

DIE TODE STUHLE

Most of you are mycophagous--this means that you eat mushrooms and other fungi. We do not normally think much about mushrooms in our diets, because they are used mainly as garnishes in dishes or salads or as appetizers. Nonetheless, mushrooms are fairly rich in vitamin B2 and niacin and also in copper, and raw mushrooms have only 10 calories per half cup and contain some protein. (The sautéed and marinated mushrooms have many calories, because they are prepared in triglycerides!)

When you look closely at a bread mold, you can see that this fungus consists of tiny threads of cells, which are called **hyphae** (collectively **mycelium**). Likewise, the solid mushroom is actually composed of thousands of interwoven hyphae. Unlike plant cells, whose cell walls consist of cellulose, fungal cells typically have cell walls made of a material called **chitin**. Moreover, typical mushroom cells have two haploid nuclei ($1n$) per cell, a condition termed **dikaryon**.

The hyphae of a mushroom first grow extensively throughout a substrate, such as soil, rotting organic matter, or manure, before producing the aboveground, umbrella-shaped structure. The mushroom that we commonly eat has a **stipe** (the so-called stem) and a hemispherical **cap**. We usually eat the common grocery store mushroom, *Agaricus bispora*, before the cap is fully expanded. When expanded, one can see the gills on the underside of the cap. These finlike structures produce the spores, which are the way mushrooms reproduce.

There are numerous more exotic mushrooms in marketplaces and restaurants, perhaps none as valuable these days as the *matsutake*, a strongly scented species that is harvested in the wild from eastern Asia, Turkey, Mexico, and British Columbia to northern California. The hunt in the Pacific Northwest is conducted largely by Asian Americans, who, armed with a \$50 permit from the U.S. Forest Service and a screwdriver, remove as much as 1.2 million pounds in a good autumn week. For their efforts, the workers can earn enormous profits, in certain years as much as \$300 per pound when scarce but rarely hitting \$100 per pound--shootings are not uncommon where collecting mushrooms has the air and profitability of a gold rush. Most of the large fungi that we consume are gill fungi, but the highly prized truffles and morels are sac fungi (Ascomycetes).

Although some mushrooms are edible and are even considered to be delicacies, many are nonpalatable or are instead poisonous and even deadly. Last century in France, where eating wild mushrooms was a favorite sport, 100-150 people died from mushroom poisoning, and this century there have been about that many deaths annually in the United States. Poisonous mushrooms are often called toadstools, derived from the German *die Tode Stuhle* or "seats of death." Most characteristic of the toadstools are the death angels in the genus *Amanita*, which have wartlike scales on the cap. Most mushroom deaths result from consumption of several species of *Amanita*; ironically, some of the species in this genus are also edible. The rule of thumb in eating mushrooms is to play it safe--never, never eat a fungus that you don't know. There are no reliable ways to tell edible from poisonous forms.

Types of mushroom poisoning. It is a real "thrill" to find and eat exotic fungi, but mushroom poison is no laughing matter. Mushroom poisoning is a difficult thing to combat once the damage is done. An antidote is known for several of the poisonous species, but people are not likely to connect the eating event with the early ailment symptoms, so that hospitalization may not come in time. There are five types of mushroom poisoning (mycetismus).

1. **Gastrointestinal type.** Early appearance of nausea, vomiting, and diarrhea; symptoms terminate rapidly, and normal health returns in one or two days.
 - Examples: *Russula emetica*, *Boletus satanus*, and *Lactarius terminosus*
2. **Cerebral type.** Exhilaration, staggering gait, and weird disturbance of vision; normalcy returns soon.
3. **Blood-dissolving type.** Abdominal distress with ensuing jaundice; blood transfusion needed.
 - Example: *Gyromitra esculenta*, which is quite edible if parboiled but which has caused about 200 recorded deaths
4. **Nerve-affecting type.** Early gastrointestinal symptoms are followed by hallucinations; lethal cases rare because many mushrooms must be eaten.
 - Example: see following account
5. **Choleric form type.** Gastrointestinal reactions rapidly develop, accompanied by violent pains (within 15 hours); rapid loss of strength, with cardiac muscle damage and coma before death; death rate 60% or more, depending upon amount eaten; fragments eaten by a child can prove fatal.
 - Examples: *Amanita*, especially *A. verna* and *A. phalloides*, *Pholiota autumnalis*, and *Hygrophorus*; these contain amanita-toxins, such as amanitine, phalloidine, and alpha-hemolysis.

Hallucinogenic mushrooms. Some of the most interesting hallucinogenic cults have arisen in relation to sacred mushrooms. One mushroom in particular, *Amanita muscaria*, is perhaps the most famous of all, and its use is documented in the soma of ancient *Rig-Veda* lore. Researchers suspect that this was the most common hallucinogen in temperate cults of the Northern Hemisphere.

The mushroom of *Amanita muscaria* is distinctive. It has a red cap 3-8 inches wide with cream scales and warts. The mushroom can be eaten raw, sautéed, or dried and still retain its hallucinogenic properties. The hallucinogenic compounds are several, including ibotenic acid and muscarine. *Amanita muscaria* is called fly agaric because when the mushroom is broken up and placed into a saucer of water, house flies are attracted to the solution, drink it, buzz around in frenzied loops, and then die.

How natives found out about this mushroom throughout the Northern Hemisphere is somewhat of a marvel. The toadstool lives in the temperate forest belts and grows under beeches, alders, pines, firs, and other common trees. It is definitely psychoactive, and accounts of fly agaric are written into the lore of many peoples. The most famous literary account of mushroom hallucinations was presented by Oliver Goldsmith (1762) about the use of *A. muscaria* in northeastern Asia with the Tungus, Yakuts, Chukdles, Koryaks, and Kamchadales. One mushroom was a prize that was traded for with as many as four

reindeer. A rich owner of mushrooms would have a woman chew a couple of the mushrooms into a sausage, which the male would ingest. Then when he walked outside to relieve himself later, the urine was saved by the poor in a wooden pot and reused. Apparently the active substances are even more potent in the urine than in the original material. The tradition was called "passing the pot." An entire village could remain high for a week on one to several mushrooms.

Additional stories about fly agaric abound. There is, for example, a 1291 fresco in Plaincouralt, France, which has Adam and Eve, the Serpent, and the Tree of Knowledge (apple tree) with the mushroom; Eve is clutching her stomach as a warning to potential users. Another story tells of Viking men in Scandinavia who presumably ate these mushrooms and became aggressive and unmanageable. They were called "Berserks," which is presumably the etymology of that particular word. However, many historians no longer believe this story. The mushroom is familiar to all of us through its appearance on modern posters, all types of artwork, the Smurfs, and so forth. The most interesting use of this in literature is the tale told of Alice by Lewis Carroll--the mushroom could make a person very large or very small.

In Mexico and Central America additional mushrooms have been used as hallucinogens, presumably independent from the *Amanita* cults. About 25 species and varieties are still used for religious ceremonies in Mexico, including species of *Psilocybe*, *Russula*, *Panaeolus*, *Stropharia*, and *Boletus*. In the South Pacific, the genus *Heimiella* is used; males and females alike develop temporary insanity from this mushroom. Accounts of *Psilocybe* rituals are published, and these were fictionalized in the film *Altered States* (William Hurt) and advertised also by the infamous Timothy Leary. Sacred mushrooms are placed on a banana leaf before personal preparations are made to ready oneself for the acceptance of the mushroom. Then the leader hands out the mushrooms in pairs, representing male and female pairs. These are eaten at one's own pace. The chemicals produce giddiness, hilarity, colored hallucinations, muscular relaxation, and serious moments of inquiry.

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