

# Edible and Medicinal Mushrooms: that mitigate the threatening diseases

## Abstract

**Background:** From ancient times mushrooms have been estimated by mankind as a safe surprise and kin medicine in Asian and Chinese system. The last century has been verified the activities of Asian work in affiliation of pharmaceutical potential of mushrooms. The major medicinal benefits of mushrooms has been exposed so far as an, neuroprotective, anti-diabetic, anti-tumor, anti-cancer, immunomodulatory, and anti-microbial agents. The mushrooms that have been trusted with reward are pleurotus, agaricus, Hericium erinaceus, Stropharia rugosoannulata, cytotybe, antrodia, Termitomyces, Xerocomus, Sarcodon, Daldinia, Flammulina, Innonotus, Tremella and Funlia etc.,. Pharmaceutical properties of mushrooms mainly includes the homeostasis maintenance, biorhythms regulation and help in the treatment of various life threatening diseases such as neuronal diseases and cancer etc. Polysaccharides contents in mushrooms work as immunomodulating agents. Edible and medicinal mushrooms exhibit various bioactive compounds that includes infratopicrin, MD fraction, 10-hydroxy-infratopicrin, hispidin, dictyophorines, tricholomalides, termitomycespin that enhance nerve growth in the brain and protect against neurotoxic stimuli such as inflammation that contribute to neurodegenerative diseases like dementia and Alzheimer's disease and many other non-communicable diseases and these bioactive compounds are not commonly found in plants. TAU are the neuronal-specific microtubule binding protein and mutation in these protein cause severe neurodegenerative diseases such as Alzheimer's and dementia etc. TAU accumulated in large quantity in mushroom body neurons that result in the prevention of pre-mature death and neuro degeneration. Total estimated medical cost for the treatment of dementia was 604 dollar billion in 2013 but mushroom works as a functional food and have neuroprotective and anti-inflammatory potential. Mushrooms extract have the potential to improve and enhance the brain function and improve human health. Mushrooms are considered as healthy food as they are low in calories and fat but rich in proteins and dietary fibers. Mushrooms contain all nine essential amino acids. This article revise the current findings on the pharmacologically effective compounds of the mushrooms, their neuroprotective potential, anti-tumor potential and various therapeutic potential of mushrooms. The growing demonstration from a variety of investigate groups all over world related to protective and beneficial utilization of mushroom extracts have increased the importance of studies related to mushroom extracts and their aspects.

**Keywords:** Mushrooms; Pharmaceutical; Bioactive compounds ;TAU ; Polysaccharides; Healthy food

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## Introduction

Mushrooms are charming creatures. They are nor plants but have been produced intelligent survival strategies which protect their coexistence to this day in a wide variety of types and about to all over our planet. With their beneficial components medicinal mushrooms have been appropriate to a variety of indications (Williams, 2014). They can be used to deal with common modern complaints such as neurodegeneration, high blood pressure, metabolic disorders and allergies as well as in the prohibition and complementary treatment of cancers. Mushrooms contain vitamin b12 that help to maintain proper

functioning of brain and nerves tissue. (Shoemark, 2015). They balance the immune system, prevent premature aging processes and have a counterbalance effect on the Psyche-and all without undesired harmful side reactions (Harrison-Dunn, 2014). Mushrooms have been rich in B-glucans which have a major group of bioactive polysaccharides that have powerful immunomodulating properties which originate in the cell wall of mushrooms and fungi (Watkinson, Boddy, Money 2015). Mushrooms are natural antioxidant due to their phenolics have ability to inhibit lipid oxidation. (Fu, 2015). Mushrooms have the large variety of bioactive compounds including infratopicrin, 10-hydroxy-infratopicrin, hispidin, dictyophorines,

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tricholomalides, termitomycesphin, strophasterol, leccinine, termitomycamides, 3,4-dihydroxybenzylacetone, caffeic acid, ethanol, caruilignan, neuroprotective diterpenes and adenosine. Eritadenine well known hypocholesterolemic agent in shiitake mushrooms (Anno, 2015 ). Nucleic acid extract help in platelet agglutination from Lentinula edodes. Dietary fibers extracts from Pleurotus cornucopiae , Tremella fuciformis, jews ear reduce LDL cholesterol, atherogenic activity. Grifola frondosa reduce pressure without reduce cholesterol level (Tonelli, 2015). Mushrooms possess anticoagulation, antiaggregatory activity thus reduce total cholesterol ,total triglyceride, and lipid levels. Dehydrotrametenolic acid found in several polypores including Wolfiporia cocos, Laricifomes officinalis act as insulin sensitizer in glucose tolerance tests and reduces hyperglycemia in mice with non insulin dependant diabetes (Tan 2010). Tau is the major microtubule associated protein (MAP) of a mature neuron. The other two neuronal MAPs are MAP1 and MAP2. An established function of MAPs is their interaction with tubulin and promotion of its assembly into microtubules and stabilization of the microtubule network. The microtubule assembly promoting activity of tau, a phosphoprotein, is regulated by its degree of phosphorylation. Normal adult human brain tau contains 2–3 moles phosphate/mole of tau protein. (Watkinson, Boddy, Money 2015). Hyperphosphorylation of tau depresses this biological activity of tau. In Alzheimer disease (AD) brain tau is three to four-fold more hyperphosphorylated than the normal adult brain tau and in this hyperphosphorylated state it is polymerized into paired helical filaments (PHF) admixed with straight filaments (SF) forming neurofibrillary tangles. TAU accumulated in large quantity in mushroom body neurons that result in the prevention of pre-mature death and neuro degeneration(Tonelli, 2015). Mushrooms extracts activate effector cells like macrophages, lymphocytes to secrete cytokines like TNF- $\alpha$  which are antiproliferative and induce apoptosis and differentiation in tumor cells. Lentinan from Lentinula edodes, schizophyllan and MD fraction are in clinical use for immunotherapy in addition to major cancer therapies ( Vikineswary, 2011). Mycelial extract from Keuhneromyces mutabilis , phenolic compounds from Inonotus hispidus and ergosterol shows antiviral activity against influenza virus type A and B (Dong, 2014) .Antiviral activity of Collybia maculata is due to phenolic compound. Ganosporeric acid A and Ganoderic acid R and S from Ganoderma lucidum shows invitro antihepatotoxic activity in the galactosamine induced cytotoxic activity. (Klein,2013) Phenol analogous compound from Hericium erinaceus have an ameliorative effect in Alzheimers dementia. Several mushrooms including Ganoderma applanatum have inhibitory effect on neutral endopeptidase for treatment of pain (More, 2014). Mushrooms represent one of the greatest available food that are not used and palatable food of the future. Mushrooms as functional food available as nutrient supplement to enhance immunity in the form of tablets (Malani, 2010). Their polysaccharide content is used as anticancer drug. Protein content depends on composition of the substratum, size of the pileus, harvest time and species of mushrooms. Fruiting body of mushrooms contain high level of mineral elements (Hinton, ,2010).Major mineral constituents in mushrooms are K, P , Na, Ca, Mg. Aqueous extracts from Pleurotus sajor caju used for

treatment of renal failure .First successful research against antitumor from the hot water extract of mushrooms (Choi, 2015). Shiitake mushroom are reduced in nutrition but have a good source of protein (Zhu, 2012) . Mushrooms also include some unsaturated fatty acids which have been produced vitamin B and Vitamin D. Some also include important vitamin as well as the minerals , Potassium , phosphorous , calcium and magnesium (Weng, 2010).

For medicinal reason, mushrooms have also been utilize to avoid cancer and heart diseases to recover blood flow and to decrease cholesterol (Patte Mensah, 2010). Some mushrooms have also been used for the dealing of physical and exciting tension, osteoporosis, and chronic hepatitis for the development of superiority of live of patients with diabetes and particularly for the invigoration of immunity (Kiryushko, 2013). Now a days there are 270 species of mushrooms have been known to have many therapeutic properties. Medicinal mushrooms have been used as common medicinal ingredients for the treatment of many diseases and relevant health problems chiefly due to their increased commercial production (Nevzglyadova , 2015)

List of medicinal and edible mushrooms used for the mitigation of neurodegenerative, cancerous and other disorders:



**Figure 1** Termitomyces titanica



**Figure 2** Leccinum extremiorientale



**Figure 3** Sarcodon cyrneus



Figure 4 Phellinus linteus



Figure 5 Tremella fuciformis



Figure 6 Stropharia rugosoannulata



Figure 7 Dictyophora indusiata



Figure 8 Tricholoma sp.

### Hericium erinaceus

*H. erinaceus* is commonly used in Chinese cuisine recipes. The extract of *H. erinaceus* was reported to exert neurotrophic action and improve myelination process in the rat brain without affecting nerve cell growth and toxicity.<sup>29</sup> A polysaccharide with a molar ratio of glucose (1.5): galactose (1.7): xylose (1.2): mannose (0.6): fructose (0.9) was isolated from the mycelium of *H. erinaceus* and it was reported to enhance neurite outgrowth in PC12 cells. *H. erinaceus* was found to promote neurite outgrowth of rat pheochromocytoma (PC12) cells, enhance NGF (neurite growth factor) mRNA expression, and increase NGF secretion from 1321N1 human astrocytoma cells (Kiryushko, 2013). They are natural antioxidant due to their phenolics have ability to inhibit lipid oxidation

### Termitomyces titanicus

It is known as jizong (Chinese). It belongs to the order Agaricales. It has a long edible stem. Its origin is from nest of termites. It enhances neurite outgrowth and gives neuroprotection. Shi et al (2012). These are ideal food for dietetic prevention of cardiovascular diseases. Eritadenine, a well-known hypocholesterolemic agent, is found in it.

### Leccinum extremiorientale

It is known as Far-eastern Scaber stalk. Its cap is red to brown in color and areolate. It gives neuroprotection. Choi et al. (2011). Nucleic acid extract helps in platelet agglutination from *Leccinum extremiorientale*. 80% reduction in serum cholesterol by eating whole mushroom and 30% ethanol extracts of this mushroom.

### Sarcodon cyrneus

It is known as bitter tooth. It belongs to the group Thelephorales. It has a bitter taste "cyrneus" due to its Mediterranean habitat. It enhances the outgrowth activity of neurons. (Marcotullio et al. (2007). It possesses anticoagulation, antiaggregatory activity thus reduces total cholesterol, total triglyceride, and lipid levels.

### Phellinus linteus

Chinese called it Songgen while Korean called it Swang Hwang. Its cap color ranges from brown to yellow in color and it grows on trees of mulberry. It enhances the activity of neurite outgrowth and causes the inhibition of BACE1 (beta-site amyloid precursor protein cleaving enzyme 1). Dai et al (2010). Polysaccharides and lectins of *Phellinus linteus* show hypoglycemic effect. Most common animal model is rat to study hypoglycemic effect of mushrooms. (Allodi, 2014) In rats, insulin-dependent diabetes mellitus induced by streptozotocin to study the effect of at 20% DW for 100 days.

### Tremella fuciformis

It is known as white jelly fungus, snow mushroom, and silver ear mushroom. Its shape is of frond-like and white in color. Its fruiting body is gelatinous. It enhances the activity of neurite outgrowth. Park et al. (2012). It has been traditionally used in China for the treatment of cancer. Calvacin isolated from giant puff ball was very effective against many experimental tumors like sarcoma 180, leukemia I-1210 etc. Approximately 650 species of higher basidiomycetes possess antitumor activity. (Darras, 2014).



**Figure 9** Daldinia concentrica



**Figure 14** Grifola frondosa



**Figure 10** Cortinarius infractus



**Figure 15** Cordyceps Sinensis



**Figure 11** Lignosus rhinoceros



**Figure 16** Auricularia Polytricha(Black Chinese fungus,Wood fungus)



**Figure 12** Mycoleptodonoides



**Figure 17** Agaricus blazei Murrill (almond mushroom)



**Figure 13** Antrodia camporata



**Figure 18** Button mushroom (Agaricus bisporus)



**Figure 19** *Coprinus commatus*



**Figure 20** *Coriolus versicolor*

#### ***Stropharia rugosoannulata***

It is known as burgundy cap and wine cap. Its fruiting body is of bell shape and color range from brown, red to tan. It also give neuroprotection. (Wu et al. (2012). They are immune potentiators and immune stimulants. Mushrooms extracts activate effector cells like macrophages, lymphocytes to secrete cytokines like TNF- $\alpha$  which are antiproliferative and induce apoptosis and differentiation in tumor cells. (Keogh, 2014)

#### ***Dictyophora indusiata***

It is known as queen of the mushrooms.also known as bamboo mushroom and *Phallus indusiata*. Its cap is of bell shape and also conical like. That covered by brown to greenish spore. It enhance the neurite outgrowth. MD fraction from this mushroom has been approved by the food and drug administration for drugs application for treatment of breast and prostate cancer. (Goyal, 2014)

#### ***Tricholoma* sp.**

It is matsutake mushroom belong to agaricales order. Its stem is fleshy and gilled cap. It is also mycorrhizal. It inhibit the activity of AChE, and enhance the neurite outgrowth. Tel et al.(2011) Applanoxidic acid isolated from *Tricholoma* show antifungal effect. Extracts from it inhibited growth of microorganisms for skin diseases. Ethanolic mycelial extracts from it possess antiprotozoal activity against *paramecium caudatum*.

#### ***Daldinia concentrica***

It is known as king Alfred,s cake, coal fungus matsutake and cramp balls. Its fruiting body is of ball in shape and coal black n color. It gives neuroprotection. Quang et al. (2002)

#### ***Cortinarius infractus***

It is also known as bitter web cap. Its cap is gray to brown in color

and have bitter and sour taste. it inhibit the AChE activity. Brondz et al (2007). Ganodermediol., Applanoxidic acid from it posses invitro antiviral activity against influenza virus type A, herpes simplex virus type 1. (Udina, 2012)

#### ***Lignosus rhinoceros***

It is known as tiger milk mushroom. It possess underground sclerotium and solitary fruiting body. It enhance neurite outgrowth.Eik at al. (2012)

#### ***Mycoleptodonoides***

It is known as breech oyster mushroom. It is edible mushroom and mostly found in Kashmir region. Its cap color is yellow to white, and have smooth surface and little stem. It has savoury taste. It enhance neurite outgrowth and give neuroprotection. Okuyama et al. (2004)

#### ***Antrodia camporata***

It belong to the class agaricomycetes and order polyporales. Only under the cavity of endemic tree species, it exhibit the growth. It is a Taiwan mushroom. It cause the inhibition of beta amyloid and gives neuroprotection. (Leeds, 2016). Eating of it led to regression of severe allergic symptoms in a patient with urticarial.

#### ***Grifola frondosa***

They are known as dancing mushrooms and hen of the woods. Highly regarded in Japan. Prized as edible in Europe, North America Heavily promoted in Asia as dietary supplement. It is of spoon shaped and manifold curled. It enhance the neurite outgrowth. (Allen, Watson 2013).Supportive treatment for Hypertension, hepatitis, Cancer especially bladder cancer, Blood sugar imbalance.

#### ***Cordyceps Sinensis***

Summer plant, winter worm. Formely only available to chinese royalty; now cultivated. Thought to promote stamina, sexual vitality. Fruiting body is of club shape. It enhance neurite outgrowth. The caterpillar mushroom have also been used for centuries as a drug.it has been increased in performance and tolerance.(Berezin V,2015). Sustain the immune system. Remove sexual function disorder. Lighten the people modes. Promotion of heart and lung function. Muscle modification.

#### ***Auricularia Polytricha*(Black Chinese fungus,Wood fungus)**

Jew,s mushroom is one of the most important edible mushroom. Reports indicated that it was earlier cultivated around 150 years ago in china. Therefore the use of *Auricularia* to develop human health have been a centuries old tradition(Levin,2014). Advancement of blood flow, for arteriosclerosis. Promote the blood pressure. Reduce blood clotting. Boosting the own body defense. *Auricularia* can promote the flow properties of blood without attacking the blood walls. (Lopez,2014)

#### ***Agaricus blazei* Murrill (almond mushroom)**

The positive response of ABM on human health were first discovered in Brazil about 40 years ago. Its demand rapidly increased from cancer point of view and ABM have many medicinal properties. it does not grow on wood but it have

been required a fermented culture medium. Prevent integrative therapy for cancers. Promote healing for skin health. Regulate blood pressure. Promote the immune system. Regulate the gut function. Promote inflammation. (Krieger DW 2013)

#### Button mushroom (*Agaricus bisporus*)

It is an edible mushroom. It has been cultivated from 17 years ago. *Agaricus* mushroom is very important for the improvement of human health. The number of studies have been shown that button mushroom is very important for human organism in terms of medicinal properties. Interdependent for therapy cancer. Reduce tumor disorder. Supporting the liver health. Inhibit excessive scarring. It follows the glaucoma surgery on the eyes. (Roupas, 2014)

#### *Coprinus commatus*

Shaggy ink cap is most important medicinal mushroom. It has been grown in forests and meadows. The protein-rich mushroom which also includes many important amino acids and large number of minerals and trace elements. It can regulate the blood sugar level for diabetes. Promote the blood flow. It can also regulate the process of digestion. It has equivalent therapy for cancer sarcomas. Prevention of blood cancer cells. Tel et al. (2011)

#### *Coriolus versicolor*

It has been widely used in South American countries for medicinal purpose. *Coriolus* is highly active for viral and bacterial infections and used as correlative therapy for cancer. It inhibits and correlates the treatment of tumor disorder. Regulates the durability of chemotherapy and radiotherapy. Supports the immune system specifically against the viral infections. Promotes liver functions. (Filli, 2012)

## Conclusion

Nowadays edible and medicinal mushrooms have gained special importance because a large number of bioactive compounds are present in mushrooms and they are widely used in the treatment of various non-communicable and life-threatening diseases and reduce the cost of expensive treatments. Edible mushrooms act as a functional food, and they proved very beneficial for health as they are high in protein content and low in fat content. Mushrooms are not in our common use because of less awareness present in our peoples regarding the mushrooms and their useful aspects, so there is a need to increase awareness in peoples relating to mushrooms and we should further improve our knowledge and increase the research in this field.

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