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Mushrooms: Immunity Booster and Nutritive Food for Human Health

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The world population is growing at an alarming rate and is anticipated to reach about 9.7 billion in 2050. India is at present the most populated country in the world, crossed its population to 142 crores. On the other hand, agricultural production is not increasing at a substantial rate. To keep pace with the food demand and to meet the protein gap some alternative food is required. Mushroom is regarded as the world's greatest untapped resource of nutrition and palatable food for human health. Mushrooms have been collected and consumed since time immemorial. The Greeks regarded mushrooms as the esteemed 'Food of the Gods', while the Romans believed they provided strength to warriors in battle. Chinese culture viewed mushrooms as a beneficial addition to a healthy diet and even referred to them as a 'life elixir'. These fungi have captivated the interest of powerful civilizations worldwide, owing to their sensory qualities, mushrooms have been an integral part of human culture for thousands of years. Out of the documented 16,000 mushroom species worldwide, approximately 7,000 are edible and about 3,000 of them are potentially excellent for consumption. Among these, around 200 have been experimentally farmed, 100 have been economically cultivated, 30 have been commercially cultivated in different regions and roughly six are produced commercially (Aditya and Bhatia 2020; Aditya *et al*., 2022c; Aditya *et al*., 2022d). Additionally, the nutraceutical properties of approximately two dozen species have been investigated. It is anticipated that mushrooms with therapeutic qualities will potentially serve as a source of novel biological medications in the future to combat lifestyle disorders and diseases. The mushrooms can successfully be widely grown on various agro-industrial

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wastes their cultivation serves as an effective bio-conversion method, converting waste materials into potentially nutritionally enriched food (Aditya *et al*., 2022b; Aditya and Jarial, 2023).

Nowadays, mushrooms have been experiencing a surge in popularity as a nutritious and future food. This is primarily due to their impressive nutritional profile, which includes low calorie, carbohydrate, fat and salt content, making them a favorable option for those seeking healthier meals. Additionally, mushrooms are naturally free from cholesterol, further enhancing their appeal as a nutritious food. One of the key factors contributing to the nutritional value of mushrooms is the presence of essential nutrients. For instance, mushrooms are a notable source of selenium, a mineral known for its antioxidant properties and its role in supporting a healthy immune system. Potassium, another important mineral is also found in mushrooms, which is essential for maintaining proper heart function and regulating blood pressure. Moreover, mushrooms provide an important B group of vitamins such as riboflavin (vitamin B_2) and niacin (vitamin B_3). These vitamins are involved in various metabolic processes within the body, including the conversion of food into energy and the maintenance of healthy skin. Mushrooms offer a unique opportunity for vegetarians as they serve as the sole natural, non-animal and unfortified source of vitamin D. Additionally, mushrooms provide proteins that play a crucial role in the development and restoration of body tissues, along with the synthesis of enzymes and hormones. The fiber content in mushrooms is also noteworthy, as it contributes to a healthy digestive system and aids in maintaining healthy blood sugar levels.

Mushrooms have been highly regarded by humans for their unique and delicious taste, making them a sought-after delicacy in the culinary world. While nature boasts a staggering 2,000 mushroom species, only about 25 of them are commonly recognized as food and a small number are commercially cultivated. These mushrooms are valued not only for their nutritional and functional benefits but also for their organoleptic qualities, medicinal properties and economic significance. During the year 2018-19, global mushroom production reached a staggering 43.0 million tonnes, with China contributing the most (77.0 %), followed by Europe (12.0 %), the United States of America (4.0 %) and India (1.0 %). In 2020, India alone produced a total of 0.22 metric tonnes of mushrooms. Among the varieties produced, white button mushrooms (*Agaricus* spp.) accounted for 73.0 percent, followed by oyster mushrooms (*Pleurotus* spp.) (16.0 %), paddy straw mushrooms (*Volvariella volvacea*) (7.0 %), milky mushrooms (*Calocybe indica*) (3.0 %), and other types (*Lentinula edodes*, *Auricularia* spp., *Morchella* spp. etc.) (1.0 %). The mushroom industry is experiencing significant growth nowadays, with China leading as the world's top producer. Cultivation of highly nutritional and medicinal mushrooms on agro-wastes is one of such effort which can provide nutrition, employment and food security and also

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an eco-friendly strategy for the alleviation of hunger globally (Aditya and Bhatia 2020; Tiwari *et al*., 2023).

Mushrooms possess a significant nutritional value due to their abundance of protein, fiber and essential amino acids. Despite having low-fat content, they contain a high concentration of essential fatty acids. In terms of vitamins (B_1, B_2, B_{12}, C, D, and E) consuming mushrooms provides substantial nutritional benefits. Moreover, mushrooms offer a diverse array of nutraceuticals and can directly enhance health when included in the human diet (Aditya *et al*., 2022a). Mushrooms have long been valued in various cultures for their health benefits, medicinal properties and hence, they are considered as the best food for patients having diabetes, hypertension, heart problems, obesity, anaemic, cancer and constipation etc. The medicinal functions of mushrooms and fungi encompass several essential roles such as antioxidation, anticancer properties, antidiabetic effects, anti-allergic responses, immunomodulation, cardiovascular protection, cholesterol reduction, antiviral & antibacterial activities, parasite & fungal inhibition, detoxification and hepatoprotection (Aditya *et al*., 2023a).

Mushrooms contain a wide array of bioactive chemicals that are found in various parts of the mushroom, including the fruit bodies (the visible part of the mushroom), cultured mycelium (the underground network of fungal threads) and cultured broth (the liquid medium in which mushrooms are grown; Aditya *et al*., 2022e; Aditya *et al*., 2023b). Mushrooms contain a diverse range of bioactive compounds, such as polysaccharides, proteins, lipids, minerals, glycosides, alkaloids, volatile oils, terpenoids, tocopherols, phenolics, flavonoids, carotenoids, folates, lectins, enzymes, ascorbic acid and organic acids. Polysaccharides are complex carbohydrates found in mushrooms and are known for their immune-modulating and anti-tumor properties. Proteins play vital roles in various physiological processes and contribute to the nutritional value of mushrooms. Lipids are essential components of cell membranes and are involved in energy storage. Minerals are inorganic substances that are crucial for maintaining proper bodily functions and are found in mushrooms in varying amounts. Glycosides are compounds consisting of a sugar molecule linked to another molecule and they have been associated with various medicinal properties. Alkaloids are organic compounds that often possess pharmacological effects. Volatile oils are aromatic compounds responsible for the distinctive flavors and scents of certain mushroom species. Terpenoids are a large group of compounds with diverse biological activities, including anti-inflammatory and antioxidant properties. Tocopherols are forms of vitamin E and serve as antioxidants. Phenolics and flavonoids are phytochemicals that exhibit antioxidant and anti-inflammatory effects. Carotenoids are pigments responsible for the vibrant colors in some mushrooms and they have antioxidant properties. Folates are important B vitamins involved in various physiological processes, including DNA synthesis and cell division. Lectins are proteins that

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can bind to specific carbohydrates and have been studied for their potential health benefits. Enzymes are catalysts that facilitate biochemical reactions in the body. Ascorbic acid (vitamin C) is an essential nutrient with antioxidant properties. Organic acids, such as citric acid, contribute to the acidic taste of some mushrooms and can have various physiological effects. The presence of these diverse bioactive chemicals in different parts of mushrooms highlights the rich nutritional and medicinal value of mushrooms and their potential contributions to human health. Polysaccharides particularly β-glucan, hold the utmost importance in modern medicine and are recognized as versatile metabolites with a wide range of biological activities.

Mushrooms provide and add a delicious taste to recipes while being low in fat, calories and salt. Besides, excellent food quality mushrooms also possess biopharmaceutical compounds and they have been used for a long time to prevent and treat disorders and diseases. Mushrooms provide the following health advantages:

1. **Reduce cancer risk:** A study conducted earlier discovered that consuming a mere 18 grams of mushrooms daily (approximately equivalent to two medium-sized mushrooms or 1/8 cup) can potentially lower your chances of developing cancer by up to 45 percent. Mushrooms possess a significant amount of ergothioneine, an amino acid and antioxidant that aids in the prevention and reduction of cellular damage. Mushrooms such as shiitake, oyster, maitake and king oyster contain higher levels of ergothioneine. It has also been revealed that regularly including any kind of mushroom in your diet decreases the risk of cancer.
2. **Lower down sodium intake:** There is often a connection between high blood pressure and sodium. Sodium leads to increased fluid retention in the body, resulting in elevated blood pressure. To decrease this salt consumption, mushrooms can be incorporated into meals. Mushrooms have naturally low sodium levels, with just five milligrams in a one-cup serving of white button mushrooms. They possess a savory taste that can help reduce the desire for extra salt to manage blood pressure.
3. **Lower cholesterol:** Mushrooms serve as an excellent alternative to red meat, being low in calories, devoid of fat and cholesterol. Research has demonstrated that Shiitake mushrooms possess properties that aid in maintaining low cholesterol levels. These mushrooms contain various compounds that hinder cholesterol production, impede cholesterol absorption and effectively reduce overall cholesterol levels in the bloodstream.
4. **Protect brain health:** Scientists are currently studying the impact of mushrooms on mild cognitive impairment (MCI), a condition often linked to Alzheimer's disease and characterized by memory and language difficulties. A recent research conducted in Singapore

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revealed that individuals who consumed more than two cups of mushrooms on a weekly basis exhibited a 50 percent reduced likelihood of developing MCI. Interestingly, even those who consumed just one cup of mushrooms experienced positive effects.

5. **Source of vitamin D:** Vitamin D plays a crucial role in enhancing the absorption of calcium, which helps the body uphold and strengthen its bones. While numerous individuals obtain their vitamin D through supplements or sunlight, mushrooms are also a notable source of this vitamin. Certain types of mushrooms can elevate levels of vitamin D when consumed. Among these mushrooms, white button, portabella and cremini varieties produce the highest amounts of vitamin D after being exposed to UV radiation or sunlight. Studies indicate that consuming slightly more than one cup of maitake mushrooms yields a comparable effect to sun exposure.
6. **Promote a healthier gut microbiota:** The presence of organisms and bacteria in our gut microbiome significantly influences both well-being and emotional state. To maintain a healthy gut, it is beneficial to consume prebiotics like mushrooms that stimulate the growth of advantageous bacteria. A recent study suggests that mushroom polysaccharides, the primary type of carbohydrate found in mushrooms, play a crucial role in promoting the growth of beneficial bacteria. Unlike various foods that are broken down by stomach acid, polysaccharides in mushrooms remain intact as they pass through the stomach and reach the colon, creating an environment where bacteria can flourish.
7. **Aid in a healthy immune system:** Mushrooms possess macronutrients that support the immune system. Selenium, a mineral, assists in generating antioxidant enzymes that safeguard cells against harm. Vitamin D enhances cell growth, boosts immune activity and reduces inflammation. Vitamin B_6 plays a role in producing red blood cells, proteins and DNA within our bodies.

The health benefits of mushrooms are extensive. They have been associated with the prevention and treatment of conditions such as Parkinson's disease, Alzheimer's disease, hypertension and an increased risk of stroke. Moreover, mushrooms are utilized for their antitumoral properties, aiding in the reduction of cancer invasion and metastasis. Rich in bioactive chemicals, mushrooms possess antimicrobial, immune-boosting and cholesterol-lowering properties. The beneficial characteristics of certain mushroom extracts have led to their utilization in enhancing human health. These extracts, known for their bioactive compounds and potential health benefits, are now commercially available as nutritional supplements. This availability allows individuals to conveniently incorporate the health-promoting properties of mushrooms into their daily routines. These mushroom extracts, carefully extracted and processed to preserve their bioactive components, offer a convenient and concentrated

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form of the beneficial substances found in mushrooms. By consuming these extracts as nutritional supplements, individuals can potentially harness the health-enhancing properties of mushrooms without the need for consuming large quantities of whole mushrooms in their diets. The commercial availability of mushroom extracts as nutritional supplements provides a practical and accessible means for people to enjoy the potential health benefits associated with these remarkable organisms. Utilizing extract from edible mushrooms appears to offer a more organic and cost-effective method that generally causes minimal undesirable effects on the human body (Aditya *et al*., 2022a; Aditya *et al*., 2023a).

Widespread malnutrition with ever increase in the protein gap in our country has necessitated the search for alternative sources of protein and food. Moreover, mushrooms are one of immunity boosters and nutritive food for human health. Mushrooms are a special group of fungi that offer an incredible array of health benefits that make them a valuable addition to our diets. From their immune-boosting properties to their potential to prevent chronic diseases, mushrooms have proven themselves to be a nutritional powerhouse. Their rich nutrient content, including vitamins, minerals and antioxidants supports overall well-being and contributes to a healthy immune system. Besides these virtues, nutritional, medicinal and therapeutic properties, mushrooms are also regarded as a delight, the strength of barriers and last but not the least elixir of life. Moreover, they are a great source of dietary fiber, which promotes digestion and helps maintain a healthy weight. Whether consumed fresh or cooked, mushrooms provide a delicious and versatile ingredient that can enhance the nutritional value of any meal. Therefore, mushrooms can be considered as future food for upcoming generations.

References

Aditya., Bhatia, J.N., 2020. Economic empowerment of rural women through mushroom farming. Int. J. Curr. Microbiol. Appl. Sci. 9(06), 1081-1089. https://doi.org/10.20546/ijcmas.2020.906.134

Aditya., Jarial, R.S., 2023. Utilization of agro-industrial wastes and organic supplements for cultivation of blue oyster mushroom. Bangladesh J. Bot. 52(01), 179-185. https://doi.org/10.3329/bjb.v52i1.65249

Aditya., Jarial, R.S., Bhatia, J.N., 2023a. Performance of various agroforestry wastes for the cultivation of elm oyster mushroom *Hypsizygus ulmarius* (Agaricomycetes) in India and its biochemical constituents. Int. J. Med. Mushrooms. 25(08), 55-62. https://doi.org/10.1615/IntJMedMushrooms.2023049037

Aditya., Jarial, R.S., Jarial, K., 2023b. Influence of physiological parameters on mycelial growth and cultural characteristics of blue oyster mushroom [*Hypsizygus ulmarius* (Bull.: Fr.) Redhead]. Indian J. Ecol. 50(01), 151-156. https://doi.org/10.55362/IJE/2023/3869

Aditya., Jarial, R.S., Jarial, K., 2022a. Commercial cultivation of the elm oyster mushroom *Hypsizygus ulmarius* (Agricomycetes) on different substrates and its medicinal benefits. Int. J. Med. Mushrooms. 24(12), 87-93. https://doi.org/10.1615/IntJMedMushrooms.2022045380

Aditya., Jarial, R.S., Jarial, K., 2022b. Performance evaluation of substrates for cultivation of blue

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***Published:*25.07.2023**

oyster mushroom. Indian J. Hort. 79(03), 323-329. https://doi.org/10.5958/0974-0112.2022.00044.5

Aditya., Jarial, R.S., Jarial, K., 2022c. Evaluation of different grain substrates for spawn production and yield performance of blue oyster mushroom [*Hypsizygus ulmarius* (Bull.: Fr.) Red Head] through bio-conversion of agri/industrial wastes. Indian J. Ecol. 49(06), 2389-2394. https://doi.org/10.55362/IJE/2022/3838

Aditya., Jarial, R.S., Jarial, K., 2022d. Evaluation of spawn quality and doses on yield and biological efficiency of blue oyster mushroom [*Hypsizygus ulmarius* (Bull.: Fr.) Redhead]. J. Eco-friendly Agri. 17(02), 393-398. https://doi.org/10.5958/2582-2683.2022.00076.4

Aditya., Jarial, R.S., Jarial, K., 2022e. Laboratory screening of different nutrient media for mycelial growth and cultural characteristics of blue oyster mushroom [*Hypsizygus ulmarius* (Bull.: Fr.) Redhead. Indian J. Ecol. 49(03), 826-830. https://doi.org/10.55362/IJE/2022/3602

Tiwari, H., Naresh, R.K., Bhatt, R., Aditya., Kumar, Y., Manisha., Das, D., Kataria, S.K., 2023. Underutilized nutrient rich millets: Challenges and solutions for India's food and nutritional security: A review. Int. J. Pl. Soil Sci. 35(02), 45-56. http://dx.doi.org/10.9734/IJPSS/2023/V35i22758