JOURNAL *of the* MEXICAN
CHEMICAL SOCIETY
(J. Mex. Chem. Soc.)
Former Revista de la Sociedad Química de México (Rev. Soc. Quím. Mex.)

https://www.jmcs.org.mx/

Review

Open Access

J. Mex. Chem. Soc. **2026**, *70(1):e2551*

Received September 14th, 2025
Accepted February 16th, 2026

http://dx.doi.org/10.29356/jmcs.v70i1.2551
e-location ID: 2551

Keywords:
Alkaloids, Basidiomycota, chemical composition, Fungi, hallucinogenic species, magic mushrooms

Palabras clave:
Alcaloides, Basidiomycota, composición química, especies alucinógenas, Fungi, hongos mágicos

***Corresponding author:**
J. Martín Torres-Valencia
email: jmartin@uaeh.edu.mx

ISSN-e 2594-0317

Chemical Constituents of *Psilocybe Sensu Stricto* Mushrooms. A 1958 – 2025 Comprehensive Review

Aylín R. Tabal-Robles[1], J. Martín Torres-Valencia[1,*], Leticia Romero-Bautista[2], María Eva González-Trujano[3], Laura Guzmán-Dávalos[4], Virginia Ramírez-Cruz[4], Susana Rojas-Lima[1]

[1]Área Académica de Química, Instituto de Ciencias Básicas e Ingeniería, Universidad Autónoma del Estado de Hidalgo, km 4.5 Carretera Pachuca-Tulancingo, Mineral de la Reforma, Hidalgo 42184, México.
[2]Área Académica de Biología, Instituto de Ciencias Básicas e Ingeniería, Universidad Autónoma del Estado de Hidalgo, km 4.5 Carretera Pachuca-Tulancingo, Mineral de la Reforma, Hidalgo 42184, México.
[3]Laboratorio de Neurofarmacología de Productos Naturales, Dirección de Investigaciones en Neurociencias, Instituto Nacional de Psiquiatría Ramón de la Fuente Muñiz, Calz. México-Xochimilco 101, Colonia Huipulco, Alcaldía Tlalpan, 14370, Ciudad de México, México.
[4]Departamento de Botánica y Zoología, Universidad de Guadalajara, Zapopan, Jalisco, México.

Abstract. The genus *Psilocybe* currently comprises approximately 165 species that are hallucinogenic. Chemical studies on them have revealed the presence of alkaloids with indole and β-carboline structures, which are responsible for their psychotropic properties. However, scarce information has been reported on other classes of metabolites present in *Psilocybe* mushrooms. The objective of this review was to integrate chemical information published on the species of mushroom recognized in this genus, specifically that including characterized metabolites. The search for this information spanned publications from 1958 to 2025 and identified at least 50 different metabolites in 32 species. Overall, most metabolites were alkaloids with an indole structure; however, amino acids, terpenoids, and saccharides were also mentioned.

Resumen. Actualmente, el género *Psilocybe* comprende aproximadamente 165 especies alucinógenas. Los estudios químicos sobre ellas han revelado la presencia de alcaloides con estructura de indol y β-carbolina, los cuales son responsables de sus propiedades psicotrópicas. Sin embargo, poca información se ha reportado sobre otras clases de metabolitos presentes en los hongos del género *Psilocybe*. El objetivo de esta revisión fue integrar la información química publicada sobre las especies de hongos reconocidas en este género, específicamente aquella que incluye la caracterización de metabolitos. La búsqueda de esta información abarcó publicaciones de 1958 a 2025 y reveló la identificación de al menos 50 metabolitos diferentes en 32 especies. En general, la mayoría de los metabolitos fueron alcaloides con estructuras de indol, pero también se incluyeron aminoácidos, terpenoides y sacáridos.

Abbreviations

CZE, capillary zone electrophoresis
ESITOFMS, electrospray ionization time-of-flight mass spectrometry
GC-MS, gas chromatography-mass spectrometry
HPLC, high-performance liquid chromatography
HPLC-ESI-MS, high-performance liquid chromatography-electrospray ionization-mass spectrometry
HPLC-FL, high-performance liquid chromatography coupled with fluorescence detector
HPTLC, high-performance thin-layer chromatography
IMS, ion mobility spectrometry
IR, infrared
LC, liquid chromatography
LC-MS, liquid chromatography-mass spectrometry
LC-MS/MS, liquid chromatography with tandem mass spectrometry
MALDI-MS, matrix-assisted laser desorption/ionization-mass spectrometry
MIKES, mass-analyzed ion kinetic-energy spectrometry
NMR, nuclear magnetic resonance
TLC, thin layer chromatography
UHPLC-HRMS, ultra-high-performance liquid chromatography coupled with high-resolution mass spectrometry
UHPLC-UV/VIS, ultra-high-performance liquid chromatography coupled with ultraviolet and visible detector
UV, ultraviolet

Introduction

Mexico has a long and important tradition of knowledge and use of hallucinogenic mushrooms in rituals and ceremonies among various indigenous groups. According to Nichols [1], the Franciscan friar Bernardino de Sahagún, upon his arrival in Mexico in 1529, dedicated several years to studying Nahuatl beliefs, culture, and history. He wrote the famous Florentine Codex, in which he referred to hallucinogenic mushrooms as teonanacatl, "God's Flesh," the sacred mushrooms. However, sacred mushrooms and the Mexican rituals of their use gained widespread attention when amateur mycologist Robert Gordon Wasson published an article in Life magazine in 1957, "Seeking the Magic Mushroom," describing his 1955 travels to Oaxaca. During these travels, he met the curandera María Sabina and participated in her rituals. On one of these trips, in 1957, the French mycologist Roger Heim accompanied R. Gordon Wasson and studied and identified several mushrooms as *Psilocybe* species, including *P. mexicana*. Heim managed to cultivate this mushroom in France and provided a quantity to the chemist Albert Hofmann of Sandoz Pharmaceuticals in Switzerland. The mushroom extract was subjected to thin-layer chromatography (TLC) to separate its components. The paper chromatogram was cut into distinct bands that fellow volunteers ingested to identify the active fraction. Hofmann managed to isolate enough of the active compound, which he characterized as psilocybin (Fig. 1), a crystalline compound relatively stable and soluble in water. Hofmann also identified another minor compound in the mushroom extract, which he named psilocin (Fig. 1).

Since the isolation and characterization of psilocybin and psilocin, scientific interest in these magic mushrooms has grown. Thus, chemical studies have been reported with the intention of demonstrating the presence of their psychoactive alkaloids, psilocybin and psilocin. It is important to mention that for a long time the name *Psilocybe* included several species that do not produce psilocybin but are morphologically similar, until phylogenetic studies carried out by Moncalvo et al. [2] and Matheny et al. [3] showed that they were two independent genera. Then, the pertinent nomenclatural and taxonomic arrangements were carried out (see Ramírez-Cruz et al. [4] for detailed information about the taxonomy of *Psilocybe sensu lato*). The main change was to apply the name *Psilocybe sensu stricto* only to those hallucinogenic mushrooms that produce psilocybin [5]. Nevertheless, literature prior 2007, and even some later works, included non-hallucinogenic mushrooms that do not produce psilocybin under the name *Psilocybe*, therefore the previously estimated number of species was between 277 and 300 [6,7]. In 2005, Guzmán [6] studied most of the 700 names of mushrooms reported as *Psilocybe sensu lato*. Then he recognized only 227 species in the genus (here still *sensu lato*), of which 144 were considered hallucinogenic (i.e., *Psilocybe sensu stricto*). The only direct and practical evidence for a possible inference as to whether a mushroom contains psilocybin, independent of a chemical or phylogenetic study, is the blue staining caused by damage, which is now known, according to Lenz et al. [8], to be an oxidative oligomerization of psilocybin leading to blue products. Currently, in 2022, Bradshaw et al. [9], recognized 165 species in the genus based on literature review, which formed the basis of this revision. The objective of this work is to list the *Psilocybe* species that have been chemically studied to date, as well as to indicate the chemical structures of the identified metabolites and the methods applied to characterize them.

Methodology

A search for published works related to chemical studies on *Psilocybe* species was conducted using the databases Google Scholar, PubMed, ResearchGate, SciFinder, Scopus, and Web of Science. Then, Bradshaw et al. [9], Guzmán [6, 10], and IndexFungorum (https://www.indexfungorum.org/) were consulted to know if there were synonyms or if the taxon mentioned belonged to *Psilocybe sensu stricto*. The following keywords were used: full name of the species, *Psilocybe*, chemical study, and chemical composition. Accessing and carefully reading published works allowed us to know the structure of the identified metabolites and the methods used for their characterization. Publications on biological studies without structural elucidation of metabolites were not considered in this review. In addition, several patents were disregarded because they did not clearly describe the identification of metabolites in the studied *Psilocybe* species.

Results and discussion

This review showed that primary and secondary metabolites have been identified and characterized to date in 32 species (Table 1). It is important to note that, due to morphological similarity, imprecision in older descriptions, and difficulty in observing all the important micromorphological characteristics, distinguishing between species of the genus *Psilocybe* is not always straightforward. Until the advent of molecular data, specifically DNA sequences, species identification had to be approached with caution, as some metabolites mentioned in the reviewed literature may not correspond to the indicated species name. Even with molecular data, names can be incorrectly assigned to sequences deposited in databases, leading to misidentified species.

Among the main secondary metabolites detected were alkaloids derived from L-tryptophan (**1**)/tryptamine (**2**), the best known being psilocybin (**3**) and psilocin (**4**) (Fig. 1), which possess psychotropic activity [4], in part due to their close structural relationship with the brain neurotransmitter serotonin or 5-hydroxytryptamine (**5**) (Fig. 1).

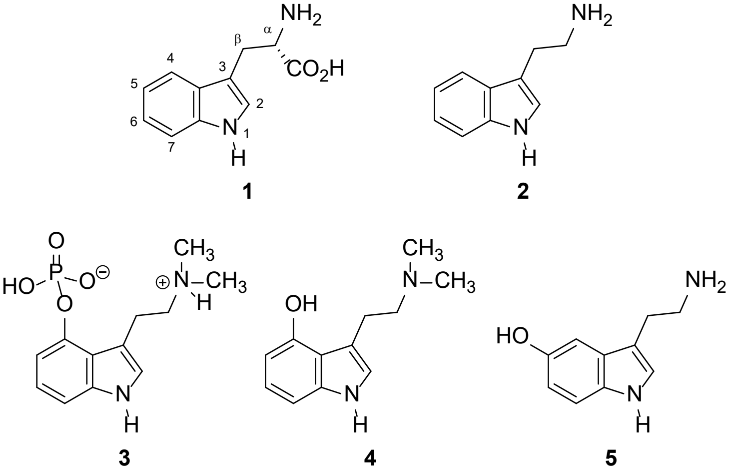


Fig. 1. Structures of L-tryptophan (**1**), tryptamine (**2**), psilocybin (**3**), psilocin (**4**), and serotonin (**5**).

Most chemical studies on *Psilocybe* mushrooms have focused on the identification, quantification, and/or isolation of psilocybin and psilocin, whose synthesis has been reported at the kilogram scale in some cases [11]. Some reports have also indicated the presence of compounds other than alkaloids, including amino acids, sesquiterpenes, sterols, and carbohydrates. The historical isolation and identification of those compounds, beginning with the alkaloids, is provided below. Figures 1–9 show the chemical structures of the metabolites, whereas Table 1 lists the species alphabetically, as well as a summary of characterization methods, the numbers assigned to the structures of the compounds, and the references of the chemical studies. A recent chemical study on *P. allenii* [12] was included. "*Psilocye mckennaii*" [13] was also considered, although it is a provisional name for a species not formally described from a taxonomic point of view.

Alkaloids derived from L-tryptophan/tryptamine

As previously mentioned, Albert Hofmann identified for the first time the presence of psilocybin (**3**) and psilocin (**4**) in *P. mexicana* [14–17]. Ten years later, two psilocybin analogs, baeocystin (**6**) and norbaeocystin (**7**) (Fig. 2) were isolated from *P. baeocystis* [18]. In these alkaloids, the structural difference from psilocybin is the presence of a single methyl group attached to the nitrogen in the C-α position in the case of baeocystin and none in norbaeocystin. Later, Repke and Leslie [19] identified baeocystin in *P. semilanceata*, in which they also detected psilocybin and traces of psilocin. They reported that the species *P. pelliculosa* also produces psilocybin and psilocin but not norbaeocystin. In the same year Repke, Leslie, and Guzmán [20] identified baeocystin in *P. baeocystis*, *P. cubensis*, *P. cyanescens*, *P. pelliculosa*, *P. semilanceata*, *P. silvatica*, and *P. stuntzii*.

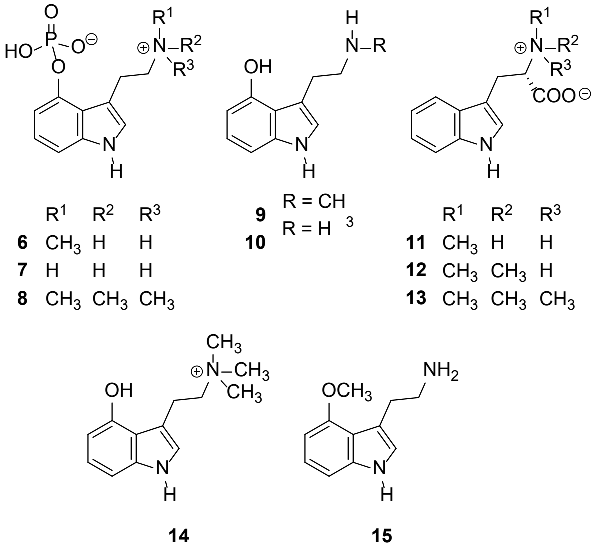
The quaternary salt aeruginascin (**8**) (Fig. 2) has been also recognized as a natural product in *Psilocybe* species [21]. This metabolite is a trimethylated structural variant of psilocybin, its name was stated because it was first identified in *Inocybe aeruginascens*, another hallucinogenic mushroom that also produces psilocybin and baeocystin [22].

Monomethylated and demethylated variants of psilocin, norpsilocin (**9**) and 4-hydroxytryptamine (**10**) (Fig. 2), respectively, were also recognized as natural products of *Psilocybe*. Norpsilocin was found in *P. cubensis* [23], while 4-hydroxytryptamine was evidenced in *P. baeocystis* and *P. cyanescens* [20].

The enzymatic and genetic studies on *P. azurescens*, *P. cubensis*, *P. cyanescens*, *P. mexicana*, and *P. serbica* showed that these species are source of derivatives direct from L-tryptophan, *N*-α-methyl-L-tryptophan or L-abrine (**11**), *N*,*N*-α-dimethyl-L-tryptophan (**12**), and the quaternary salt *N*,*N*,*N*-α-trimethyl-L-tryptophan or hypaphorine (**13**) (Fig. 2) [21,24,25]. Also, Waldbillig et al. [12] evidenced the presence of 4-hydroxy-*N*,*N*,*N*-trimethyltryptamine (**14**) and methoxy-tryptamine (plausible 4-methoxytryptamine, **15**) (Fig. 2) in the mycelium and basidiomes of *P. allenii*, *P. cubensis*, and *P. cyanescens*. It is assumed that compound **14** is the dephosphorylated variant of aeruginascin, while **15** is the *O*-methyl derivative of 4-hydroxytryptamine.

J. Mex. Chem. Soc. **2026**, *70(1):e2551*
Regular Issue

ISSN-e 2594-0317



	R^1	R^2	R^3
6	CH_3	H	H
7	H	H	H
8	CH_3	CH_3	CH_3

9 R = CH_3
10 R = H

	R^1	R^2	R^3
11	CH_3	H	H
12	CH_3	CH_3	H
13	CH_3	CH_3	CH_3

Fig. 2. Structures of alkaloids **6**–**15** present in *Psilocybe* mushrooms.

After 63 years of the chemical studies on *Psilocybe* species, the results shows that the main alkaloids present in them possess a tryptamine structure. However, the presence of alkaloids with β-carboline structure has been observed in *P. cubensis*, *P. cyanescens*, *P. mexicana*, and *P. semilanceata* [26]. Thus, harmane (**16**), harmine (**17**), norharmane (**18**), and perlolyrine (**19**) (Fig. 3) were identified in all four species, while a possible isomer of harmol (**20**) and cordysinin C/D (**21**/**22**) were also considered as metabolites of *P. mexicana* (Fig. 3). It is important to mention that β-carbolines were identified in trace amounts in simultaneous with psilocybin and psilocin. This fact is interesting because β-carbolines possess biological activity as inhibitors of the monoamine oxidase A (MAO-A), an enzyme that inactivates psilocin by transforming it into 4-hydroxyindol-3-yl-acetaldehyde [26].

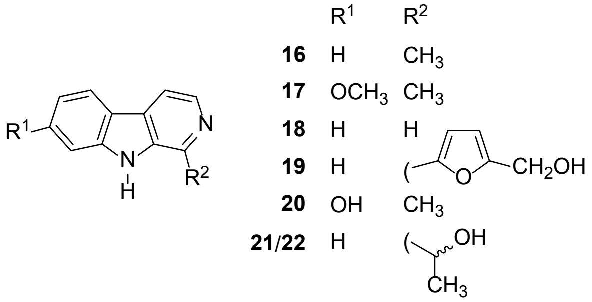
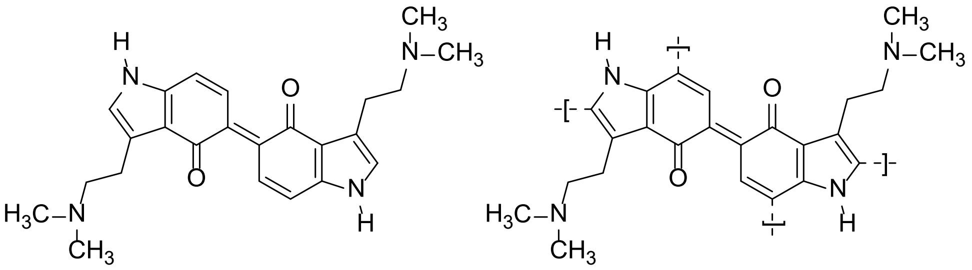


Fig. 3. Structures of β-carbolines **16**–**22** present in *Psilocybe* mushrooms.

An important characteristic of psilocybin-producing mushrooms is that they develop a deep blue color when the basidiome is intentionally damaged. This effect is significant to show that the species produce psilocybin and therefore be considered as a diagnostic feature in *Psilocybe* species [9]. Lenz et al. [8] discovered the compounds responsible for this effect (at least in *P. cubensis*) are quinoid derivatives in the form of dimer (**23**), trimer (**24**), and tetramer (**25**) (Fig. 4), which are generated from psilocybin through a series of dephosphorylation, oligomeric oxidation, and polymerization reactions. This is mediated by the enzymes phosphatase (PsiP) and laccase (PsiL) of *P. cubensis*.

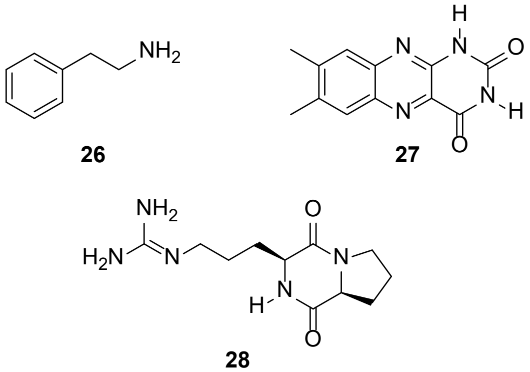


23 **24/25**

Fig. 4. Structures of quinoid derivatives **23**–**25** present in *Psilocybe* mushrooms.

Other alkaloids and amino acids

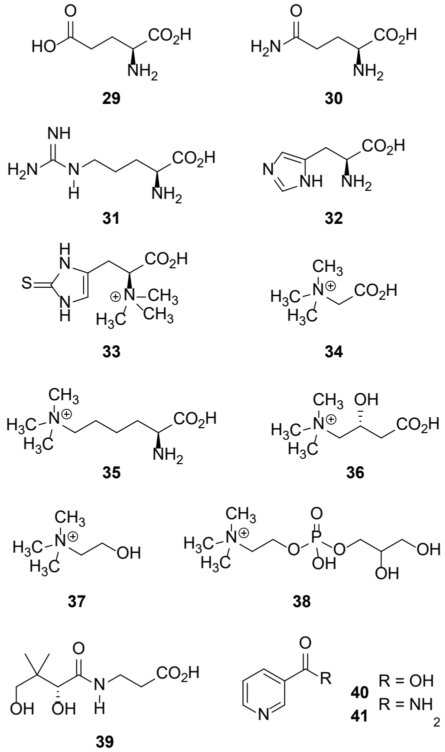
Beck et al. [27] reported the identification of phenylethylamine (**26**) (Fig. 5) in *P. semilanceata*. It was found that the concentration of this amine in the fungus was 146 µg/g dry weight, suggesting that this alkaloid might play a role in the development of adverse reactions on *Psilocybe* mushroom intake. Likewise, *P. azurescens*, *P. cubensis*, *P. cyanescens*, *P. mexicana*, and *P. serbica* were identified as producers of lumichrome (**27**) and verpacamide A (**28**) (Fig. 5) [25]. Lumichrome is an isoalloxazine and follow-up product of riboflavin, while verpacamide is a cyclo (arginine-proline), both were described for the first time in the *Psilocybe* genus.



26 **27** **28**

Fig. 5. Structures of phenylethylamine (**26**), lumichrome (**27**), and verpacamide A (**28**) present in *Psilocybe* mushrooms.

Waldbillig et al. [12] identified several compounds from the methanol extract obtained of mycelia and basidiomes of *P. allenii*, *P. cubensis*, and *P. cyanescens*, using UHPLC-HRMS, such as the amino acids tryptophan (**1**) glutamic acid (**29**), glutamine (**30**), arginine (**31**), histidine (**32**), ergothioneine (**33**), trimethylglycine (betaine, **34**), and trimethyllysine (**35**), as well as phenylethylamine (**26**), carnitine (**36**), choline (**37**), α-glycerylphosphorylcholine (**38**), pantothenic acid (**39**), nicotinic acid (**40**), and nicotinamide (**41**) (Fig. 6).

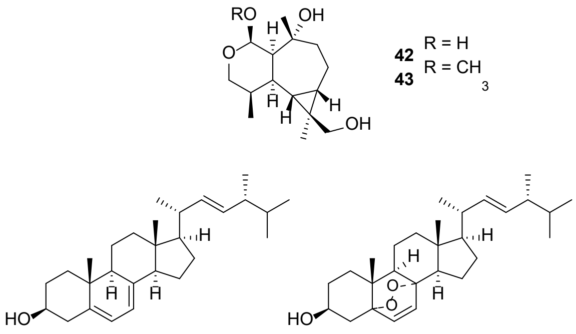


29 30 31 32 33 34 35 36 37 38 39 40 41

Fig. 6. Structures of compounds **29**–**41** present in *Psilocybe* mushrooms.

Terpenoids

The only sesquiterpenes reported in *Psilocybe* are the 2,3-secoaromadendrane-type psilosamuiensin A (**42**) and psilosamuiensin B (**43**) (Fig. 7), which were isolated from the EtOAc extract of cultured mycelia of *P. samuiensis* and characterized by their spectroscopic data and by X-ray diffraction analysis [28]. Moreover, only two sterols with ergostane structure have been reported, ergosterol (**44**) and ergosterol peroxide (**45**), which were isolated from the methanolic extract of the basidiome of *P. argentipes* [29] (Fig. 7). Also, Picker and Rickards [30] identified ergosterol in *P. subaeruginosa*.



42 43 44 45

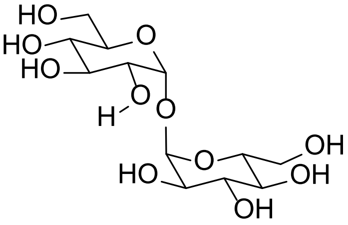
Fig. 7. Structures of psilosamuiensin A (**42**), psilosamuiensin B (**43**), ergosterol (**44**), and ergosterol peroxide (**45**) present in *Psilocybe* mushrooms.

J. Mex. Chem. Soc. **2026**, *70(1):e2551*
Regular Issue

ISSN-e 2594-0317

Saccharides

Carbohydrates reported in *Psilocybe* mushrooms are the symmetrical, non-reducing (α-1,1) glucose disaccharide known as α,α-trehalose (**46**), and *N*-acetylglucosamine-anhydro (conceivable 1,6-anhydro, **47**) (Fig. 8). In the case of this disaccharide, it was isolated from the methanolic extract of the basidiome of *P. argentipes* [29], while *N*-acetylglucosamine-anhydro was identified from the mycelia and basidiomes of *P. allenii*, *P. cubensis*, and *P. cyanescens* [12].


46

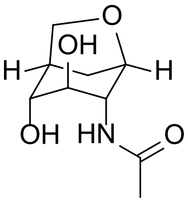
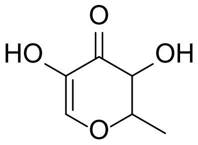
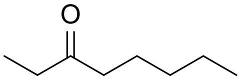

47

Fig. 8. Structure of α,α-trehalose (**46**) and acetylglucosamine-1,6-anhydro (**47**) present in *Psilocybe* mushrooms.

Miscellaneous

Chemical study of *P. natalensis* led to the proposal of 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyranone (**48**), 3-octanone (**49**), and hexadecanoic acid (palmitic acid, **50**) (Fig. 9), in addition to tetradecane, nonadecane, and dibutyl phthalate [31]. However, it is well known that dibutyl phthalate is a toxic plasticizer and a common impurity.


48


49

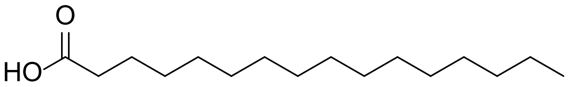

50

Fig. 9. Structures of 2,3-dihydro-3,5-dihydroxy-6-methyl-4H-pyranone (**48**), 3-octanone (**49**), and palmitic acid (**50**) present in *Psilocybe* mushrooms.

Dhanasekaran et al. [32] analyzed the ethyl acetate extract of *P. cubensis* using UV-Visible, FT-IR and GC-MS, which they compared with the NIST database. This led to the identification of (2-aziridinylethyl)amine, 2-methyl-8-quinolinol, 9(10H)-acridinone 1,2-dihydro-3-methoxy-2-oxo, ethylamine 2-(adamantan-1-yl)-1-methyl, propanoic acid 2-[(1-cyclohexylethyl)carbamoyl]-methyl ester, and 1-(4,5-diphenyl-oxazol-2-yl)-ethylamine, together with cyclotrisiloxane hexamethyl. These compounds were first reported in *Psilocybe*, and given their rarity, we believe that further experimental evidence is required for their correct characterization.

Recently, in 2025, Luz et al. [33] made a review to report on the chemical composition and biological activity of *Psilocybe* mushrooms. However, several species currently recognized within this genus that have undergone chemical studies were omitted, such as *P. allenii*, *P. aztecorum*, *P. atlantis*, *P. atrobrunnea*, *P. caerulescens*, *P. candidipes*, *P. cyanofibrillosa*, *P. muliercula*, *P. natalensis*, *P. ovoideocystidiata*, *P. quebecensis*, *P. subaeruginascens*, and *P. subcaerulipes*, or others that do not currently belong to the genus *Psilocybe* were included, such as *P. coprophila*, *P. inquilina*, *P. merdaria*, *P. montana*, and *P. pseudobullacea*, which correspond to *Deconica* species. Additionally, some compounds were mentioned as natural products of these fungi. For example, *ent*-kaur-16-ene-19-oic acid-derived diterpenes have been reported from *P. cubensis*. In fact, this mushroom generated the hydroxylated products because it was fed the compound, and this does not mean that it naturally produces these metabolites.

Table 1. Recognized species of *Psilocybe sensu stricto* that have been chemically studied.

Species	Chemistry performed	Compounds	References
1. *P. allenii* Borov., Rockefeller & P.G. Werner	UHPLC-UV/VIS, UHPLC-HRMS	**1**, **3**, **4**, **6–9**, **14**, **15**, **26**, **29–41**, **46**, **47**	[12]
2. *P. arcana* Borovicka et Hlaváèek	GC-MS	**3**, **4**	[36]
3. *P. atlantis* Guzmán, Hanlin et C. White	HPLC	**3**, **4**	[37]
4. *P. aztecorum* R. Heim emend. Guzmán = *P. bonetii* Guzmán = *P. quebecensis* Ola´h & R. Heim	TLC	**3**, **4**	[38–41]
5. *P. azurescens* Stamets et Gartz	HILIC-HPLC, HPTLC, TLC	**3**, **4**, **6**, **7**, **9**, **27**, **28**	[25,38,42–45]
6. *P. baeocystis* Singer et A.H. Sm. emend. Guzmán	HPLC, TLC, MS, IR, UV	**1**, **3**, **4**, **6**, **7**	[19,38,46–49]
7. *P. bohemica* Šebek	HPLC, MS, TLC, IR	**3**, **4**, **6**	[36,38,50–58]
8. *P. caerulescens* Murrill var. *caerulescens* = *P. caerulescens* var. *ombrophila* (R. Heim) Guzmán = *P. wrightii*	GC-MS, TLC	**3**, **4**, **6**	[38,59–62]
9. *P. caerulipes* (Peck) Sacc.	TLC, UHPLC-MS/MS	**1**, **3**, **4**, **6**, **7**, **8**	[60,63]
10. *P. cubensis* (Earle) Singer = *P. fasciata* Hongo	GC-MS, HPLC, IR, MALDI-MS, LC-MS/MS, NMR, TLC, UHPLC-MS/MS, UV	**1**, **3**, **4**, **6–9**, **11–19**, **23–41**, **46**, **47**	[8,9,12,20,2,23,25,26,38,45,59,60,64,65–80]
11. *P. cyanescens* Wakef.	GC-MS, HPLC, HPLC-FL, HPLC-ESI-MS, MIKES, UHPLC-UV/VIS, MS/MS, TLC, UHPLC-HRMS	**1**, **3**, **4**, **6–9**, **14**, **15**, **26–41**, **44**, **46**, **47**	[12,36,43,46,50,69,70,76,81]
12. *P. cyanofibrillosa* Guzmán et Stamets	TLC	**3**, **4**	[82]

13. *P. fimetaria* (P. D. Orton) Watling	TLC	**3**	[83]
14. "*P. mckennaii*"	LC-MS	**3**, **4**	[13]
15. *P. medullosa* (Bres.) Borov.	GC-MS	**3**, **4**	[35]
16. *P. mexicana* R. Heim	NMR, TLC, UHPLC-MS/MS	**3**, **4**, **6–8**, **16–22**	[14–17, 26,60,84–95]
17. *P. muliercula* Singer & A.H. Sm.	IR, TLC, UV	**3**, **4**	[39]
18. *P. natalensis* D.A. Reid & Eicker	GC-MS, HPTLC,	**3**, **4**, **6**, **7**, **48–50**	[31,42]
19. *P. ovoideocystidiata* Guzmán & Gaines	UHPLC-MS/MS	**3**, **4**, **6–8**	[60]
20. *P. pelliculosa* (A.H. Sm.) Singer & A.H. Sm.	GC-MS, TLC, UV	**3**, **4**, **6**	[19,35,46,96]
21. *P. samuiensis* Guzmán, Band.-Muñoz & J. W. Allen	ESITOFMS, HPLC, NMR, IR, X-ray	**3**, **4**, **6**, **42**, **43**	[28,36,38,97]
22. *P. semilanceata* (Fr.) P. Kumm.	CZE, GC-MS, UHPLC-MS/MS, HPLC, NMR, TLC, UV	**3**, **4**, **6–8**, **16–19**, **26**	[19,20,26,27,50, 51,53,60,72,74, 76,98–116]
23. *P. serbica* M. M. Moser & E. Horak	HPLC, MS, LC-MS, TLC	**3**, **4**, **6–8**, **11–13**, **27**, **28**	[20,24,25]
24. *P. silvatica*	TLC	**3**, **4**, **6**,	[20]
25. *P. strictipes* Singer & A. H. Smith	TLC	**3**	[63]
26. *P. stuntzii* Guzmán & J. Ott	HPTLC, TLC	**3**, **4**, **6**, **7**	[34,42,46]
27. *P. subaeruginascens* Höhn.	TLC, HPLC	**3**	[29]
28. *P. subaeruginosa* Cleland	HPTLC, HPLC	**3**, **4**, **6**, **7**, **44**	[30,42,117–119]
29. *P. subcaerulipes* Hongo = *P. argentipes*	HPLC, IR, LC-MS, LC-MS/MS, RMN	**3**, **4**, **44**, **45**, **46**	[29,38,80,120, 121]
30. *P. subcubensis* Guzmán	IMS, UHPLC-MS/MS	**3**, **4**	[121–123]
31. *P. tampanensis* Guzmán & S.H. Pollock	HPLC	**3**, **4**	[67]
32. *P. zapotecorum* R. Heim emend. Guzmán = *Psilocybe candidipes*	HPTLC, HPLC, TLC	**1**, **3**, **4**, **6–8**, **10**	[40,42,59,62, 124]

Conclusions

The genus *Psilocybe* currently comprises 165 hallucinogenic species. A search of the species that have been studied for their chemical composition revealed that 50 metabolites were identified in only 32 of them. Most metabolites are alkaloids with indole or β-carboline structure (20) and amino acids (9), although terpenoids and saccharides have also been characterized. The presence of psilocybin in all studied species

J. Mex. Chem. Soc. **2026**, *70(1):e2551*
Regular Issue
©2026, Sociedad Química de México
ISSN-e 2594-0317

confirms that they are hallucinogenic mushrooms. In the references analyzed here, some species were screened for psilocybin and psilocin, but its presence was undetected, even though the basidiomes analyzed showed bluing (caused by the enzymatic oxidation of psilocin when fresh). Therefore, caution should be exercised if these alkaloids are not detected, as this is likely due to the age of the basidiomes, rather than a complete absence of these compounds in the species [34] or maybe the biosynthesis of these alkaloids was lost like in *P. fuscofulva* (= *P. atrobrunnea*) [35].

Acknowledgements

A.R.T.-R. are grateful to SECIHTI-Mexico for a scholarship 1145607. L.G.-D. and V.R.-C. thanks the support of the University of Guadalajara. Thanks to SECIHTI for the position to V.R.-C. as Researchers for Mexico.

References

1. Nichols, D. E. *J. Antibiot.* **2020**, *73*, 679–686. DOI: https://dx.doi.org/10.1038/s41429-020-0311-8
2. Moncalvo, J.-M.; Vilgalys, R.; Redhead, S. A.; Johnson, J. E.; James, T. Y.; Catherine Aime, M.; Hofstetter, V.; Verduin, S. J. W.; Larsson, E.; Baroni, T. J.; Greg Thorn, R.; Jacobsson, S.; Clémençon, H.; Miller, O. K. *Mol. Phylogenet. Evol.* **2002**, *23*, 357–400. DOI: https://dx.doi.org/10.1016/S1055-7903(02)00027-1
3. Matheny, P. B.; Curtis, J. M.; Hofstetter, V.; Aime, M. C.; Moncalvo, J.-M.; Ge, Z.-W.; Yang, Z.-L.; Slot, J. C.; Ammirati, J. F.; Baroni, T. J.; Bougher, N. L.; Hughes, K. W.; Lodge, D. J.; Kerrigan, R. W.; Seidl, M. T.; Aanen, D. K.; DeNitis, M.; Daniele, G. M.; Desjardin, D. E.; Kropp, B. R.; Norvell, L. L.; Parker, A.; Vellinga, E. C.; Vilgalys, R.; Hibbett, D. S. *Mycologia.* **2006**, *98*, 982–995. DOI: https://dx.doi.org/10.1080/15572536.2006.11832627
4. Ramírez-Cruz, V.; Guzmán, G.; Villalobos-Arámbula, A. R.; Rodríguez, A.; Matheny, P. B.; Sánchez-García, M.; Guzmán-Dávalos, L. *Am. J. Bot.* **2013**, *91*, 573–591. DOI: https://dx.doi.org/10.1139/cjb-2013-0070.
5. Redhead, S. A.; Moncalvo, J.-M.; Vilgalys, R.; Matheny, P. B.; Guzmán-Dávalos, L.; Guzmán, G. *Taxon.* **2007**, *56*, 255–257.
6. Guzmán, G. *Int. J. Med. Mushrooms.* **2005**, 7, 305–331. DOI: https://dx.doi.org/10.1615/IntJMedMushr.v7.i12.280
7. Kirk, P. M.; Cannon, P. F.; Minter, D. W., Stalpers, J. A., in: *Ainsworth and Bisby's dictionary of the Fungi.* CABI International, **2008**, DOI: https://dx.doi.org/10.1079/9780851998268.0000
8. Lenz, C.; Wick, J.; Braga, D.; García-Altares, M.; Lackner, G.; Hertweck, C.; Gressler, M.; Hoffmeister, D. *Angew. Chem. Int. Ed.* **2020**, *59*, 1450–1454. DOI: https://dx.doi.org/10.1002/anie.201910175
9. Bradshaw, A. J.; Backman, T. A.; Ramírez-Cruz, V.; Forrister, D. L.; Winter, J. M.; Guzmán-Dávalos, L.; Furci, G.; Stamets, P.; Dentinger, B. T. M. *Appl. Environ. Microbiol.* **2022**, *88*. DOI: https://dx.doi.org/10.1128/aem.01498-22
10. Guzmán, G. *Acta Bot. Mex.* **2012**, *100*, 79–106.
11. Kargbo, R. B.; Sherwood, A.; Walker, A.; Cozzi, N. V.; Dagger, R. E.; Sable, J.; O'Hern, K.; Kaylo, K.; Patterson, T.; Tarpley, G.; Meisenheimer, P. *ACS Omega.* **2020**, *5*, 16959–16966. DOI: https://dx.doi.org/10.1021/acsomega.0c02387
12. Waldbillig, A.; Baranova, M.; Neumann, S.; Andrade, J.; Sidhu, S. *Front. Fungal Biol.* **2023**, *4*. DOI: https://dx.doi.org/10.3389/ffunb.2023.1295223

13. Otvos, R. A.; Mladic, M.; Arias-Alpizar, G.; Niessen, W. M. A.; Somsen, G. W.; Smit, A. B.; Kool, J. *SLAS Discovery.* **2016**, *21*, 459–467. DOI: https://dx.doi.org/10.1177/1087057115625307
14. Hofmann, A.; Heim, R.; Brack, A.; Kobel, H. *Experientia.* **1958**, *14*, 107–109. DOI: https://dx.doi.org/10.1007/BF02159243
15. Hofmann, A.; Heim, R.; Brack, A.; Kobel, H.; Frey, A.; Ott, H.; Petrzilka, Th.; Troxler, F. *Helv. Chim. Acta.* **1959**, *42*, 1557–1572. DOI: https://dx.doi.org/10.1002/hlca.19590420518
16. Hofmann, A.; Troxler, F. *Experientia.* **1959**, *15*, 101–102. DOI: https://dx.doi.org/10.1007/BF02166696.
17. Hofmann, A. *Chimia* **1960**, *14*, 309–318
18. Leung, A. Y.; Paul, A. G. *J. Pharm. Sci.* **1968**, *57*, 1667–1671. DOI: https://dx.doi.org/10.1002/jps.2600571007
19. Repke, D. B.; Leslie, D. T. *J. Pharm. Sci.* **1977**, *66*, 113–114. DOI: https://dx.doi.org/10.1002/jps.2600660130
20. Repke, D. B.; Leslie, D. T.; Guzmán, G. *Lloydia* **1977**, *40*, 566–578.
21. Fricke, J.; Blei, F.; Hoffmeister, D. *Angew. Chem. Int. Ed.* **2017**, *56*, 12352–12355. DOI: https://dx.doi.org/10.1002/anie.201705489
22. Jensen, N.; Gartz, J.; Laatsch, H. *Planta Med.* **2006**, *72*, 665–666. DOI: https://dx.doi.org/10.1055/s-2006-931576
23. Lenz, C.; Wick, J.; Hoffmeister, D. *J. Nat. Prod.* **2017**, *80*, 2835–2838. DOI: https://dx.doi.org/10.1021/acs.jnatprod.7b00407
24. Blei, F.; Fricke, J.; Wick, J.; Slot, J. C.; Hoffmeister, D. *ChemBioChem.* **2018**, *19*, 2160–2166. DOI: https://dx.doi.org/10.1002/cbic.201800336
25. Dörner, S.; Rogge, K.; Fricke, J.; Schäfer, T.; Wurlitzer, J. M.; Gressler, M.; Pham, D. N. K.; Manke, D. R.; Chadeayne, A. R.; Hoffmeister, D. *ChemBioChem.* **2022**, *23*. DOI: https://dx.doi.org/10.1002/cbic.202200249
26. Blei, F.; Dörner, S.; Fricke, J.; Baldeweg, F.; Trottmann, F.; Komor, A.; Meyer, F.; Hertweck, C.; Hoffmeister, D. *Chem. Eur. J.* **2020**, *26*, 729–734. DOI: https://dx.doi.org/10.1002/chem.201904363
27. Beck, O.; Helander, A.; Karlson-Stiber, C.; Stephansson, N. *J. Anal. Toxicol.* **1998**, *22*, 45–49. DOI: https://dx.doi.org/10.1093/jat/22.1.45
28. Pornpakakul, S.; Suwancharoen, S.; Petsom, A.; Roengsumran, S.; Muangsin, N.; Chaichit, N.; Piapukiew, J.; Sihanonth, P.; Allen, J. W. *J. Asian Nat. Prod. Res.* **2009**, *11*, 12–17. DOI: https://dx.doi.org/10.1080/10286020802435794
29. Koike, Y.; Wada, K.; Kusano, G.; Nozoe, S.; Yokoyama, K. *J. Nat. Prod.* **1981**, *44*, 362–365. DOI: https://dx.doi.org/10.1021/np50015a023
30. Picker, J.; Rickards, R. *Aust. J. Chem.* **1970**, *23*, 853. DOI: https://dx.doi.org/10.1071/CH9700853
31. Nkadimeng, S. M.; Nabatanzi, A.; Steinmann, C. M. L.; Eloff, J. N. *Plants.* **2020**, *9*, 1127. DOI: https://dx.doi.org/10.3390/plants9091127
32. Dhanasekaran, D.; Latha, S.; Suganya, P.; Panneerselvam, A.; Senthil Kumar, T.; Alharbi, N. S.; Arunachalam, C.; Alharbi, S. A.; Thajuddin, N. *Microb. Pathog.* **2020**, *143*, 104138. DOI: https://dx.doi.org/10.1016/j.micpath.2020.104138
33. Luz, M. A.; Guedes, H. V. S.; Bisneto, A. B. M.; Jesus, R. A. de; Galdino, T. P.; Oliveira, L. C.; Afonso, V. I.; Fook, M. V. L.; Lima, A. G. B.; Silva, S. M. de L.; Torres, M. C. M. *Pharmaceuticals.* **2025**, *18*, 989. DOI: https://dx.doi.org/10.3390/ph18070989
34. Guzmán, G.; Ott, J. *Mycologia.* **1976**, *68*, 1261–1267. DOI: https://dx.doi.org/10.1080/00275514.1976.12020019
35. Borovička, J.; Oborník, M.; Stříbrný, J.; Noordeloos, M. E.; Sánchez, L. A. P.; Gryndler, M. *Pers.: Mol. Phylogeny Evol. Fungi.* **2015**, *34*, 1–9. DOI: https://dx.doi.org/10.3767/003158515X685283
36. Stríbrný, J.; Borovicka, J.; Sokol, M. *Soud Lek.* **2003**, 48, 45–49.
37. https://patents.google.com/patent/NL2018190B1/en?q=(Psilocybe+atlantis)&oq=Psilocybe+atlantis, accessed in February 2026.

38. Wurst, M.; Kysilka, R.; Flieger, M. *Folia Microbiol. (Praha).* **2002**, *47*, 3–27. DOI: https://dx.doi.org/10.1007/BF02818560
39. Heim, R.; Wasson, G., in: *Les champignons hallucinogènes du Mexique; études ethnologiques, taxinomiques, biologiques, physiologiques et chimiques*, Muséum national d'histoire naturelle: París, **1958**.
40. Ott, J.; Guzmán, G. *Lloydia.* **1976**, *39*, 258–260.
41. Ola'h, G. M.; Heim, R. *C. R. Acad. Sci. D* **1967**, *264*, 1601–1604.
42. Windsor, C.; Kreynes, A. E.; Chilton, J. S.; Chioffi, W. A.; Niebergall, C.; *J. AOAC Int.* **2025**. DOI: https://dx.doi.org/10.1093/jaoacint/qsaf007
43. https://patents.google.com/patent/WO2023225186A1/en?oq=WO2023225186A1, accessed in February 2026.
44. https://patents.google.com/patent/US20230398166A1/en?oq=US20230398166+A1, accessed in February 2026.
45. Tylš, F.; Páleníček, T.; Horáček, J. *European Neuropsychopharmacology.* **2014**, *24*, 342–356. DOI: https://dx.doi.org/10.1016/j.euroneuro.2013.12.006
46. Beug, M. W.; Bigwood, J. *J. Ethnopharmacol.* **1982**, *5*, 271–285. DOI: https://dx.doi.org/10.1016/0378-8741(82)90013-7
47. Leung, A. Y.; Paul, A. G. *J. Pharm. Sci.* **1967**, *56*, 146. DOI: https://dx.doi.org/10.1002/jps.2600560132
48. Benedict, R. G.; Brady, L. R.; Smith, A. H.; Tyler, V. E. Jr. *Lloydia.* **1962**, *25*, 156–159.
49. Benedict, R. G.; Brady, L. R.; Tyler, V. E. *J. Pharm. Sci.* **1962**, *51*, 393–394. DOI: https://dx.doi.org/10.1002/jps.2600510428
50. Wurst, M.; Kysilka, R.; Koza, T. *J Chromatogr A.* **1992**, *593*, 201–208. DOI: https://dx.doi.org/10.1016/0021-9673(92)80287-5
51. Wurst, M.; Semerdžieva, M.; Vokoun, J. *J Chromatogr A.* **1984**, *286*, 229–235. DOI: https://dx.doi.org/10.1016/S0021-9673(01)99190-3
52. Gartz, J.; Moller, G. K. *Biochem. Physiol. Pflanz.* **1989**, *184*, 337–341. DOI: https://dx.doi.org/10.1016/S0015-3796(89)80023-X
53. Semerdžieva, M.; Wurst, M.; Koza, T.; Gartz, J. *Planta Med.* **1986**, *52*, 83–85. DOI: https://dx.doi.org/10.1055/s-2007-969085
54. Kysilka, R. *Chem. Listy.* **1990**, *84*, 988–992.
55. Kysilka, R.; Wurst, M.; Pacáková, V.; Štulík, K.; Haškovec, L. *J. Chromatogr. A.* **1985,** *320*, 414–420. DOI: https://dx.doi.org/10.1016/S0021-9673(01)90521-7
56. Kysilka, R.; Wurst, M. *J. Chromatogr. A.* **1989**, *464*, 434–437. DOI: https://dx.doi.org/10.1016/S0021-9673(00)94264-X
57. Kysilka, R.; Wurst, M. *Planta Med.* **1990**, *56*, 327–328. DOI: https://dx.doi.org/10.1055/s-2006-960970.
58. Gartz, J.; Wiedemann, G. *Drug Test. Anal.* **2015**, *7*, 853–857. DOI: https://dx.doi.org/10.1002/dta.1795.
59. Heim, R.; Hofmann, A. *Rev. Mycol.* **1958**, *23*, 347–351.
60. Gotvaldová, K.; Borovička, J.; Hájková, K.; Cihlářová, P.; Rockefeller, A.; Kuchař, M. *Int. J. Mol. Sci.* **2022**, *23*, 14068. DOI: https://dx.doi.org/10.3390/ijms232214068
61. Rossato, L. G.; Cortez, V. G.; Limberger, R. P.; Guzmán, G. *Mycotaxon.* **2009**, *108*, 223–229. DOI: https://dx.doi.org/10.5248/108.223
62. Heim, R. *Actual. Pharmacol.* **1959**, *12*, 171–192.
63. Leung, A. Y.; Smith, A. H.; Paul, A. G. *J. Pharm. Sci.* **1965**, *54*, 1576–1579. DOI: https://dx.doi.org/10.1002/jps.2600541104
64. Bigwood, J.; Beug, M. W. *J Ethnopharmacol.* **1982**, *5*, 287–291. DOI: https://dx.doi.org/10.1016/0378-8741(82)90014-9

65. Goff, R.; Smith, M.; Islam, S.; Sisley, S.; Ferguson, J.; Kuzdzal, S.; Badal, S.; Kumar, A. B.; Sreenivasan, U.; Schug, K. A. *Anal. Chim. Acta* **2024**, *1288*, 342161. DOI: https://dx.doi.org/10.1016/j.aca.2023.342161
66. Polo-Castellano, C.; Álvarez, J. Á.; Palma, M.; Barbero, G. F.; Ayuso, J.; Ferreiro-González, M. *J. Fungi.* **2022**, *8*, 598. DOI: https://dx.doi.org/10.3390/jof8060598
67. Laussmann, T.; Meier-Giebing, S. *Forensic. Sci. Int.* **2010**, *195*, 160–164. DOI: https://dx.doi.org/10.1016/j.forsciint.2009.12.013
68. Rafati, H.; Riahi, H.; Mohammadi, A. *Int. J. Med. Mushrooms.* **2009**, *11*, 419–426. DOI: https://dx.doi.org/10.1615/IntJMedMushr.v11.i4.80
69. Saito, K.; Toyo'oka, T.; Fukushima, T.; Kato, M.; Shirota, O.; Goda, Y. *Anal. Chim. Acta* **2004**, *527*, 149–156. DOI: https://dx.doi.org/10.1016/j.aca.2004.08.071
70. Saito, K.; Toyo'oka, T.; Kato, M.; Fukushima, T.; Shirota, O.; Goda, Y. *Talanta.* **2005**, *66*, 562–568. DOI: https://dx.doi.org/10.1016/j.talanta.2004.11.031
71. Tsujikawa, K.; Kanamori, T.; Iwata, Y.; Ohmae, Y.; Sugita, R.; Inoue, H.; Kishi, T. *Forensic. Sci. Int.* **2003**, *138*, 85–90. DOI: https://dx.doi.org/10.1016/j.forsciint.2003.08.009
72. Musshoff, F.; Madea, B.; Beike, J. *Forensic. Sci. Int.* **2000**, *113*, 389–395. DOI: https://dx.doi.org/10.1016/S0379-0738(00)00211-5
73. Gartz, J. *Planta Med.* **1989**, *55*, 249–250. DOI: https://dx.doi.org/10.1055/s-2006-961995
74. Borner, S.; Brenneisen, R. *J. Chromatogr. A.* **1987**, *408*, 402–408. DOI: https://dx.doi.org/10.1016/S0021-9673(01)81831-8
75. Casale, J. F. *J. Forensic. Sci.* **1985**, *30*, 247–250.
76. Margot, P.; Watling, R. *Trans. Br. Mycol. Soc.* **1981**, *76*, 485–489. DOI: https://dx.doi.org/10.1016/S0007-1536(81)80077-0
77. Repke, D. B.; Leslie, D. T.; Mandell, D. M.; Kish, N. G. *J. Pharm. Sci.* **1977**, *66*, 743–744. DOI: https://dx.doi.org/10.1002/jps.2600660539
78. Catalfomo, P.; Tyler, V. E. Jr. *Lloydia.* **1964**, *27*, 53–63.
79. Neal, J. M.; Benedict, R. G.; Brady, L. R. *J. Pharm. Sci.* **1968**, *57*, 1661–1667. DOI: https://dx.doi.org/10.1002/jps.2600571006
80. Maruyama, T.; Kawahara, N.; Yokoyama, K.; Makino, Y.; Fukiharu, T.; Goda, Y. *Forensic Sic. Int.* **2006**, *163*, 51–58. DOI: https://doi.org/10.1016/j.forsciint.2004.10.028
81. Unger, S. E.; Cooks, R. G. *Anal. Lett.* **1979**, *12*, 1157–1167. DOI: https://dx.doi.org/10.1080/00032717908067906
82. Stamets, P. E.; Beug, M. W.; Bigwood, J. E.; Guzmán, G. *Mycotaxon.* **1980**, *11*, 476–484. DOI: https://dx.doi.org/10.5962/p.417274
83. Benedict, R. G.; Tyler, V. E. J.; Watling, R. *Lloydia.* **1967**, *30*, 150–157.
84. Stamm, C. *Schweiz. Lab.-Z.* **1992**, *49*, 383–390.
85. Stamm, C. *Schweiz. Lab.-Z.* **1993**, *50*, 72–74.
86. Stamm, C. *Schweiz. Lab.-Z.* **1993**, *50*, 53–54.
87. Stahl, E.; Brombeer, J.; Eskes, D. *Arch. Kriminol.* **1978**, *162*, 23–33. PMID: 567963.
88. Weber, H. P.; Petcher, T. J. *J. Chem. Soc.* **1974**, 1974, 942–946. DOI: https://dx.doi.org/10.1039/P29740000942
89. Petcher, T. J.; Weber, H. P. *J. Chem. Soc.* **1974**, 1974, 946–948. DOI: https://dx.doi.org/10.1039/P29740000946
90. Cerletti, A. *Dtsch. Med. Wochenschr.* **1959**, *84*, 2317-2321. DOI: https://dx.doi.org/10.1055/s-0028-1114618
91. Hofmann, A. *Acta Physiol. Pharmacol. Neerl.* **1959**, *8*, 240–258.
92. Heim, R.; Brack, A.; Kobel, H.; Hofmann, A.; Cailleux, R. *C. R. Hebd Seances Acad. Sci.* **1958**, *246*, 1346–1351.
93. Weidmann, H.; Taeschler, M.; Konzett, H. *Experientia.* **1958**, *14*, 378–379. DOI: https://dx.doi.org/10.1007/BF02159166

94. Hofmann, A.; Frey, A.; Ott, H.; Petrzilka, Th.; Troxler, F. *Experientia.* **1958**, *14*, 397–399. DOI: https://dx.doi.org/10.1007/BF02160424
95. Tyler, V. E. *Science.* **1958,** *128*, 718–718. DOI: https://dx.doi.org/10.1126/science.128.3326.718.a
96. Tyler, V. E. Jr. *Lloydia.* **1961**, *24*, 71–74.
97. Gartz, J.; Allen, J. W.; Merlin, M. D. *J. Ethnopharmacol.* **1994**, *43*, 73–80. DOI: https://dx.doi.org/10.1016/0378-8741(94)90006-X
98. Gartz, J. *Pharmazie.* **1985**, *40*, 134.
99. Babakhanian, R. V; Bushuev, E. S.; Zenkevich, I. G.; Kazankov, S. P.; Kostyrko, T. A.; Kuz'minykh, K. S. *Sud. Med. Ekspert.* **1998**, *41*, 24–26.
100. Pedersen-Bjergaard, S.; Rasmussen, K. E.; Sannes, E. *Electrophoresis.* **1998**, *19*, 27–30. DOI: https://dx.doi.org/10.1002/elps.1150190107
101. Pedersen-Bjergaard, S.; Sannes, E.; Rasmussen, K. E.; Tønnesen, F. *J. Chromatogr. B Biomed. Sci. Appl.* **1997**, *694*, 375–381. DOI: https://dx.doi.org/10.1016/S0378-4347(97)00127-8
102. Brenneisen, R.; Borner, S. *Z. Naturforsch. C.* **1988**, *43*, 511–514. DOI: https://dx.doi.org/10.1515/znc-1988-7-806
103. Ohenoja, E.; Jokiranta, J.; Mäkinen, T.; Kaikkonen, A.; Airaksinen, M. M. *J. Nat. Prod.* **1987**, *50*, 741–744. DOI: https://dx.doi.org/10.1021/np50052a030.
104. Gartz, J. *Biochem. Physiol. Pflanz.* **1986**, *181*, 117–124. DOI: https://dx.doi.org/10.1016/S0015-3796(86)80079-8
105. Gartz, J. *Pharmazie.* **1985**, *40*, 274–275.
106. Stijve, T.; Kuyper, Th. *Planta Med.* **1985**, *51*, 385–387. DOI: https://dx.doi.org/10.1055/s-2007-969526
107. Vanhaelen-Fastré, R.; Vanhaelen, M. *J. Chromatogr. A.* **1984**, *312*, 467–472. DOI: https://dx.doi.org/10.1016/S0021-9673(01)92800-6
108. Jokiranta, J.; Mustola, S.; Ohenoja, E.; Airaksinen, M. *Planta Med.* **1984**, *50*, 277–278. DOI: https://dx.doi.org/10.1055/s-2007-969703
109. Christiansen, A. L.; Rasmussen, K. E.; Tønnesen, F. *J. Chromatogr. A.* **1981**, *210*, 163–167. DOI: https://dx.doi.org/10.1016/S0021-9673(00)91195-6
110. Christiansen, A.; Rasmussen, K.; Høiland, K. *Planta Med.* **1981**, *42*, 229–235. DOI: https://dx.doi.org/10.1055/s-2007-971632
111. Christiansen, A. L.; Rasmussen, K. E. *J. Chromatogr. A.* **1982**, *244*, 357–364. DOI: https://dx.doi.org/10.1016/S0021-9673(00)85700-3
112. Christiansen, A. L.; Rasmussen, K. E. *J. Chromatogr. A.* **1983**, *270*, 293–299. DOI: https://dx.doi.org/10.1016/S0021-9673(01)96375-7
113. White, P. C. *J. Chromatogr. A.* **1979**, *169*, 453–456. DOI: https://dx.doi.org/10.1016/0021-9673(75)85080-1
114. Mantle, P. G.; Waight, E. S. *Trans. Br. Mycol. Soc.* **1969**, *53*, 302–304. DOI: https://dx.doi.org/10.1016/S0007-1536(69)80066-5
115. Hofmann, A.; Heim, R.; Tscherter, H. *Compt. Rend.* **1963**, *257*, 10–12.
116. Hofmann, A.; Heim, R.; Tscherter, H. *Chem. Zentralbl.* **1964**, *135*, 150
117. Anastos, N.; Barnett, N.; Lewis, S.; Gathergood, N.; Scammells, P.; Sims, D. *Talanta-* **2005**, *67*, 354–359. DOI: https://dx.doi.org/10.1016/j.talanta.2004.11.038
118. Anastos, N.; Lewis, S. W.; Barnett, N. W.; Sims, D. N. *J. Forensic Sci.* **2006**, *51*, 45–51. DOI: https://dx.doi.org/10.1111/j.1556-4029.2005.00033.x
119. Perkal, M.; Blackman, G. L.; Ottrey, A. L.; Turner, L. K. *J. Chromatogr. A-* **1980**, *196*, 180–184. DOI: https://dx.doi.org/10.1016/S0021-9673(00)80375-1
120. Gonmori, K. *Jpn. J. Forensic Toxicol.* **1997**, *15*, 3–15.
121. Kamata, T.; Nishikawa, M.; Katagi, M.; Tsuchihashi, H. *J. Forensic Sci.* **2005**, *50*, 336–340.
122. Keller, T.; Schneider, A.; Regenscheit, P.; Richard Dirnhofer; Rücker, T.; Jaspers, J.; Kisser, W. *Forensic Sci. Int.* **1999**, *99*, 93–105. DOI: https://dx.doi.org/10.1016/S0379-0738(98)00168-6

123. Keller, T.; Schneider, A.; Tutsch-Bauer, E.; Skopp, G.; Aderjan, R., in: *Ion Mobility Spectrometry for the Detection of Drugs in Confiscates and on Body Surfaces. In Nachweis Berauschender Mittel im Strassenverkehr -- Forensische Aspekte der Toxischen Praeparation von Lebensmitteln, Beitraegezum Symposium der Gesellschaft fuer Toxikologische und Forensische Chemie*; Pragst, F., Aderjan, R., Eds.; Mosbach, Germany, **1999**;129–145.

124. Miller, D. R.; Jacobs, J. T.; Rockefeller, A.; Singer, H.; Bollinger, I. M.; Conway, J.; Slot, J. C.; Cliffel, D. E. *bioRxiv.* **2023**. DOI: https://dx.doi.org/10.1101/2023.11.01.564784