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**FILE: ■ Medicinal Mushrooms  
■ Medicinal Fungi**

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**RE: Medicinal Mushrooms: A Review**

Meletis CD, Barker JE. Medicinal mushrooms. *Altern Complement Ther.* 2005(June):141-145.

This is a selective overview of four mushrooms with long histories of medicinal use: cordyceps (*Cordyceps sinensis*); maitake (*Grifola frondosa*); reishi (*Ganoderma lucidum*); and turkey tails (*Trametes versicolor*). Besides being good dietary sources of protein, fiber, several minerals, B vitamins and ascorbic acid, many of the 38,000 species of mushrooms have medicinal uses, either known or as yet unknown.

Cordyceps "has perhaps one of the oddest places of origin of any natural medicine": it was originally found on a caterpillar, *Hepialus armoricanus*, in the mountains of Asia. Historically, use of cordyceps was limited to ancient royalty. Traditional uses included enhancing endurance, energy, and sexual vitality; supporting the heart, lungs, kidney, and immune systems and the vital essence (*Chi*); and supporting longevity. Active constituents include several saccharides, sterols, peptides and polyamines, fatty and organic acids (nearly 30 fatty-acid compounds), vitamins, nucleotides, and inorganic compounds and minerals. Today, several species of cordyceps (*C. capita*, *C. ophioglossoides*, *C. militaris*), and their artificially cultured mycelium (particularly strain Cs-4) are used commercially.

Cordyceps extracts have demonstrated some "potent antioxidant activity", although it was found that the extracts' ability to scavenge superoxide ions was minimal and that they inhibited hydroxyl radical byproducts only moderately. However, when incubated with low-density lipoprotein and copper chloride in the presence of macrophages, a cordyceps extract strongly inhibited lipid peroxidation. This effect was similar to that of superoxide dismutase (SOD), one of the cell's main protectors against oxidative damage. In one trial, SOD activity increased by 16% while plasma malondialdehyde and lipoperoxide decreased by about 34% in patients who used a cordyceps supplement. Cordyceps also benefits the vascular system and microcirculation. It is hypotensive and vasodilating and may prevent clotting and ischemia. Its ability to decrease serum lipid peroxidase levels and inhibit LDL oxidation may contribute to these vascular protective effects in particular. Several studies have found that cordyceps can affect immune-cell function and population, e.g., causing a significant increase in the number of T-helper cells and their ratio to T-suppressors. Others have found that cordyceps could "enhance" natural killer (NK) cells and certain CD marker designations in people with leukemia, giving improved binding ability on lymphocytes. Inhibition of melanoma in an animal study was attributed to improved NK-cell function. In one animal study, cordyceps extract stimulated mononuclear blood cells, inhibited human leukemia cell growth by about 80%, and induced immature immune cells into maturity. Other immune-enhancing effects of cordyceps include increasing levels of cytokines such as interferon- $\gamma$ , tumor necrosis factor- $\alpha$ , and interleukin-1; prolonging lymphocyte survival, and even direct toxicity to cancer cells, especially lung carcinoma. Cordyceps is a

promising anti-inflammatory. It modulates cytokines and increases levels of corticosteroids although the mechanism of action is unclear. Increased corticosteroids may be responsible for tonifying effects of cordyceps in adrenal-gland support programs.

Maitake, reishi, and turkey tails are all among a class of mushrooms known as the higher Basidiomycetes, many of which have medicinal properties. Active ingredients among many include  $\beta$ -glucan polysaccharides, particularly valuable in immune system enhancement. Maitake has been found to stimulate regulation of interleukin-1, NK-cells, cytotoxic T-cells, and superoxide anions. Reishi's  $\beta$ -D-glucan assists macrophage maturation. Reishi also has a triterpene compound, *Ling Zhi-8*, believed to be a generalized immunomodulator and anti-allergen. Reishi activates macrophages and T-lymphocytes, enhancing cytokine levels. Turkey tails, which has several  $\beta$ -glucans compounds, is known for its immune-enhancing effects. In particular, its protein-bound polysaccharide krestin (PSK) and polysaccharide peptide (PSP) have been researched for anti-tumor effects and are used widely in anticancer regimens in Japan. PSP is used throughout Asia as an adjunctive cancer treatment. PSK has shown benefit against gastric, esophageal, colorectal, breast, and lung cancers. Turkey tails also shows promise as an antiviral, with both PSK and PSP inhibiting HIV-1 virus in vitro, and "appears to have wide-ranging immunomodulatory effects, making it a prime therapy in conditions of impaired immunity."

Both maitake and reishi have vascular effects and benefit circulation in several ways. Maitake changes the metabolism of lipids, inhibiting accumulation in liver and serum. It lowers blood glucose, reducing the insulin burden on the circulatory system. It may lower blood pressure. Reishi contains an alkaloid, cyclo-octasulfur, which has cardiogenic effects; a triterpene, ganoderadiol, which lowers blood pressure; and ganodermic acids, which are antihypertensive and inhibit cholesterol synthesis. Reishi has also been found to inhibit platelet aggregation.

Both reishi and turkey tails have been studied for antioxidative effects. In reishi, terpene and polysaccharide fractions have been found to have dose-dependent antioxidative effects, with the terpene having the strongest. In one study, turkey tails inhibited oxidation by approximately 59%. Its free-radical scavenging ability was nearly 25% in vitro. This effect could improve immune function in cancer patients, since PSK can mimic SOD, restoring NK-cell function.

Maitake, with one of the largest fruiting bodies of any mushroom, is prized gastronomically. It was used historically to lower blood pressure and treat cancer, and for general wellness. It is now considered an adaptogen. Reishi, which grows on decaying logs and plant matter in coastal areas, was already valued medicinally in the first century BCE, with the most applications of any medicine in the Chinese pharmacopoeia of that time. Traditional Chinese Medicine uses reishi to treat fatigue, weakness, insomnia, asthma, and coughs. Besides the benefits mentioned previously, it has demonstrated hepatoprotective, anti-aging, antidiabetic, antiviral, and antibacterial effects. Turkey tails' traditional applications included improving vitality and strength, enhancing respiratory function, promoting calm and a sense of well-being, restoring energy following physical exertion, strengthening tendons and bones, enhancing liver health, and promoting longevity.

The article includes sidebars describing hot-water extraction of medicinal mushroom components, and suggested doses for the four discussed in detail.

— *Mariann Garner-Wizard*

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