

Mushrooms of Immortality: Anti cancerous use of mushrooms in Chinese medicine- A Review

Gosavi Mahavir C

Dept. of Botany, SIES College of Arts, Science & Commerce, Sion (W), Mumbai, 400022.

Email: mahavirgosavi04@rediffmail.com

Manuscript details:	ABSTRACT
<p>Available online on http://www.ijlsci.in</p> <p>ISSN: 2320-964X (Online) ISSN: 2320-7817 (Print)</p> <p>Editor: Dr. Arvind Chavhan</p> <p>Cite this article as: Gosavi Mahavir C (2015) Mushrooms of Immortality: Anti cancerous use of mushrooms in Chinese medicine: A Review, <i>Int. J. of Life Sciences</i>, Special Issue, A5: 1-6.</p> <p>Copyright: © Author, This is an open access article under the terms of the Creative Commons Attribution-Non- Commercial - No Derives License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non- commercial and no modifications or adaptations are made.</p>	<p>Traditional Chinese Medicine has used mushrooms for thousands of years. There are over 200 species of mushrooms in China that are used to practice healing. The last decade has witnessed the overwhelming interest of western research fraternity in pharmaceutical potential of mushrooms. Medicinal mushrooms and mushroom extracts are used worldwide to fight cancer and enhance and modulate immune response. The Chinese were among the first people to appreciate the value of the mushroom. About 100 species are being studied for their health-promoting benefits. More than 50 mushroom species have yielded potential immunocuticals that exhibit anticancer activity in vitro or in animal models and of these, six have been investigated in human cancers which are rich in polysaccharides and beta glucans, the primary active immune-enhancing constituents. Research, including 4 Nobel Prizes, shows that glycoproteins can help cellular communications.</p> <p>Key Words: Mushroom, Anticancer, Immunocuticals, Chinese, Glycoproteins.</p> <p>INTRODUCTION</p> <p>Mushrooms have been used in traditional chinese medicines for many centuries over past two millenia. They have been used in both nutritional and herbal medicine applications. (Aung, 2005). The chinese have included many mushroom species in their cooking and also healing purposes. Mushrooms have long been regarded as a great delicacy and are often included in the main daily meal (Hobbs, 1995). Mushrooms have been utilized in folk medicine since ancient time (Wasson and Wasson, 1957; Wasson, 1968; Hobbs, 1995). Mushrooms are gaining popularity as a beneficial super food worldwide. Not only are mushrooms a healthy addition to the diet, they also have important medicinal properties (Lee <i>et al.</i>, 2003).</p>

Traditional Chinese Medicine has used mushrooms for thousands of years. There are over 200 species of mushrooms in China that are used to practice healing. An amazing 25 percent of these mushrooms are credited with tumor-fighting capabilities (Wasser and Weis, 1999). All varieties of mushrooms possess cleansing capabilities. Another amazing property of mushrooms is a compound named Polysaccharides. This enables mushrooms to boost the immune system and fight the growth of tumors. Medicinal mushrooms also contain other compounds that further enhance tumor-fighting capabilities (Kidd, 2000). Long-chain polysaccharides, particularly alpha- and beta-glucan molecules, are primarily responsible for the mushrooms beneficial effect on immune system (Sakagami and Aoki, 1991; Wasser, 2002). Other compounds in mushrooms such as fungal proteins, lectins, peptides and laccases have also been reported to have significant effects on immune function. A protein-bound polysaccharide extract from turkey tail mushrooms is also being used to boost cancer patients' immune function. An extract from maitake mushrooms has also been shown to stimulate the immune system in breast cancer patients (Lull *et al.*, 2005 and Lindequist *et al.*, 2005).

Mushrooms in Cancer Treatment:

From long time mushrooms have been valued by humankind as a culinary wonder and folk medicine in Oriental practice (Patel and Goyal, 2012; Sharma *et al.*, 2013). Here are six of the most well-researched anti-cancer mushrooms rich in polysaccharides and beta glucans, the primary active immune-enhancing constituents.

1. *Reishi (Ganoderma lucidum (W.Curt:Fr.) P.Karst):*

Commonly called the **Ling-Zhi** in China and **Reishi** in Japan. This species is one of the bracket fungi, but unlike most species, typically has a long slender stalk that attaches to the side of the "cap" of the fruiting body. This is one of the great

longevity tonics of Chinese Medicine used in cancer treatment (Sanodiya *et al.*, 2009). Reishi enhances immune response, alleviates chemotherapy side effects such as nausea and kidney damage. A number of anti-cancer constituents have been isolated from *G. lucidum*. These compounds have demonstrated antitumor and immunostimulating activities. Various studies showed that Reishi, restricted blood vessels to prostate cancer tumours and stopped cancer cell proliferation (Gao *et al.*, 2002). Anticancer effect of *Ganoderma lucidum* has been studied alone or in combination with chemotherapeutic drugs as well as radio therapy effectively (Sharma *et al.*, 2013). Ganoderic acids A and C from *G. lucidum* are inhibitors of farnesyl protein transferase, an enzyme that participates in Ras-dependent cell transformation. Inhibitors of this enzyme represent a potential therapeutic strategy for the treatment of cancer (Lee *et al.*, 1998). The proliferation, maturation and activities of both T and B lymphocytes, NK cells and dendritic cells improved significantly during both lab and animal tests when taking Reishi. Beta-glucan is the most constituent for immune support (Zhou *et al.*, 2011).

2. *Turkey tail mushroom (Coriolus versicolor (L.er.Fr)):*

Coriolus versicolor is one of the most clinically studied botanical in the world with over 400 studies. It is a biological response modifier. Turkey Tail has been used in Chinese Medicine as a tonic for centuries. Studies show that it improves survival rates and acts as an immune modulator with immune stimulating and anti-tumor properties. Some studies show that it can enhance the effects of chemotherapy cancer treatment and reduce the side effects of radiation therapy (Monro, 2003). Reports showed that gastric cancer, lymphoma, leukaemia and lung cancer cell lines being suppressed by extracts of *Coriolus*. *Coriolus versicolor* also increases Natural Killer cells, and CD8+ T-cells (a type of white blood cell) that can kill cancer cells (Eliza *et al.*, 2012). *Coriolus Versicolor* has been shown to

activate T-lymphocyte production, macrophage activity and other immune system functions. The *Coriolus* extract, PSP, has been shown to have immune boosting and modulating effects and anticancer properties in both pre-clinical experiments and clinical trials (Torkelson and Sweet, 2012). The protein bound polysaccharide that was isolated from the mushroom is called Polysaccharide-K (Krestin, PSK). Their research found that PSK is effective as an immune system boosting agent (Kidd, 2000). In the 1980s, Chinese researchers improved upon the Japanese finding a decade earlier and introduced a more potent extract called Polysaccharide-Peptide or PSP. Both PSK and PSP have been successfully used in Japan, China, Hong Kong, and some European countries for medical treatments of various types (Tomochika *et al.*, 1989).

3. Caterpillar mushroom (*Cordyceps sinensis* (Berk.) Sacc):

In the wild, this mushroom is parasitic on caterpillar with an elongated, cylindrical fruiting body with the mycelium invading and completely covering the caterpillar. This caterpillar fungus or “mushroom” has been used in Chinese medicine for centuries. Because of the scarcity of this mushroom in the wild, the mycelia of this mushroom is now cultivated on solid substrate such as brown rice or in liquid medium for use as a dietary supplements (Holliday and Cleaver, 2008). *Cordyceps* acts an immune stimulator by raising cancer- and virus-fighting T Cells and

Natural Killer Cells and prolongs the life of white blood cells, improving resolution of infections. It has demonstrated anti-tumor properties and also protects the kidneys from chemotherapy side effects. It is one of the most widely used tonics in anti-cancer formulas in Chinese Medicine (Khan *et al.*, 2010). Some studies have shown that CS prevents metastasis by inhibiting angiogenesis; the process by which tumor cells make new blood vessels, allowing tumors to grow in size, allowing cancer cells to enter the blood stream and travel to other parts of the body (Li *et al.*, 2009).

4. Brazilian mushroom (*Agaricus blazei* Murill):

Brazilian mushroom is an edible mushroom native to Brazil and is cultivated widely. A cold-water extract of this mushroom is consumed traditionally in Brazil. Delmanto *et al* (2001) studied immunomodulatory, anti-carcinogenic and anti-mutagenic effects of *Agaricus blazei* Murrill extracts on clastogenicity induced by cyclo-phosphamide (CP) in mice. KA₂₁ is the polysaccharide fraction of this mushroom with immune-modulating activity containing a β -glucan content of about 12%. Several studies have shown that beta glucans from these mushrooms can alter cytokine and T- and B-cell activity (Liu *et al.*, 2008). This prompted the view that the mushrooms would not just be applicable to fighting solid tumour cancers, but also in fighting blood cancers where the white cells themselves were in trouble like leukaemia.



Fig. 1: Reishi (*Ganoderma lucidum*)



Fig. 2: Turkey tail mushroom (*Coriolus versicolor*)



Fig.3: Caterpillar mushroom (*Cordyceps sinensis*)



**Fig. 4: Brazilian mushroom
(*Agaricus blazei*)**



**Fig. 5: Shiitake mushroom
(*Lentinus edodes*)**



**Fig. 6 Maitake mushroom
(*Grifola frondosa*)**

Research showed that *Agaricus blazei* has anti-angiogenic (inhibits the formation of new blood-vessels to the tumour) properties. It inhibits the enzyme aromatase, which is associated with the development of breast cancer. Liver protective and detoxifying properties of *Agaricus blazei* extracts have a detoxifying, blood purifying effect that can help rid the body of dangerous toxins and restore a healthful balance (Fujimiya *et al.*, 1998). In addition, other health benefits including normalized liver function and decreased blood cholesterol levels, were also observed. Mushroom extract also was beneficial in reducing the chemotherapeutic side effects such as nausea, hair loss, loss of appetite, insomnia and other symptoms (Ahn *et al.*, 2004).

5. Shiitake mushroom (*Lentinus edodes* (*Berk*) Sing):

Lentinula edodes is an antiproliferative mushroom widely known as Shiitake mushroom an edible fungus native to Asia, and cultivated for food in many countries. The fresh and dried forms of the mushroom are commonly used in East Asian cooking. Extracts from the mushroom, and sometimes the whole dried mushroom, are used in herbal remedies. Shiitake mushroom is used for boosting the immune system, lowering blood cholesterol levels, treating prostate cancer, and as an anti-aging. One shiitake extract called lentinan is a beta glucan. This is a type of complex sugar compound. Beta glucan is believed to stimulate the immune system and trigger certain cells and proteins in the body to attack cancer

cells. In laboratory studies, it seems to slow the growth of some cancer cells (Ritz, 2011). Lentinan, a compound found in Shiitake, is used as an intravenous anti-cancer drug with antitumor properties (Yang *et al.*, 2008). Both α and β -glucans derived from shiitake are used as adjuvants in various clinical studies. Clinical studies have associated lentinan with a higher survival rate, higher quality of life and lower recurrence of cancer (Shah *et al.*, 2011). From a clinical standpoint, AHCC has generally been administered as an adjuvant in combination with surgery and chemotherapy or radiation (Gu and Belury, 2005).

6. Maitake mushroom (*Grifola frondosa* (*Dicks*) Gray):

Maitake (Japanese for “dancing mushroom”) is an edible mushroom that grows in clusters at the foot of oak trees. Maitake (*Grifola frondosa*) contains grifolan, a beta glucan polysaccharide. This activates macrophages which search and engulf foreign invaders in the body. Another ingredient, termed d-fraction, stimulates the immune system at the cellular rather than blood stream level. D-fraction can be used on its own, but seems capable of enhancing the effect of cancer drugs whilst reducing side-effects such as nausea and hair loss. For medicinal purposes, maitake is used as a dried powder, hot water extracts, or isolated fractions and compounds. β -glucan is the active polysaccharide extracted or isolated from fruiting bodies. This is used in traditional Chinese and Japanese medicine to

enhance the immune system (Nanba *et al.*, 1987). Studies have shown that it can enhance both the innate immune response to fight infections as well as adaptive immune response conferring long-term immune enhancement. Maitake also protects cells with its antioxidant properties and decreases the inflammatory factor COX2 enzyme so common in cancer physiology. Studies have also shown that Maitake has potential anti-metastatic properties inhibiting the proliferation and spread of cancer.

CONCLUSION

Mushrooms have long been used in medicine, the earliest records go back over 4,000 years in China. There are thousands of species of mushroom growing in the wild, but most studies have focused on six main varieties discussed here. In the last few decades, large number of mushroom fungi has been progressively used as a source of medicinal compounds and therapeutic adjuvants or health food supplements. Recently, the anticancer and anti-proliferative activities of polysaccharides or polysaccharide-protein complexes derived from mushrooms have received much attention in cancer treatment. Medicinal Mushrooms contain high levels of glycoproteins and polysaccharides. A trend toward integration of immunopotent agents with the extant cancer regimens of surgery, chemotherapy, and radiation therapy is now considerably advanced in Japan and China – countries where mushroom preparations have been an anticancer resource for centuries. Glucan and proteoglycan mushroom immunocuticals offer hope for cancer patients. These substances as dietary supplements, they are safe, clinically proven, and exhibit near-perfect benefit-risk profiles have also been successfully studied in humans.

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