Magic Mushroom Cultivation

Steven H. Pollock, M.D.

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Art and Illustrations by
Robin Klause

Herbal Medicine Research Foundation
San Antonio, Texas 1977

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A MUST FOR MAGIC MUSHROOM ENTHOUSIASTS!

$5.00”

Foreword

In Mexico there is an ancient native tradition that the sacred mushroom speaks. *Es habla!* It is language! Indeed plants that alter consciousness have been used by man for psychogenesis as early as civilization itself. Even today, sacred mushrooms play a vital role as divinatory medicinal agents in Latin America. Naturally enough, with the Twentieth Century explosive rise in psychotropic mushroom consciousness, magic mushroom use has become a worldwide transcultural phenomenon. The mushrooms speak for themselves.

When psychobotanicals are employed prudently, they can

be of great benefit to the mind and body. Used inappropriately, however, they can induce unpleasant or bad trips. Organic psilocybin-containing mushrooms are safer and more pleasant than LSD, STP, PCP and other synthetic hallucinogens. Home-grown magic mushrooms are truly marvelous herbs and should be regarded always with deep respect. Like their wild progenitors, cultivated psilocybian mushrooms have powerful natural energies that can soar the mushroom eater to paradise or deposit him into abysmal psychic turmoil.

Interest in growing magic mushrooms at home has increased tremendously in recent times. It is a worthwhile endeavor because persons who grow their own psychobotanicals usually tend to live in a harmonious relationship with them. Diverse techniques for magic mushroom cultivation are offered in this book. Some are novel and have never before been made available to the public, whereas others include innovative improvements on well established methods. Each technique offers certain advantages compared with other techniques, and enthusiasts may want to experiment with all of them or choose one most suitable for a particular cultivation project

Introduction

Psychotropic mushrooms naturally grow throughout most of the terrestrial world and are eagerly hunted by psychomycophiles, i.e. magic mushroom enthusiasts, worldwide (Pollock, 1975-77). The majority of these mushrooms produce psilocin (4-hydroxy-N,N-dimethyltryptamine) as a hallucinogenic constituent but store their magic predominantly in
the form of psilocybin (4-phosphoryloxy-N,N-dimethyltryptamine). This unique phosphate analog of serotonin (5-hydroxy-tryptamine), a neurotransmitter in the

human central nervous system, is biosynthesized not only by numerous psilocybian mushroom species belonging to the genera *Panaeolus* and *Psilocybe* but also by at least two species of *Conocybe* and some *Stropharias*. Even serotonin itself occurs as a metabolite in some of these mushrooms, but it is not responsible for their psychotropic effects.

Psychoactive *Stropharia* species, such as the magnificent cubensis and the less well known subaerugina.scens, are regarded by some taxonomists to be *Psilocybes* because they lack certain sterile cells called chrysocystidia, the function of which is still unknown. The genera *Stropharia* and *Psilocybe* are in fact so closely related through these intergrades that *Stropharias* should probably be reclassified as *Psilocybes*. The binomials *Psilocybe cubenis*, *P. stuntzii*, and *P. subaeruginascens* will therefore be employed in this book.

Most psilocybian species stain cyan blue when bruised, especially on the stem, but not all mushroom species that stain blue are hallucinogenic. Some are actually poisonous and correct identification of field collections is important. Some *Amanita* species, notably the striking *muscaria* and the divine *pantherina*, contain the hallucinogenic amino acids ibotenic acid and muscimol. Because of the ecological nature of *Amanitas*, no one has been able to obtain fruit from them under artificial conditions. In contrast, many species of *Psilocybe* and Panaeolus have been successfully cultivated.

The first successful cultivation of sacred hallucinogenic mushrooms from Mexico was accomplished by the mycologists Roger Heim and Roger Cailleux in Paris during the late 1950’s. They were able to obtain fruit of some *Psilocybe* species under sterile conditions on compost in glass flasks and also grew various species under nonsterile conditions on composts in earthenware pots in a greenhouse (Heim & Cailleux, 1957; Heim & Wasson, 1959; Heim & coll., 1967). The latter technique was found to be ideal for obtaining plenty of magic fruit since beautiful flushes of mushrooms appeared.

Psilocybe mexicana Heim, *P. caerulescens* Murrill, and *P. cubensis* (Earle) Singer were the first hallucinogenic species fruited in this manner and *P. semperviva* Heim & Cailleux, *P. mixaeensis* Heim, and *P. zapotecorum* Heim soon followed. *P. cubensis* not only turned out to be the most aggressive species to fruit in cultivation but also produced the largest mushrooms. It is no wonder that *P. cubensis* has become the mushroom of choice for cultivation by magic mushroom enthusiasts.

Psychotropic fungi from diverse areas of the world have been tested by the author for growth and fruiting ability on various media. Observations have been made on the following Psilocybes: a strain of *P. argentipes* Yokoyama from Japan; strains of *P. baeocystis* Singer & Smith from Oregon. Washington, and British Columbia; two strains of *P. Caerulescens* Murrill from Mexico; a strain of *P. coprophila* (Bulliard per Fries) Kummer from Texas; multiple strains of *P. cubensis* (Earle) Singer from Texas, Mexico, and Colombia; strains of *P. cyanescens* Wakefield from British Columbia, Washington, and Scotland; two strains of *P. fasciata* Hongo from Japan; strains of *P. semilanceata* (Fries) Kummer from British Coltunbia and Oregoii ; strains of P. subaerugiuascens Höhnel from California and Japan; a strain of *P. subaeruginosa* Cleland from Australia; a strain of *P. subcaerulipes* Hongo from Japan; multiple strains of *P. stuntzii* Guzmán & Ott from British Columbia, Oregon, and Washington; and finally a strain of *P. zapotecorum* Heim from Mexico.

Observations have also been made on the following species of *Panaeolus*: a strain of *P. cambodginiensis* Ola'h & Heim from Colombia; strains of *P. cyanescens* (Berkeley & Broome) Saccardo from Hawaii and Mexico; and two strains of *P. subbalteatus* (Berkeley & Broome) Saccardo from Oregon.

Mexican strains of *Psilocybe yungensis* Singer & Smith, a species that typically inhabits fallen trees and humus, were fruited after five or more months of culture on a moss medium

in glass flasks (Heim & coll., 1967). But such a lag is entirely impractical for psilocybian mushroom fanciers. Therefore, this book will focus primarily on cultivation of species that can be grown easily and relatively rapidly. Techniques for their cultivation are applicable, nevertheless, to many other magic mushroom species and to various "food" mushrooms as well.

The Magic Mushroom Life Cycle

Mushrooms are spore bearing organs (carpophores or sporocarps) of higher fungi, which live in soil, on dung of wild and domesticated animals, or in other habitats. *Amanita* species live in symbiosis with the roots of various trees and have largely undefined growth factor requirements. *Amanitas* therefore cannot be readily brought to fruition in the laboratory or at home. The life cycles of all magic mushrooms nevertheless follow the same basic pattern as portrayed for *Psilocybe cubensis* (figure 1).

The vegetative or somatic fungal organisms exist as strands of interconnected mycelia. Generally in nature the mycelia cannot be seen in the substrate with the naked eye. The fluffy or stringy white mycelia of *Psilocybe cyanescens* and *P. cubensis*, however, are characteristically luxuriant and readily perceptible when probing the substrate. Although carpophores are normally regarded as fruit because of their fleshiness, the purpose of a mushroom is to make and disperse germ cells (gametes) for propagation of the species. A mushroom is actually analogous more to a flower than to a fruit in this respect.

Specialized cells known as basidia and located on mushroom gill edges undergo reduction division (meiosis), which allows for genetic recombination in the successive generation. The nucleus of a diploid basidium contains paired chromosomes that separate and double in the reduction division. This results in the formation of four nuclei with

unpaired chromosomes. These nuclei migrate into basidial cell wall extensions which pinch off and become spores. Each spore is borne by the basidium on a pedicel known as a sterigma and is ultimately ejected by electrostatic forces. Spores have a protective surface covering enabling them to survive for months or even years in a dormant state. An hallucinogenic strain of *Panaeolus sphinctrinus* (Fries) Quélet was even revived from a seven year old spore deposit (Ola'h, 1970).

Spores and the monokaryotic hyphae which germinate from them are haploid, i.e. they have unpaired chromosomes. After forming clamp connections, the monokaryotic hyphal cells undergo somatogamy exchanging nuclear material and becoming dikaryotic. The diploid mycelia (strands of hyphal cells) have paired chromosomes. If the genetic makeup of the diploid mycelia permits, the proper environmental conditions will stimulate mushroom formation. Primordia or "pinheads" appear first and expand into mature mushrooms by absorbing water. Some psilocybian species, such as *Psilocybe cubensis*, *P. subaeruginascens*, *P. stuntzii*, and *Panaeolus semiovatus* (Fries) Lundell, possess a partial veil that encloses the undersurface of the pileus (cap), thereby helping to maintain a humid micro-environment for spore development. As the mushroom matures, its partial veil ruptures leaving an annulus (ring) on the stipe (stem). These features are so obvious that *P. stuntzii* sporocarps are sometimes called "Blue Veils" and P. cub ensis "Purple Rings." Although mushrooms do not have chlorophyll, some have light sensitive pigments which cause them to orient toward natural and artificial light (phototropism) as they are growing, and indeed light is necessary to induce fruiting of psilocybian mushrooms.

Individual spores are invisible to the naked eye, but adeposit of spores known as a spore print (figure 2) can easily be obtained from a fresh mushroom by cutting off the cap, placing it bottom-side down on a piece of clean paper, and

setting a glass or cup over it for a few hours or overnight. Usually white paper is used in order to discern the color of the spore print. The print will have a characteristic color depending on the genus of mushroom. *Panaeolus* spore prints are black except for those of *P. foenisecii* (Persoon per Fries) Kühner and *P. castaneifolius* (Murrill) Smith which are dark brown. *Psilocybe* spore prints are typically purplishbrown. *P. cubensis* usually gives such a dark print that it appears black, often with a purple hue. Under a microscope *Psilocybe* spores such as those of *P. cubensis* (figure 3) appear yellowish-brown in 10% KOH solution. Black *Panaeolus* spores retain their color even in concentrated sulfuric acid solution. This readily distinguishes them from the black spores of *Coprinus*, etc., which fade in sulfuric acid solution. Spores of *P. foenisecii* and *P. castaneifolius* have a warted internal appearance that is distinctive under the microscope.

It is nof known whether spores of psilocybian mushrooms contain psilocin and psilocybin, but conceivably they do. Mycelia of *Psilocybe cubensis*, *P. baeocystis*, and numerous *Panaeolus* species, have been reported to biosynthesize psilocybin, psilocin, or both of these psychoactive compounds in liquid culture (Catalfomo & Tyler, Jr., 1964; Leung & Paul, 1969; Ola'h, 1970). On solid media such as agar, psilocybian mycelia will often develop a blue discoloration. This is probably due to an enzymatically catalyzed oxidation of psilocin to a blue quinone.

The Simplest Technique from Scratch

The simplest cultivation technique for growing magic mushrooms from spores requires very little in the way of supplies. All that is needed is some manure, vermiculite, water, canning jars, a pressure cooker, and of course spores. This technique works well for San Isidro (*Psilocybe cubensis*) and other mushrooms which grow on dung in nature,

especially *Panaeolus* species.

The selection of manure is very important. Slightly aged manure should be used. If the manure is too fresh, it is messy to work with. But if it is too old, it is less suitable as a growth medium. Because of its porous texture, horse manure is preferable to cattle manure but manure from other herbivorous mammals, such as sheep and even elephants, can be used for growing mushrooms. Composted manure is excellent. If the manure is gathered directly from a stall in a stable after breaking down for over a year, however, it is sometimes unsuitable for this method. Do not use commercially packaged manure either. After commercial processing, it is usually more like dirt than real manure. Sometimes farms will sell cow manure that has been largely separated from dirt by a machine and placed in a huge pile, where it begins to compost. This is ideal!

After manure is selected, the next step is to pour some vermiculite (about 1/4 to 1/3 cup) into a wide mouth canning jar. Then add some manure. You should not overdo it. Add enough to cover the vermiculite with a layer of about 1 to 1½ inch manure. The amount is not critical. For instance, it is not necessary to cover all the vermiculite. The purpose of the vermiculite is to hold moisture and to keep the manure from burning onto the bottom of the jar when it is steam sterilized in the pressure cooker. The manure layer need not have uniform thickness. In fact, it is best to use relatively small broken pieces of manure with irregular shapes in order to provide plenty of surface area for growing mycelia. Besides, relatively large intact pieces of manure tend to be more resistant to complete sterilization in the pressure cooker.

After the manure layer is in place, squirt it well with water from a spray bottle. It is desirable to start with plenty of water so as to produce an environment with adequate moisture for the spores to germinate. Pressure cooking tends to dry out the manure unless, there is sufficient water. If water cannot easily

be seen accumulating at the bottom of the jar in the vermiculate layer after spraying, then add about 1/8 cup water (more or less as deemed necessary). Too much water, however, can cause the manure to undergo dissolution into a muddy consistency during sterilization. This is not desirable. An advantage of uncomposted horse manure is that it is rather resistant to dissolution during sterilization. It should not take much effort to get the knack of how much water to use. Prepare as many jars as desired, the more the better. Other glass containers, such as Erlenmeyer flasks, may be used in lieu of canning jars for this method of starting spores, but canning jars are convenient and practical.

After enough water has been added, place the dome of each canning jar lid upside down over the mouth of each jar so that the rubber seal faces up and screw on the band of each lid (figure 4). Leave it loose because the object is to allow pressure on the inside of the jar to equilibrate with that in the pressure cooker during sterilization. The jars are ready for the pressure cooker. If flasks or other glass containers are being used, cotton plugs can be employed with aluminum foil as an outer wrapping. A 22 quart pressure cooker holds 7 quart canning jars. A larger pressure cooker with room for two layers of quart jars allows for greater production.

Place the jars on a bottom rack in the pressure cooker and add water. Usually about three quarts of water is sufficient for a 22 quart cooker. One way to be sure enough water has been added is to fill the pressure cooker until the jars start to tip over from floating and then to scoop out some water with a small cup to prevent this. Pressure cookers that do not require a rubber gasket are a better buy, but either type will work fine. Be sure to use a little vaseline to obtain a good seal with either type. Then pressure cook the jars at 15 lbs. pressure for a full hour from the time the pressure has reached 15 lbs. After the steam sterilization is completed, allow the pressure cooker and contents to cool. Open the pressure lock to release

any excess residual pressure and remove the jars. Screw the lids tight until ready to begin spore inoculation.

To prepare for spore inoculation, heat the end of a wireloop or probe, dull knife, or any other suitable object in the flame of an alcohol lamp or -gas burner on a stove until it begins to glow. Then carefully set it down being sure to keep the end from touching anything. It is best to lay down the wire loop or eqijivalent object at the edge of a counter so that the heat sterilized end is not near any surface. Carefully upfold a spore print if it is folded. Then lift off the lid of the jar to be inoculated, removing both the band and inverted dome together. As soon as the two piece lid is off, turn it over so that the dome will not fall out and set it down. Pick up the unfolded spore print and hold it at an acute angle over the jar with one hand. The spore print should be facing the jar. With the other hand take the loop and scrape off some spores, letting them fall into the jar (figure 5). Gentle tapping of the spore print with the loop insures that lots of spores will fall into the jar. Do not overdo the tapping as it is not good to cause air currents. Then put the lid back on the jar with the rubber seal of the dome still facing up. Do not screw the band too tight since is is necessary to let oxygen diffuse into the jar and carbon dioxide out.

Many jars can be started from one large spore print. During the entire inoculating procedure, it is important to work in a draft-free area. Therefore keep doors and windows closed and do not run heating or air conditioning for at least several hours before making the spore inoculations. It is also important to control breathing when inoculating the jars, since breathing over the open jars may contaminate them. It is not really necessary in most cases to wear a mask, but it may make a difference for some enthusiasts.

In anywhere from three days to a couple of weeks, depending on the age of the spore print, white mycelia should be noticeable in each jar at multiple sites on the manure. San

Isidlro mycelia are more fluffy than mycelia from *Panaeolus*. If contaminants start to grow, they will usually be some other color, most often green. Since manure is a natural substrate for the mushroom species being grown, ordinarily growth of mushroom mycelia rather than contaminants will be favored. San Isidro mycelia will frequently complete growth and commence to form mushrooms within a month but may take up to six weeks or rarely longer. *Panaeolus* species are slower to make mushrooms in small containers.

Furthermore, when mushrooms are grown in small containers such as quart jars, they tend to be much smaller than when grown in larger containers or on compost outdoors. Therefore magic mushroom growers might reasonably wish to use mycelia in the quart jars as "spawn" for larger containers or compost beds. It is advisable to refrain from using such spawn for large scale cultivation projects until after it has been observed to make mushrooms.

Culture on Agar Media

Agar is a concentrated extract of red marine algae belonging to the genera *Gelidium*, *Gracilaria* and *Pterocladia*. It is principally employed as a gelatinizing agent for microbiological culture media and has a history of use as a non-habit-forming laxative, a gelatin substitute in food preparation, and a sizing for paper and silk. Agar is sometimes called agar-agar or Japanese Isinglass and is available in powder form from many biological supply companies or in strips from health food stores. The commercial powdered agar is less expensive. If agar strips are purchased, they should be ground into powder prior to use. Agar does not dissolve in cold water but readily dissolves in at least 65 times its weight of boiling water. Upon cooling, the agar becomes a firm jelly that is particularly suitable as a medium for germinating magic mushroom spores and isolating pure cultures of mycelia. Agar media are also

excellent for the growing and storage of stock mycelia.

Agar is actually a polysaccharide composed mainly of the sugars galactose and uronic acid in various combinations and chemical forms, but the nutritional value of agar is minimal. Therefore, it is necessary to fortify agar media with extra nutrients for growing magic mushroom mycelia. PDY (potato-dextrose-yeast) agar is superb. This medium consists of potato water, dextrose sugar (D-glucose), an extract of yeast, and agar. Potato water is made by cutting a moderately large unpealed potato, or at least 200 grams of small potatoes, into one-inch sections and boiling them in a liter of tap or distilled water for an hour. The water is then strained, through a metal strainer or cheesecloth to remove pieces of potato and extra water is added to bring the final volume back to one liter. The potato water is heated to a gentle boil and 20 grams dextrose, 3 to 10 grams yeast extract, and 15 grams agar are stirred in until completely dissolved. The yeast extract is rich in vitamins, protein and minerals. Nutritional yeast may be used as a substitute for the yeast extract, but the extract is better. Fresh potato water is rich in essential growth factors. This is evident since mushroom mycelia will grow rather poorly in glass culture tubes containing commercial potato dextrose agar with yeast extract but will grow very well on PDY agar made with fresh potato water.

If the PDY agar is going to be used to germinate spores of *Psilocybe* or *Panaeolus* mushrooms, it is important to lower the pH, which is normally about 5.6, to 4.5 with a weak organic acid such as lactic, oxalic, or tartaric acid. The pH can be easily measured with pH paper and germination is much faster at the lower pH. Also, growth of undesired bacteria is significantly inhibited at the lower pH. With this pH 4.5 medium, it is not necessary to use any antibiotics. If the spore print is greatly contaminated, the benzimidazole compound known as benomyl may be added to the medium prior to sterilization. About 1 mg benomyl per liter of agar solution

generally inhibits growth of many different potential fungal contaminants much more than it retards growth of mushroom mycelia (Edington, Khew & Barron, 1971).

The medium is now ready for sterilization. If an autoclave is going to be used, pour each 500 ml of agar solution into a liter flask. If a pressure cooker is going to be used, pour each 250 ml portion of agar solution into a quart canning jar or liter flask. Sterilize at 15 lbs. pressure for at least thirty minutes but preferably f or a full hour. After sterilized PDY agar has been allowed to cool in the pressure cooker or autoclave, carefully pour it into plastic petri dishes, which come presterilized and can only be used once. They would melt in the pressure cooker. Glass petri dishes can also be used and are recyclable. After use they can be cleaned and then resterilized in the pressure cooker. They should be wrapped in a dish towel and placed on a rack for sterilization. Petri dishes of media are excellent for germinating spores or growing stock mycelia because of their large surface area and ease of making transfers.

Other containers such as canning jars, baby food jars, glass test tubes, etc. will also work for culturing mycelia. Glass culture tubes with autoclavable plastic screw-on caps are available in various sizes. When using any of these containers, pour in a small volume of unsterilized agar solution and loosely screw on each cap. If using canning jars, invert the domes. If using containers without autoclavable lids such as flasks or glass test tubes, the openings should be plugged with cotton or glass wool and covered with aluminum fail prior to sterilization. If using glass beakers, aluminum foil will suffice as a cover. The containers with agar solution are then placed in a pressure cooker using appropriate racks and sterilized for an hour. Glass culture or test tubes should be taken out while media are still warm. Tubes of liquid agar media are then placed at an angle of less than 20° to cool. When the agar media solidify in the inclined tubes, there is more surface area

for growth of mycelia than if the tubes had been allowed to cool in the vertical position. Since the tubes have a slanted agar surface, they are often referred to as “slant tubes.”

It is important to work ‘in a draft-free place when opening the sterile containers of agar media to inoculate with spores, make transfers of mycelia, or make tissue cultures from the mushrooms themselves. To make an inoculation from a spore print, heat the end of a wire loop in the flame of an alcohol lamp or gas burner. It will rapidly begin to glow. Then lift up the cover of the petri dish and dip the loop into the sterile agar medium. This will both cool the loop and give it a coating of agar to which spores will adhere. Immediately recover the petri dish and gently scrape the wire loop across the spore print. Many spores will stick to the loop. Then open the petri dish and smear the spores on the agar. This is ordinarily accomplished by first streaking the wire loop across the agar medium and then sweeping over the agar surface in a narrow “S” pattern (figure 6). Recover the petri dish and flame the wire loop for the next spore inoculation.

When all the dishes are inoculated, seal them with strips of paper masking tape. This will help to keep the agar media from drying out. Store the dishes in a convenient place at room temperature. It is best to label them with the date, species, strain, etc. in order to follow their development. It is not necessary to wear a mask during the inoculation procedure, but caution should be taken not to breathe on open petri dishes. It is important to keep the risk of contamination to a minimum.

Another inoculation technique which can be employed is the “quadrant dilution technique.” Divide each petri dish into four equal quadrants and spread out the spores by sweeping at first only in one quadrant. Recover the petri dish and reflame the loop. Allow it to cool. Then streak once across the inoculated quadrant and move to the next quadrant into which spores should be spread using a recurring “S” pattern. Time

can be saved by flaming more than one inoculating loop at a time. The process is repeated, streaking spores from the second into the third quadrant and finally from the third into the fourth. The fourth quadrant will have the fewest spores but should also be least likely to be invaded with contaminants in the original spore sample.

If a mushroom enthusiast does not have a spore print but does have a sun-dried or air-dried magic mushroom, it may be possible to isolate a pure mycelial culture. This is especially true if the specimen is not very old. Two approaches can be tried. The first is simply to flame a wire loop, cool it in the agar medium as if preparing to streak spores from a spore print, dip the loop briskly into the gill tissue of the mushroom, and finally streak it on the agar medium using the "quadrant dilution technique."

The other apprpach is a spore dilution technique using sterile water. A piece of mushroom gill tissue is placed in a vial containing less than 1 ml sterile water. The tissue is then broken up and swirled around with a flamed wire loop. Then a small sample of the water containing spores is transferred to another vial containing a small amount of sterile water. The more transfers the better, but five is usually plenty. Finally, a small amount of the spore-containing solution from the last vial is streaked on agar media using a wire loop.
Vials and transfer implements should be sterilized prior to use for best chances of success. If glass eyedroppers are used for making transfers, they can be sterilized without their rubber suction pieces in a pressure cooker along with other supplies. This technique can also be applied to spores from fresh mushrooms by dripping sterile water over the gills, collecting it, and making spore dilutions.

Often within a few days or so, white mycelia formed from hyphae germinating from the spores become visible to the naked eye. Contaminants are rarely white but are usually colored due to green, black or other pigments. The most

frequent contaminants are molds and seem to be *Penicillium*, *Neurospora*, and *Aspergillus* species. The desired white mycelia can be transferred to agar media in other petri dishes or the contaminants may be carefully removed using. a flamesterilized probe or scalpel that has been allowed to cool. In either manner a pure culture of mycelia can be successfully "isolated." Since fungal contaminants often grow much more rapidly than mushroom mycelia, it is necessary to remove contaminants with the surrounding medium very promptly or they will quickly take over. If the spores are several months or more old, it may take a month or even longer to observe germination. If the spores are less than a couple of months old, however, luxuriant fluffy white mycelia will usually begin to cover the surface of the agar medium within about one to three weeks (see color plate on page 33).

Mycelial strains isolated from spore prints may possess different fruiting characteristics. One culture obtained from a print may fruit aggressively, whereas another may not make mushrooms at all. Still another may make only tiny abortive mushrooms. Therefore it is necessary to test a strain for fruiting ability rather than to make assumptions that it will fruit. Nutrient requirements are also important in determining fruiting. For instance, a strain of San Isidro from the village of Huautla de Jiménez in Oaxaca, Mexico has been observed to make typical healthy mushrooms on composted straw with manure, unusually small mushrooms on brown rice, and only dwarfed abortive mushrooms on cased rye grass seed. Other strains of San Isidro have been observed to make large healthy mushrooms on all these media. Many different substances can serve as growth media for mushroom mycelia. The diversity of media is only limited by the genetically controlled ability of the mycelia to utilize available nutrients. Although some strains produce mushrooms aggressively, they loose their vigor upon prolonged growth. Sometimes a manifestation of this reduced vitality is that the strain will

become erratic in making mushrooms or cease to make mushrooms altogether.

One way to combat loss of vigor is to challenge the mycelia periodically with different media, MEA (malt extract agar) is excellent, for example, to alternate with PDY agar. Commercial MEA powder is available from biological supply companies or may he made by adding 20 grams malt extract. powder or syrup and 20 grams agar to liter of gently boiling water. Also, 15 to 20 ml corn-steep liquor can be added as an optional ingredient to the preparation. Liquid malt extract and sometimes malt extract powder are available from supermarkets. Corn-steep liquor can be made by boiling uncooked fresh or dried corn in water, allowing the resulting corn-steep water to stand for a few days and then sterilizing it in a canning par. The agar preparation is sterlized prior to use.

Another excellent agar preparation is DFA (dog food agar). Purina Dog Chow works well. Simply boil a cup of dry dog chow in a liter of tap water, strain the solution, stir in 15 grams agar powder, and sterilize prior to use. Psilocybian mushroom mycelia will occasionally yield limited fruitings directly on PDY or other agar media such as MEA. In contrast, DFA is an excellent medium for growing San Isidro mushrooms in canning jars, beakers or other glass containers. Within limits, the more concentrated the dog food extract the more biomass of mushrooms will be produced.

Although mycelial cultures isolated from spores may have different fruiting characteristics than the parental strain by virtue of a difference in genetic makeup, mycelial cultures obtained via direct tissue culture from a mushroom should behave the same as the mycelia that produced the mushroom. This is expected because the genetic makeup of the tissue culture isolate is the same as that of the parental mycelia. Tissue cultures are easy to make, especially when working with large fleshy mushrooms such as San Isidro. The object is to transfer a piece of uncontaminated mushroom tissue to a

sterile medium for culturing. Glass culture tubes containing a medium such as PDY agar are very useful.

To make a tissue culture first flame-sterilize a scalpel containing a narrow blade. A #11 scalpel blade is ideal. In the case of a large mushroom such as San Isidro, a sharp probe can be used in place of a scalpel, but the latter is more effcient for the excision: Then break apart the mushroom to obtain a cross section through the middle of the cap and stem. This can ordinarily be done with one gentle but brisk tear. If the mushroom is young, free of rain damage, and without insect larvae, the inner tissue should be uncontaminated. Carefully excise a small piece of newly exposed tissue from the cap or stem and place it on the slanted agar medium in a culture tube (figure 7). It is sometimes easier to make the excision with a scalpel but to transfer the piece of tissue with a probe to the agar medium. It is a good practice to flame the mouth of the glass culture tube before recapping, but it is not essential. Since the stem of San Isidro and most other magic mushroom species is hollow, tissue should be taken from as high on the stem as possible to minimize the risk of contamination. Contaminating organisms tend to be more numerous at the lower end of the stem in young specimens. Within a few days white mycelia can usually be seen growing upon and spreading from the piece of mushroom tissue used for culture. If some tubes show signs of contamination, sterilize and recycle them. Tissue cultures should he transferred for growing stock inocula and can be used directly as starter for spawn production.

When mycelia are not being intentionally propagated, it is best to store them in a refrigerator at about 4° C (almost 40° F). If petri dishes are being used, they should be placed in plastic bags to reduce the rate of drying of the agar media. Culture tubes are better for storage. Some magic mycelia will keep for over a year if stored on agar media in sealed glass culture tubes at 40° C.

The Rice-Cake Technique

This technique is extremely easy and highly recommended for its convenience in growing *Psilocybe cubensis* mushrooms. All that is needed is a pressure cooker, some canning jars, uncontaminated live mushroom starter (mycelia), and brown rice. Either long grain or short grain brown rice may be used. The former is usually more economical. Do not use white rice. It is inferior in quality to brown rice because most of the vitamins have been lost in converting brown to white rice.

Into each quart jar place ¼ cup brown rice and between 1/3 to ½ cup tap water. One-half cup or more of water is too much because The rice will turn into mush rather than a cake. One-third cup water leads to a dry cake that is adequate, but mycelia grow faster on the wetter cakes resulting from use of more than 1/3 cup of water. Up to 1/8 teaspoon of agricultural gypsum (calcium sulfate) may be added to each jar prior to sterilization to serve as a buffer, but gypsum is not really necessary. Some *cubensis* strains seem to prefer it, but so do many contaminants. It seems more practical not to bother using gypsum except for purposes of experimentation to find out if a particular mushroom strain will fruit more aggressively with it. In most cases it probably will not make any difference.

Invert the dome of each two-piece lid and place it on the mouth of each canning jar with the rubber seal facing upward. Then loosely screw on the lid bands. Pressure cook the jars at 15 lbs. pressure for an hour. Actually 45 minutes at 15 lbs. pressure is adequate, but an hour gives even greater likelihood of complete sterilization. Allow the pressure cooker to cool and remove the jars, screwing the bands tighter until ready to inoculate the rice-cakes with mushroom mycelia. Using a flame-sterilized probe, carefully transfer a piece of agar medium containing live uncontaminated mycelia into

each jar (figure 10). It is best to loosen the jar lid beforehand so that it will lift off easily. To make the transfer, cut out a section of agar medium containing mycelia using a flame-sterilized scalpel or probe. Then spear the agar block of mushroom starter with the probe, life up the lid of the jar, and drop in the piece of mushroom starter. Close the lid but do not screw it too tight since it is necessary for growing myeelia to breathe. To enhance the rate of mycelial growth, very soon after the jar is inoculated the lid can be screwed tight and the jar shaken to bring the piece of mushroom starter into contact with more of the rice-cake surface. Then loosen the lid before setting the jar in place to incubate. In about four weeks mushrooms will start to grow. Sometimes they commence after only three weeks, but they may frequently take up to six weeks to appear. This depends a lot on the strain and room temperature.

The mycelia can be grown in the dark but light is needed when it is time for the fungus to make mushrooms. As little as five minutes twice a day from an overhead incandescent light in a closet can be sufficient to initiate mushroom formation. But much better crops seem to come when fluorescent “grow lights” are used for longer periods during the day. When mushrooms are growing, the lid of each jar should be very loose since much condensation occurs as the mushrooms breathe.

Some growers remove the lids completely at this time or replace the domes with a double layer of paper towels. The towels can be secured in place with the lid bands and the jars may be set near a window for natural light. Paper towel tops should be sprayed with water at least once a day to help maintain a humid environment. As the rice-cake dries, fruition is promoted. But if the dome is left very loosely in place, fruiting continues much longer. Sometimes fruiting occurs for three months or more! Mushrooms will keep appearing after harvesting of previous crops.

To harvest the magic mushrooms, a fancier can reach in through the mouth of the jar and pull them out. It is best to grasp each mushroom near the bottom of the stem and to give it a twist. If the mushroom cap is tugged, it might just break off from the stem. Alternatively, a long knife may be used to cut the mushrooms at the bottom of the stem. Still another method is to turn the jar facing down so that the cake will fall near the orifice. This makes it easier to grasp the mushrooms. Sometimes it is advantageous after a second or third harvest to flip the cake over in the jar before putting the lid back on. This maneuver often promotes a luxuriant fruiting from the newly exposed rice-cake surface.

When the cakes have dried out too much for mushrooms to appear, they can be squirted with water from a spray bottle to induce another fruiting or better yet used as spawn for a mushroom garden on compost. If there is absolutely no sign of contamination, the cakes themselves may be fried or broken up and cooked in mushroom soup or other cuisine for a psychedelic experience. One cake is usually sufficient for two to four enthusiasts.

The rice-cake technique is very efficient. A 14 ounce package of brown rice can be obtained often for less than fifty cents and is enough for seven quart jars. When the cakes have completely become covered by mycelia, small pieces can be cut out with a sterilized scalpel or probe and transferred to newly prepared rice-cakes in other jars. This will not interfere significantly with mushroom production and will insure a continuing supply of magic San Isidro mushrooms.

San Isidro is the only species that has been observed so far to make mushrooms on rice-cakes. Rice-cake medium nevertheless can be used to grow mycelia of other *Psilocybe* species besides *cubensis*. *Psilocybe cyanescens* and *subaeruginascens* mycelia thrive on brown rice, whereas *baeocystis*, *caerulescens*, *semilanceata*, *stuntzii*, *subaeruginosa*, and *zapotecorum* mycelia spread more slowly

on this medium. Brown rice also supports growth of *Panaeolus* mycelia. With further experimentation, especially with temperature regulation, modifications of the rice-cake technique may render it useful for obtaining fruit from various magic mushroom species.

Growing Spawn On Seed

Seeds make excellent growth media for psilocybian mushroom mycelia. Especially suitable for spawn production is the seed of perennial ryegrass (*Lolium perenne*), which is available from many nurseries and garden supply centers. Usually it is possible to purchase ryegrass seed in bulk quantity, such as in 50 lb. bags. This makes it a very convenient medium for quantity spawn production. Furthermore, ryegrass seed is more economical than many other seeds.

When preparing ryegrass seed medium, it is important to use carefully measured volumes of seed and water. First an appropriate amount of seed is poured into canning jars and then tap water is added. If using one-quart wide mouth canning jars, place 2 cups ryegrass seed with 7/8 cup tap water in each jar. One cup water seems to turn the seed into mush, whereas ¾ cup water leaves the seed too dry after sterilization. For 1½ pint tapered wide mouth canning jars, which are truly ideal in size for ryegrass seed spawn production, use 1 1/3 cup ryegrass seed with 5/8 cup water. For wide mouth pint canning jars use 1 cup ryegrass seed with ½ cup water.

Invert the dome of each canning jar lid so that the rubber seal faces upward and loosely screw on the band of each lid. Place the jars on a bottom rack in a pressure cooker, pour a sufficient quantity of water into the pressure cooker, and steam sterilize the jars with ryegrass seed by cooking at 15 lbs. pressure for a full hour. Remember to start timing after 15

lbs. pressure is reached. It is best to remove jars of ryegrass seed media or other seed media from the pressure cooker while they are still warm but not hot. Use heat resistant gloves. Then screw the lids tight and shake each jar vigorously to loosen the seeds. If the jars are not adequately shaken prior to cooling, seed media will usually clump into a solid mass that is very hard to break up and that retards mycelial growth considerably. This is especially true of the ryegrass seed medium.

Keep cooled jars in a draft-free place such as on a shelf in a closet. Mushroom mycelia can be added as soon as desired after the jars have cooled. But if the jars have been sitting for three or more days, inspect them for early signs of contamination. Any mold growing in a jar at this point is a contaminant. Remove any contaminated jars for resterilization in the pressure cooker. Most, if not all, the jars should be free of contamination. It is necessary to shake these jars again just prior to the time of inoculation with magic mycelia to be sure the seed medium is lo,ose rather than a solid mass. Inoculation is accomplished using a flame-sterilized probe that has been allowed to cool.

Uncontaminated live mushroom starter (mycelia) on an agar medium in a glass culture tube, petri dish, or other container is cut into sections with the probe. An agar section containing mycelia is then speared with the probe and placed on ryegrass seed medium in a canning jar (figure 8). This constitutes a transfer of magic mycelia from agar to seed medium. It is most practical to loosen each canning jar lid prior to inoculation so that it will open easily dctring the transfer procedure. For convenience more than one probe can be used. Each time a probe is used for a transfer, it should be resterilized in a flame and allowed to cool. This helps to reduce the chance of making a contaminated transfer. Sterile technique is critical for success. Therefore, do not leave mycelia exposed to the open air any longer than necessary

and control breathing. Breathing directly into a mycelial culture or into an open container of sterilized medium may contaminate it. An enthusiast who has difficulty regulating his breathing can wear a mask over his mouth and nose.

Petri dishes of mycelia on agar media are easy to work with, can be sectioned in advance with a sterilized scalpel or probe, and provide sufficient mushroom starter for many jars. Because of their large surface area, however, petri dishes of media become contaminated more easily than culture tubes of media when opened. But culture tubes of mycelia on agar media are more difficult from which to make transfers. To excise a block of mycelia from a culture tube, it is more practical to use a probe that is bent at an acute angle near the tip rather than straight (see figure 8).

Maintain the inoculated jars of ryegrass seed in a draft-free place. For convenience the jars can be put back into the cardboard box in which they were shipped. After three days but no later than the fifth day, the jars should be inspected for mycelial growth and given a brisk shaking to help spread the mycelia. Then every four or five days the shaking is repeated. Shaking allows the mycelia to break up and come in contact with seed at multiple sites in the, jar to insure a fast rate of growth. Sometimes within two weeks but usually in about four weeks the mycelia will have completely permeated the seed media in the jars. Occasionally there are some jars that take up to six weeks to fill with mycelia, but this usually is a result of neglect. Mycelia that have completed growth in the jars can be employed at once to inoculate other jars of media using sterile technique, cased to produce mushrooms (see next chapter), or used as spawn to start compost cultivation.

Mycelia of *Psilocybe* and *Panaeolus* species thrive on ryegrass seed medium. Mycelia of *Psilocybe cyanescens*, *cubensis*, *subaeruginascens*, and *subaeruginosa* grow profusely and luxuriantly on this medium, whereas mycelia of *Psilocybe argentipes*, *baeocystis*, *caerulescens*, *fasciata*,

semilanceata, *stuntzii*, *Psilocybe subcaerulipes*, and *zapotecorum* grow diffusely. *Panaeolus cambodginiensis* and *cyanescens* also produce luxuriant mycelia on ryegrass seed medium, whereas *Panaeolus subbalteatus* mycelia are aggressive but grow diffusely onthis medium.

Other types of seed can also be sterilized and used for spawn production. Even seeds of *Cannabis sativa* work well for growing San Isidro mycelia. Grain, the seed of cereal grasses, is very suitable for spawn production. Crimped oats, machine cracked seed of the cereal grass *Avena sativa*, are particularly useful for mycelial growth of *Panaeolus* and certain *Psilocybe* species such as the Mexican "derrumbe" (*Psilocybe caerulescens*). Curiously, this medium is not very suitable for San Isidro spawn production.

For preparation of crimped oat medium, pour 2 cups crimped oats and between ½ and ¼ cup water into each quart canning jar. The amount of water depends on the brand of crimped oats. Since some brands contain other ingredients, such as alfalfa pellets, corn chops, and even molasses, more water is absorbed in cooking. Screw on each lid band tightly with the dome inverted and shake each jar well to evenly wet the oats. Then loosen the lids and pressure cook for an hour at 15 lbs. pressure as in preparation of other media. It is important with crimped oat media, as with all grain media, to remove the jars while still quite warm from the pressure cooker for shaking. Be sure to tighten the lids first. As with other seed media, grain media also need to be shaken again prior to inoculation with mycelia and then shaken periodically afterwards to help the mycelia spread throughout the media in the jars.

Rye grain, seed from the hardy annual grass *Secale cereale* (rye), is a very popular medium for grdwing San Isidro mycelia. In 1968, a method using rye grain for *P. Cubensis* spawn production was first offered to the public (Brown et al., 1968). For quart canning jars it calls for 225 grams rye grain

(just over 1 cup) with 275 ml water (about 1 and 1/10 cup) and 4 grams chalk as a buffer. For pint jars it calls for the use of 100 grams rye grain (just under ½ cup) with 160 ml water (just under 2/3 cup) and 2 grams chalk. Sterilized rye grain is inoculated with mycelia. Instructions suggest that the spawn can then be used to inoculate compost in order to grow San Isidro mushrooms. This method of spawn production did not seem to catch the imagination of the public for some time.

In 1976, interest in magic mushroom cultivation via rye grain spawn skyrocketed owing to the discovery that San Isidro mushrooms can be made to grow simply by casing spawn (see next chapter). Oss and Oeric (1976) popularized the technique using 112 grams whole rye grain with 180 ml tap or distilled water, 2.0 grams calcium carbonate ($CaCO_3$), and 0.2 grams monobasic potassium phosphate (K_2HPO_3) as an optional buffer. The 112 grams rye grain is just over ½ cup and the 180 ml water is just under ¾ cup. This same quantity of rye grain and water can also be employed in a pint canning jar and the calcium carbonate is not really needed. It seems easier to shake up the sterilized rye grain after pressure cooking if a little more grain or a little less water is used than called for in the recipe.

An alternate procedure suggested for preparing rye grain medium is to pre-cook rye grain by boiling it in a pot for 35 to 50 minutes (anonymous, 1976). For each quart jar ¾ cup rye grain is boiled in 1½ cup water. Quart canning jars are then filled ¾ full and sterilized for a half hour at 15 lbs. pressure. The recipe calls for calcium carbonate and yeast extract but these ingredients are not really necessary. Brown rice, seed of the annual cereal grass *Oryza sativa*, may be substituted for rye grain in this procedure.

Still other grains such as wheat berries, which are seeds of the annual cereal grass *Triticum aestivum*, and milo seeds can also be used for growing spawn. The seed of milo, an Old World tropical grain sorphum (*Sorghum vulgare*), seems to

have a greater tendency than rye grain to clump after pressure cooking and is therefore less likely than rye grain to bring satisfaction as a medium for spawn production.

In addition to growing spawn, certain seed media may be used for storage of mycelia. The seeds should be small for ease in filling culture tubes. Parakeet seed, which often contains a mixture of white millet, canary seed and hulled oats, is ideal. Millet, grain of the annual cereal grass *Panicum miliaceum*, is frequently used for spawn production of *Agaricus bisporus* by commercial mushroom growers. Canary seed comes from a grass (*Phalaris canariensis*) that is indigenous to the Canary Islands. To prepare parakeet seed medium, gently boil the seed in a pot for thirty minutes using an excess of tap water. Strain the seed and place it with some gypsum in a pan. Roll the seed in the gypsum by hand to coat it. Then fill glass culture tubes about 2/3 to ¾ full with the gypsum coated seed, screw on the caps loosely, place the tubes upright in a rack, and sterilize them at 15 lbs. pressure for 45 minutes. Carefully remove the tubes while still warm, screw on the caps tightly, and shake up the media. Shake the media again before inoculating with mushroom mycelia. When mycelia has permeated the seed, the tubes may be placed in a refrigerator at 4° C (near 40° F) for storage. Some magic mycelia will remain viable for over a year if stored in this manner.

Cultivation On Compost

Compost cultivation is a versatile method suitable for most psilocybian mushroom species. The pioneering procedure that first brought *Psilocybe mexicana* to fruition on composts in Paris during the late 1950's is illuminating. Spawn of *P. mexicana* was grown in flasks under sterile conditions on composted straw that had been well washed. Mycelia used to inoculate the sterilized compost were initially grown on a malt extract agar medium. Unwashed straw compost was placed in

earthenware pots and sterilized. The pots of compost were then inoculated with spawn from the flasks and set in a greenhouse. After about two weeks the compost was well invaded by the mycelia and covered with a thin layer of casing material. The casing material consisted of an unspecified mixture of various sands and calcareous (chalky) earths. The greenhouse temperature oscillated between about 19 to 25° C. In three to six weeks after casing, mushroom sporocarps appeared. It was found that spawn could not be easily grown in the flasks unless the compost was well washed prior to sterilization. In contrast, unwashed compost was observed to be superior for obtaining mushroom fruit. Composted corn debris (leaves and stalks) worked almost as well as composted straw for fruiting P. nrexicana in the clay pots.

Psilocybe caerulescens was grown in a similar manner to P. mexicana but would not produce fruit on composted straw. Composted corn debris served as a suitable medium, however, for fruiting *P. caerulescens* in greenhouse culture. Less abundant crops of *P. caerulescens* were obtained using a mixture of straw and corn debris composts. *Psilocybe semperviva* readily fruited on composted straw, but yielded more luxuriant flushes on the corn debris compost. *Psilocybe mixaeensis* produced carpophores on various composted media, such as wheat straw, corn debris, and horse dung. *Psilocybe cubensis* was fruited on cased horse dung compost in earthenware pots. Some specimens attained a full twenty centimeters (almost eight inches) in pileus diameter.

Psilocybe zapotecorum, a species first fruited on a medium of moss, was grown both on straw and horse dung composts in glazed earthenware pots designed to retain water. The mycelial laden compost was cased with calcareous sand and then completely submerged under water. Magnificent *P. zapotecorum* mushrooms came up right through the water! This interesting phenomenon is in keeping with the “sub-aquatic” ecological nature of the species.

For the home cultivator it is especially convenient when ready-to-use compost can be obtained, such as "separated" manure that has composted after being piled in gigantic mounds. Commercial packaged compost is often of very poor quality for mushroom growiilg despite artificial chemical enrichment. Fresh completely organic compost is without doubt the best. Industrial compost production for mushroom growing usually utilizes about 95% straw and 5% horse manure for compost starter. Manure contains thermophilic bacteria, which break down the straw into compost. For home preparation of compost it is best to use more horse or cattle manure (about one ton per ten bales of hay) and to shred the hay by machine. Either a shredder can be rented or a motor driven lawn mower can be used. Commercial composting require less manure per given amount of straw because it is done in such vast quantity that there is great pressure from the weight of the composting material. The pressure aids in breaking down the straw.

Straw from wheat (*Triticum aestivum*) is better to use for composting than straw from oats (*Avena sativa*) or barley (*Hordeum vulgare*). Other grasses, such as Johnson grass (*Sorghum halepense*) and timothy grass (*Phleum pratense*), also make suitable hay for composting as do various leguminous herbs of the pea family, such as alfalfa (*Medicago sativa*) and certain clovers (*Trifolium species*).

Procedures for making compost vary considerably. One to two tons poultry manure, five tons cattle manure, or three to four tons sheep or horse manure is layered with one ton of shredded straw (dry weight) that has been soaked with water. The taller the compost heap the better. There is flexibility regarding the addition of extra ingredients. Gypsum (calcium sulfate) is often used to decrease greasiness of the final compost. If it is intended to cultivate species that are lignicolous or grow on soil enriched with woody debris, such as *Psilocybe cyanescens*, plenty of sawdust should be added to

the compost. Beauty bark or wood chips may also be added.

An- excellent compost recipe in use in the Pacific Northwest utilizes a pickup truck load of fresh leached cow manure available from dairy farms, 2 to 3 bales of well soaked wheat straw, 25 lbs. of horticultural gypsum, and commerical compost starter. Also, 5 lbs. of cottonseed meal or oil is added. The compost pile is made by stacking the straw and manure in layers 10 to 12 inches thick, adding the other ingredients in the process. Soaking of the straw should be started about two or three days prior to preparing the heap. The bales must be broken up first to insure thorough soaking. Gypsum, cottonseed meal or oil, and compost starter may be added at this time and the straw is fluffed up with a pitchfork for layering. The layered heap should be made at least 4 feet tall by 4 feet wide by 6 feet long.

The temperature of the composting heap should soon reach greater than 140° F. A temperature of 145° F (68° C) for 48 hours will kill pests and most unwanted fungal spores. It is necessary to keep the stack moist. Therefore water every day if the weather is hot and dry or cover the heap with a plastic tarpaulin. The temperature of the inside of the heap can be checked with a candy thermometer. Within two weeks the heap should have heated up and composted sufficiently on the inside to be ready for turning with a pitchfork. Sometimes heaps are ready to turn after only a few days. In turning, the center of the heap is moved and placed as a new bottom, the top and side portions of the heap become the new center, and the bottom becomes the top. Each part is shaken thoroughly with the pitchfork when it is moved. After another three days or more this process is repeated. Still another few days later, the pile is thoroughly shaken and mixed, fluffing it up for aeration. In a couple of days after that, the compost is ready to use. As an alternate procedure instead of turning the pile, the center portion may be removed and used as soon as it has maintained a high temperature for a few days. Finished

compost from the center of the pile should be somewhat black and soft.

For outdoor cultivation compost beds at least a foot high and several feet wide should be made. The beds are inoculated with spawn and kept moist by watering with a hose using a spray nozzel or running a lawn sprinkler system. It is necessary to water at least once a day in hot dry climates but not necessary to water at all in wet climates. Spawn from canning jars or other containers is broken up and placed about six inches under the suface of the compost bed. A couple of quarts of spawn is plenty for a six foot long bed but more can be used to reduce the chance of takeover by "weed" mushrooms such as *Coprinus* species. Ironically, the hallucinogenic Panaeolus subbalteatus used be a common weed mushroom in commercial mushroom houses, but for magic mushroom growers weed mushrooms usually happen to be non-psychoactive.

Outdoor compost cultivation works especially well for coprophilous mushrooms such as *Psilocybe cubensis*, *Psilocybe coprophila*, and many *Panaeolus* species. There are other magic mushrooms that can be grown this way, but none are as easily fruited as dung-inhabiting species. In fact, beds of fresh uncomposted horse manure may be used to grow coprobious mushrooms outdoors, especially *Panaeolus* species. It usually takes about a month to six weeks for' mushrooms to appear on outdoor beds and flushes may continue for over two months, but the fruition is largely dependent on rain. Rain is what it takes for successful outdoor mushroom growing. Without adequate rain, crops can be induced to appear by frequent watering with sprinklers or a hose set in place with a sprinkler attachment. Compost beds inoculated with *Panaeolus* mycelia should not be cased and it is not necessary to case compost beds when growing *Psilocybe cubensis*.

Compost can also be placed outdoors in various containers

such as flower pots, wooden fruit boxes, and so forth. It is important for whatever container is used to have good drainage, since it is necessary to provide periodic sprayings with water to keep the compost from drying out. The containers of compost should therefore not be placed in direct hot sun. In a month at most after inoculation with mushroom spawn, compost in containers ought to be permeated with mycelia and ready for casing. If growing a species for the first time, case some containers but not others and observe the difference. Vermiculite, peatmoss, sand, and crushed oyster shells make a good mixture for casing compost.

Indoor compost gardens also work quite well. If an enthusiast happens to have a spare bathtub in a garage, he can line it with kitty litter, add compost and a heater if the garage is cold, and grow San Isidro (Harris, 1976). It is more practical, however, to use containers such as plastic wastebaskets, cardboard boxes lined with plastic garbage bags, or styrofoam ice chests. Cellophane tops are easy to make and convenient for maintaining a humid environment in such chambers. To reduce the chance of getting mushroom flies in the indoor compost gardens, the compost should first be well watered, then placed in Brown-In-Bags and baked in an oven at 300° F for at least several hours. Also, heat-treat dry vermiculite in the oven.

Place a half-inch layer of vermiculite at the bottom of each clean container to be used for an indoor magic mushroom garden. Then layer on a couple of inches of heat-treated compost and inoculate it with spawn. Seed spawn is usually employed but mycelia grown directly from spores on sterilized manure or compost may be used instead. It is best in making an inoculation to mix a pint of spawn per container evenly through the compost. Using a spray bottle with boiled water that has been allowed to cool, mist the inoculated compost and place the cellophane top over the container. Each day the container should be well aerated and misted lightly. In about a

month mushrooms should appear if there is sufficient light. It does not take much light to initiate fruiting though, so mushrooms will probably appear.

Often contaminants grow on the compost, but mushroom mycelia will usually take over and eventually make mushrooms. If plenty of spawn was employed for the inoculation and the containers are adequately aerated from the beginning, contaminants normally will not flourish. If the containers are kept humid without sufficient air circulation, contaminants may initially outgrow.the mushroom mycelia. It is not advisable to eat mushrooms grown on grossly contaminated substrate because some contaminants, notably species of *Aspergillus*, produce deady toxins.

If a magic mushroom fancier does not have a greenhouse, a room can easily be converted into a growth chamber by providing fluorescent lights and employing a humidifier. Removable shelves can be built with wooden compost trays. If growing tropical species such as *P. cubensis*, a heater can be used to provide daytime temperatures near 80° F. For growing temperate species such as *Psilocybe cyanescens*, a cold environment is needed such as an attic or basement during winter months. The temperature should fluctuate between about 40° F at night and 60° F during the day.

A useful source of live spawn that has ‘not yet been mentioned is the mycelial substrate from nature. Cow patties with San Isidro mushrooms or beauty bark mulch on which *Psilocybe cyanescens* is fruiting, for example, may be gathered. The natural substrate containing magic mushroom mycelia is then broken up and placed in the compost gardens. Unfortunately this procedure can introduce undesirable insects into the gardens. Casing indoor compost gardens often improves the yield of San Isidro and other *Psilocybe* species but can interfere with fruition of various *Panaeolus* species. It is best to experiment with a particular strain of any species to find out its preferences. After fruiting is completed, the spent

compost with live mycelia can be used directly as spawn for new compost gardens. This process can be repeated indefinitely.

Storing the Harvest

By following methodology described in this book, enthusiasts can grow bountiful crops of psilocybian mushrooms. In harvesting each delectable fruit, remember that it is best to grasp the lower portion of the stem firmly and then to twist the mushroom free from the mycelial network. Handle the mushrooms with care, being cautious not to crush them because damage diminishes their potency. Various storage techniques are available to mushroom fanciers for preserving the magic harvest.

Mushrooms should be cleaned prior to storing. A good way to clean a magic mushroom that has some compost or casing material at the bottom of the stem is to use a sharp serrated knife. Carefully scrape off the outer surface of the lower portion of stem. If it is deemed necessary to clean the cap of a mushroom, it can be wiped gently with a paper towel. It is not advisable to wash magic mushrooms, since they decompose faster if stored wet. Also, washing may slightly decrease their potency because the hallucinogenic agents in the mushrooms are water soluble.

Fresh cleaned mushrooms may be placed in paper bags and stored for several days or longer in a refrigerator. Do not store fresh mushrooms in cellophane, plastic bags, or containers that hold in moisture lest the magic harvest will become soggy and rapidly lose potency.

A popular way of preserving magic mushrooms is to immerse them in a jar of honey. The mushrooms should first be cut into small pieces and then stirred into the honey. "Mushroom honey" is savory when fresh, but do not let it sit around for months. Microorganisms eventually will decompose

the mushroom biomass, rendering the mushroom honey rather unpalatable and unsuitable for consumption.

Magic mushrooms can be preserved by canning. The jars are first packed full with fresh clean mushrooms. Water is then added to fill residual volume to about 11/4 inch from the top of each jar and lids are put on loosely. Jars are next placed on a bottom rack in a pressure cooker and sterilized at 15 lbs. pressure for an hour. After the pressure has dissipated, the pressure cooker is opened and the lids are sealed completely air-tight. Some canners prefer to boil mushrooms to reduce their volume prior to filling the canning jars. If this is done, the broth should be canned along with the mushrooms. The canned mushroom soup that results should keep for many months and conceivably even for years. But canning is risky. If sterilization is not complete or the jars inadvertently later become contaminated, enthusiasts can acquire severe food poisoning such as botulism.

The most practical way to prepare mushrooms for prolonged storage is to completely dry them. If climatic conditions are favorable, sun-drying is ideal. Otherwise, pieces of stiff wire can be put through the stems and the mushrooms suspended upside down from racks in an oven. The oven should be set at low temperature (less than 200° F) and the oven door should be left slightly open to provide plenty of air circulation. Paper clips can be pulled fully open and used instead of wire. After a few hours the mushrooms should be thoroughly dry and ready for storage.

Another drying technique is to place the mushrooms on a drying rack. A drying rack can be made simply by putting a hot plate or incandescent light source under a screen. More sophisticated drying racks can be made with a wooden frame and screen shelves that slide in and out. An infra-red heat lamp works well for drying mushrooms, making them crisp. Caution must be taken not to burn mushrooms by placing them too close to the heat source.

The ability of magic mushrooms to retain potency after drying appears to be species related. If they are kept in a cool dry place, some species such as Psilocybe cyanescens and *P. cubensis* can remain psychoactive for months or sometimes for even over a year. There tends to be a gradual diminution of potency as time progresses.

Some devotees prefer to store their magic harvest in a freezer. The mushrooms need to be thoroughly dry and may be placed in air-tight plastic containers, plastic Ziploc bags, or plastic bags that are heat-sealed with a bag sealer prior to freezing. Fresh mushrooms, which contain about 90% water, should not be placed in a freezer because the intracellular water expands as it freezes and fractures cell membranes. With the cellular integrity destroyed, enzymes in the mushrooms gradually seem to catalyze the breakdown of psilocybin to psilocin by dephosphorylation and to facilitate the oxidation of psilocin to a blue quinone. The beautiful dark blue mushrooms are then unfortunately devoid of psychotropic properties.

The Magic Mushroom Agape

Be sure to treat psilocybian mushrooms with the respect they deserve, for these magical herbs are powerful psychostimulants. Outside of a shamanic ritual, they should be consumed only by persons in good mental health who are at peace with themselves and their surroundings or by persons in a genuine psychotherapeutic situation with appropriate supervision and a supportive environment. This is important because the outcome of a psychedelic mushroom experience is largely dependent on each participant’s personality make-up, psychological set, setting, and dose of mushrooms. Six to ten grams of fresh psilocybian mushrooms usually provide an effective psychedelic dose and one to five grams of dried mushrooms constitute an average dose.

It is best for novices to start with small doses in the company of an experienced "guide." Small doses may not induce colorful visual imagery but provide interesting and worthwhile experiences. Appropriate dosage depends on body weight of the consumer. Therefore women should usually employ smaller doses than men. It is imperative to keep magic mushrooms out of reach of young children. For reasons that are not completely understood, children are much more prone than adults to experience psilocybian psychotoxicity with manifestations such as high fever and convulsions.

Magic mushrooms are effective and taste delicious in omelettes, spaghetti sauce, or any other dish which is good with ordinary mushrooms. Especially popular is a mushroom "smoothie." This psychedelic beverage can be made in a blender with milk, banana, honey or chocolate and magic mushrooms. Another option is to blend fresh fruit or fruit juice with magic mushrooms, adding honey or sugar if desired for sweetness. "Strawberry psilocybin" made with fresh strawberries and ice, for example, is a supreme treat. Magic mushroom tea is a popular brew that is also customarily sweetened with honey. The flavor may be enhanced by adding spices such as cinnamon, cloves, or nutmeg. After gently boiling sliced psilocybian mushrooms for about fifteen minutes, most of the psilocybin is in the tea itself. Therefore an enthusiast can experience the magic of mushroom tea without actually eating the mushrooms themselves. On the other hand, with sufficient parboiling, which requires usually at least thirty minutes, the mushrooms can be enjoyed in cuisine without triggering any psychotropic effects.

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