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Mushroom Farming in Modern Agriculture: Types, Cultivation and Benefits

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Fungi that naturally grow on soil, organic matter, and decomposing materials produce fleshy, spore-producing fruiting structures called mushrooms. Their excellent nutritional worth, therapeutic qualities, and economic significance make them highly prized. While low in fat and calories, mushrooms are high in proteins, vitamins (particularly B-complex and vitamin D), minerals, dietary fiber, and antioxidants. Edible mushrooms, medicinal mushrooms, and wild mushrooms are the three primary groups into which mushrooms are typically divided based on their uses and traits. *Agaricus bisporus*, *Pleurotus ostreatus*, and *Volvariella volvacea* are examples of edible mushrooms that are frequently grown and eaten. *Ganoderma lucidum* and other medicinal mushrooms are well-known for their therapeutic advantages, which include illness prevention and immune system support. and disease prevention. Compost, sawdust, and straw are examples of agricultural wastes that can be used in the productive agricultural practice of growing mushrooms. Substrate preparation, sterilization or pasteurization, spawning, incubation, and harvesting are typically steps in the culture process. In order to produce mushrooms successfully, environmental elements including temperature, humidity, light, and ventilation are crucial. Small farmers and rural business owners can benefit from mushroom cultivation because it requires comparatively little land and capital. All things considered, mushrooms have a major positive impact on food security, nutrition, health, and sustainable agriculture. They can also be grown commercially to generate revenue.

Introduction

Mushrooms are among the most popular foods because of their unique flavor as well as their many health advantages. Mushrooms are fleshy fungus (Basidiomycota, Agaricomycetes) with a stem, a cap, and gills beneath the cap. They may be poisonous, edible, or wild. Together with the kingdoms of prokaryotes, eukaryotes, plants, and animals, fungi constitute a distinct kingdom. There are between 2.2 and 3.8 million known species of fungi worldwide, of which 150,000 have been named, 2000 are thought to be edible, and more than 200 species of wild mushrooms are thought to be therapeutic. For six to eight months a year, they thrive in temperatures between 20 and 35 °C and humidity levels between 65 and 70%. For the best growth, each variety of oyster mushroom has a varied ideal temperature depending on its stage of development. The ideal temperature range for the fruiting stage is between 10 and 15 °C, which is comparatively lower than the temperature needed for the mycelia—the vegetative portion of the fungus that will grow to form mushrooms—to grow and colonize the growth media during the spawn running period, which is between 20 and 25 °C.

Types of mushroom

Fungi that grow naturally in grasslands, forests, and agricultural fields are called mushrooms. Although there are many different kinds of mushrooms, they are typically divided into three categories: edible, wild, and medicinal. Edible mushrooms are frequently used in cooking and

are safe for human consumption. Uncultivated woodlands are home to wild mushrooms, some of which are edible and others of which, like fly agaric, can be dangerous. Traditional medicine uses medicinal mushrooms because of their well-known health advantages.

Major Mushroom Varieties Grown in India

- White Button Mushroom (*Agaricus bisporus*)
- Oyster Mushroom (*Pleurotus* spp.)
- Milky Mushroom (*Calocybe indica*)
- Shiitake Mushroom (*Lentinula edodes)*
- Paddy Straw Mushroom (*Volvariella volvacea)*

The abundance of moisture in hilly areas makes it easy to produce mushrooms, but they can also be cultivated in artificial environments with the right humidity and temperature control. Varieties need to be carefully recognized because some of them may induce allergies or food illness when consumed. The following are some of the main types consumed in India.

Oyster mushrooms: Oyster mushrooms in the class The family Agaricaceae, which includes basidiomycetes, is commonly referred to as "dhingri" in India. It grows naturally on dead and rotting wooden logs in temperate and tropical forests, as well as occasionally on dying trunks of deciduous or coniferous woods.Additionally, it might thrive on decomposing organic waste. Depending on the species, the fruit bodies of this mushroom have a distinctive shell or spatula form and can be white, cream, grey, yellow, pink, or light brown in color.

Button mushroom: The button mushroom, or *Agaricus bisporus*, is indigenous to North America and Europe and family Agaricaceae and class Basidiomycetes. There are two varieties: white and brown. In India, white button mushrooms are most frequently cultivated.For vegetative growth (spawn run), white button mushrooms need a temperature of 20–28°C; for reproductive growth, they need a temperature of 12–18°C. In addition, cropping needs enough ventilation and a relative humidity of 80–90%. It is grown seasonally for eight to ten months of the year on the hills and during the winter in India's northwest plains. However, this mushroom can now be grown anywhere in India because to the development of contemporary cultivation technologies. Depending on the type and variations grown, growers can harvest three to four crops of white button mushrooms year.

Shiitake mushroom: The edible and therapeutic wood-dwelling fungus known as shiitake mushrooms (*Lentinula edodes*) is indigenous to East Asia. One of the most widely grown fungi worldwide is the shiitake mushroom. Shiitake mushrooms are a staple in many Asian and vegetarian recipes and are rich in iron, copper, selenium, manganese, B vitamins (particularly pantothenic acid), and dietary fiber. The fungus contains several physiologically active compounds, including the polysaccharide lentinan, which may be helpful against cancer and other illnesses, and it has been widely utilized in traditional Asian medicine.

Paddy straw mushroom: The third most popular mushroom in the world, paddy straw mushrooms (*Volvariella volvacea*) are tropical delicacies that are commonly grown on rice straw in East and Southeast Asia. They are sometimes referred to as straw or Chinese mushrooms.They fruit quickly in 4–7 days from button to mature egg-shaped stages with grayish-brown caps up to 12 cm broad, pink spores, and a deep, meaty, savory flavor. They flourish in hot, humid environments over 80°F (27°C).Rich in nutrients, including high protein (up to 42% dry weight), fiber, antioxidants, flavonoids, and bioactive compounds with anti-inflammatory, anti-cancer, and immune-boosting properties, they are frequently used fresh, canned, or dried in Asian cuisine, however in the early stages they may resemble lethal death caps.

Cultivation

Manure or compost, spawning, the proper temperature, and humidity are essential for growing mushrooms. 80% to 90% relative humidity, lots of ventilation, and temperatures between 20 and 28 °c for spawn run and between 12 and 18° c for reproductive growth are all ideal growing conditions. The temperature must be kept at 23 ± 20 C for the first week and then lowered to 16 ± 20 C for the following weeks. The ideal CO2 content is between 0.08 and 0.15 percent [13]. In a matter of days, pin heads begin to emerge and gradually develop into button stage if the aforementioned parameters are properly maintained. A healthy harvest also requires nutritional supplements including water, vermiculite, and nitrogen in addition to these insecticides. To cultivate mushrooms, the following procedures must be followed:

Compost preparation

Phase I (outdoor, 6–12 days): Chop 1 ton of wheat straw, soak it overnight, combine it with 600 kg of horse or chicken manure, heap it to a 1.5 x 1.5 m base (45 cm high), turn it every two to three days (days 4, 7, and 9), add 40–50 kg of bran, 10 kg of urea, and 40 kg of gypsum; aerate to create a peak temperature of 65–80°C for ammonia breakdown (target <0.5%). Phase II (indoor, 5–8 days): Fill trays, steam pasteurize at 58°C for 6–8 hours, condition at 45°C for 2 days to choose microorganisms that are friendly to *Agaricus*, then cool to less than 25°C.

Spawning and spawn run

Place 20–25 kg of cooled compost in 90x50x15 cm polythene trays (30–35 trays/100 sq m), evenly distribute 500g of sterilized grain spawn (2% rate) in two layers, cover with damp newspaper, stack the trays, and incubate in a dark spawn-run room at 22–25°C and 65–70% relative humidity for 13–18 days until the mycelium fully colonize (white, cottony growth).

Casing application

Casing is a type of sterilized soil or dressing that is applied to the spawn mixed compost and contains cow dung. When the mycelium starts to grow on the surface of the compost, it is applied. Mushroom heads or pins begin to show on the surface after 15 to 20 days of

treatment. They are picked prior to the cap opening after being given a certain amount of time to grow. Mushrooms with an open cap, which resembles an umbrella when the cap is opened, are unpleasant and regarded as of low quality.

Harvesting

After 10 to 12 days, mushroom pinhead initiation begins, and the crop is harvested in 50 to 60 days. Harvest the mushrooms by gently twisting them without disturbing the casing soil. Once the harvesting process is complete, fill the spaces on the beds with new, sterile casing material and mist with water. Harvesting the crop before the gills are ready could reduce its quality and market value.

Nutritional value of mushroom

Along with fiber and protein, mushrooms also include vitamins and minerals that improve health. For instance, a cup of cremini mushrooms has 2 grams of protein and almost 1 gram of fiber despite having only 15 calories. Additionally, certain substances found in mushrooms, such as sterols and polysaccharides, may assist shield your health and ward off illness. Among the nutrients found in mushrooms are:

- Selenium: Assists your body in producing antioxidants to shield cells from harm
- Vitamin B6: Aids in the formation of red blood cells and supports the brain system.
- Pantothenic acid, niacin, and riboflavin : involved in the synthesis of energy and aid in a number of metabolic processes.
- Potassium: Supports normal blood pressure, aids in fluid balance, and aids in muscular contraction.
- Zinc: Promotes healthy development in infants and youngsters as well as your immune system.

Health benefits of mushroom

1. Decrease the risk of cancer: Ergothioneine, an amino acid and antioxidant that stops or reduces cellular damage, is abundant in mushrooms. Higher levels of ergothioneine are found in some types of mushrooms, including shiitake, oyster, maitake, and king oyster. However, researchers discovered that eating any kind of mushroom on a regular basis will reduce your chance of developing cancer.

2. Lower sodium intake: High blood pressure and sodium frequently coexist. The body retains more fluid when exposed to sodium, which can raise blood pressure. Think about include mushrooms in your meals to reduce the amount of salt you consume. A cup of white button mushrooms has only five milligrams of sodium, indicating that mushrooms are naturally low in sodium. They have a delicious taste that lowers your blood pressure without the need for additional salt.

3. Promote lower cholesterol: While reducing calories, fat, and cholesterol, mushrooms are a great alternative to red meat. Shiitake mushrooms in particular have been found to help lower cholesterol. They contain substances that reduce the total quantity of cholesterol in your blood, prevent cholesterol from being absorbed, and prevent cholesterol from being produced.

4. Protect brain health: Because they include a number of bioactive substances that both preserve nerve cells and enhance cognitive function, mushrooms are widely known for promoting brain health. Hericium erinaceus, Ganoderma lucidum, and Pleurotus ostreatus are examples of edible and medicinal mushrooms that include antioxidants, polysaccharides, vitamins, and minerals that support brain function. These substances aid in lowering inflammation and oxidative stress in brain cells, both of which are significant contributors to neurodegenerative illnesses. Ergothioneine and glutathione, two potent antioxidants that shield brain neurons from harm and enhance memory and learning, are also abundant in mushrooms.

5. Provide a source of vitamin D: Your body needs vitamin D to absorb calcium in order to maintain and grow healthy bones. Many people receive their vitamin D from sunshine or supplements, but if you want to get it from your diet, mushrooms might be the solution. They are the only kind of vegetable that contains vitamin D. Certain mushrooms that are exposed to sunshine or UV light can boost their vitamin D levels, just like people.

6. Stimulate a healthier gut: Your gut's microbiome is home to bacteria and other organisms that have a significant impact on your mood and overall health. Using prebiotics, like mushrooms, to encourage the growth of beneficial bacteria in your gut is one approach to maintain its health. According to research, the most prevalent carbohydrate in mushrooms, polysaccharides, promotes the growth of beneficial microorganisms. The polysaccharides in mushrooms travel through the stomach unaltered and can enter the colon to promote the growth of bacteria, whereas many meals are broken down by stomach acid.

7. Support a healthy immune system: Macronutrients included in mushrooms help maintain a strong immune system. The Mushroom Council claims that the following substances found in mushrooms will strengthen your immune system: Selenium aids in the production of antioxidant enzymes that shield cells from harm. For maximum benefits, select portabella or cremini mushrooms. Vitamin D lowers inflammation, strengthens the immune system, and promotes cell growth. Vitamin D can be easily added to your diet using maitake mushrooms. Your body uses vitamin B6 to produce proteins, DNA, and red blood cells. For vitamin B6, shiitake mushrooms are the best option.

Conclusion

A significant class of fungi, mushrooms offer economic, medical, and nutritional advantages. They can be generically categorized as wild, edible, and medicinal mushrooms, each with distinct qualities and applications. Because of their high nutritional content, edible mushrooms including Lentinula edodes, Pleurotus ostreatus, and Agaricus bisporus are commonly grown and consumed. Small farmers and rural business owners can benefit from the sustainable agricultural technique of mushroom production because it takes less land, water, and capital. Protein, vitamins, minerals, fiber, and antioxidants that promote human health are all abundant in mushrooms. Frequent mushroom eating benefits heart and brain health, boosts immunity, and may lower the risk of conditions like Parkinson's and Alzheimer's. As a result, mushrooms are an important food source for the future because of their involvement in sustainable agriculture, medicine, and nutrition.

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