

Mycelium is Medicine

An introductory guide to the medicinal
properties of fungi & techniques for
integrating their healing into humyn lives



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HARMONIC MYCOLOGY

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The interwoven stories of fungi and humyns are truly ancient and endlessly fascinating. For as long as humyns have lived, we have lived beside the fungi. We have consumed them as food and medicine, allied with them in the arts of fermentation (beer, bread), and been awe-struck by their capacity to unveil the numinous in shamanic ceremony – enabling the temporary dissolution of humyn concerns and the blossoming of ecological awareness. In these early days of the 21st Century we have begun to remember the humble intelligence of fungi and to understand their extraordinary capacities for filtration, remediation and fabrication. We stand on the precipice of a quantum leap in the sophistication of humyn-fungal techniques and technologies. What role will you play in this interspecies alliance?

Mushrooms in the archaeological record

- Tassili n'Ajjer

A national park in the Sahara desert (Algeria) featuring over 15,000 cave paintings and engravings. Several artworks depict mushrooms and mushroom-covered humanoids. These are the oldest currently-known artistic representations of mushrooms, dating between 7,000 – 9,000 years old.

- “Ötzi the Iceman”

The well-preserved body of a man was found in the Ötztal Alps, on the border of Italy and Austria, in 1991. Europe's oldest known humyn mummy, he is believed to have lived between 5,000 & 5,400 years ago. Among his possessions were two species of polypore mushrooms: the birch polypore (*Fomitopsis betulinus*) – known to be antiparasitic & the tinder fungus (*Fomes fomentarius*) – likely carried as tinder for fire-making.

- Mushroom stones Over 300 carved stones have been identified from the Mayan culture of contemporary Central America, featuring humyn & animal figures with mushroom caps above their heads. These stones are dated to approximately 2,500 – 3,000 years old.

Six species of fungi are included in an ancient text on Chinese herbal medicine, the *Shennong Bencaojing*, believed to have been written in the 28th Century BCE. The medicinal use of mushrooms also features in the writings of Hippocrates – commonly referred to as the father of Greek medicine – and Dioscorides.



Lords of Xibalba represented with mushrooms in the Mayan *Codex Vindobonensis*

WORKING WITH MEDICINAL MUSHROOMS

Mushrooms and mycelium can be prepared for use by employing one of several techniques, the most basic and common of which is cooking. These preparatory processes ensure some or all of the fungal medicinal constituents are accessible to our bodies.

Ways of using mushrooms medicinally

- Tincture (alcohol extraction)
- Tisane (hot-water extraction)
- Cold-water soak
- Cooked (as main ingredient or additive)
- Juicing
- Oil or fat extraction (useful for cosmetics & external applications)
- Liquid culture (drink or dehydrate)



Reishi (*Ganoderma lucidum*) mycelium growing on organic wheat grain

HOW TO DRY & STORE MUSHROOMS

1. Clean (brush or wipe with damp cloth)
2. Place in sunshine, gill- or pore-side up for 30 minutes
3. Slice or tear into thin strips
4. Dehydrate in a food dehydrator / biltong maker **OR**
Place on a baking tray and oven-dry at low temp (50 - 100C for 1 hour or until cracker-dry)
5. Store in a clean, air-tight container (glass is best) and label with species, source / location and date (cool darkness is best for long-term storage)

Myceliated grain

Cultivating mycelium on sterilised grain provides a cheap and easy way to access the medicinal properties of a wide range of fungi. In fact, most capsule-based mushroom supplements on the market are simply composed of powdered, myceliated brown rice. This simple process really only requires glass jars, grain (rice, wheat, rye), a pressure cooker and a starter liquid culture (the initial mycelium) - plus a few other odds & ends. Once the mycelium has grown through the grain it can be cooked or baked for direct consumption ('space cakes' a la Tradd Cotter) or dehydrated and powdered for use in soups, smoothies, capsules etc. When it comes to powdering the myceliated grain, the general rule is: the finer, the better. A flour mill / stone mill will produce the finest grind. This process breaks the chitin in the fungal cell walls and makes the medicinal polysaccharides bioavailable.

LIQUID EXTRACTIONS

Liquid extractions come in three main forms: cold-water, hot-water & alcohol (tincture). A dual-extraction is the combination of a tincture and hot-water extract. Since some of the medicinal constituents of mushrooms are water-soluble (polysaccharides) & others are alcohol-soluble (terpenoids), a dual-extraction is an excellent way to process, store & consume medicinal mushrooms or mycelium.

Note: When making a tincture, alcohol of 40% or higher is recommended (higher alcohol percentage = shorter extraction time). Vodka & gin both work well for making tinctures. Tinctures can be made with either fresh or dried material (dried mushrooms will absorb some of the alcohol, requiring more).

Super simple dual-extraction

1. Fill a glass jar half-full with mushrooms (small pieces or blended pulp)
2. Fill the jar with alcohol, leaving 1-2cm of space at the top
3. Place lid securely on jar & label with date, species & alcohol percentage
4. Store jar on a shelf and shake daily for 4-6 weeks (good vibes)
5. After a month, use a sieve to separate the alcohol and mushrooms
 - Pour alcohol (tincture) into a glass container and set aside
 - *Optional:* filter tincture through cheesecloth to remove particulate
6. Add water (spring or rainwater is best) to a pot and bring to a simmer
 - Use an amount of water equal to 1-2 times the volume of alcohol used to produce the tincture
7. Add the mushrooms from step 5 into the water. Simmer until the volume is approximately half that of the tincture (should take 1-2 hours)
 - If you started with 750ml alcohol, you're aiming for approximately 350ml tea
 - You can add additional water during the process if it evaporates very quickly
8. Turn off the stove and let the water cool
9. Use a sieve to separate the hot-water extract from the mushrooms
 - Compost the mushrooms
 - Filter liquid through cheesecloth to remove particulate
10. Measure final liquid quantities and write them down (both tincture & hot-water extract)
11. Combine the tincture & hot-water extraction
 - You should end up with a total alcohol percentage of 25-35% (shelf stable)
 - Use an alcohol dilution calculator, along with the volumes from step 10 to calculate the final percentage of your dual-extract
12. Store the dual-extraction in a dark-coloured glass container and place it in a cool, dark location
 - Dropper bottles work well for daily use
 - Large amounts can also be stored in clear-glass vessels in the fridge

LIQUID CULTURE (LC)

In addition to solid substrates such as grain, cardboard or sawdust, mycelium can also be grown in a liquid medium (sometimes referred to as 'submerged fermentation'). Put simply, a liquid culture (LC) is mycelium growing in sugar water. This inexpensive and simple approach to cultivation can be carried out over relatively short durations (4-8 weeks) - making it an excellent technique for the home-scale cultivator. As the mycelium grows it releases enzymes and medicinal sugars into the liquid medium contained within a glass jar. Notable compounds released in liquid culture are LEM, LAP, Schizophyllan, PSK and PSP. It's important to note that the composition of the liquid culture medium (recipe, pH, mineral supplementation, concentration of carbon & nitrogen) has a major impact on the medicinal production of the fungus.



Reishi (*Ganoderma lucidum*) mycelium growing in a 4% honey-water solution

Processing the mycelium and culture broth

1. Filter the liquid culture through a double coffee filter into a jar (optional: funnel)
 - Use multiple filtering jars to speed up the process
2. Remove the mycelium from the filter and place on a clean glass or ceramic dish to air-dry
3. Once dry, grind the mycelium into a fine powder using a coffee grinder, pestle & mortar or flour mill (the finer, the better)
 - More concentrated than myceliated grain – can be consumed directly or mixed with other extracts
4. Use a double boiler to reduce the filtered liquid from step 1 into a thick, sugary paste (vacuum distillation is another option)
5. Store the concentrated liquid (paste) in a dark-coloured glass container and place it in a cool, dark location

LC recipes (500 ml water)

[MDLC]

Dextrose – 1 Tbsp.
Light malt extract – 1 Tbsp.

[HLC]

Honey – 2 tsp. or 10 g

Place water in a metal pot & heat gently. Add ingredients to water and stir until dissolved. Pour solution into glass jars (half-full), secure lids and pressure cook for 20 mins at 15 psi.

MEDICINAL CONSTITUENTS OF FUNGI

Polysaccharides are complex, long-chain sugar molecules primarily found in fungal cell walls - where they may comprise up to 90% of the molecular architecture. They are generally found in greater quantity & diversity in mushroom fruit bodies as opposed to mycelium, with each fungal species exhibiting a unique blend. Mushrooms contain a mix of galactose, glucose, mannose & fucose, while mycelia primarily offer protein-containing glucans.

In terms of human health, polysaccharides enhance the body's ability to defend against many forms of disease, such as autoimmune disorders, viruses & various types of cancer. These effects occur largely through the activation of the body's major systems, including the hormonal, nervous, regulatory & reproductive systems (depending on species). Polysaccharides are non-toxic & place no additional stress on the body.

Two of the best studied examples of polysaccharides are lentinan, produced by Shiitake (*Lentinula edodes*), & schizophyllan, produced by the Split Gill mushroom (*Schizophyllum commune*). Both sugars seem to be T-cell oriented immunopotentiators that increase helper T-cell & macrophage production.

Some polysaccharides bind to proteins, forming a polysaccharide-protein complex (glycoprotein). Notable examples are PSK (Polysaccharide Krestin) & PSP (Polysaccharide Peptide), both produced by Turkey Tail (*Trametes versicolor*). Both glycoproteins have been shown to activate T-cells, monocytes & macrophages, as well as increase interferon-alpha & interleukin-2 production. Interestingly, PSK was the number one anticancer therapy in the world prior to the discovery of taxol.

Terpenoids are hydrophobic molecules, the presence and concentration of which differs across fungal species. This class of molecules generally confer anti-inflammatory effects and are able to calm an overactive immune system without suppressing it (useful in the case of allergies). Fungal terpenoids have also been shown to balance the body's systems during times of stress and fatigue.

Medicinal terpenes in mushrooms

Volatile monoterpenes & sesquiterpenes (essential oils)

- Research into the properties of fungal essential oils is still relatively sparse

Diterpenes

- Only a limited number of fungal diterpenoids have been assessed for medicinal properties
- Some confer antimicrobial or antitumor effects
- Includes the erinacines - produced by *Hericium erinaceus* and able to induce production of Nerve Growth Factor (can help in treatment of dementia and other nervous system disorders)
- Erinacine P is found in liquid culture broths of *Hericium erinaceus*

Non-volatile triterpenoids & sterols

- Triterpenoids are the most active and well-researched terpenes produced by fungi
- Reishi and Artist's Conk (*Ganoderma applanatum*) produce at least 100 different triterpenoids (some in fruit bodies and some in mycelium)
- Includes polyporenic acid - an anti-inflammatory produced by the Birch Polypore (*Fomitopsis betulina*)

Common Medicinals & Associated Benefits

| | anti-bacterial | anti-candida | anti-inflammatory | anti-oxidant | anti-tumor | anti-viral | blood pressure | blood sugar moderator | cholesterol reducer | immune enhancer | cardio-vascular | kidney tonic | liver tonic | lungs/respiratory | nerve tonic | sexual potentiator | stress reducer |
|---|----------------|--------------|-------------------|--------------|------------|------------|----------------|-----------------------|---------------------|-----------------|-----------------|--------------|-------------|-------------------|-------------|--------------------|----------------|
| <i>Agaricus blazei</i> (Himematsutake) | | | | | T | T | | T | | T | | T | | | | | |
| <i>Cordyceps sinensis</i> (Cordyceps) | T | | | T | T | T | T | T | T | T | T | T | T | T | T | T | T |
| <i>Ganoderma applanatum</i> (Artist's Conk) | T | T | | T | | | | | | | | | | T | | | |
| <i>Ganoderma lucidum</i> (Reishi / Ling Chi) | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T | T |
| <i>Ganoderma oregonense</i> (Oregon Reishi) | T | | | | T | | | | T | | T | | | T | T | | |
| <i>Grifola frondosa</i> (Maitake) | T | T | | | T | T | T | T | | T | T | | T | | | | T |
| <i>Hericium erinaceus</i> (Lion's Mane) | T | T | | | T | | | | | | | T | | | | | |
| <i>Lentinula edodes</i> (Shiitake) | T | T | | | T | T | T | T | | T | T | T | T | | T | T | T |
| <i>Pleurotus ostreatus</i> (Oyster Mushroom) | T | | | | T | T | | | T | T | | | | | | | T |
| <i>Trametes versicolor</i> (Turkey Tail / Yun Zhi) | T | | | | T | T | T | | | | T | T | T | | | | |

NOTABLE SPECIES

Reishi / Ling Zhi (*Ganoderma lucidum*)

- Highly revered in Chinese & Japanese medicine for centuries
 - One of the only Three Treasure tonics in TCM: believed to nourish the Jing ('essence'), Qi ('life force') and Shen ('spirit') energies
- First recorded mention of Ling Zhi was in the era of the first emperor of China, Shinghuang of the Ch'in Dynasty 221-207 BCE
- Produces over 200 polysaccharides & 150 triterpenes
- Anti-bacterial, anti-viral, anti-inflammatory & anti-oxidant
- Radioprotective: guards against harmful effects of UV radiation to skin & DNA
- Activates human immune cells: macrophages, NK & cytotoxic T-cells, on a dose-dependent basis
- Exceptional heart tonic
 - Lowers serum cholesterol levels, enhances myocardial metabolism, improves coronary artery function
- Adjunct use of reishi may augment chemotherapeutic drugs to treat cancer & may extend their effectiveness
 - Decreases side-effects of chemotherapy drugs & protects healthy tissues



Turkey tail (*Trametes versicolor*) mushrooms growing on a tree stump in Constantia, Cape Town

Cordyceps (*Cordyceps sinensis* & *Cordyceps militaris*)

- Cordyceps species are entomopathogenic fungi (they grow from the bodies of dead insects) - over 200 such species are known to science
- First written description comes from the Tang Dynasty of China 620 CE
- While *Cordyceps sinensis* has received the most attention in terms of medicinal use & research, *Cordyceps militaris* is currently rising in popularity
- Contains Cordycepin which has shown anti-tumor, anti-bacterial, anti-fungal & anti-viral effects
- Minimises fatigue, increases stamina & blood oxygen levels, increases libido & / or sperm count
- Myceliated grain spawn may contain 5-20% fungal polysaccharides

Lion's Mane (*Hericium erinaceus*)

- Outstanding edible mushroom, highly regarded for lobster-like flavour
- Fruit bodies are approximately 20% protein by weight
- Contains compounds known as Erinacines, isolated from the fruiting body, and Hericenones, isolated from the mycelium
 - Stimulate Nerve Growth Factor (NGF) production, increase neural functionality, repair damaged neural tissue & function as active antioxidants
 - Both are alcohol soluble (hydrophobic)
- Significant anti-fatigue effects & acceleration of wound healing found in research conducted on rats

Turkey tail (*Trametes versicolor*)

- Perhaps the most widely distributed of all major medicinal mushrooms
- Revered as a mushroom of endurance by ancient Taoists, capable of collecting yang energy from long-lived trees
- Has been researched more than any other medicinal mushrooms
- Contains Polysaccharide Krestin (PSK) & Polysaccharide Peptide (PSP)
 - Both shown to activate T-cells, monocytes & macrophages, while increasing interferon-alpha & interleukin-2 production
- Widely used in China and Japan as an adjunct therapy for the treatment of gastric, esophageal, colorectal, breast & lung cancers
- Shown to boost immune cell production, ameliorate the side effects of chemotherapy & radiotherapy, & significantly increase the survival rates of all stages of cancer patients

IMMUNE SYSTEM

Since many of the beneficial effects of medicinal mushrooms occur through modulation of the human immune system, it can be useful to have a basic understanding of the cells which make up that system. This simple reference guide may prove particularly helpful when reading scientific journal articles detailing the effects of constituent molecules from medicinal fungi.

Natural Killer (NK) cells

- Important for recognizing and killing virus-infected cells or tumor cells
- Filled with proteins that can form holes in the target cell and also cause apoptosis
 - Apoptosis, unlike necrosis, does not release danger signals that can lead to greater immune activation and inflammation
- Through apoptosis, immune cells can discreetly remove infected cells and limit bystander damage

B-cells

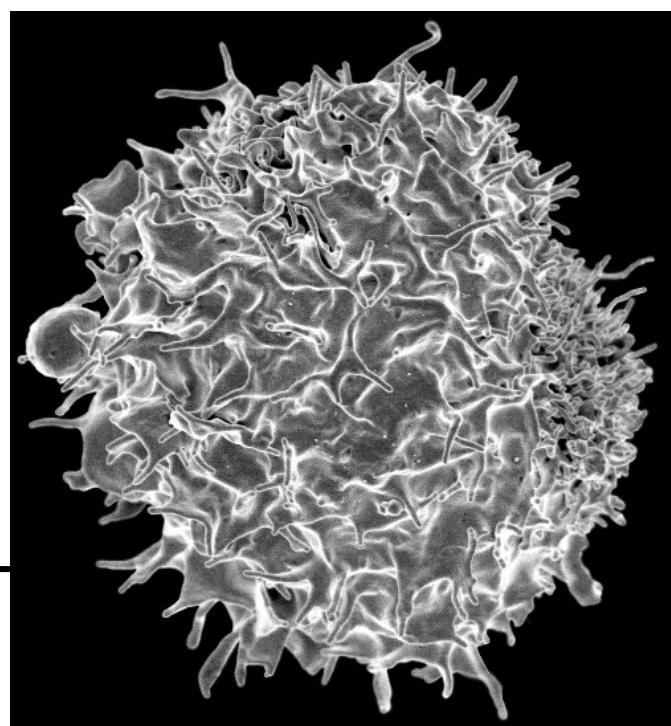
- B-cells have two major functions: They present antigens to T-cells, and more importantly, they produce antibodies to neutralize infectious microbes

Phagocytes (macrophages, monocytes and neutrophils)

- Protect the body by ingesting harmful foreign particles, bacteria, and dead or dying cells
- Pivotal cells for controlling the initial response to infection, and initiating, sustaining, or resolving inflammation

Immune signaling proteins (cytokines)

- Small proteins with diverse functions
- Important for immune cell growth, activation, and function
- Interferons
 - Necessary for immune-cell activation
 - Made and released by host cells in response to the presence of viruses (they 'interfere' with viral replication)
 - Virus-infected cells release interferons which cause nearby cells to heighten their anti-viral defenses
 - Interferons also activate immune cells such as NK cells and macrophages
 - Type II interferon is important for antibacterial responses
- Interleukins
 - Promote development and differentiation of T and B-cells
 - Vital to the correct functioning of the human immune system (deficiencies can result in autoimmune diseases)
- Tumor Necrosis Factor (TNF)
 - Family of cytokines which stimulate immune-cell proliferation and activation
 - Critical for activating inflammatory responses



Scanning Electron Micrograph (SEM) of a T-cell (credit: NIAID)

RESOURCES

BLOGS

Female & Fungi - Mara Fae Penfil
[<https://femaleandfungi.com/>]

Forest Floor Narrative - Phil Pinzone
[<https://www.forestfloornarrative.com/>]

Mycopigments: An Exploration of Mushroom and Lichen Dyes - Alissa Allen
[<http://mycopigments.com/>]

Fungi for the People - Ja Shindler
[<https://fungiforthepeople.org/>]

BOOKS

Radical Mycology: A Treatise on Seeing & Working with Fungi - Peter McCoy (2016)

The Psilocybin Mushroom Bible: The Definitive Guide to Growing and Using Magic Mushrooms - Virginia Haze and Dr. K. Mandrake, Ph.D. (2016)

Organic Mushroom Farming and Mycoremediation: Simple to Advanced and Experimental Techniques for Indoor and Outdoor Cultivation - Tradd Cotter (2014)

Growing Gourmet and Medicinal Mushrooms - Paul Stamets (2000)

Psilocybin Mushrooms of the World: An Identification Guide - Paul Stamets and Andrew Weil, M.D. (1996)

VIDEOS

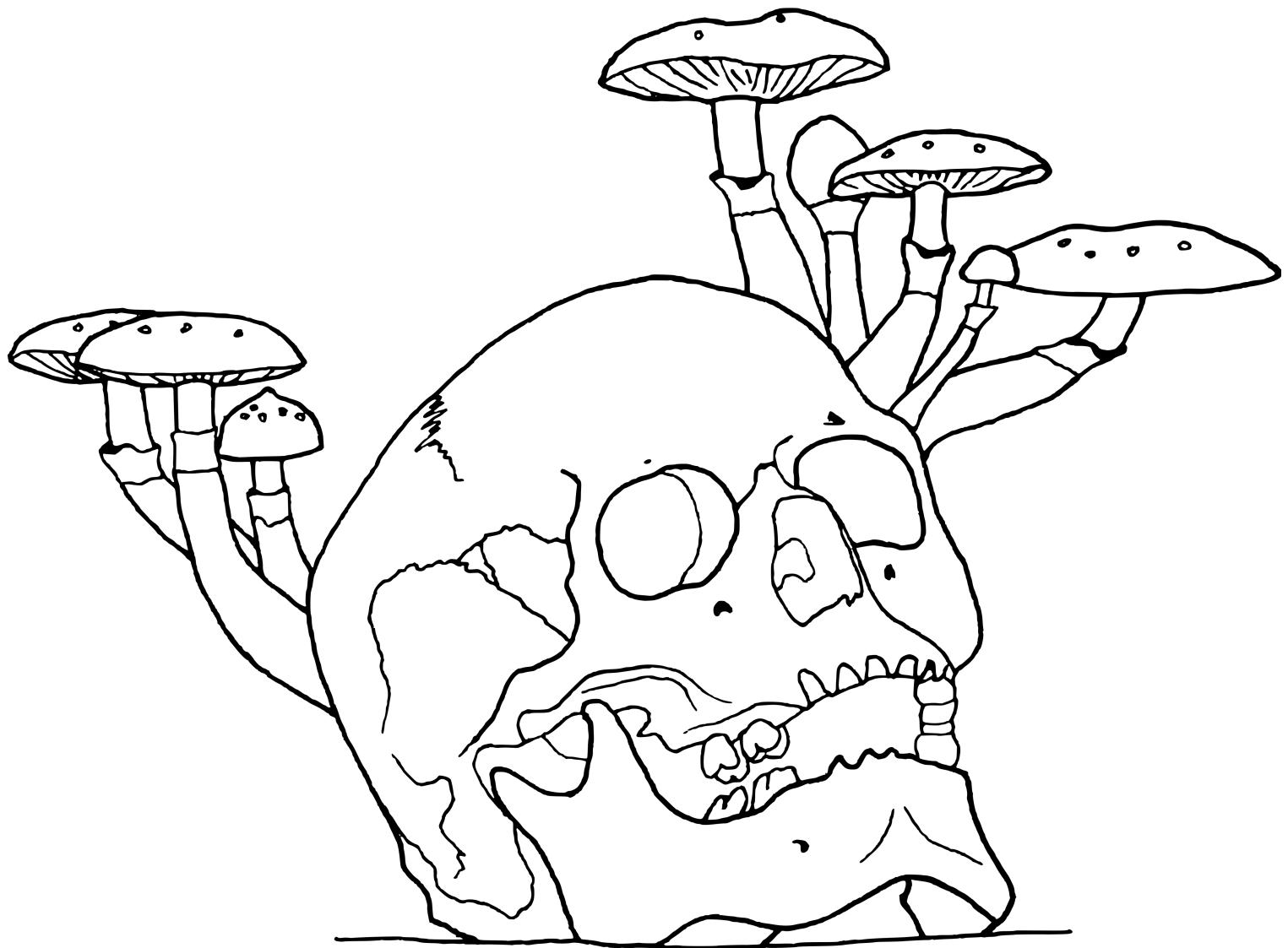
Gary Lincoff - Magic Mushrooms: Mushrooms That Heal Body and Soul (Telluride, 2010)
Shroomfest 2013 James Wieser: Growing Mushrooms at Home
Mushrooms as Medicine - Paul Stamets (November, 2014)
Radical Mycology Webinar 1: Seeing Fungi (June, 2016)

WEBSITES

Memorial Sloan Kettering Cancer Center: Search About Herbs
[<https://www.mskcc.org/cancer-care/diagnosis-treatment/symptom-management/integrative-medicine/herbs/search>]

Mycologos: Mycology Education and Research
[<https://mycologos.world/>]

NOTES



Death is not the End

Version 1.1

July 2019



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