

CORDYCEPS CULTIVATION

HANDBOOK VOL.1



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Cordyceps Cultivation Handbook

A guide to growing Cordyceps militaris

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otherwise stated) by
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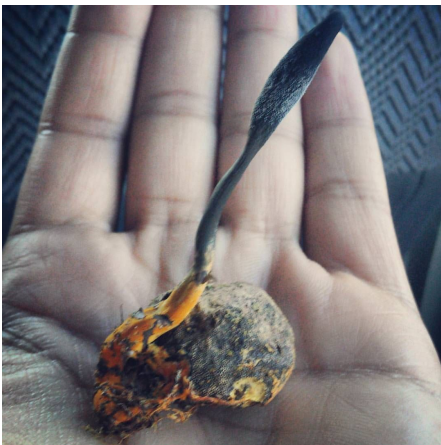
Shouts out to My Partner Lydia for dealing with all my craziness, my son Leonidas for infinite inspiration, Olga Tzogas for keeping it real since day 1, Charlie Aller for finding the original wild cordyceps militaris, Ryan Paul Gates for sharing info at the beginning, Allie Osipov for the awesome watercolor Cordyceps on the cover! Alex Dorr for discovering the fruiting culture in my mess, Ja Schindler for inspiring me to work hard, Seppi Garrett for providing me space to teach when no one understood what I was doing, and all the other Gnomies doing good work to make a better reality for all Life!

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MY CORDYSTORY

In my late teens, after a few too many oatmeal cream pies and lies, I became infatuated with nutrition. The first diet I tried was raw vegan, this was too intense for me and I never felt full, but the diet allowed me to detox years worth of crap. One other thing the raw vegan diet did for me was introduce me to 'Super Foods' as I needed to seek out the most nutrient dense foods for the diet. With my introduction to the realm of superfoods I quickly became aware of the nutritional value of mushrooms, one of them being Cordyceps. The first Cordyceps I ever tried was from a big bag of imported Asian *C. militaris* gifted to me by a facebook friend, I felt noticeable uplifting effects! January 2015 I attended the NOFA-NY conference in Saratoga Springs, New York. While at the NOFA conference I attended every lecture offered by Tradd Cotter, this was the first time I had met him, and I was very interested in his work after reading his book 'Organic Mushroom Farming and MycoRemediation'. During one of Tradd's lectures



at the NOFA conference, he mentioned utilizing cordyceps species as biological pesticides, this inspired me to find a wild cordyceps mushroom!

August 1st & 2nd 2015 I hosted the MycoSymbiotics Mushroom & Arts Festival at the Amethyst Retreat Center in Duncannon, Pennsylvania.



During the weekend of the festival we found and identified over 70 species of mushrooms including one *Cordyceps militaris* found by our friend Charlie Aller (aka Charlicepts). Understanding the medicinal benefits of cordyceps, I was eager to get a culture of this mushroom. Charlie graciously allowed me to take the mushroom home with me, as this was a trophy find. From the festival I took this mushroom to my home lab for tissue culturing. Extracting tissue from such a small mushroom was daunting, but with good dental picks I was able to pull some clean tissue. Out of 10 agar petri plates only 1 took, I proceeded to split this culture, and send it to fellow mycologists. Ryan Paul Gates operator of Terrestrial Fungi had a grain based substrate recipe from a commercial cordyceps farm in thailand, he sent me the recipe when I sent out the cultures. September 16th 2015 I found my first Golden Thread Cordyceps (*Tolypocladium ophioglossoides*) in the Michaux State forest, I took this mushroom to the lab, and isolated a healthy culture, 2 days later I was listening to Tradd talk about it's medicinal properties at the Mother Earth News Fair in Seven Springs, Pennsylvania. Things in the CordyStory went silent for a few months only a few messages went back and forth between Ryan and myself. December 2nd 2015 Ryan sent me a picture of fruiting bodies forming in vitro on agar! Once I knew the culture was capable of fruiting I began researching all I could on cultivating *Cordyceps militaris*. One of the first things I do when I want to learn something new is search it on



YouTube. There were no instructional videos on cordyceps cultivation in english (With the help of Visionary Organics we fixed this). With a little searching I stumbled upon Tawat Tapingkae's youtube channel featuring videos of a cordyceps production operation. เพาะเลี้ยงเห็ดถั่งเช่าสีทอง roughly translates to Gold tank lease mushroom if you search this online you will find loads of photos, and videos of *Cordyceps militaris* cultivation. After watching about 50 foreign videos on cordyceps cultivation I felt like the gist of it. I tried the jar method, and the bread pan method I had seen in the videos, my initial success was with the bread pan, but the jars proved to be

easier for everyone. March 25th 2016 I harvested my first cultivated fruit bodies in front of my filter box, scraped the perithecia and streaked them on some agar plates, I ended up isolating 6 multispore intra-strain crosses. April 26th 2016 I cultivated my first *Tolypocladium ophioglossoides* in a jar with the same substrate as the *Cordyceps militaris*. Summer 2016 I attempted to fruit all 6 *C. militaris* isolates via jar method in my mushroom grow room in Lemoyne, Pennsylvania. In the heat of the summer I had no success, so I put all the jars in a box, brought them home, and forgot about them in my basement as I planned the 2nd annual MycoSymbiotics Mushroom and Arts Festival with Olga Tzogas. On August 8th 2016 the day after the MycoSymbiotics Mushroom Fest, I was joined by Alex Dorr at my home in New Cumberland. While giving Alex a tour of my home, he became intrigued with the box of jars, he pulled one out and asked “what’s this” in his hand he was holding a glass jar with cordyceps fruiting in it, we both danced with joy! The culture that fruited was labeled CM4, I went back to the original CM4 culture in my lab, and began expanding it for commercial production. August 17th 2016 I flew out to Telluride Colorado to teach at the Telluride Mushroom Festival. One of my presentations at Telluride was on my experience with cultivating cordyceps, during this workshop we harvested the first cordyceps I fruited in a jar, and I distributed about 20 wild *Cordyceps militaris* cultures. October 6th 2016 I traveled to Wingdale, New York with Michael Weese to present on cordyceps cultivation at the Radical Mycology convergence, I distributed 30 CM4 cultures during this event. October 26th my CM4 jar trials proved successful providing me with a half ounce of dried cordyceps. November 1st 2016 I traveled to Atlanta Georgia to spend some time with the ineffable Cornelia Cho, and Sam Landes, present to the Mushroom Club of Georgia, and Lead the First Cordyceps Cultivation workshop in Decatur, Georgia. November 7th to the 10th I worked at Mushroom Mountain, during this time I learned invaluable skills that helped me in my Cordyceps cultivation endeavors. Now it is December 20th 2016 and I write this as I sit directly above a hydroponic fruiting tent in my basement filled to the brim with cordyceps fruiting in trays and in bags!

CORDYCEPS MILITARIS 101

Kingdom: Fungi
Phylum: Ascomycota
Class: Sordariomycetes
Order: Hypocreales
Family: Cordycipitaceae
Genus: Cordyceps
Species: Cordyceps militaris

Cordyceps militaris is quite the curious organism! Cordyceps militaris is classified as an entomopathogenic fungi. When we break down the word entomopathogenic we get *entomo* derived from Greek meaning insect, literally translating to “to cut up in pieces” as insects appear to be segmented, on the other end we have pathogenic, meaning to cause disease. So it is understood that Cordyceps militaris will cause dis-ease in insects, this happens in a very



interesting way. When a Cordyceps militaris spore (or anamorph) successfully sticks to a host insect, it develops a germ tube with an appressorium (A specialized infection cell) that forms an infection peg that releases

enzymes, and penetrates the exoskeleton, allowing hyphae to enter. Once inside the insect the hyphae (haploid) or mycelium grows into a small endosclerotia (a hard fungal mass containing energy reserves). With



endosclerotia inside the insect, the fungus begins weaving in and around the insect's vital organs. Depending on the species of insect the fungus will hijack the insect's nervous system, causing it to relocate itself somewhere where the mushroom spore will be better distributed, before the insect dies. Once the insect is dead depending on the species, the fungus will either revert to a sclerotia and wait for the proper time to produce mushrooms, or it will begin forming mushrooms anywhere it finds suitable on the body of the insect.

Cordyceps militaris is known as Scarlet Club Fungus, or Caterpillar Killer in the U.S. In China it is called 蛹虫草 (Yǒng chóngcǎo) which roughly translates to pupa grass, cordyceps flower, or insect grass flower. The name *Cordyceps* is derived from Greek *kordyle* meaning “club”, and *ceps* meaning “head”. *Militaris* may refer to their militant nature with insects, or their growth pattern resembling toy soldiers. *C. militaris* has a wide distribution across North America, and Asia. We commonly find them in the mountains, in bogs. *C. militaris* is the most commonly collected cordyceps species, due to the fact it has the widest insect host range, extending to 2 orders, 13 families, and 32 species.

Insect Hosts

Order: Coleoptera (Beetles)

Families: Curculionidae, Tenebrionidae

Species: *Ips. sexdentatus*, *Tenebrio molitor*

Order: Lepidoptera (Butterflies & Moths)

Families: Bombycidae, Endromidae, Erebididae, Drepanidae, Geometridae, Lasiocampidae, Noctuidae, Notodontidae, Saturniidae, Sphingidae

Species: *Andraca bipunctata*, *Calliteara pudibunda*, *Leucoma salicis*, *Achlya flavicornis*, *Ochropacha duplaris*, *Tethea ocularis*, *Tetheella*

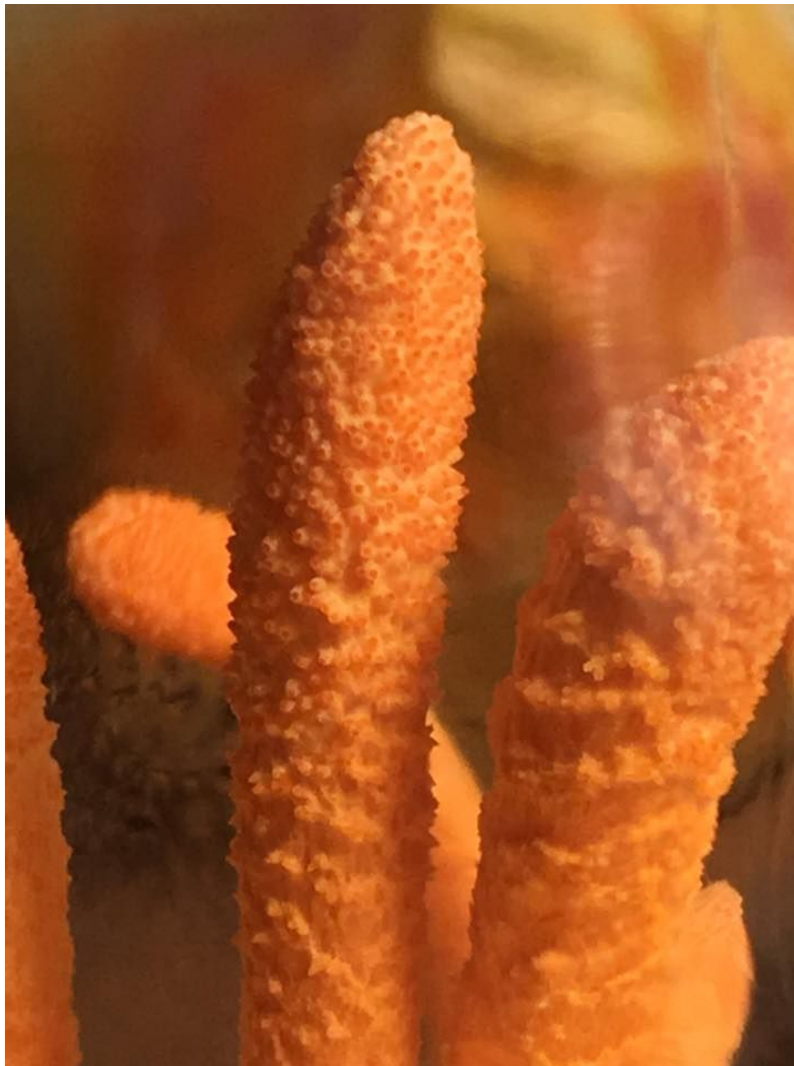
fluctuosa, *Biston panterinaria*, *Lycia hirtaria*, *Dendrolimus pini*, *D. superans*, *Macrothylacia rubi*, *Arcte coerula*, *Colocasia coryli*, *Euxoa ochrogaster*, *Panolis flammea*, *Fentonia ocypete*, *Lampronadata cristata*, *Phalera assimilis*, *P. bucephala*, *Syntypistis punctatella*, *Anisota senatoria*, *Callambulyx tatarinovii*, *Laothoe populi*, *Marumba sperchius*, *Mimas tiliae*, *Hyles euphorbiae*, *Sphinx pinastri*

MIGHTY MORPHIN MUSHROOMS!

Cordyceps militaris shares similar macroscopic, and microscopic features with *C. pseudomilitaris*, *C. roseostromata*, and *C. cardinalis*. Although they prefer different host species, at this time the only way to get a true identification is with gene sequencing, which isn't as hard as it sounds. There are companies, and individuals offering genetic sequencing services that can be found online. *Cordyceps militaris* also expresses Anamorphs, asexual mold forms, that are classified differently due to their different sexual reproductive structures. *Cordyceps militaris*' anamorphs are classified as *Simplicillium*, and *Lecanicillium*. My current understanding is that *C. militaris* exists as a soil mold until it comes in contact with a suitable host, then it morphs back into *C. militaris*.

C. militaris behaves as a bipolar heterothallic fungus and requires two mating compatible strains in order to produce regular club shaped perithecial stromata. Self-fertility is occasionally observed in some strains of *C. militaris*. Transcriptional profiling shows fruiting involves induction of the Zn2Cys6-type transcription factors and MAPK pathway; unlike other fungi, however, the Protein kinase A (PKA) pathway is not activated. PKA enzymes are dependent on cyclic adenosine monophosphate which is incredibly interesting as this mushroom produces adenine, and cordycepin which is very similar to adenosine. The picture on the next page displays a

regular club shaped perithecial stromata, with the perithecium circled. Perithecia are like cups where the ascospores are produced. *C. militaris* will senesce faster than most mushroom producing fungi, once they reach senescence they lose their ability to produce mushrooms. It is important that a commercial *Cordyceps* farmer maintains new spore cultures.



MEDICINAL PROPERTIES

Beside being eye candy, and tasting delicious *Cordyceps militaris* are highly valued for their medicinal properties. This chapter goes over medicinal properties backed by scientific, and medical research.

Valuable Compounds

Cordycepin
Adenine
Cordymin
Homocitrullyaminoadenosine
Superoxide Dismutase
Adenosine
Guanosine
Cytidine
Uridine
Uracil
Novel Isoflavones

The contents of bioactive ingredients cordycepin and adenosine in *Cordyceps militaris* are higher than those of *Ophiocordyceps sinensis*.

Known Medicinal Properties

Anti-inflammatory, anti-oxidant/anti-aging, anti-tumour/anti-cancer/anti-leukemic, anti-metastatic, immunomodulatory, anti-microbial, anti-bacterial, anti-viral, anti-fungal, antiprotozoal, insecticidal, larvicidal, anti-fibrotic, steroidogenic, hypolipidemic, anti-angiogenic, anti-diabetic, anti-HIV, anti-malarial, anti-fatigue, neuroprotective, liver-protective, reno-protective and pneumo-protective

Cordycepin shows antifungal activity against multiple species of *Candida*.

Cordymin shows antifungal activity. Cordymin has been shown to inhibit HIV-1 reverse transcriptase. Cordymin displays antiproliferative activity toward breast cancer cells.

The *Cordyceps* genome does not contain genes for known human mycotoxins

Cordyceps militaris produces a fibrinolytic enzyme, and shows fibrin binding activity, which allows for the local activation of the fibrin degradation pathway.

Cordycepin inhibits lipopolysaccharide-induced inflammation

Cordycepin shows selective inhibition of *Clostridium* spp. known to cause infant botulism. Cordycepin can inhibit the growth of *Clostridium* without adverse effects on probiotic gut bacteria.

Cordyceps militaris has shown the ability to increase sperm production in rats, and boars.

Water Extracts of *C. militaris* have been shown to induce apoptosis of lung carcinoma cells via a signaling cascade of death receptor-mediated extrinsic and mitochondria-mediated intrinsic caspase pathways. Apoptosis of lung carcinoma cells is mediated with decreased telomerase activity through the inhibition of human telomerase reverse transcriptase transcriptional activity.

Cordyceps militaris can improve pulmonary function.

A BRIEF HISTORY

The first written record of the *Cordyceps* mushroom comes from China, in the year 620 A.D., during the Tang Dynasty. Later described in 1753 as *Clavaria militaris* by Carolus Linnæus. In 1757, we see the earliest illustration of the *Cordyceps* mushroom drawn by Wu-Yiluo in 'Ben Cao Congxin' during the Qing Dynasty (The insect in the illustration resembles the caterpillar associated with the *Ophiocordyceps sinensis*). In 1790 Johan Theodor Holmskjold beautifully illustrates '*Clavaria militaris*' in his '*Beata ruris otia fungis Danicis impensa*' ('Happy Resting Periods in the Country Studying Danish Fungi') In 1812 François Victor Mérat de Vaumartoise classifies *C. militaris* as *Hypoxylon militare* in '*Nouvelle Flore des Environs de Paris*'. We see the first *Cordyceps militaris* classification in Paris in 1818 by Cristiaan Hendrik Persoon in '*Observationes Mycologicae*'. In 1865 we see another wonderful illustration of *C. militaris* classified as *Sphaeria Militaris* by Sarah Price in '*Illustrations of the Fungi of Our Fields and Woods*'. George Edward Masee, first president of the British Mycological Society mentions *C. militaris* in some detail in his '*Revision of the Genus Cordyceps*' in 1895. We see the first mentions of artificial cultivation in Tokyo, Japan in 1941 from Yoshio Kobayashi in '*The genus Cordyceps and its allies*'. It wasn't until 1950 that German scientist K.G. Cunningham, and colleagues discover the antibiotic properties of a *C. militaris* culture, and isolate cordycepin. In 1958 identification of *C. militaris* in the Jilin Province in China led to the connection of this species with the more established *Ophiocordyceps sinensis*, and research into cultivation. Beginning 1986 wild *Cordyceps militaris* specimens were collected in mountains, national

parks, and recreation parks in Korea by the Entomopathogenic Fungal Culture Collection at Kangwon National University, this ended in 2002. 1996 with the release of 'Insect-borne fungi of Korea' by J.M. Sung, we see the development of liquid culture inoculum for mass cultivation, and discovery of variation in *C.militaris* isolates, and their subcultures, which to this day is one of the biggest issues in cultivation, as some variants won't produce fruits. In 1999 we see 'The condition of artificial fruiting body of *Cordyceps militaris*' from Chonbuk-do Agricultural Research & Extension Services, Iksan and Chonbuk National University, Chonju. Department of Agricultural Biology in the Korean Republic. From the early 2000's on we see a boom in research of *Cordyceps militaris* for its medicinal compounds and nutrient medias for higher biopolymer production. All significant research on commercial cultivation has been developed in China, Japan, Korea, Thailand, and Vietnam. From 2003 to 2005 work by Shrestha Bhushan at Kangwon National University in Korea revealed a better understanding of bipolar heterothallism, and the relationship between culture pigmentation, and mating type. The 1st *Cordyceps* cultivation training was held at Chiang Mai Rajaphat University (CMRU) on 9th October, 2010 by Dr. Tanya Tapingkae from the Faculty of Agricultural Technology, CMRU, organized by the Research and Development Institute of CMRU.

DESIGNING A CORDYCEPS CULTIVATION SYSTEM



Finding a culture is a good place to start! I recommend starting with a local wild culture. *Cordyceps militaris* can be found all around the world, in the North Eastern U.S. and Mid Atlantic we find them from June-October in the Appalachian Mountains near springs, in bogs, and in mature forests with more humus in the soil. Studying their host insects will lead to more sightings of

cordyceps. If finding a local wild culture isn't an option for you, viable fruiting cultures are available online.

A Cordyceps Cultivation System requires a kitchen like room, a worktable or lab, a space for incubating the fungus, and a fruiting room/space (For home scale cultivation this can all be done in a kitchen). The requirements of the kitchen like room are a sink, countertop workspace, and stovetop, or rice cooker, and food dehydrator. There needs to be a space that is kept clean for this system, this should be the worktable. A glovebox, filterbox, or laminar flow hood is required for use on the worktable or in a lab. The

Incubation space needs shelves, or racks for holding spawn, and some sort of temperature control, 65-75 degrees fahrenheit is required to maintain optimal growth. It is important the incubation space is kept dark as *C.militaris* is very photosensitive. The fruiting room is where the mushrooms will grow (requirements listed in modular fruiting section)! The kitchen will also serve as a harvesting/processing area (For businesses this can not be a kitchen in a home with pets).

As mentioned before, *C. militaris* will senesce faster than most mushroom producing fungi, once they reach senescence they lose their ability to produce mushrooms. It is important that a commercial *Cordyceps* farmer maintains new spore cultures. Maintaining spore cultures requires sterile practices, more so than production of fruiting bodies.

A cordyceps farming operation can begin with ordering in liquid cultures, this requires much less sterility. With cordyceps culture developing in North America there will be more availability of viable cultures, currently many *C.militaris* cultures online aren't capable of producing fruiting bodies. Basic understanding of fungal culturing techniques is all that is necessary for developing, and maintaining spore cultures, this work can be done in a glovebox, in front of a filter box, in front of a flow hood in a laboratory.

The Vessel

Cordyceps militaris grow well in jars, bread loaf pans, and polypropylene spawn bags. The mushrooms need a closed space, that light can pass through to produce fruits. When working with jars it's important you choose jars that have a wide mouth so



the mushrooms can be easily harvested. Working with loaf pans requires plastic wrap or a plastic bag to create a closed environment, and allow light in. Polypropylene spawn bags can be used in conjunction with loaf pans, by putting your colonized pans in the bags for fruiting they stay fairly clean, and can be reused. Polypropylene bags have the longest turnover time, but can produce huge yields. Polypropylene bags can be reused until they rip open.

Modular Fruiting Rooms

Beginning with modular fruiting rooms is a great way to learn how to produce consistent harvests. Start by equipping a closet, 2x4, or 4x4 hydroponic grow tent, with one or 2 plastic shelving racks. Basements are great for setting up grow tents due to their consistent temperature throughout the year. It is easy to keep a grow tent warm with higher power lights in the winter, but cooling them is a little more intensive, and may require using an A.C. to cool the room around it. *Cordyceps militaris* fruit best at 65-70 degrees fahrenheit.

Fill one shelf, then wait a week to fill the next one, and continue like this for weekly harvests, or fill all the shelves at the same time for massive harvests! If you plan on filling up the room for big harvests you can use the fruiting room for incubation. Cool white fluorescent bulbs, t5s, fluorescent mini strips, and blue/red spectrum l.e.d.s work great for lighting. *Cordyceps militaris* mushrooms fruit in vitro, so it isn't necessary to humidify the fruiting room.

Dehydrators and or Dehydration Space

Once your mushrooms are harvested, it is important to dry them unless you intend on using them within the next 2-3 days. When choosing a dehydrator keep in mind the mushrooms are small and will shrink up, so

watch out for dehydrators with large holes in the trays. The mushrooms can be dried in the open on paper towels, this will require a lot of undisturbed space with larger harvests.

Processing Space

In the U.S. it is required that we use a USDA certified processing facility for drying, and packaging mushrooms. This can be a local certified kitchen, or a kitchen you have had certified yourself. Most cordyceps systems will benefit from a food processor and a capsule making tool. This area will be used for packaging fresh, and dried cordyceps (intended for human consumption) for sale.

DEVELOPING CULTURES

There are a few ways to begin developing cultures of *C. militaris*. You could order a fruiting culture online, fruit mushrooms from it, and collect spores from those mushrooms. You could find a wild specimen, clone it, or collect spores, or both! Say you find some dry *C. militaris* at a local Asian market, you could clone the dry mushroom, and possibly collect spores. *Cordyceps militaris* produces ascospores that look like little straight white lines. Developing *C. militaris* cultures requires spores, unfortunately they don't take the best traditional spore prints. You can easily collect and germinate single or multiple spores on agar by using petroleum jelly to adhere mature cordyceps mushrooms to the lid of your petri dish. Let

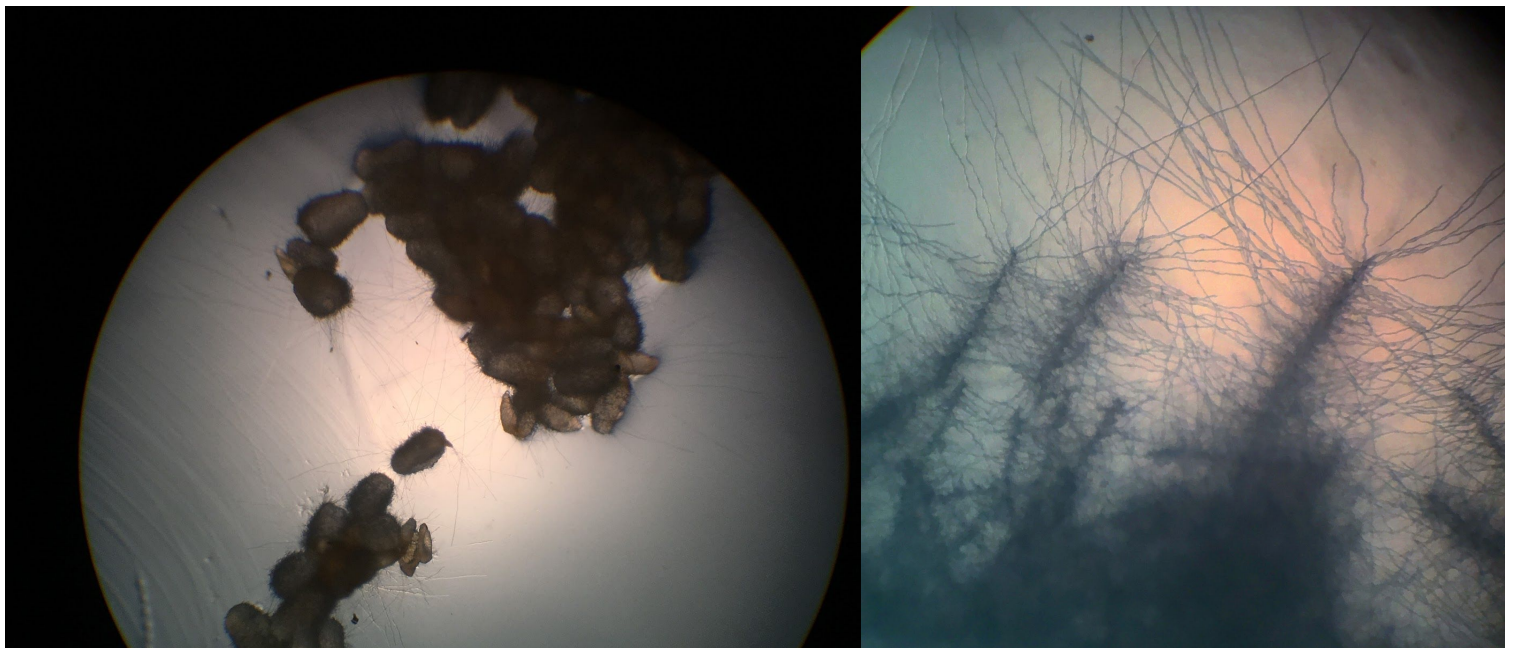


them sit for about 12 hours to ensure spores have dropped.

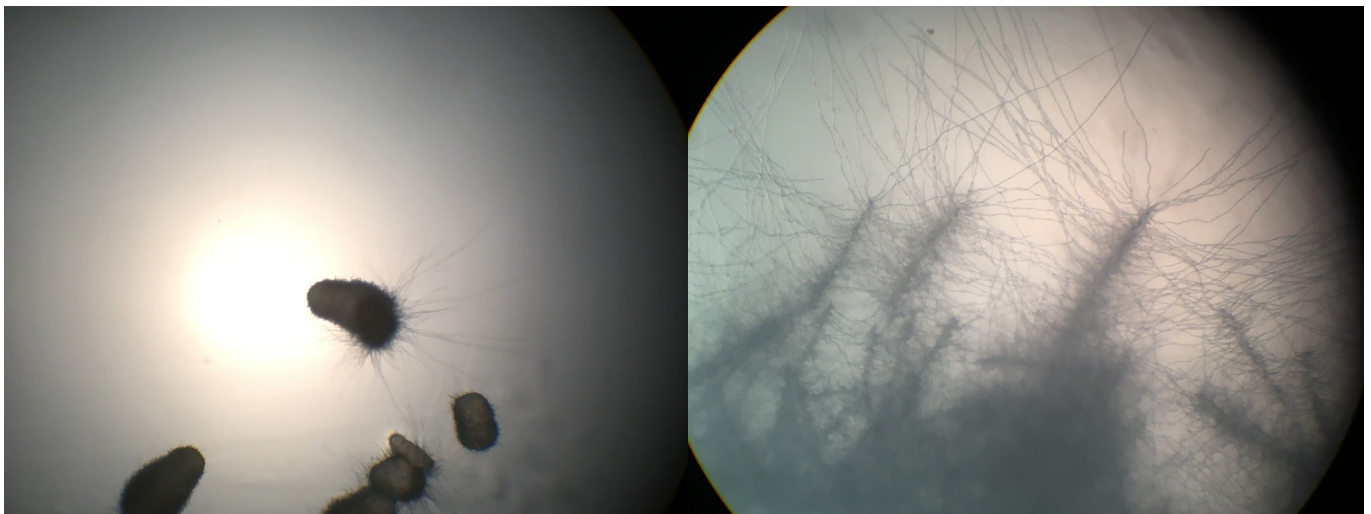
Check Alan Rockefellers youtube channel for a video of *Cordyceps militaris* releasing spores!

When developing cultures of *C. militaris* it is helpful to understand intra-strain, and inter-strain crosses. Mixing spores of the same mushroom together is an intra-strain cross. Mixing spores of different *C. militaris* mushrooms is an inter-strain cross.

You can easily start multispore intra-strain crosses by using a sterile scalpel or dental pick to scrape the perithecium from freshly picked cordyceps, and streak them on agar plates. It is important that periodically the cordyceps farmer seek out wild cordyceps, or fruiting cultures from colleagues for inter-strain crosses to ensure genetic diversity and resilience in lab grown cultures.



On the left we have ascospores germinating from mature perithecium. On the right we have freed ascospores germinating, captured via the petroleum jelly method.



Working with single ascospore isolates may prove very fruitful in developing unique strains. Individual ascospore isolates, and crosses will display different pigmentation under the same conditions, it will be interesting to see how pigmentation affects the overall life cycle of the mushrooms after we study them further.

When starting new cultures it is important to start many as some may not produce mushrooms. Once you successfully propagate new cultures it's time to test them! When I test my new cultures I cut pieces of the culture from the agar plate, and introduce them to the jars in my clean area. When I introduce the cultures to the jars, I expand them to another petri dish with a slightly different nutrient profile, and a small amount of liquid culture. I will use at least 3 jars per isolate during testing, just incase one of them was

somehow impaired. Make sure to keep all the jars labeled! The jars will be tested in the fruiting room, give these some time as some cultures will take longer than others. Any cultures that remain dormant after month are not commercially viable. When you see jars fruiting, allow them to reach maturity, monitor growth, and check fresh, and dry weights of mushrooms. Commercial operations will benefit from exclusively propagating the fastest growing, or highest yielding strains

NUTRIENT MEDIAS

So we know Cordyceps grow on insects in the wild, do they also grow on insects in cultivation? Although Cordyceps grow well on insects in cultivation, insects make the mushrooms undesirable for many. In this chapter we will go over nutrient medias that utilize insects, and grains. Recipes are measured out for a 12 pack of wide mouth quart jars, or quart sized deli containers.

Jar Preparation

You'll need-

Polyester Fibers

Ice Pick or Drill

To prepare the jars for growing Cordyceps, simply puncture a hole in the jar lid with an ice pick, or drill through it, and pull a small piece of polyester fiber through the hole to act as a filter.

Using an Insect

C. militaris will produce fruits on sterile insects in jars, research has shown it is possible to get *C. militaris* to grow on species it wouldn't naturally grow on in controlled conditions.

Easily Accessible Insect Hosts

Zophobas morio aka Superworms- SuperWorms can be found at pet stores. Superworms can be used as larvae, pupae, or in their beetle form.

Bombyx mori aka Silkworms- Silkworms can be ordered online, or found at specialty pet stores. Silkworms can be used in their larvae, pupae, and moth form. Dried SilkWorm Pupae can be ordered online. Dried Silkworm Pupae can be mixed with water at a ratio of 1:1 or mixed in as an additional ingredient or nitrogen source in other nutrient medias.

Manduca sp. aka Tomato and Tobacco Hornworms- Hornworms can be found on tomatoes and tobacco in the summer, or ordered online. Hornworms can be used as larvae, pupae, or moths. Hornworm Pupae are an ideal host for *C.militaris*. To induce pupation take a large hornworm and isolate it in a small container with no food or water, within a few days the worm will pupate.

Basic Media Recipe

3 cups of Grains (Rice, Millet, Local Wild Grass Seed, Popcorn)
6 cups Water
2 tbsp Sucrose
1 tbsp Corn or Potato Starch
1 tbsp Yeast Extract or Nutritional Yeast (Nitrogen Source)
1 tsp Azomite

For Glass WideMouth Jars

Measure out and fill your quart jars with ¼ cup of dry grain. Fill a container with 6 cups of water, add your dry ingredients and mix them in one by one. Once your nutrient broth is thoroughly mixed add ½ cup of the broth into each jar. Close the jar and cover the top with aluminum foil. Proceed to pressure cook your jars at 15psi for 1hr. Let Jars cool in canner.

For Deli Containers

Fill rice cooker with your grains, then add your water, mix dry ingredients in one by one, then run your cooker. (It's okay if the grains are a little wet when finished) When the cooker is finished use a ½ cup measuring utensil to add grains to the bottom of your deli containers, do this one by one, and cover each with its lid, or plastic wrap secured with a rubber band.

Tek found on Shroomery

500 g potatoes (peeled and sliced thin)
200g bean sprouts
2 liters of Water (distilled or mineral water)
100 ml potato broth
2 g KH₂PO₄
1 g MgSO₄
1 g C₆H₁₄N₂O₇ (Ammonium citrate)
30 g glucose
3 g Soybean peptone
50 mg vitamin B1 (thiamine)
360 g brown rice

Cook peeled and sliced potatoes and bean sprouts in mineral water or distilled water on low heat until tender. Filter the broth through a sieve and discard the potatoes and sprouts. Add all dry ingredients (except rice) and mix in one by one. Measure 35 ml of nutrient solution and pour into wide mouth glass jars. Measure 30g of rice and put it in the jars along with the nutrient solution. Close the jar, and cover the top with aluminum foil. Proceed to pressure cook your jars at 15psi for 1hr. Let Jars cool in canner.

Eggs

In many foreign videos, I've seen farmers mixing eggs into their nutrient solution. There is even a video online of *C.militaris* being inoculated into and fruiting from the top of boiled eggs. I have yet to try this method but it deserves exploration.

Rice Cooker Tank Rental Tek

200 g of potatoes

1 liter of water

4 cups of rice, millet, corn, sorghum, or lentils

10g peptone (or powdered baby formula).

10 grams of yeast extract (or 3 whole blended eggs, shell included).

3 100 mg Vitamin B1 Tablets

10 grams of brown sugar (or glucose).

50 ml of hydrogen peroxide

10 ml vinegar

Cut potatoes into small pieces. Bring 1 liter of water to a boil, add the potatoes, and let them boil for 20 minutes.

Filter the broth through a sieve discard the potatoes, and set aside the broth to cool. Once cooled, stir in the rest of your ingredients one by one. Add water to bring volume to 4 cups if necessary.

Add 4 cups of grains to rice cooker, add your nutrient broth, and set the cooker for a white rice setting, or cook for 20-30 mins depending on your rice cooker.

When the grains are done, and still hot, scoop them from the pot into sterile container, and cover it (If your dishwasher has a sterilizer setting this

will work, other wise pour some boiling water on your containers to sterilize them)



LET'S GROW CORDYCEPS WITHOUT THE BUG!

So it turns out you don't need insects to cultivate cordyceps, this is a relief to many. *Cordyceps militaris* will grow on a wide range of grain based substrates. Check the Nutrient Medias Chapter to see which media will work best for you. The rest of the handbook will focus on grain based substrates as the mushrooms will initially be more marketable.

First things first, we will need a Mother culture for the grow. The Mother culture is what you will utilize to start all your fruiting jars/containers. Liquid culture has been the most effective way for me to maintain a mother culture for my operation.

Liquid Cultures

You'll need

A Glass Jar or Bottle

Polyester fiber
RTV Silicone
Ice Pick or Drill
Pressure Cooker
Syringes & Needles for Jars
Starter Culture Plate or Syringe
Spray Bottle of Alcohol
Scalpel
Butane Torch or Lighter

You can order liquid cultures online, but knowing how to make your own will save you lots of money. Making liquid cultures requires a pressure cooker, pint or quart regular mouth jar or glass bottle, rtv silicone(for jar method), polyfil, drinking water, corn syrup, a pack of luer lock syringes, 18g or higher needles, a spray bottle of alcohol, and a starter culture. First step is to punch a hole on one end of the jar lid the size of your syringe needle, this can be done with a nail, punch a hole on the opposite end big enough to put a tiny piece of polyfil in, to act as a filter. Cover the top and bottom of the smaller hole with the rtv silicone, place the lid on its ring to dry for 24 hours. For Glass Bottles, ensure the bottle is clean and pull a wad of polyester fiber big enough to fill the opening. When preparing the liquid media make sure to leave enough space in your container to swish around the water without getting the filter all wet. For every cup of drinking water I use 1 tbsp of corn syrup, completely dissolve the syrup in the water. Secure the lid on your jar, or suff the polyester fiber back into the



bottle, cover with aluminum foil, and run it through your pressure cooker at 10 psi for 30 mins. Once your pressure cooker has cooled remove your jar and take it to a clean space for the next step. Prepare your starter culture syringe by taking a flame to the needle tip until it is red, remove the aluminum foil, spray the lid with some alcohol, and put the syringe through the silicone port, introduce 2-5 ml of culture per container, for bottles secure the polyester fiber, and insert the syringe through it, or quickly remove it to introduce the 5 ml of culture. For starter cultures on agar plates, loosen the ring on the jar, and crack the lid leaving the lid resting on top of the jar, spray the outside of the plate with rubbing alcohol, heat up your scalpel to kill germs, open the plate, and cool the scalpel by sticking it in the agar somewhere the fungus hasn't grown yet, with a cool blade cut a piece of the fungus tissue open the jar and gently tap the scalpel on the jar lid to flick the piece of tissue into the liquid, quickly return the lid and screw it shut. Set your container in a cool dark place, and stir once a day. After a week you should notice a cloud in your liquid, this is your culture of Cordyceps!

For Bottles

You'll need a butane torch.

When cultures are mature in bottles you can use them for inoculations in a sterile area by spraying the polyester fiber with alcohol, allowing it to dry, remove the fiber and take a flame to the opening of the jar for a few seconds (Do not heat too hot or it may crack) You can then pour the smallest amount of liquid in your substrate jars or containers to spread the culture. When finished spray the polyester fiber with alcohol and put it back in the opening.

Liquid Culture Jars

For the next step bring your culture, and unopened syringes, and needles to a clean space, spray the lid of your jar with alcohol, carefully attach the needle to the syringe, uncap the needle, and carefully insert it into the

silicone port, and draw up your culture. Congrats you made a liquid culture syringe!

Bulk Media Preparation

When you're ready to step up to commercial production, it is very easy to scale up the media recipes with simple math. I have been preparing my nutrient solution in my home sink, this allows me to mix a couple gallons at a time. The only difference in bulk media preparation as compared to preparing 12 jar recipes is the amount of substrate you are working with. Spent brewery grains may be a helpful filler in bulk substrates, saving farmers money on grain costs, I have yet to try this, but it deserves exploration.

Polypropylene bags provide great surface area for cordyceps cultivation, bread loaf pans are also great for this reason, and many of them will fit in standard pressure canners, and cookers. When preparing media in polypropylene bags or bread loaf pans all steps will be the same, the only difference is that the pan has no lid and will need to be covered with aluminum foil, and the bag should be heat sealed or closed with pins before being put in the pressure cooker.





Inoculation

Gloves

Face Mask

Liquid Culture

Spray Bottle of Alcohol

Lighter

Once jars/containers are cooled bring them to a clean room with no moving air, a still air box, or in front of your filter box. Put on your mask and gloves, then open the cooker and place your jars/pans/bags on your workspace. Take a flame to your needle tip or top of liquid culture bottle before each inoculation, and spray your hands with alcohol between every couple jars/containers.



For Jars

One at a time, remove the aluminum from the top of the jar, wait for the needle to cool down, then insert your syringe through the polyester fiber, and introduce 1ml of liquid into each jar.

For Deli Containers

Spray the plastic wrap with alcohol, wait for the needle to cool down then insert it through the plastic introduce 1 ml of liquid into each container.

For Bread Loaf Pans

Spray the aluminum foil with alcohol, wait for the needle to cool then puncture the foil and insert 1 ml of culture into each corner of the pan, and one in the middle. (If you keep your syringes clean they can be refilled with culture 3-4 times when doing bulk pans)

For Polypropylene Bags

Spray the top of the bag with alcohol, allow the top of the bottle to cool down, pour a small amount of your culture into each bag then immediately seal the bag.

Incubation

Allow your jars to incubate in the dark between 60-75 degrees fahrenheit. In a week or two your substrate will be fully colonized, and some may be expressing orange pigments, this is ok! When working with pans wait two weeks before checking them to ensure you do not disturb them before they colonize all the media. Check on your pans by peeling up the aluminum and peeking in one corner, if the media is all white they are ready to go. Pans will need to be put into bags or covered with plastic wrap



for fruiting. (Search Precious Plastics on Google if you're concerned about plastic use in your system)

Fruiting

WooHoo time to fruit your Cordyceps! Once the mycelium has completely covered your substrate, it's time to expose it to light. You can place your jars/pans/bags in indirect sunlight from a window, otherwise they respond very well to combination blue and red l.e.d., or cool white fluorescent Lights. Maintaining a temperature between 65-70 degrees fahrenheit is key for triggering fruiting. Due to the fact that cordyceps grow in closed



containers there is no need to humidify your fruiting room. Enjoy watching

your fungus turn orange, and produce fruiting bodies over the next 4 weeks.







HARVESTING & PROCESSING

Once you notice your mushrooms growth slowing, or mycelium creeping up the fruiting body it's time to harvest. With clean hands (gloves for extra



cleanliness) and a clean knife open the jars/containers and cut the cake in half, this makes it easier to pull them out.

Once your cakes are out, gently pluck the mushrooms at their base, and place them on a drying rack or paper towel (They can be used fresh but have a very short shelf life). Once picked exposure to high temperatures, and light will cause the beneficial compounds in the mushrooms to begin

breaking down. Once the mushrooms are picked the cakes are still valuable for eating, extracting intra/extracellular biopolymers, or feeding to livestock. Research from Taiwan has shown feeding laying hens spent cordyceps substrate can increase the mass, and reduce the cholesterol of the eggs.

Processing

Fresh Cordyceps mushroom can be stored in a paper bag in fridge for 2-3 days. Fresh mushrooms can be lightly processed in a food processor for making tinctures. When making cordyceps tinctures with fresh mushrooms use 1 cup of processed fresh mushrooms per quart of everclear, store this in an amber jar in a cool dark place.



Over the next 3 weeks shake your jar of mushroom tincture once a day. After 3 weeks separate the mushrooms from the tincture with a strainer, pour the tincture into a half gallon container, bring a quart of



water to a boil, add the mushrooms, and reduce it to a low simmer for an hr, once this tea has cooled separate, and discard the mushrooms, then combine the tea with the tincture to create a dual extraction tincture. This method of tincturing works with dry cordyceps as well, when tincturing dry cordyceps it is easier to work with them whole.



The mushrooms will dry well on a paper towel in an open space within a day. To dehydrate both the mushrooms and the spent substrate set your dehydrator on its lowest setting, and monitor the materials until dry.

Once your mushrooms are fully dry store them in amber jars in a cool dark place. Ensure your mushrooms are fully dry (will snap easily) before

closing them in the jar, or they will release moisture, if this goes unnoticed they can become moldy within a few days. Spent substrate can be dried, and stored in brown paper bags in a cool dark place. Both the mushrooms,

and the spent substrate can be powdered in a coffee grinder, or food processor. Dry powders can be stored in amber jars, vacuum sealed, or encapsulated with a cap m quik kit.



PEST & CONTAMINATION MANAGEMENT

Working with liquid cultures significantly reduces the opportunity for contamination. If you notice your Cordyceps jar/pans/bags are all getting contaminated, stop agitating your liquid culture for a few days, and allow the fungus to collect at the top, if you notice any other colors besides white on the top, your liquid culture has become contaminated, and should be discarded. When working with the loaf pan method, be sure that all the pans are fully colonized before putting them in bags for fruiting, any uncolonized media becomes target for contamination once the foil is removed. The most common contaminations will be Trichoderma and Penicillium, these are molds that look green and blue. If your media begins to look off colored and slimy, or has wet spots, you have a bacterial contamination. Discard media with weed fungi (molds), and bacterial contaminations.

As you will soon learn Cordyceps militaris is very pungent! Building up large amounts of Cordyceps militaris mycelium will attract fungal mites. Mites are less likely to build up in clean fruiting rooms, especially if they are being cleaned between harvests. The biggest issue with mites is them spreading contamination on your petri plates. The only point in your operation that you should have enough petri plates to attract mites is during strain development. Keep an eye on your petri plates if you notice patches, or dimples in your mycelium take a look at it under a microscope

or magnifying glass, once you know what they look like most mites will be visible to the naked eye under good light. So you got mites on your number one fruiting culture, it's not the end of the world, mites will die off if you expose the petri plate to temperatures between 100 and 140 degrees fahrenheit for short periods of time, in short periods these temperatures will not kill your fungal culture. To prevent mites from spreading, store petri plates on sticky mats. FDA CPG Sec. 585.500 states the FDA can take legal action if there are 75 or more mites per 15 g of dried mushrooms. Monitor every few cakes of your harvest with a magnification tool to ensure they aren't infested with mites (This is more important for commercial growers).

Although they haven't been an issue for me yet, rodents pose a threat to the Cordyceps farmer. With the mushrooms being so fragrant, and the fruiting rooms being kept warm in the winter, a cordyceps farm seems like a great home for a rodent. Rodents can easily rip through plastic bags, and begin munching on the mushrooms, and substrate. Rodents consuming Cordyceps mushrooms will be more fertile, meaning more babies, so if you notice an issue handle it ASAP! Try to avoid chemical pest controls in your farm. There are myriad rodent traps pick whichever one will work best for the rodents on your farm. Ideally the rodents will be trapped and released far away.

During commercial cordyceps production in China, a fungal parasite was found infecting the fruiting bodies causing significant decrease of yield and quality. Two isolates were cultured from *C. militaris* fruiting bodies obtained from farms in Beijing and Shanghai, and were identified by small subunit and internal transcribed spacer sequence data. The sequences showed that the fungal parasite belong to the genus *Calcarisporium* and are related to the species, *C. arbuscula* with 91% internal transcribed spacer sequence similarity. The interaction between *Calcarisporium* and *C. militaris* is not fully understood at this time. In my operation I will see white

mycelium form on the fruiting bodies if I allow the temperatures to rise above 70 degrees fahrenheit.

MARKETING

This chapter will be focusing on Marketing locally, although these ideas can be expanded for online sales, and distribution. You'd think Cordyceps mushrooms could market themselves, they are so intriguing! Alas there is an "ick" factor around mushrooms, especially ones that grow from bugs. Educating our market is very important, people won't buy something if they don't know it's value. Lucky for us there is a superfood/herb craze spreading across the world, as more people are concerned with their health. This superfood/herb craze has many people interested in the medicinal value of Cordyceps mushrooms, simply searching "Cordyceps benefits" on Youtube will lead you to pages of videos of professionals, and consumers talking about their experience, or understanding of Cordyceps. People like myself, are traveling around and teaching about Cordyceps at schools, conferences, festivals, and clubs. With the information in this book you can begin educating your local market. For legal safety it is important when marketing we don't make any claims that these mushrooms will cure anything. It is ok to talk about experience when marketing, "When I use Cordyceps I don't need coffee!" "I wake up feeling refreshed when I've been drinking Cordyceps tea!" these are great ways to market the mushrooms without making definite claims. People can be inspired to research the medicinal properties of Cordyceps on their own, I love recommending videos for people to watch. Social media is a great place for sharing legitimate research for people to read themselves.

Most states in the U.S. will require you utilize a USDA certified kitchen for preparing, and packaging products for people to eat. Check your local area for kitchens in churches, or community buildings that may already be certified, sometimes they will let you use

them for free! Getting a kitchen certified isn't too hard, the kitchen can not be in a home with pets. Some Cordyceps farms in Asia have small cafes attached where they prepare Cordyceps teas, Smoothies, Soups, and Desserts. Starting with a small farm stand with a couple Cordyceps products is a great way to begin marketing. If dealing with customers directly isn't your forte, selling your products to other farm stands, cafes, health food stores, and restaurants may be a viable option for you. Although it may seem tempting I don't think it is a good idea to approach a sale before you have product. Once you have a nice harvest, and have processed it the way you like, take your product to the potential seller, at this point you can sell, consign or gift a small amount for them to try.

Consignment is a great way to develop a sales relationship, other farm stands, or stores will hold your product on their shelves, and pay you when it sells.

Seek out local artist, or friends who may be able to help you with a graphic for your Cordyceps brand. Once you have a nice Graphic utilize

local print shops or office supply stores to print out stickers for your products.



Ideas from products being sold in Thailand

Powdered Fruit Bodies, and Powdered substrates for adding to foods, and smoothies.

Jars of Dry Fruit Bodies

Cordyceps Soap

Cordyceps Facemask

Cordyceps Coffee

CORDYCEPS RECIPES

Cordyceps militaris Tea for 2

2 grams of dry Cordyceps
4 cups of water
2 teaspoons of local honey

Bring water to a boil in a pot with a lid. Once the water is boiling add mushrooms, and reduce heat to low. Allow the mushrooms to simmer for 20-30mins, then add honey. Include the mushrooms into your cup of tea, and eat them as you drink. (Can be brewed strong and diluted with your favorite hot or iced tea)



Cordyceps Flower Chicken Soup

Serves 4-5

1 whole chicken
20g fresh cordyceps militaris
5 sticks dang shen (optional)
2 tbsp goji berries
2 small ginger roots
12-15 jujubes aka red chinese dates
2-3 liters of water (adjust accordingly)

Salt to taste

Bring 1 liter of water to a boil. Remove the chicken skin. Trim the excess fat, and save for something else. Rinse the chicken. Cut into large chunks.

Blanch chicken in boiling water. Rinse again and set aside. Rinse dang shen and cut into 2 portions for each stick. Rinse and remove seeds from jujubes. Cut ginger into slices. Set aside.

Adjust water to 2 liters and bring to a boil. Put all ingredients (except for goji berries) into the pot and allow it to a boil again. Reduce to medium

heat for 10 minutes. Then simmer for another 2 hours. Add goji berries 5 minutes before it's finished. Turn off the heat. Add salt to taste, and serve.

Sacral Orange Vegetarian Soup

Serves 3-4

2 tablespoons coconut oil (or olive oil)
1 medium yellow onion, peeled and chopped
1 medium sized fresh turmeric root finely grated
1 oz Fresh Cordyceps militaris
1 tablespoon garam masala
3/4 teaspoon ground cumin
1 clove of fresh garlic finely grated
2 large sweet potatoes, peeled and diced
1 cup water
1 cup vegetable broth
1 can of coconut milk
1 teaspoon salt
1 cup toasted cashews, chopped
1/2 cup cilantro, roughly chopped

Heat 1 tablespoon of oil in a large dutch oven, or pot over medium-high heat. Add the sweet potatoes and saute for 3-5 minutes until lightly browned. Add the onion, garlic, and turmeric and continue to cook for another 1-2 minutes until softened. Sprinkle in the Cordyceps, garam masala and cumin over the vegetables and saute for 30 seconds. Add the vegetable broth and allow it to boil. Cover the pot, reduce the heat to low, and simmer 10 or until the vegetables are tender.

Transfer the soup into a blender and puree, *Make sure top of blender is secure*

Pour the coconut milk and salt into the blender and pulse until well combined. Taste and add salt as needed. Serve garnished with cashews and cilantro.

Steamed Chicken with Cordyceps Flower

Serves 2

1 piece of chicken thigh meat

10g of dry Cordyceps

10g of dates

A couple green onions

1 clove of garlic

2 teaspoons of sesame oil

1 teaspoon of soy sauce

1 teaspoon of chicken powder

1 teaspoon of cornstarch

1 small Ginger root, thinly slice

Cut the chicken thigh into medium size pieces. Set aside.

Wash and soak the dates and Cordyceps in water for about 30 minutes, or until softened.

In a medium bowl, combine the chicken meat, Cordyceps, and dates with the seasoning ingredients. Mix well and transfer to a serving plate, and prepare for steaming. Steam for 13-15 minutes, until fully cooked.

Cordyceps Stuffed Peppers

Serves 3-4

1 cup rinsed quinoa or rice
2 cups vegetable stock
4 large bell peppers cut in half and cleaned out
1 oz fresh Cordyceps militaris
1/2 cup salsa
2 tsp cumin powder
1 1/2 tsp chili powder
1 1/2 tsp garlic powder
1 can black beans, drained
1 cup whole kernel corn, drained
1 ripe avocado, sliced
Fresh limes
Cilantro, chopped
Diced red onion

Add quinoa and vegetable stock to a saucepan and bring to a boil over high heat. Once boiling, reduce heat, add cordyceps, cover, and simmer until all liquid is absorbed and quinoa is fluffy - about 20 minutes. Preheat oven to 375 degrees F and lightly grease a 9x13 baking dish or rimmed

baking sheet. Brush halved peppers with a neutral, high heat oil, such as grape seed, avocado or refined coconut. Add cooked quinoa and cordyceps to a large mixing bowl and add the beans, and corn. Mix to thoroughly combine then taste and adjust seasonings accordingly, adding salt, pepper, or more spices as desired. Stuff halved peppers with quinoa mixture until all peppers are full, then cover the dish with foil. Bake for 30 minutes covered, then remove foil, increase heat to 400 degrees F, and bake for another 15-20 minutes, or until peppers are soft and slightly golden brown. Serve with avocado, lime, cilantro, and diced onions.

Pickled Cordyceps

6 cups Fresh Cordyceps
4 sprigs Fresh Thyme
½ cup Apple Cider Vinegar
½ cup White Vinegar
3 tablespoons of olive oil
1 tablespoon of Honey
10 whole peppercorns
1 dried bay leaf
1 large clove garlic, sliced
1 small dried hot red chile
1 tablespoon. Sea Salt

Bring a large pot of water to a boil. Carefully dunk a quart-size canning jar, and lid separately the water and boil for 10 minutes to sterilize. Remove with tongs and set on a clean towel..

Brew a strong tea with your mushrooms. Drain (Save the tea) and pack them into the jar along with the thyme sprigs.

In a small saucepan, bring the vinegar, oil, sugar, peppercorns, bay leaf, garlic, chile, salt, and 1/2 cup water (or the tea) to a boil over medium heat.

Pour the mixture over the mushrooms until it reaches the top of the jar.

Screw on the lid, cool to room temperature, and refrigerate for 3-4 days before using.

THE FUTURE OF CORDYCEPS (CORDYCEPS MICROFARMS)

Why Now?

Why not now, is a better question! The word is out, an amazing BBC video, and recent TED talks, have introduced the internet masses to the wonders of the Cordyceps fungus. The mushrooms have been cultivated in Asia for over a decade, and a handful of Westerners have taken the opportunity to visit cordyceps farms, establish trades, and even participate in workshops.

It was inevitable that someone would begin farming Cordyceps in North America.

Cordyceps mushrooms have a bright Future! As more people learn about the benefits of using Cordyceps, the demand will continue to rise. Being the curious organism that it is, we will be seeing more Cordyceps in media helping everyone develop a better understanding of the mushrooms. I envision Summer Cordyceps Festivals/Forays, where people will gather in Nature to celebrate and collect new Cordyceps specimen. I will travel around this year (2017) initiating Cordyceps MicroFarms! I will be sharing information on Cordyceps cultivation, helping set up fruiting rooms, and sharing my cultures. With more people growing Cordyceps militaris we will see all sorts of new recipes, and products. I believe Cordyceps militaris is the gateway cordyceps. With more confident Cordyceps militaris farmers someone will soon be successful with producing other species of Cordyceps. Another "Cordyceps" showing potential for cultivation is *Tolypocladium ophioglossoides*. I envision Cordyceps farmers in communities around the world providing an ethical living for themselves. I'm excited to see all the genetic expression in the Cordyceps militaris species! 2017 I will be collecting more wild specimen and doing DNA analysis. I hope to work with mycologist around the country to develop

techniques for working with *C. psuedomilitaris* *C. cardinalis*, and
C.roseostromata.

Cordyceps militaris has reached out to me in partnership in this great time
of change. Cordyceps are prepared to ally with humans for the betterment
of both species!

Cordyceps are Coming to a Community Near you Soon!









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Induction of apoptosis and inhibition of telomerase activity in human lung carcinoma cells by the water extract of *Cordyceps militaris*

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Effects of *Cordyceps sinensis*, *Cordyceps militaris* and their isolated compounds on ion transport in Calu-3 human airway epithelial cells

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Effects of culture conditions on the mycelial growth and bioactive metabolite production in submerged culture of *Cordyceps militaris*

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Metabolomics Revealed Novel Isoflavones and Optimal Cultivation Time of *Cordyceps militaris* Fermentation

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Pharmacological actions of *Cordyceps*, a prized folk medicine

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Studies on the Antidiabetic Activities of *Cordyceps militaris* Extract in Diet-Streptozotocin-Induced Diabetic Sprague-Dawley Rats

Yuan Dong, Tianjiao Jing, Qingfan Meng, Chungang Liu, Shuang Hu, Yihang Ma, Yan Liu, Jiahui Lu, Yingkun Cheng, Di Wang, and Lirong Teng, College of Life Science, Jilin University, Changchun 130012, China, College of Clinical Medicine, Jilin University, Changchun 130012, China, College of Life Science, Zhuhai College of Jilin University, Zhuhai 519000, China

Calcarisporium cordycipiticola* sp. nov., an important fungal pathogen of *Cordyceps militaris

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William Padilla-Brown is a Social entrepreneur, Urban Shaman, BioHacker, MultiDisciplinary Scientist and a Certified Permaculture designer. William has spent most of his life traveling the world, stopping at such places as The Pyramid of the Sun, Olmec Ruins in Villahermosa and Campeche Mexico, England, France, Taiwan, and various States on the East and West coast of Northern America. He has run a nonprofit in New Cumberland called Community Compassion since he was 18, focusing on Radical Sustainability. Will operates MycoSymbiotics llc a small mycological research, and Mushroom production business. He has educated children and adults on topics varying from Mushroom Cultivation to Nutrition via. various workshops and programs around the United States. William dropped out of High School at age 16 and has since been pursuing a Non-traditional Independent approach to his Higher Education actively promoting alternative education options. William received a certification in Permaculture from Susquehanna Permaculture, and NGOZI. Will hosts the MycoSymbiotics Mushroom & Arts Festival the first weekend of August in Central Pennsylvania every year. William is currently engaged in running for local office, and gaining access to a warehouse to convert to a Mushroom Farm, and Community Lab/Maker Space in New Cumberland Pennsylvania. Find more about William Padilla-Brown by following him on Facebook, or Instagram @MycoSymbiote. Lots of Youtube videos @ Youtube.com/ApexGrower. Information on classes @ MycoSymbiotics.Blog

