THE All-in-One, Do-It-Yourself Learn-As-You-Grow GOURMET MUSHROOM KIT

A hands-on crash course in mushroom cultivation

www.fungaia.life

Dear Fungaian,

What a joy! You are a symbiont with the mycosphere.

This kit is meant to provide you everything you need to grow your own Reishi mushrooms at home. As your mushrooms grow, so may your love of all things fungi. Hopefully this experience will inspire many future mycological endeavors. No matter how far you choose to wander down this path, there is truly no end to the knowledge that awaits your discovery.

This guide will get you started, but if you are new to mushroom cultivation and wish to pursue it further, the best first step is to invest in some well-rounded literature on the topic. Two great books filled with indispensable information for do-it-yourself mushroom growers are Radical Mycology by Peter McCoy and Organic Mushroom Farming and Mycoremediation by Tradd Cotter.

The enclosed liquid culture syringe contains living mushroom mycelium. You can store it in the refrigerator until you are ready. Use it promptly for best results.

Thank you for taking the time to learn, grow and share the joy of fungi. The world could use a lot more people like you. Keep it up!

Mush love...

In this kit you will find:

- A liquid culture syringe with a sterile needle
- A bag of sterilized, organic mushroom substrate and grains
- A small spray bottle
- Isopropyl alcohol wipes
- A plastic humidity tent

Contents

A Crash-Course in Mycology

Some Fundamentals

Mycology is the study of fungi. Some of the most adaptive and versatile organisms in the universe, fungi are a backbone of the biosphere and a cornerstone of civilization. As decomposers, they are the architects of succession, playing vital roles in the continuity of the cycles of life. Though they are intimately involved in nearly every living system, the intricacies of fungal ecology are still largely shrouded in mystery.

Mushrooms have been prized for their flavor, nutrition and medicinal benefit by nearly every culture in human history. The word "mushroom" is often used in a general sense to describe a fungus, but strictly speaking, a mushroom is actually an ephemeral *fruiting body,* a growth produced by a fungus for the purpose of reproduction.

While mushrooms usually emerge aboveground, the majority of the organism remains under the surface, or invisibly intermingled with plants. The bulk of a multicellular fungus is called *mycelium*. Mycelium is a dense network of microscopic cellular fibers, called *hyphae*. A single hypha is too small to see without a microscope, but when many are woven together to create mycelium, the fibers can be easily observed, often forming dense dendritic ribbons or cloud-like cottony tufts.

Cultivation Basics

Mushroom cultivation is a form of symbiosis. The cultivator sets the scene for fungal reproduction, and in return receives beneficial food-medicine. The basic process is simple. It begins with introducing either the spores or the mycelium of a chosen fungus into a prepared *substrate*, a mixture of the species' preferred food, such as hardwood sawdust or manure. This is called

inoculation. The inoculated substrate is *incubated* until fully grown, then it is either used to inoculate more substrate (called *spawning*), or else it is given a careful balance of light, humidity, warmth and airflow to encourage mushroom formation.

Liquid Culture

Mushrooms reproduce by *spore*. Spores are like seeds: each one is different. Mushrooms exhibit a remarkable amount of genetic variability. This is great for their long-term vitality, but leads to unreliable results for the cultivator. When a desirable culture is identified and isolated from innumerable possible spore combinations, it can be cloned indefinitely and raised to maturity with consistent success.

A good analogy is with apples: if you plant an apple seed, the chances are 10,000 to 1 that you will get sweet, tasty fruit. This is why apples grown for food are always *cloned*. A clone is genetically identical to its "mother," and retains the particular qualities of the fruit.

Typically, the cloning process takes place in petri dishes in a sterile laboratory setting. A single petri dish can be expanded by many orders of magnitude, and ultimately give rise to thousands of pounds of mushrooms and billions of new spores.

The most efficient way to expand a mushroom culture for cultivation is to make *liquid culture*: a single clone is fragmented in a nutritive broth and fermented with constant, vigorous agitation. The result is a dense slurry of separate, tiny clusters of cells.

When added to a prepared substrate like sterilized grain, sawdust or manure, this liquid creates thousands of distinct points of simultaneous initial growth. Invisible for the first days, the mycelium rapidly expands, finds its genetically

identical counterparts, and fuses back into a single organism. To the observer it appears to suddenly explode into life.

Because they are easy to use, keep well and can handle the rigors of transport, liquid culture syringes are the most affordable, reliable, convenient and efficient way to produce your own mushroom spawn at home.

Spawn & Substrate

Many of the mushroom varieties we know and love, such as Reishi, are primary decomposers of dead trees, called *saprophytes*. For many centuries humans have been cultivating these delicious mushrooms by inoculating hardwood logs. However, the dense structure of the wood makes for slow growth, and it can take months to get results. A very common and much faster approach is to use a mix of sawdust and wood chips, as the mycelium can quickly grow throughout the loose mixture of smaller particles. This mix is also usually supplemented with additional nitrogen, which is a key ingredient for strong growth, such as wheat bran or soy hulls.

To speed the process along even more, mycelium is usually first given a running start on sterilized grains, called *grain spawn*. When used to inoculate a bulk substrate like sawdust, each grain serves as a leap-off point and a reservoir of nutrients so the mycelium can quickly envelop its new food source.

This kit is designed to guide you through a typical cultivation process, using liquid culture to inoculate grain spawn, then grain spawn to bulk substrate. To simplify the process, the grains and bulk substrate are layered in the same bag, so they can be inoculated and spawned without ever opening it, effectively combining two steps into one.

The grain is organic rye. The *Ganoderma* species included with this kit is a wood-loving fungus, so the base ingredient of the bulk substrate is hardwood

sawdust. It is mixed with various ingredients for additional nitrogen, minerality, pH balance, and structure. Water is the most important ingredient of all; since mushrooms, like people, are mostly made of the stuff, a properly hydrated substrate is key to producing a good crop.

The Conditions of Mushroom Formation

Once a substrate has been inoculated or "spawned," it is incubated until the mycelium envelops it completely. When fully grown, this substrate may either be used again as spawn—sometimes for numerous successive inoculations, to expand its biomass by several orders of magnitude—or it may be subjected to specific environmental conditions to induce mushroom formation. In many cases this simply means that the mycelial substrate is exposed to light and fresh, humid air. Some species require very specific environmental triggers, while others reproduce prolifically with indifference to circumstance.

There are many different strategies for inducing mushroom formation, or "fructification." The general idea is to simulate the events that precede fungal reproduction in the wild. One common technique is to fluctuate the ambient temperature much like the first deep chill of autumn, which small-scale mushroom growers do by simply placing the mycelium in a refrigerator overnight.

Another technique used widely in the shiitake industry is to apply a brief, high-voltage jolt of electricity, simulating the lightning that often attends a good rain. Though the underlying electro-biochemical mechanisms that make this work are not yet fully understood, it works nonetheless, and is remarkably effective.

The natural mushroom-formation trigger most relevant to indoor growers is that mycelium will usually seek to produce spores when it senses it is running out of food and space.

The other primary factors needed to induce mushroom formation are light, humidity and airflow.

Contrary to common preconceptions, mushrooms need abundant light to grow. Direct sunlight will irradiate and harm raw mycelium, but indirect sunlight or daylight-spectrum indoor grow lights work well to provide the kind of diffuse light found in the shady forest understory where mushrooms typically abound.

Usually scarce in the dry seasons, some mushrooms need as much as 95-100% relative humidity during the early stages of their growth. Large-scale indoor mushroom growers use high-volume mist nozzles or powerful ultrasonic humidifiers to maintain a consistently humid fruiting environment. These conditions are often replicated on a small scale with a handheld spray bottle and a semi-closed environment like a plastic bag or storage tub.

Mycelium, like people, requires oxygen and produces carbon dioxide. Without fresh air, it can suffocate. Fine-tuning carbon dioxide levels is one of the most important factors in honing advanced and commercial-scale mushroom cultivation techniques, but for the purposes of the small-scale cultivator, simply ensuring constant or periodic ventilation is sufficient.

Striking a balance between maintaining high humidity and good airflow is one of the main "tricks" of the trade, and while most commercial cultivators rely on complex and high-tech feedback and control mechanisms, there is no substitute for developing a good, intuitive, working understanding of the relationships between these factors and mushroom growth. There is not a perfect, stable balance to achieve, as nothing in nature is ever so consistent, and mushrooms generally benefit from periodic environmental fluctuations, allowing excess water to evaporate with moving air, then rehydrating, and so on.

One of the most intriguing things about Reishi is how it responds to different levels of carbon dioxide. In the wild, it is common to find Reishi growing on fallen trees. If buried under the CO_2-rich decomposing organic matter on a forest floor, it will reach to where fresh air is moving before trying to release its spores.

By simulating these conditions, the cultivator can guide the shape and appearance of the mushroom. When kept in a high-CO_2 environment, it will stretch toward the light in search of fresh air, forming thin branches or "antlers." When given plenty of oxygen, it will fan out into a flat conk, or bracket, and begin to produce spores.

Reishi growers are finding that by changing the orientation of the light, it is possible to create extraordinary, beautiful forms. This manipulation of growing conditions is quickly becoming a unique art form, akin to bonsai. This kit is designed to give you the opportunity to play with these techniques.

Sterility

Why All the Fuss?

The basic principle of mushroom cultivation is to create the ideal conditions for fungal growth and then let the mycelium weave its magic. But there are many, many organisms that thrive in the same conditions, and not all of them are friendly. The most surefire way to grow a particular, desirable fungus is to give it a running start in a sterile environment, completely free of competition.

Like most organisms, a fungus is delicate and vulnerable during the earliest stages of its growth. Once it "grows up" and achieves sufficient biomass, it has a remarkable array of biochemical tools to ensure its survival.

The enclosed liquid culture is prepared under strictly sterile conditions, and the substrate is thoroughly sterilized with high-pressure steam. Outfitted with an injection port, you can inject the culture into the sterile environment inside the bag without opening it, thus circumventing the need for fancy laboratory equipment.

This technique almost always succeeds, but nonetheless care should be taken to minimize the chance of allowing any uninvited guests to crash your party. For best results, take the time to read and carefully follow the step-by-step instructions below.

Goof and Grow

A Note about Failure

When researching mushroom cultivation, newcomers to the field are often wooed and wowed with pictures of big beautiful mushrooms and abundant harvests, and there is a tacit conspiracy among professionals to make it look easy. It is not.

Mushroom cultivation involves numerous intricate steps, and in each one there is plenty of room for error. More art than science, it is a practice which requires foresight and intuition. Like any creative enterprise, failure is an inevitable part of the process.

Our culture instills in us an expectation of consistent success. There are specialists in every trade, if not masters, and we learn to leave the heavy lifting

to the professionals. One of the great tragedies of this cultural landscape is that it discourages experimentation.

If everything were to work out just as we expect, what would be the point of trying? We are not automata, and neither are our fungal friends. It is too seldom said that any healthy, balanced approach to trying something new requires the acceptance of possible failure. Nothing can sap a passionate enthusiasm faster than disappointment, but taking strides in a new direction will always yield positive results, even if they are not readily apparent.

There is no shorter path to discovery, wisdom and joy than embracing uncertainty and trying something new. So hope for the best, prepare for the worst, and venture forth. To fail, and try again, and again—that is success.

Step 1: Inoculation

Before you begin, take a look at the bags of sterilized mushroom substrate (but leave them in the box). You'll see they have two layers, one of grain and the rest a mixture of sawdust and other supportive ingredients. They also have an air filter to allow for oxygen to enter without carrying any other spores along, and there is a rubber disc that will allow you to inject the culture into the bags without leaving an entrance for mold.

With painstaking effort to achieve total sterility, contamination is rare, but it does happen. Inspect the substrate for signs of mold. Look for small patches of green, gray or black. (Sometimes natural discoloration of the organic substrate can be mistaken for contamination, so if you're unsure, give it a couple of days to see if it grows. If you do find some mold, please send a picture along with your order confirmation for a replacement, and discard the unopened bag. Mold spores can be noxious so it's best just to avoid them.)

Create a clean workspace, free of drafty air. Wash your hands thoroughly. Wipe the surface of the rubber injection port with an alcohol swab to sanitize it. It's best to perform the inoculation quickly to provide the smallest possible window for ambient spores to find their way into the nutritious substrate.

Vigorously shake the syringe. (Hold the tube, not the plunger, or the plunger might pop out while you're shaking it.) As quickly and cleanly as possible, peel open the top of the sterile needle package just enough to expose the fitting, unscrew the syringe cap, and twist the needle onto the syringe. Avoid touching the tip of the syringe or the needle if you can.

Remove the cover from the needle and gently insert it through the center of the rubber plug into one of the bags.

CAUTION: The needle is extremely sharp! Take care not to tear any holes in the plastic, or yourself.

Steadily inject half of the contents of the syringe into the bag, distributing the liquid across the surface of the grains. Remove the needle gently to avoid peeling the rubber, then repeat this process and inject the remaining culture into the other bag. Peel-and-stick the included foil tape over the needle hole for good measure.

Gently shake the bags side-to-side to mix the liquid around in the grain layer. Thoroughly mixing the liquid culture at this early stage will dramatically accelerate the growth rate. Avoid breaking up and mixing the block just yet: allowing the mycelium to eat the grains first will accelerate the overall process.

Step 2: Incubation

Place the inoculated substrate back in the box and keep it in a warm place. 68-75ºF (20-24ºC) is ideal; much warmer than 90ºF (32ºC) can cook the mycelium, and below about 55ºF (13ºC) growth is slowed and can stall. Light is harmless but unnecessary during this phase of growth. Avoid direct sunlight.

A perfect place for incubation, if you have one, is the cabinet above the refrigerator. Any comfortably warm, accessible and out-of-the-way place will do.

Growth should be visible within a few days to a week, first appearing as little white tufts that expand and begin to interconnect. You can gently shake the grains around to mix them up once during this first stage to accelerate growth, but allow the mycelium to get comfortable with the grains before breaking up the whole substrate block.

After about 1-2 weeks, once the mycelium is visibly growing on a good portion of the grain layer, it's time to break up the block. Mixing the substrate disperses the incubating mycelium and allows it to grow quickly and evenly.

Lay the bag on the counter and gently but firmly loosen, break up and spread the contents along the length of the bag. Shake it up and down, turn it over, wiggle it around and whisper sweet nothings in its ear. Mashing the mycelium too aggressively or too often may be harmful, but disturbing it in this way invigorates and stimulates its growth. The goal is to mix the substrate thoroughly, evenly and with benevolent intentions.

Once mixed, grab the top of the bag and bounce it on the counter a few times to settle the substrate back to the bottom. Gently compress it back into a

block so the mycelium can easily leap from one particle to the next. Flick the air filter and upper corners to shake off substrate that might have stuck there, then put the bag back in its happy place and watch as the mycelium proliferates.

One thorough mixing is usually sufficient. If after 1-2 more weeks you see large, untouched patches of substrate, you can try another break-and-shake.

After about 3 to 4 weeks of incubation, the whole substrate block should be enveloped by mycelium.

Step 3: Tending the Crop

Once your mycelium is fully grown out, it's time to stand the bags upright to make space for your Reishi to ascend. If you've been keeping them in the dark, it will also help to move them to where they will get a little light. Avoid direct sunlight.

6-8 weeks after inoculation, you should see mushrooms beginning to form. They first appear as white lumps on the surface of the mycelium, and they will develop slowly over the next few weeks.

Most people like to leave the mushrooms in the bag for quite a while, where the high-CO_2 environment will encourage the development of desirable antlers. Eventually, however, the mushrooms will press themselves against the inside of the bag and start to look deformed. When and if you open the bags simply depends on your creative discretion!

When you think your mycelium is ready to enter its next phase of growth, there are a few ways to go about it. The main consideration is that it needs

fresh air, plenty of light and lots of moisture to grow best. If you provide a good balance of these conditions, your mushrooms will thrive.

The simplest approach is to cut a hole in the bag to increase airflow. Try trimming off one corner to leave a hole about 1 inch in diameter. About once per day (depending on your climate), use the provided mister to spray a bit of water into the bag and keep your developing mushrooms from drying out. A little condensation on the inside of the bag is a good indication of adequate humidity. Too much moisture can lead to mold and rot, but with too little the mushrooms dry out and stop growing. If they begin to shrivel, this is usually a sign they are too dry.

The mushrooms will respond to contact with the air, and over the course of the next few days you will see your Reishi changing shape. Different species and cultivars exhibit different growth patterns, but the general idea is that the increased airflow will encourage the fruitbodies to begin the process of producing spores, and therefore to form conks or brackets.

If you want to experiment with just how wild and wooly your Reishi can get, the next upgrade is a large, clear plastic storage container. Any size will do, but getting something tall and narrow will allow for those long, meandering antlers. Larger containers will lead to lower concentrations of CO_2.

Use some perlite (available as a soil amendment from most garden stores) or clean sand to make a moisture reservoir. Submerge it in water and drain it to get it saturated, then make a 2-inch deep layer at the bottom of your container. Adding a splash of hydrogen peroxide will help keep it from getting funky. Cut the plastic from your Reishi bags, even with the top of the substrate, and place them inside. Put the lid on the tub and leave it be.

If leaving the lid in place, carbon dioxide will accumulate and the antlers will grow. Because very little moisture escapes, you won't need to mist very often

or at all. To encourage conk formation, you can experiment with leaving the lid ajar, but you will need to spray the inside daily with water, or as often as necessary to keep the humidity up. Add a bit of peroxide each time you replenish the water reservoir.

If you want even more airflow, you can also make holes along the sides, near the bottom, to allow CO_2 to escape, and cover them with 3M Micropore tape to keep moisture in and mold spores out.

Reishi antlers grow toward light. By moving them around and changing the orientation to the window or other light source, you can guide the direction of their growth to create wild shapes and patterns!

Addressing Contamination

While your mushrooms are growing, you'll want to keep an eye out for mold. Many newcomers to mushroom cultivation are scared off by a general atmosphere of panic regarding mold in the commercial mushroom cultivation community, but for the home grower it is a far less troublesome concern.

Because Reighi grows so slowly, there is ample opportunity for uninvited guests, so mold is quite common. Reishi is generally quite at home with other fungi, and doesn't seem to mind. Nonetheless, it's not something you want in your house, so it's best to nip it in the bud.

Hydrogen peroxide is the best treatment, because it destroys spores and single-celled organisms but the mycelium, which naturally produces its own peroxides, will be able to neutralize it with no ill effect. Add a capful of standard household-strength hydrogen peroxide to the mister, top it off with water, and give the moldy spot a firm blast. If it fizzes, the peroxide is doing its work. If not, try a higher concentration. Avoid spraying too much peroxide

on the mushroom itself, as it can be harmful in larger amounts. You can also attempt to cut away the contaminated area with a clean, sharp knife.

Keep an eye on it and repeat this spot treatment if necessary. If it keeps coming back with a vengeance, you may have to discard the substrate and try again. Some mold spores can be noxious, especially if you are prone to allergies, but a little bit here and there is quite tolerable, as is often seen on wild specimens (not to mention all over the kitchen). Many folks pay it no mind, and simply rinse it off the mushrooms at harvest.

In the long run, every mushroom cultivator will inevitably encounter these *fungi imperfecti*, so don't let it discourage you when you do.

Step 4: Harvest

Your Reishi can continue growing for several months. Eventually, it will exhaust its food and slow its growth, and other decomposers will take over. It will also produce spores, which is generally considered undesirable when growing it for medicinal purposes.

Once your Reishi has reached the end of its life cycle, you can either preserve it as a decorative specimen or harvest it for making tea or for extraction.

To harvest the mushroom, you can simply slice it off of the substrate using a sharp knife. Dry it using a dehydrator or just place it somewhere with plenty of airflow, then store it in a cool, dry place until use.

You can also simply remove the mushrooms from the humid environment and allow them to air dry. Some folks like to buff them to a lovely shine, and once they are completely dry coat them in lacquer or varnish to preserve them as a mantlepiece.

Step 5: Uses

Reishi is among the most medicinally beneficial foods on Earth. Lauded for centuries for its healing properties, it is typically used to make tea. In recent years, it has also become popular to make tinctures and extracts.

Dried Reishi is quite woody and tough. To make tea, chop it into chunks with a cleaver, then pulverize it in a coffee grinder, mortar or food processor. For best results, steep it for a long time in hot water, but don't boil it. Good methods are to use a crock pot on low or a thermos for an overnight soak.

A simple dual extract involves soaking the dried, pulverized mushrooms in high-proof ethanol for a few weeks, straining out the alcohol, then extracting overnight in hot water and combining the two in equal proportions. (Or, if you really want to get the good stuff, look into Soxhlet extraction. It's not as challenging as it might first appear, and the results are exceptional.)

Next Steps

When it comes to fungi, the end is just the beginning. Here are some ways to continue the journey after your first harvest:

- ➔ Start an outdoor mushroom bed

When the mycelium has begun to exhaust its substrate, it can be mulched, composted or fed with more wood shavings and paper waste to continue growing outside. An easy experiment is to use the cardboard box this kit came in: peel the tape off, soak it thoroughly with water, let it drain, then fill it with your spent substrate and bury it under mulch in a shady, irrigated corner of the yard. In the worst case it will make great compost!

➔ Inoculate a log

Your mycelium can be used to inoculate a freshly cut hardwood log. (Conifers are generally too resinous to support the growth of gourmet mushroom species.) A 3-foot (1m) log of 4-8 inches diameter is an ideal size. Use a half-inch (12mm) drill bit to make numerous holes into the center of the log, spaced a few inches apart. Break up and crumble the mycelium with your fingers, then use a funnel and a stick or dowel to stuff it deep into the holes. Use a candle to drip a thin layer of wax to seal the holes and the cut ends of the log, then store it off the ground to incubate. If you live in a cold climate, you can keep it in a cellar or greenhouse through the winter. Place the incubated log in a shady, well-irrigated corner of the yard and keep an eye out for mushrooms, especially after rain in the spring and fall.

➔ Explore myco-materials

Reishi mycelium is vigorous and tenacious, making it an exceptionally good candidate for use as an all-natural, renewable, eco-friendly material to replace styrofoam for packaging and insulation. You can use your leftover mycelium to inoculate sawdust, hemp hurd, straw or other low-nitrogen agricultural byproducts, form it into unique shapes, and then dry it. This is a new field with great promise, and so much is possible with a little imagination and experimentation!

➔ Refill your kit

You can get more mushroom cultures, kits, and supplies, by donation, at:

www.fungaia.life

Fungaia is a heart-centered, donation-based mushroom company, driven by deep passion and a vision for sustainable symbiosis. Firmly rooted in a do-it-yourself ethos, we endeavor to demystify fungi and make mushroom cultivation accessible to newcomers and lifelong mycophiles alike.

From unique learn-as-you-grow mushroom kits, to educational and consultation services, to our lifelong dream of Free School, we live and breathe creative education. We believe that fungi are the finest teachers, and some of our greatest allies in the quest for prosperity—both our own and that of the living planet we call home.

Your support means the world to us and helps to sustain our vision. If you have any thoughts, questions or issues, please get in touch. We're here to help, and we'd love to hear from you!

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