

# Diversity and Use of Traditional Mexican Medicinal Fungi. A Review

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**ABSTRACT:** In this review, more than 70 species of medicinal mushrooms from Mexico, which can help treat over 40 illnesses or health problems, are discussed. Among the latter, anxiety and rejuvenation are considered, as well as traditional beliefs about the evil eye or hearing the voice of a specific person. This article is based on an extensive bibliographic review, as well as the inclusion of field work done by the author during several years of study in Mexico. *Schizophyllum commune*, several species of *Pleurotus* and *Ustilago maydis*, as well as some lichens, are the most important medicinal fungi considered for the treatment of specific illnesses or health problems. Many medicinal mushrooms are also edible and are currently sold in the marketplace. *Amanita muscaria* is the only toxic mushroom used in traditional medicine, as well as some hallucinogenic species of the genus *Psilocybe*.

**KEY WORDS:** medicinal mushrooms, relationships, traditions, distribution, ethnomycology, Mexico

## I. INTRODUCTION

Different ethnic groups in Mexico have extensive knowledge about the use of many species of fungi, including medicinal mushrooms. However, this knowledge about medicinal fungi has been insufficiently documented. Sufficient evidence is lacking regarding their proven use for medicinal purposes even for those mushrooms used among the people in modern society in some cities, such as Mexico City. In these cities and towns, it is common to find stores selling medicinal plants mixed with fungi. The studies of Trappe et al.,<sup>1</sup> Mapes et al.,<sup>2</sup> Martínez-Alfaro et al.,<sup>3</sup> Guzmán,<sup>4–6</sup> Estrada-Torres and Aroche,<sup>7</sup> Mata,<sup>8</sup> Godínez and Ortega,<sup>9</sup> González-Elizondo,<sup>10</sup> and Lampman<sup>11</sup> represent only a few isolated ethnomycological references in relation to the medicinal mushrooms used in Mexico. These studies include approximately 10 ethnic groups; however, there are more than 60 different Indian cultures in Mexico, which emphasizes how important is to study medicinal fungi.

Guzmán<sup>12,13</sup> published two works on this subject. Unfortunately, with the development of modern civilization, Indian traditions are affected by the introduction of foreign medicinal products and by progress in modern medicine, as well as by the development of agricultural and cattle practices, which affect the forests and the populations of fungi in all the country, as the author observed many years ago. However, several ethnic groups continue with their traditions and teach their practices, helping their sons learn how to recognize these fungi in the field, which holds good promise for the future.

An updated review of traditional medicinal fungi in Mexico is presented herein to show the important roles fungi still play in Mexico and to prevent this knowledge from being lost.

## II. MATERIALS AND METHODS

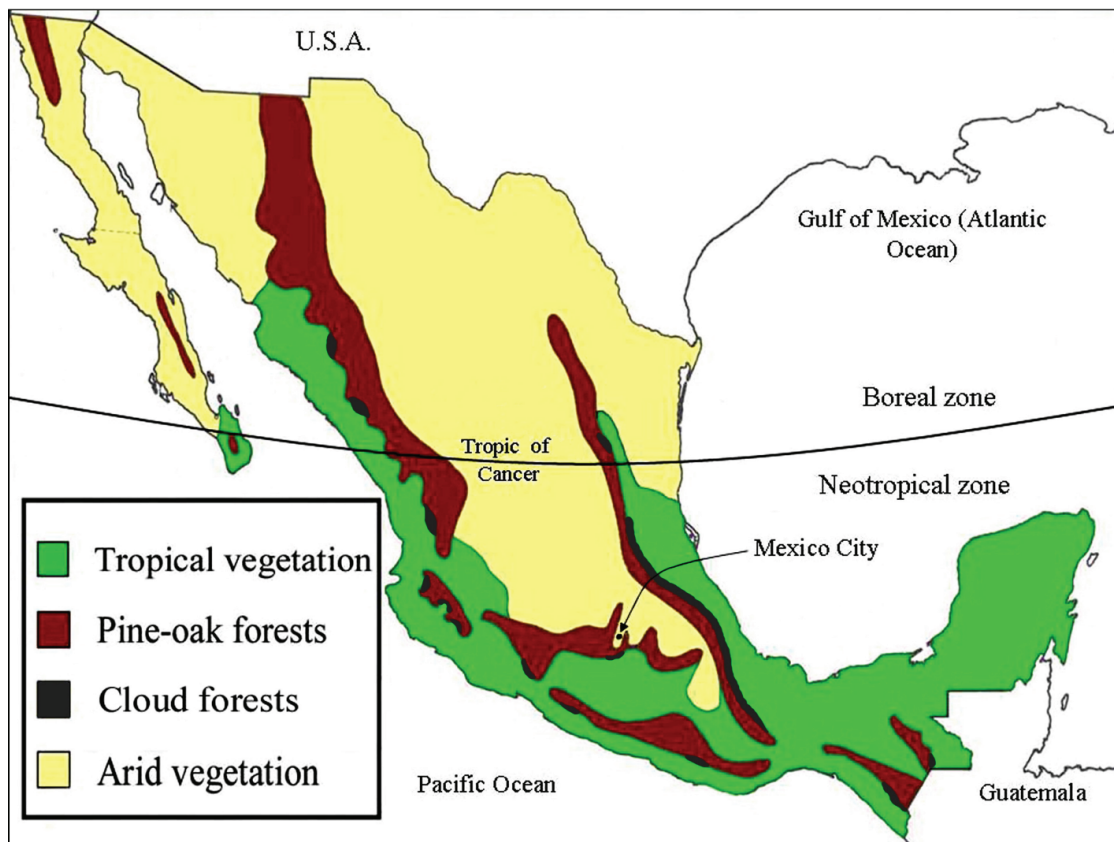
This article is based on an extensive bibliographic review, as well as the field notes of the author,

which he has made during several investigations in Mexico through more than 50 years of study over which time he established direct contact with the Indians to learn more about the use of medicinal fungi.

### III. HIGH MYCODIVERSITY IN MEXICO

The diversity of fungi in Mexico is very high due to its special geographical location between two important biogeographic regions: the Neotropical from South America and the Boreal from North America, as the author<sup>14</sup> discussed in a plenary lecture at the Fourth International Medicinal Mushroom Conference in Ljubljana, Slovenia. The two biogeographical regions divide the country in the

middle into two parts, through the Tropic of Cancer (Fig. 1). However, due to two important mountain ranges, which run from the south to the north (up to 4000 m in altitude), one in the Pacific slopes in the west and the other in the slopes of the Gulf of Mexico in the east, this division is not a simple one. Both ranges are covered by coniferous-oak forests, but the lowlands toward the coasts present tropical vegetation, of which the southeast is made up of a very humid, green jungle. Between coniferous-oak forests and tropical regions (at 1000–1800 m in altitude), there is a temperate humid zone covered by a cloudy subtropical forest, which represents one of the highest biodiversities in the country. In contrast, the northern part of the country is covered by xerophytic vegetation, which forms a true desert in the northwest. However, despite the



**FIGURE 1.** The four types of vegetation in Mexico, divided into two important biogeographic zones by the Tropic of Cancer: Tropical vegetation, with both deciduous and rain forests; pine-oak forests, with coniferous and *Quercus-Pinus* forests; cloud, subtropical, or mesophytic forests; and arid or xerophytic vegetation. Meadows exist in all four cases.

high mycodiversity of Mexico, knowledge is still limited. In Guzmán's studies,<sup>6,15</sup> there are more than 200,000 species of fungi in Mexico, of which, unfortunately, only 6% has been studied, in spite of the progress that has been made in Mexican mycology over the last 40 years.

Tropical fungi still remain poorly understood in comparison with those from temperate regions. Nevertheless, the traditions encompass a great deal of knowledge about the use of certain fungi, which began before the Spanish conquered Mexico in the 16th century. This includes the indirect use of yeasts by different ethnic groups in the preparation of traditional beverages such as pulque, tepache, tesguino, and others,<sup>16</sup> and the use of edible, medicinal, and hallucinogenic mushrooms, which is discussed below. However, one of the important problems in the study of Mexican fungi is the widespread destruction of the original vegetation, especially in the tropics. The use of forest lands by cattle or the implementation of certain agricultural practices present serious problems throughout the country.

#### IV. RESULTS

There are over 70 species of fungi used in traditional medicine practices in more than 10 ethnic groups to treat over 40 types of illnesses or health problems in Mexico (Tables 1 and 2, and Fig. 2). Health problems, such as anxiety, obesity, low production of mother's milk, weakness, need for rejuvenation, and others, can be treated with medicinal fungi. In addition, certain species of *Geastrum*, *Dictyophora indusiata*, *Lycoperdon candidum*, *Vascellum qudenii*, and other lycoperdaceous fungi are traditionally used, for example, against the evil eye (with species of *Geastrum*), or in some witchcraft practices to raise the voice of a specific person with other fungi, as discussed by Heim and Wasson<sup>17</sup> and Heim et al.<sup>18</sup> (with *Dictyophora* and the lycoperdaceous fungi cited above).<sup>19</sup> Mata<sup>8</sup> reported that boiled water from *Geastrum triplex* was used in the treatment of babies to avoid the evil eye that had been placed on them.

It is interesting to observe that there are several important edible mushrooms that are selling in popular markets, such as the above-mentioned

lycoperdaceous fungi, *Amanita caesarea*-complex, *Auricularia* spp., *Boletus edulis*-complex, *Calvatia cyathiformis*, *Clitocybe gibba*, *Hypomyces lactifluorum*, *Lactarius* spp., *Langermannia gigantea*, *Lycoperdon perlatum*, *Schizophyllum commune*, *Suillus* spp., and *Ustilago maydis*. The complex of *Amanita caesarea* is formed by seven species found in Mexico, as discussed by Guzmán and Ramírez-Guillén (see Table 1).<sup>20</sup> These species of *Amanita* are commonly found in popular markets and are also used in medicine against inflammation. There are many common names for the *A. caesarea* species, but among them, "ahuevado" (like an egg), "yema" (yolk), and "tecomate" (like a red pumpkin, by the form and color of the pileus) are the most frequently used. Referring to the complex *Boletus edulis*, it seems that true *B. edulis* does not grow in Mexico but is rather represented by *B. pinophilus* and *B. variipes* (J. García, pers. communication).

Other medicinal fungi are the gelatinous types: *Clathrus crispus* and *Tremellodendron schweinitzii*, and the tough species: *Ganoderma* spp., *Pogonomyces hydnooides*, *Pycnoporus sanguineus*, *Thelephora cervicornis*, and *Trametes versicolor* (as shown in Fig. 2). *Pycnoporus sanguineus*, in spite of its tough context, was reported as an edible mushroom by the Amazonian Indians.<sup>21</sup> In Mexico, besides its medicinal properties, *P. sanguineus* is used by girls in some Chiapas communities to color their cheeks by rubbing the fungus on their faces. It is interesting to note that *Schizophyllum commune*, in spite of its tough context, is one of the most important edible fungus in the tropics, where it is also sold in popular markets.<sup>22-24</sup>

The only toxic mushroom used as a medicine is *Amanita muscaria*<sup>7,12</sup> (Fig. 2), which is also used to kill flies. As a medicine, it is advised only to take small amounts of this fungus, because large quantities can produce gastrointestinal disturbances, such as vomiting; it can also produce hallucinations because it contains ibotenic acid, which has the same action as psilocybin. *Amanita muscaria* was probably used by Maya Indians in Chiapas and Guatemala and by Purepechas in Michoacan (Mexico) centuries ago as a sacred mushroom for its hallucinogenic properties, as discussed by Lowy,<sup>25</sup> as well as Mapes et al.<sup>2</sup> and Guzmán.<sup>26</sup> *Daldinia* spp. is used as a medicinal fungus (Fig. 2), but in

**TABLE 1**  
**Medicinal Mushrooms Considered in This Article and Illnesses or Health Problems That They Solved**

## Ascomycotina

<i>Daldinia concentrica</i> (Bolton) Ces. & De Not. ....	3, 8, 17, 28, 40
<i>D. eschscholzii</i> (Ehrenb.: Fr.) Rehm.....	3, 8, 17, 28, 40
<i>Elaphomyces granulatus</i> Fr. ....	4, 23, 32, 36
<i>E. muricatus</i> Fr. ....	4, 23, 32, 36
<i>E. reticulatus</i> Vittad. ....	4, 23, 32, 36
<i>E. variegatus</i> Vittad. ....	4, 23, 32, 36
<i>Hypomyces lactifluorum</i> (Schwein.: Fr.) Tul. et Tul. ....	18

## Basidiomycotina

## Ustilaginales

<i>Ustilago maydis</i> (DC.) Corda.....	4, 5, 10, 11, 17, 20, 22, 38, 40, 44?
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## Auriculariales and Tremellales

<i>Auricularia auricula</i> (L.) Underw. ....	1, 30
<i>A. cornea</i> Ehrenb. ....	1, 30
<i>A. delicata</i> (Fr.) Henn. ....	1, 30
<i>A. fuscisuccinea</i> (Mont.) Henn. ....	1, 30
<i>Tremellodendron schweinitzii</i> (Peck) G.F. Atk. ....	18, 20, 21, 22, 41

## Aphylophorales

<i>Ganoderma lucidum</i> (Fr.) P. Karst. complex.....	8?, 15?
<i>Clavicornia pyxidata</i> (Pers.) Doty.....	18, 20, 21, 22, 41
<i>Clavulina cinerea</i> (Bull.: Fr.) J. Schröt. ....	18, 20, 21, 22, 41
<i>Pogonomyces hydroides</i> (Sw.: Fr.) Murrill.....	17, 35, 40
<i>Pycnoporus sanguineus</i> (L.: Fr.) Murrill.....	11, 17, 21, 35, 40
<i>Ramaria</i> sp. ....	18, 20, 21, 22, 41
<i>Schizophyllum commune</i> Fr. ....	18, 20, 21, 22, 26, 33, 41
<i>Thelephora cervicornis</i> Corner (reported as <i>T. paraguayensis</i> Corner <sup>28</sup> ).....	40
<i>Trametes versicolor</i> (L.: Fr.) Lloyd.....	17, 31, 35, 40

## Agaricales

<i>Amanita basii</i> Guzmán et Ram.-Guill. ....	21
<i>A. caesarea</i> (Scop.: Fr.) Pers. ....	21
<i>A. jacksonii</i> Pomerl.....	21
<i>A. laurae</i> Guzmán et Ram.-Guill. ....	21
<i>A. muscaria</i> (L.) Lam. ....	12, 13, 31
<i>A. tecomate</i> Guzmán et Ram.-Guill. ....	21
<i>A. tullossi</i> Guzmán et Ram.-Guill. ....	21
<i>A. yema</i> Guzmán et Ram.-Guill. ....	21
<i>Boletus edulis</i> Bull.: Fr. ....	18, 33, 34
<i>B. pinophilus</i> Pilát et Dermek.....	18, 33, 34
<i>B. variipes</i> Peck.....	18, 33, 34
<i>Clitocybe gibba</i> (Pers.: Fr.) P. Kumm. ....	15
<i>Lactarius deliciosus</i> (L.: Fr.) Gray.....	15, 18, 20, 22
<i>L. indigo</i> (Schwein.: Fr.) Fr. ....	31?, 45
<i>L. salmonicolor</i> R. Heim et Leclair.....	15, 18, 20, 22
<i>Lentinus crinitus</i> (L.: Fr.) Fr. ....	37
<i>Pleurotus albidus</i> (Berk.) Pegler <sup>27</sup> .....	6, 12, 18, 19, 32, 34, 36, 45
<i>P. cornucopiae</i> (Paulet: Fr.) Rolland.....	6, 12, 18, 19, 32, 34, 36, 45
<i>P. djamor</i> (Rumph.: Fr.) Boedijn.....	6, 12, 18, 19, 32, 34, 36, 45

<i>P. ostreatus</i> (Jacq.: Fr.) P. Kumm. ....	6, 12, 18, 19, 32, 34, 36, 45
<i>P. pulmonarus</i> (Fr.) Quél. ....	6, 12, 18, 19, 32, 34, 36, 45
<i>P. smithii</i> Guzmán.....	6, 12, 18, 19, 32, 34, 36, 45
<i>Psilocybe angustipleurocystidiata</i> Guzmán.....	1, 24
<i>P. barrerae</i> Cifuentes et Guzmán emend. Guzmán.....	1, 24
<i>P. hoogshagenii</i> R. Heim.....	1, 24
<i>P. muliercula</i> Singer et A.H. Smith.....	1, 24
<i>P. sanctorum</i> Guzmán.....	1, 24
<i>Suillus brevipes</i> (Peck) Kuntze.....	18, 34
<i>S. granulatus</i> (L.: Fr.) Roussel.....	18, 34
<i>S. luteus</i> (L.: Fr.) Roussel.....	18, 34

Gasteromycetes

<i>Bovista pusilla</i> (Batsch) Pers.(= <i>Lycoperdon pusillum</i> Batsch).....	4, 10, 29
<i>Dictyophora indusiata</i> (Vent.) Desv. ....	46
<i>Calvatia cyathiformis</i> (Bosc) Morgan.....	4, 5, 10, 29
<i>Clathrus crispus</i> Turpin.....	9
<i>Geastrum fimbriatum</i> Fr. ....	2, 14, 17, 38, 39
<i>G. saccatum</i> Fr. ....	2, 14, 17, 38, 39
<i>G. triplex</i> Jungh. ....	2, 14, 17, 38, 39
<i>Langermannia gigantea</i> (Batsch.: Fr.) Rostk. ....	4, 5, 10
<i>Lycoperdon candidum</i> Pers. (reported as <i>L. marginatum</i> Vittad. <sup>29</sup> ) .....	4, 5, 10, 16, 29, 40, 42, 43
<i>L. perlatum</i> Pers. ....	4, 5, 10, 16, 29, 40, 42, 43
<i>L. pyriforme</i> Schaeff. ....	4, 5, 10, 16, 29, 40, 42, 43
<i>Vascellum pratense</i> (Pers.: Quél.) Kreisel.....	4, 5, 10, 29
<i>V. qudenii</i> (Bottomley) P. Ponce de León (= <i>Lycoperdon mixtecorum</i> R. Heim <sup>29</sup> ).....	4, 5, 10, 29

Lichens

<i>Dictyonema pavonium</i> (Sw.) Parmasto.....	5, 7, 8, 12, 15, 20, 25, 27
<i>Pseudevernia consocians</i> (Vain.) Hale et W.L. Culb. ....	5, 7, 8, 12, 15, 20, 25, 27
<i>P. intensa</i> (Nyl.) Hale & W.L. Culb. ....	5, 7, 8, 12, 15, 20, 25, 27
<i>Pseudoparmelia caperata</i> (L.) Hale.....	5, 7, 8, 12, 15, 20, 25, 27
<i>Ramalina ecklonii</i> (Spen.) Meyreng. et Flot. ....	5, 7, 8, 12, 15, 20, 25, 27
<i>Roccella babingtonii</i> Mont. ....	5, 7, 8, 12, 15, 20, 25, 27
<i>Usnea strigosa</i> (Ach.) Eaton.....	5, 7, 8, 12, 15, 20, 25, 27
<i>Xanthoparmelia cumberlandia</i> (Gyel.) Hale.....	5, 7, 8, 12, 15, 20, 25, 27

**Note:** The numbers presented in the table text correspond to the illnesses and health issues listed in Table 2. "?" = documented information is contradictory regarding the respective illness, health issue, or fungus identification.

Guatemala, and probably in Chiapas (Mexico), it is also edible and sells in popular markets.<sup>27</sup> The species of *Elaphomyces* are used to combat low production of mother's milk, as well as for bleeding wounds, rejuvenation, and as a stimulator. However, in the Nevado de Toluca region (Mexico), the Indians link *Elaphomyces* spp., which is called "el gran mundo" (the great world), to sacred ceremonies with *Psilocybe muliercula* or *P. sanctorum*, both named "mujercitas" (little women), and with *Cordyceps*

*capitata* (Holms.: Fr.) Link or *C. ophioglosoides* (Fr.) Link, both of which are called "hombrecitos" (little men), and both are parasitic on *Elaphomyces* spp. In these ceremonies, some people eat "mujercitas" and others eat "hombrecitos," while "el gran mundo" is placed in the center of the room to preside over the ceremony. When the ceremony is over, all people attending the ceremony eat the *Elaphomyces* with deference.<sup>1,12,13</sup> It is also interesting that *Cordyceps* is a relative of *Claviceps*

**TABLE 2**  
**Illnesses, Health Problems, and Functions**  
**Treated with Mushrooms**

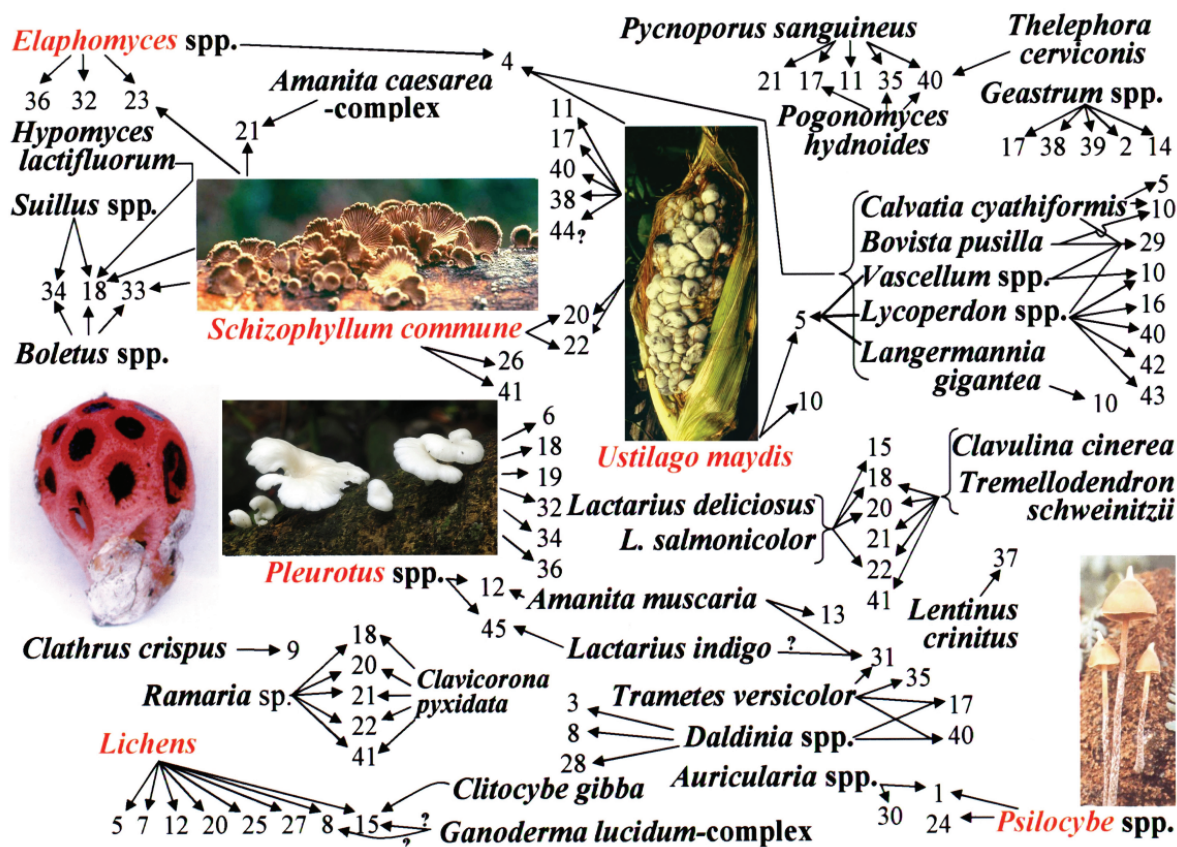
1. Anxiety
2. Asthma
3. Back pain
4. Bleeding wounds
5. Burns
6. High cholesterol levels
7. Teeth cleaning
8. Colds
9. Conjunctivitis
10. Cuts
11. Diarrhea
12. Diuretic
13. Epilepsy
14. Evil eye
15. Febrifuge
16. Goiter
17. Grains
18. Headache
19. High blood pressure
20. Indigestion
21. Inflammations
22. Intestinal pains
23. Low production of mother's milk
24. Molar tooth pain
25. Mouth ulcers
26. Obesity
27. Pectoral
28. Phlegm
29. Stings by wasps or bees
30. Fear
31. Purgative
32. Rejuvenate
33. Rheumatism
34. Sadness
35. Scalp ringworms
36. Stimulating
37. Weakness
38. Softening a baby's skin
39. Umbilical alleviation
40. Warts
41. Weakness
42. Bedwetting
43. Swollen/itchy penis in infants
44. Eryzipelas
45. Laxative
46. Witchcraft practices to raise the voice of a specific person

*purpurea* (Fr.) Tul., which is the famous ergot from which LSD, the first isolated hallucinogenic drug, was obtained.<sup>30</sup>

Regarding *Ganoderma lucidum*, it is interesting to note that in contrast with the large amounts of this fungus that are used in several Asian countries in traditional medicine,<sup>31</sup> very little of it is used in Mexico. It is only known by the Tzeltal group in Chiapas,<sup>11</sup> who use the complex *G. lucidum* to “warm a cold body,” as a tea, after the fungus is crushed and boiled. (We do not know if this use is in relationship with febrifuge or cold treatments.) Purgative fungi, such as *Lactarius indigo*, *Trametes versicolor*, and *Amanita muscaria*, are confused with those used as laxatives, a difference that depends on their intestinal mode of action. Estrada-Torres and Aroche<sup>7</sup> questioned the purgative properties of *Lactarius indigo* because it is an edible mushroom, but it is most probable that this mushroom is a light laxative.

In describing the use of the hallucinogenic species of *Psilocybe*, first known in Mexico through the Spanish writings from the 15th century as “teonanácatl,” named by Sahagún,<sup>5,12,13,17,32</sup> it is interesting to note that 90% of these mushrooms (e.g., *Psilocybe hoogshagenii*; Fig. 2) grow in the cloudy subtropical forests or in the meadows of these forests (Fig. 1). However, it seems that only *P. angustipleurocystidiata* and probably *P. barrerae* are used in traditional medicine to help fight against toothaches in the town of Tetela del Volcán, in Morelos, Mexico.<sup>5</sup> They are also used in religious ceremonies, along with other hallucinogenic species. Moreover, all the species of the hallucinogenic *Psilocybe* are used in sacred ceremonies against anxiety and other health issues.

Among the medicinal mushrooms (as shown in Fig. 2), *Ustilago maydis*, *Schizophyllum commune*, and *Pleurotus* spp. are most essential for treating numerous illnesses and health problems (Fig. 2). It is important to note that *Ustilago maydis*, the corn smut fungus, called “cuitlacoche” (secretion of the corn), in spite of its appearance, is one of the most important edible fungi in temperate Mexico and has high commercial value in the marketplace.<sup>2,13,33</sup> However, it is not frequently used in the tropics, even though it grows there. Among the important medicinal uses of this fungus is to soften and soothe a baby's skin after an irritation; the fungal spores (chlamydospores) are mixed with oil and rubbed on the skin. It is also probably used against erysipelas.<sup>7</sup>



**FIGURE 2.** The interrelationships of Mexican medicinal fungi in the treatment of illnesses and health problems. The numbers refer to those of Table 2. The pictures of *Clathrus*, *Pleurotus*, *Ustilago*, and *Psilocybe* were taken by S. Chacón, E. Fanti, L. Guzmán-Dávalos, and J. Jacobs, respectively (important fungi are written in red). "?" = documented information is contradictory regarding the respective illness or health issue.

The most traditional medicinal species of *Pleurotus* is *P. djamor*, and probably *P. albidus*,<sup>34</sup> *P. smithii*, and *P. cornucopiae*, as well.<sup>13,33,34</sup> Moreover, after commercial mushroom cultures were established in Mexico with *P. ostreatus* and *P. pulmonaris*, these species were also used in traditional medicines, mainly in the cities, for example, Mexico City. All species of *Auricularia* known to Mexico<sup>33</sup> are edible, except for *A. mesenterica* Pers., and are used in traditional medicine solely against anxiety and fear.<sup>11</sup> However, Kim et al.<sup>35</sup> reported the effect of species of *Auricularia* in intestinal constipation in Korea. *Clathrus crispus* (Fig. 2), which is called "colador del brujo" (colader or lech mushroom of the medicine man or wizard) and is common in the tropical areas, is used by Maya people in the Yucatan Peninsula to treat eye infections. The

fungus is squeezed with their hands, and the liquid obtained is placed on the infected eye.<sup>4,12,26</sup>

In general, people dry the fruit bodies in the sun after collecting them in the field and then store them in the house until they are used. However, fleshy mushrooms such as *Amanita*, *Boletus*, and *Suillus* do not dry well and rot quickly, and these mushrooms should be used when they are fleshy and fresh. Medicinal fungi from the fields can be collected the whole year, but they are mainly picked in the summer time when the rainy season occurs and when mushrooms grow well. Medicinal fungi are usually boiled for tea, but at other times they are either grilled or prepared as a soup. Other fungi are crushed before preparation. Sometimes, the crushed fungi are mixed with beverages as "posol" (a fermented corn beverage). Spores of puffballs,

such as *Calvatia*, *Geastrum*, *Langermannia*, and *Lycoperdon*, are spread on the affected area of the skin. With some fungi (e.g., *Clavicornia*, *Clavulina*, and *Tremellodendron*) and some puffballs (e.g., *Langermannia*), people made poultices to put on the affected skin. The use of fungi to gain personal strength is ambiguous, except in the case of *Lentinus crinitus*. Tzeltal Indians used this fungus to help women recover after giving birth.<sup>11</sup> These Indians also rub some fungi on warts or scalp ringworms, especially *Daldinia*, *Pogonomyces*, *Pycnoporus*, and *Trametes*. Other indigenous groups use the fresh fruits of *Calvatia*, *Lycoperdon*, and *Vascellum* to recover from a sting by a wasp or bee by rubbing the fungus on the wound. The author of this research had an interesting personal experience with *Lycoperdon perlatum*, which he used when a bee stung his hand. He immediately rubbed the fresh fungus on his skin, following the advice of the Tzeltal Indians, and recovered very quickly.

Several lichens, such as species of *Dictyonema*, *Pseudevernia*, *Pseudoparmelia*, *Ramalina*, *Roccella*, *Usnea*, and *Xanthoparmelia* (see Table 1), are used in traditional medicine against pectoral problems, as febrifuge or against colds, for diuretic problems, to treat ulcers in the mouth and as a mouthwash, or for aiding in digestive problems.<sup>2,7,9,13</sup> *Roccella babingtonii* has been reported to also aid against asthma and burns.<sup>9</sup>

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