Oyster Mushroom Cultivation

Part I. Mushrooms

Chapter 2

Mushroom Growing for a Living Worldwide

MUSHROOM GROWING IN INDIA

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The Potential of the Mushroom Industry in India

Figure 1. Button mushroom grown in India
(Photo courtesy f Meera Pandey)

India is not a major producer of any of the mushroom varieties, but it does cultivate mushrooms and has great potential as an important producer in the future. From a production standpoint, the white button mushroom has the highest growth rate and potential for production. However, the cultivation of oyster mushrooms has been more common since the end of the last century, when the infrastructure of oyster mushroom growing was much improved and therefore capital requirements went way down in comparison with the requirements for white button mushroom cultivation.

Though India's present share in the world production and trade of oyster mushroom is meager, being only an estimated 2,000 tons, the potential for the future is rated as high for a variety of reasons. India has a very large availability of various types of raw substrate material such as wheat straw, paddy straw, bagasse, chicken manure, gypsum, tea waste, de-oiled cakes and so forth in almost all the regions and these materials are relatively inexpensive when compared with international prices. In 2001-2002, the production of wheat and paddy in India was estimated to be 73.53-90.75 million tons respectively. Although the residue straws are commonly used as fodder, almost 50% of the crop residues are still potentially available for the growing of mushrooms.

Figure 2. Oyster mushroom grown in India (Photo courtesy of Meera Pandey)

India has large number of agro-climatic regions that offer congenial climatic conditions for mushroom cultivation. India also has a good combination of both the technical and non-technical manpower needed to operate and manage the mushroom growing operations. The supply and demand gap in the world trade of mushrooms and the shrinkage of production in countries like Taiwan and South Korea due to high labor costs would result in better market prices for Indian mushroom producers. The costs of building materials and other inputs related to construction costs are much lower in India than in many other countries. This keeps the investment cost per unit weight of mushroom produced more advantageous in India.

Figure 3. India in Asia

India is also developing its infrastructure rapidly and therefore enjoys a large and well-organized distribution network that facilitates the marketing of products in order to meet domestic consumer demands. From a dietary standpoint mushrooms are a particularly favorable food in vegetarian-predominant India. With a domestic population of more than one billion, India itself is a large market for mushrooms. The per capita consumption of mushrooms in India is currently only about 25g per year although there has been a steady increase in the consumption of exotic mushrooms including oyster mushrooms in addition to the use of regular button mushrooms. This increase can be seen as a highly encouraging sign coming from the potential mushroom consumers in India. Cultivated mushrooms are available today in all common vegetable shops, grocery stores, department stores in both small and big towns in India. One final reason for optimism concerning India's potential as a major mushroom producer is its strategic geographical location with respect to exportation, making it convenient to export oyster mushrooms to the Middle East, Europe, the United States, Africa, and Southeast Asia.

Benefits of Oyster Mushroom Growing

There are many remarkable ecological advantages in the cultivation of edible fungi. One major advantage is the efficient re-integration of agricultural residues such as horse and chicken manure, cereal straw, bagasse and others. The spent mushroom substrate can then be used either as animal feed or as compost for application in farm fields.

The cost of oyster mushroom cultivation varies according to regions and the specific type of cultivation, but generally, the growing of oyster mushrooms is less expensive than that of other cash crops. The major reason for this is it requires little space and inexpensive raw materials. Oyster mushroom cultivation is economically efficient for the farmers of other crops, who do not have to buy the raw materials for substrate and can use low cost structures for mushroom cultivation on seasonal basis. Table 1 would provide a view on the cost-benefit relationships of oyster mushroom cultivation in India.

Table 1. Cost-benefit relationship of oyster mushroom cultivation in India

Growing methods	Production cost (USD)	Yearly Production (tons)	Price Per kg* (USD)	Value of sales (USD)	Earning rate
Traditional hut growing with purchased raw materials	16,383.06	27.37	1.1	30,107	45.58%
Traditional hut growing with their own raw materials	12,364.78	27.37	1.1	30,107	58.94%
Seasonal growing with purchased raw materials	6,832.34	11.4	0.95	10,830	36.91%
Seasonal growing with their own raw materials	5,156.81	11.4	0.95	10,830	52.38%
Growing in their own constructed houses	16,392.23	27.37	1.1	30,107	45.55%

*Average yearly price realization for kg of Fresh Mushrooms

As the table depicts, there are two most likely situations. Some growers are growing mushrooms with purchased raw materials, while others are growing mushrooms with their own raw materials. If the substrate materials are from the owner's own fields, this produces maximum profits. To obtain the maximum benefit mushroom growers should be farmers of other crops or young farmers in rural areas. The Indian agencies involved in the promotion of oyster mushroom growing are using this information to promote self-employment among rural youth. This particular aspect holds good for all developing nations in which rural youth are migrating to industrialized cities in search of employment.

The oyster mushroom has various species and each has its own characteristics. Therefore, each geographic region in India chooses the appropriate species for its climate and environment. In addition, the substrate materials used and growing methods are also different according to species and regions. Table 2 shows the cultivation aspects of various species of oyster mushroom.

Table 2. The cultivation aspects of various species of oyster mushroom

Species grown or collected	Substrate materials used	Regions(States)	System of cultivation	cultivation period	Growing temperature
Pleurotus ostreatus	Paddy Straw paddy Husk Wheat bran	Southern India particularly, Niligiri Hills	Poly bags cylindrical block	The whole year	12-25℃
Pleurotus sojar-caju	Paddy Bagasse, wheat bran	Southern India	Poly bags, Pressed blocks	June to February	22-35℃
Pleurotus Florida	Paddy straw, Wheat straw, Bagasse, Wheat bran and *Cassia hirsute* (a leguminous weed) at 20% combination with bagasse	Off-season in Northern India (Goa, Maharastra karnatake, parts of Gujarat and Andhra Pradesh)	Poly bags and poly blocks of cylindrical shape	June to February	20-32℃
Pleurotus spp.	Paddy straw, wheat straw, wheat bran, and sawdust supple-mented with wheat or rice bran	Goa, Maharastra, Karnataka, parts of Gujarat and Andhra Pradesh	Poly bags and poly blocks	June to March	22-35℃
Pleurotus spp.	From nature	Himalayan regions, Western Ghat, Niligiri Hills and Other forest areas		In rainy season	

How to Grow Oyster Mushroom in India

Substrate preparation and treatment

Figure 4. Soaking wheat straw in water

The wheat or paddy straw is chopped in 3-5cm long by hand or mechanically. The chopped wheat straw is filled into gunny bags for 12-24 hours of soaking (Fig. 4), while paddy straw is treated in boiled water for 15-25 minutes. The wheat straw is also treated with boiled water. This decision is purely based on the capacity of straw to absorb and retain the moisture. In some cases, bavistin (carbendasim) is used instead of the boiled water treatment. The hours of treatment vary according to the substrate or substrate composition.

Spawn preparation

10kg of wheat grains are boiled for 15 minutes in 15L of water and then allowed to soak for another 15 minutes without heating. The excess water is drained off and the grains are cooled in sieves. The grains should be turned several times with a spoon for quick cooling. The cooled grains are mixed with the gypsum ($CaSO_4 \cdot 2H_2O$) and 30g of calcium carbonate ($CaCO_3$). The gypsum prevents the grains from sticking together and the calcium carbonate is necessary to correct the pH. The prepared grains are filled into half-liter milk bottles or polypropylene bags (150-200g per bottle or bag) and autoclaved for 2 hours at 121℃. After sterilization, the material should have a pH value of 7. The bottles are inoculated with grains or bits of agar medium colonized with mycelium, and then incubated at 22-24℃ in a dark place. The mycelium completely spreads through the grains in about 2 weeks.

Substrate inoculation

The cooled substrate is inoculated with spawn by layers at a rate of 2% on a wet basis to make the blocks. The procedure of block making is as follows.

1. The wooden frame of 60×45cm is placed on a smooth floor (Fig. 5).
2. The jute ropes and poly sheet are placed on the frame (Fig. 6, 7).
3. The frame is filled with approximately 5cm of cooled pre-treated straw and compressed by the wooden lid (Fig. 8).
4. The spawn is sprinkled over the whole surface (Fig. 9).
5. The same procedure is repeated five times to achieve a depth of 25-30cm (Fig. 10).
6. The plastic sheet is folded over the top of the frame and tied down with help of ropes previously placed below the plastic. The frame is removed from the block.
7. Small holes of approximately 2mm in diameter are punched in the block for breathing. The blocks are later placed on the shelves in single layer for incubation.

Spawn run and pin initiation

The block temperature is maintained at 25℃ for 12-15 days. Once the blocks are fully colonized, they are hung, after removing the polythene, in a room where the relative humidity is maintained above 85%. The humidity is normally maintained by frequent spraying of water on the blocks and on the floor. The pins are visible 9 days after the opening of the blocks.

Figure 5. The wooden frame

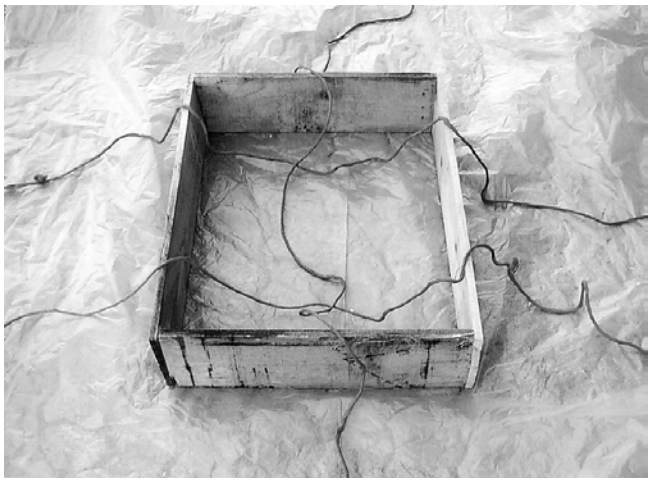

Figure 6. Jute ropes on the wooden frame

Figure 7. Poly sheet on the jute ropes

Figure 8. Filling cereal straws

Figure 9. Sprinkling spawn over the surface

Figure 10. Repeating filling and spawning 5 times

Fruiting and picking

A high relative humidity and proper ventilation is maintained in the growing room during pinning and fruitbody development. The mushrooms are usually picked for fresh market sales. Most of the growers take 3 flushes. Mushrooms picked in the third flush are mostly used for sun drying, where maximum dry matter is achieved.

For Better Mushroom Industry in India

Most growers in India are self-employed and operating small-scale farms. They have different backgrounds with low or no knowledge of running small biological enterprises. Many short-sighted and non-committed growers are getting out of mushroom growing enterprises due to small setbacks they encounter before they accumulate enough experience in mushroom cultivation management. This situation creates fluctuations in the total number of oyster mushrooms growing units and causes an inconsistent supply-demand curve in the marketplace. This in turn causes the market price for oyster mushroom producing growers to fluctuate. As such, the market of oyster mushroom is highly localized with individual traders having great control on prices. The retail price of fresh oyster mushroom varies in India from INR*30-120 (USD0.66-2.65) per kg.

To make the oyster mushroom growing business more profitable, the following efforts should be made:

- The present growers must join hands to form co-operative societies in order to share the technical information on day to day growing and spawn production, and in order to control the price of mushrooms in the market place. The idea of co-operative formation among growers is already proposed among the grower communities but no leader has emerged to date.
- The costs of production should be maintained as low as possible by utilizing the local agricultural residue.
- Introduction of value-added products like oyster mushroom powder for soups, and oyster mushroom pizza should be made.
- Mature and committed entrepreneurs should be encouraged to become involved in the mushroom industry.
- The Indian government sectors must take the initiative in assisting in the marketing of fresh and processed oyster mushrooms for export by purchasing crops from the small scale mushroom farms. The revenue from this process can later be utilized in improving the rural infrastructure.

* INR (India Rupee, INR1≒USD0.0221 in Feb 2004)