

## Full length Research Paper

# Medicinal mushrooms - a novel crop for horticultural diversification in India

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Wide range of agro-climatic conditions that exists in India favour cultivation of a large variety of horticultural crops, including mushrooms. Mushrooms enjoy high economic value because of their nutraceutical properties. They can be successfully cultivated in an eco-friendly manner through efficient use of land and natural resources. Besides strengthening nutritional security, mushroom cultivation provides employment to resource less farmers and especially the womenfolk. In recent years, there has been a huge upsurge of interest in mushrooms as a vegetable and the production has increased to more than a lakh tonne in India. Even though cultivation of edible mushroom is expanding moderately, enough attention had not been given to either create awareness or cultivate medicinal mushrooms in India. Medicinal mushrooms are used as a remedy to treat more than 20 different illnesses, which include cardiovascular problems, cancer, leukemia, leucopenia, hepatitis, nephritis, gastritis, insomnia, asthma and bronchitis. Scientific evidence has been accumulating during the last two decades on their disease curing and rejuvenating effects on human health. This paper deals with the importance, mushrooms, suitability and cultivation potential of medicinal mushrooms in India

**Key words:** Diversification, medicinal mushroom, India, *Lentinula*, *Ganoderma*, *Trametes*, *Schizophyllum*, *Pycnoporous*, mushroom cultivation

## INTRODUCTION

Production of mushrooms worldwide has been steadily increasing, mainly due to contributions from developing countries, such as China, India, Poland, Hungary and Vietnam (Chang, 2007). The world market for the mushroom industry in 2001 was valued at over US\$40 billion. The mushroom industry can be divided into two main categories: edible mushrooms and medicinal mushrooms. Of the 14,000 species of mushroom in the world, around 700 have been known for medicinal properties. Thus mushrooms have vast prospects as sources of medicines. Although mushrooms have been collected from the wild and consumed as medicine for hundreds and thousands of years, their artificial cultivation is of recent origin. Much work on medicinal mushrooms has been done in countries like China, Korea, Taiwan, Japan etc. Cultivation of medicinal mushrooms in India is still in preliminary stages though cultivation packages had been developed for *Lentinula edodes*, *Ganoderma lucidum*, *Flammulina velutipes* and *Auricularia* sp. An attempt had been made to study the

potential of medicinal mushrooms as an additional crop towards diversification of Indian horticulture.

## Importance of Medicinal Mushrooms

In addition to their nutritional value, many edible mushrooms have long been used in the Orient for medicinal purposes. At present there are at least 270 species of mushrooms that are known to have various therapeutic properties (Ying et al., 1987). Medicinal mushrooms have become more widely used as traditional medicinal ingredients for the treatment of various diseases and related health problems largely due to their increased commercial production. As a result of large numbers of scientific studies on medicinal mushrooms especially in Japan, China and Korea, over the past three decades, many of the traditional uses have been validated and new applications were developed. While much attention has been focused on their immunological and anti-cancer properties, mushrooms also known to have other potentially important therapeutic properties including antioxidants, anti-hypertensive, cholesterol

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**Figure 1.** *Lentinula* cultivation at IIHR**Figure 3.** *Trametes versicolor***Figure 2.** *Ganoderma* cultivation at IIHR**Figure 4.** *Schizophyllum commune***Figure 5.** *Pycnoporus cinnabarinus*

lowering, liver protection, anti- fibrotic, anti- inflammatory, anti- diabetic, anti- viral and anti-microbial properties.. Many polysaccharide- bound proteins produced by Basidiomycete fungi have been classified as anti-tumour chemicals by the US National Cancer Institute (Jong and Donovan, 1989).

### Status of Medicinal Mushroom Cultivation in India

*Ganoderma lucidum* is probably the first medicinal mushroom to gain lot of importance in India. Successful cultivation of this mushroom on sawdust/ wheat straw + rice/ wheat bran had been reported by various workers in India (Mishra and Singh 2006; Rai, 2003; Veena and Pandey, 2004). This is an exclusive medicinal mushroom and tastes bitter unlike edible mushrooms.

Cultivation of Shiitake mushroom on wood logs, saw dust and wheat straw had been reported by many workers (Sohi and Upadhyay, 1988; Suman and Seth, 1982; Thakur and Sharma, 1992). Cultivation of shiitake mushroom on sawdust, rice bran and calcium carbonate mixture was also reported (IIHR, 2007). Sharma (2004) could grow a Malaysian strain of shiitake on wheat straw.

Apart from these two mushrooms, domestication of *Flammulina velutipes*, (Sharma et al., 2005), *Auricularia polytricha* (Sharma, 1989), *Trametes versicolor* (Veena and Pandey, 2007), *Pycnoporus cinnabarinus* (Pandey and Veena, 2007) had been reported.

### Scope of Medicinal Mushroom Cultivation in India

Even though much importance is given to medicinal plants in India by policy makers, so far no attention has been paid to medicinal mushrooms. However, traditionally people are using mushrooms to treat various illnesses like use of white polypores to treat ear infection (Andaman) and *Ganoderma* for mumps (northern parts of Kerala). Most of these medicinal mushrooms are being cultivated on sawdust/ wood chips/ wheat straw/paddy straw. In India, these raw materials are available in plenty. India produces about 600 million tones of crop residues/year (Tewari, 2007). Selection of a mushroom species for cultivation should depend on the appropriate availability of raw materials required for the species and the suitability of environmental conditions. The temperature and humidity are the major factors which affect mushroom production. It should not be excessively costly to maintain the necessary temperature for mycelial run and for mushroom development. The temperature requirement of important medicinal mushrooms is given.

Many of these mushrooms can be successfully cultivated in different parts of the country without much temperature modification. The mushrooms which require very low temperature can be cultivated at low temperature pockets of India during winter. Search for

**Table 1** Temperature Requirement for different growth stages of medicinal mushrooms

Mushroom	Spawn run (°C)	Primordia formation (°C)	Fruitbody Development (°C).
<i>Ganoderma lucidum</i>	21-27	21-27	21-27
<i>Lentinula edodes</i>	21-27	10-16	16-18
<i>Grifola frondosa</i>	21-24	10-15.6	13-16
<i>Flammulina velutipes</i>	21-24	4-10	10-16
<i>Auricularia polytricha</i>	24-30	12-20	21-30
<i>Hericium erinaceus</i>	21-24	10-15.6	18-24
<i>Pleurotus ostreatus</i>	24	10-15.6	10-21
<i>Trametes versicolor</i>	24-29	27	18-24
<i>Tremella fuciformis</i>	23-25	20-25	23-25
<i>Agaricus blazei</i>	21-27	21-24	24-27

tropical strains of these mushrooms will further strengthen the possibility of cultivation. Mushroom cultivation is labour intensive and it gives high returns/unit area. These factors are highly suitable for Indian conditions and medicinal mushrooms fetch more returns in the market. However, at present India imports medicinal mushrooms from countries like Malaysia. Market for *Ganoderma* based nutraceuticals alone was estimated to be about US \$20.00 million in 2000-2001 (Thakur 2005).

### Status of Medicinal Mushroom Research at IIHR

Complete cultivation package of *Lentinula edodes* (shiitake mushroom), an excellent edible and medicinal mushroom on mixed sawdust + rice bran 20% + calcium carbonate 3% was developed and transferred to the growers (Figure 1). Reishi mushroom (*Ganoderma lucidum*) is one of the most widely used medicinal mushrooms in the world. The complete cultivation package of reishi mushroom was developed and transferred to the growers. Sawdust/ paddy straw 90% + rice bran 10% was the ideal substrate for indigenous strains. A temperature of  $30 \pm 2^\circ\text{C}$  and 90-95% relative humidity ensured high yield and quality (Figure.2). Being a sub-tropical/tropical mushroom, Indian forests are rich with the mushroom. A total of 37 isolates have been collected, cultured and domesticated on sawdust, rice bran substrate.

Apart from this, medicinal mushrooms viz., *Trametes versicolor* (Coorg, Karnataka), *Pycnoporus cinnabarinus* (Coorg and Shimoga, Karnataka), *Schizophyllum commune* (Andaman) were collected and successfully domesticated on sawdust, rice bran substrate combination (Figure 3-5). Development of complete cultivation technology for these mushrooms is in progress.

### CONCLUSION

Mushroom cultivation is highly suitable for Indian condition due to the availability of agricultural wastes in plenty, labour availability and varied agro-climatic conditions exists in different parts of the country. Most of the leading medicinal mushrooms can be successfully cultivated in India without much environmental modification. It merges with the existing horticultural crop system. Increased awareness about nutraceutical properties of mushrooms leads to import of medicinal mushroom products. Medicinal mushroom cultivation is lucrative and generates lot of employment opportunities and is suitable for house wives and handicapped people. Considering all aspects, cultivation of medicinal mushrooms is a good avenue for the diversification of Indian horticulture. However, research and development on medicinal mushrooms should be strengthened to attain the goal.

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