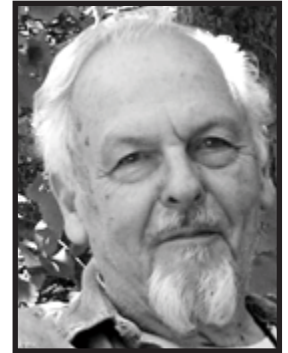


Introducing: The Mushroom Evibase

by Dr. James A. Duke
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The Mushroom Evibase is an independent database specifically focused on the phytochemicals, dosage, nutrients, medicinal activities, indications, habits, cautions and folklore of medicinal fungi. Containing over 400 species of fungi, this project, like my Phytochemical Database, strives to create a searchable database to allow research and stimulate investigation. A researcher can locate known fungal species with beta-secretase 1 (BACE1) actions, search for mycochemicals within a specific genus, or look for associations in medicinal action and mycochemicals. Presently in development, the Mushroom Evibase is projected to be available early in 2015.

From the common culinary button mushroom (*Agaricus bisporus*) to the rare Taiwanese *Antrodia*, our understanding of mushroom medicinal activity is both ancient and new. Mushrooms are known to possess immunomodulating, analgesic, antibacterial, anti-viral, anti-tumor, antimicrobial, antioxidant, lipidemic, cardiogenic, antifungal (yes, even anti-fungal!), and hepatoprotective properties, as well as toxic ones (Duke & Bennett 2014). (We should never forget that some species are VERY toxic.)

According to the Agricultural Resource Marketing Center (ARMC 2014), over 2,000 mushroom species are considered edible. French markets have as many as 72 species available

for sale. In the United States, 2012-2013 sales of edible mushrooms totaled \$1.11 billion (ARMC 2014). Our interest in mushrooms, both culinary and medicinal, appears to be growing.

Common Medicinal Properties of Fungi (and Other Considerations)

Fungi are fantastic immune modulators. They stimulate, calm and bring our immune systems into balance. Many species have been found to be immune-active: *Agaricus*, *Albatrellus*, *Armillaria*, *Auricularia*, *Bjerkandera*, *Calvatia*, *Cordyceps*, *Phallus (Dictyophora)*, *Flammulina*, *Fomes*, *Fomitopsis*, *Ganoderma*, *Grifola*, *Hericium*, *Inonotus*, *Lentinula*, *Lentinus*, *Lenzites*, *Lycoperdon*, *Lyophyllum*, *Marasmius*, *Morchella*, *Paxillus*, *Peziza*, *Phallus*, *Phellinus*, *Piptoporus*, *Polyporus*, *Poria*, *Schizophyllum*, *Sparassis*, *Trametes*, *Tremella*, *Tricholoma*, *Volvariella*.

Mushrooms play various roles in the prevention and management of cancer. At the Psychedelic Research Group at New York University, Dr. Stephen Ross uses the *Psilocybe*-derived compound psilocybin to treat anxiety in cancer patients (Sarris, McIntyre and Canfield 2013; Morin 2014). The FDA has approved a clinical trial of *Trametes versicolor* (turkey tail) for treatment of cancer at the Bastyr Integrative Oncology Research Center (Torkelson et al 2012). Many medicinal fungi contain ergothioneine, a powerful antioxidant (Cheak & Halliwell 2012; Duke & Bennett 2014).

In his distinguished career, James Duke served the US Department of Agriculture for over 30 years. Before retiring, he developed his online ethnobotanical and phytochemical database. It is one of the most frequently consulted areas of the USDA website. Duke grows hundreds of plants on his six-acre Green Farmacy Garden with his wife, Peggy. Since retiring from the USDA, Dr. Duke served for five years as Senior Science Advisor to Nature's Herbs and with allherb.com. Since 2001, he has been a distinguished herbal lecturer at Tai Sophia Healing Institute (now Maryland University of Integrative Health). He has written over 30 books on medicinal plants.

Kathleen Bennett is a researcher for the Mushroom Evibase. She has been working with Jim Duke on this project since 2013.

Additionally, mushrooms have been shown to activate alternative complement, protect gastric tissue, support bone health, increase the absorption of nutrients, enhance liver function, and modulate the hypothalamic-pituitary-adrenal (HPA) axis.

Mushrooms are also great bioaccumulators. A recent study found that an aqueous extract of *Tricholoma matsutake* yielded the following nutrients: tyrosine, cytidine, uridine, eritadenine, phenylalanine, nicotinamide, inosine, guanosine, tryptophan, adenosine, 5'-deoxy-5'-methylthioadenosine and riboflavin (Ying et al 2013). Because of their ability to uptake nutrients or other compounds from their surroundings, substrates on which mushrooms are grown are important. *Lentinus sajor-caju* grown on coffee pulp were able to uptake caffeine (Fan et al 2006; Ramirez, Angarita and Zuloaga 2007). On the not-so-positive side, mushroom growers often focus more on yield rather than constituents. Commercial mushroom farming studies often focus on evaluating mushroom harvests in terms of percentage yields across different substrates and don't test for nutrients or medicinal potency (Pala, Warri and Mir 2012).

On the downright scary side, both edible and medicinal mushrooms are also known to take up heavy metals and radioactive compounds (de Roman, Boa and Woodward 2006). While this ability has potential use in decontaminating soils and environments, we must be careful that they do not enter our diets. Dioscorides echoed this when he wrote: "Poisonous mushrooms grow where the lion has lain, or on rotted clouts, or near serpent dens or on trees that bear poisonous fruit." In other words, if the environment or substrate is toxic, the mushrooms growing there may be toxic as well.

Medicinal Mushrooms of the United States

Seven of the most popular medicinal mushrooms in the United States are: reishi (*Ganoderma lucidum*), matsutake (*Tricholoma matsutake*), maitake (*Grifola frondosa*), shiitake (*Lentinula edodes*), button mushroom (*Agaricus bisporus*), turkey tail (*Trametes versicolor*), and lion's mane (*Hericium erinaceus*). A short

discussion of each follows, culminating with an abbreviated sample write-up on shiitake from the upcoming Mushroom Evibase.

***Agaricus bisporus* (Button mushroom)**

This supermarket staple is perhaps best not eaten raw. Author Denis Benjamin (1995) laments that modern chefs push raw or barely seared mushrooms, but all mushrooms should be well cooked. Unfortunately, analysis of *A. bisporus* has shown that this species activates the enzyme BACE1 which releases beta-amyloid peptide, associated with Alzheimer's disease. Other species considered to activate BACE1 are *Flammulina velutipes* (enoki) and *Lentinula edodes* (shiitake) (Bennett et al 2013). Benjamin (1995), having noted numerous studies of shiitake in Asia, comments: "In contrast, in the West, almost all the work on our favorite edible mushroom, *Agaricus bisporus*, has focused on its dangers. Once again, the fundamental difference between East and West in their approaches to medicine is underscored." Only recently have studies begun in the U.S. for button mushroom's possible health benefits (Xu, Beelman and Lambert 2012).

***Grifola frondosa* (Maitake)**

Some people believe that maitake (Japanese for "dancing mushroom") is so named because collectors danced with joy upon finding it (it was worth its weight in silver back in the old days in Japan). Others speculate that the name stems from the dancing appearance of the overlapping fruit bodies, like dancing butterflies. Japanese cultivators produced nearly 8,000 tons in 1990 (Hobbs 1996). Some maitake can be as heavy as a pumpkin, well worth the effort to transport it (Williamson 2002). Maitake may be of use for conditions of compromised immunity (Stamets 1993). The extract is hepatoprotective at 300 mg/kg; aqueous extracts have been shown to lower cholesterol (Hobbs 1996). At 250 ug/ml, the fatty acid fraction of maitake inhibited COX-1 98% and COX-2 99% and showed antioxidant activity (Zhang, Mills and Nair 2002).

***Ganoderma lucidum* (Reishi/Ling zhi)**

Reishi is arguably the most common medicinal mushroom in health food products throughout

the world (Hobbs 1996). *Ling zhi* purportedly stimulates sexual virility, especially in older men. For this purpose, the antler form is preferred (Stamets 1993). The antler form abounds on our wooden trail boundaries in Amazonian Peru, where I call them “Peruvian soldiers” because of their resemblance to soldiers with khaki or brown uniforms and white hats. None of my Peruvian guides knew about reishi in 1991 when I first visited. I’ll bet they tell visitors it is aphrodisiac in the new millennium, via ethnobotanical drift (Duke 2013). In Chinese medicine, several species are used interchangeably with *G. sinense* including: *Ganoderma tenue* (*mi wen bao shu’ zhi*), *G. capense* (*bao shu zhi*) and at least eight other *Ganoderma* species (Bensky, Claver and Stoger 2004). According to the ancient *Shennong Bencao Jing* (*Divine Farmer’s Classic of the Materia Medica*, ca. 300 ACE) there were six different types of *Ganoderma*, distinguished by color, each with slightly different properties (Bensky, Claver and Stoger 2004). Given the numbers of active compounds, a comparison between the species might be quite enlightening.

***Tricholoma matsutake* (Matsutake/ pine mushroom)**

Benjamin (1995) suggests that the most prized mushroom among the Japanese may well be the matsutake or pine mushroom which possesses a unique scent, that once smelled is never forgotten (although not everyone likes it). Pine mushroom (*Tricholoma matsutake*) grows on old pines and is believed to absorb the vital energy of these long-lived trees. Studies have shown matsutake extract to possess antitumor, antioxidant, and immunomodulating activities (Yang et al 2010; Wang et al 1995; Hou et al 2013; You et al 2013). *Tricholoma magnivelare* is considered to be the American matsutake (Benjamin 1995).

***Trametes versicolor* (Turkey tail)**

In 1987, polysaccharide Kureha (PSK aka KRESTIN) accounted for 25 percent of the Japanese national expenditure for anticancer agents (Hobbs 1996). In his book *Natural Compounds in Cancer Therapy*, John Boik (2001) begins his polysaccharides chapter with polysaccharide-rich herbs and features

the purified polysaccharides PSK and polysaccharide-P (PSP) derived from *Trametes*. He notes that such polysaccharides may increase production of immune-stimulating cytokines, generating cytokine cocktails (e.g. colony-stimulating factor, IL-1, IL-2, IL-6, interferons, TNF) that stimulate immune activity. More than 16 studies on PSK and/or PSP in vitro (and more than 39 in vivo) demonstrate their capacity to stimulate the immune system or inhibit cancer cell proliferation. Used in combination with chemotherapy, both seem to inhibit the immunosuppressive side effects of chemotherapy. In one human study, PSK at ~1 uM increased proliferation of lymphocytes 1.3-fold (average 1.4-fold). Natural compounds that are immunomodulating may be amphoteric, having both immunostimulating and immunosuppressant actions depending on dosage (Duke 2013). Additionally, Boik (2001) admits that higher doses of many herbal immunostimulants “may cause insomnia, increased heart rate, palpitations, hypertension, and general feelings of overstimulation, or all of these.”

***Hericium erinaceus* (Lion’s mane)**

The delicious lion’s mane mushroom is true food pharmacy (Facciola 1998)! This attractive toothy sporocarp is tasty when young, but sours with age. It may be cooked and seasoned with garlic after parboiling, imparting the flavor of lobster (Stamets 1998). Soak 60 dry grams in water until soft, then slice and decoct. Take twice daily with millet wine (Ying et al 1997). For debility and neurasthenia, slice 150 grams and cook into a chicken soup, taking twice daily (Ying et al 1997). Research has found lion’s mane to inhibit metastasis of cancer cells (Kim, Nam and Friedman 2013); other studies show that it is neurotrophic (Lai et al 2013), gastroprotective (Wong et al 2013), antihyperglycemic, and antihyperlipidemic (Liang et al 2013).

***Lentinula edodes* (Shiitake)**

Shiitake extracts showed greater antioxidant activity than alpha-tocopherol, butylated hydroxyanisole (BHA), butylated hydroxytoluene (BHT), and propyl gallate

at inhibiting lipid oxidation, based on lipid peroxidation, deoxyribose, and peroxidase. Shiitake is considered to act as a releaser/activator for BACE1 which releases beta-amyloid peptide associated with Alzheimer's disease in the brain (Bennett et al 2013).

Following is an abbreviated example of just one of over 400 formatted write-ups which can be searched manually or in a proprietary database for medicinal actions, indications and mycochemical associations available through the Mushroom Evibase. Numbers preceded by "X" are searchable PubMed identification numbers and are live links online. Some activities and indications are tagged with "f" for folklore, "1" for scientific study, or "2" for clinical trial. For the full write-up, visit the *Journal* page at www.americanherbalistsguild.com.

If you have questions about the Mushroom Evibase, or if you would like to have a search performed, please contact researcher Kathleen Bennett directly at katroving@hotmail.com.

Shiitake (*Lentinula edodes* (Berkeley) Pegler)

"Black Forest Mushroom" (Eng.; GOU); "Black Mushroom" (Eng.; GOU); "Chinese Mushroom"

Mushroom Evibase Acronym Guide

References in the Evibase are assigned an acronym matched to an author or study. Following is a brief guide to the ones appearing in the shiitake entry sampled here. Full references can be found at the end of this article.

APA (American Pharmaceutical Association 1998)
 DRB (Benjamin 1995)
 FAC (Facciola 1998)
 GOU (Stamets 1993)
 HH3 (Blaschek et al 1996)
 HOB (Hobbs 1996)
 JAF49:2343 (Mattila et al 2001)
 JAF50:5333 (Brauer, Kimmons and Phillips 2002)
 SAY (Foster & Yue 1992)
 SKY (Liningner 1998)
 WAM (White & Mayor 1998)
 YIN (Ying et al 1997)

(Eng.; GOU); "Don-Ku" (Chi.; GOU); "Dried Mushroom" (Eng.; HH3); "Forest Mushroom" (Eng.; HH3); "Hongo Shiitake" (Sp.; HH3)...

SYN.. *Agaricus edodes* Berkeley; *Armillaria edodes* (Berk.) Sacc.; *Collybia shiitake* Schroet.; *Cortinellus berkeleyanus* Ito & Imai.; *Cortinellus edodes* (Berk.) Ito & Imai.; *Cortinellus shiitake* (Tanaka) P. Henn.; *Lentinus edodes* (Berkeley) Singer; *Tricholomopsis edodes* Sing. (fide HH3)...

ACTIVITIES (Shiitake): Adaptogenic (f; HOB); Allergenic (1; X11030382; X11466919); Antiaggregant (1; X8717283); Antibiotic (X19161947); Anticancer (1; SAY; X20574918); Anticaries (1; X10601791); Antiendotoxic (1; HOB); Anti-fatigue (X19643126)...

INDICATIONS (Shiitake): Anemia (f; APA); Bacillus (1; SAY; X11137653); Bacteria (1; SAY; X19161947); Bronchosis (1; HOB); Cachexia (X20574918); Cancer (1; APA; SAY; SKY); Cancer, breast (1; hob; SKY); Cancer, cervix (1; SAY)...

DOSAGES (Shiitake): Food pharmacy!!! (FAC); Flesh tough but certainly edible, eaten raw in salads or broiled, fried, oil-roasted, or in soup. Dried mushrooms may be used after soaking in warm water, or shredded up and added to soup stock. Cooked in gravies, omelettes, pastas, sauces and teas. Classified into *donko*, *koko* and the former being most prized (and expensive) (FAC). Almost essential in some Japanese sushi and Kwantang-style Chinese dishes. (FAC). 1-3 606 mg capsules up to 3x/day (APA); 1-3 g *Lentinula edodes* mycelium; 6-16 g mushroom/day (SKY); extract 2-3x/day (SKY); 2-4 ml tincture (SKY); 6-16 g dry fungus/day, ca 90 g fresh (HOB).

DOWNSIDE (Shiitake): Class 1 (AHPA, 1997). No contraindications known (WAM); safety during pregnancy not established (SKY); high dosages may induce bloating and diarrhea (SKY). Allergenic (HOB). People who bleed easily or are taking blood-thinners should reconsider before taking shiitake or its water soluble fractions chronically (HOB). Analysis of *L. edodes* has shown that this species activates BACE1 which releases beta-amyloid peptide in the brain

(associated with Alzheimer's). Other species that are considered releasers/activators are *Agaricus bisporus* and *Flammulina velutipes* (X23662612).

NOTES (Shiitake): Growing on stumps of *Alnus*, *Carpinus*, *Castanea*, *Fagus*, *Pasania*, and *Quercus* in China, Japan and Vietnam (HH3) Shiitake extracts showed greater antioxidant activity than alpha-tocopherol, BHA, BHT, and propyl gallate at inhibiting lipid oxidation, based on lipid peroxidation, deoxyribose, and peroxidase. In decreasing antioxidant capacity, *Cantharellus*, *Agrocybe*, *Lentinus*, *Terfezia*, *Picoa*, *Lepista*, and *Hydnum*. X12380748

EXTRACTS (Shiitake): LEM used for recurrent stomach cancer in Japan, increasing survival rate, especially in combination with chemotherapy. The antiaggregant activity of extracts had IC₅₀=80 ug/ml (X7196068). MGN-3 Extract -Immune support (X22433044). ADENINE Hepatoprotective HH3 YIN ALUMINUM 1,820 PL HOB AMINES PL HH3 6-AMINO-9H-PURIN-9- PROPANIC-ACID PL HH3... ■■

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