

Mushroom cultivation:

A lucrative agribusiness venture

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*Mushroom farming is a potential agri-business venture for employment generation as well as raising the income of the rural poor nowadays. There are four types of mushrooms namely Oyster mushroom (*pleurotus spp*), Paddy straw mushroom (*volvariella spp.*), Milky mushroom (*calocybe spp*) and Button mushroom (*agaricus spp.*) commonly grown in different seasons in India. Button Mushroom cultivation is prevalent in northern India. Mushroom are dense with thiamine (vitamin-B-1), riboflavin (B-2), niacin, pantothenic acid (B-5), biotin, folic acid, vitamin C, D, A and K. In addition, mushrooms contains nearly 85–90% moisture, 3% protein, 4% carbohydrates, 0.3–0.4% fats and 1% minerals and vitamins. Owing to the above properties it can be treated as future food for the population. It is not only good for health conscious peoples but also create the employment opportunities for rural farmers and women as well.*

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INDIAN food is primarily based on cereals and pulses, consumed as a major source of carbohydrates. Mushrooms are evolved as a supplemental source of protein to Indian diet. From the beginning of time, people have consumed mushrooms as food. Around 1630 white button mushroom (*Agaricus bisporus*) cultivation began for the first time in France. Mushroom cultivation in India started before a century, as the *Volvariella volvacea* was cultivated on paddy straw. In 1950, an attempt was made to grow the mushroom on paddy straw in Coimbatore.

An attempt was also made for the first time to artificially cultivate *Agaricus bisporus* using wheat straw and horse dung. In the similar lines a coordinated plan was started in Solan, Bengaluru, Ludhiana and New Delhi in 1974 for cultivation of mushroom. Out of total mushroom production in India (approximately 0.13 million tonnes) white button mushrooms account for 73% of all produced mushrooms, followed by

oyster mushrooms (16%), paddy straw mushrooms (7%) and milky mushrooms (3%). In India, per capita consumption of mushrooms is low as compared to other vegetables.

Mushrooms are the eukaryotic, spore bearing fungi lacking chlorophyll, grown on the dead and decomposed matter. Mushrooms are positioned between meat and vegetables in the dietary hierarchy. They are a good source of carbohydrate, vitamins and rich in protein in comparison to cereals, fruits and vegetables. In addition, mushroom contains 9 essential amino acids that are required for human growth and development.



White button mushroom (*Agaricus bisporus*)

India is suitable for the growing varieties of temperate, subtropical and tropical mushrooms because of a diverse agro-climatic, plenty of agricultural waste and human labour. It can be the best business venture for landless farmers and jobless youngsters. So, mushroom cultivation plays a significant role in integrated rural development by increasing the income and generating the self-employment for youths, landless farmers, and women's for economically vibrant.

Cultivation method

Mushroom can be cultivated through garden, field, cave and house cultivation method. In the garden and field cultivation method, there is no need to construct the infrastructure just small ridges are made for cultivation. To prevent the spawn's mycelia from drying up, leaf litter is placed on top of the spawn-inoculated soil. In cave cultivation the little tunnels are created in the rocky places and mushroom farms are constructed. Additionally, mines

are used and then get developed into mushroom farms. Small flat beds (16 feet) are prepared inside the mines and tunnels to grow mushrooms. In house cultivation, different sized houses with temperature and moisture control systems are built. These homes may be above the ground or partially above ground. Small beds are set up in tiers inside the house, one on each side and one in the center. Spread the compost over beds, either alone or in combination with the soil.

Cultivation technology of button mushroom

A healthy harvest of a white button mushroom is a difficult procedure that calls for a specialized technical competence. Temperature requirements for white button mushroom growth is ranging between 22–28°C for spawn run and 15–18°C for fructification. In addition, it needs appropriate ventilation and relative humidity between 85–90%. The cultivation is more prevalent in hilly regions due to the low temperature. But with the improvements in cultivation technique and the creation of carefully monitored facilities, it is now effectively expanded to the plains. The process for Button Mushroom production can be divided into different steps, viz. spawn production, compost preparation, spawning, spawn running, casing and fruiting.

Spawn production: Spawn can be produced from fruiting culture under sterile conditions in the laboratory. The bulk production of spawn may be done in laboratory of reputataed private or government training centres or agriculture universities. Before start of the mushroom production, kept in mind that spawn should have the potential for a high production and a long shelf-life, in addition to good flavour, texture and size.

Composting: A combination of plant wastes (cereal straw, sugarcane bagasse, etc.), salts (urea, superphosphate, gypsum, etc.), additives (rice bran, wheat bran) and water is used to produce the substrate for the button mushroom

growth. It takes 220 g of dry substrate materials to create 1 kg of mushroom. A 6.6 kg of nitrogen, 2.0 kg of phosphate and 5.0 kg of potassium should be present in each tonne of compost (N:P:K-33:10:25), which translates into 1.98% N, 0.62% P and 1.5% K on a dry weight basis. A good substrate should have a C: N ratio of 25–30:1, and 16–17:1 for final compost.

In the initial stage of compost preparation, layers of paddy straw are put in a stack together with water, fertilizers, wheat bran, molasses, etc. The straw is properly combined with everything before being stacked. On the 2nd day, the stack is flipped and water is applied again. Gypsum is added and watered on the fourth day, when the stack is flipped once again for the second time. On the 12th day, when the colour of the compost turns dark brown and it begins to give off a potent ammonia odour, the third and final tuning is performed. The pasteurization phase is the next step in composting. In order to kill unwanted microorganisms, competitors and to turn ammonia into microbial protein, the compost created by the microbe-mediated fermentation process needs to be pasteurized. The final compost should have a granular structure, 70% moisture content and a pH of 7.5.

Spawning: It is the process of combining spawn with compost. The various spawning techniques include:

- i) **Spot Spawning:** Spawning lumps are placed 20–25 cm apart in 5 cm deep hole dug in the compost. Later, compost is used to cover the holes.
- (ii) **Surface Spawning:** The spawn is blended to a depth of 3–5 cm



Composting

after being equally distributed in the compost's top layer. A thin layer of compost should be placed on top of the area.

- (iii) **Layer spawning:** Similar to surface spawning, 3–4 layers of prepared spawn is mixed with compost and then coated with a thin layer of compost. The spawn is mixed with compost at a rate of 7.5 ml/kg of compost, or 500–750 g/100 kg of compost (0.5–0.75%).

Spawn running: After spawning, the compost is put into polythene bags (90 cm x 90 cm, 150 gauge thick, with a capacity of 20–25 kg/bag)/trays (often wooden trays, 1 x 1/2 m, and allowing 20–30 kg composts)/shelves, covered with a newspaper sheet or polythenes. Fungal bodies take around two weeks (12–14 days) to colonize when they emerge from the spawn. The cropping chamber should kept at a constant temperature of 23±20°C. Any temperature over that will hinder the spawn growth, while any temperature below that would slow down the spawn run. A CO₂ content that is greater than usual would be advantageous and the relative humidity should be approximately 90%.

Casing: To encourage fruiting, the compost beds should be covered with a layer of soil (casing) that is 3–4 cm deep. The casing material should be highly porous, capable of retaining water and have a pH between 7–7.5. Due to the lack of peat moss, mixing of garden loam soil and sand (4:1), decomposed cow dung and loam soil (1:1), spent compost (2–3 years old), sand and lime are frequently used.

Before using, the casing soil should either be steam sterilized, treated with formaldehyde (2%), formaldehyde (2%) and bavistin (75 ppm), or pasteurized (at 66–70°C for 7–8 hours). Before the material is utilized for casing, the treatment must be completed at least 15 days in advance. Following the completion of the casing, the room is once again kept at a temperature of 23–28°C and a relative humidity of 85–90% for an additional 8–10 days. At this stage, low CO₂ concentrations are

beneficial for reproductive growth.

Fruiting: The fruiting body initially appears in the form of pin heads and gradually develop into button stage and start growing under favourable environmental conditions, at temperature (initially 20-23°C for about a week and then 16–20°C), moisture (2–3 light sprays per day for moistening the casing layer), humidity (above 85%), proper ventilation and CO₂ concentration 0.08–0.15%.

Harvesting and post-harvest handling

At the button stage, caps that are closed and ranging between 2.5–4 cm in diameter are perfect for harvesting. The first crop appears in 3 weeks after casing. Light twisting is required to harvest mushrooms without disrupting the casing soil. After the harvest is over, the beds should be watered and the gaps should be filled with new, sterilized casing material.

In a two month harvest, a person can get 10–14 kg of fresh mushrooms for every 100 kg of compost.

Mushrooms are a highly perishable commodity. The soil is removed from the harvested mushrooms by cutting them at the soil line and washing them in a solution of 5 g KMS in 10 litre of water to enhance whiteness. These

are placed in perforated polybags, each containing between 250 and 500 g of mushrooms. They can be kept in polythene bags for a brief duration of 3–4 days at 4–50°C.

For retail sales, the mushrooms are often packaged in plain, unlabeled polypropylene or polythenes. There is no bulk packing available for mushrooms. Modified atmosphere packaging (MAP) and controlled atmosphere packaging (CAP) are very popular in industrialized nations. Ordinarily, white button mushrooms are not dried using the same techniques as oyster and paddy mushrooms. Mushrooms should be dried in a dust-free environment and in the containers. Sun-drying of mushrooms is beneficial as it added vitamin D in products. A dehydrated final product with reduced moisture content, a longer shelf-life and superior quality can be produced by drying mushrooms in cabinet dryers rather than by sun exposure. The most common way to preserve white button mushrooms is through canning. Cleaning, blanching (5–6 min at 95–100°C), filling the can with brine solution (2% salt with 0.1% citric acid or 100 ppm ascorbic acid), heat sterilization (118°C), cooling, labeling and packaging are all steps in the canning process. Mushrooms can be canned for international trade



Harvested button mushrooms

or for longer marketing. According to demand, mushrooms can be canned whole, chopped, or in stems and bits.

Value added products of mushroom

Fresh mushrooms can be used to produce a variety of value-added products like pickles, jams, sauces, candies, chips, while, dried mushrooms can be used to manufacture products like instant soup mixes, bakery goods, papad and nuggets.

SUMMARY

Mushroom are the supplemental source of proteins and vitamins for human health. They are enriched with vitamin-B1, B2, niacin, pantothenic acid, biotin, folic acid, vitamin C, D, A and K. Mushroom farming is very prevalent as it generates the additional income of farmers. Button Mushroom is commonly grown between November–February in northern India. It can be grown through the garden and field cultivation, cave cultivation, and house cultivation methods. They can also be used to produce various value-added products. Dried mushrooms powder can be used to manufacture instant soup mixes, bakery products, papad, and nuggets. The value added mushroom products create a significant demand and treated as the future food. Mushroom farming has ample opportunity to create the employment for rural women and unemployed youths.



Button stage of mushroom

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