IN INDIA'S NORTHWESTERN REGION OYSTER MUSHROOMS MAY BE A NEW SUPERFOOD AND OYSTER MUSHROOM CULTIVATION METHOD AND DISEASE MANAGEMENT

Abstract

In India's northwestern region, oyster mushrooms are gaining recognition as a potential superfood due to their nutritional value and ease of cultivation. Oyster mushroom cultivation is relatively straightforward and can provide a sustainable source of protein and other essential nutrients. oyster mushrooms are being promoted as a new protein source in the northern part of India. Oyster mushrooms have gained attention in various regions as a nutritious and sustainable food source due to their high protein content and potential health benefits. They are relatively easy to cultivate, making them a viable option for local food production. Dhingri are considered a good source of protein, vitamins (such as B vitamins), minerals (like potassium, phosphorus, and zinc), and dietary fiber. They are low in fat and calories, which can be beneficial for those looking to maintain a healthy diet. Additionally, they have a unique texture and flavor that make them a popular choice for various culinary applications. If oyster mushrooms are being introduced as a protein source in the northern part of India, it's likely that local initiatives are promoting their cultivation and consumption to address nutritional needs and sustainability challenges.

Keywords: Oyster mushrooms (Pleurotus spp.), Superfood, Cultivation methods, Disease management, Nutritional value

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I. INTRODUCTION

Mushrooms are large reproductive structures of edible fungi which acts as a major group of lower plant kingdom. Mushrooms are low in calories and a good source of vitamins, especially B vitamins like niacin and riboflavin. They also provide minerals like selenium and copper. Mushroom so often called as "Queen of vegetables" and table delicious from ancient as well it is a nature's hidden treasures of nutrition. Mushroom has a great potential for reducing malnutrition (Varghese and Pavitra, 2020).

There are over 0.3 million different types of mushrooms; some of these are completely edible and don't have any hazardous effects, thus they are referred to as edible mushrooms. Approximately 151 of the 2000 species of mushrooms have been grown experimentally, 20 are grown commercially, and 4–5 are produced on an industrial scale globally. But there are approximately 30 dangerous types of mushrooms, and just a few of them are fatal (Hasan *et al*., 2015).

Mushroom farming is becoming profitable because of its very low inputs. It is determined that about 300 million tons of fresh mushrooms can be brought from just one-fourth of words annual yield straw (2.325 million tons). It was calculated that approximately 317 million metric tons of fresh mushroom could be supplied annually that would provide 197g of fresh mushroom daily to each person in the world (Somashekar *et al.*, 2020).

Mushroom cultivation is one of the most commercially important step towards assortment of agriculture. Agriculture waste can be recycled on a massive scale with the use of microbiological technologies.This is regarded as one of the most profitable and environmentally friendly technologies, and it is particularly relevant for converting trash into riches.(Biswas, 2014). Mushroom cultivation is easily done as it doesn't required skilled persons for production.

Flank first cultivated mushrooms in 1917 in Germany. Oyster mushroom consists of several species of genus Pleurotus. It is generally known as 'Dhingri' in India. Pleurotus caps are typically shell-like and 5-9 cm in diameter. The cap is fleshy and has an eccentric or lateral stripe. Pleurotus can be white, yellow, cream, pink, brown, or dark grey in colour. Fungal populations grow through both sexual and asexual reproduction. (Naraian et al., 2016). Thirty-nine species of these mushroom have been recorded (Garcha et al., 1997), of which 9 are grown commercially world- wide. China alone accounts for 80% of the total world produce. Oyster mushrooms have a wide range of temperature tolerance (15-30^{o}C) so, these are ideally suitable for cultivation under both temperature and tropical climatic condition. Throughout the year, oyster mushrooms are grown and harvested (Ogundele *et al*., 2014).

It is an excellent diet for diabetics and heart patients because of its low calorie, high protein, and high fibre content, as well as its medicinal benefits.(Lavi et al., 2010). It also has antihypertensive and anti- hypercholesterolemia property, fully packed with vitamins (mainly B complex and C) and anti- oxidants. These mushroom shows anti-tumour properties (Jayakumar *et al.,* 2009). The methanol extract of P. florida fruiting bodies inhibits OH-radical scavenging and lipid catabolism.

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Natural plant wastes, also known as agro-wastes, are the primary substrate for the formation of all edible mushrooms. able to utilize high C/N ratio organic matter such as lignin, cellulose and hemicelluloses, require minimum space and low speculation cost and has short gestation period.

They can be grown in cultivation media of any lignocellulosic material such as rice straw, wheat straw, cereal straws, sawdust, sugarcane bagasse, maize cobs, cereal straw, corn cobs, sawdust, wood pulp, cotton and oil palm waste, banana leaves, coconut husks, poultry wastes, tree bark, leaves, paper, cotton seed hull and aquatic weeds with varying yield and performance (Sadh et al., 2018).

II. LIFE CYCLE OF WHITE OYSTER MUSHROOM (PLEUROTUS FLORIDA)

Spore to spore stage, which defines the term life cycle of Pleurotus, is similar to any pileate basidiomycete, a major fungal group. It occurs with the germination of a basidiospore in a suitable substrate, which develops a monokaryotic mycelium with genetically identical nuclei (n) and capacity to develop indefinitely by itself and mate to produce in turn the dikaryotic mycelium; the dikaryotic mycelium expands and passes through the natural substrate with its genetic power, developing fruiting primordia, which grow into larger fruit bodies under optimum climatic conditions (temperature, light, relative humidity), followed by the creation and discharging of basidiospores (Adebayo and Martínez, 2015).

III. MUSHROOM CROP ROOM CLEANING AND STERILIZATION

The mushroom crop room was properly cleaned and washed with water. White washing of the mushroom crop room was done on the next day. The crop room was properly sprayed with the insecticide chlopyriphos 50% + cypermethrin 5% EC @ 30ml in 10 liters of water with a fungicide carbendazim 12% WP @ 10 g in 5 liters of water. The doors and windows of the mushroom room were closed for one day, a solution of 10 g potassium permanganate and 100 ml formalin was kept in four corners of the room on the following day, the doors and windows were closed for two days, spawning was completed on the third day, and the mushroom bags were kept inside the crop room for incubation.(maurya *et al*., 2019 c and Maurya *et al.*, 2020)

1. Substrates

- Maize leaves, corn flour, banana leaves, sugarcane bagasse, wheat bran, paddy straw and other agriculture waste

2. Sterilization of Substrates

- All five substrates viz., wheat straw, paddy straw, sugarcane bagasse, maize leaves, and banana leaves were collected from various locations in Prayagraj and sun dried prior to cutting into small pieces (2-3 inches). A clean 200-liter drum was filled with 150 litres of water. Chemical sterilization method was used for decontamination of the substrates. 3 g of 75 ppm carbendazim (12% WP), 2 ml of insecticide (chlorpyriphos 50% + cypermethrin 5% EC), and 9 ml of 500 ppm formalin (40%) solution were mixed in the water and stirred together with a clean stick, then all five five substrates were soaked separately in the 15 litres bucket for 18 hours (Singh et

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al., 2019). The mouth of the plastic bucket was covered or sealed shut with a plastic sheet. Excess water was decanted onto a sloppy concrete floor which was pre-cleaned with formalin 2% water solution and dried for 3-4 hours in the shed to maintain 65–70% moisture (Kumar *et al.*, 2020; Maurya *et al*., 2020; Murmu *et al*., 2020).

3. **Surface Sterilization**
   - **Formalin:** 4 % of formalin solution was prepared by diluting 100ml of commercial formalin (40%) with 900 ml of distilled water to sterilize the polythene sheet on which the substrates were shade dried

4. **Preparation of Mushroom Bed:** For bed preparation, standard compact polybag approach was followed by using sterilized organic substances. Prior to usage, the polyethene bags of size 13×18" with 100 gauge thicknesses were disinfected by soaking them in @ 2% formalin, and the lower corners of the bags were knotted with string to form a round bed. Spawning was done @ 3% per 1kg of wet substrates (Patil et al., 2014).The spawn was thoroughly mixed with the substrates and packed into the polythene bags by layering methods. Rubber bands were used to tie the openings of the bags once they were filled with the substrate containing spawn. To aid aeration, 10-12 holes were created all around the filled bags with a sterile needle. Each 1 kg bag of agricultural waste was maintained for six treatments and six replications. The mushroom compost bags were kept in the crop room, which had been sterilised. All of the spawning bags were kept at a distance of 20-25cm from one another.. The spawned bags were incubated in a dark (Chauhan and Gupta, 2017) at temperature ranging from 20^0C-25^0C and humidity levels of 70 to 85%. Water was sprinkled twice a day on the walls and floor of the mushroom crop room to maintain temperature and humidity.(Maurya et al., 2019 b)

IV. CARE AFTER SPAWNING

The spawned bags were moved inside the crop room and placed on a flat surface at room temperature. During the spawn run, there was no light or cross ventilation. The spawn run was observed carefully in the bags. When the fungus mycelium had fully covered the substrate, the polythene covering was carefully removed with a sterile needle to expose the substrate's surface for pinhead initiation. At least twice a day, the substrate was sprayed with water using hand sprayer. In 3-5 days, small pinheads appeared on the side of the blocks after the polythene bags were removed. With the use of a sprayer, the humidity of the cropping room was maintained by sprinkling tap water over the walls, roof, floor and beds. 2-3 hours of light and 2-3 hours of cross ventilation per 24 hours was provided for cropping (by opening doors and windows). The temperature was maintained between 20-30°C and the moisture level in the crop room was maintained between 72 and 75% (Biswas and Kuiry, 2013)

V. HARVESTING

Mushrooms were harvested when the fruiting bodies reached maturation. Harvesting was done in the morning hours before 10 a.m. to minimize transpiration loss and before spore shedding. Watering was withheld a day before harvesting (Biswas and kuiry, 2013). The mature fruiting bodies were gathered by twisting them clockwise or anticlockwise and picking them by hand (Bhuvanesh et al., 2020) .

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Table 1: List of Mushroom Infectious Diseases and Moulds with Their Causal Organisms

Sl. No.	Diseases Name	Causal Agents
1	Olive Green Mould	*Chaetomium olivaceum* and other species
2	Green Moulds	*Trichoderma aggressivum*
3	Black Moulds	*Mucor* spp., *Rhizopus* spp., *Fusarium* spp., *Cephalosporium* spp., *Gliocladium* spp., *Papulospora* spp.
4	White Plaster mould	*Scopulariopsis fimicola*
5	Brown Plaster mould	*Papulospora byssina*
6	Lipstick mould	*Sporendonema purpurascens*
7	False truffle	*Diehliomyces microsporus*

1. **Bacterial Soft Rot** (*Pseudomonas spp.*)

   - **Symptoms:** Soft, slimy, and water-soaked spots on the mushrooms, often with an unpleasant odor. The affected areas can quickly degrade.
   - **Control:** Maintain proper hygiene, sterilize substrate, and ensure good air circulation to reduce moisture on mushrooms.

2. **Cobweb Mold** (*Hypomyces perniciosus*)

   - **Symptoms:** Grayish-white, cottony growth on the substrate or mushrooms, often spreading rapidly.
   - **Control:** Maintain proper hygiene, ensure good ventilation, and avoid high humidity conditions.

3. **Brown Blotch** (*Pseudomonas tolaasii*)

   - **Symptoms:** Brown to reddish-brown blotches on the mushroom cap, causing aesthetic and economic damage.
   - **Control:** Avoid overhead watering, maintain proper air circulation, and practice good sanitation.

4. **Virus Diseases**
   - **Symptoms:** Stunted growth, irregular fruiting, and abnormal mushroom shapes.
   - **Control:** Use certified disease-free spawn, avoid cross-contamination, and practice strict hygiene.

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5. **Wet Bubble Disease** (*Mycogone perniciosa*)

- **Symptoms:** Small, watery blisters on the mushroom cap, often causing distortion.
- **Control:** Maintain proper humidity, avoid overcrowding, and use disease-free substrate and spawn.

6. **Dactylium Disease**

- **Symptoms:** White, fluffy mycelial growth on the mushrooms, leading to deformities.
- **Control:** Maintain proper ventilation, avoid overcrowding, and practice good sanitation.

7. **To Prevent and Manage these Diseases, it's Essential to Follow Good Cultivation Practices**

- Use clean and disease-free substrate and spawn.
- Maintain proper hygiene throughout the cultivation process.
- Provide adequate air circulation and ventilation to reduce humidity.
- Avoid over-watering and maintain consistent moisture levels.
- Monitor for early signs of disease and act promptly if detected.
- Maintain optimal temperature and humidity conditions for oyster mushrooms.
- Practice crop rotation and avoid reusing contaminated substrate.
- If you suspect a disease outbreak, it's recommended to consult with experienced growers, agricultural extension services, or mycologists for proper identification and advice on management strategies specific to your region and conditions.

VI. CONCLUSION

Oyster mushroom cultivation offers a sustainable and nutritious source of protein. The cultivation process involves substrate preparation, inoculation, incubation, and controlled fruiting conditions. By following these steps, growers can enjoy multiple harvests of these delectable and versatile mushrooms.

For detailed and region-specific guidance, it's recommended to refer to comprehensive cultivation guides or seek advice from experienced cultivators or agricultural experts.

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