On the underside of the pileus, gills are situated. These gills bear spores on their surface and exhibit a change in colour corresponding to that of the spores. The attachment of the gills to the stipe helps in the identification of the mushroom. On the basis of the attachment, gills are of following types:
Free gill: when the gills do not touch the stipe or only do so by a fine line.
Adnate gill: when gills are attached directly to the stem forming nearly a right angle with the stem/stipe.
Decurrent gill: when the gills extend down the stem to a greater or lesser degree.
Adnexed gill: if the attachment of the gills is only by a part of the stem to a greater or lesser degree.
Sinuate gill: when gills are near the stalk in a deep notch.



EDIBLE MUSHROOMS:

Volvariella volvacea (also known as **paddy straw mushroom** or **straw mushroom**) is a species of edible mushroom cultivated throughout East and Southeast 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. Worldwide, straw mushrooms are the third most consumed mushroom.

Cultivation

Straw mushrooms are grown on rice straw beds and are most commonly picked when immature (often labeled "unpeeled"), during their button or egg phase and before the veil ruptures.[3] They are adaptable and take four to five days to mature, and are most successfully grown in subtropical climates with high annual rainfall. No record has been found of their cultivation before the 19th century

Nutrition

One cup of straw mushrooms is nutritionally dense and provides 240 kilojoules (58 kilocalories) of food energy, 27.7 µg selenium (50.36% of RDA), 699 mg sodium (46.60%), 2.6 mg iron (32.50%), 0.242 mg copper (26.89%), 69 µg vitamin B_9 (Folate) (17.25%), 111 mg phosphorus (15.86%), 0.75 mg vitamin B_5 (pantothenic acid) (15.00%), 6.97 g protein (13.94%), 4.5 g total dietary fiber (11.84%), and 1.22 mg zinc (11.09%)

Identification

In their button stage, straw mushrooms resemble poisonous death caps, but can be distinguished by several mycological features, including their pink spore print (spore prints of death caps are white). The two mushrooms have different distributions, with the death cap generally not found where the straw mushroom grows natively, but immigrants, particularly those from Southeast Asia to California and Australia, have been poisoned due to misidentification.

AGARICUS BISPORUS:

Agaricus bisporus is an edible basidiomycete mushroom native to grasslands in Europe and North America. It has two color states while immature – white and brown – both of which have various names, with additional names for the mature state.

A. bisporus is cultivated in more than seventy countries,[2] and is one of the most commonly and widely consumed mushrooms in the world.

When immature and *white*, this mushroom may be known as **common mushroom**, **white mushroom**, **button mushroom**, **cultivated mushroom**, **table mushroom**, and **champignon mushroom** (or simply **champignon**). When immature and *brown*, it may be known variously as **Swiss brown mushroom**, **Roman brown mushroom**, **Italian brown mushroom**, **cremini/crimini mushroom**, **chestnut mushroom** (not to be confused with *Pholiota adiposa*), and **baby bella**.
When marketed in its mature state, the mushroom is brown with a cap measuring 10–15 centimetres (4–6 inches). This form is commonly sold under the names **portobello mushroom**, **portabella mushroom**, and **portobella mushroom**, but the etymology is disputed

Description

The pileus or cap of the original wild species is a pale grey-brown in color, with broad, flat scales on a paler background and fading toward the margins. It is first hemispherical in shape before flattening out with maturity, and 5–10 centimetres (2–4 inches) in diameter. The narrow, crowded gills are free and initially, pink, then red-brown and finally a dark brown with a whitish edge from the cheilocystidia. The cylindrical stipe is up to 6 cm (2 ½ in) tall by 1–2 cm (½–¾ in) wide and bears a thick and narrow ring, which may be streaked on the upper side. The firm flesh is white, although stains a pale pinkish-red on bruising. The spore print is dark brown. The spores are oval to round and measure approximately 4.5–5.5 μm × 5–7.5 μm, and the basidia usually two-spored, although two-tetrasporic varieties have been described from the Mojave Desert and the Mediterranean, with predominantly heterothallic and homothallic lifestyles, respectively.

This mushroom is commonly found worldwide in fields and grassy areas following rain, from late spring through to autumn, especially in association with manure. In many parts of the world it is widely collected and eaten; however, resemblance to deadly or poisonous lookalikes (see below) should be noted.

Cultivation history

A. bisporus being cultivated

The earliest scientific description of the commercial cultivation of *A. bisporus* was made by French botanist Joseph Pitton de Tournefort in 1707. French agriculturist Olivier de Serres noted that transplanting mushroom mycelia would lead to the propagation of more mushrooms.

Originally, cultivation was unreliable as mushroom growers would watch for good flushes of mushrooms in fields before digging up the mycelium and replanting them in beds of composted manure or inoculating 'bricks' of compressed litter, loam, and manure. Spawn collected this way contained pathogens and crops commonly would be infected or not grow at all. In 1893, sterilized, or pure culture, spawn was discovered and produced by the Pasteur Institute in Paris, for cultivation on composted horse manure.

Modern commercial varieties of the common agaricus mushroom originally were light brown in color. The white mushroom was discovered in 1925 growing among a bed of brown mushrooms at the Keystone Mushroom Farm in Coatesville, Pennsylvania. Louis Ferdinand Lambert, the farm's owner and a mycologist by training, brought the white mushroom back to his laboratory. As with the reception of white bread, it was seen as a more attractive food item and became grown and distributed. Similar to the commercial development history of the navel orange and Red Delicious apple, cultures were grown from the mutant individuals, and most of the cream-colored store mushrooms marketed today are products of this 1925 chance natural mutation.

A. bisporus is now cultivated in at least seventy countries throughout the world. Global production in the early 1990s was reported to be more than 1.4 billion kilograms (1.5 million short tons), worth more than US$2 billion. In the U.S., the white button form of *A. bisporus* alone accounts for about 90% of mushrooms sold.[

Nutritional profile

In a 100-gram serving, raw white mushrooms provide 93 kilojoules (22 kilocalories) of food energy and are an excellent source (> 19% of the Daily Value, DV) of the B vitamins, riboflavin, niacin, and pantothenic acid (table). Fresh mushrooms are also a good source (10–19% DV) of the dietary mineral phosphorus (table).

While fresh *A. bisporus* only contains 0.2 micrograms (8 IU) of vitamin D as ergocalciferol (vitamin D2), the ergocalciferol content increases substantially after exposure to UV light.

Pleurotus citrinopileatus

Pleurotus citrinopileatus, the **golden oyster mushroom** (*tamogitake* in Japanese), is an edible gilled fungus. Native to eastern Russia, northern China, and Japan, the golden oyster mushroom is very closely related to *P. cornucopiae* of Europe, with some authors considering them to be at the rank of subspecies. In far eastern Russia, *P. citrinopileatus*, they are called *iI'mak*, is one of the most popular wild edible mushrooms

Description

The fruiting bodies of *P. citrinopileatus* grow in clusters of bright yellow to golden brown caps with a velvety, dry surface texture. Caps range from 20–65 millimetres (¾–2 ½ inches) in diameter. The flesh is thin and white, with a mild taste and without a strong smell. Stems are cylindrical, white in color, often curved or bent, and about 20–50 mm (¾–2 in) long and 2–8 mm (1⁄16–5⁄16 in) in diameter. The gills are white, closely spaced, and run down the stem. The spores of the golden oyster mushroom are cylindrical or elliptical in shape, smooth, hyaline, amyloid, and measure 6-9 by 2–3.5 micrometres.

Ecology

The golden oyster mushroom, like other species of oyster mushroom, is a wood-decay fungus. In the wild, *P. citrinopileatus* most commonly decays hardwoods such as elm. Spores are spread by *Callipogon relictus*, a beetle.

Uses

Golden oyster mushrooms are cultivated commercially, usually on a medium of grain, straw, or sawdust. *Pleurotus* species are some of the most commonly cultivated mushrooms, particularly in China, due to their ease of cultivation and their ability to convert 100 g of organic refuse into 50-70 g of fresh mushrooms.

P. citrinopileatus mushrooms are a source of antioxidants. Extracts from *P. citrinopileatus* have been studied for their antihyperglycemic properties, decreasing blood sugar levels in diabetic rats. They have also been studied as a source of lipid-lowering drugs; *P. ostreatus*, a related oyster mushroom, has been found to contain the cholesterol-lowering drug lovastatin

INFRASTRUCTURE The production of mushrooms need some basic infrastructure before the production of mushrooms in large scale. These are as follows: Substrates (locally available) – Different types like straw, dried plant parts, wheat. Wheat husk, Outer seed coat of groundnut, stems of Soybean etc. Polythene bag- Used to fill up the substrate Vessels- also used to hold the substrates , Inoculation hook- To inoculate the substrate with the spawns Inoculation loop- to inoculate the substrate from the media. low cost stove- For warming up Sieves- as air filters Culture rack- to place the culture media with the degree of sterilization, Mushroom unit (Thatched house) – the place for large scale production, Water sprayer- water to maintain the desire humidity of the substrates Tray-used to hold the substrate for larger area, Small polythene bag

SUBSTRATES: As the agriculture waste possesses high nutrients in one hand but causes soil pollution on the other, the lignocelluloses can be used for the growth of the mycelia. Straw, wheat straw, banana leaf, wood waste etc mostly used for the same. Microbes from the substrates must be disposed off as it can interferes the growth of the mycelia.

 Cellulose, lignin, mostly induce the growth of Pleurotus ostreatus but Volvariella volvacea mostly promoted by cellulose, For better yield, gypsum, lime, urea may be added to the main substrate for better performance, The substrate depends upon the nature of the edible fungi supposed to be produced in this regard.

POLYTHIN BAGS: Plerotus sp production , 20*30 cm or 18*25 polythin bags used for mushroom beds. The mouth of the polythin bag is open to insert straw, keeping 3-5 cm. space upon which the spawns are inoculated

3-4 layers of straw beds are made with spawn for better yield with proper space making sufficient humidity & aeration facilities in this regard. After 25-30 days, the mushrooms growth visible.

VESSEL:A cultivation vessel for fungi has a wide-mouthed upper opening and a lower opening, each of which is detachably covered by a respective top and bottom end cap. One or more such vessels are prepared, sawdust and rice barn are packed as the culture medium therein, and a mushroom spawn is inoculated thereon to spread and culture the hypha. After culturing for about 20 days, the culture mediums are taken out and further successively cultured for about 3 to 30 days in contact with each other to develop the fruit bodies.

INOCULATION HOOK & INOCULATION LOOP: Before the spawn preparation, fungi mycelia are grown in PDA medium for multiplication in sterilized container, appears as white layer, the fungal growth is added to the seed using the device called inoculating needle & the inoculating needle contains 5 mm circular loop called inoculating loop. The entire transfer is done inside the sterile chamber . Very often, inoculating hook can be used for the same purpose for effective transfer of the fungal mycelia.

USE OF STOVES IN MUSHROOM CULTIVATION: □ Small LPG containing stoves to be used, □ The wheat grains preparation by sterilization that to be used as spawn, □ High heat resistant polythene bags containing the seeds of wheat for spawn to be sterilized using autoclave, □ The heating of autoclave followed by the use of steam to be used in this purpose. □

USE OF SIEVE IN MUSHROOM CULTIVATION: The wheat grains used to be as spawn may consists of debris, □ The debris to be disposed off by using sieves, □ When the straw is used as spawn medium, the excess water from the straw to be disposed off by using sieves, □ The diameter of the sieve must be larger than the usual sieves used for this purpose

RACK USED IN MUSHROOM CVULTIVATION: Iron racks to be used, It consists of 5-6 stairs, Each stirs must have distance of 60 cm. Each rack consists of compost or the polythin bags containing spawns, The distance between the two racks must be more than 30 cm. The room having the iron racks have the area of 24 mt * 8 mt. Each culture room may contain 52-55 tones compost for better mass production of mushroom, The culture room might be concrete made with plaster finishing, The roof of the culture room must be made of concrete, The aeration facilities with adequate arrangement of moisture must be maintained

CHARACTERS OF MUSHROOM CULTIVATION ROOM: The production unit of the mushroom cultivation depends upon the yield, Each room generally consists of 60*20*10 ft having bamboo made rach, The roof of the house made up of bamboo, paddy straw or sarkandra grass, Each rack may have the area of 55 * 4.0 ft, Each 1 MT mushroom production unit have 1536 sq mt. cropping unit, The temperature maintaining is very important with AHU It may contain separate processing unit, The entire unit must comply the all sorts of safety measures as desired by the safety rules and protocols

How to Grow Button Mushroom

Making Compost

The first step to grow mushrooms is composting that is done in the open. Compost yard for button mushroom farming is prepared on clean, raised platforms made of concrete. They should be raised so that the excess water does not get collected at the heap. Though the composting is done in the open, they should be covered to protect from rain water. Compost prepared is of 2 types – natural & synthetic compost. The compost is made in trays of dimensions 100 X 50 X 15 cm.

Synthetic Compost for Mushroom Farming

The elements for synthetic compost include wheat straw, bran, urea, calcium ammonium nitrate / ammonium sulphate and gypsum. The straw should be cut to 8 to 20 cm. in length. It is then spread equally to form a thin layer on the composting yard. After this it is soaked thoroughly by sprinkling water. The next step is to blend all other ingredients like urea, bran, gypsum, calcium nitrate with the wet straw & mound them into a pile.

Natural Compost

Here the ingredients required are horse dung, poultry manure, wheat straw and gypsum. Wheat straw must be sliced finely. Horse dung should not be mixed with that of other animals. It must be freshly collected & not exposed to rain. After the ingredients are mixed, they are uniformly spread on the composting yard. Water is sprayed on the surface to wet the straws. It is heaped & turned like that for synthetic manure. Due to fermentation, the temperature of the heap goes up and it gives a smell because of ammonia escaping. This is a sign that the compost has opened. The heap is turned every three days and sprinkled with water.

Filling the Compost in Trays

The prepared compost is dark brown in color. When you fill the compost into trays, it should be neither too wet nor too dry. If the compost is dry then spray a few drops of water. If too damp, then let some water to evaporate. The size of the trays for spreading the compost could be as per your convenience. But, it must be 15 to 18 cm deep. Also make sure that the trays are made of soft wood. The trays must be filled with compost to the edge and levelled on the surface.

Spawning

Spawning is basically the process of sowing the mushroom mycelium into the beds. The spawns can be obtained from certified national laboratories at nominal price. Spawning can be done in 2 ways – by scattering the compost on the bed surface in the tray or else mixing the grain spawn with compost before filling the trays. After spawning cover the trays with old newspapers. The sheet is then sprinkled with little water to maintain moisture & humidity. There must be a head space of at least 1 meter between the top tray and the ceiling.

Casing

Casing soil is made by mixing finely crushed and sieved, rotten cow dung with the garden soil. The pH should be on the alkaline side. Once ready, the casing soil has to be sterilized to kill the pests, nematodes, insects & other molds. Sterilization can be done by treating it with formalin solution or by steaming. After the casing soil is spread on the compost the temperature is maintained at 25ºC for 72 hours & then lowered to 18ºC. Remember that casing stage requires a lot of fresh air. Therefore the room must have sufficient ventilation facilities during the casing stage.

Cropping

After 15 to 20 days of casing, the pinheads start becoming noticeable. White colored, small-sized buttons start developing within 5 to 6 days of this stage. Mushrooms are ready for harvesting when the caps are placed tight on the short stem.

Harvesting

During harvesting, the cap should be twisted off gently. For this, you need to hold it gently with the forefingers, press against the soil & then twist off. The base of the stalk in which mycelial threads & soil particles cling should be chopped off.

How to Grow Paddy Straw Mushroom

Paddy straw mushroom is grown in South-east parts of Asia. It is one of the most popular mushrooms owing to its taste. Unlike button mushrooms, they are grown on raised platforms under shadow or in well-ventilated rooms.

Spawning

Paddy straw mushrooms are spawned on chopped, soaked paddy straws. At times they are spawned on cereal grains or millets. When they are spawned on paddy straw, they are known as straw spawn and when spawned on cereal grains, they are called grain spawn.

In India, the mushroom of this variety is grown on paddy straw. Well dried and long straws are tied together in bundles of 8 to 10 cm in diameter. Then they are chopped to uniform length of 70 to 80 cm & soaked in water for 12 to 16 hours. Excess water is then drained off.

Bed Preparation

Since the mushrooms are cultivated on raised platforms, the foundations made of bricks & soil ought to be raised. The size must be a little larger than the bedding and should be strong enough to hold the weight of the bed. A bamboo frame of the size of the foundation is put on top of the foundation. At least 4 bundles from the soaked straw is put on the frame. Another 4 bundles are located but with the loose ends in the opposite direction. These 8 bundles together make up the 1st layer of bedding. Around 12 cm away from the 1st layer, the grain spawn is scattered.

After the last layer is made, cover the whole bed with a transparent plastic sheet. However proper care must be taken to make sure that the sheet is not in contact with the bed.

Mushrooming

Usually, mushrooms begin to grow within 10 to 15 days of spawning. They continue to grow for the next 10 days. Once the volva erupts & the mushroom inside is exposed, the crop is ready for harvesting. These mushrooms being very fragile have a very short shelf life hence they must be consumed fresh.

How to grow Oyster Mushroom

Oyster Mushroom is grown where the climatic conditions are not good for the button mushrooms. It is the simplest to grow & most delicious to eat. Being very low in fat content it is usually suggested for controlling obesity & also to patients suffering from diabetes, and blood pressure.

Oyster mushroom can grow at moderate temperature that ranges from 20 – 300 C and humidity 55-70 percent for a period of 6 – 8 months in a year. It can also be cultivated in summer season by providing the extra humidity needed for its growth. In hilly areas – the best growing season is during March or April to September or October while in the lower regions it is from September or October to March or April.

The process for oyster mushroom cultivation can be divided into following 4 steps:

•Preparation of spawn

•Substrate preparation

•Spawning of substrate

•Crop management

Oyster mushroom can be cultivated on several agro-wastes having cellulose & lignin that helps in more enzyme production of cellulose, which is correlated with more yield. These consist of straw of paddy, wheat / ragi, stalk & leaves of maize, millets and cotton, used citronella leaf, sugarcane bagasse, saw dust, jute and cotton waste, used tea leaf waste, useless waste paper and synthetic compost of button mushrooms etc. It can also be cultivated with the use of industrial wastes such as paper mill sludges, coffee byproducts, tobacco waste, etc.

THE END