

Medicinal Mushrooms

A Selective Overview

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Most people, if they think about mushrooms at all, consider them a food with no particular value beyond taste. As a significant source of protein, fiber, several minerals, B vitamins, and ascorbic acid, mushrooms are actually a healthy addition to the diet. They also have uses beyond nutrition, having numerous medicinal qualities. A large body of work details the health benefits of mushrooms. There is even a journal that specializes in mushroom use in medicine, the *International Journal of Medicinal Mushrooms*.

Recent interest in the medicinal qualities of mushrooms has paralleled the rise in widespread commercial cultivation of these useful fungi. Their production and sales in the year 1999 totaled 18 billion dollars, an amount similar to that of coffee sales worldwide.¹ However, the use of fungi for medicinal purposes predates modern cultivation and scientific interest by thousands of years. In traditional Eastern medicine, mushrooms were used to treat diseases, increase longevity, and cleanse the mind and spirit.² Modern investigations into the medicinal effects of mushrooms began in the late 1960s.³ Science continues to reveal the efficacy of mushrooms, and new uses for them will undoubtedly be discovered.

Among the 38,000 species of mushrooms, four are especially important to our current natural medicine pharmacopoeia. Cordyceps or *DongChongXiaCao* (*Cordyceps sinensis*), maitake (*Grifola frondosa*), reishi (*Ganoderma lucidum*), and coriolus or turkey tail (*Coriolus versicolor*) are used as antioxidants, vascular support agents, immune-system enhancers, and anti-inflammatory agents.

Cordyceps

Cordyceps sinensis has perhaps one of the oddest places of origin of any natural medicine. Sometimes referred to as “caterpillar fungus,” cordyceps was originally found on the surface of a caterpillar, *Hepialus armoricanus*. Considered to be rare, the fungus was found at high elevations in the mountains of Asia and its use was limited to ancient royalty. Traditional uses included enhancing endurance and stamina; boosting energy and fighting

fatigue; promoting sexual vitality; supporting the lungs, heart, kidney, and immune system; nourishing the vital essence; and promoting longevity.

Cordyceps research has increased markedly, together with research on other popular medicinal mushrooms. Modern investigations on the benefits of cordyceps have supported its ancient use as a tonifying agent.

Several active constituents have been identified, including saccharides (oligosaccharide, polysaccharide, and D-mannitol), sterols (ergosterol, ergosterol peroxide, β -sitosterol, daucosterol, and cam-pasterol), peptides and polyamines (cadaverine, spermidine, spermine, 1,3-diamino propane, and putresine), fatty and organic acids (nearly 30 identified fatty-acid compounds), vitamins, nucleotides (adenosine, adenine, deoxyuridine, guanosine, thymidine, uracil, and uridine), and inorganic constituents and minerals (numerous macrominerals and trace minerals, including selenium).^{4,5}

More than one species of cordyceps and artificially cultured mycelium are all currently used. *C. capita*, *C. ophioglossoides*, and *C. militaris* are in many commercial preparations. The strain Cs-4, an artificially propagated form of cordyceps, is used most frequently in these preparations.

Antioxidative Effects

Research on natural medicine substances almost always includes an investigation into their antioxidative abilities. Cordyceps research is no exception. One study examined the antioxidative abilities of both water and ethanol soluble extracts of *C. sinensis* and revealed what investigators termed “potent antioxidant activity.”⁶ While the extracts’ ability to scavenge superoxide ions was minimal, the extracts inhibited hydroxyl radical byproducts moderately.

In addition, when incubated with low-density lipoprotein (LDL) and copper chloride (a pro-oxidative molecule) in the presence of macrophages, a cordyceps extract strongly inhibited lipid peroxidation in the medium and in the macrophages. The researchers noted that this effect was similar to that of superoxide dismutase (SOD), a powerful cellular weapon against superoxide radicals. SOD is one of the cell’s main protectants against oxidative damage. Researchers in another trial showed that SOD activity was increased by 16 percent while plasma malondialdehyde (a product of hydroxy radicals) and plasma lipoperoxide were decreased by roughly 34 percent in patients who used cordyceps as a supplement.⁷

Dosing of Selected Mushrooms

Latin binomials	Common names	Dosages
<i>Cordyceps sinensis</i>	Cordyceps; caterpillar fungus; <i>DongChongXiaCao</i>	3 g/day
<i>Grifola frondosa</i>	Maitake	5–7 g/day
<i>Ganoderma lucidum</i>	Reishi; <i>Ling Chih</i> ; <i>Ling Zhi</i>	1.5–9 g/day
<i>Coriolus versicolor</i>	Coriolus; turkey tail	20 g, 3 times/day; PSK can be taken in 3-g doses

Note: All doses refer to the dried form of the fungus' fruiting body.

Vascular Effects

Recent studies suggest that cordyceps is beneficial for the vascular system and useful for supporting healthier microcirculation. Cordyceps has demonstrated hypotensive and vasodilating effects⁸ and may prevent blood clotting and ischemia.⁹ Cordyceps' ability to decrease serum lipid peroxide levels and inhibit LDL oxidation, and thus aortic cholesteryl ester deposition, may contribute to the fungus' vascular protective ability.¹⁰

Immune Enhancement

One of the most frequent therapeutic uses of medicinal mushrooms is for immune enhancement. While not the leading mushroom for this purpose, cordyceps nonetheless has some value. Several studies demonstrate the ability of the fungus to affect immune-cell function and populations. In one experiment, cordyceps use led to a significant increase in the number of T-helper leukocytes and increased the ratio of T-helper to T-suppressor cells.¹¹ Other studies showed that cordyceps could enhance natural killer (NK) cells as well as certain CD marker designations and their binding abilities on lymphocytes in people with leukemia.¹²

Cordyceps was also shown to inhibit the formation of melanoma in laboratory animals treated with a fungal extract; researchers attributed this effect to improved NK cell function.¹³

This mushroom has been studied in other models of cancer as well. In another experiment utilizing laboratory animals, a cordyceps extract was able to stimulate mononuclear blood cells and inhibit human leukemia-cell growth by roughly 80 percent and to induce other immature immune cells into mature tumor-fighting form.¹⁴

Numerous other immune effects of cordyceps have been identified. These include the ability to increase levels of specific cytokines including interferon- γ , tumor necrosis factor- α (TNF α) and interleukin-1 (IL-1).¹⁴ Cordyceps has prolonged the survival of lymphocytes¹⁵ and has had direct toxic effects on cancer cells,^{16,17} especially against carcinoma of the lung.¹⁸ The use of cordyceps for promoting immune function is relatively well-documented; however, more research is needed for application to human health and to disease prevention.

Anti-Inflammatory Effects

The use of cordyceps as an anti-inflammatory holds promise as well. In conditions with inflammation, cordyceps may be valuable as an adjunctive agent because of its ability to modulate

cytokines and increase levels of corticosterone.¹⁹ Corticosterone is one of the body's primary means of controlling inflammation. It is not yet known if the fungal extract works directly by increasing adrenal gland output or indirectly through the hypothalamus–pituitary axis. An increase in levels of corticosterone may be responsible, in part, for the tonifying effects of this fungus when it is included in adrenal-gland supportive protocols.

Maitake

Maitake is found mainly in temperate mountainous regions of Japan, North America, and Europe. The fruiting body of this mushroom is one of the largest of any mushroom, approaching the size of a basketball. Maitake fruiting bodies grow with a distinctive overlapping pattern, which has been described as looking like dancing butterflies. Maitake is prized for its culinary benefits; its medicinal effects have only recently been emphasized although some of them have been known for many years. The mushroom was used medicinally as a general tonic to promote wellness and vitality, and is now considered to be an adaptogenic medicine.

Historically, maitake was also used for lowering high blood pressure and treating cancer; these uses are two foci of current research. This mushroom has been a staple in Asian diets for thousands of years. Once difficult to cultivate, maitake is now grown relatively easily in Japan, increasing the mushroom's availability as a medicine.

Vascular Effects

Maitake can benefit the circulation in a number of ways, one of which is to prevent cardiovascular conditions caused by elevated blood lipids. Maitake changes the metabolism of lipids in the body by inhibiting their accumulation in the liver and in the serum. The exact mechanisms of these actions are not yet fully known.²⁰

Other actions of maitake include its ability to lower blood glucose, thereby decreasing the insulin burden on the micro- and macrovasculature. Mounting evidence shows a correlation between elevated insulin levels and cardiovascular morbidity.²¹ Maitake is thought to lower blood glucose levels by activating insulin receptors.^{22,23} Another effect of this mushroom on vascular health may be an ability to lower blood pressure. Two preliminary studies demonstrated that maitake lowered blood pressure in laboratory animals significantly.^{24,25}

Immune Enhancement

Other significant health effects of maitake include its immune-enhancing properties. One of the active ingredients of the fungus is β -glucan. Found in several plants, β -glucan is a polysaccharide molecule that can support the body's defenses against tumors. Maitake's β -glucan content may be responsible for its immunostimulatory actions, including regulation of interleukin-1, NK cells, cytotoxic T-cells, and superoxide anions.²⁶

Several preliminary studies on the effects of maitake on certain cancers were performed in the mid-1990s.^{27–29} However, no follow-up studies have been done yet. Promising studies on β -glucan as an immune stimulant suggest that maitake is a viable

choice for treating conditions that involve impaired immunity. Other immunostimulatory principles of this fungus should be examined in future research.

Reishi

Reishi mushrooms are sometimes referred to as *Ling Chih* or *Ling Zhi*. The medicinal use of this mushroom is detailed in the Chinese pharmacopoeia of the first century BC³⁰ Reishi was highly valued even at this time and had the most medical applications of all medicines in the pharmacopoeia. The very slow growth of reishi, along with its scarcity in the wild, made the mushroom highly prized. Recently, however, it has been cultivated successfully and is now widely available.

Reishi's native habits includes decaying logs and plant matter near coastal areas. The mushroom comes in several different colors, with the red one most frequently used in Asia and North America. Traditional Chinese Medicine uses of reishi included treating fatigue, weakness, insomnia, asthma, and coughs.³¹ Despite a long history of medical use, research was on reishi's many health benefits was not able to be conducted until the mushroom became more available recently. Some of its health benefits include cardiovascular and liver protection, and immune boosting, antiaging, antidiabetic, antiviral, antibacterial, and anticancer effects.

Antioxidative Effects

Several constituents of the reishi mushroom have antioxidant effects. Investigators isolated the active terpene and polysaccharide fractions and investigated their ability to protect cells against oxidative damage.³² The study looked primarily at the ability of these constituents to protect cells against lipid peroxidation and erythrocyte membrane oxidation. The results showed that the fractions had dose-dependent antioxidative capabilities, with the terpene fraction having the strongest effect.

Vascular Effects

Reishi contains several components that improve vascular health. Among these are the alkaloid cyclo-octasulfur, which has known cardiogenic effects;³³ the triterpene ganoderadiol, known for its ability to lower blood pressure by blocking the effects of angiotensin converting enzyme;³⁴ and the ganoderic acids, which also have antihypertensive effects and can inhibit the synthesis of cholesterol.

One study showed that reishi can inhibit platelet aggregation. This dose-dependent effect was noted in both healthy subjects and in those with atherosclerotic disease.³⁵ The exact mechanism of inhibition was not elucidated in the study, however. The reishi mushroom's wide-ranging effects on the vascular system make it an important supportive therapy for prevention or treatment of vascular conditions caused by cholesterol accumulation, platelet aggregation, and high blood pressure.

Immune Enhancement

Reishi contains two constituents that are thought to be responsible for its effectiveness as an immune system modulator. Like maitake, reishi contains the immune-stimulating compound β -

Formulation of Medicinal Mushrooms and Extraction of Active Constituents

According to Mark Stengler, N.D.,^a a naturopathic physician in private practice in La Jolla, California, there are two major sources of information on the use of medicinal mushrooms: traditional Chinese medical texts and recent medical research reports. A review of these sources, he says, reveals a common thread in how medicinal mushrooms have been used, over thousands of miles and thousands of years.

The active components of medicinal mushrooms are typically made bioavailable by a hot-water extraction method. Traditional Chinese medical practitioners made teas or decoctions out of medicinal mushrooms, either brewing the mushrooms in very hot water or simmering them in hot water for 20–120 minutes. The most thoroughly studied modern medicinal mushroom extracts are generally made by starting with a hot-water extraction of active ingredients followed by concentration of the solution and, in some instances, further chemical concentration of the components.

Dr. Stengler notes: "A review of the published literature on medicinal mushrooms demonstrates that the majority of mushroom supplements tested in the medical research were hot-water or hot-water/alcohol extracts. This method is used for the most commonly used mushroom extracts, including coriolus, shiitake, maitake, cordyceps, and reishi. Hot-water extraction is also used for all of the well-known isolate products."^a

^aStengler M. The Health Benefits of Medicinal Mushrooms, North Bergen, NJ: Basic Health Publications, 2005.

glucan in the form of β -D-glucan.³⁶ β -D-Glucan is well-known for its ability to assist one of the body's premier immune cells, the macrophage, to mature.

Researchers have also identified a triterpene compound, *Ling Zhi-8*, which is believed to be a generalized immune-system modulator and to have antiallergy effects.³⁷ By activating cells of the immune system (macrophages and T-lymphocytes), reishi components enhance cytokine levels, propagating the immune systems' alarm effect further.³⁸ Commercially, reishi is often found in combination with other medicinal mushrooms that have immunostimulatory effects.

Coriolus

Yet another traditional medicine in the Chinese medical armamentarium, coriolus was harvested and ground to make a powder and tea. Traditional medical applications included improving vitality and strength, enhancing respiratory function, promoting calmness and well-being, restoring energy following intense physical exertion, strengthening tendons and bones, enhancing liver health, and fostering longevity. Coriolus became very popular during the Ming Dynasty, when the mushroom was widely prescribed to enhance vigor and longevity. Like to the other three mushrooms discussed in this article, the traditional uses of coriolus have recently been validated to an extent by modern medical research.

Antioxidative Effects

As an antioxidative agent, coriolus has shown great potential. In one study, the fungus demonstrated an approximately 59 percent inhibitory effect on the oxidative process. The mushroom's

free-radical scavenging ability was near 25 percent when challenged in a laboratory setting.³⁹ Free-radical scavenging ability can be applied to immune function. NK cells can be damaged easily by reactive oxygen species. Polysaccharide krestin (PSK), which is derived from coriolus, can mimic SOD and restore NK-cell function in people who have cancer.⁴⁰

Immune Enhancement

Coriolus, like other medicinal mushrooms, is well-known for its immune-enhancing effects. One group of researchers noted a wide-ranging enhancement of immune-cell function and the mushroom's ability to inhibit the growth of certain cancers.⁴¹

Numerous studies have been conducted on coriolus' immune-enhancing properties. These studies have identified the mushroom's active constituents. Among them are the β -glucan polysaccharides. Coriolus contains several different types: 1–3 β -glucan, 1–4 β -glucan, and 1–6 β -glucan, protein-bound PSK, and polysaccharide peptide (PSP).⁴²

The target of numerous research investigations, PSK and PSP have antitumor effects and are used widely as biologic response modifiers in cancer chemotherapy regimens in Japan.^{43,44} In fact, PSP has been used throughout Asia as an adjunctive cancer treatment for the last 30 years. PSK has shown benefit in gastric, esophageal, colorectal, breast, and lung cancer therapies.⁴⁵

Coriolus holds promise as an antiviral as well. Both PSK and PSP have demonstrated inhibitory effects against HIV-1 in laboratory settings.^{46,47} Coriolus appears to have wide-ranging immunomodulatory effects, making it a prime therapy in conditions of impaired immunity.

Summary

Cordyceps, maitake, reishi, and coriolus mushrooms have been used as traditional medicines and modern studies are showing that they have antioxidant, vascular, immune, and anti-inflammatory effects. In addition, we are now learning the mechanisms by which these mushrooms work. □

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