



## SIGNIFICANT POTENTIAL OF MEDICINAL MUSHROOMS IN IMMUNOMODULATION

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### ABSTRACT:

Medicinal mushrooms plays important role in immunomodulation as they contains number of bioactive compounds. The search for novel polysaccharides with immune enhancing properties seems from the basic shortcomings of existing therapies. Majority of chemical compounds, which have been identified as cytotoxic to cancer cells, are also toxic to normal cells. Hence, the discovery and identification of safer new drugs, without severe side effects, has become an important goal of research in the biomedical sciences. A future significant observation is the ability of all the mushroom polysaccharides when administered to significantly reduce the side effects so often encountered. Therefore current review enlightened the important bioactive polysaccharides from medicinal mushroom with immunomodulation.

**Keywords:** Medicinal mushroom, Polysaccharides, bioactive compounds.

### INTRODUCTION:

Fungi are the potential source of bioactive compounds with diverse nature and revered for their immense health benefits and extensively used in folk medicine. Mushrooms have been used in traditional Chinese medicine for thousands of years based on knowledge and keen observation of practitioners. Bioactive compounds in mushrooms are responsible for improving human health in many ways. These bioactive compounds include polysaccharides, tri-terpenoids, low molecular weight proteins, glycoproteins and immunomodulating compounds. The medicinal use of mushrooms has a very long tradition and they have nutritional properties (Lindequist et al, 2005). Bioactive compounds isolated from medicinal mushroom shows a different activity against various diseases.

Mushrooms and fungi plays significant role in boosting immune system. Bioactive compounds like polysaccharides and minerals, isolated from mushroom are responsible for up-regulating the immune system. These compounds enhance the host non-specific and acquired specific immune responses by activating immune Cells (Ming G. 2006 and C. K. Cheung 2006). Antitumor and immunomodulatory effects of monosaccharide composition *Phellinus* on tumor cells Sarcoma 180 and Hepatoma 22 in implanted mice (Chen et al; 2010). There are variety of compounds having pharmacological properties have been isolated from mushrooms, which include polysaccharides,

polysaccharopeptides, polysaccharide-proteins with immunoenhancing and anticancer activities, lectins with immunomodulatory, anti-proliferate, antitumor and hypotensive activities. The medicinal mushroom used against various physiological disorders and the recognition of numerous biological response modifiers in mushrooms (Chang and Buswell, 1996).

Mushroom based components have advantage over herbal drugs, Numerous bioactive polysaccharides, glycoproteins, glycopeptides, and proteoglycans from medicinal mushrooms are considered as immunomodulators affecting on proliferation and differentiation of immune cells and cytokines, as well as interleukins and receptors production. These compounds recognized by the certain receptors located on the leukocytes and other immune cells that lead to enhance the innate and cell-mediate immune response (Chang, S. T., and J. A. Buswell. 1999). Many compounds include Polysaccharides, Polysaccharopeptides, Terpenoids, Steroids, Lectins, Proteoglycans, Phenolic compounds etc. have been extracted, isolated, identified and characterized from different mushrooms and their effects against different ailments have been recorded.

#### *Polysaccharides*

In particular, and most importantly for modern medicine, medicinal mushroom represent an unlimited source of polysaccharides with antitumor and immune stimulating properties. Polysaccharides are structurally diverse group of

macromolecules consist of two types **Homopolysaccharides** (Starch, Glycogen, Dextrans, Chitin etc.) and **Heteropolysaccharides** (Hyaluronic acid, Peptidoglycan, Glycosaminoglycans). Basidiomycetes mushrooms contain biologically active polysaccharides in fruit bodies, cultured mycelium, culture broth. Polysaccharides which are abundantly found in mushrooms are  $\beta$ -glucans, hetero- $\beta$ -glucans, heteroglycans,  $\alpha$ -manno- $\beta$ -glucans. Among them  $\beta$ -glucans are most important polysaccharides which show immunomodulatory and antitumor properties.

These polysaccharides are of different chemical composition, with most belonging to the group of beta-glucans; these have beta-(1 $\rightarrow$ 3) linkages in the main chain of the glucan and additional beta-(1 $\rightarrow$ 6) branch points that are needed for their antitumor action (Wasser, 2002). Mushroom polysaccharides prevent oncogenesis, show direct antitumor activity against various allogeneic and syngeneic tumors, and prevent tumor metastasis. Polysaccharides from mushrooms do not attack cancer cells directly, but produce their antitumor effects by activating different immune responses in the host. More than 100 types of polysaccharides with biological activities have been isolated from the fruit body & mycelia of *Ganoderma lucidum*. Even Lentinan, Schizophyllan, grifolan are the polysaccharides which are studied for immunomodulatory and/or antitumor activity.

#### **Grifolan**

Antitumor glucan, grifolan LE, from *Grifola frondosa* was chemically modified to examine the structure-function relationship of the products. Grifolan is a macrophage activator which augments cytokine production essential factors required for antitumor activity were (1-3)-beta-D-glucosyl linkages and high molecular weight, and that accessory groups and it also enhances mRNA level of IL-6, IL-1 and TNF- $\alpha$  of macrophages.

#### **Phellinus**

The extraordinary preventative or inhibitory effect of *Phellinus* sps. against diabetes and cancer is one of the most appreciated property. It possesses multiple functions against various diseases, especially against various types of cancer. *Phellinus linteus* is an acidic polysaccharide that is introduced as an immunomodulator, anti-inflammatory and antitumor agent. PL can modulate circulating cytokine responses in lipopolysaccharide (LPS)-treated mice and administration of this compound in vivo decreased IL-2 and TNF- $\alpha$  production.

#### **Ganoderma**

The *Ganoderma lucidum* polysaccharide is extensively used as immunomodulatory activity, including promoting the function of mononuclear phagocytes, humoral immunity and cellular immunity. It also enhances and increase immune precursor cells proliferation and differentiation of effectors cells. The bioactive substances in *Phellinus* are important as health-beneficiary. *Phellinus* and *Ganoderma* is an excellent herbal resource of immunoregulatory, anticancerous, antioxidants and liver-protectants (Kohda;1985).

#### **Terpenoids**

Monoterpenoids is important in the prevention and cure of several cancers. They are the compounds having 5-carbon unit i.e isoprene units as their structural units. Many Terpenoids have been isolated but there is little work on activities. A large number of tri-terpenoids have been shown to suppress the growth of a variety of cancer cells without exerting any toxicity in normal cells. (Roslin J Thoppil, Anupam Bishayee)

The triterpenes are also called Ganoderic acids (C<sub>30</sub>). Among these, triterpenes have found extensively from mushrooms that are famous compounds with biological activity & medicinal property. Highly oxidized lansonate type terpenoids have anti-infective, cytotoxic & immunomodulatory activities. Other triterpenoids from medicinal mushrooms are Ganoderic acids, Applanoxidic acid, Ganoderals, Lucidone, Ganodermanondiol, Ganodermanontriol etc.

#### **DISCUSSION:**

There are various compounds isolated from the medicinal mushroom are being used as one of the major sources of therapeutic agents for immunomodulatory and anti-tumor properties. Terpenoids are novel candidates in the chemo preventive and chemotherapeutic strategies to combat cancer.

These compounds are regarded as biological response modifier (BRM) i.e. they cause no harm and place no additional stress on the body, but help the body to adopt to environmental and biological stress. A trend toward integration of immunopotentiating agents with the extant cancer regimens of surgery, chemotherapy, and radiation therapy is now considerably advanced. With their capacity to mobilize the immune system against formed tumors as well as metastases, while they have no adverse side-effects, mushroom immunocuticals should be a better option for the oncologist. Nowadays almost all of the important medicinal mushrooms have been

subjected to large scale artificial cultivation. This also ensures accuracy of identification and increased reliability and consistency of derived extracts. Mushroom immunoceuticals are a potential substance for individuals afflicted with cancer, living with impaired immunity.

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