

Short Communication

**ETHNOBOTANY OF PSILOCYBIN MUSHROOMS, ESPECIALLY
*PSILOCYBE CUBENSIS***

EDMOND R. BADHAM

Department of Biological Sciences, Lehman College, CUNY Bronx, NY 10468 (U.S.A.)

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Mushrooms containing psilocybin have been used for millennia in primitive societies for religious/medical purposes. However, today these fungi are used in Western countries primarily as a form of recreation. Although this use does not seem to be causing significant health problems, more study is needed to evaluate the significance of this phenomenon.

Essentially all the ethnobotanical use of *Psilocybe cubensis* (Earle.) Sing. rests on the fact that it contains the compounds psilocybin and psilocin, both of which are hallucinogenic. The most complete interdisciplinary study of this and other "psilocybin" mushrooms is that of Heim and Wasson (1958). Singer (1958), Singer and Smith (1958), Pollock (1975, 1976), Ott (1976), Lincoff and Mitchel (1977), Ott and Bigwood (1978), Rumack and Salzman (1978), Schultes and Hofmann (1980) and Stamets (1978) have also published works on various aspects of hallucinogenic fungi. Because *Psilocybe cubensis* grows commonly in the southeastern United States and is easily cultivated (Stamets, 1978), it is probably the most commonly eaten hallucinogenic mushroom in this area today. The unauthorized possession, sale, or use of psilocybin or psilocin is a crime in the United States (Public Law 91-513) although few, if any, people have been convicted of possession of mushrooms. The purpose of this paper is to review the literature of man's past and present use of psilocybin mushrooms, especially *P. cubensis*.

According to Schultes and Hofmann (1980), the earliest known published reports referring to aboriginal use of hallucinogenic mushrooms in Mexico are those of Spaniards after the conquest. Despite the fact that the Spanish were highly intolerant of "pagan" religions, several references to the ceremonial use of mushrooms have survived. One of the earliest is that of Sahagún (1829–1830, published 3 centuries after it was written) who wrote of ". . . small mushrooms called 'Teonanácatl' which grow in pastures and cause a kind of intoxication the same way as wine". "Nanácatl" refers

to mushrooms in general; and “Teonanácatl” refers to the intoxicating types used ceremonially. In the same work he wrote “. . . the first thing that they ate at the banquet were small mushrooms called ‘nanácatl’ which intoxicate and make one see visions. . .”. The personal physician to the King of Spain described teonánactl as “the intoxicating kind” of mushroom (Hernández, 1651). Over a dozen early references mentioned “teonanácatl” either directly or indirectly (Wasson, 1962), but contemporary knowledge of ritualistic use of mushrooms was virtually unknown outside of Mexico for almost 400 years.

The proof that teonanácatl is a species (probably several species) of hallucinogenic basidiomycetes came when Schultes (1939) collected specimens used in mushroom rites. Such rites are still practiced in certain parts of Mexico. Since his collection of Teonanácatl, more evidence has been found that continues to corroborate the existence of very ancient Mexican Indian religious rites involving hallucinogenic mushrooms. Wasson (1957) described some of these ceremonies and was the first to make the American public aware of hallucinogenic mushroom use in Mexico. Mushroom stones — which are icons of part animal (or man) and part mushroom — have been found in southern Mexico, Guatemala and El Salvador and have been dated conservatively at 1000 B.C. Lowy (1971, 1972) described mushroom stones and Maya codices with mushroom symbols from southern Mexico and Guatemala which he believed were part of religious ceremonies and, or fertility cults.

Psilocybe cubensis grows commonly in the dung of cattle and horses, and since the Spaniards re-introduced these animals to North America it is possible that they also brought the fungus. Other hallucinogenic species of *Psilocybe* may have been used in Pre-Columbian times. Some curanderos (shamans) consider *P. cubensis* to be inferior to other hallucinogenic mushrooms. However, this may be the result of cultural prejudice rather than chemical properties.

Ritualistically used mushrooms (*Psilocybe mexicana* Heim) collected by Heim were sent to Hofmann et al. (1959) who identified the active ingredients — psilocybin and psilocin. They reported that these dried mushrooms contained 0.2–0.4% (of dry weight) psilocybin. Catalfomo and Tyler (1964) found 0.52% psilocybin in mycelium of *P. cubensis* grown in submerged culture. Heim et al. (1966) reported concentrations of 1.5% psilocybin (*Psilocybe* sp.). The highest reported concentration of psilocybin in any mushroom is 2% of dry weight (Beug and Bigwood, 1982). Bigwood and Beug (1982) studied the variation of psilocybin and psilocin content in cultivated basidiocarps of *P. cubensis*. They found a maximal concentration of 1.4% (psilocybin and psilocin), minimal concentration of 0.5%, and an average of 0.7%. They also found that the concentration of psilocybin was greatest at the fourth flush. Various chromatographic procedures (Beug and Bigwood, 1982; Leung, 1967) have been used to isolate psilocybin and its analogs. A relatively simple technique (Haard and Haard, 1975) involving

extraction with methanol, defatting with chloroform, developing with butanol/acetic acid/water (12:3:5) on circular filter paper and locating with *p*-dimethylaminobenzaldehyde can be used to verify the presence of psilocybin and psilocin.

The median oral dose for man is 7 mg or about 1 g dried (10 g fresh) *P. cubensis*. The toxicity of psilocybin is low (LD_{50} for mouse = 280 mg/kg), especially when compared to its effective dose (for man = 0.02 mg/kg) (Chilton, 1978). Cross tolerance can be exhibited among psilocybin, LSD and mescaline, and this implies that the mode of action of all three compounds is similar, although psilocybin is apparently less toxic than the other two compounds. Psilocin is 1.4 times as potent as psilocybin, suggesting that dephosphorylation must occur before psilocybin is active (Heim and Wasson, 1958). Only 50% of labeled psilocybin is absorbed by the gastrointestinal tract of the rat after 30 min (Kalberer et al., 1962). Behavioral effects closely parallel brain concentration. Injections of psilocybin result in 65% excretion of psilocybin in the urine and 20% in bile and feces (Kalberer et al., 1962). Psilocybin is still detectable in the urine after 7 days. It has been suggested that the activity of psilocybin may be associated with its structural similarity to serotonin (Woolley and Campbell, 1962; Chilton, 1978).

The effects of an average dose include an increase in body temperature, dilation of the pupils, erection of hairs, pleasant or apprehensive mood, unmotivated laughter, compulsive movements, muscle weakness, drowsiness, and visions of altered shapes and colors. Although often referred to as "hallucinogenic," the frequency of hallucinations by users at moderate doses is low (Hollister, 1968). Treatment (if necessary) is diazepam (Valium[®]) 5–10 mg for seizures, chlorpromazine (Thorazine[®]) 50–100 mg i. m. for psychoses, and reassurance for apprehension (Mitchel and Rumack, 1978). Usually recovery occurs within 6 h.

One of the most common descriptions of the psychological effects of these mushrooms is that of a "dream-like" state. The parallelisms of dreams and hallucinations have been noted by philosophers and scientists alike since the time of Plato (Jacobs, 1978). The suggestion of an actual homology between the two states has been made by Jacobs (1978). Jacobs and Trulson (1979) have discussed the relationships between drug induced hallucinations, dreams and psychosis.

Although psilocybin mushrooms are remarkably non-toxic (if the toxicity is similar in man as in mice, an individual might have to eat his weight in fresh mushrooms to risk death), there is the added possibility of psychological injury. However, despite large scale use under non-controlled conditions, there is a paucity of reports of serious adverse reactions. This contrasts with the use of synthetic street drugs and may reflect the ability of mushroom users to estimate dosage more accurately. If one assumes that *P. cubensis* has a psilocybin concentration of 0.7% (Bigwood and Beug, 1982) and one consumes 1 g of dried mushrooms, then one would have taken 7 mg psilocybin. Due to the known variation, psilocybin concentration could be

twice this amount (Bigwood and Beug, 1982); and since only a limited number of mushrooms have been analyzed, even greater variation is quite possible. Brown (1968) suggests a maximum safe dose of 150 mg psilocybin (less than 10 g dried mushroom) and warns that higher doses may produce a complete break with reality, a situation that few can handle pleasantly.

On the black market, the quality of hallucinogenic mushrooms is highly unreliable. Not only is the variation in psilocybin concentration greater (Bigwood and Beug, 1982), but adulterants are very common. One study (Pharm Chem, 1975) reported that of 333 specimens, 25% were inert, 53% were *Agaricus bisporus* (J. Lange) Pilat plus LSD, 1% were *Agaricus bisporus* plus PCP, 4% were *Agaricus bisporus* plus LSD and PCP, and 15% were hallucinogenic *Psilocybe* sp. Additionally, street "psilocybin" is most often found to be LSD (Johnson and Gunn, 1972; Brown and Malone, 1973; Kok et al., 1973; Mattke and Steinigen, 1973).

To my knowledge, no one has ever died from the deliberate consumption of psilocybin mushrooms. However, a life-threatening situation does exist with respect to children. A child who had eaten considerable quantities of *Psilocybe baeocystis* Sing. & Smith developed pyrexia to 41.1°C, had convulsions, and later died (McCawley et al., 1962). Also one death of an adult who accidentally ate *Galerina* sp. believing that it was a psilocybin mushroom, has been reported (G. Lincoff, pers. commun.). The reports (Imai, 1932) mentioned in Singer and Smith (1958) of *Psilocybe* sp. causing deaths of adults are apparently incorrect (Pollock, 1975).

Although historically these fungi have been used within a framework of religious/medical protocol, the contemporary use by young adults (Ott, 1978) is more along the lines of recreation. When asked how he felt about this, Wasson replied, "I deplore it, it's a disgrace — it's a disgrace" (G. Wasson, pers. commun.). When asked if there was a framework in which these mushrooms could be used beneficially in modern society he said, "it must be used quietly . . . it must be used in private." Did he favor laws restricting its use? "Absolutely not." Wasson agreed with the suggestion that laws frequently result in an increase in misinformation that is the primary hindrance to any purposeful use of these fungi. He also regrets tremendously the desecration of the mushroom ceremonies in Mexico. Wasson supports adoption of the term "entheogen" in place of "hallucinogen" a term which carries a pejorative connotation.

Hallucinogenic mushrooms should be treated with the utmost respect since the user is dealing with a powerful mind altering drug. This is an experience that the user will not necessarily relish; although the majority of users are said to look back on the experience as a pleasant one (Lampe, 1978; Ott, 1978).

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