The Shiitake Mushroom – Lentinula edodes


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Mushrooms have been around for over 715 million years and in recent years the ancient mushroom, *Lentinula edodes*, has gained popularity. *Lentinula edodes* is commonly known as the shiitake mushroom which is the second most cultivated mushroom for commercial and medicinal use around the world. This mushroom is native to the Far East and was consumed in Ancient China and Japan as early as 600 CE, where it was known as "Shiang-gu" or "Hoang-mo" too. The Japanese name "Shiitake" is taken from the Shii tree, one of the many tree species on which this mushroom grows, and "take" refers to mushrooms in Japanese. Since Japan is the world leader in cultivating it, this mushroom is wildly known as shiitake.

The shiitake mushroom has a medium-sized, umbrella-shaped, tan-to-brown cap where the edges of the cap roll inwards. The underside of this mushroom is white. In Eastern Countries like China, Japan, Taiwan and Indonesia, this mushroom can be found growing in the wild in warm and moist climates. Shiitake mushrooms feed as saprotrophs on the deadwood of broad-leaved trees, particularly oak trees. Since this mushroom has gained great popularity around the globe for its distinctive texture and flavour, its cultivation has expanded to areas outside its natural habitat to meet the demand. Commercially, it is cultivated on logs, sawdust blocks or sawdust pellets.

Naturally, these mushrooms have been used in the culinary industry for millennia. They are usually served in miso soup, as the basis of vegetarian dashi or also in steamed or fried dishes. Shiitake mushrooms are sold in their dried form too and in the western world are known as "Black Forest Mushrooms". Some people tend to prefer their dried form over their fresh one due to a superior umami flavour that is brought about by the breaking down of proteins into amino acids and the transformation of ergosterol to vitamin D.

Apart from being used in cuisine, these mushrooms have outstanding nutritional value and health benefits offering great potential in the medicinal and pharmacological industries. The species' phytochemicals are largely responsible for its properties. Phytochemicals are bioactive compounds that are produced by plants and contribute to the plant's health benefits.

Shiitake mushrooms are rich in minerals, vitamins, lipids and protein, containing essential amino acids. Furthermore, since these mushrooms have a glycemic index between 10 and 15, they are considered a low glycemic food. They are also cholesterol and fat-free as well as low in sodium. Being rich in fibre too, 145 g of shiitake mushrooms provides 12% of one's daily fibre intake. Having both soluble and insoluble fibre composed of beta-glucans, hemicelluloses and lignin amongst other compounds aid in adding bulk to faeces, relieving constipation. In addition, shiitake mushrooms are a natural source of manganese, numerous B vitamins, copper, folate and choline which aid in achieving a healthier metabolic system. Moreover, its significant calcium and zinc content offers useful supplementation in elders and growing children.

Lentinula edodes is composed of various bioactive chemicals including but not limited to polysaccharides, terpenoids, sterols and alkaloids which all contribute to its medicinal benefits in preventing cancer, gingivitis and promoting a healthy immune system amongst others. In addition, the alkaloid content in this mushroom has proven to be stimulant to the central nervous system and demonstrated antimicrobial, antihypertensive, antipyretic, antimalarial and sympathomimetic vasodilatory activities. Furthermore, numerous epidemiological studies have depicted the therapeutic effects of this mushroom's polyphenol content in combating cancer, cardiovascular diseases like hypercholesteremia and neurological diseases like Alzheimer's disease.

Over the years, literature has extensively described shiitake's immunomodulatory effect which is related to the increased function of monocytes in the production of Interleukin-1 (IL-1) and the expression of cytokines. This species is also responsible for increasing the mRNA levels of IL-1-alpha, IL-1-beta, tumour necrosis factor-alpha and interferon-delta. This is indicative of its therapeutic effect when combating various diseases. Bioactive compounds in aqueous extracts of *Lentinula edodes* have also depicted direct inhibition of the proliferation of breast cancer cells solidifying the protective effects of shiitake against mutagenesis and carcinogenesis.

In conjunction with the above, in clinical studies, this mushroom species demonstrated antitumour activity and increased the survival time of patients with inoperable gastric cancer and women with recurrent breast cancer following surgical therapy. Likewise, mycelium extract of *Lentinula edodes* was observed to increase the immune response in AIDS patients. In fact, when it was used to treat HIV-positive patients, the T-cell count increased significantly.

Similarly, rats induced with diabetes that were treated with a submerged culture of *Lentinula edodes* mycelium, demonstrated a reduction in plasma glucose levels as well as a reduction of cholesterol and triglycerides proving shiitake's anti-hypercholesteremia and anti-diabetes properties. Similarly, its hepatoprotective activity was demonstrated when injured rats were subjected to an aqueous extract of *Lentinula edodes* as aspartate aminotransferase and alanine aminotransferase levels in the blood were reduced. High levels of these enzymes are indicative of liver problems and thus normalisation of their levels is a consequence of healing.

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Apart from shiitake's numerous medicinal benefits, it is also an antimicrobial agent. In fact, lanthionine which is a cyclic organosulfur compound that is partially responsible for the distinctive mushroom's flavour exhibited inhibitory effects against the bacteria, *Staphylococcus aureus, Bacillus subtilis* and *Escherichia coli*. Similarly, studies have shown how some extracts obtained from this mushroom inhibit the growth of the main oral pathogens that cause cavities and gingivitis.

The shiitake mushroom has proven to have countless health benefits and thus great potential in the medicinal industry. This makes this mushroom very appealing to several consumers to use as self-medication over modern drugs. However, it is important to understand that whilst many botanicals are great natural remedies, establishing a basic understanding of the safety, pharmacological interactions and toxicity of the plant is vital to prevent adverse outcomes.

Whilst shiitake mushrooms are not considered an allergen, some individuals may experience some minor side effects or allergic reactions. Although this is quite rare, this allergic reaction was seen in one case to induce asthma through an IgE-mediated reaction. Symptoms usually include fever, headache, congestion, coughing, sneezing and nausea. Additionally, a water extract of the fruiting body is known to decrease the effectiveness of blood platelets in stimulating coagulation and can thus lead to bleeding. *Lentinula edodes* mycelium has exhibited no evidence of being acutely toxic even when large doses of over 50 mg/day were taken for 1 week, though side effects like diarrhoea and skin rash may occur. Furthermore, whilst no serious side effects have been observed labelling this mushroom as relatively safe, clinical trials with advanced cancer patients, had shown minor adverse reactions to it such as mild pressure on the chest and elevated aspartate aminotransferase. However, these were reversed to normal levels upon withdrawal of shiitake.

In 2015, according to the China Edible Fungi Association, the production of shiitake mushrooms was 7.67 million tons accounting for 20% of the total edible mushroom production in China. As people are setting their sights on healthier foods that offer maximal health benefits, especially since the COVID-19 outbreak, it is no surprise that the consumption and demand for shiitake mushrooms have increased due to their nutritional and therapeutic values. Whilst 45% of this mushroom is sold fresh, the rest is sold dried and is commercially available in many forms from sugar-coated tablets to syrups to teas.

With the emerging application of shiitake mushrooms in the cosmetic industry, it is predicted that the shiitake mushroom market is to strive and grow even more. Interestingly, in 2021, the fresh segment dominated the market with a market share of around 43% and revenue of 0.9 billion. This may be due to the increased interest in consuming fresh and unprocessed shiitake mushrooms to get the most out of this superfood. In fact, according to the report published by The Brainy Insights, the global shiitake mushroom market is expected to grow from $2.3 billion in 2021 to $4.7 billion by 2030, at a compound annual growth rate of 8.3% between 2022 and 2030. Thus, as demand continues to surge, further medical research on this species is urged to unlock the full potential of the shiitake mushroom, *Lentinula edodes*.

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