

Present mushroom production scenario of India and the World

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Abstract

Mushroom industry in India is gaining momentum as an efficient and economically viable process for converting lignocelluloses residue into high-quality protein food. Mushrooms have immense nutritional and health benefits. The economic importance of mushrooms is also great for the farmers and they are highly proteinaceous. Each mushroom has a constituent which is extensively nutritional or medicinal in nature. In India mushroom cultivation started in 1961. At present, the total mushroom production in India is approximately 0.20 million tons. From 2010-2018, the mushroom industry in India had registered an average growth rate of 4.3% per annum and more than 15% in the last two years. Haryana is the leading state in mushroom production with more than 20000 tonnes per annum.

Introduction

Edible mushrooms have been consumed by humans, not only as part of the normal diet but also to maintain health and increase longevity. Mushroom is an excellent source of dietary components such as protein, vitamins, minerals, folic acid, carbohydrates, and low in fat. Mushroom industry is gaining momentum as efficient and economically viable process for converting lignocelluloses residue into high-quality protein food. For centuries, Scientists have understood that foods have both preventive and therapeutic effects and are an essential part of good health. This view is now being increasingly adopted around the world. In addition, mushroom extracts have been found to have profound health promoting benefits and, as a result, became essential components in many traditional Chinese medicines.

Importance of mushrooms

Mushroom is an excellent source of dietary components such as protein, vitamins, minerals, folic acid, carbohydrates, and low in fat. The economic importance of mushrooms is great. They are highly proteinaceous and are used as food. The white button mushroom is sold as fresh mushroom or is canned and made into soups, sauces and other food products. Protein in mushrooms have 60-70 % digestibility and contains all the essential amino acids. Mushrooms have immense nutritional and health benefits. Some of these are following:

Table 1. Medicinal properties of mushrooms

Increased longevity	Improved blood flow	Cholesterol and blood sugar normalization
Liver protection, including protection from adverse effects of alcohol consumption	Kidney support	Antiviral (including HIV), antibacterial, and antifungal properties
Destruction of cancer cells; improved outcomes for people receiving chemo and radiation	Improved respiratory illnesses, including asthma	Reduced risk for heart disease, decreased platelet aggregation and improved blood flow
<u>Nerve regeneration</u> (Lion's Mane mushroom)	Improved skin and hair	Increased sexual function and athletic ability

World Mushroom Production Scenario

Mushrooms have been collected and consumed in different parts of the world, but their cultivation at commercial scale started only after World War II. Few mushrooms like *Agaricus bisporus*, *Lentinula edodes*, *Auricularia* spp, *Pleurotus* spp, *Flammulina velutipes*, *Volvariella volvacea* contribute about 90% of the world mushroom production.

Even though man started growing crops more than 10,000 years ago, the cultivation of mushrooms is a relatively new phenomenon. There are reports of success in cultivation of mushrooms like *Auricularia* (600 AD), *Flammulina* (800-900 AD), *Lentinula* (1000–1100 AD) and *Volvariella volvacea* (1700 AD) in China; *Agaricus bisporus* in France in 1650, and *Pleurotus* in 1900 in USA. All these six species contribute maximum to world mushroom production today. The scientific approach to their cultivation started only in the beginning of the 20th century when it became possible to prepare pure culture by germinating spores or from tissues. In 1914, USA, that was importing poor quality spawn from Europe, produced pure spawn. Thereafter, there were many changes like selection of white strain of *Agaricus* in America in 1926 by Lambert (1959), development of grain spawn by Sinden in 1932, studies on compost by Lambert leading to two zone system and other similar scientific works. Lambert started marketing pure spawn and by 1935 over 80% of button mushrooms cultivated in USA was of white type. Button mushroom was being cultivated in France, USA, etc and was emerging as the dominant species representing mushrooms in West at the same time there was work going on in East where pure culture of shiitake was made and inoculation techniques were developed.

According to FAO mushroom production has increased from 0.5 million ton in 1960 to 10.38 MT by 2014. According to various other agencies the mushroom production has increased from 0.17 MT to 34.8 MT in 2013. That FAOstat does not cover all the mushrooms cultivated in Asia has been exemplified by comparing data of FAO and MAFF, Japan where FAOstat includes data of only fresh shiitake production which at present is only about 14% percent of total mushroom production of Japan. Despite rapid overall increase in mushroom production, the relative contribution of button mushroom has been declining mainly due to rapid increase in production of wood rot fungi like shiitake, *Auricularia* and *Pleurotus* species.

Considering growth curve to be sigmoid and relatively less increase in coming years, the current estimated mushroom production should be around 40 MT. It can be seen that there is about 200 times increase in 58 years over 1960 value and about 40 times increase in last 40 years. Production was 0.17 MT in 1960 and it took 18 years for the production to reach 1 MT. It touched 5 MT in 1994, 10 MT in 2000, 20 MT in 2006 and crossed 30 MT in 2012. China is the largest producer contributing over 70% of world mushrooms. Presently, the mushroom production for 2014 in China is reported as 34.67 MT.

There has been increase in production of all the six species and the world production of 0.92 million ton in 1975 increased to 4.91 MT in 1997 and 43.8 MT by 2013. The increase, however, was much more in mushroom species other than *Agaricus* as a result of which its share in the world production declined from 73% to 15% during this period. The share of button to world mushroom production prior to 1975 was still higher. Shiitake has been an important mushroom and its production has been increasing steadily and at present is number one contributor. The other four species (*Pleurotus* spp, *Auricularia* spp, *Flammulina velutipes* and *Volvariella volvacea*) contributed less in the initial years but there has been sudden jump in their production in this century. *Pleurotus* includes many species and there have been changes in contribution of different of *Pleurotus*. The major contributor in this growth has been by China that at present accounts for more than 87% of the world mushroom production. Major emphasis in China has been on wood rot fungi, though at present China is also number one producer of button mushroom. In 2015 *Lentinus edodes*, *Auricularia* spp, *Pleurotus* spp, *Agaricus bisporus* and *Flammulina velutipes* contributed 22, 18, 17, 10 and 7.5 % respectively to the total mushroom production of 34.76MT of China.

Indian Mushroom Production Scenario

The global mushroom industry has expanded very rapidly in the last two decades by the addition of newer types of mushrooms for commercial cultivation. However, mushroom as a vegetable is yet to find regular place among the Indian consumers. Despite of favourable agro-climate, abundance of agro wastes, relatively low-cost labour and a rich fungal biodiversity, India has witnessed a lukewarm response in its growth till year 2000. At present, the total mushroom production in India is approximately 0.15 million tons. From 2010-2018, the mushroom industry in India has registered an average growth rate of 4.3% per annum. However, exponential growth was registered during the last two years.

Out of the total mushroom produced, white button mushroom share is 73% followed by oyster mushroom (16%), paddy straw mushroom (7%) and milky mushroom (3%) during 2018. Compared to other vegetables; per capita consumption of mushrooms in India is meagre and data indicates it is less than 100 grams per year. In the year 2016-2017, Indian mushroom industry generated revenue of Rs. 7282.26 lakhs by exporting 1054 quintals of white button mushroom in canned and frozen form.

Mushroom industry in India is overwhelmingly focused on white button mushroom which is a highly sophisticated and capital-intensive activity. There are two main types of mushroom growers in India, those who are growing white button mushroom round the year under controlled conditions and seasonal growers who are growing button mushrooms during the winter seasons. Seasonal button mushroom cultivation is popular in north India and western part of India. Farmers cultivate

oyster, paddy straw and milky mushroom seasonally in low cost structures. Oyster is popular in Bihar, Chhattisgarh, Uttarakhand and North eastern states. Paddy straw mushroom is popular in Orissa and Chhattisgarh whereas milky mushroom is popular in Tamil Nadu.

The data collected through different AICRP centres and horticulture departments of the country is presented in Table 1.

Table 2. Mushroom production in India during 1996-97 and 2017-18

S. No.	State	Mushroom Production (tonnes)*		
		1996-97	2017-18	2019-20
1.	Andhra Pradesh	2500	3650	3650
2.	Arunachal Pradesh	-	60	60
3.	Assam	-	220	1200
4.	Bihar	-	5600	15280
5.	Chhattisgarh	-	540	1050
6.	Delhi	-	3160	3160
7.	Goa	1000	4470	6400
8.	Gujarat	-	12000	14000
9.	Haryana	4000	20050	20050
10.	Himachal Pradesh	500	14505	15600
11.	Jammu and Kashmir	400	770	1500
12.	Jharkhand	-	1000	3000
13.	Karnataka	600	1220	1220
14.	Kerala	100	910	910
15.	Maharashtra	7000	18380	19000
16.	Madhya Pradesh	2000	500	500
17.	Manipur	-	70	70
18.	Meghalaya	-	35	35
19.	Mizoram	-	65	65
20.	Nagaland	-	405	405
21.	Odisha	700	19532	19532
22.	Punjab	4000	12750	18000
23.	Rajasthan	50	1400	13400
24.	Sikkim	-	06	6
25.	Tamil Nadu	10000	11475	11475
26.	Tripura	-	120	120
27.	Uttarakhand	-	11670	14200
28.	Uttar Pradesh	4000	7600	9700
29.	West Bengal	250	3000	7500
30.	North East, Delhi, Chandigarh	2900	390	3650
	Total	40000	155553	201088

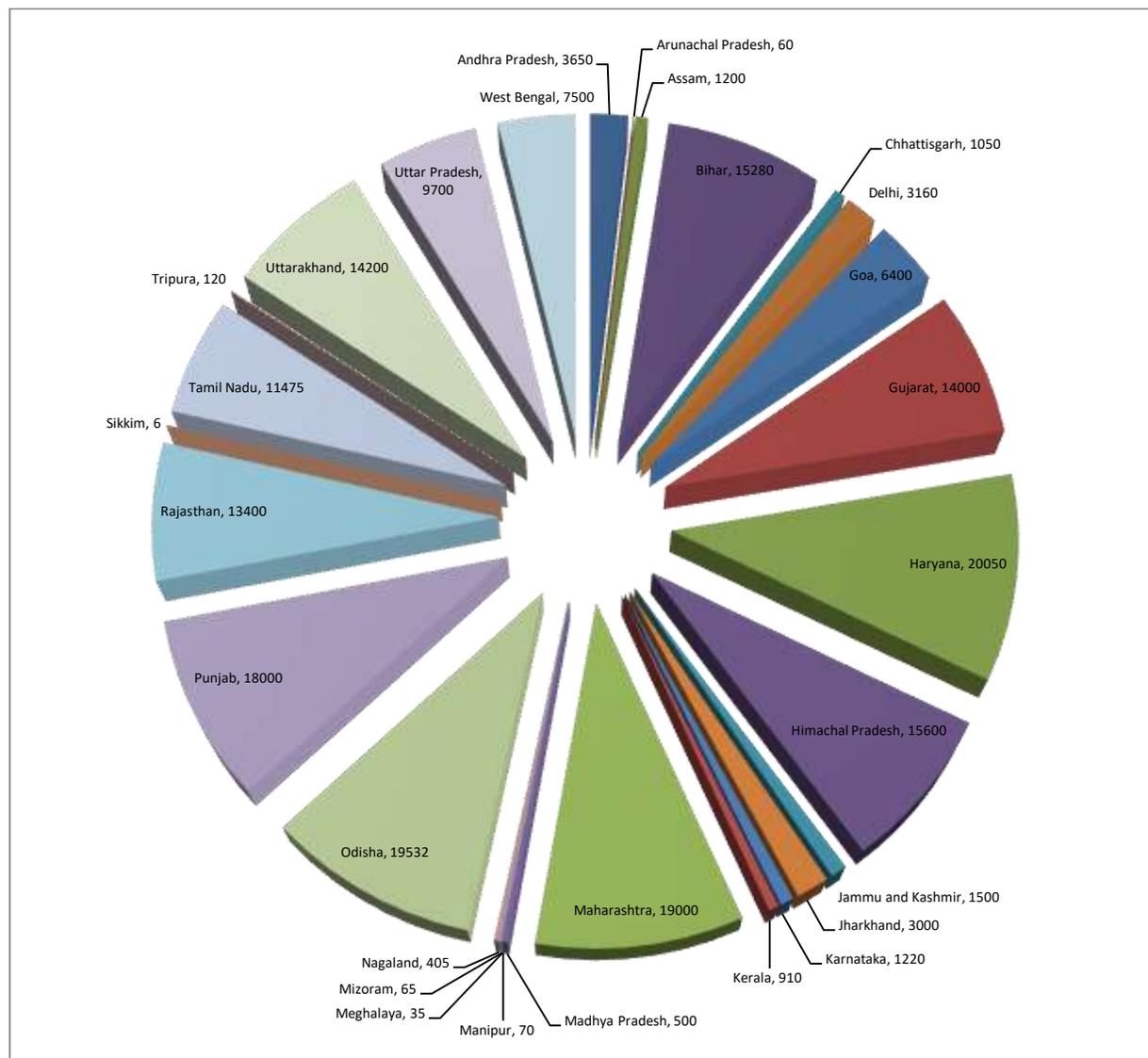


Fig 1. State wise mushroom production in India during 2019-20 (in metric tons)

Relative contribution of different mushroom species

In India, there are five mushroom species viz., white button mushroom (*Agaricus bisporus*), oyster (*Pleurotus spp.*), paddy straw (*Volvariella volvacea*), milky (*Calocybe indica*) and shiitake (*Lentinula edodes*) are in commercial cultivation. Eventhough, cultivation technologies of many exotic mushrooms have been standardized, the commercial markets are still dominated by *Agaricus bisporus*, *Pleurotus spp.* and *Volvariella volvacea*. These three mushrooms are contributing about 96% of total mushroom produced in India. Milky mushroom (*Calocybe indica*) is indigenous tropical mushroom of the country. However, the commercial cultivation is restricted to south Indian states only and contributing up to 3% to the total mushroom production. Production of paddy straw mushroom became more popular in the states of Odisha and Chhattisgarh and its production was registered at 7% to the total mushroom production.

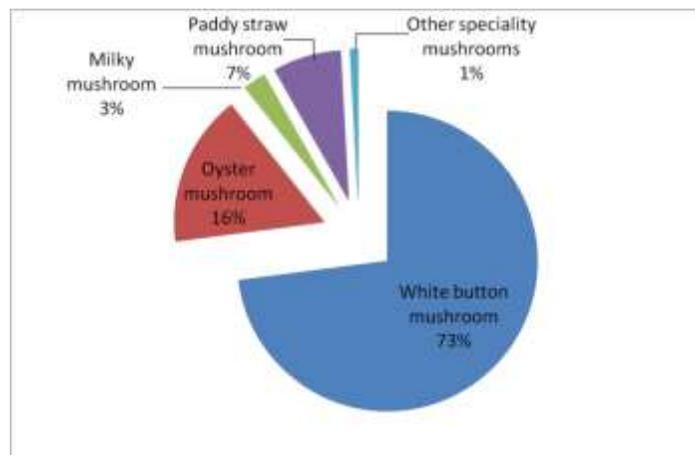


Fig 2. Relative contribution of different mushroom species in total production

Cultivation of *Flammulina velutipes*

The cultivation of *Flammulina velutipes*, also known as enokitake, enoki, golden needle mushroom, velvet foot or velvet stem mushroom, was initiated at ICAR-DMR during the year 2008. Now, they are being grown on large scale using PP bottles. Bottle cultivation of mushrooms can save in input cost, thereby reducing the cost of cultivation. The cultivation technology of the mushroom is ready for dissemination among farmers. *Flammulina* prevents as well as cures liver ailments and gastroenteric ulcers if taken on regular basis. A crop of more than 45% Biological Efficiency has been obtained at ICAR-DMR with excellent fruit bodies.

Conclusion/Way Forward

It takes approximately 13 weeks (90 days) for button mushroom to complete an entire production cycle, from the start of composting to the final cook out after cropping has ended. For this work, a mushroom grower can expect anywhere from 25 kg to 35 kg per 100 kg compost in a period of 4-6 weeks of cropping. Final yield depends on how well a grower has monitored and controlled the temperature, humidity, pests, and so on. All things considered, the most important factors for good production are experience plus an intuitive feel for the biological rhythms of the commercial mushroom. The production system used to grow a crop can be chosen after the basics of mushroom growing are understood. The international competition has forced mushroom producers to minimize costs and at the same time increase yields per unit weight of compost and improve quality levels. As the upsizing of mushroom farms continues with the change from family scale to industrial scale, logistic and labour/energy saving alternatives will play a more important role in automation. Automatic climatic control will be an obligatory investment for survival in the competitive mushroom industry in days to come. Indian Mushroom industry has witnessed exponential growth during the last couple of years, however, considering the agro-climatic conditions, availability of raw materials and man power, there is tremendous scope for expansion of mushroom industry in the country.

Table 3. Some of the medium to large scale button mushroom production units in India

S. No	Name of the mushroom unit	Location	Production capacity
1.	M/s Himalyan International Pvt. Ltd.	Vadnagar, Gujarat	10000 TPA
2.	M/s Agro Dutch Mushrooms Pvt. Ltd	Chandigarh	8000 TPA
3.	M/s Himalyan International Pvt. Ltd.	Paonta Sahib	4000 TPA
4.	M/s Zuari Agro Farm	Goa	4000 TPA
5.	M/s Tirupati Balaji Agro Products Pvt. Ltd	Baramati, Pune	4000 TPA
6.	M/s Cambium Mushrooms	Nasik	4000 TPA
7.	M/s British Agro Products India pvt ltd	Tamil Nadu	3000 TPA
8.	M/s Flex Foods Pvt. Ltd	Dehradun, Uttarakhand	3000 TPA
9.	M/s Weikfield Foods Pvt. Ltd.	Haveli, Pune	3000 TPA
10.	M/s Welkins Overseas Pvt. Ltd.	Roorke, Uttarakhand	500 TPA
11.	M/s Vikas Mushroom Farm	Solan, Himachal Pradesh	500 TPA
12.	M/s Kulakarni Farm Fresh	Belgam, Karnataka	350 TPA

* TPA-Tons Per Annum

Table 4. Some of the small to medium scale sub-tropical and tropical mushroom production units in India

S. No	Name of the mushroom unit	Type of mushroom	Location	Production capacity
1	M/s Prince Mushroom	Milky mushroom	Erode, Tamilnadu	100 TPA
2	M/s V Chandrasekaran mushroom farm	Milky mushroom	Villupuram, Tamilnadu	100 TPA
3	M/s Siddharth Mushroom	Oyster mushroom	Nashik, Maharashtra	90 TPA
4	Mr. Mohan Prasad	Oyster mushroom	Jamai, Bihar	50 TPA
5	Flora Agro,	Oyster mushroom	Thane, Maharashtra	10 TPA
6	Dhepe Mushrooms	Oyster mushroom	Ahmednagar, Maharashtra	10 TPA
7	Ruchi Mushroom,	Paddy straw mushroom	Mayurbhanj, Odisha	40 TPA
8	Mrs. Jayanti Pradhan	Paddy straw mushroom	Kendupalli, Odisha	10 TPA
9	SM Mushroom Laramba	Paddy straw mushroom	Bargarh, Odisha	10 TPA
10	Mahadev Sahoo Barpali, Bargarh	Paddy straw mushroom	Bargarh, Odisha	10 TPA