VIVEKANANDA COLLEGE
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NAAC ACCREDITED 'A' GRADE

Topic: Introduction, nutritional and medicinal value of edible mushrooms; poisonous mushrooms, hallucinogenic mushrooms, diseases of mushrooms
Course Title: Mushroom Culture Technology
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Name of the Department: Botany

Mushroom Production Technology

What is mushroom ?

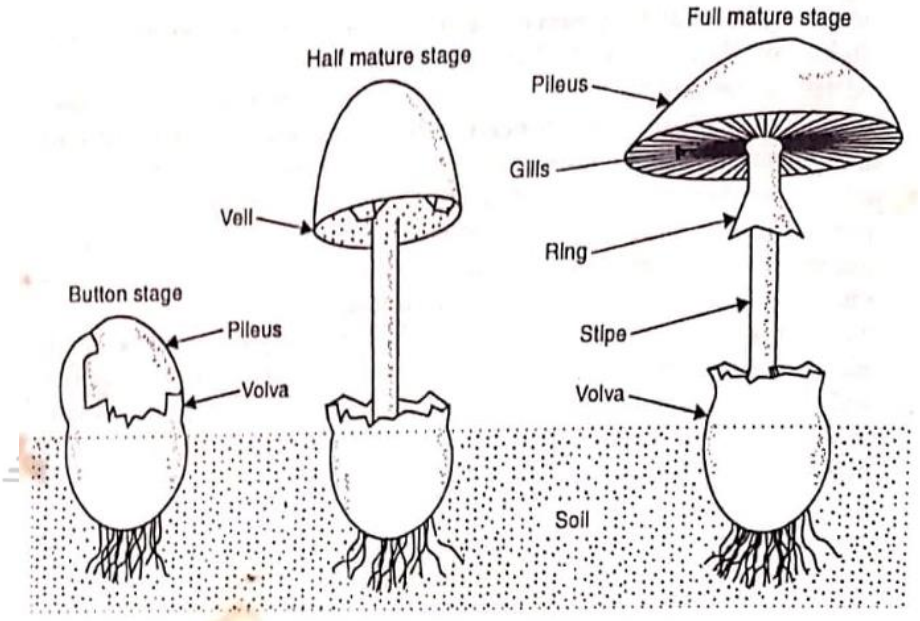
Mushrooms are the fleshy fungi which constitute a major group of lower plant kingdom. The mushroom is a common fungal fruit body that produces basidiospores at the tip of club-like structures, called *basidia*, which are arranged along the gills of the mushroom. Beneath the mushroom, in the soil, is the mold colony itself, consisting of a mat of intertwined hyphae, sometimes several feet in diameter. The mushrooms first appear as white tiny balls consisting of short stem (stipe) and a cap (pileus), which begin to open like an umbrella. The delicate membrane or veil (velum) enveloping the cap tears off, if allowed to develop fully, and lamellae (gills) radiating from the stalk into the cap become visible. These gills become darkened as the basidiospores (seeds) develop into millions and fall to the ground for starting their lifecycle once again for second generation of mushrooms. Since mushrooms grow independently of sunlight so they can be grown in complete darkness but the darkness is not an essential prerequisite. They are relatively fast growing, do not require fertile soil, since grown on composted or uncomposted agro-wastes and their culture can be concentrated within a relatively small space. In addition to floor, air space is also utilized resulting in higher production. It is a labour intensive indoor activity which can help the landless, small and marginal farmers to raise their income, diversify economic activity and can create gainful employment especially for unemployed/under-employed youths, weaker section of the society and women folk. It produces nutritious food from unused resources, available surplus in India (25 million tones of agricultural waste) and also can earn foreign exchange.

Agaricus camestris is one among several types of mushroom seen growing wild. It is popularly called temperate mushroom or '*Khumb*' and grows on dead organic matter under suitable environmental conditions. It derives its carbonaceous food by decomposing lignin, cellulose and hemicelluloses present in agro-wastes with the help of extracellular enzymes secreted by the mycelium. Microbic protein available in compost is the chief source of organic nitrogen for its assimilation.

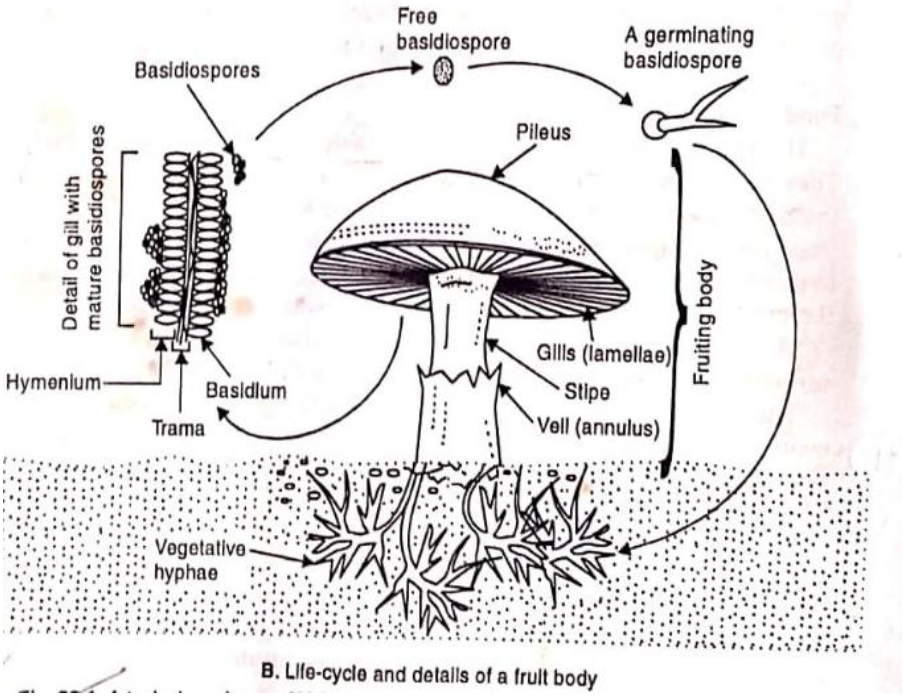
Food value of Edible Mushrooms

Mushrooms provide a rich addition to the diet in the form of proteins, carbohydrates, minerals and vitamins.

1. The protein content of fresh mushrooms (3 g/100 g) is about 3.7 percent. It is twice as high as that in most vegetables except green peas, Brussels sprouts and pulses and is much lower to meat, egg, fish and cheese.
2. They have a high percentage of all the nine essential amino acids.
3. These are richer in vitamins (B_1, B_2, Niacin, B_{12}, pantothenic acid and vitamin C) than most vegetables and almost free from fat (0.2g/100 g).
4. They are also a good source of minerals- P, K., Fe and Copper.
5. They are low in calories (less than 35 K Cal per 100 g) with traces of sugar and without cholesterol.



A. Different stages of maturity of a basidiocarp



B. Life-cycle and details of a fruit body

Cultivated Edible Mushrooms

Presently about a dozen fungi are cultivated in over 100 countries with a production of 2.2 million tones. Five genera, *Agaricus, Lentinus, Volvariella, Pleurotus* and *Flammulina*, contributed about 91 percent of total production. **White button** [*Agaricus brunnescens* (*bisporus*)] has the largest share (56%) followed by **Shiitake** (*Lentinus edodes*) (14%), **paddy straw** (*Volvariella volvacea*) (8%), **Oyster** (*Pleurotus* sp.) (7.7%) and others (13%). It is now grown in almost all the continents. Technology for its cultivation has advanced to a state in which this mushroom can be grown profitably in locations with climatic conditions quite different from those in Europe and America where mushroom culture had its beginning and greatest development.

Poisonous Mushrooms

The order Agaricales, commonly called *gill fungi* contains over 270 genera. These include the mushrooms, the toadstools and the boletes. The edible species are called 'mushrooms' and the poisonous ones, toadstools. These fungi are incapable of causing infectious diseases but produce toxic substances that poison a person who ingests them. These poisonous substances are collectively known as **mycotoxins** (*myco*= fungus + *toxin* = poison) and result in **mycetismus** (mushroom poisoning) following ingestion of poisonous mushrooms. These mushrooms contain lethal substances that destroy liver cells and excite the nervous system. The most deadly mushrooms are the **death cap**- *Amanita phalloides*, the closely related **destroying angles**- *Amanita virosa*, the **fool's cap**- *Amanita verna* and the **fly-agaricus**- *Amanita muscaria*. In the death cap, the toxic principle is a mixture of α and β-amanitin and phalloidin- both complex cyclic polypeptides containing sulpher. Cooking does not destroy the toxin nor it is effected by the human digestive juices. Symptoms of poisoning appear only after 8-24 hours of ingestion and by time the toxin is absorbed by the body, neither vomiting nor a stomach pump can help then. Eating poisonous mushrooms may result in various types of reaction like nervous disorder, gastric disorder, haemolytic disorder and muscular disorder.

It may be remembered that even edible mushrooms can cause indigestion in healthy people and some people may be allergic to a species which is harmless to others. Causes of discomfort and indigestion may be due to eating too much, or eating mushrooms with indigestible food, or having been incorrectly cooked. Mushrooms may also cause illness if they are taken with alcohol.

Hallucinogenic Mushrooms

The Amanitas

The unmistakable scarlet and white spotted fly Agaric, *Amanita muscaria*, common in birch and pine Woods is probably the best known hallucinogenic mushroom. The fly agaric is so-called from its long-known property of repelling or killing flies, a property now known to be linked to a chemical, **ibotenic acid**, first isolated from the mushroom by Japanese scientists. The hallucinations that these mushroom cause after eating, have been known for a long time in Siberia. The interaction of Indians with fungi started thousands of years ago. There are scientific evidences that the mushroom, *Amanita muscaria* may have been the oldest of the hallucinogens used by the Aryans. It is firmly believed that the fly agaric is the Soma of the Vedas. There are references to the use of mushrooms as foods and medicines in India in the ancient medical text, Charaka Samhita (3000+500 MV). The narcotic-intoxicant action for which *A. muscaria* and *A. pantherina* were eaten by tribesmen in Siberia, was absent in muscarine isolated from these fungi. The search for these stimulants was pursued and four compounds were discovered, which induced hallucinations. Three of these (ibotenic acid, muscimol, muscazone) are isoxazole derivatives and found in the above two species of *Amanita*. The fourth tricholomic acid is found only in *Tricholoma muscarium*, reported from japan. The predominant effect of these toxins is inhibition of motor functions. Muscimol is 5 to 10 times more potent than ibotenic acid. Muscimol is stererochemically γ–aminobutyric acid (GABA) and so its effect on the nervous system stems from stimulation of GABA receptors of the cells of the central nervous system.

The Psilocybes

The sacred hallucinogenic mushrooms, consumed in religious ceremonies in remote parts of Mexico, belong primarily to the genus *Psilocybe* and secondly to *Stropharia* and *Conocybe*. *Psilocybe* mushrooms have been called 'flesh of God'. The hallucinogens were isolated from

Psilocybe Mexicana, and named as psilocybin and psilocin. These toxins cause stimulations of the central nervous system. Psilocybin is active in human in very low dose: 4 mg, taken orally, causes wild intoxication, but 6-20 mg elicit marked psychotropic response. Overdose can be dangerous and cause psychoses, leading to suicide mania. Primarily, *Psilocybe* hallucinogens acts as serotonin antagonists; therefore, they are used in physiotherapy and neurological researches.

Diseases of Mushrooms

Mushrroms are attacked by various diseases of fungal, bacterial and viral origin like the higher plants.

1. Fungal disease: The fungal diseases of mushrooms are ***soft mildew*** or ***conweb*** caused by *Dactylium dendroides,* ***brown plaster mould*** caused by *Papulospora byssina*, ***white plaster mould*** caused by *Scopulariopsis fumicola*, ***olive green mould*** caused by *Chaetomium olivacearum*, ***inky cap*** caused by *Coprinus lagopus* and C. *comatus,* ***green mould*** caused by *Trichoderma viride,* ***truffle disease*** caused by *Pseudobalsamia microspora,* ***wet bubble disease*** caused by *Mycogone perniciosa,* ***dry bubble, brown spot disease*** caused by *Verticillium malthousei* or *V. psallistae.*
2. Bacterial disease: *Pseudomonas tolaassi*, a bacterium cause ***bacterial blotch*** on mushrooms.
3. Viral disease: The viral diseases of mushrooms are: ***brown disease*** and ***water stipe, X-disease*** and ***dieback*** disease.