9. Mushroom Production

Can you recall?

1. Harmful and beneficial fungi
2. *Bhuchhatra or* mushroom in rainy season

9.1 IMPORTANCE AND SCOPE

9.1.1 Mushroom : The Mushroom is a fleshy, spore bearing fruiting body of a fungus, typically produced above ground, or on its food source. All edible fungi are saprophytes. The edible species are commonly known "Mushrooms" while those, which are poisonous, are known as "Toadstools".

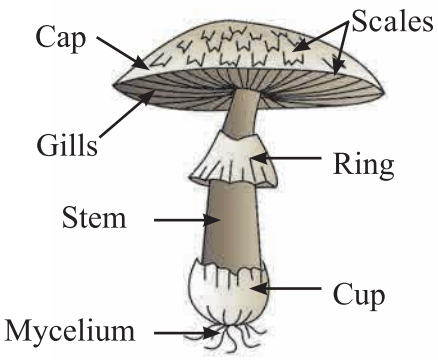

Fig. 9.1 Parts of mushroom

Various types of mushroom occur in nature which are different in sizes and colours. Mushroom is a fungus lacking in chlorophyll and obtains nutrients from organic compounds mainly available in organic waste. We see mushrooms on woody material, compost and decomposing plant, etc. in rainy season. Near about 4000 varieties of mushroom are found but very few varieties of mushroom are edible. So many varieties of mushroom are partial or highly poisonous and allergic. In India, 150 varieties of mushroom are found, out of them only five edible species are cultivable.

Do you know ?

India. U.S.A., China, France, Japan, Holland, England, South Korea, etc. are major mushroom producing countries in the world. India among those is a small scale mushroom producer.

Remember this

'Guchhi' type of mushroom found in Jammu and Kashmir and hilly area of U.P. is the best counted variety in the world. Common mushrooms are button, shiitake, pleurotus and paddy straw mushroom.

In India, button and pleurotus mushrooms are very popular for cultivation. In Maharashtra edible button, pluerotus and paddy straw mushrooms are commercially cultivated on large scale.

Importance and potential of mushroom is well known in all aspects of human life as well as ecosystems. Mushroom solves many problems such as quality food demand, unemployment, economical issues and human health. The importance of the mushroom is as follows.

1. Mushrooms are being used as food and medicine since time immemorial.
2. Mushrooms are popular for their delicacy and flavor rather than food.
3. Mushrooms are great source of protein (veg. mutton) fiber, vitamin B, (specially niacin, folic acid) C and D.
4. It is a source of minerals like P, K, Cu, Zn, Fe, Mn and Mg.
5. It contains antioxidants that are unique to mushroom such as eargothionine and glutathione which is highly powerful antioxidant.
6. Raw materials for cultivation of mushrooms are very cheap and easily available.
7. Agricultural wastes can be used for production of mushrooms.
8. Cost of cultivation of mushrooms is very low and require small area for cultivation.
9. It enhances the income of farmer.
10. It cleans environment by decomposing organic waste.

Mushroom contains near about 17.00 % to 37.50% protein, these are easily digestible and good quality compared to vegetable proteins.

It is a complete quality and healthy food suitable for all age group. Nutritive value of mushroom depends upon numerous factors such as species, variety, stage of development and environmental condition. Mushrooms are rich in proteins, dietary fiber, vitamins, and minerals.

Do you know ?

ICAR has established all India coordinated mushroom research project at College of Agriculture, Pune for technical support and training to interested candidates.

9.1.2 Nutritive value of different mushroom (dry weight basis g/100 g) :

Mushroom type	Carbohydrates	Fibre	Protein	Fat	Ash	Energy (K cal)
Button (*Agaricus bisporus*)	46.17	20.90	33.48	3.10	5.70	499
Oyster/Dhingri (*Pleurotus* spp.)	63.40	48.60	19.23	2.70	6.32	412
Paddy straw (*Volvariella volvaceae*)	54.80	5.50	37.50	2.60	1.10	305
Milky (*Calocybe indica*)	64.26	3.40	17.69	4.10	7.43	391
Shitake (*Lentinula edodes*)	47.60	28.80	32.93	3.73	5.20	387

Source Manjit Singh et al, 2011

Vitamins value (mg/100 gm)

Vit- B_1 (Thiamin) : 1.1 to 4.8 mg

Vit- B_2 (Riboflavin) : 3.3 to 5.0 mg

Vit- C (Ascorbic acid) : 0.0 to 81.9 mg

9.1.3 Scope for mushroom cultivation :

Day by day the unemployment is increasing very fast in urban as well as rural areas. Therefore, mushroom cultivation is the best tool for farmers, unemployed youth and rural women for enhancing their per capita income. Mushroom cultivation requires inexpensive raw material, which is easily available at farm, as paddy, cotton, cashew, wheat, etc. are the common cultivable crops in Maharashtra. Now a days, many more people are turning towards mushroom cultivation in Maharashtra due to low input cost requirement in it. It can be grown in places like huts, small room tunnels, sheds or shelter, etc. It can be grown almost by anyone, anywhere and has a great market demand due to its medicinal, vegetative and nutritional value.

9.2 TYPE OF MUSHROOM : TYPES CULTIVATED IN INDIA AND THEIR PRODUCTION TECHNIQUE

9.2.1 Types of mushroom :

1. Button mushroom
2. Oyster mushroom
3. Paddy straw mushroom
4. Milky mushroom
5. Shitake mushroom

1. Button or European mushroom (*Agaricus bisporus*) : This mushroom is commonly known as "White button, European or temperate mushroom". It is cultivated in temperature range of 16-24^{0}C. In winter season found naturally in Himachal Pradesh, J & K, Nilgiri and Kumaon hills and can be cultivated any-where under artificial conditions.

Fig. 9.2 Button mushroom

2. Oyster mushroom (*Pleurotus* spp.) : This mushroom is also known as "wood fungus" and in India it is commonly known as "Dhingri". It requires 20-30^{0}C temperature for growth and grows under natural conditions on trees or dead woody branches of trees. Some common species of Pleurotus are *P. sajor caju* (grey coloured), *P. florida* (white), *P. eous* (pink), *P. ostreatys* (blue), *P. flabellatus* (white or turning red), *P. citrinopileatus* (golden yellow).

Fig. 9.3 Oyster mushroom

3. Paddy straw mushroom (*Volvariella* spp.) : It is commonly known as "Paddy straw mushroom or Chinese mushroom". Very fast growing mushroom (15 to 18 days from spawning). Grows at higher temperature 25 to 35^{0}C and relative humidity (RH) of >85 per cent. Most widely cultivated in Odisha, West Bengal and some other parts of India. Commonly cultivated species is *Volvariella volvaccea*.

Fig. 9.4 Paddy straw mushroom

Internet my friend

Collect information on mushroom types in the world.

4. Milky mushroom (*Calocybe indiaca*) : It is milky white coloured and hence commonly known as "Dudh chatta". Widely grown in South India and West Bengal. Grows at higher temperature 25 to 35^{0}C and RH of > 75%. The robust mushroom and has a firm consistency.

Fig. 9.5 Milky mushroom

9.2.2 Mushroom production technique :

Requirements for mushroom production are infrastructure, equipments and materials.

A. Infrastructure : For oyster mushroom production partially ventilated covered area of specific size is essential. Materials like bamboo, grass, poly-ethylene, fiber sheets, etc. can be utilized for building the structure. For button mushroom cultivation composting yard, pasteurization chambers (Bunkers and tunnels), spawning room insulated A. C. cropping rooms are essential.

B. Equipments : Air conditioner, exhaust fan, spray pump, steam boiler, compost turner, humidifier, weighing balance, humidity and temperature recorder of hygroscope.

C. Materials :

i. **Agro waste raw material :** Wheat, paddy, jowar or soybean straw, sugarcane trash, dried cotton plants, hay, etc. are generally used as raw material. It should be sufficiently dried and stored carefully.

ii. **Container :** For mushroom production poly ethylene bags are used widely. It's thickness should be 80 to 100 gauge and size 18 to 22 inch in length.

iii. **Spawn :** Seed for production of mushroom.

iv. Soil, sand, FYM; coir pith, thread, polytherne bags, bucket.

v. **Other material :**

a. Drum - for soaking raw material

b. Heater - for water heating

c. Foggers - for humidity generation and maintenance

d. Dryer - for drying mushroom

e. Thermometer - temperature measurement

f. Hygrometer - humidity measurement

D. Chemicals : Formalin; insecticides like malathion and fungicides like carbendazim.

E. Water : Cultivation of mushroom requires clean and pure water in sufficient quantity.

9.2.3 Button mushroom cultivation technique:

Cultivation of the white button mushroom is a complex process and requires special technical skill for raising a successful crop. It requires different temperatures, 22^{0}C to 28^{0}C for spawn and case run and 15^{0}C to 18^{0}c for fruit body formation. Besides specific temperature it requires proper humidity (85-95%) and enough ventilation during fructification. Cultivation of white button mushroom is accomplished in three basic steps like production or procurement of spawn, compost prepartion and cultivation.

I. Production or procurement of spawn : The spawn of required the strain can be prepared in the laboratory or purchased.

II. Preparation of growth medium (compost) : Button mushroom is cultivated on specially prepared compost. The compost is prepared as follows.

1. Long method of composting (LMC) compost prepartion duration is 28 to 30 days.
2. Short method of composting (SMC) compost prepartion duration 18 days.

The following ingredients are required to fill 50 bags of compost @ kg/bag as mentioned:

Sr. No	Ingredients	Long method	Short method
1	Wheat straw	300kg	300kg
2	Wheat bran	30 kg	21.6 kg
3	Ammonium sulphate	9 kg	----
4	Urea	3.6 kg	4.5 kg
5	Sulphate of potash	3.0 Kg	----
6	Super phosphate	3.0 Kg	----
7	Gypsum	30.0 Kg	9.0 Kg
8	Lindane	1.0 Kg	----
9	Chicken manure	----	120.0 Kg

At present, short method of composting is being adopted on large scale.

Short method of composting

Days Stage I/ Phase I	Activity	Work to be done
0	Spreading + wetting straw and mixing of ingredients	Spread the straw on the floor. Sprinkle sufficient amount of water on it. After 24 hrs mix all other raw ingredients, moisten them and follow the following procedure.
2	Stacking/Pile prepartion	Stack the straw and other ingredients except gypsum, the size of stack can be kept up to 5' x 5' in length (anaerobic fermentation).
4	First turning	Turn the stack, watering should be done if required (anaerobic condition).

Stage II/ Phase II	Activity	Work to be done
6	Second turning	At this stage moisture content should be 75-77%.
8	Third turning	Adjust water content to 70-72% and required quantity of gypsum is added.
10	Forth turning	Turn the stack; watering should be done if required. Moisture content is 70-72%
11	Filling in phase II/ Pre-pasteurization	Load the compost in bulk chamber for phase II after confirming that compost colour is dark brown. Moisture content is 70-72%. The door of the tunnel is closed and the entire compost mass is brought to uniform temperature of 45^{0}C by use of blower.
12	Pasteurization	Raise the temperature slowly by 1-2^{0}C per hr up to 54^{0}C to 59^{0}C by adjusting the air flow by blower. Maintain it for 6 to 8 hrs for peak heating of the compost.
13	Post pasteurization	Lower the temperature slowly by 1-2^{0}C per hr up to 45^{0}C to 48^{0}C.
14-16	Conditioning	The temperature is maintained at 45^{0}C - 48^{0}C for conditioning the compost, 20% aeration is also provided. During this, the thermopiles develop very fast in the compost.
18	Cooling of compost	Compost is allowed to cool to 25^{0}c to 28^{0}C by increasing the speed of blower and giving fresh air and spawning.

III. Cultivation : Different steps in cultivation are as follows.

a. Spawning : Spawning means mixing of spawn in the fully prepared compost. Thorough spawning is adopted in button mushroom. In this case mix the grain spawn evenly and throughout the compost. Rate of spawning is 0.5 to 0.75 per cent of fresh weight of compost. Maintain relative humidity at about 80 to 90 per cent and temperature at 25^{0}C ± 1^{0}C in the spawning room. The spawn run (period from spawning to full development of mycelium in the compost) is completed within 15-20 days showing whitish strands of mycelium.

b. Casing : The process of covering the compost with a thin layer of soil or soil like material after the spawn run is known as casing. The purpose of casing is to provide necessary stress for induction of fruiting. It also provides support to the mushroom. It is also known to supply water for growth and development of fruit body and maintain humidity and temperature in cropping room by evaporative cooling and gaseous exchange.

The casing material is prepared by mixing sandy loam soil with neutral reaction + one year-old FYM in 1:1 proportion or coir pith + soil (5:1 ratio). Casing material is treated either by steam at 65-70^{0}C for 6-8 hrs. or sterilize the mixture in an autoclave at 30 lbs pressure for 1 hour or with 2 L formalin (40%) in 40 lit water per m^3.

c. Crop management : After casing maintain the temperature at 20^0 to 24^{0}C for about one week and R.H. 85-90 per cent. After this period lower down the temperature to 15-18^{0}C and supply fresh air.

The pinhead starts appering after 12-15 days of casing and cropping continues for about 2 months. After appearance of the pinhead it requires 8 to 10 days when they are 3-5 cm in diameter. Take out the mushroom by twisting and without much disturbance to the casing soil. During casing and cropping period give light watering by spray to prevent the casing soil from becoming dry and hard. Avoid heavy watering.

The proper air exchange is necessary to replace excessive carbon dioxide with fresh air. Maintain the relative humidity at 85-90 per cent and temperature at $16^0C \pm 2^0C$ throughout the cropping. The every 7 to 10 days cleanup campaign should be adopted after bloom cutting.

9.2.4 Oyster mushroom cultivation technique:

A. Medium/Substrate : This mushroom is cultivated on waste dried straw of threshed crops of field. These medium should be dried and from current season only.

B. Preparation of substrate and pasteurization : Dhingri can be grown on various substrates like wheat, cotton waste, paddy and rye straw, soybean husk, sugarcane bagasse, banana leaves, etc. Cultivation on wheat/paddy straw is more economical as these are easily available. The straw should be chopped in to small pieces of 2 to 3 cm size and then soaked in tap water for 8 to 10 hours. Drain out excess water. Pasteurize the same straw by any one method as follows:

1. **Steam pasteurization :** In steam pasteurization the substrate is exposed to steam at 80^0C temperature for one hour.
2. **Hot water treatment :** In hot water treatment, the substrate is kept in hot water (80^0C temperature) for one hour. Then take out it, drain excess water and cool the straw.
3. **Chemical sterilization :** Take dried straw and fill it in gunny bags. In chemical pasteurization, the substrate is soaked in the solution of formalin (125ml) and carbendazim (7.5gm) mixed in 100 litre of water for nearly 18 hours. Then take out it, drain excess water and carry out spawning.

C. Bed preparation : The polythene bag method is used for bed preparation that is to be carried out in a close disinfected room. The polythene bags of 35 x 55 cm size is disinfected in 5 per cent formalin solution. The beds are prepared by layer method. First layer of straw measuring about 2-3 cm at the bottom is given. Then spread the spawn evenly over the surface of straw. Likewise fill up the bed by giving 3-4 layers by pressing the straw lightly after every layer. The rate of spawning should be @ 2% on the wet weight basis of straw. Tie the neck of the bag with thread tightly. Make 30-40 pinholes on the surface of bag. The bags are then kept for incubation (spawn run) at $25^0C \pm 2^0C$ and 70-80% R.H.

D. Crop management : The spawn run is completed within 12-17 days depending on species and climatic conditions. After completion of spawn run in the substrate, remove the polythene bags and the beds are kept in partially ventilated growing room where provisions for moderate light and high humidity are made. Light watering should be done for 2 to 3 times in a day. The temperature of growing room should be in the range of 25 ± 2^0C with relative humidity of 80-90 per cent. After removing the plastic bags, pinheads start appearing within 3-5 days and become ready for harvest in a week. Harvest all mushroom crop at a time. Remove rotted, loose layer of straw by hand. After that regularly spray water 2-3 times in a day. In 45 to 50 days 0.8 to 1.0 kg of fresh mushroom can be obtained from a bed of one kg dry straw. These beds can be used as manures for plants and feed for cattle.

9.2.5 Paddy straw mushroom cultivation :

Paddy straw mushroom being 3rd most important cultivated mushroom in India is well known for its pleasant flavour and taste. It is a mushroom of the tropics and subtropics. It is considered to be one of the easiest mushrooms to cultivate and is very fast growing that takes about 10-12 days from spawning to harvesting. Three species of Volvariella are grown in India viz., *V. Volvacea*, *V. diplasia* and *V. esculanta*.

A. Cultivation technique : For cultivation of paddy straw mushroom shelter (thatched house) is required for protection from light, wind and rain. In addition, it can also be done under the shade of tree. The bamboo or wooden stands are required for placing square beds. Now days, it is cultivated inside poly houses by maintaining the temperature of around $25-35^0C$ and relative humidity of 75 to 80%.

Spawning with gram floor

Criss-cross arrangement of paddy bundles

Spawned beds of paddy straw

Fig. 9.6 Traditional Technique

The paddy straw mushroom can be cultivated by following methods :

a. Traditional technique and

b. Modern technique

a. Traditional technique : Clean, fresh, dried and un-chopped paddy straw is required for successful cultivation. The paddy straw is tied in to bundles each weighing about 1.0 kg. These bundles are then soaked in clean fresh water for 16 to 20 hrs followed by draining of excess water by placing the bundles on a sloppy surface so as to attain 70% moisture level. First, it is advised to sterilize the paddy straw by soaking in 80^{0}C temp water or fumigate under tarpaulin with 5% formalin solution to prevent contamination. These bundles are laid in the form of bed on a slightly raised bamboo platform. Each bed consists of 22 bundles arranged in four layers of 5 bundles each in a criss-cross fashion with two loose bundles at the top. The beds are spawned in between the layers with 5 to 7 days old grain spawn @ 1.5% on the basis of dry weight straw. The red gram or gram floor can be used @ 150 g/bed below the spawn. The spawn is placed 8 to 10 cm from inside the edges and all-round the bed. The beds are pressed from the top and covered with plastic sheet. No ventilation in the room is required till the buttons appear. Beds are watered regularly till the end of the crop by sprinkling water once or twice a day. During cropping period the temperature should be 28^0 to 32^{0}C with relative humidity of 80-90%. Maintain moisture level of 65-70% in beds.

Mushrooms start appearing in clusters from all the sides after 10-12 days of spawning and are harvested after about 3 weeks. Each bed of 22 bundles would yield about 2.5 to 3.0 kg mushroom.

Remember this

Mushroom processing : Mushrooms are highly perishable and they start deteriorating immediately after their harvest. They develop a browning discolouration on the surface of the mushroom cap due to enzymatic action and it quickly become soft at high temperature.

b. Modern technique : Cotton waste and rice straw 2:1 or 1:1 proportion, chicken manure @ 5% and lime stone (3 to 4%) are mixed together, moistened with water and piled on a concrete platform with the help of a wooden frame (90 cm x 90 cm x 30 cm) for fermentation. One pile of compost usually consists of 4 to 6

Fig. 9.7 Modern technique

such layers and is about 70 to 90 cm high. The process of fermentation is completed within 2 to 4 days. At least one turning is necessary during fermentation. After preparation of bed, the pasteurization is done at 60-62°C for 4-5 hours followed by conditioning for 2-3 days at 45-50°C temperature. Then, gradually the temperature is lowered to 32 - 34°C after about 8 to 12 hours, when the straw / compost is ready for spawning. The amount of spawn used is 1.5% of the dry weight of compost. About 4 days are required for completion of spawn run. No water and light are needed but little ventilation is necessary. On the fifth day after spawning primordia of fruit bodies appear on the surface of the bed. It usually takes about 4 days for these tiny bodies to develop to the stage of harvesting. Maximum two flushes can be harvested.

9.3 HARVESTING AND PACKING OF MUSHROOMS

9.3.1 Harvesting :

a. Button mushroom (*Agaricus bisporus*) :

Harvest the fully developed buttons of 3 to 5 cm diameter. Pick up mushrooms in the early hours of day by light twisting. Clean the harvested mushrooms by cutting the bases of stalks adhering casing soil. Generally, the yield of mushroom is about 15 to 20 kg/100kg compost.

b. Dhingri *(Pleurotus spp.)* mushroom :

First harvesting is done in 20-25 days after filling of bags. This is done when it attains full size by twisting of fruits before edges of mushroom turn inside and before spore shading. Clean the harvested mushroom with dry cloth before packing. Send fresh mushroom to market. The expected yield is about 750 to 800 g of fresh mushrooms from one kg of dry straw.

c. Paddy straw mushroom (*Volvariella* spp.) :
Harvest the mushroom at button stage or when volva is about to rupture. If allowed to open, stem turns a bit hard which is not preferred. Harvest mushroom by twisting. Each bed of 22 bundles gives about 2.5 to 3.0 kg mushroom in traditional method and 3.5 to 4.0 kg in modern method of cultivation. It can be dried as like oyster mushroom.

9.3.2 Mushroom packing : Before packing pay full attention towards cleaning of mushrooms. Generally plastic bags or punnets with holes are filled in with 200 gm of mushroom. Then they are sent in market for selling as early as possible. If market is at long distance, then fill the mushroom packets in boxes with ice blocks.

9.4 PRESERVATION OF MUSHROOM

9.4.1 Drying

A. Dehydration of mushrooms :

If process of canning is not possible then dehydration is beneficial. For dehydration purpose mushrooms are harvested at a maturity stage. They can be dried in the sun or in a mechanical dehydrator at 60^0 to 70^0C. After complete drying the mushrooms are reduced to nearly 1/10th of their fresh weight. Mushrooms can also be dried after steam or water blanching at 60^0 to 70^0C. Dipping in aqueous solution of chlorine followed by sulphiting [processing with sulphur dioxide (SO_2) and citric acid] retains the whiteness of the product. Dried mushrooms should be stored in airtight containers in a cool dry place.

B. Freeze drying :

It is done by immersing the sliced mushroom in solution of 0.05% sodium metabisulphite and 2% common salt for about 30 minutes. These are then blanched in boiling water for 2 minutes followed by cooling. The product is frozen at -22^0F for one minute. The frozen mushrooms are dried to a moisture content of 3% in freeze drier and packed in cans under vaccum.

9.4.2 Canning of mushroom :

Button mushrooms can be canned either whole, sliced or in smaller pieces. Mushrooms are washed gently to remove any adhering soil. Fresh mushrooms are then dipped in boiling water for 2 to 3 minutes and put in cold water to prevent leaching losses. Blanching can also be done in steam for 2 to 3 minutes. Blanched and cooled mushrooms are then filled in cans.

Brine solution consisting of 2% common salt, 2% sugar and 0.3% citric acid, is boiled, filtered and added into the can to fill just up to the brim (125ml solution per can of lb capacity). After placing the lid the can are exhausted in boiling water till the center temperature reaches 80 - 85^{0}C. Cans are then sealed on a seamier to get an air tight seal. These cans are later steamed at 115^{0}C for 25 to 30 minutes. Soon after sterilization, the cans are kept in fresh water for cooling. Later they are wiped dry and kept in cool, dry place.

9.4.3 Pickling of mushroom: Components of pickle are as follows :

Fresh mushroom(buttom)	-	500gm
Salt	-	20gm
Ginger (ground)	-	05gm
Onion (chopped)	-	20gm
Mace (ground)	-	02gm
Fenugreek/methi seeds (ground coarsely)	-	10gm
White paper (powder)	-	20gm
Red chilli powder	-	10gm
Vinegar	-	10 ml
Mustard seed oil	-	100ml
Sodium benzoate	-	200mg

Use button mushrooms for pickles. Immerse them in cold water for a few minutes and drain. Put clean mushrooms in a pan and mix with salt, pepper, mace, fenugreek, red chilies. Fry onion and ginger in oil to a light brown colour and mix with mushroom. Add vinegar (0.01 %) and cook for 10 minutes. Pour the whole mixture into small glass jars, taking care that all the spices are divided equally in the jars. Seal the jar with lid and label it. Leave it for a few days at room temperature and use after one month.

Exercise

Q. 1 Anwer the following question.

A. Select the appropriate alternative and complete the following statement.

1. ---------- is the most widely cultivated mushroom in the world.
   a. Button b. Milky
   c. Oyster d. Paddy straw
2. Mushrooms are great source of ----------
   a. Fats b. Carbohydrates
   c. Proteins d. Minerals
3. Seed of mushroom is called ----------
   a. Spawn b. Weed
   c. Spore d. Conidia
4. Foggers are used in mushroom production for maintaining ----------
   a. Humidity b. Temperature
   c. Soaking d. Drying
5. In India, among the following mushrooms only ---------- is not cultivable.
   a. *Pleurotus sajor caju*
   b. *Agaricus bisporus*
   c. *Volvariella volvacea*
   d. *Morchella esculenta*

B. Make the pairs.

Group A	Group B
1. Button mushroom	a. Dhingri
2. Oyster mushroom	b. *Dudh Chatta*
3. Paddy straw mushroom	c. Temperate
	d. Shitake Mushroom
	e. Chinese Mushroom

C. Find the odd one out.

1. Paddy straw/wheat straw/soybean husk/ sugarcane trash/ *dal*.
2. Ammonium sulphate/urea/foggers/sulphate of potash/ super phosphate.
3. Button/oyster/bhuchatra /paddy straw/ milky.

4. Formalin/Carbendazim/Steam/Vinegar.
5. Dried mushroom/Fresh mushroom/Pickled mushroom/Canned mushroom.

D. Write true or false.

1. Mushroom is fleshy fungus spore bearing fruiting body.
2. Button mushroom is insensitive to high temperature.
3. Mushroom seed is called as button.
4. Straw sterilization is not required in oyster mushroom cultivation.
5. Paddy straw mushroom requires low temperature (15 to 20^0C) for its growth.

Q. 2 Answer in brief.

a. List out methods of pasteurization for oyster mushroom.
b. Write in short the preparation of bed for paddy straw mushroom.
c. Explain spawning.
d. Enlist chemicals used for sterilization of paddy straw.
e. Name the value added products prepared from mushroom.

Q. 3 Answer the following questions in brief.

1. Describe milky mushroom.
2. Explain morphology of mushroom with suitable diagram.
3. Explain in short the method of compost preparation for button mushroom.
4. Discuss the harvesting and packaging of mushroom.
5. Enlist ingredients used in short and long method of composting .

Q. 4 Answer the following questions.

1. Explain freez drying of mushroom.
2. Discuss about materials requirement for mushroom production.
3. Expain casing are the modern techniques in cultivation of paddy straw mushroom.
4. Write note on dehydration of mushrooms.
5. Explain casing.

Q. 5 Answer the following questions in detail.

1. State cultivation techniques for button mushroom.
2. Explain traditional method of paddy straw mushroom cultivation.

Q. 6 Answer the following questions in detail.

1. Explain the method of pickling of mushroom.
2. Write the importance of mushrooms.

Activity

1. Prepare wheat straw for mushroom production.
2. Visit local mushroom production unit and participate in production.