

Medicinal Mushrooms:

Powerful Immune System Support

The healing effects of mushrooms have been recognized for thousands of years. Maitake, shiitake, reishi and brazilian mushrooms, for example, have long histories of medicinal use. Only more recently have scientists begun to understand what components of mushrooms are responsible for their beneficial properties. Several major substances with immunomodulatory and/or antitumor activity have been isolated from mushrooms. These include mainly polysaccharides; in particular β -glucans, polysaccharopeptides (PSP), polysaccharide proteins, and proteins. Furthermore, other bioactive substances, including triterpenes, lipids, and phenols, have been identified and characterized in mushrooms and have been shown to have proven medicinal properties.

The various glucans, and especially β -glucans, have become the focus of a great deal of research into immune system modulation, infection prevention and cancer. β -glucans are large polysaccharides, which means that they are formed from a large number of sugar molecules (glucose) linked together in specific patterns. Research has shown that the most active types of β -glucans are insoluble and have a very specific type of linkage between their individual molecules called a β 1,3/ β 1,6 linkage¹ (see Figure 1).

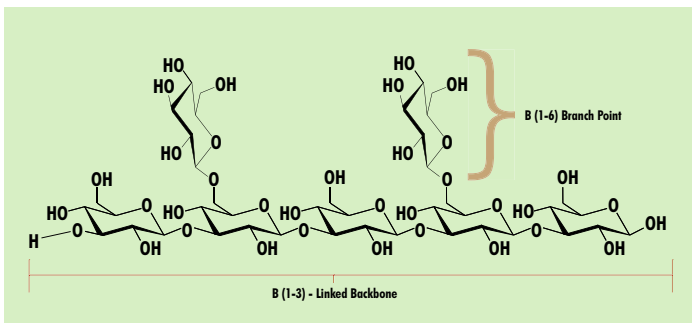


Figure 1. The Typical Structure of immunomodulatory β -glucans from mushrooms

Immune System Modulation and Enhancement

Studies have shown that the active substances in mushrooms can act to modulate and enhance both the innate and adaptive immune response.¹ Overall, the major immunomodulating effects of these active substances is their ability to stimulate the proliferation and enhanced functioning of important immune system cells. The therapeutic effects of mushrooms, such as protection against infection, anticancer activity and the suppression of autoimmune diseases and allergies have been associated in many cases with these immunomodulating effects.

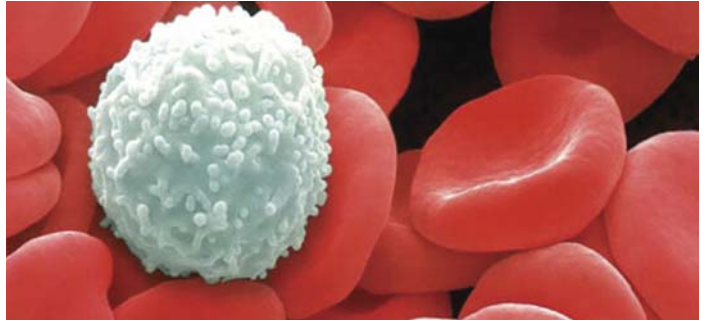


Figure 2. Human immune cell (white blood cell or lymphocyte) surrounded by red blood cells.

For example, some mushroom metabolites like the D-fraction from the maitake mushroom represent important biological response modifiers due to their ability to enhance the activity of natural killer cells in cancer patients.² Mushroom polysaccharides also induce the maturation and function of cells called dendritic cells, causing them to stimulate the proliferation of T-cells, thereby enhancing the immune response. B cells and antibody production have also been shown to be activated by mushroom polysaccharides.² Overall, glucans and other mushroom molecules have wide ranging effects on the immune system, and are able to enhance its function, whether it is for preventing infection with the common cold or flu or for improving the health of cancer patients.

Anti-Cancer Effects

The most studied use for medicinal mushroom extracts is their potential in the treatment and prevention of cancer. Progression to malignant cancer occurs when the tight controls that normally govern cellular division break down, resulting in the uncontrolled proliferation of cancerous cells. It also involves the ability of these cells to spread and invade into surrounding tissue. The modulation of the host immune system attributed to mushrooms, particularly mushroom glucans, is likely

to affect primarily the promotion and progression stages of cancer. When mushroom glucans stimulate macrophages this results in the production of various signaling molecules called cytokines which induce anti-tumor activity by the macrophages.²

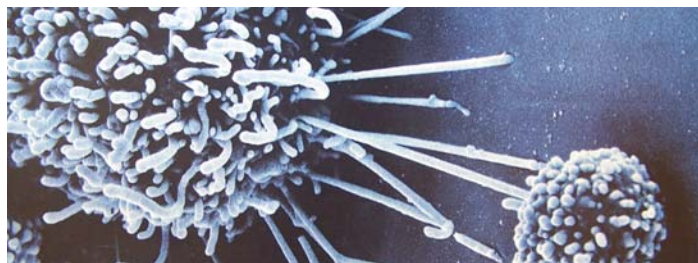


Figure 3. A Tiny Natural Killer Cell attacking a huger Cancer Cell

A highly specific extract from Basidiomycetes mushrooms called Active Hexose Correlated Compound (AHCC) has been shown to have very promising anti-cancer effects. Arguably the most active nutrient in AHCC is acetylated α -glucan, a component known to enhance the immune system.³ A prospective cohort study with AHCC involving 269 patients with liver cancer showed positive results.⁴ 113 of these patients were given AHCC following surgery and the remainder was not. The survival rate of the AHCC group was 79% compared to 51% for the control group. Furthermore, the recurrence rate among the AHCC group was 49% compared to 67% for the control group.⁴ Other studies have shown that AHCC can work synergistically with chemotherapy, helping to improve outcome and reducing side-effects.⁵

Other substances contained in mushrooms may be able to interfere with tumor initiation through a variety of mechanisms, such as enhancing the host's antioxidant capacity, or up-regulating enzymes involved in the detoxification of cancer causing compounds. For example, extracts of *Agaricus blazei* (Brazilian mushroom) and *Grifola frondosa* (maitake mushroom) have been found to contain a compound with antitumor activity called ergosterol. Ergosterol has been shown to exhibit antioxidant activity and anti-inflammatory actions through the suppression of inflammation inducing molecules like COX-2. Oxidative damage is strongly implicated in the development of many chronic diseases, including cancer. COX-2 also appears to play an important role in certain cancers. Thus, its inhibition can result in the inhibition of tumor development, and it appears to be beneficial even in some established tumors.

Mushrooms for Everyday Immune Support

The immune system enhancing effects of mushroom extracts and glucans have benefits for everyday support as well. By increasing the proliferation of and activity of the cells of the immune system they can boost the body's defenses against all kinds of infections. This was demonstrated in a study examining the effects of AHCC on the body's response to influenza infection. In the study, 29 individuals were immunized with an influenza vaccine. Half of them were supplemented with 3000 mg/day of AHCC on the day of vaccination and for two weeks following the inoculation, the other half were given a placebo.⁶ It was found that individuals taking AHCC had significantly higher levels cytotoxic T-cells and Natural Killer cells, suggesting an improved immune response. In studies with mice, AHCC has been shown to improve survival and viral clearance in mice infected with influenza.⁷

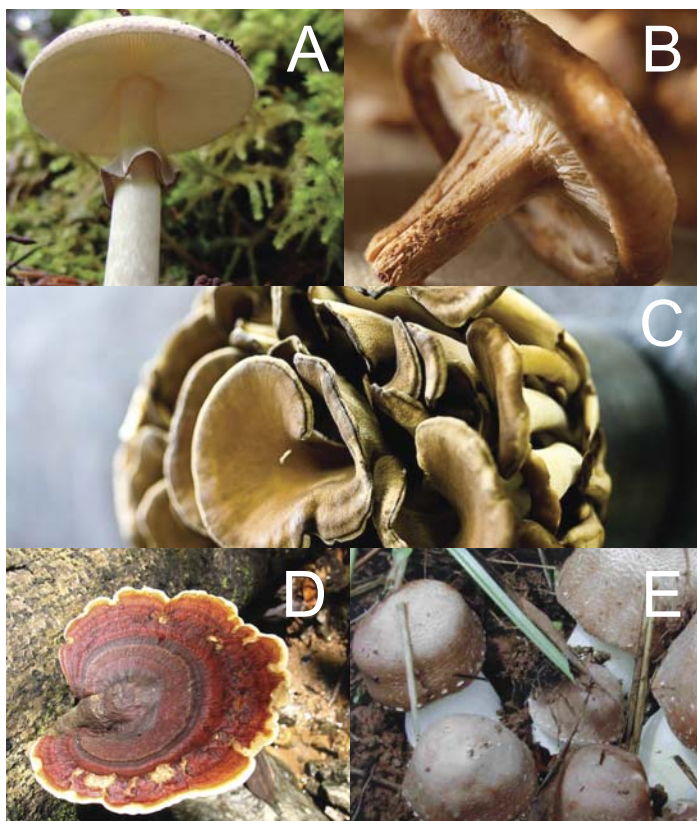


Figure 4. Various types of mushrooms with immune enhancing effects. A) Basidiomycetes; B) Shitake; C) Maitake; D) Reishi and E) Brazilian.

Other types of mushroom extracts have also been shown to improve resistance to infection. For example, a patented blend of four mushroom species (maitake, shiitake, reishi and Brazilian mushrooms) called Immunutrin™ has been clinically shown to enhance

immune function and to help prevent infection. In one open-label study involving 18 subjects, supplementation with 1000 mg per day of Immunutrin™ for two months resulted in a 10% increase in levels of natural killer cells, helper T cells, cytotoxic T cells, and B cells and an 18% increase in total lymphocytes.⁸ During the study, 16 of 18 subjects reported no symptoms of viral or bacterial infection, indicating that the heightened immune response was associated with prevention of sickness. In a follow-up study, five subjects were given 3000 mg of Immunutrin™ per day for 2 weeks to assess the supplements' effect on natural killer cell cytotoxicity, which is their ability to attack and destroy infected cells.⁸ It was found that the number of natural killer cells increased by 19% compared to baseline after two weeks of supplementation, and natural killer cell cytotoxicity increased by 17%. These results confirm that the increased natural killer cell numbers generated by taking Immunutrin™ are associated with greater immune activity in the body.

Conclusion

Cumulatively, the studies on mushroom extracts suggest that they contain compounds that may support immunity, help prevent infection and modulate tumorigenesis and carcinogenesis at different stages. Overall, the compounds contained in mushrooms could potentially provide additive, or even synergistic, effects in supporting immunity and in the prevention

and treatment of cancer. Furthermore, evidence suggests that these substances also have benefits for everyday immune support by enhancing immune system activity, thereby helping the body to stave off infection.

References

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