

Edible and Medicinal Mushrooms: that Mitigate the Threatening Diseases

Saber Hussaina^{1*}, Aisha Umara¹, Abdul Mananb², Sumaira Mustafa³, Muhammad Sajida¹, Shanila Bukharid⁴,

¹Institute of Botany, University of the Punjab, Lahore-54590, Pakistan

²Institute of Chemical Engineering and technology, University of the Punjab

³Lahore college for women University Lahore

⁴ Kinnaird College for Women Lahore

***Corresponding author:** Saber Hussaina, ¹Institute of Botany, University of the Punjab, Lahore-54590, Pakistan, Tel: 3438465560; Email: saberbotanist@gmail.com

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Abstract

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, cytozyme, antrodia, Termitomyces, Xerocomus, Sarcodon, Daldinia, Flammulina, Inonotus, 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, termitomycesphin 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 aminoacids. 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 properties of mushroom; bioactive compounds; TAU; Polysaccharides contents of mushrooms; healthy food

Introduction

Mushrooms are charming creatures. They are not 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). 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). 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). 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). Mushrooms are natural antioxidant due to their phenolics have ability to inhibit lipid oxidation. (Fu). Mushrooms have the large variety of bioactive compounds including infratopicrin, 10-hydroxy-infratopicrin, hispidin, dictyophorines, tricholomalides, termitomycesphin, strophasterol, leccinine, termitomycamides, 3,4-dihydroxybenzylacetone, caffeic acid, ethanol, caruillignan, neuroprotective diterpenes and adenosine. Eritadenine well known hypocholesterolemic agent in shiitake mushrooms (Anno).

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). 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). 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). 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 neurodegeneration (Tonelli, 2015). Mushrooms extracts activate effector cells like macrophages, lymphocytes to secrete cytokines like TNF- α 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). 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) Phenol analogus 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). 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). 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). Shittake mushroom are reduced in nutrition but have a good source of protein (Zhu). 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)[1-3].

For medicinal reason, mushrooms have also been utilize to avoid cancer and heart diseases to recover blood flow and to decrease cholesterol (Patte Mensah). 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). 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)[4-6].

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

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. 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). They are natural antioxidant due to their phenolics have ability to inhibit lipid oxidation

Termitomyces titanicus

It is known as jizong (Chinese). It belong to the order agaricales. It have long edible stem. Its origin is from nest of termites. It enhance the neurite outgrowth and gives neuroprotection. Shi et al (2012). These are ideal food for dietetic prevention of cardiovascular diseases. Eritadenine well known hypocholesterolemic agent in it.



(Adopted from Shi et al. 2012)

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 help 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 telephorales. 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.



Stropharia rugosoannulata

It is known as burgundy cap and wine cap. Its fruiting body is of bell shape and color ranges from brown, red to tan. It also gives neuroprotection. (Wu). They are immune potentiators and immune stimulants. Mushroom extracts activate effector cells like macrophages, lymphocytes to secrete cytokines like TNF- α which are antiproliferative and induce apoptosis and differentiation in tumor cells. (Keogh) [7-11].



Phellinus linteus

Chinese call it Songgen while Korean call 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. Polysaccharides and lectins of Phellinus linteus show hypoglycemic effect. Most common animal model is rat to study hypoglycemic effect of mushrooms. (Allodi) In Rats Insulin dependent diabetes mellitus induced by streptozotocin to study the effect of 20% DW for 100 days.



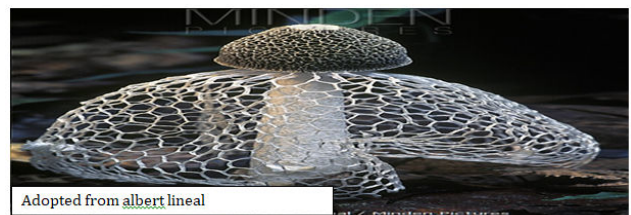
Dictyophora indusiata

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 is covered by brown to greenish spore. It enhances the neurite outgrowth. MD fraction from this mushroom has been approved by the food and drug administration for drug application for treatment of breast and prostate cancer. (Goyal)



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. 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) [12-14].



Tricholoma sp.

It is matsutake mushroom belonging to agaricales order. Its stem is fleshy and gilled cap. It is also mycorrhizal. It inhibits the activity of AChE, and enhances the neurite outgrowth. Tel. Applanoxidic acid isolated from Tricholoma shows antifungal effect. Extracts from it inhibited growth of microorganisms for skin diseases. Ethanolic mycelial extracts from it possess antiprotozoal activity against paramecium caudatum.



Adopted from Nikola (2014)

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.



Adopted from Nikola (2014)

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. Bronz. Ganodermediol., Applanoxidic acid from it posses invitro antiviral activity against influenza virus type A, herpes simplex virus type 1. (Udina)



Adopted from Bu W, 2014

Lignosus rhinoceros

It is known as tiger milk mushroom. It possess underground sclerotium and solitary fruiting body. It enhance neurite outgrowth.Eik.



Adopted fom Nikola 2014

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)



Adopted from Nikola, 2014

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). Eating of it led to regression of severe allergic symptoms in a patient with urticarial.



Adopted from Nikola, (2014)

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).Supportive treatment for Hypertension, hepatitis ,Cancer especially bladder cancer, Blood sugar imbalance.



Adopted from Nikola, 2014

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 centuriese as a drug.it has been increased in performance and tolerance.(Berezin V). Sustain the immune system. Remove sexual function disorder. Lighten the people modes. Promotion of heart and lung function. Muscle modification.



Adopted from Park YE, 2014

Auricularia Polytricha(Black Chinese fungus,Wood fungus)

Jews 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). 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,)



Adopted from Park, 2014

Agaricus blazei Murrill (almond mushroom)

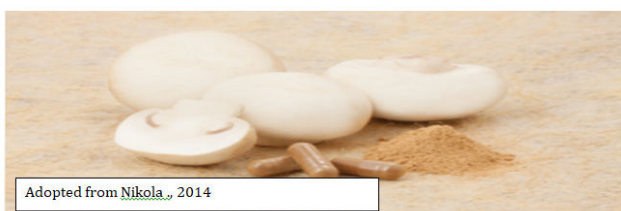
The positive response of ABM on human health were first discovered in Brazil about 40 years ago. Its demand rapidly increased from cancer point of view and ABM have many medicinal properties. it does not grow on wood but it have been required a fermented culture medium. Prevent integrative therapy for cancers. Promote healing for skin health. Regulate blood pressure. Promote the immune system. Regulate the gut function. Promote inflammation. (Krieger DW)



Adopted from Nikola, 2014

Button mushroom (Agaricus bisporous)

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 follow the glaucoma surgery on the eyes.(Roupas) [15,16].



Adopted from Nikola, 2014

Coprinus commatus

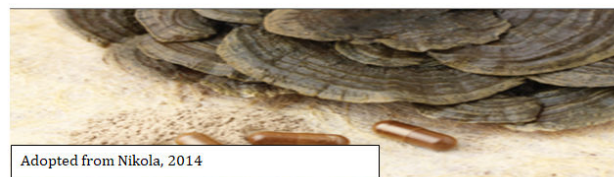
Shaggy ink cap is most important medicinal mushroom. It has been grown in forests and meadows. The protein-rich mushroom whicj also include many important amino acids and large number of minerals and trace elements. It can regulate the blood sugar level for diabetes. Promote the blood flow. It can also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



Adopted from Bu W, 2014

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 inhibit and correlate the treatment of tumor disorder. Regulate the durability of chemotherapy and radiotherapy. Support the immune system specifically against the viral infections. Promote liver functions.(Filli,)



Adopted from Nikola, 2014

Conclusion

Now a days 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 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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