LECTURE 1

Introduction to Mushrooms

Importance & History

Importance: Mushrooms are being used as food since time immemorial. These have been considered as the delicacy. From the nutrition point of view mushrooms are placed between meat and vegetables.

- These are rich in protein, carbohydrate and vitamins. Mushrooms are low in caloric value and hence are recommended for heart and diabetic patients. They are rich in proteins as compared to cereals, fruits and vegetables. In addition to proteins (3.7 %), they also contain carbohydrate (2.4 %), fat (0.4%), minerals (0.6 %) and water (91%) on fresh weight basis. Mushrooms contain all the essential nine amino acids required for human growth. Mushrooms are excellent source of thiamine (vitamin-B1), riboflavin (B2), niacin, pantothenic acid, biotin, folic acid, vitamin C, D, A and K which are retained even after cooking. Since mushrooms possess low caloric value, high protein, high fibre content and high K: Na ratio, they are ideally suited for diabetic and hypertension patients. They are also reported to possess anticancer activities.
- India is primarily agriculture based country blessed with a varied agro-climate, abundance of agricultural waste and manpower, making it most suitable for cultivation of all types of temperate, subtropical and tropical mushrooms. It can profitably be started by landless farmers, unemployed youths and other entrepreneurs. It requires less land as compared to other agricultural crops and is basically an indoor activity. These are the ideal tools for recycling the agricultural wastes which otherwise may pose problem of disposal and atmospheric pollution.
- Therefore, mushroom cultivation is not only of economic importance but also has important role to play in integrated rural development programme by increasing income and self employment opportunities for village youths, woman folk and housewives to make them financially independent.

History:

A. Button mushroom

- **1630:** Cultivation of white button mushroom started first in France in the open on ridges made out of horse dung manure.
- **1707:**Tournefort at Royal Academy of Science, France, mentioned about compost preparation and mushroom cultivation.
- **1731:** French method of cultivation was introduced into England by Miller.
- **1779:** Abercrombie described a method of composting stable horse manure in stacks.
- **1831:** Callow grew mushroom in cropping houses warmed by fire heat and got fairly good yield (1.5 lbs/sq.ft)
- **1893:**Costanitin pointed out that the incidence of diseases made constant changing of growing area necessary.
- **1902:** Ferguson published details of spore germination and growing of mycelium.
- **1905:** Duggar succeeded in making mycelium cultures from the tissue of mushroom caps.
- **1929:** Lambert discovered that spawn could also be prepared from single spore cultures.
- **1937:**Sinden found that about one third of monospore cultures of *A.bisporus*he prepared were incapable of producing fruit bodies. **1950:**Sinden and Hauser introduced ―Short Method ‖ of composting.

- **1973:** The first strain of *A.bitorquis* introduced commercially by a French firm Somycel as strain No. 2017 and later by Le Lion

B. Oyster mushroom:

- **1917:** Falck described the first successful cultivation of *Pleurotusostreatus.*
- **1951:**Lowhag was the first to grow *Pleurotus* on sawdust mixtures.
- **1962:** Bano and Srivastava reported mass production on straw-based substrates and their work paved the way for large scale commercial exploitation.

History of Mushroom Cultivation in India

Cultivation of edible mushrooms in India is of recent origin, though methods of cultivation for some were known for many years. The important historical developments in the cultivation of edible mushrooms are as below:

- **1886:** Some of specimens of mushrooms were grown by N.W. Newton and exhibited at the annual show of Agriculture, Horticulture Society of India.
- **1896-97:**Dr. B.C. Roy of the Calcutta Medical College carried out chemical analysis of the local mushrooms prevalent in caves or mines.
- **1908:** A thorough search of edible mushroom was initiated by Sir David Pain.
- **1921:** Bose was successful in culturing two agarics on a sterilized dung medium, details of which were published in the Indian Science Congress held at Nagpur during 1926.
- **1939-45:** Attempts on experimental cultivation of paddy straw mushroom (*Volvariella)* was first undertaken by the Department of Agriculture, Madras.
- **1941:**Padwick reported successful cultivation of *Agaricusbisporus*from various countries but without much success in India.
- **1943:** Thomas *et al*. gave the details of cultivation of paddy straw mushroom (*V. diplasia)* in Madras.
- **1947:**Asthana reported better yields of paddy straw mushroom by adding red powdered dal to the beds. He suggested April-June as the most suitable period for cultivating this mushroom in central Provinces and also carried out the chemical analysis of this mushroom.
- **1961:** A scheme entitled ―Development of mushroom cultivation in Himachal Pradesh‖ was started at Solan by the H.P. State Govt. in collaboration with I.C.A.R. This was the first serious attempt on cultivation of *Agaricusbisporus*in the country.
- **1962:** Bano*et al.* obtained increased yield of *Pleurotus* on paddy straw.
- **1964:** Cultivation of *Agaricusbisporus* on experimental basis was started by CSIR and State Govt. at Srinagar in J&K.
- **1965:**Dr. E.F.K. Mantel, F.A.O., Mushroom Expert, guided and assisted Department of Agriculture for construction of modern spawn laboratory and a fully air conditioned mushroom house. Research on evaluation of different strains and use of various agricultural wastes, organic manures and fertilizers for preparing synthetic compost were undertaken. Dr. Mantel's consultancy concluded after a period of 7 years.
- **1974:**Dr.W.A. Hayes, F.A.O., Mushroom Expert, guided further in improving the method of compost preparation, pasteurization and management of important parameters in the mushroom house. New compost formulations, casing materials and important parameters like nitrogen content in the compost, moisture in the casing mixture, air movements and maintenance of proper environmental factors were also standardized which raised the mushroom yields from 7 to 14 kg/m².
- **1977:** A 1.27 crore, Mushroom Development Project was launched under U.N.D.P by the Department of Horticulture (H.P) wherein the services of Mr. James Tunney were made available. He got a bulk pasteurization chamber constructed and made available readymade compost and casing to the growers of H.P. The U.N.D.P. Project was concluded during 1982 and since then the Department of Horticulture (H.P) is running the project.

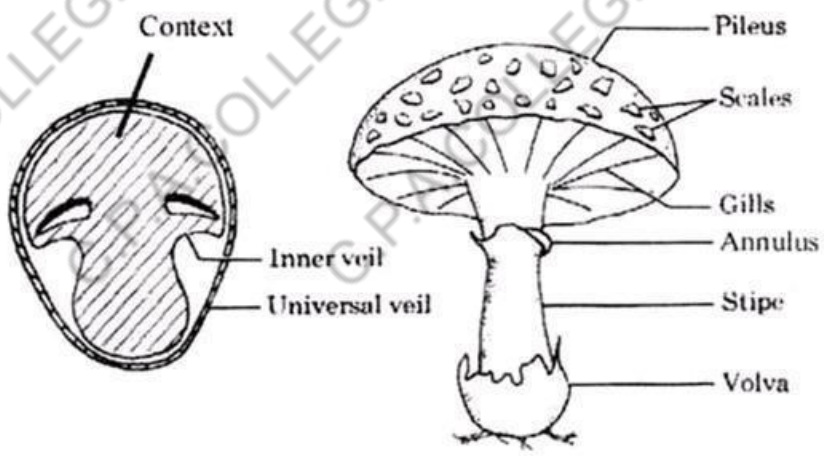
- **1982:** The Indian Council of Agricultural Research (ICAR) sanctioned the creation of National Centre for Mushroom Research and Training (NCMRT) during VIth plan on October 23, 1982 with the objectives of conducting research on mushroom production, preservation and utilization and to impart training to scientists, teachers, extension workers and interested growers.
- **1983:** All India Coordinated Project on Mushroom (AICRPM) was initiated during VIth FiveYear Plan on 01.04.1983 with its headquarter at National Research Centre for Mushroom Presently known as Directorate of Mushrooms.
- Presently there are ten co-ordinating and one co-operating centres working under AICRPM located in 11 states. Of these,nine centres are based at State Agricultural Universities, while two at the ICAR institutes.

Classification of Mushrooms

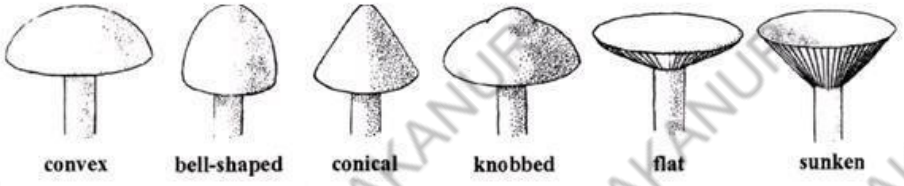
Classification of Mushrooms □ Mushroom is a fleshy fruiting body of some fungi arising from a group of mycelium buried in substratum. Most of the mushrooms belong to the Sub- Division: Basidiomycotina and a few belong to Ascomycotina of Kingdom-Fungi.

□ It is reported that there are about 50,000 known species of fungi and about 10,000 are considered as edible ones. Of which, about one hundred and eighty mushrooms can be tried for artificial cultivation and seventy are widely accepted as food. The cultivation techniques were perfected for about twenty mushrooms and about dozen of them have been recommended for commercial cultivation. However, only six mushrooms are widely preferred for large-scale cultivation. They are :

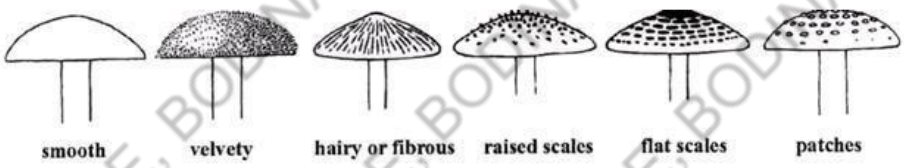
1. Paddy straw mushroom - *Volvariella spp.*
2. Oyster mushroom - *Pleurotus spp.*
3. Button mushroom -*Agaricus spp.*
4. Milky mushroom - *Calocybe spp.*
5. Shiitake mushroom _ *Lentinulla spp.*
6. Jew's ear mushroom - *Auricularia sp.*



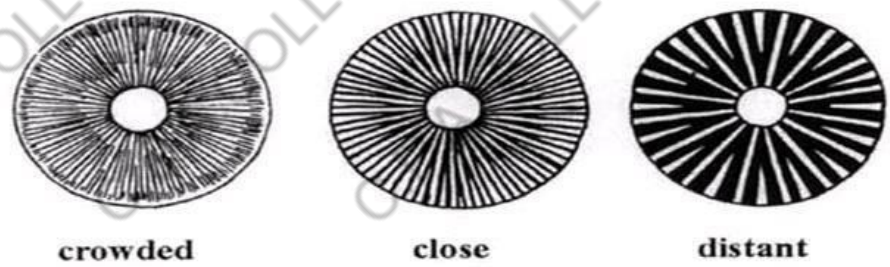
Mushroom cap shapes



Mushroom cap surfaces



Gill spacing



Gill tissue arrangements

A .*Agaricusbisporus:* The Button Mushroom

- Cap: 3-16 cm, convex to broadly convex or nearly flat in age; dry; smooth or with pressed-down or small scales; white in some varieties, brown in others. Gills free from the stem; close; pinkish to pinkish brown at first, becoming dark brown to blackish. Stem 2-8 cm long; 1-3 cm. thick; sturdy;

more or less equal; smooth or with small scales below the ring; white, often bruising brownish; with a ring that sometimes disappears in maturity. Flesh ¬white and firm; usually bruising and staining brownish (see top illustration).Odour and taste pleasant.Chemical Reactions -cap not yellow with KOH. Spore print brown .Microscopic Features -spores 5.5-8.5 x 4-6.5 µ; elliptical; smooth. Basidia 2-spored.

B.*Pleurotusspp*.:The Oyster mushroom

- The cap of oyster mushroom is tongue shaped , maturing to a shell shaped form , 50-150 mm in diameter , whitish to grey to blue grey in colour . Flesh is thin and white , margin is occasionally wavy, gills are white, decurrent , broadly spaced, stem attached in an off - centred fashion and is short at first and absent in age . Spores are whitish to lilac grey in mass, mycelium whitish , fast growing rhizomorphic to linear . Basidiatetrapoplar , producing 4 haploid spores, heterothallic, clamp connections present . Because of the allergic nature of spores , some sporeless strains have also been developed.

C. *Volvariellaspp.*:The Paddy straw mushroom Mushrooms are white initially, become dark tan in colour as the veil tease and then changes to a pale tan with age. Fruiting bodies are small when young enveloped by a sheath like universal veil, which soon breaks as fruit bodies mature, leaves an irregular cup-like sack at the base of the stem known as volva. Cap 5-15 cm broad, egg shaped and expands to campanulate or convex with slight umbo .

Gills are free, white first and soon pinkish, spores are pinkish to pinkish brown in mass, 7.5–9 x 4–6 µ in size. Stem 4-20 cm long, solid, smooth and white to yellowish in colour. Stem base is encased in a thick volva .Basidia are tetrapolar , producing four haploid spores , primary homothallic, clamp connections are present, form cheilocystidia, pleurocystidia and chalamydospores.

Mushroom Poisoning and treatments

Eating poisonous mushrooms may cause different types of reactions which can broadly be classified as follows :

1. **Gastric disorder:** The poison causes serious gastric disturbance, it chiefly acts by exciting and then paralysing the central nervous system as by *Amanita muscaria* or poison containing irritant which cause gastric enteritis by direct action on the mucous membrane of the digestive system.e.g *Gyromitraesculenta.*
2. **Nervous disorder:** It causes degeneration of cells , especially of the nervous system and grandularparenchymatous tissues like liver as in case of *Amanita phalloides.*
3. **Muscular disorder:** There may be exciting of the muscular system , especially the smooth muscular fibre as it is there in the uterus , vessels etc.
4. **Haemolytic disorder:** There can be destruction of blood or haemolysis as in case of *Amanita rubescens*

Treatments : All the collectors of wild mushrooms should be careful about mushroom poisoning and have some knowledge of the first –aid remedies in case of mushroom poisoning and then the patient should immediately be taken to a doctor.

- The patient should be made to cover his body with a blanket , lie down calmly and given the first – aid treatment till the arrival of the doctor.
- **Removal of poison from the stomach** : The patient may be made to vomit by putting his fingers inside the mouth or throat or by giving warm water with one tablespoonful of mustard seeds or apomorphine. The stomach should be completely washed by means of a stomach tube . One can also

give some sedatives like warm water , 4--5 tablespoonful of warm milk , two tablespoonful of olive oil beaten with the yolk of an egg etc.

- **Elimination of the toxin**: The ingested poison in the stomach can be removed by putting charcoal powder in the stomach and if it has already been absorbed in blood then subcutaneous injections of atropine or other antidotes can help in removing the effect of poisoning.