Cultivation, nutritional value and substrate optimization in Oyster mushroom (*Pleurotus* spp.)

R. Kaviya, R. Mohana Priya, V. Tamizhazhagan

Mushrooms are recognized as a valuable source of nutrition and bioactive compounds with significant health benefits. Among cultivated varieties, oyster mushrooms (*Pleurotus* spp.) are widely appreciated for their adaptability, high nutritional value, and ability to grow on diverse agricultural residues. This study highlights the effective utilization of lignocellulosic wastes such as paddy straw, sawdust, and sugarcane bagasse as substrates for mushroom cultivation, promoting both productivity and environmental sustainability. The findings emphasize that substrate selection, quality of spawn, and controlled environmental conditions are critical factors influencing yield and quality. Utilizing agricultural waste not only reduces environmental burden but also offers a cost-effective approach for farmers. With the rising demand for functional foods and sustainable farming practices, oyster mushroom cultivation presents a promising opportunity to enhance food security, generate additional income, and support eco-friendly agricultural systems.

Keywords: *Mushroom, Bioactive compound, Paddy straw, Agriculture, Food*

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Introduction

Mushrooms are macro fungi that produce distinctive fruiting bodies and have long been valued as nutritious food and medicinal resources in many parts of the world. They belong to the kingdom Fungi and play an essential ecological role in the decomposition of organic matter and nutrient recycling. Globally, more than 2000 species of mushrooms are considered edible, although only a limited number are commercially cultivated (Erbiai et al., 2021). Among cultivated mushrooms, species belonging to the genera *Agaricus*, *Pleurotus*, and *Lentinula* account for the majority of global production. Mushroom cultivation has gained significant attention over the past few decades due to its nutritional, medicinal, and economic benefits. Since the 1990s, global mushroom production has increased rapidly as a result of increasing demand for functional foods and sustainable agricultural practices (Rosmiza et al., 2016; Raut, 2019). Edible mushrooms are rich sources of proteins, carbohydrates, vitamins, minerals, and bioactive compounds, making them an important component of human nutrition (Valverde et al., 2015). Additionally, mushrooms contain various biologically active compounds such as polysaccharides, phenolics, terpenoids, and sterols that contribute to their medicinal properties. Among cultivated mushrooms, oyster mushrooms (*Pleurotus* spp.) are widely popular due to their high nutritional value, medicinal properties, and adaptability to diverse environmental conditions. Oyster mushrooms rank third in global production after button mushroom (*Agaricus bisporus*) and shiitake (*Lentinula edodes*) (Raman et al., 2021). They are commonly cultivated in tropical and subtropical regions because they grow well on a wide variety of agricultural wastes and lignocellulosic substrates. In India, mushroom cultivation has emerged as a promising agro-based enterprise that can convert agricultural waste materials into high-value food products. The country produces large quantities of agricultural by-products and lignocellulosic residues annually. It is estimated that nearly 25 million tonnes of such wastes are generated each year, posing disposal challenges and environmental pollution. Mushroom cultivation offers an efficient method of recycling these wastes into protein-rich food, thereby contributing to environmental sustainability and food security.

Oyster mushroom cultivation is particularly popular in South India because of its adaptability to varying climatic conditions and its ability to grow on different organic substrates. Paddy straw is the most commonly used substrate in Tamil Nadu due to its abundance and suitability for mushroom growth. However, several other agricultural residues such as wheat straw, sawdust, sugarcane bagasse, maize cobs, and banana leaves have also been successfully used for cultivation. This chapter focuses on the cultivation, nutritional value, and substrate optimization for oyster mushroom production, highlighting the importance of agricultural waste utilization in sustainable mushroom farming.

Global Importance of Mushroom Cultivation

Mushroom cultivation has become an important agricultural practice worldwide due to increasing consumer demand for nutritious and functional foods. Mushrooms are valued not only for their flavour and texture but also for their health-promoting properties. Global production of cultivated mushrooms has increased significantly in recent decades 40-50 million tonnes annually (Kalač, 2019). China is currently the largest producer of mushrooms in the world, followed by countries such as Italy, the United States, the Netherlands, and Poland. The growth of the mushroom industry has been driven by increasing awareness of the nutritional benefits of mushrooms and the development of improved cultivation technologies. Edible mushrooms are considered environmentally friendly crops because they can be grown using agricultural and industrial waste materials. The cultivation process requires relatively small land area, low water consumption, and minimal investment compared to other agricultural enterprises. Consequently, mushroom cultivation has been recognized as an important tool for rural development and income generation for small and marginal farmers (Ramamurthi & Geethalakshmi, 2025).

Nutritional and Medicinal Importance of Mushrooms

Mushrooms are widely recognized as functional foods due to their rich nutritional composition. They contain significant amounts of proteins, carbohydrates, dietary Fiber, vitamins, and minerals while being low in fat and calories. Fresh mushrooms contain approximately 90% moisture, while dried mushrooms contain higher concentrations of nutrients. The protein content of mushrooms ranges from 20-40% on a dry weight basis, making them an excellent alternative to animal protein sources (Kurtzman, 2005). Mushroom proteins contain all essential amino acids required for human nutrition, including leucine, lysine, and valine (Mshigeni & Chang, 2001). In addition to essential amino acids, mushrooms also contain non-essential amino acids such as arginine, glutamic acid, and alanine.

Mushrooms are also rich in vitamins such as riboflavin, niacin, beta-glucans, thiamine, and folic acid, along with minerals including potassium, phosphorus, iron, calcium, and magnesium. These nutrients contribute to improved human health and help prevent various diseases. Several studies have demonstrated the medicinal properties of mushrooms. They possess antioxidant, antimicrobial, anti-inflammatory, antitumor, and immunomodulatory activities. These biological activities are primarily attributed to bioactive compounds such as polysaccharides, phenolics, terpenoids, and flavonoids present in mushrooms (Dilfy et al., 2020).

Biology of Oyster Mushroom (*Pleurotus* spp.)

Oyster mushrooms belong to the genus *Pleurotus*, which comprises several edible species widely cultivated around the world. Commonly cultivated species include *Pleurotus ostreatus*, *Pleurotus sajor-caju*, *Pleurotus florida*, *Pleurotus djamor*, and *Pleurotus sapidus*. Oyster mushrooms are white-rot fungi capable of degrading lignin, cellulose, and hemicellulose in lignocellulosic materials. This ability allows them to grow on a wide variety of agricultural wastes such as straw, sawdust, and corn cobs. The enzyme systems produced by these fungi enable them to convert complex organic materials into simple nutrients required for growth. One of the major advantages of oyster mushroom cultivation is its simple production technology. Unlike button mushrooms, oyster mushrooms do not require composting and can be cultivated using relatively simple substrates and environmental conditions. They grow well at temperatures between 20°C and 30°C and require moderate humidity levels for optimal growth (Zhang et al., 2000).

Agricultural Waste as Substrate for Mushroom Cultivation

The substrate used for mushroom cultivation plays a critical role in determining the yield and quality of the mushroom crop. Substrates provide the nutrients necessary for the growth of fungal mycelium and the formation of fruiting bodies. Agricultural residues rich in lignocellulosic materials are commonly used as substrates for oyster mushroom cultivation. Examples include: Paddy straw, Wheat straw, Sugarcane bagasse, Sawdust, Corn cobs, Banana leaves, Coffee husk, Cotton waste. These materials contain cellulose, hemicellulose, and lignin, which serve as carbon sources for fungal growth. Paddy straw is one of the most widely used substrates in India due to its availability and favourable chemical composition. It contains approximately 32–47% cellulose, 19–27% hemicellulose, and 5–24% lignin, making it suitable for oyster mushroom cultivation (Saha, 2003; Karimi et al., 2006). Several studies have reported that different substrates influence mushroom yield, biological efficiency, and fruit body characteristics. For example, sawdust and sugarcane bagasse have been reported to produce higher yields compared to some other agricultural residues (Ahmed, 1998).

Spawn Production and Mycelial Growth

Spawn is the vegetative mycelium of mushrooms grown on a suitable carrier material such as grains or sawdust. It serves as the seed material for mushroom cultivation. The preparation of high-quality spawn is essential for successful mushroom production.

Spawn production generally involves the following steps:

1. Isolation of pure culture from fruiting body
2. Maintenance of culture on nutrient media such as potato dextrose agar (PDA)
3. Preparation of grain or sawdust spawn
4. Inoculation of sterilized substrate

Different types of grains such as wheat, sorghum, and millet are commonly used for spawn production. The quality of spawn significantly affects the rate of mycelial growth and the overall yield of mushrooms. Environmental factors such as temperature, pH, moisture content, carbon-nitrogen ratio, and aeration also influence mycelial growth and mushroom productivity (Kadiri, 1999).

Bioactive Compounds and Nutraceutical Value of Oyster Mushrooms

Oyster mushrooms are known to contain numerous bioactive compounds that contribute to their nutraceutical value. These include: Phenolic compounds, Terpenoids, Polysaccharides, Sterols, and Flavonoids. These compounds possess antioxidant, anti-inflammatory, antimicrobial, and anticancer activities. Polysaccharides such as β-glucans have been extensively studied for their immunomodulatory properties and potential role in preventing chronic diseases. Mushrooms are also considered functional foods because they provide health benefits beyond basic nutrition. Regular consumption of mushrooms has been associated with reduced risk of cardiovascular diseases, improved immune function, and better metabolic health.

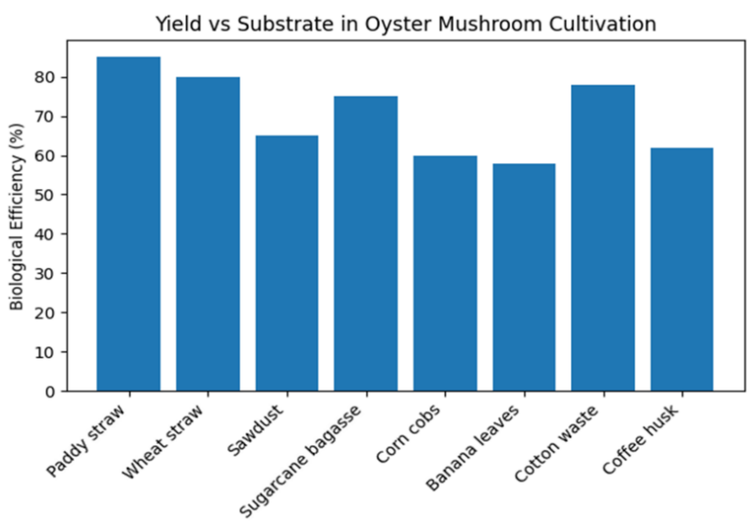

Figure 1. **Yield vs Substrate**

Environmental and Economic Benefits of Mushroom Cultivation

Mushroom cultivation provides several environmental and economic benefits. It enables the recycling of agricultural and industrial wastes, reducing environmental pollution and promoting sustainable agriculture. Spent mushroom substrate (SMS), the residual material remaining after mushroom harvesting, can also be utilized as organic fertilizer, animal feed, or soil conditioner. This contributes to the circular economy and minimizes waste generation. Economically, mushroom cultivation offers an attractive opportunity for income generation, particularly for small farmers and rural entrepreneurs. The relatively low investment required for starting mushroom cultivation makes it accessible to many individuals.

Future Prospects of Mushroom Cultivation

The future of mushroom cultivation appears promising due to increasing global demand for healthy and sustainable foods (Figure 1). Advances in biotechnology, improved cultivation techniques, and the development of value-added mushroom products are expected to further expand the mushroom industry. Research efforts are also focused on exploring new substrates, improving yield, and identifying novel bioactive compounds from mushrooms. These developments will contribute to the growth of mushroom-based food and pharmaceutical industries.

Conclusion

Mushrooms represent an important source of nutritious food and valuable bioactive compounds. Among cultivated mushrooms, oyster mushrooms (*Pleurotus* spp.) are particularly significant due to their adaptability, nutritional value, and ability to grow on various agricultural wastes. The use of lignocellulosic residues such as paddy straw, sawdust, and sugarcane bagasse as substrates not only enhances mushroom production but also contributes to waste recycling and environmental sustainability. Proper selection of substrates, spawn quality, and environmental conditions plays a crucial role in maximizing mushroom yield and quality. Given the increasing demand for functional foods and sustainable agricultural practices, mushroom cultivation holds great potential for improving food security, generating income, and promoting eco-friendly farming systems.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this chapter.

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