

# *Medicinal Mycology*



# MUSHROOMS VS. MYCELIUM: CHOOSING THE BEST MEDICINAL

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## THE HEALTH BENEFIT CONTROVERSY SURROUNDING MUSHROOM FRUITING BODIES VERSUS MYCELIUM—OUR EXPERT REPORTS ON WHAT IS KNOWN

**T**hey say it is important to respect traditions. But they also say doing the same thing over and over again, expecting a different outcome, is a sign of insanity. Which brings us to the task at hand: trying to decipher the evidence surrounding medicinal properties from different mushroom products. Where does the marketing stop, and the science begin?

The use of medicinal mushrooms has a long tradition in Asia, going back thousands of years. And in traditional medicinal systems, the fruiting body was the part wild-harvested (or cultivated) and prepared or eaten for its health benefits. After maturation, the fruiting body was dried and later decocted, or made into a wine tonic with a low percentage of alcohol. The fruiting bodies contain important medicinal compounds including beta-glucans, triterpenoids including ergosterols, nucleosides and various secondary metabolites.

Early research focused on these compounds in well-known mushroom fruiting bodies including reishi, turkey tail, maitake, shiitake; and later in cordyceps, lion's mane and others. Compounds from over 500 mushrooms and mycelium have now been identified and published in various journals.

This is all good, and this research has led to a rapid growth of commercial medicinal mushroom production in North America. But many of the products readily available to consumers on this continent are either combinations of fruiting body and mycelium extracts; or solely mycelium. Mushrooms have long been grown as mycelium in culture for health, and food flavorings, especially in Japan.

And herein lies the problem. Fruiting body exponents argue mycelium products contain very little beta-glucan or triterpenoid content and are an unproven or inferior product. Now, the mycelium is the actual living organism,

and the fruiting body, if you will, is the reproductive structure that pops up to produce spores and continue the life cycle. Research in the past two decades suggests the organism does contain some valuable compounds, but rather different than the fruiting body. An analogy would be an apple tree and the fruit itself.

Mycelium can grow and develop for years, often competing in a hostile environment of bacteria, viruses and other fungi ready to consume it at first chance. It creates and develops compounds to protect itself, eventually fruit (thus reproduce sexually) and continue its life cycle. Some mature fruiting bodies are keenly adept at attracting animals (insects, mammals, and birds) that will help spread the spores.

There are several issues of concern to consumers of commercial products. Total polysaccharide tests measure all sugars, not just beta-glucans. One mushroom product company currently advertises their products contain 40% polysaccharides. So what? Currently there is no beta-glucan test approved by the Association of Official Analytical Chemists. A test frequently used to directly detect beta glucans is not available, and it cannot distinguish between grain starches and those produced by fungal mycelium ingesting the grain. These converted starches do provide immune benefit. Jeff Chilton, president of Nammex, a reputable organic medicinal mushroom company, believes the presence of beta-glucans, identifies a quality product.

A testing method designed for measuring beta-D-glucans in mushrooms and yeast was developed by Megazyme International in Ireland. It has been used by the USDA, and various scientific researchers to test for mushroom beta-glucans. Jeff tested both fruiting bodies and mycelium products on the market and published

a paper called "Redefining Medicinal Mushrooms: A new scientific screening program for active compounds." The valuable, full report is available for free download at [www.nammex.com](http://www.nammex.com).

The above mentioned test, however, cannot differentiate between beta glucans from mushrooms or yeast, which could be used as an adulterant to "top up" the beta glucan percentage. Individuals with yeast sensitivities, including *Candida albicans* over-growth would be at significant allergenic risk.

There are numerous studies of mycelium grown on grain and their clinical application. And mycelium does indeed contain beta glucans, albeit at a lower level than fruiting bodies. Work by Bak et al. (2014) found stipe and pileus of shiitake fruiting bodies showed beta glucan in the range of 29-56%, while mycelium ranged from 15-27%. Note the low range of the former and top range of the latter. Chaga mycelium grown on rice was found to reduce oxidative stress in lymphocytes from irritable bowel disease patients (Najafzadeh et al., 2007). What can be significant is the manner in which extraction methods affect biological activity (Coy et al., 2015). A number of compounds identified in ethanol/water extracts show activity at very low concentrations. "The protein coding genes [in *Ganoderma lucidum*] were expressed higher in mycelia or primordial stages compared to those in fruiting bodies" (Li et al., 2013). This work suggests mycelium contains substances that are not yet fully identified, nor their potential benefits.

And while beta-glucans are important, not all are the same, and may not be the active ingredient, in some cases. Recent work suggests lipids present in mushroom products contribute to previously thought benefits attributed to beta glucans. PSK, for example, derived from turkey tail (*Trametes versicolor*) mycelium, was found to be significantly



“Good and good for you! Cultivated *Hericium* sp. fruit body, in culture, and fruit body made into delicious soup.”

less effective as TLR2 agonist when lipids were removed (Quayle et al., 2014). Fucose is neither a beta-glucan nor a true starch, but is a prominent sugar in turkey tail and reishi mycelium. Also found extensively in seaweed, this compound has valuable medicinal properties but is not measured in many laboratory tests on mushrooms. One study found 1-fucose induced antibodies against lung carcinoma cell lines (Liao et al., 2013).

The benefits of mycelium grown on grain and recent scientific articles can be found at [www.mushroomreferences.com](http://www.mushroomreferences.com).

So what do consumers look for if they wish to purchase a quality medicinal mushroom product? It would appear both fruiting bodies and mycelium have much to offer. The latter is significantly less costly to produce, so is often found in many encapsulated products. Some growers combine extracts of both fruiting body and mycelium and then sell the bulk product to companies to bottle and identify with a brand name.

I have seen products on market that advertise micronized (nano-particles) powdered product, in attempts to convince consumers the product is superior regarding absorption and myco-availability to body. This is very interesting as beta-glucans and other polysaccharides are too large to pass from the intestinal tract into the blood stream. Lion's mane (*Hericium* spp.) may be the notable exception, as the active compounds are water soluble and do



Heridium teeth in sumashi broth.

cross the blood-brain barrier.

Another significant factor, regarding quality, is product coming from China. This country produces around 80% of the world's mushrooms. Analysis of ORGANIC CERTIFIED fruiting body hot water extracts show extremely high levels of heavy metals, including lead, cadmium and arsenic and a banned fungicide in products destined for shelves. Carbendazim is a fungicide that should not be consumed in food, according to the FDA, if levels exceed one part per billion. One Chinese hot water mushroom extract tested, showed 50 parts per billion, as well as the known endocrine disruptor endosulfan at 100 part per billion. This toxin is globally banned by the Persistent Organic Pollutants Review Committee of the Stockholm Convention, as it is toxic to bees and other beneficial insects. Companies purchasing medicinal mushroom products from China would be well advised to do their own third party testing, and put little faith in organic certifying parties from that part of the world. I love medicinal mushrooms. But when I see a large bag of dried shiitake mushrooms, in an oriental food store, and for an unbelievably cheap price, I

have to walk away.

Dr. Solomon Wasser (2014), Editor in Chief of *The International Journal of Medicinal Mushrooms* and author of over 600 papers on the subject, writes “It is not known whether bioactive effects are caused by a single component or are the result of a synergistic impact of several ingredients. There is insufficient data to determine which components have better effects—those from mushroom fruiting bodies or from submerged mycelia powder versus extracts.”

**Some products labelled ORGANIC CERTIFIED show high levels of heavy metals, including lead, cadmium and arsenic, and a banned fungicide.**

As for my personal take on the fruiting body/mycelium controversy?

I consume both, the latter powder in vegetable and fruit smoothies in the morning and the former in tincture or extract form, when I feel the need. Being a thrifty bio-regional myco-herbalist, I harvest and prepare local fruiting bodies, including chaga, red belted conk, *Ganoderma tsugae*, and turkey

tail when available. I now juice fresh *Hericium* and freeze it in ice cubes for later use. And, of course, I regularly purchase fresh organic oyster, shiitake, crimini and enoki, produced in North America, for my dinner plate. Both have their place, so why not take advantage of these fabulous fungi as part of a healthy dietary regimen?

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