# PRODUCTION TECHNOLOGY OF MUSHROOMS

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**ABSTRACT**

Mushroom cultivation has been commercialized in India in recent decades. It is mainly grown on hills because it requires low temperature for its growth; however, with the advent of modern cultivation technology, it is now possible to grow this mushroom seasonally under controlled conditions and year-round using environmentally controlled conditions. Mushrooms are a nutrient-rich food that is suitable for all age groups. In addition to a higher content of protein, lysine and tryptophan, they also have more carbohydrates and micronutrients. The outputs of this review are then synthesized oyster and milk mushroom production technology, required resources and overall success. The challenges and opportunities associated with mushroom cultivation in the developing world are also identified. For example, significant challenges in the developing world are spore production, disease and pest control, post-harvest technology, storage and marketing. Future practitioners, researchers, and entrepreneurs will be able to take advantage of these innovative ways in which technological advances in mushroom cultivation in high-resource environments can be applied to resource-limited environments.

**Keywords:** Edible, non-edible or poisonous, medicinal mushroom, spawn.

**INTRODUCTION**

Mushrooms are fleshy, macroscopic, achlorophyllous, spore-forming fruiting structures of fungi belonging to the class basidiomycetes of the order Agaricales. They are divided into three categories such as edible, non-edible or poisonous mushrooms and medicinal mushrooms. Most edible and non-edible mushrooms grow wild in the region. In nature, many types of mushrooms are found mainly in the rainy season, on almost all types of soil, on decaying organic matter, wooden stumps, etc. The consumption of forest mushrooms has led to the loss of precious lives, which is evident from the reports of the time in local newspapers and beyond.

This calls for promoting mushroom cultivation on a mass scale to ensure nutritional security, improve livelihoods and empower unemployed and farm women. Mushroom cultivation in the region did not really take off. However, the region has all the potential to become the mushroom center of the country with a pleasant climate and available resources for their cultivation. A diverse climate with an average temperature range of 5-35ºC and high humidity, abundant raw materials, ready local markets and market access in neighboring countries give the region the advantage of mushrooming.

On the other hand, lack of knowledge about production technology in remote areas, unavailability of high-quality and adaptable germplasm, irregular supply of high-quality swabs, lack of skills in cultivation, processing, etc., were a brake on the mushroom industry. grow in this region. Many people are starting to grow mushrooms as an alternative to small-scale farming in almost all states of the region. In order to exploit the potential benefits of this non-traditional cash crop, large-scale production and an organized market must be developed.

The land of mushroom production in every sense of the word

1. Worldwide, 11,898,399 tons of mushrooms and truffles are produced annually.

2. China is the largest producer of mushrooms and truffles in the world, producing 8,948,099 tons per year.

3. China alone produces more than 75% of the world's mushrooms and truffles.

4. Japan ranks second with an annual production of 4,70,000 tonnes.

5. With 3,83,960 tons of production per year, the United States is the third largest producer of mushrooms

Varieties of mushrooms and their values

1. There are more than 30,000 identified species of fungi worldwide. 99% of them are safe to eat and about 1% are poisonous.

2. Nevertheless, there are still many undiscovered mushroom species and the effects of some mushrooms on human health remain unknown.

3. A wide variety of mushrooms are eaten around the world.

4. Mushrooms and field mushrooms are popular in Europe. Shitake mushrooms are mostly eaten in China and Japan, while Thais prefer Yanagi or straw mushrooms.

5. Some mushrooms have medicinal properties and their popularity is also increasing. Nowadays, almost every country pays more attention to the research, experimentation, selection and development of mushrooms.

The word "mushroom" used for the edible members of the macro fungi. The name "mycology" was coined to mean "the study of fungi" (Mykes = fungus). While the term "toadstool" is generally used to refer to poisonous "gill" macrofungi. However, the word "mushroom" does not always mean an edible or safe variety, and the word "toadstool" a poisonous or inedible mushroom. The word toadstool is actually a corruption of the German word "Toadestuhl" which means "chair of death". Many mushrooms can be inedible and poisonous, while some are edible or safe. Fungi occupy an important place in the biological world in terms of diversity, economic value and environmental impact. Wild edible mushrooms are not well documented, little studied and little exploited, despite being a rich source of non-timber forest product. In the hilly regions of Northeast India, these non-timber forest resources, wild edible mushrooms are used by the ethnic mycophilic society as food and medicine. Wild edible mushrooms are sold in local markets, providing income to local villagers and forest dwellers mostly during the rainy season. Although the region is rich in mushroom diversity due to the lack of knowledge about the edible and poisonous nature, extensive exploitation of wild mushrooms is hindered. There is no foolproof method to separate edible mushrooms from poisonous mushrooms. Good experience and practical knowledge are needed to identify and distinguish between poisonous and non-poisonous mushrooms. Evidence of this is time and the published report of food poisoning and death from eating poisonous mushrooms.

From a layman's perspective, there are no unscientific tests or rules that can accurately determine the safety or toxicity of a mushroom. Mushroom identification is an art that is very difficult and time consuming and requires skills cultivated over time. The scientific methods that are available cannot be done immediately and are limited only to the laboratory. Some notable differences between poisonous and non-poisonous mushrooms are listed as follows. Although the reliability of these differences is less, they can be used for identification in order to avoid accidental deaths associated with the consumption of poisonous mushrooms.

Mushrooms as food and healthy mushrooms

(Manikandan, 2011) have a long association with humanity and have a profound biological and economic impact. Once considered a food for royalty in Rome and a miracle ingredient in folk medicine in East Asian countries. Mushrooms are today recognized as an ideal food, suitable for all age groups, and from a nutritional point of view occupy a place between meat and vegetables. Mushrooms not only taste delicious, but are also a nutritional powerhouse, packed with a long list of nutrients. (Khan et al., 2006). Protein-rich mushrooms complement India's carbohydrate-rich, protein-deficient diet, primarily on cereals. All types of edible mushrooms contain varying amounts of protein, minerals, vitamins, antioxidants and fiber. These can have various health benefits. Factors such as the type of mushroom, its developmental stage and environmental conditions affect its nutritional value. The moisture content of the fruit is usually 80-90% with plenty of carbohydrates (26-82%) and low fat content. Cholesterol is absent in mushrooms, instead it contains ergo sterol, which acts as a precursor for vitamin D synthesis.

In addition to a high crude protein content (12-35%), they are also rich in fiber (8-10%) and are an excellent source of vitamins and minerals. Threonine and valine are abundant in the content of free amino acids, but methionine and cysteine ​​are lacking. If mushrooms are exposed to UV radiation before or after harvest, they are an excellent source of vitamin D and are rich in B complex vitamins, vitamin C and vitamin B12 (Ahmed et al., 2009). B vitamins help the body get energy from food and form red blood cells. In addition, many of these B vitamins are essential for a healthy brain. Consumption of vitamin C can ward off cardiovascular disease. Minerals such as potassium, sodium, and phosphorus are abundant in the fruit along with traces of copper, zinc, and magnesium, but iron and calcium are lacking (Islam et al., 2013). Mushrooms are also known to provide some folic acid or folate, which is a beneficial supplement during pregnancy to boost fetal health. The absence of cholesterol with a higher proportion of unsaturated fatty acids in edible mushrooms makes them the best food for cardiac patients. For example, Agaricus bisporus and Lentinula edodes can lower cholesterol levels by 34 and 35%, respectively. The balance of salt and blood circulation in the human body is preserved, because mushrooms contain a minimum of sodium and more potassium. The nutritional values ​​of various mushrooms are shown in Table 1.

**Table 1: Nutritive value of different mushrooms (dry weight basis g/100g)**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Mushroom**  **species** | **Carbohydra te** | **Fibre** | **Protei n** | **Fat** | **Ash** | **Energy (Kcal)** |
| *Pleurotus*  *sajor- caju* | 63.40 | 48.60 | 19.23 | 2.70 | 6.32 | 412 |
| *Pleurotus*  *ostreatus* | 57.60 | 8.70 | 30.40 | 2.20 | 9.80 | 265 |
| *Agaricus*  *bisporus* | 46.17 | 20.90 | 33.48 | 3.10 | 5.70 | 499 |
| *Auricularia*  *auricula* | 82.80 | 19.80 | 4.20 | 8.30 | 4.70 | 351 |
| *Calocybe*  *indica* | 64.26 | 3.40 | 17.69 | 4.10 | 7.43 | 391 |
| *Lentinula*  *edodes* | 47.60 | 28.80 | 32.93 | 3.73 | 5.20 | 387 |
| *Flammulina*  *Velutipes* | 73.10 | 3.70 | 17.60 | 1.90 | 7.40 | 378 |
| *Volvariella*  *volvacea* | 54.80 | 5.50 | 37.50 | 2.60 | 1.10 | 305 |

Mushrooms have proven themselves over the years as a perfect food for young and old alike by providing nutritional and health benefits. In addition to diet, they were and are an important or main component of folk medicine and modern medicine. The medicinal values ​​of some important mushrooms are shown in Table 2.

**Table 2. Medicinal values of some important mushrooms**

|  |  |  |
| --- | --- | --- |
| **Mushroom species** | **Compounds** | **Medicinal properties** |
| *Ganoderma lucidum* | Ganoderic acid Beta- glucan | Augments immune system Liver protection Antibiotic properties  Inhibits cholesterol synthesis |
| *Lentinula edodes* | Eritadenine Lentinan | Lower cholesterol Anticancer agent |
| *A. bisporus* | Lectins | Enhance insulin secretion |
| *P*. *sajor*-*caju* | Lovastatin | Lowers cholesterol |
| *G*. *frondosa* | Polysaccharide Lectins | Increase insulin secretion, Decrease blood glucose |
| *Auricularia auricula* | Acidic polysaccharides | Decrease blood glucose |
| *Flammulina velutipes* | Ergothioneine Proflamin | Antioxidant  Anti-cancer activity |
| *Trametes versicolor* | Polysaccharide-K (Kresin) | Decrease immune system de-pression |
| *Cordyceps sinensis* | Cordycepin | Cures lung infections Hypoglycaemic activity Cellular health properties Anti-  depressant activity |

Agroclimatic conditions for growing mushrooms

Before starting to grow mushrooms, choosing a suitable place is a very important task. Mushrooms are very fragile in nature, so they don't need too much sunlight. A temperature in the range of 18'C to 35°C is considered ideal and favorable for the profitability of mushroom cultivation. Also, good humidity is more beneficial to promote good fungal development. For this, the air humidity should be maintained at 85 to 90%.

Considerations for selecting a site for growing mushrooms

Distance to the market, Availability of substrate, Transport of product and substrate, Climatic conditions must suit the cultivated mushroom and Availability of clean water.

Mushroom production technology

The production of dietary supplements, functional foods and other similar products as a commercial activity has recently been gaining spectacular growth. Mushroom cultivation is an environmentally friendly activity, as it uses waste from agriculture, poultry, brewing, etc., and produces fruiting bodies with excellent nutritional and medicinal properties. The mushroom industry has a wide scope to flourish successfully and can become a lucrative business for unemployed rural youth, housewives and an additional source of income for farmers. the local economy by contributing to the provision of food, nutrition and medicine, creating additional jobs and income through local, regional and national trade and offering opportunities for manufacturing businesses. There are said to be about 50,000 known species of mushrooms, and about 10,000 are considered edible. Of these, about one hundred and eighty mushrooms can be tried for artificial cultivation, and seventy are widely accepted as food. Cultivation techniques have been perfected for about twenty mushrooms, and about a dozen of them have been recommended for commercial cultivation. However, only six mushrooms are widely preferred for large-scale cultivation. They are 1) Oyster mushroom - Pleurotus spp. 2) Unpeeled mushroom - Volvariella spp. 3) Button mushroom - Agaricus spp. 4) Milk mushroom - Calocybe spp. 5) Shiitake mushroom - Lentinus spp. 6) Mushroom - Auricularia spp.

Oyster mushroom

Thanks to the simple cultivation technology, low production costs and adaptability, this mushroom is the most widespread throughout the country.

The bioconversion capability is the highest, i.e. more than 60%. A moderate temperature range of 20-30oC and 80-85% humidity favors good growth of this fungus. Especially in the northeastern region, the growing season of the oyster mushroom is longer. It can be grown for ten months or almost a whole year.

Vegetation period

The most suitable months of the year for growing this crop are November to April, when the optimum temperature range is usually 18oC to 25oC in different parts of the region. However, sometimes production is reduced with sudden temperature fluctuations. In the summer months, if proper care is not taken, the yield of summer oyster mushroom varieties decreases due to insect and pest attacks.

Background

Mass production of oyster mushroom on straw-based substrates was reported in India in the early 1960s. Cellulosic farming using products available from rice, maize, banana mustard/tori etc or even sawdust is suitable for growing this mushroom. However, paddy straw is the best substrate and is easily available (Y. Zhang., 2014). The straw should be of good quality and should not be exposed to rain. Maize and bananas are also widely grown crops. Maize stalks, leaves or peeled cobs and banana pseudo stem can be used but this method requires more labor and the output is comparatively less.

Cultivation method

Oyster mushroom cultivation can be done by the following methods, viz; I) Polybag culture/polyethylene bag method and II) Cube culture method. The most convenient is the polythene bag method, where the polythene bag can be reused.

Polybag culture / polythene bag method Materials needed:

(i) Paddy straw (ii) Trays (iii) Spawn (mushroom seed) (iv) Drum for boiling water (v) Chaff cutter

(vi) Atomizer/hand spray (vii) Transparent poly bags (size: 40-45 cm X 20 cm) (viii) Single hole punch machine (ix) Garlic extract and (x) Jute thread.

Methodology:

Preparation of documents

I. Collect good quality paddy straw (golden yellow in color without spots and blemishes) and chop 2 kg of dry straw with hand chopper/chaff cutter (about 5 cm long) into one polythene bag.

II. Soak the straw overnight (6-8 hours) in cold water; 2 kg of dry straw will do

4.5 kg / 5 kg weight.

III. Treat the soaked straw with hot water (70-800C) for 30 minutes.

IV. By cooking, the straw gets rid of all impurities and the cellulose is easily broken down by the sponge.

V. Remove the straw from the boiled water and let it cool by spreading it on a clean floor. Squeeze or pour out excess water.

VI. Spray garlic extract (stock solution) mixed with water (3-5 ml/l of water) onto the cooked straw. One liter of garlic solution is enough for 5 kg of boiled straw.

In the winter months, problems with diseases and pests are less pronounced. Straw can be minimally processed during the winter season by soaking the straw (as instep ii) in a lime water solution, i.e. prepared by adding 20 g of CaCO3 to each litter of water needed to soak the straw.

Garlic extract

Prepare a paste from 50 g (approx. 10 large cloves) of peeled garlic by adding 50 ml of water (approx. 10 teaspoons). The paste is squeezed through a muslin cloth to obtain a stock solution. Spraying with garlic extract prevents contamination of mushroom beds with green molds, especially in the summer months. Spraying the soaked/cooked straw with garlic extract (as in step V) may be an optional practice during the winter months.

Prepare a polythene bag

Fold polybags (mushroom bags) measuring 40 cm x 20 cm lengthwise twice and perforate with a punching machine at a distance of about 10 cm between the holes. The size of the holes is approx. 5 mm in diameter. Polybag should have 15-20 no. holes for proper ventilation. Tie the closed end of the poly bag with a piece of jute thread to make a round flat bottom. The use of a vent pipe is optional with this method. A PVC pipe with a diameter of 3 cm and a length of about 35 cm with holes on two opposite sides at intervals of 5 cm can be used as a ventilation pipe. Alternatively, a small diameter bamboo can be used for this purpose by opening the knots inside and peeling off a strip of waxy hair lengthwise on opposite sides. The use of a vent tube was found to provide adequate air circulation in the closed bed during the mycelial run. Later in the pruning phase, it is advisable to water the bed, and the beds can also be left hanging through the hole created by the ventilation pipe.

Spawn preparation

Spawn is used in an amount of 2%, i.e. 20 g per kg of straw. The entire package of 200g of screed is used for a bed with 2kg of straw. Break the clumps of seed onto a plate and divide into four equal portions of 50g each. Friction

Fill the bag with a layer of 10 cm of straw. Compact the layer by pressing the palms to a height of about 4-5 cm. Spread a layer of straw with 50g of the spread, sprinkle more on the sides and a little less in the center. Similarly, with a total of five layers of straw and four layers of screed in between, fill a polythene bag. Once the bag is filled, tie the open end of the bag with a piece of jute string. A label with the name of the species and the date of spawning or bed preparation should be affixed to the bed for record. Before placing the straw layer, keep the ventilation tube in a polythene bag if the bed is to be left hanging in the grow room. If the pipe is left after laying the first layer of straw, it is properly watered through the hole created by the ventilation pipe. Beds with mushrooms can be prepared even without the use of a ventilation pipe.

Spawn is running

Place the mushroom bag in a cool, dark place away from rodents and other insects to rub. It is more convenient for the mushroom bag to be kept in the paddock room for swabbing, which is completed within 15-18 days at 25°C. Completion of swabbing is indicated by a white to cream colored mycelial mat covering the entire straw (Kumari and Achal., 2008).

Opening a mushroom bed

After spawning is complete, remove the polythene bag to give room for fruiting. Open the mouth of the bag; grasp the bag with your right hand upside down and place your other hand on the open end below, gently pull the polybag out. The same polybag can be reused after washing with a mild detergent and drying in the shade. Alternatively, the mushroom bed cannot be removed from the polybag during the summer to minimize insect infestation. A slit can be created with a clean blade in the area where lumps and then pinheads form.

Mushroom house or nursery or nursery

Growing mushrooms is an indoor activity and should be protected from heavy rains, direct sunlight and heat. A well-constructed mushroom house is essential for commercial production. The choice of material, size and design depends on the needs of the grower. A low-cost thatched house made of bamboo mats allowing diffused sunlight, suitable cross ventilation with clean surroundings may be suitable.

Cropping

Place the mushroom bed on stands or hang it as a pot in a mushroom house. Keep the bed moist by sprinkling water. Watering is done as needed by the touch of the hand. Harvesting of fruiting bodies should be done sometime (8-10 hours) after watering and start watering only after harvesting.

After placing the beds in the nursery, mushroom fruits grow in clusters after 5-7 days. In the initial stage, these tiny clusters of fruit are known as pin heads. The pin heads grow into fully developed fruiting bodies after 3-5 days from their appearance. These fruiting bodies should be harvested just before maturity

i.e. when the shutters start to open outwards. The edge of the pile, when it begins to curl upwards or downwards, indicates that the fruiting bodies are overripe. By eating mushrooms fresh and when harvested at the right stage, it is possible to obtain the complete food value, medicinal values ​​and taste.

Harvest

The fruit bodies are harvested by holding the stem between the thumb and forefinger and turning it clockwise. Harvest any part of the rhizome left in the bed to prevent saprophytic growth of other fungi and bacteria. Rushes of mushroom fruiting bodies appear at 15-20 day intervals and the harvest from the first three rushes is considered an economical harvest in commercial cultivation in terms of time and space. Cut off the petiole/stalk of the fruit to remove the adhering straw particles. Pack the fruit bodies in 250g or 500g packs as required in either perforated poly bags or paper bags. Adding value can be done through attractive packaging, labels and recipes.

Milk mushroom

It is known that the milk mushroom (Calocybe indica) has the highest biological efficiency, up to 140%. In addition, this mushroom has a good durability and a good texture that is preserved even after cooking. The method of cultivation is almost similar to that of oyster mushrooms. The method of preparing the bed is the same as for oyster mushrooms. (Maurya et al., 2019) However, cooked straw should be dried in the sun for 30 minutes to 1 hour to reduce the moisture content to 40-50%. The moisture content of processed straw is decisive for optimal production of milk mushrooms. Spawning is done at a rate of 3% and the spawning run is completed in 15-20 days. The polybag will not open after the spawn run is completed and the bed will be cut into two beds about 20 cm high. The exposed surfaces of the two beds are covered with a 1-2 cm coat. Shell materials are nutritionally poor with high water holding capacity. Some of the commonly used casing materials are:

(FYM + clay soil (1:1),

Rotten cow dung + soil (3:1),

Spent compost + sand + lime (4:1:1),

Soil + moss (1:1) and soil + sand (1:1).

Any combination can be used. Add lime or chalk powder @ 50g/kg material per casing to adjust pH to 7-7.5. Before application, the packaging material is sterilized by steam. For cultivation, the beds are kept in grow rooms that allow enough or more light. A horticultural polyhouse with a roof made of UV-stabilized low-density polyethylene film can be used together with the shade Netlon Agro 75%. Pin heads appear 6 to 10 days after bagging, and second and third crops appear at 10-day intervals. A water mist is sprayed on the packaging soil every day. Mushrooms should be harvested before the cap is fully opened.

The main differences in the cultivation practices of milk mushroom and oyster mushroom are:

(i) Moisture content of soaked and cooked straw should be possibly lower (40-50%) in case of milk mushroom and can be up to 60-70% in case of oyster mushroom.

ii) The bed is cut into two halves after processing the mycelium and applying the packaging in the case of milk mushrooms, which is not done in the production of oyster mushrooms.

Diseases and pest control

DISEASE:

Green mold:

Sometimes, during spawning, mushroom beds can be seen covered with green-colored velvety growth, completely or in places. This is due to the fungus Trichoderma harzianum, which disrupts the course of the mycelium and causes a drastic reduction in yield. Contamination occurs as a result of improper boiling of straw (sterilization) or as a result of a contaminated swab. (Borah., et al 2013). Green mold causes more problems during the warmer months of the year.

Management

Spray garlic extract before rubbing. Before spawning, check the spawn packet for mold contamination. Discard contaminated spawn and remove contaminated beds outside the mushroom house. Wash the sponge bags properly before using them again. Pick up the green fungus in the initial stage and spray the area with garlic extract.

Ink cap:

Ink cap fungus, Coprinus spp. is a weed fungus. Affected beds turn black to deep blue due to excessive spore production of the weed fungus. Contamination of mushroom beds with this weed fungus is mainly caused by excessive moisture in the straw or decomposed straw used to prepare the mushroom bed.

Management:

Use high-quality and properly dried straw to prepare the flower bed. Avoid decomposed straw or straw exposed to rain. Remove all ink caps at the young stage whenever you see them on the beds.

Browning:

A yellow to light brown color may develop on the margin of the fruiting bodies and peduncle due to the bacterium Pseudomonas sp. Accumulation of water on the fruiting bodies when watering the beds leads to the growth of bacteria.

Management:

Avoid watering mushrooms directly. After watering, shake the bed gently so that no water droplets settle on the mushrooms.

PEST:

Insect pests in mushrooms generally do not cause much trouble, except in the summer months. Insects such as Sciarid, Phorid, Staphylinid, Scaphisoma and Pleasant are commonly found on mushrooms. Sciarid and Phorid fly adults lay eggs on the gills but do not cause damage. The worms emerging from the eggs eat the soft tissues of the fruiting bodies. They also bore tunnels in the pileus and turnips, rendering the fruiting bodies unfit for consumption. Adult beetles feed on fruiting bodies and also mycelium during mycelium. Fungi make irregular holes in the gills and gills where they hide. The back attack becomes intense during the months of June to August. Slugs and snails also cause damage by feeding on mushroom fruiting bodies and excreting a slimy liquid on the beds.

Management:

Remove overripe fruits as soon as possible to prevent adults from laying eggs. Bleaching powder repels bugs; apply in the mushroom house and its premises. Spray neem (Azadirachtin) based insecticides like Rakshak, Neemagon, Neemazol etc. @ 3 ml per liter of water thrice. The first spraying should be done before applying on boiled straw. The second after opening the beds and one more spray after the first harvest. To prevent the entry of flies and bugs, nylon netting must be attached to the ventilation and windows of the mushroom house. Light traps are made of polyethylene sheeting coated with a sticky material such as mustard oil and placed near a yellow or white light bulb. Adult insects are attracted to white light at a temperature above 150 C and yellow light at a lower temperature. Smoke daily or every other day to get rid of insect pests from the mushroom house

Post-harvest technology

Mushrooms have become a valuable component of the diet for their attractive taste, aroma and nutritional value. Fresh mushrooms are perishable, have a very short shelf life with a high moisture content of more than 90%. Keeping mushrooms fresh for a long time is a difficult and expensive task. Fruiting bodies become soggy because many metabolic activities continue after harvest. The high water content of mushrooms also contributes to the proliferation of various microbes that cause rotting of harvested fresh mushrooms. However, it can be preserved for a period of time using the preservation procedures below.

Selection of fruiting bodies of mushrooms for preservation.

Young and overripe fruit should not be picked. The correct harvesting stage for oyster mushrooms is when the edge of the lump begins to curl and in the case of boletus or boletus mushrooms, harvesting is done at the button stage. Mushrooms of the first pickle are considered the best, because the color and taste remain intact during preservation. Spotted, deformed, insect-damaged fruiting bodies must be discarded. Fruiting bodies should be sorted by size and age to maintain uniformity.

Short-term storage (only for a maximum of 10-15 days)

Room temperature: At a room temperature of around 30-33oC, mushrooms stay fresh for only 8-12 hours, while in winter at lower temperatures this is possible for 24-36 hours.

Refrigeration: Fresh mushrooms can be stored for 7-15 days in the refrigerator, depending on the type of packaging and storage temperature.

Brine Preservation: In a high concentration (10-15%) table salt solution (in water), fresh mushrooms can be kept safe for 6-7 days.

Other methods: Lactic fermentation and gamma radiation. They are time-consuming, expensive and sometimes risky.

Long-term storage

Drying in the sun: Fresh mushrooms after sorting and selection (cutting off the hard stem parts), spread on a sieve and dry in the sun for 3-5 days or until 10 kg of mushrooms weigh 1 kg. To prevent browning of the fruit, shade may be provided for the mushrooms by spreading black cloth about 1 foot above the sieve. This type of dry mushroom can be stored in airtight containers for up to 5-6 months.

Machine drying: In machine drying, fresh mushrooms are dried in an electrically controlled dryer for 6-8 hours. It is an expensive method.

Blanching: We soak the sorted mushrooms for 1-2 minutes in warm water 80-850C. only and then dried in the sun. Sometimes sodium chloride @ 400 ppm and citric acid @ 0.1-0.2% can be added to the water before boiling to preserve or enhance the natural color.

Other methods: lyophilization, canning, pickling, etc.

Value - added products

The real value addition in the Indian market is mushroom soup powder. Technologies for the production of some other products such as mushroom crackers, nuggets, pickled vegetables, noodles, chips, murabba, ketchups, candies and ready-made mushroom curry in retort pouches have been developed but not yet popularized (Wakchaure, 2011)

Mushroom: production and marketing

Marketing is about getting the right product to the right people, at the right price, at the right time, and in the right way. The sale of fresh mushrooms worldwide is not very organized, apart from the auction system in the Netherlands. Manufacturers directly try to get production to super markets, and the "wholesale distributor" element is mostly missing. However, the processed (canned and dried) trade is substantial and organized.

Scope for entrepreneurs or self-employed people in mushroom cultivation:

Unemployment is a general problem among the nation's youth due to lack of opportunities or technical skills. The mushroom industry could provide a huge scope for unemployed youth, housewives and landless farmers. There are the following areas where a person thinks about business or self-employment and improves his economic situation and plays his role in a developing country.

Importance of Mushroom Cultivation in India

1. Growing mushrooms is a laborious activity

2. Mushroom harvesting is not an automatic process

3. It helps maintain the cycle of nature by decomposing agro-residues.

4. Good source of high quality protein rich in vitamins and minerals. It is good for the vegetarian population.

5. It provides an excellent opportunity to educate the rural youth and provide employment.

6. The possibility of using wastelands.

7. Rural women who are educated or uneducated can easily manage.

Availability of research and training facilities in India

In India, research and training are provided from time to time by the National Mushroom Research Center and Training Institute at Solan (Himachal Pradesh) and their stations like New Delhi, Ludhiana and Bangalore. State Agricultural Universities in particular states, several Krishi Vigyan Kendra's (KVK's) and District Agriculture Offices through ATMA also conduct mushroom training and also facilitate spawning of a particular mushroom.

summary

A mushroom that is also known as vegetarian without vegetables. It contains a large amount of nutrients. And growing it is an easy process. It mainly needs waste material as a substrate, and the fungus contains several enzymes that break down dead organic matter and transform it into a simpler form. So today mushroom growing is a growing industry especially for rural people. Who satisfy their demand through mushroom cultivation, which is also possible indoors. And today, due to population growth, the demand for food nutrition is essential. Mushrooms are the main food for these people who shop at a normal price and live a healthy life. Last but not least, it is a large growing sector future.

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