

## Contribution of mushroom production for better environment, nutrition and health

**Mushroom, a super food suitable for all age groups, contains all the vital nutrients required for human body in desired proportion. The production of mushrooms in India has increased by an average growth rate of 8.3% in last 25 years. Different types of mushrooms viz. white button (*Agaricus bisporus*), oyster (*Pleurotus spp.*), paddy straw (*Volvariella volvacea*), milky (*Calocybe indica*) and shiitake (*Lentinula edodes*) mushroom with a total production of about 2.43 lakh tonnes are being cultivated on commercial scale in India because of its diversified agro-climatic conditions. Mushrooms have been recognized to contain highest and quality protein per unit area from agro-wastes generating employment, improving economic status of growers, checking pollution and earning foreign exchange. They also restore the environment by playing a role in degrading the pesticides and persisting chemicals. The spent mushroom substrate after cropping, remain as a good source of protein and other nutrients for animal feed. Mushrooms with their good nutritional, medicinal and functional properties are considered as a health food as they contain low calories, high protein, dietary fibre, vitamins, and minerals with high antioxidant capacity. Hence, mushroom cultivation is an effective way for resource poor farmers to generate wealth from waste using a limited space within a short duration. It also provides an opportunity to produce a highly tradable commodity, thereby contributing to income generation and improved socio-economic status.**

### Mushrooms

Appearing with their attractive and spectacular shapes and structures, mushrooms have always been intriguing to human beings since ancient times. Mushrooms belong to a group of organisms called fungi. Fungi have always been found growing on the dead organic matter helping to decompose and utilize it for production of nutrition rich food. The thread like structures (mycelium) spread in the substrate help absorb the nutrition with formation of fruiting body called mushroom. Very often, people associate appearance and growth of the mushrooms with thunder and lightning.

As per the reports, about 14,000-16,000 species of mushroom have been recorded worldwide out of which about 3,000 species are primarily considered edible. Throughout the world, about 200 mushroom species have been grown successfully, 100 are economically cultivated, about 60 have commercial importance and 10 have industrial application in different countries. As far as vital bioactive compounds are concerned, 2,000 species have shown health attributes addressing a number of disorders and diseases and 30 species were reported lethal if consumed. Because of nutritious components, mushrooms have phenomenal contribution in combating malnutrition

among women and children. Supplementing Indian diets with mushroom thus will help in bridging the protein gap among general population while improving the socio-economic status of resource poor farmers. At present, out of total 43 million tonnes of world mushroom production, China is leading producer and India ranks Sixth in terms of total mushroom production in the world. It is reported that average world mushroom consumption is 5-6 kg/person/year, whereas it is 22-23 kg in China and about 175 g in India. Presently, shiitake (*Lentinula edodes*) has become the most cultivated mushroom in the world followed by oyster (*Pleurotus spp.*) and wood ear (*Auricularia spp.*) mushrooms. In India, about 70% mushroom production is contributed by button mushroom, though there is a great scope for others including speciality mushrooms. Now with people becoming more and more aware about healthy foods, which are complete in all respect, the demand for mushrooms is increasing every year.

India is blessed with varied agro-climatic conditions, abundant availability of agricultural wastes and human resource and thus is most suitable for the cultivation of all the types of mushrooms. In India, commercial cultivation started in 1960s, in 1970 total mushroom production was 3,000 tonnes, which rose to 40,000 tonnes in 1997, and



Fig. 1. Commercially cultivated mushrooms in India

126,000 tonnes in 2016. In the last five years country has witnessed exponential growth and presently India is producing 242,000 tonnes of mushrooms per annum. White button mushroom is still the most commonly grown mushroom and oyster (*Pleurotus* sp.), milky (*Calocybe indica*), paddy straw (*Volvarella volvacea*) and shiitake (*Lentinula edodes*) are the other commercially cultivated mushrooms in India (Fig. 1). Fig. 2 provides the growth of mushroom production in India which shows exponential growth over last two decades. When compared, yield of food grains have increased at a very low rate (1.96%) than mushroom production (8.30%) over the last 25 years. This can be attributed to more recent inclination of Indians towards healthy and functional foods and hence setting up of more commercial seasonal and round the year mushroom cultivation units.

#### Mushrooms for better resource utilization

Mushroom production not only provides diversification and improves nutritional security but also address the alarming issues related to dwindling natural resources like land and water. Mushroom cultivation is typical example of

vertical farming and can easily be taken up by the resource poor farmers in the country. Mushroom utilizes agricultural residues, can be cultivated vertically, highest protein producer per unit area per unit time. Mushrooms have high nutritive value and being a labour intensive industry provides ample opportunities for the employment. The land requirement for mushroom cultivation is almost negligible owing to vertical farming; water requirement for mushroom cultivation is also very less (25-30 litre/kg production of mushroom). Hence, mushroom cultivation is helping in the judicious use of fast depleting natural resources and can pave the path towards sustainable agriculture.

#### Mushrooms for better environment

*Cleaning up of agricultural waste:* Pollution is an important threat for sustainability of environment. Leading environmental pollutants are automobile emission, industrial wastes, agricultural wastes and municipal waste. According to an estimate around 700 million tons of crop residues are generated per year and most of it is left unutilized which creates environmental pollution. A huge amount of paddy straw and stubbles are burnt in the fields every year especially in north India. This practice of burning paddy straw and dumping of other agricultural wastes affect the quality of air, soil and water in addition to the life of farm animals and the microclimate of the crop. Mushroom farms can utilize this agricultural waste for growing mushrooms. Mushroom mycelium produces extracellular enzymes such as ligninases, cellulases, and laccases, which can degrade and utilize diverse crop residues and reduce pollution. Mushrooms also play an important role in synthesizing non-toxic nanoparticles of metals from their salts. Hence, mushroom farming is an eco-friendly sustainable technology, which produces nutritive and medicinal fruiting bodies utilizing agricultural waste.

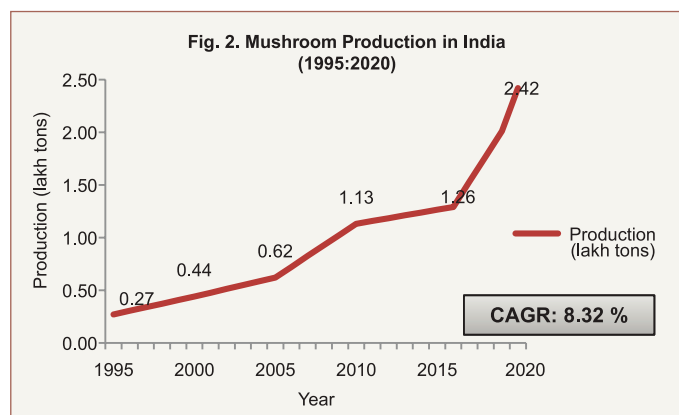


Fig. 2. Growth curve of Indian mushroom industry.

*Removal of environmental pollutants:* Mushrooms also play a significant role in the restoration of damaged environments. Bioremediation involving the use of mushroom mycelia to remove or neutralize a wide variety of pollutants is an effective way of reducing soil and water pollution. The injudicious use of pesticides has caused accumulation of a lot of pesticide residue in agricultural products and in soil. Many insecticides have been reported to be mineralized by the mushrooms. *Pleurotus ostreatus* degrades DDT as well as malathion. Spent oyster mushroom substrate can also perform denaturation and removal of biocide penta-chlorophenol in water systems.

*Spent mushroom substrates for animal feed :* Agricultural crop residue is used as one of the important animal feed for increasing milk production and for improving body mass of animals. But the nutritional quality of these crop residues is poor many a times. Hence, animal feeds need to be supplemented with enriched nutrient sources. Oyster mushroom spent mushroom substrate (SMS) is one of the suitable nutrient rich supplements for animals. The spent substrate remained after cropping of mushrooms, is a very good source of protein for livestock and poultry. It contains a number of beneficial microorganisms, extracellular enzymes and relatively high level of proteins and macronutrients like nitrogen, potassium, phosphorus, calcium and trace elements such as iron and silicon. Spent straw or compost also have good digestibility in animals. SMS also contains good amount of polysaccharides and vitamins, which are beneficial for animals. Mushroom also have positive effect on health of animals and poultry. Since mushrooms are rich in antioxidants and have antibacterial properties, they may also act as probiotics for poultry feed. SMS can also be given in diet of pigs to improve their body weight. The SMS mixed with barley powder can also be used as fish feed, and have shown increased fish production with reduced feed cost.

### Mushrooms for better nutrition and health

*Nutritional value of mushrooms:* Mushrooms are rich in protein, vitamins, minerals and are low in fat and sugar because of which it is considered a super food. Mushrooms contain a good amount of quality proteins (30-40% of

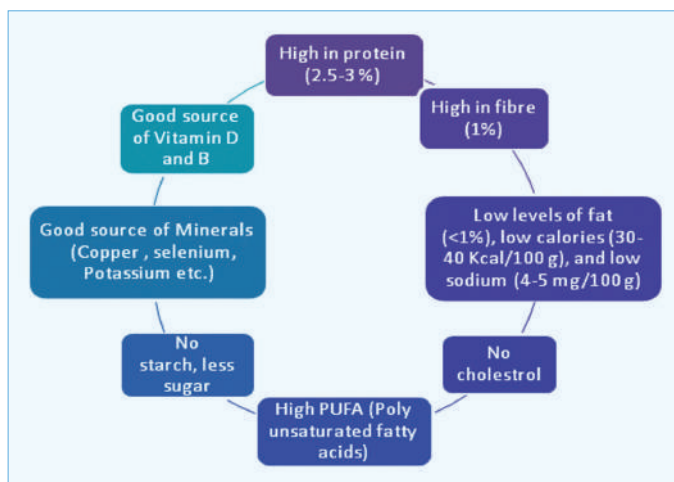


Fig. 3. Nutritive value of mushrooms.

dried mass) rich in essential amino acids required for good health. Mushrooms are rich in leucine and lysine amino acids, which are commonly lacking in many staple cereal foods. Mushrooms are low in sugar and fat and thus are very useful for the people suffering from diabetes and heart related problems. Being rich in fibres, they help to overcome the acute constipation problem. Mushrooms provide several groups of vitamins, particularly vitamin D, thiamine, riboflavin, niacin, biotin, pantothenic acid and ascorbic acid. Being the only vegetarian source of vitamin D, mushrooms can be very helpful in alleviating the prevalent vitamin D deficiency among masses. Moreover, mushrooms are also rich in various minerals like phosphorus, zinc, manganese, potassium, copper, selenium (an antioxidant), iron, magnesium, etc. (Fig. 3).

*Mushroom: A functional food:* Mushrooms also provide many added health benefits apart from their rich nutritional values and thus can be categorized under functional foods. Mushrooms have a lot of functional food ingredients such as dietary fibre, poly-unsaturated fatty acids (PUFA), proteins, peptides, amino acids, keto acids, minerals, vitamins and other antioxidants (glutathione, selenium, etc.), which make them a health food. The high proteins, sterols, macro-elements and low calorie content make mushroom ideal for prevention of cardiovascular diseases. Thus they are an ideal food for patients, old people, pregnant women and children. Mushroom also contains bioactive compounds like  $\beta$ -1-3-glucans, which have an ability to control the blood cholesterol level preventing cardiovascular diseases. Besides,  $\beta$ -glucans also have immuno-modulatory properties and have been used clinically as part of a combination therapy for a variety of cancers (Fig. 4).

*Medicinal value of mushrooms:* Some mushrooms are also classified as medicinal mushrooms, as they contain some bioactive compounds that are Host Defense Potentiators (HDP) and can have immune system regulating properties. These compounds include polysaccharides ( $\beta$ -glucans), polysaccharide-peptides, nucleosides, triterpenoids,

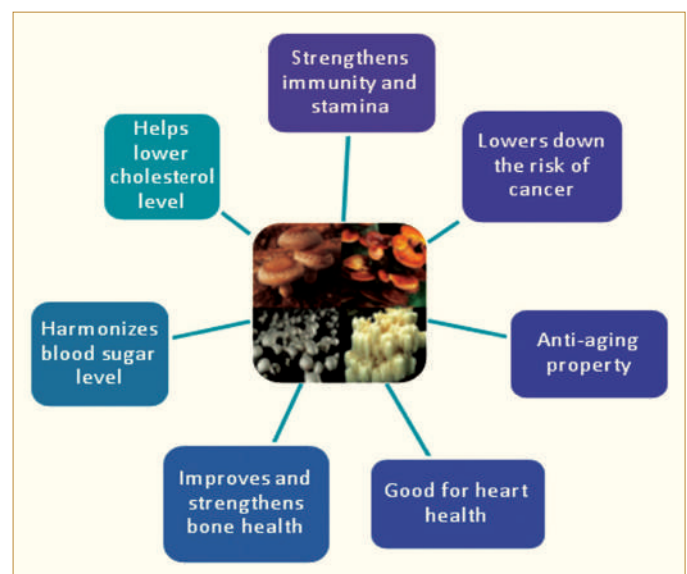


Fig. 4. Health benefits of mushrooms.



complex starches, and other metabolites. Shiitake mushroom (*Lentinula edodes*) possesses antitumor, antihypertensive, hypocholesterolemic, and antibacterial activities. Reishi mushroom (*Ganoderma lucidum*) has been proven to have antimicrobial and anti-HIV effects, while the  $\beta$ -glucan polysaccharide and the ganoderic acid of this mushroom have shown anti-tumorogenic effects. Oyster mushrooms (*Pleurotus* species) also contain cholesterol lowering and immune-stimulatory properties.

### Conclusion

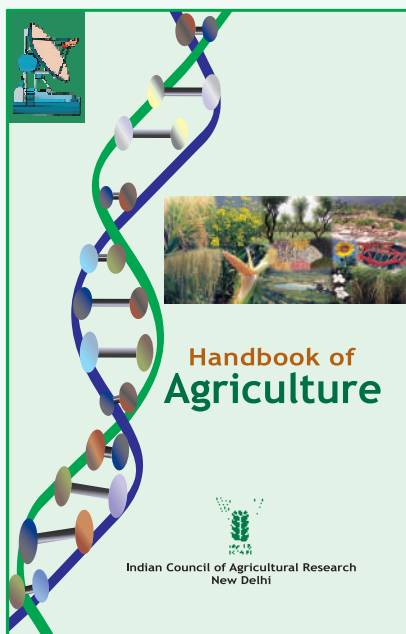
Mushroom production is indoor activity, hence, does not need agricultural land thus suited to small farmers and landless labourers. Many agricultural wastes can be utilized to produce quality food and organic manure for field crops. Besides mushroom have high bio-efficiency

i.e. conversion of dry substrate into fresh mushroom. Spent mushroom substrate can be used to produce organic manure and animal feed. It can generate self-employment and can improve socio-economic status. It can provide nutritional security particularly to poor people through incorporating mushrooms in their diets. Thus, mushroom production is a vocation that should be encouraged in the country vigorously.

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### TECHNICAL SPECIFICATIONS

Size	:	Royal Octavo (16 cm x 24 cm)
No. of pages	:	i-xii + 1618
Price	:	₹ 1500
Postage	:	₹ 100
ISBN No.	:	978-81-7164-096-6

*For obtaining copies:*

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