Potential and Supplementary Health Benefits from Mushrooms

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Potential benefits of “mushrooms” have not been adequately understood and appreciated by Western society until recently. The Chinese and Japanese people have long consumed a wide variety of mushrooms that the West has neither known of nor gained from. One of the reasons for such a discrepancy is a lack of understanding about the nature and properties of these mushrooms. Exemplifying this is a wide perception of mushrooms as “fungi” without nutritional value; another is a less widely held belief that eating mushrooms may make one vulnerable to Candida or yeast infections. As is now known, neither view is valid. To the contrary, most mushrooms are rich in vitamins, minerals, amino acids and fiber, while they are low in fat, cholesterol and calorie content. In addition, extensive basic and clinical research on mushrooms over the past 20 years has revealed them as having an unfolding number of properties that seemingly provides remarkable health benefits.

Properties of Mushrooms
All mushrooms appear to have immunomodulatory, antiviral, antibacterial, antitumor and anti-metastatic activities. Their physiologic actions also include hypotensive, hypoglycemic, hypcholesterolemic, antioxidant and anti-inflammatory effects, among others. Such biologic activities of these mushrooms are attributable primarily to their polysaccharides or glucans, which have different types of glycosidic linkages including beta-(1,3), beta-(1,6), or alpha-(1,3) linkages. Some of these polysaccharides are bound to protein residues, forming polysaccharide-protein complexes. These various biopolymers give immunomodulatory and anticancer activity to a wide array of mushrooms. For example, mushroom polysaccharides have been shown to stimulate the immune system in its defensive role by activating various immune competent cells including T-cells, B-cells, macrophages, and natural killer (NK) cells, with the concomitant release of various cytokines such as interferons and interleukins. Terpenes and steroids, smaller molecules than polysaccha-
rides found in certain mushrooms, have also shown anti-inflammatory and anticancer properties.

It is important to note that despite structural and functional similarities in the polysaccharides or glucans of various mushrooms, their efficacy may vary with specific health states. This points to the need for further investigation toward establishing the properties of various mushrooms.

The following discussion focuses on the biologic properties of several common mushrooms having potential health benefits.

**Maitake (Grifola frondosa)**

Maitake (Grifola frondosa), literally meaning “dancing mushroom,” is a tasty edible mushroom with an enormous size that often reaches 20 inches in a diameter and weighs up to 100 pounds. Beyond its enticing taste, maitake has been shown to have numerous health benefits, ranging from immunomodulatory and antitumor effects to therapeutic and/or preventive applications in diabetes, hypertension, hypercholesterolemia, obesity, and human immunodeficiency virus (HIV) and hepatitis B virus infections. (Note: The National Cancer Institute confirmed that maitake extract had potential antiviral activity against HIV in 1992.) The extract was also found to significantly inhibit metastasis of liver carcinoma in mice, suggesting that it can provide anti-metastatic activity.

The primary bioactive components of maitake have been characterized as polysaccharides consisting either of beta-(1,6) glucan with beta-(1,3) glucosides, or beta-(1,3) glucan with beta-(1,6) branches. These polysaccharides have been successfully extracted from maitake and are commercially available. The U.S. Food and Drug Administration (FDA) has exempted the D-fraction of maitake from a phase I studies of toxicology, indicating its safety, and has approved it for an Investigational New Drug (IND) application for a phase II pilot study in patients with advanced breast and prostate cancer.

The D-fraction of maitake has been shown to stimulate the immune system by activating T-lymphocytes, macrophages, and NK cells, while also promoting the production of various lymphokines. The resulting stimulated immune response, targeting cancer cells, is believed to be the primary mechanism of antitumor activity of the D-fraction. An early, uncontrolled clinical study of patients with various types of advanced cancers showed that the D-fraction was capable of improving the clinical status of patients with breast, prostate, lung and liver cancers, while showing less effective in patients with bone and gastric cancers or leukemia. Recently, the D-fraction has also been reported to induce apoptotic cell death in prostate cancer cells in vitro, suggesting this apoptosis-inducing activity as an additional mechanism of antitumor activity. These findings therefore indicate that the D-fraction may have two potential mechanisms of antitumor activity, through both immunomodulatory and an apoptotic effects. Clinical trials of the maitake D-fraction in prostate cancer are currently being conducted at several institutions.

In addition to its D-fraction, maitake has also yielded another fraction, known as the SX-fraction, which has shown promising antidiabetic activity through reductions in serum glucose, insulin and triglyceride levels in diabetic mice. Recent clinical studies found that a powder of whole maitake containing 4 to 5 percent of the SX-fraction, and available in a caplet dosage form, was capable of significantly decreasing blood glucose levels in patients with type-2 diabetes. It is therefore conceivable that the hypo-glycemic activity of maitake may have wide applicability for improving blood glucose control in patients with type-2 diabetes.

**Reishi (Ganoderma lucidum)**

Reishi (Ganoderma lucidum), also called “monkey’s bench” because it resembles a hard wooden shelf, is the oldest historically known and also the most prized mushroom in China. Yet despite its traditional reputation of promoting health and longevity, it is inedible.

The active component of reishi is a beta-(1,3) glucan with beta-(1,6) branches, which is capable of stimulating the immune system by activating T-lymphocytes, macrophages, and NK cells and promoting the release of interleukins, tumor necrosis factor (TNF)-alpha, and interferon (IFN)-gamma. Reishi extracts have been reported to show antineoplastic activity against human leukemia HL-60 and U937 cells, human cervical cancer HeLa cells, and cells of the sarcoma 180 line. The beta-glucan of reishi was also found to significantly inhibit pulmonary metastases of sarcoma 180 implanted in mice. Its antiviral activity was shown against hepatitis B virus, HIV, and herpes simplex virus (HSV) type 1 (HSV-1) and type 2 (HSV-2), in addition to exhibiting antibacterial activity.

Additionally, reishi extract may act on specific signal-transduction pathways, as shown by its ability to induce rat neuronal cell differentiation by activating mitogen-activated protein (MAP) kinase. Its other potential health benefits include alleviating allergies and bronchitis and reducing
blood glucose levels, blood pressure, and levels of circulating lipids. Moreover, triterpenes extracted from reishi have been found to have anti-inflammatory and antioxidative effects. Recently, an antifibrotic effect of reishi extract was also reported in rats with liver cirrhosis, suggesting this mushroom as a possible antifibrotic agent.

Shiitake (Lentinus edodes)

The alluring taste of the shiitake (Lentinus edodes) mushroom has made it the most familiar edible mushroom in the United States. Its bioactive component, known as a lentinnan, is a beta-(1-3)-glucan with beta-(1-6) glycosidic side-chains, and can stimulate macrophages and facilitate the production of IFN-gamma, thus giving it immunomodulatory, antitumor, antibacterial and antiviral activities. The antineoplastic activities of this lentinnan have been demonstrated with U937 cells in vitro, and also in mouse sarcoma 180 and bladder cancer in vivo. An antiviral effect of lentinnan has been shown against HSV-1, HIV and influenza virus. In addition, shiitake has other physiologic effects, including hypotensive and hypcholesterolemic properties. It should be noted that the greatest efficacy of shiitake lentinnan and shiitake extracts is achieved through their intravenous administration, and that higher oral doses are needed for efficacy.

Royal Agaricus (Agaricus blazei murill)

Royal agaricus (Agaricus blazei murill) originated in the mountain region of Brazil, where it is called cogmele de Deus, or “mushroom of God.” Its cultivation was established in the late 1970s in Japan, making it widely available to the public. Initially, steroids isolated from royal agaricus were found to

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have a cytotoxic effect on HeLa cells. The water-soluble fraction of a beta-(1\(\rightarrow\)3) glucan with beta-(1\(\rightarrow\)6) branches, as well as the water-insoluble fraction of a beta-(1\(\rightarrow\)6) glucan-protein complex, were then isolated from the mushroom, and showed antitumor activity against sarcoma 180 and MethA fibrosarcoma when given intraperitoneally to mice. An acid-treated fraction was recently also isolated from agaricus and characterized as an alpha-(1\(\rightarrow\)4) glucan with beta-(1\(\rightarrow\)6) branches. This latter proteoglycan was found to have a selective tumoricidal effect on metha fibrosarcoma cells that is mediated through NK cell activation and results in apoptosis. The death of the tumor cells was also in part due to loss of the S or DNA synthesis phase of the cell cycle. Other extracts of agaricus have also shown immunostimulatory effects, through activation of macrophages and T-lymphocyte subsets, further explaining the antitumor activity of this mushroom.

Although other physiologic effects of royal agaricus have been postulated, including hypoglycemic, hypotensive and hypcholesterolemic activities, further studies are required for confirmation.

Cordyceps (Cordyceps sinensis)

Cordyceps sinensis is the most popular species of the Cordyceps family, and is also called "caterpillar fungus" because it grows directly out of larvae of the order Lepidoptera such as moths and butterflies. The fruit body of cordyceps, together with the host worm, has been used for many years in Traditional Chinese Medicine (TCM). Various properties of cordyceps derive from several polysaccharides, sterols (e.g., ergosterol peroxide), and sugar alcohols (e.g., mannitol) that have been identified in the fruit body of the mushroom or in its mycelium (liquid culture). Antitumor activity of cordyceps polysaccharides has been reported in both in vivo, and in vitro studies, and in vitro studies have shown that sterols from the cordyceps mycelium also have antitumor activity. Additionally, the mushroom has shown anti-metastatic activity in inhibiting liver metastases of lung carcinoma and melanoma cells in mice.

As in the case of several other mushrooms, cordyceps has exhibited immunostimulatory activity, through the activation of NK cells and macrophages, and other physiologic properties, including hypoglycemic, vasorelaxant, anti-atherosclerotic and antioxidative effects. It has also been confirmed to improve hepatic energy metabolism in mice, indicating an acceleration in hepatic function that probably promotes stamina, and mannitol—also found in cordyceps and a well-known diuretic agent—is presumed to have cosmetic effect in maintaining skin tone and texture. A newly purified compound (H1-A) from cordyceps has recently been reported to delay disease progression and improve renal function in a mouse model of lupus, suggesting that the mushroom may have potential in treating autoimmune diseases.

Lion's Mane (Hericium erinaceus)

Lion's mane (Hericium erinaceus)—whose name originates from its beautiful appearance, with a covering of white, icicle-like spines—is another edible mushroom, and is widely distributed in Japan and China. About 10 years ago, Japanese scientists isolated from this mushroom two cytotoxic phenols, hericenone A and B, and a novel fatty acid, which exhibited cytotoxicity against HeLa cells. Six additional hericenones (C, D, E, F, G and H) were then isolated and found to induce the synthesis of the nerve growth factor, which may be associated with positive effects in certain dementias such as Alzheimer's disease. More recently, two diterpenoids, erinaceins H and I, were obtained from the mycelium of the mushroom and found to have stimulatory activity on NGF synthesis. Yet, potent antitumor activity of lion's mane was attributable substantially to five polysaccharides—glucosylan, xylan, heteroxyl glucan, a glucosylan-protein complex and a galactoxyloglucan-protein complex—found in its fruit body and which inhibited tumor growth by 64 to 76 percent in mice, presumably by inducing a host-mediated immune response. Although human studies of these effects remain to be performed, it is believed that the antitumor potential of lion's mane could be applicable in gastric, esophageal and skin cancers.

Silver Ear (Tremella fuciformis)

The silver ear (Tremella fuciformis) mushroom has been used in traditional Chinese medicine for facilitating renal function and alleviating bronchopulmonary problems such as bronchitis and asthma. Customarily, it is used in Chinese cui-
sine for providing a viscous, smooth texture to certain dishes. This characteristic texture is provided by glucuronoxylomanan, a hot water-extractable acidic polysaccharide of silver ear, consisting of a backbone of alpha-(1Æ3) mannosidic linkages. The silver ear also has a high content of dietary fiber that may exert physiologic effects. In studies with rats, silver ear was capable of significantly reducing serum cholesterol and glucose levels, demonstrating that it has hypocholesterolemic and hypoglycemic effects. It has also been shown to increase the production of interleukins and TNF-alpha by monocytes, indicating cytokine-stimulating (immunostimulatory) activity, and to exert host-mediated antitumor effects in tumor-bearing mice.

Conclusions

A substantial number of mushrooms, among their thousands of species, have been known to ancient and modern societies for their culinary, nutritional and health value. The advance of scientific technology has revealed the nature of many of the substances that carry these useful properties. Today, there are a wide variety of fresh or "processed" mushrooms to choose from, but you may have to make an educated guess as to which mushrooms to eat or which mushroom capsules to take for your own health benefits. Hopefully this article would provide sufficient information to help you make the right decision when discussing mushrooms with your patients.

Although supermarket shelves display a wide variety of mushrooms for the dining table, some of them are inedible, as noted earlier, in the case of reishi. Nevertheless, the health food and nutritional supplement industries have seen to it that even these "inedible" mushrooms are available to consumers, in capsules or tablet forms for convenience. To further maximize their benefits, some mushrooms are also available as combinations of different mushroom extracts, as in the case of three-mushroom extracts of maitake, reishi and shiitake, or six-mushroom extracts of maitake, reishi, agaricus, cordyceps, lion's mane and silver ear.

References are available at todayschiropractic.com