Oyster Mushroom Cultivation

Part I. Mushrooms

Chapter 1

Introduction to Mushroom

WHAT IS MUSHROOM

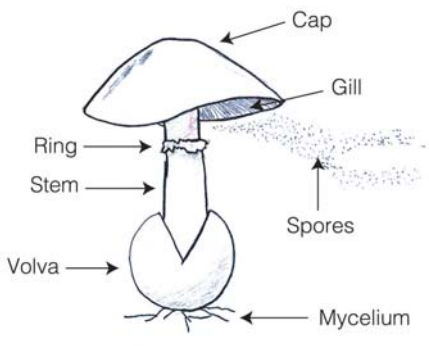
Song Baek Cho
MushWorld
Translated by Seung Woo Kang

What is Mushroom?

A mushroom is defined as "a macrofungus with a distinctive fruiting body which can be either epigeous or hypogeous. The macrofungi have fruiting bodies large enough to be seen with the naked eye and to be picked up by hand" (Chang and Miles, 1992). In a narrow sense, the word mushroom also refers only to the fruitbody.
Mushrooms used to be classified into the Kingdom Plantae, but now they belong to the Kingdom Fungi due to unique fungal characteristics which draw a clear line from animals or plants. Unlike green plants, mushrooms are heterotrophs. Not having chlorophyll, they cannot generate nutrients by photosynthesis, but take nutrients from outer sources. Most mushroom species are under the Basidiomycota and Ascomycota, the two phyla under the Kingdom Fungi (Table 1).

Table 1. Kingdom Fungi

Ascomycota	sac fungi (yeast to large cup fungi)
Basidiomycota	higher fungi (toadstool, puffball, bracket fungi)
Zygomycota	molds, mycorrhizal fungi and soil decomposers
Chytridiomycota	primitive fungi, chytrids
Deuteromycota	asexually reproducing fungi



Mushrooms breed by spores (seeds for plants). Under the proper conditions, spores germinate into hyphae (collectively, mycelia). Mycelia are filamentous and generally unseen with the naked eye. Germinated hyphae form primary mycelia, and then secondary mycelia through plasmogamy (hyphal fusion). They accumulate nutrients from the substrate (soil for plants) and colonize substrate. When stimulated by temperature, humidity, etc., the mycelial colony forms pins under certain conditions and grow to fruitbodies (fruits for plants). Young fruitbodies are called pins (buds for plants). Pins differentiate into a cap and stem forming fruitbodies. Under the cap, spores are produced in the gills (Fig.

1). Fruitbodies release spores in order to produce the next generation.

This life cycle of mushroom is divided into two phases: vegetative and reproductive growth. Vegetative growth indicates linear growth of fungal mycelia dissolving complex substrate components into simpler molecules and absorbing them as nutrients. When low temperature, high humidity, much oxygen, and sometimes light are offered, the mycelia cease vegetative growth and begin to produce fruitbodies, which we call 'mushroom'. This is reproductive growth. Mushroom cultivation can be said the practice of obtaining fruitbodies by artificially repeating these two growing stages.

Mushroom cultivation requires enough understanding on the optimal growing conditions of each mushroom species and how to make favorable environment for both vegetative and reproductive growth of mushrooms.

Three Factors of Mushroom Cultivation

Spawn

A. Grain spawn

B. Sawdust spawn

C. Plug spawn

D. Liquid spawn

Figure2. Various types of spawn

What spawn is to mushroom is like seed is to crop. Unlike spore, spawn is already at its mycelial stage growing on its own substrate such as sorghum, barley or sawdust. The life cycle of mushroom starts from spores, but growers inoculate mycelial origin spawn rather than spore origin spawn because of possible variations and mutations. The quality of spawn is one of the most decisive factors for successful crop. Therefore, growers need to use qualified spawn for commercial production. Spawn should maintain the strain characteristics and is propagated by subcultures. New strains are developed with genetic methods such as variation and mating. The various types of mushroom spawn include grain, sawdust, plug and liquid.

Substrate

Mushrooms can be classified as 3 categories by their tropic pattern; saprophytes, parasites or mycorrhizae. The most commonly grown mushrooms are saprophytes, decomposers in an ecosystem growing on organic matters like wood, leaves and straw in nature. Raw materials can be used as substrate for primary decomposers such as oyster mushroom and enokitake which have lignocellulosic enzymes. On the other hand, secondary decomposers like button mushroom or straw mushroom require substrate degraded by bacteria or other fungi. Mushroom requires carbon, nitrogen and inorganic compounds as its nutritional sources and the main nutrients are carbon sources such as cellulose, hemicellulose and lignin. Thus, most organic matters containing cellulose,

hemicellulose or lignin can be used as mushroom substrate. Examples are cotton, cottonseed hull, corncob, sugarcane waste, sawdust, and so on. However, demanded amount of each nutritional sources differs according to mushroom species. For example, button mushroom (*Agaricus bisporus*) requires relatively high nitrogen source, so the optimal C/N ratio of button mushroom compost is 17. On the other hand, oyster mushroom and shiitake require less nitrogen and more carbon source. Mushroom mycelia secrete digestive enzymes into the substrate and absorb the dissolved nutrients. Cellulose, the main nutritional source of mushroom is one of the most abundant organic matters on earth, but its digestive enzyme, cellulase is owned by several microorganisms including fungi. Here comes the reason mushroom is considered an important food source. Mushroom is the only one by which cellulose is dissolved and absorbed and transformed into food for mankind. Mushroom is also influenced by acidity of substrate. The optimal pH value of substrate ranges from 6 to 8, varying with mushroom species.

Environment

The last important factor for mushroom growing is providing an appropriate environment both for vegetative and reproductive growth. Not being protected by a skin layer, fungi are easily affected by their growing conditions. So it can be said that the success or failure of mushroom cultivation depends on the control of growing conditions. Environmental factors affecting mushroom cultivation include temperature, humidity, light and ventilation. Optimal levels of them at vegetative stage differ from those at reproductive stage.

Mushroom mycelia can survive between 5 and 40℃ depending on the species. Mushroom mycelia grow well with the temperature range between 20 and 30℃. Pins form at 10-20℃, lower than that of mycelial growth by 10℃. Over 80% of the fruitbody is water. Substrate moisture content should be 60-75% and log moisture content, 35-45%. During fruiting, different relative humidity levels, ranging from 80-95%, are needed at the early, mid and latter stage. Though mycelia can grow without light, some species require light for fruitbody formation. Being aerobic fungi, mushrooms need fresh air during growing, but ventilation is more required for reproductive stage. No matter how well the substrate is colonized, it is useless if it fails in fructification. Therefore creating the optimal conditions for transition from vegetative stage to reproductive stage is crucial to successful mushroom cultivation.

In conclusion, among the three factors, the most important is environmental control. By maintaining optimal conditions at each growing stage and for each species, growers can produce the desired yield of quality mushrooms.

Glossary

- **Epigeous** Growing on (or close to) the ground.
- **Hypogeous** Growing under ground.
- **Plasmogamy** Fusion of cells or protoplasts without fusion of the nuclei, as occurs in higher terrestrial fungi. Nucleus fusion is called karyogamy.
- **Heterotroph** An organism that cannot synthesize its own food and that is dependent on complex organic substances for nutrition. Most organisms except green plants (autotrophs) are heterotrophs.
- **Saprophyte** An organism which grows on and derives its nutrient from dead or decaying organic matter.
- **Parasite** An organism that grows, feeds, and is sheltered on or in a different organism while contributing nothing to the survival of its host.
- **Mycorrhiza** The symbiotic association of the mycelium of a fungus with the roots of certain plants, such as conifers, beeches, or orchids.
- **Aerobe** Organism that is living or occurring only in the presence of oxygen.