ADVANCES IN MACROFUNGI

Diversity, Ecology and Biotechnology

Editors

Kandikere R. Sridhar

Sunil K. Deshmukh

ADVANCES IN MACROFUNGI

Diversity, Ecology and Biotechnology

Editors

Kandikere R. Sridhar
Senior Professor, Department of Biosciences
Mangalore University
Mangalore, India

Sunil K. Deshmukh
Nano-Biotechnology Research Centre
The Energy and Resources Institute (TERI)
New Delhi, India

CRC Press
Taylor & Francis Group
Boca Raton London New York

CRC Press is an imprint of the
Taylor & Francis Group, an **informa** business
A SCIENCE PUBLISHERS BOOK

CRC Press
Taylor & Francis Group
6000 Broken Sound Parkway NW, Suite 300
Boca Raton, FL 33487-2742

Printed on acid-free paper
Version Date: 20181018

International Standard Book Number-13: 978-1-138-58727-4 (Hardback)

Library of Congress Cataloging-in-Publication Data

Names: Sridhar, K. R., editor.
Title: Advances in macrofungi : diversity, ecology and biotechnology / editors, Kandikere R. Sridhar, Senior Professor, Department of Biosciences, Mangalore University, Mangalore, India, Sunil K. Deshmukh, Area Convenor, Nano-Biotechnology Research Centre, The Energy and Resources Institute (TERI), New Delhi, India.
Description: Boca Raton : CRC Press, [2018] | "A science publishers book." | Includes bibliographical references and index.
Identifiers: LCCN 2018049237 | ISBN 9781138587274 (hardback)
Subjects: LCSH: Macrofungi.
Classification: LCC QK603 .A37 2018 | DDC 579.6--dc23
LC record available at https://lccn.loc.gov/2018049237

Visit the Taylor & Francis Web site at
http://www.taylorandfrancis.com

and the CRC Press Web site at
http://www.crcpress.com

8

Some Edible, Toxic and Medicinal Mushrooms from Temperate Forests in the North of Mexico

Fortunato Garza Ocañas,[1,*] *Miroslava Quiñónez Martínez,*[2] *Lourdes Garza Ocañas,*[3] *Artemio Carrillo Parra,*[4] *Horacio Villalón Mendoza,*[1] *Humberto Gonzalez Rodríguez,*[1] *Ricardo Valenzuela Garza,*[5] *Gonzalo Guevara Guerrero,*[6] *Jesús García Jiménez*[6] **and** *Mario García Aranda*[7]

INTRODUCTION

Mexico is considered as a biologically mega diverse country. It is located between the Neartic and Neotropical biogeographic regions and, as a consequence, has a high diversity of topographic and climatic conditions (Challenger, 1998; González et al., 2015; Salinas et al., 2017; Mororne et al., 2017). Mexico has a high diversity of ecosystems which are ecologically complex and heterogeneous. Semiarid vegetation

[1] Facultad de Ciencias Forestales, Carretera Nacional km 145, Linares, N.L. Mexico, A.P. 41, C.P. 67700, México.
[2] Universidad Autónoma de Ciudad Juárez, Instituto de Ciencias Biomédicas, Avenida Plutarco Elías Calles 1210, Fovissste Chamizal Ciudad Juárez, Chihuahua, México C.P. 32310, México.
[3] Facultad de Medicina, Departamento de Farmacología y Toxicología, Universidad Autónoma de Nuevo León, México.
[4] Instituto de Silvicultura e Industria de la Madera, Universidad Juárez del Estado de Durango, México.
[5] Escuela Nacional de Ciencias Biológicas Carpio y Plan de Ayala, Santo Tomás Instituto Politécnico Nacional México, D.F., México.
[6] Emilio Portés Gil, 1301 Poniente, Apartado Postal 175, Ciudad Victoria, Tamaulipas, México, 87010, México.
[7] Mario García Aranda Mar Caspio, 8212, Loma Linda, Monterrey, N.L. C.P. 64120, México.
* Corresponding author: fortunatofgo@gmail.com

and grassland are found in the high plateau in the North and temperate forests are mainly located in the Sierra Madre Occidental in the west and Sierra Madre Oriental in the east and tropical rain forests in the south (González et al., 2012). Different vegetation types including grassland and oak chapparral sometimes merge with forests in some areas forming very important and highly diverse fungal communities. Mushrooms are widely distributed in the world and in Mexico and they are intimately linked to forest ecosystems functioning as they grow and live, degrading organic matter through different enzymatic activities, functioning either as saprotrophic, parasitic, pathogenic or mycorrhizal symbionts (Schmidt and Müller, 2007). The relationship between plants and fungi has a very long history, stretching back to the Devonian period, and big fossil sporocarps of some species like *Prototaxites* sp. or *Gondwanagaricites magnificus* from lower Cretaceous crato formations are the evidence of such long-lasting coexistence (Retallack and Landing, 2014; Heads et al., 2017). Thus, forests around the world evolved over time and important groups of plants formed intimate relationships with fungi as a strategy to survive. Nowadays, they are widely dispersed through the world and some have migrated from the Arctic southwards into Tropical regions (e.g., *Pinus* spp.) in America. Conifers and Oaks are widely distributed in North America, Mexico and Central America, and mushroom species are intimately related to these species (Halling and Müller, 2002; Müller et al., 2006; Binion et al., 2008). Mycorrhizal fungi played an important role in migration of this group of plants as they help with nutrient uptake from different soils including poor soils. sapotrophic, parasitic and pathogenic fungal species also established nutrition relationships with Oaks and Conifer trees and contribute significantly to the cycle of nutrients in forests (Hybbett, 2006). In America, fungi have interesting relationships with Oak and Conifer forests and contribute to their development and growth (Singer et al., 1983; North, 2002; Allen, 2005). Current distribution of some plants is the result of their simbiotic associations. Spore dispersion mechanisms contribute significantly to the survival of fungi and mycophagia, i.e., consumption of mushrooms by animals is a very important ecological mechanism wherein animals such as slugs, mites, insects, as well as vertebrates are involved (turkeys, squirrels, mice and rats, rabbits, turtles, peccaries, deers and cervids in general as well as foxes, bears and wolves) (Frank et al., 2007; Binion et al., 2008). Air and rain water are also important spore dispersion factors and millions of spores are carried away through the forests every year. Spore germination processes *in vitro* occur with different degrees of difficulty and parasites, pathogens and sapotrophic fungal species have evolved to germinate their spores more easily in comparison to some mycorrhizal species. Thus, water and some enzymes in the animal digestive system promote germination and these mechanisms have evolved over millions of years. Some squirrels and mice search for mushrooms during the rainy season and eat the fertile hymenophore of epigeous and hypogeous mushrooms, thereby dispersing spores in their excreta (Kendrick, 1994). These spores are ready to germinate and grow, producing new mycelium of the species involved. They will start searching for food in the vicinity; some will find it in fallen leaves, others in tree branches and trunks and some others in living roots depending on their growth habit. All together mushrooms are an important part of the forests and they are alive using different survival strategies during the dry season. Mexico is known for the great diversity of organisms living in the different climatic

and edaphic conditions occurring throughout its territory (Sarukhán et al., 2015). Mushrooms are abundant and it is believed that there are ca. 8000 fungi species studied so far out of the 200,000 probable species occurring in the different vegetation types of the country (Guzmán, 1998; Hawksworth, 2001). The North of Mexico has an influence of Artic and Neotropical biogeographic regions and temperate forests have a high diversity of hosts for fungi such as Pines, Fir, Douglas fir, and Oaks and a high variety of edible, toxic, and medicinal fungal species are associated (Peinado et al., 1994; Müller et al., 2006). In the states of Chihuahua and Durango, toxic mushroom species have caused casualties, mostly due to missidentification of edible species like *Amanita caesarea* group confused with old specimens of toxic species, e.g., *A. muscaria* var. *flavovolvata* (Garza et al., 1985; Quiñónez and Garza, 2015). In these states ethnic groups and people in general may eat wild edible mushrooms and there are no records of people eating wild edible mushrooms from the states of Coahuila, Nuevo Leon and Tamaulipas. Some of the edible wild species frequently used as food when in season include *Amanita jacksonii, A. cochiseana, A. rubescens* (this one is edible only after cooking), *Agaricus campestris, A. bitorquis, Hypomyces lactifluorum, Lactarius deliciosus, L. indigo, Russula delica, Cantharellus cibarius, Boletus pinophilus, B. rubriceps, B. barrowsii, Harrya chromapes and Aureoboletus russellii*. Also, some medicinal mushrooms occur in temperate forests in the north of Mexico, such as *Coriolus versicolor*, *Ganoderma* spp., *Pycnoporus sanguineus* and others.

This paper aims to provide information regarding mushroom diversity, as well as identifying those species reported as edible, toxic or medicinal. This, together with a list of some of the main Conifers, Fagaceae and Ericaceae tree hosts from temperate forests in the North of Mexico. It is also intended to generate relevant information regarding the potential that many mushroom species have for research as well as for social and economic development for people in rural forestry conditions in the North of Mexico.

Materials and Methods

Field collection of mushrooms was carried out during the months of February and March in the state of Baja California; July and August for the states of Chihuahua, Sonora and Durango; and from September-October in the states of Coahuila, Nuevo Leon and Tamaulipas. These states are located in the North of Mexico in the Neartic and Neotropical regions and they include the biogeographic provinces known as California, Sonora, Sierra Madre Occidental, Sierra Madre Oriental and Tamaulipas (Morrone et al., 2017). Collection of mushrooms was carried out in very many localities in the last 25 years at several altitudes ranging from 360–3650 m. The main vegetation types studied were temperate Forests with Conifers, i.e., *Picea, Pseudotsuga, Abies,* and *Pinus*; Oaks, i.e., *Quercus* spp., as well as *Arbutus* spp. and *Arctostaphyllos* spp. Trees from these genera host many mycorrhizal fungi species both in the Basidiomycetes and Ascomycetes. Mushrooms were collected following traditional methods recording macroscopic characteristics, photographs were taken in the field and specimens were transported to the laboratory, specimens were dehydrated and microscopic characteristics recorded for identification using

specilized keys for the different groups (Leonard, 2010). Some edible and toxic species of fungi associated to temperate forests in the North of Mexico have been reported (Quiñónez and Garza, 2015; García et al., 2014; Guevara et al., 2014). For toxic species, the identification criteria used was based on several authors (Lyncoff and Mitchell, 1977; Groves, 1979; Hallen and Adams, 2002; Hall et al., 2003; Lindequist et al., 2005; Duffy, 2008). An artificial classification of species depending on the degree of danger for health was made as follows:

1) Species which can be fatal
2) Species causing serious intoxications requiring hospital attention but are not fatal
3) Species causing light poisoning not requiring hospital attention and are not life threatening.

Fig. 1. Biogeographic provinces of Mexico (Morrone et al., 2017) (http://mexicanmap.atlasbiogeografico.com/MexicanBiogeographicProvinces.tif).

Results

In this study, 282 species were identified from the states of Baja California Norte, Chihuahua, Sonora, Coahuila, Nuevo Leon and Tamaulipas (Tables 1–3; Figs. 5–12). A total of 272 species belong to the Phyllum Basidiomycota and 10 to the Phyllum Ascomycetes, 54 families and 120 genera were studied (Table 1). They are associated with temperate forests and 147 tree hosts are widely distributed in these states. Most edible and toxic species occur in the Sierra Madre Occidental and are closely related to species found in the south states of North America. Species from the Sierra Madre Oriental are more diverse and there are edible species in the forests but are not very abundant, many toxic species are abundant in this Sierra. Oak forests and mixed oak-pine forests have a higher diversity of fungal species throughout the North, followed by pine-oak forests.

Results of diversity and distribution of fungal species show that in the state of Nuevo León more collections have been made with 225 species, followed by the

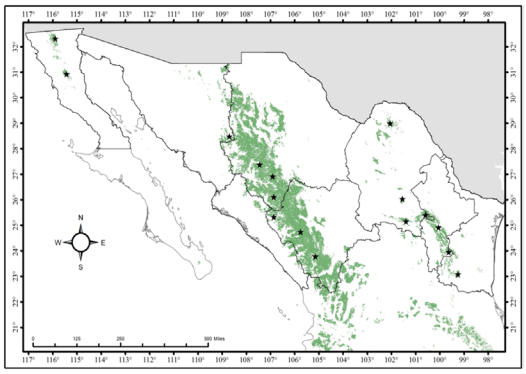

Fig. 2. Distribution of temperate forests in the North of México.

Fig. 3. Forests in the North of México. Top left Pine forest; Top right Oak forest.

Fig. 4. Forests in the North of Mexico. Top left 1. Conifer forests at 3200 m.a.s.l.; Top right 2. inside look of conifer forest; Central left 3. *Quercus* spp. forests at 2300 m.a.s.l.; Central right 4. Inside look of *Quercus* forest; Below left 5. *Pinus-Quercus* forests; Below right 6. Inside look of the *Pinus-Quercus* forests.

Table 1. List of tree species in temperate forests in the North of Mexico.

Family Pinaceae
P. pseudostrobus var. *apulcensis* (Lndl.) Shaw
Pinus teocote Schltdl. & Cham.
Pinus nelsonii Shaw
Pinus greggii Engelm. ex Parl. var. gregii
P. culminicola Andresen & Beaman
P. cembroides Zucc.
P. monophylla Torr. & Frém.
P. quadrifolia Parl. ex Sudw.
P. coulterii D. Don
P. engelmannii Carr.
P. lambertiana Douglas
*P. montezumae Lamb.*var. *montezumae*
P. johannis (Rob.) Pass.
P. hartwegii Lindl.
P. leiophylla Schiede ex Schltdl. & Cham.
P. arizona var. *cooperii* (C.E. Blanco) Farjon
P. duranguensis Martínez
P. chihuahuana Engelm.
P. devoniana Lindl.
P. discolor Bailey & Hawksw.
P. douglasiana Martinez
P. patula Schiede ex Schltdl. & Cham.
P. lumholtzii B.L. Rob. & Fernald
P. ayacahuite Ehrenb. ex Schltdl.var. brachyptera
P. flexilis E. James
P. herrerae Martinez
Pinus strobiformis Engelm.
P. yecorensis Debreczy & I. Rácz
P. arizonica var. *arizonica* Engelm.
P. arizonica var. *stormiae* Martínez
P. jeffreyi Balf.
Abies duranguensis Martinez
A. vejarii Martinez
A. concolor (Gordon & Glend) Lindl.
Abies guatemalensis Rehd.
Picea chihuahuana Martinez
Picea engelmanii ssp. *mexicana* (Martínez) P. Schmidt
P. engelmanii Parry ex Engelm.
Pseudotsuga mensiezii (Mirb.) Franco

Table 1 cont. ...

...Table 1 cont.

Family Fagaceae
Q. affinis Scheidw.
Quercus emoryi Torr.
Q. canbyi Trel.
Q. cupreata Trel. et C.H. Mull.
Q. castanea Née
Q. conspersa Benth.
Q. crassifolia Bonpl.
Q. crassipes Bonpl.
Q. delgadoana Nixon & L.M. Kelly
Q. alpescens Trel.
Q. depressa Bonpl.
Q. flocculenta C.H. Mull.
Q. fulva Liebm.
Q. furfuracea Liebm.
Q. galeanensis C.H. Mull.
Q. gentry C.H. Mull.
Q. graciliramis C.H. Mull.
Q. gravesii Sudw.
Q. hintoniorum Nixon et C.H. Mull.
Q. hirtifolia M.L. Vázquez
Q. hypoleucoides A. Camus
Q. eduardii Trel.
Q. hypoxantha Trel.
Q. jonesii Trel.
Q. laurina Bonpl.
Q. mexicana Bonpl.
Q. miquihuanensis Nixon et. C.H. Mull.
Q. ocoteifolia Liebm.
Q. pinnativenulosa C.H. Mull.
Q. runcinatifolia Trel. et C.H. Mull.
Q. rysophylla Weath.
Q. saliicifolia Née
Q. saltillensis Trel.
Q. sapotifolia Liebm.
Q. sartorii Liebm.,
Q. sideroxyla Bonpl.
Q. skinneri Benth.
Q. tenuiloba C.H. Mull.
Q. viminea Trel.
Q. xalapensis Bonpl.
Q. chihuahuensis Trel

Table 1 cont. ...

...Table 1 cont.

Family Fagaceae
Q. convallata Trel.
Q. diversifolia Née
Q. edwardsae C.H. Mull.
Q. fusiformis Small
Q. germana Bonpl.
Q. glaucoides M. Mart et Gal.
Q. gregii (A. DC.) Trel.
Q. intrincata Trel.
Q. invaginata Trel.
Q. laceyi Small.
Q. laeta Liebm.
Q. lancifolia Schltdl. et Cham.
Q. magnolifolia Née
Q. microlepis Trel.
Q. microphylla Née
Q. muehlenbergii Engelm.
Q. oblongifolia Torr.
Q. obtusata Bonpl.
Q. oleoides Schltdl. et Cham.
Q. opaca Trel.
Q. pastorensis C.H. Muller
Q. pendicularis Née
Q. polymorpha Schltdl. et Cham.
Q. praeco Trel.
Q. pringlei Seemen ex Loes.
Q. pungens Liebm.
Q. rugosa Trel.
Q. sebifera Trel.
Q. sinuata Walt var. *breviloba* (Torr.) C. H. Mull.
Q. splendens Née
Q. striatula Trel.
Q. supranitida C.H. Mull.
Q. thinkhamii C.H. Mull.
Q. toxicodendrifolia Trel.
Q. monterreyensis Trel. et C.H. Mull.
Q. vaseyana Buckl.
Q. verde C.H. Mull.
Q. mohriana Buckl. ex Rydb.
Q. toumeyei Sarg.
Q. tarahumara Spellenb., Bacon & Breedlove
Q. basaseachicensis C.H. Mull.

Table 1 cont. ...

...Table 1 cont.

Family Fagaceae
Q. chrysolepis Liebm.
Q. arizonica Sarg.
Q. durifolia Seem.
Q. gambelli Nutt.
Q. grisea Liebm.
Q. potosina Trel.
Q. tuberculata Liebm.
Q. mcvaughii Spellenb.
Q. scytophylla Liebm.
Q. subpathulata Trel.
Q. deppressipes Trel.
Q. intricata Trel.
Q. tardifolia C.H. Mull.
Q. clivicola Trel. & C.H. Mull.
Q. sartorii Liebm.
Q. agrifolia Née
Q. dumosa Nutt.
Q. urbanii Trel.
Q. virginiana Mill.
Q. coahuilensis Nixon & C.H. Müll.
Q. carmenensis C.H. Müll.
Family Ericaceae
Arbutus xalapensis var. *texana* (Buckley) A. Grey
Arbutus arizonica (A. Gray) Sarg.
Arctostaphylos pungens KBK
A. glauca Lindl.
A. peninsularis Wells
A. platyphylla (A. Gray) Kuntze

states of Chihuahua, Durango, Tamaulipas, Sonora, Coahuila and Baja California Norte with 189, 188, 186, 104, 106, and 70 respectively.

Classification Depending on the Degree of Danger of Species

1) From the species studied in the North of Mexico, 180 have been reported as toxic and 20 of these can be deadly poisonous, including *Amanita verna, A. virosa, A. bisporigera, A. phalloides, Boletus satanas* and *Hypholoma fasciculare* (Figs. 8–11). They have different toxins and some of them destroy liver cells and cause irreversible liver failure and death. These species represent a real threat or risk for humans and should be avoided.
2) Some species that should not be ingested raw include *Amanita rubescens, Boletus subvelutip*es, *Suillelus luridus* and *Boletus amigdalinus*. The first species is used

Table 2. List of edible, toxic and medicinal mushroom species from temperate forests in the North of Mexico (xeranquical taxonomic arrangement as in Kirk et al., 2008).

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Leotiaceae	*Leotia*	*lubrica*	(Scop.) Pers.	Wide	Saprotrophic	Toxic
Leotiaceae	*Leotia*	*viscosa*	Fr.	Low	Saprotrophic	Toxic
Discinaceae	*Gyromitra*	*esculenta*	(Person:Fries) Fr.	Low	Saprotrophic	Toxic
Discinaceae	*Hydnotrya*	*cerebriformis*	Harkn.	Low	Mycorrhizal	Toxic
Helvellaceae	*Helvella*	*crispa*	(Scop.).	Wide	Saprotrophic	Toxic
Helvellaceae	*Helvella*	*elastica*	Bull.	Wide	Saprotrophic	Toxic
Helvellaceae	*Helvella*	*macropus*	(Pers.) P. Karst.	Low	Mycorrhizal	Toxic
Pezizaceae	*Hydnobolites*	*cerebriformis*	Tul. & C. Tul.	Low	Mycorrhizal	Toxic
Pezizaceae	*Pachyploeus*	*carneus*	Karkn.	Low	Mycorrhizal	Toxic
Pezizaceae	*Pachyploeus*	*virescens*	Gilkey	Low	Mycorrhizal	Toxic
Ophiocordycipitaceae	*Elaphocordyceps*	*capitata*	(Holmsk.) G.H. Sung, J.M. Sung & Spataphora	Medium	Mycorrhizal	Toxic
Morchellaceae	*Morchella*	*esculenta*	(L.) Pers.	Medium	Mycorrhizal	Edible
Tuberaceae	*Tuber*	*lyonii*	Butters	Medium	Mycorrhizal	Edible
Tuberaceae	*Tuber*	*regimontanum*	G. Guevara, Bonito & Julio Rodr.	Low	Mycorrhizal	Edible
Agaricaceae	*Agaricus*	*xanthodermus*	Genev.	Wide	Saprotrophic	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Agaricaceae	*Agaricus*	*campestris*	L.	Wide	Saprotrophic	Edible
Agaricaceae	*Agaricus*	*silvaticus*	Schaeff.	Medium	Saprotrophic	Toxic
Agaricaceae	*Agaricus*	*silvicolae-similis*	Bohus & Locsmándi	Low	Saprotrophic	Toxic
Agaricaceae	*Agaricus*	*arvensis*	Schaeff.	Medium	Saprotrophic	Edible
Agaricaceae	*Agaricus*	*bitorquis*	(Quél.) Sacc.	Low	Saprotrophic	Edible
Agaricaceae	*Calvatia*	*bovista*	(L.) Murrill	Wide	Saprotrophic	Edible
Agaricaceae	*Calvatia*	*cyathiformis*	(Bosc) Morgan	Wide	Saprotrophic	Edible
Agaricaceae	*Chlorophyllum*	*molybdites*	(G. Mey.) Masse	Wide	Saprotrophic	Toxic
Agaricaceae	*Lepiota*	*cristata*	(Bolton) P. Kumm.	Wide	Saprotrophic	Toxic
Agaricaceae	*Lepiota*	*naucina*	(Fr.) P. Kumm.	Wide	Saprotrophic	Toxic
Agaricaceae	*Lepiota*	*clypeolaria*	(Bull. ex Fr.) P. Kumm.	Wide	Saprotrophic	Toxic
Agaricaceae	*Leucoagaricus*	*rubrotinctus*	(Peck) Singer	Midium	Saprotrophic	Toxic
Agaricaceae	*Leucocoprinus*	*birnbaumii*	(Corda) Singer	Medium	Saprotrophic	Toxic
Agaricaceae	*Leucocoprinus*	*fragilissimus*	(Berk. & Rav.) Pat.	Medium	Saprotrophic	Toxic
Agaricaceae	*Leucocoprinus*	*cepistipes*	(Sow. ex Fr.) Pat.	Medium	Saprotrophic	Toxic
Agaricaceae	*Lycoperdon*	*perlatum*	Pers.	Wide	Saprotrophic	Edible

Agaricaceae	*Lycoperdon*	*pyriforme*	Schaeff.	Wide	Saprotrophic	Edible
Agaricaceae	*Lycoperdon*	*mammaeforme*	Pers.	Low	Saprotrophic	Edible
Agaricaceae	*Lycoperdon*	*marginatum*	Vitt.	Medium	Saprotrophic	Toxic
Agaricaceae	*Cystoderma*	*amianthinum*	(Scop.) Fayod	Low	Saprotrophic	Toxic
Agaricaceae	*Cystodermella*	*cinnabarina*	(Alb. & Schwein.) Harmaja	Medium	Saprotrophic	Toxic
Agaricaceae	*Cystodermella*	*granulosa*	(Batsch) Harmaja	Medium	Saprotrophic	Toxic
Agaricaceae	*Panaeolus*	*papilionaceus*	(Bull.) Quél.	Wide	Saprotrophic	Toxic
Agaricaceae	*Panaeolus*	*semiovatus*	(Sowerby) S. Lundell y Nannf.	Medium	Saprotrophic	Toxic
Agaricaceae	*Panaeolus*	*antillarum*	(Fr.) Dennis	Wide	Saprotrophic	Toxic
Agaricaceae	*Panaeolus*	*cinctulus*	(Bolton) Sacc.	Medium	Saprotrophic	Toxic
Agaricaceae	*Coprinus*	*comatus*	(OF Müll.) Pers.	Wide	Saprotrophic	Edible
Agaricaceae	*Phaeolepiota*	*aurea*	(Matt.) Maire	Low	Saprotrophic	Toxic
Amanitaceae	*Amanita*	*cochiseana*	Sanchez et al., 2015	Medium	Mycorrhizal	Edible
Amanitaceae	*Amanita*	*basii*	Guzmán & Ram.-Guill.	Medium	Mycorrhizal	Edible
Amanitaceae	*Amanita*	*phalloides*	(Vaill. Ex Fr.) Link	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*jacksonii*	Pomerl.	Medium	Mycorrhizal	Edible
Amanitaceae	*Amanita*	*abrupta*	Peck	Low	Mycorrhizal	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Amanitaceae	*Amanita*	*crocea*	(Quél.) Singer	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*fulva*	Fr.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*muscaria*	(L.) Lam.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*citrina*	Pers.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*flavoconia*	G.F. Atk.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*gemmata*	(Fr.) Bertill.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*pantherina*	(DC.) Krombh.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*polypyramis*	(Berk. & M.A. Curtis) Sacc.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*rubescens*	Pers.	Wide	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*flavorubescens*	G.F. Atk.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*virosa*	Bertill.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*verna*	(Bull.) Lam.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*bisporigera*	G.F. Atk.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*strobiliformis*	(Paulet ex Vittad.) Bertill.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*calyptroderma*	G.F. Atk. & VG Ballen	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*cokeri*	E.-J. Gilbert & Kühner ex E.-J. Gilbert	Low	Mycorrhizal	Toxic

Amanitaceae	*Amanita*	*magniverrucata*	Thiers & Ammirati	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*onusta*	(Howe) Sacc.	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*perpasta*	Corner & Bas	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*peckiana*	Kauffman	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*porphyria*	Alb. & Schwein.	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*smithiana*	Bas	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*vaginata*	(Bull.) Lam.	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*variabilis*	E.-J. Gilbert y Cleland	Low	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*tuza*	Guzmán	Medium	Mycorrhizal	Toxic
Amanitaceae	*Amanita*	*spreta*	(Peck) Sacc.	Low	Mycorrhizal	Toxic
Amanitaceae	*Limacella*	*illinita*	(Fr.) Maire	Low	Mycorrhizal	Toxic
Bolbitiaceae	*Conocybe*	*lateritia*	(Fr.) Kühner	Medium	Saprotrophic	Toxic
Bolbitiaceae	*Conocybe*	*apala*	(Fr.) Arnolds	Low	Saprotrophic	Toxic
Bolbitiaceae	*Bolbitius*	*titubans*	(Bull.) Fr.	Low	Saprotrophic	Toxic
Cortinariaceae	*Cortinarius*	*sanguineus*	(Wulfen) Gray	Wide	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*semisanguineus*	(Fr.) Gillet	Medium	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*elegantissimus*	Rob. Henry	Low	Mycorrhizal	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Cortinariaceae	*Cortinarius*	*violaceus*	(L.) Gray	Wide	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*collinitus*	(Sowery) Gray	Medium	Mycorrhizal32	Toxic
Cortinariaceae	*Cortinarius*	*corrugatus*	Peck	Low	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*purpureus*	(Bull.) Bidaud, Moënne-Locc. & Reumaux	Medium	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*traganus*	(Fr.:Fr.) Fr.	Medium	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*magnivelatus*	Dearness ex Fogel	Low	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*smithii*	Amirati, Niskaenen & Liimat	Low	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*pinetorum*	Fr. Kauffman	Low	Mycorrhizal	Toxic
Cortinariaceae	*Cortinarius*	*paleaceus*	(Weinm.) Fr.	Low	Mycorrhizal	Toxic
Entolomataceae	*Entoloma*	*mexicanum*	(Murrill) Hesler	Low	Mycorrhizal	Toxic
Entolomataceae	*Entoloma*	*sinuatum*	(Bull.) P. Kum.	Wide	Saprotrophic42	Toxic
Entolomataceae	*Entoloma*	*incanum*	(Fr.:Fr.) Hesler	Low	Saprotrophic	Toxic
Entolomataceae	*Entoloma*	*abortivum*	(Berk. & MA Curtis) Donk	Low	Saprotrophic	Toxic
Hydnangiaceae	*Laccaria*	*bicolor*	(Maire) PD Orton	Medium	Mycorrhizal	Edible
Hydnangiaceae	*Laccaria*	*laccata*	(Scop.) Cooke	Wide	Mycorrhizal	Edible
Hydnangiaceae	*Laccaria*	*proxima*	(Boud.) Pat.	Low	Mycorrhizal	Edible

Hygrophoraceae	*Hygrocybe*	*acutoconica*	(Clem.) Singer	Medium	Saprotrophic	Toxic
Hygrophoraceae	*Hygrophorus*	*erubescens*	(Fr.) Fr.	Medium	Mycorrhizal	Toxic
Hygrophoraceae	*Hygrophorus*	*russula*	(Schaeff. Ex Fr.) Kauffman	Wide	Saprotrophic	Edible
Hygrophoraceae	*Hygrocybe*	*conica*	(Schaeff.) P. Kumm.	Medium	Saprotrophic	Toxic
Hygrophoraceae	*Gliophorus*	*psittacinus*	(Schaeff.) Herink	Low	Saprotrophic	Toxic
Inocybaceae	*Crepidotus*	*mollis*	(Schaeff.) Staude	Wide	Saprotrophic	Toxic
Inocybaceae	*Inocybe*	*erubescens*	A. Blytt	Medium	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*geophylla*	(Bull.) P. Kumm.	Medium	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*histrix*	(Fr.) P. Karst.	Low	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*rimosa*	(Bull.)P.Kumm.	Medium	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*lacera*	(Fr.) Kumm.	Medium	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*confusa*	P. Karst.	Low	Mycorrhizal	Toxic
Inocybaceae	*Inocybe*	*maculata*	Boud.	Low	Mycorrhizal	Toxic
Lyophyllaceae	*Lyophyllum*	*decastes*	(Fr.) Singer	Low	Saprotrophic	Edible
Mycenaceae	*Mycena*	*pura*	(Pers.) P. Kumm	Medium	Saprotrophic	Toxic
Mycenaceae	*Panellus*	*pusillus*	(Pers. ex Lév.) Burds. & O.K. Mill.	Medium	Saprotrophic	Toxic
Mycenaceae	*Panellus*	*stipticus*	(Bull.) P. Karst.	Medium	Saprotrophic	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Mycenaceae	*Xeromphalina*	*cauticinalis*	(With.) Kühner & Maire	Medium	Saprotrophic	Toxic
Mycenaceae	*Xeromphalina*	*tenuipes*	(Schwein.) A.H. Sm.	Medium	Saprotrophic	Toxic
Physalacriaceae	*Armillaria*	*mellea*	(Vahl) P. Kumm.	Wedium	Pathogenic	Toxic
Physalacriaceae	*Desarmillaria*	*tabescens*	(Scop.) RA Koch y Aime	Medium	Pathogenic	Toxic
Physalacriaceae	*Cryptotrama*	*chrysopeplum*	(Berk. & M. A. Curtis) Singer	Low	Saprophitic	Toxic
Physalacriaceae	*Flammulina*	*velutipes*	(Curtis) Singer	Low	Saprotrophic	Edible
Physalacriaceae	*Oudemansiella*	*canarii*	(Jungh) Höhn.	Low	Saprotrophic	Edible
Pleurotaceae	*Pleurotus*	*dryinus*	(Pers.) P. Kumm.	Low	Saprotrophic	Edible
Pluteaceae	*Pluteus*	*petasatus*	(Fr.) Gillet	Low	Saprotrophic	Toxic
Pluteaceae	*Pluteus*	*cervinus*	(Schaeff.) P. Kumm.	Wide	Saprotrophic	Toxic
Pluteaceae	*Volvariella*	*volvacea*	(Bull.) Singer	Low	Saprotrophic	Edible
Pluteaceae	*Volvariella*	*bombycina*	(Schaeff.) Cantante	Low	Saprotrophic	Edible
Pluteaceae	*Volvariella*	*gloiocephala*	(DC.) Boekhout y Enderle	Medium	Saprotrophic	Edible
Psathyrellaceae	*Psathyrella*	*candolleana*	(Fr.) Maire.	Wide	Saprotrophic	Toxic
Psathyrellaceae	*Coprinellus*	*atramentarius*	(Bull.) Redhead, Vilgalys & Monclavo	Wide	Saprotrophic	Toxic
Schizophyllaceae	*Schizophyllum*	*commune*	P.	Wide	Saprotrophic	Edible

Strophariaceae	*Pholiota*	*adiposa*	(Batsch: Fr.) P. Kumm.	Medium	Saprotrophic	Toxic
Strophariaceae	*Pholiota*	*squarrosa*	(Batsch.) P.Kumm.	Low	Saprotrophic	Toxic
Strophariaceae	*Protostropharia*	*semiglobata*	(Batsch ex Fr.) Quél.	Wide	Saprotrophic	Toxic
Tapinellaceae	*Tapinella*	*panuoides*	(Fr.) Fr.	Wide	Saprotrophic	Toxic
Tapinellaceae	*Tapinella*	*atrotomentosa*	(Batsch) Šutara	Wide	Saprotrophic	Toxic
Omphalotaceae	*Gymnopus*	*alkalivirens*	(Singer) Halling	Low	Saprotrophic	Toxic
Omphalotaceae	*Gymnopus*	*confluens*	(Pers.) Antonín, Halling & Noordel.	Medium	Saprotrophic	Toxic
Omphalotaceae	*Gymnopus*	*fusipes*	(Bull.) Gray	Medium	Saprotrophic	Toxic
Omphalotaceae	*Omphalotus*	*olivascens*	H.E. Bigelow, OK Mill. & Thiers	Low	Saprotrophic	Toxic
Omphalotaceae	*Omphalotus*	*subilludens*	(Murrill) HE Bigelow	Medium	Saprotrophic	Toxic
Tricholomataceae	*Leucopaxillus*	*gentianeus*	(Quél.) Kotl.	Medium	Mycorrhizal	Toxic
Tricholomataceae	*Leucopaxillus*	*albissimus*	(Peck) Singer	Low	Mycorrhizal	Toxic
Tricholomataceae	*Resupinatus*	*applicatus*	(Batsch) Gray	Medium	Saprotrophic	Toxic
Tricholomataceae	*Clitocybe*	*dealbata*	(Sow.:Fr.) Kumm.	Medium	Saprotrophic	Toxic
Tricholomataceae	*Clitocybe*	*gibba*	(Pers.) P. Kumm.	Medium	Mycorrhizal	Edible
Tricholomataceae	*Lepista*	*nuda*	(Bull.) Cooke	Medium	Saprotrophic	Edible
Tricholomataceae	*Lepista*	*sordida*	(Schumach.) Cantante	Low	Saprotrophic	Edible

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Tricholomataceae	*Tricholoma*	*sejunctum*	(Sow. ex Fr.) Quél	Medium	Mycorrhizal	Toxic
Tricholomataceae	*Tricholoma*	*sulphureum*	(Bull.:Ffr.) Kumm.	Medium	Mycorrhizal	Toxic
Tricholomataceae	*Tricholoma*	*virgatum*	(Fr.:Fr.) Kumm.	Medium	Mycorrhizal	Toxic
Tricholomataecee	*Tricholoma*	*vaccinum*	(Pers.:Fr.)Kumm.	Medium	Mycorrhizal	Toxic
Tricholomataecee	*Tricholoma*	*flavovirens*	(Pers.) S. Lundell	Low	Mycorrhizal	Edible
Tricholomataceae	*Tricholoma*	*magnivelare*	(Peck) Redhead	Low	Mycorrhizal	Edible
Tricholomataceae	*Tricholomopsis*	*rutilans*	(Schaeff.) Singer	Medium	Saprotrophic	Toxic
Tricholomataceae	*Tricholomopsis*	*decora*	(Fr.) Singer	Low	Saprotrophic	Toxic
Auriculariaceae	*Auricularia*	*nigricans*	(Sw.) Birkebak, Looney & Sánchez-García	Medium	Saprotrophic	Edible
Auriculariaceae	*Exidia*	*glandulosa*	(Bull.) Fr.	Wide	Saprotrophic	Toxic
Auriculariaceae	*Exidia*	*recisa*	(Ditmar) Fr.	Low	Saprotrophic	Toxic
Boletaceae	*Caloboletus*	*inedulis*	(Murrill) Vizzini	Medium	Mycorrhizal	Toxic
Boletaceae	*Boletellus*	*coccineus*	(Sacc.) Singer	Low	Mycorrhizal	Edible
Boletaceae	*Boletellus*	*ananas*	(MA Curtis) Murrill	Medium	Mycorrhizal	Edible
Boletaceae	*Hortiboletus*	*rubellus*	(Krombh.) Simonini, Vizzini & Gelardi	Wide	Mycorrhizal	Edible
Boletaceae	*Hortiboletus*	*campestris*	(AH Sm. & Thiers) Biketova & Wasser	Medium	Mycorrhizal	Edible

Boletaceae	*Boletus*	*variipes*	Peck	Medium	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*amigdalinus*	(Thiers) Thiers	Low	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*paulae*	J. García, Singer y F. Garza-Ocañas	Low	Mycorrhizal	Edible
Boletaceae	*Boletus*	*subluridellus*	A.H. Sm. & Thiers	Medium	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*subvelutipes*	Peck	Medium	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*luridellus*	(Murrill) Murrill	Low	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*barrowsi*	Thiers & AH Sm.	Low	Mycorrhizal	Toxic
Boletaceae	*Boletus*	*pinophilus*	Pilát & Dermek	Wide	Mycorrhizal	Edible
Boletaceae	*Porphyrellus*	*cyaneotinctus*	(A.H. Sm. & Thiers) Cantante	Medium	Mycorrhizal	Toxic
Boletaceae	*Sutorius*	*eximius*	(Peck) Halling, Nuhn & Osmundson	Wide	Mycorrhizal	Toxic
Boletaceae	*Aureoboletus*	*russellii*	(Escarcha) G. Wu y Zhu L. Yang	Wide	Mycorrhizal	Edible
Boletaceae	*Butyriboletus*	*frostii*	(JL Russell) G. Wu, Kuan Zhao y Zhu L. Yang	Wide	Mycorrhizal	Edible
Boletaceae	*Suillellus*	*luridus*	(Schaeff.) Murrill	Wide	Mycorrhizal	Toxic
Boletaceae	*Leccinum*	*manzanitae*	Thiers	Medium	Mycorrhizal	Edible
Boletaceae	*Leccinum*	*aurantiacum*	(Bull.) Gray	Low	Mycorrhizal	Edible
Boletaceae	*Harrya*	*chromapes*	(Frost) Halling, Nuhn, Osmundson y Manfr. Binder	Medium	Mycorrhizal	Edible
Boletaceae	*Tylopilus*	*felleus*	(Bull.) P. Karst.	Low	Mycorrhizal	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Boletaceae	*Tylopilus*	*plumbeoviolaceus*	(Snell y EA Dick) Snell y EA Dick	Medium	Mycorrhizal	Toxic
Boletaceae	*Tylopilus*	*tabacinus*	(Peck) Singer	Low	Mycorrhizal	Toxic
Boletaceae	*Tylopilus*	*alboater*	(Schwein) Murrill	Low	Mycorrhizal	Toxic
Boletaceae	*Strobilomyces*	*confusus*	Singer	Medium	Mycorrhizal	Edible
Boletaceae	*Strobilomyces*	*strobilaceus*	(Scop.) Berk.	Wide	Mycorrhizal	Edible
Boletinellaceae	*Boletinellus*	*merulioides*	(Schwein.) Murrill	Medium	Mycorrhizal	Edible
Boletinellaceae	*Phlebopus*	*portentosus*	(Berk. & Broome) Boedijn	Low	Mycorrhizal	Edible
Boletinellaceae	*Phlebopus*	*brassiliensis*	Singer	Low	Saprotrophic	Edible
Gyroporaceae	*Gyroporus*	*castaneus*	(Bull.) Quél.	Medium	Mycorrhizal	Edible
Gyroporaceae	*Gyroporus*	*subalbellus*	Murrill	Low	Mycorrhizal	Edible
Gyroporaceae	*Gyroporus*	*castaneus*	(Bull.) Quél.	Medium	Mycorrhizal	Edible
Hygrophoropsidaceae	*Hygrophoropsis*	*aurantiaca*	(Wulf. ex Fr.) Maire	Medium	Saprotrophic	Toxic
Rhizopogonaceae	*Rhizopogon*	*occidentalis*	Zeller & CW Dodge	Low	Mycorrhizal	Edible
Rhizopogonaceae	*Rhizopogon*	*luteolus*	Fr.	Medium	Mycorrhizal	Edible
Sclerodermataceae	*Scleroderma*	*areolatum*	Ehrenb.	Wide	Mycorrhizal	Toxic
Sclerodermataceae	*Scleroderma*	*verrucosum*	(Bull.) Pers.	Wide	Mycorrhizal	Toxic

Sclerodermataceae	*Scleroderma*	*texense*	Berk.	Medium	Mycorrhizal	Toxic
Sclerodermataceae	*Scleroderma*	*cepa*	Pers.	Medium	Mycorrhizal	Toxic
Sclerodermataceae	*Scleroderma*	*citrinum*	Pers.	Medium	Mycorrhizal	Toxic
Sclerodermataceae	*Pisolithus*	*arhizus*	(Scop.) Rauschert	Wide	Mycorrhizal	Edible
Suillaceae	*Suillus*	*brevipes*	(Peck) Kuntze	Wide	Mycorrhizal	Edible
Suillaceae	*Suillus*	*cothurnatus*	Cantante	Medium	Mycorrhizal	Edible
Suillaceae	*Suillus*	*granulatus*	(L.) Roussel	Wide	Mycorrhizal	Edible
Suillaceae	*Suillus*	*spraguei*	(Berk. & MA Curtis) Kuntze	Medium	Mycorrhizal	Edible
Suillaceae	*Suillus*	*pseudobrevipes*	A.H. Sm. Y Thiers	Medium	Mycorrhizal	Edible
Suillaceae	*Suillus*	*tomentosus*	Singer	Wide	Mycorrhizal	Edible
Suillaceae	*Suillus*	*luteus*	(L.) Roussel	Medium	Mycorrhizal	Edible
Cantharellaceae	*Cantharellus*	*cibarius*	Fr.	Wide	Mycorrhizal	Edible
Cantharellaceae	*Cantharellus*	*lateritius*	(Berk.) Cantante	Medium	Mycorrhizal	Edible
Cantharellaceae	*Cantharellus*	*cinnabarinus*	(Schwein.) Schwein.	Low	Mycorrhizal	Edible
Cantharellaceae	*Craterellus*	*fallax*	A.H. Smith	Low	Mycorrhizal	Edible
Cantharellaceae	*Craterellus*	*cornucupioides*	(L.) Pers.	Low	Mycorrhizal	Edible
Hydnaceae	*Hydnum*	*repandum*	L.	Medium	Mycorrhizal	Edible

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Clavariadelphaceae	*Clavariadelphus*	*truncatus*	Donk	Wide	Saprotrophic	Edible
Clavariadelphaceae	*Clavariadelphus*	*ligula*	(Schaeff.) Donk	Low	Saprotrophic	Edible
Gomphaceae	*Gomphus*	*clavatus*	(Pers.) Gray	Medium	Mycorrhizal	Edible
Gomphaceae	*Turbinellus*	*floccosus*	(Schwein.) Earle & Giachini & Castellano	Low	Mycorrhizal	Toxic
Gomphaceae	*Ramaria*	*formosa*	(Pers.:Fr.) Quél.	Medium	Mycorrhizal	Toxic
Gomphaceae	*Ramaria*	*flava*	(Schaeff.) Quél.	Wide	Mycorrhizal	Toxic
Gomphaceae	*Ramaria*	*botrytoides*	(Peck) Corner	Medium	Mycorrhizal	Toxic
Tremellaceae	*Tremella*	*foliacea*	Pers.	Medium	Saprotrophic	Edible
Tremellaceae	*Tremella*	*lutescens*	Lloyd	Wide	Saprotrophic	Edible
Tremellaceae	*Tremella*	*fuciformis*	Berk.	Medium	Saprotrophic	Edible
Hymenogastraceae	*Hebeloma*	*crustuliniforme*	(Bull.) Quél.	Medium	Mycorrhizal	Toxic
Hymenogastraceae	*Galerina*	*marginata*	(Batsch) Kühner	Low	Saprotrophic	Toxic
Hymenogastraceae	*Gymnopilus*	*fulvosquamulosus*	Hesler	Low	Saprotrophic	Toxic
Hymenogastraceae	*Gymnopilus*	*penetrans*	(Fr.) Murrill	Medium	Saprotrophic	Toxic
Hymenogastraceae	*Hypholoma*	*capnoides*	(Fr.) P. Kumm.	Medium	Saprotrophic	Toxic
Hymenogastraceae	*Hypholoma*	*fasciculare*	(Huds. ex Fr.) P. Karst.	Wide	Saprotrophic	Toxic

Hymenogastraceae	*Psilocybe*	*mexicana*	R. Heim.	Low	Saprotrophic	Toxic
Hymenogastraceae	*Deconica*	*coprophila*	(Bull.) P. Kumm.	Wide	Saprotrophic	Toxic
Hymenogastraceae	*Gymnopilus*	*aeruginosus*	(Peck) Singer	Wide	Saprotrophic	Toxic
Fomitopsidaceae	*Phaeolus*	*schweinitzii*	(Fr.) Pat.	Wide	Pathogenic	Toxic
Ganodermataceae	*Ganoderma*	*applanatum*	(Pers.) Pat.	Wide	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*curtisii*	(Berk.) Murrill	Medium	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*resinaceum*	Boud.	Medium	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*lobatum*	(Cooke) GF Atk.	Medium	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*colossus*	(Fr.) Baker	Low	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*oerstedii*	(Fr.) Torrend	Medium	Pathogenic	Medicinal
Ganodermataceae	*Ganoderma*	*brownii*	(Murrill) Gilb.	Medium	Pathogenic	Medicinal
Ganodermataceae	*Humphreya*	*coffeata*	(Berk.) Staeyaert	Low	Pathogenic	Medicinal
Meruliaceae	*Cymatoderma*	*caperatum*	(Berk. & Mont.) D.A.	Medium	Saprotrophic	Medicinal
Meruliaceae	*Phlebia*	*tremellosa*	(Schrad.) Nakasone & Burds.	Medium	Saprotrophic	Medicinal
Phanerochaetaceae	*Byssomerulius*	*incarnatus*	(Schwein.) Gilb.	Wide	Pathogenic	Medicinal
Polyporaceae	*Hexagonia*	*hydnoides*	(Sw.) M. Fidalgo	Wide	Saprotrophic	Medicinal
Polyporaceae	*Pycnoporus*	*sanguineus*	(L.) Murrill	Wide	Saprotrophic	Medicinal

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Polyporaceae	*Trametes*	*versicolor*	(L.) Lloyd	Medium	Saprotrophic	Medicinal
Polyporaceae	*Lentinus*	*crinitus*	(L.) Fr.	Wide	Saprotrophic	Edible
Polyporaceae	*Neolentinus*	*lepideus*	(Fr.) Redhead & Ginns	Low	Pathogenic	Edible
Albatrellaceae	*Albatrellus*	*ellisi*	(Berk.) Pouzar	Low	Pathogenic	Edible
Fomitopsidaceae	*Laetiporus*	*sulphureus*	(Bull.) Murrill	Low	Saprophitic	Edible
Bondarzewiaceae	*Amylosporus*	*campbellii*	(Berk.) Ryvarden	Low	Saprotrophic	Medicinal
Bondarzewiaceae	*Heterobasidion*	*annosum*	(Fr.) Bref.	Low	Pathogenic	Toxic
Hericiaceae	*Hericium*	*erinaceus*	(Bull.) Pers.	Wide	Saprotrophic	Edible
Hericiaceae	*Hericium*	*coralloides*	(Scop.) Pers.	Low	Saprotrophic	Edible
Russulaceae	*Lactarius*	*rufus*	(Scop.) Fr.	Medium	Mycorrhizal	Toxic
Russulaceae	*Lactarius*	*scrobiculatus*	(Scop.) Fr.	Low	Mycorrhizal76	Toxic
Russulaceae	*Lactarius*	*torminosus*	(Schaeff.) Gray	Low	Mycorrhizal	Toxic
Russulaceae	*Lactarius*	*vellereus*	(Fr.) Fr.	Low	Mycorrhizal	Toxic
Russulaceae	*Lactarius*	*chrysorrheus*	Fr.	Low	Mycorrhizal	Toxic
Russulaceae	*Lactarius*	*piperatus*	(L.) Pers.	Low	Mycorrhizal	Toxic
Russulaceae	*Lactarius*	*uvidus*	(Fr.) Fr.	Low	Mycorrhizal	Toxic

Russulaceae	*Lactarius*	*deliciosus*	(L.) Gray	Medium	Mycorrhizal	Edible
Russulaceae	*Lactarius*	*indigo*	(Schwein.) P.	Low	Mycorrhizal	Edible
Russulaceae	*Lactarius*	*volemus*	(Fr.) Fr.	Low	Mycorrhizal	Edible
Russulaceae	*Lactarius*	*zonarius*	(Bull.) Fr.	Low	Mycorrhizal	Toxic
Russulaceae	*Russula*	*emetica*	(Schaeff.) Pers.	Wide	Mycorrhizal	Toxic
Russulaceae	*Russula*	*nigricans*	Fr.	Medium	Mycorrhizal	Toxic
Russulaceae	*Russula*	*albonigra*	Fr.	Low	Mycorrhizal	Toxic
Russulaceae	*Russula*	*cyanoxantha*	(Schaeff.).	Medium	Mycorrhizal	Edible
Russulaceae	*Russula*	*brevipes*	Peck	Wide	Mycorrhizal	Edible
Russulaceae	*Russula*	*virescens*	(Schaeff.).	Medium	Mycorrhizal	Edible
Russulaceae	*Russula*	*rosea*	Pers.	Low	Mycorrhizal	Toxic
Russulaceae	*Russula*	*foetens*	(Pers.) Fr.	Medium	Mycorrhizal	Toxic
Stereaceae	*Stereum*	*ostrea*	(Blume & T. Nees)	Wide	Saprotrophic	Toxic
Sebacinaceae	*Tremellodendron*	*schweinitzii*	(Peck) G.F. Atk.	Medium	Mycorrhizal	Toxic
Bankeraceae	*Hydnellum*	*scrobiculatum*	(Fr.) P. Karst.	Medium	Mycorrhizal	Toxic
Bankeraceae	*Phellodon*	*niger*	(Fr.) P. Karst.	Medium	Mycorrhizal	Toxic
Bankeraceae	*Sarcodon*	*scabrosus*	(Fr.) P. Karst.	Medium	Mycorrhizal	Toxic

Table 2 cont. ...

...Table 2 cont.

Family	Genus	Species	Authors	Distribution	Habit	Edibility
Bankeraceae	*Sarcodon*	*imbricatus*	(L.) P. Karst.	Medium	Mycorrhizal	Toxic
Hypocreaceae	*Hypomyces*	*lactifluorum*	(Schwein.) Tul. Y C. Tul.	Wide	Pathogenic	Edible
Pyronemataceae	*Aleuria*	*aurantia*	(Pers.) Fuckel	Wide	Saprotrophic	Toxic

Table 3. Distribution of species in the Northern States of Mexico.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Leotia	*lubrica*			x	x	x	x	x
Leotia	*viscosa*			x	x			x
Gyromitra	*esculenta*			x	x		x	
Hydnotrya	*cerebriformis*						x	x
Helvella	*crispa*	x	x	x	x	x	x	x
Helvella	*elastica*			x	x	x	x	x
Helvella	*macropus*	x	x	x	x	x	x	x
Hydnobolites	*cerebriformis*						x	x
Pachyploeus	*carneus*						x	x
Pachyploeus	*virescens*						x	x
Elaphocordyceps	*capitata*			x	x		x	x
Morchella	*esculenta*			x		x	x	x
Tuber	*lyonii*					x	x	x
Tuber	*regimontanum*						x	
Agaricus	*xanthodermus*	x		x	x	x	x	x
Agaricus	*campestris*	x	x	x	x	x	x	x

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Agaricus	*silvaticus*	x		x	x		x	
Agaricus	*silvicolae-similis*			x	x		x	
Agaricus	*arvensis*	x		x	x	x	x	
Agaricus	*bitorquis*	x	x	x	x			
Calvatia	*bovista*		x	x	x	x	x	x
Calvatia	*cyathiformis*	x		x	x	x	x	x
Chlorophyllum	*molybdites*	x	x	x	x	x	x	x
Lepiota	*cristata*	x	x	x	x	x	x	x
Lepiota	*naucina*		x	x	x		x	
Lepiota	*clypeolaria*		x	x	x	x	x	x
Leucoagaricus	*rubrotinctus*				x		x	x
Leucocoprinus	*birnbaumii*	x		x	x	x	x	x
Leucocoprinus	*fragilissimus*			x	x		x	x
Leucocoprinus	*cepistipes*		x	x	x	x	x	x
Lycoperdon	*perlatum*	x	x	x	x	x	x	x
Lycoperdon	*pyriforme*	x	x	x	x	x	x	x

Lycoperdon	*mammaeforme*					x	x	x
Lycoperdon	*marginatum*			x	x	x	x	x
Cystoderma	*amianthinum*	x		x	x	x	x	x
Cystodermella	*cinnabarina*		x	x	x	x	x	x
Cystodermella	*granulosa*		x	x	x	x		x
Panaeolus	*papilionaceus*	x	x	x	x	x	x	x
Panaeolus	*semiovatus*			x		x		x
Panaeolus	*antillarum*	x	x	x	x	x		x
Panaeolus	*cinctulus*			x		x		
Coprinus	*comatus*	x	x	x	x	x	x	x
Phaeolepiota	*aurea*					x		x
Amanita	*cochiseana*		x	x	x	x	x	x
Amanita	*basii*		x	x	x	x		
Amanita	*phalloides*			x	x			
Amanita	*jacksonii*				x			x
Amanita	*abrupta*			x	x			
Amanita	*crocea*			x	x		x	x

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Amanita	*fulva*		x	x	x	x	x	x
Amanita	*muscaria*	x	x	x	x	x	x	x
Amanita	*citrina*		x	x	x	x		
Amanita	*flavoconia*	x	x	x	x	x	x	x
Amanita	*gemmata*	x	x	x	x	x	x	x
Amanita	*pantherina*	x	x	x	x	x		x
Amanita	*polypyramis*	x	x	x	x	x		x
Amanita	*rubescens*	x	x	x	x	x	x	x
Amanita	*flavorubescens*			x	x			
Amanita	*virosa*		x	x	x	x		x
Amanita	*verna*	x		x	x	x		x
Amanita	*bisporigera*	x	x	x	x	x		x
Amanita	*strobiliformis*	x		x	x			
Amanita	*calyptroderma*		x	x	x			
Amanita	*cokeri*	x	x	x	x			
Amanita	*magniverrucata*	x	x	x	x			
Amanita	*onusta*			x	x	x		x

Amanita	*perpasta*			x				
Amanita	*peckiana*			x	x			
Amanita	*porphyria*		x	x	x	x		x
Amanita	*smithiana*		x	x	x			
Amanita	*vaginata*	x	x	x	x	x	x	x
Amanita	*variabilis*		x	x	x			
Amanita	*tuza*			x	x			
Amanita	*spreta*		x	x	x			
Limacella	*illinita*					x		x
Conocybe	*lateritia*			x	x	x		x
Conocybe	*apala*			x	x	x		x
Bolbitius	*titubans*		x	x		x		x
Cortinarius	*sanguineus*		x	x	x	x	x	x
Cortinarius	*semisanguineus*		x	x	x	x	x	x
Cortinarius	*elegantissimus*				x			x
Cortinarius	*violaceus*		x	x	x	x	x	x
Cortinarius	*collinitus*					x		x

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Cortinarius	*corrugatus*					x		x
Cortinarius	*purpureus*			x				
Cortinarius	*traganus*				x			
Cortinarius	*magnivelatus*			x				
Cortinarius	*smithii*		x	x				
Cortinarius	*pinetorum*					x		
Cortinarius	*paleaceus*					x		
Entoloma	*mexicanum*					x		
Entoloma	*sinuatum*			x		x		x
Entoloma	*incanum*					x		
Entoloma	*abortivum*				x	x		
Laccaria	*bicolor*	x		x	x	x		
Laccaria	*laccata*	x	x	x	x	x	x	x
Laccaria	*proxima*	x				x		x
Hygrocybe	*acutoconica*			x				
Hygrophorus	*erubescens*		x	x	x			

Hygrophorus	*russula*		x	x	x	x	x	x
Hygrocybe	*conica*	x	x	x	x	x	x	x
Gliophorus	*psittacinus*			x	x	x		
Crepidotus	*mollis*	x	x	x	x	x	x	x
Inocybe	*erubescens*							
Inocybe	*geophylla*				x	x		x
Inocybe	*histrix*			x		x		x
Inocybe	*rimosa*	x	x	x	x	x		
Inocybe	*lacera*			x	x	x		
Inocybe	*confusa*			x				
Inocybe	*maculata*				x			
Lyophyllum	*decastes*			x				
Mycena	*pura*	x	x	x	x	x	x	x
Panellus	*pusillus*	x	x	x	x	x	x	x
Panellus	*stipticus*				x	x		x
Xeromphalina	*cauticinalis*	x	x	x		x		x
Xeromphalina	*tenuipes*			x	x	x		x

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Armillaria	*mellea*	x	x	x	x	x	x	x
Desarmillaria	*tabescens*	x	x	x	x	x		x
Cryptotrama	*chrysopeplum*				x	x		x
Flammulina	*velutipes*		x	x		x		x
Oudemansiella	*canarii*					x		x
Pleurotus	*dryinus*		x	x	x	x		
Pluteus	*petasatus*					x		x
Pluteus	*cervinus*	x	x	x	x	x		x
Volvariella	*volvacea*					x		x
Volvariella	*bombycina*					x		x
Volvariella	*gloiocephala*	x				x		
Psathyrella	*candolleana*	x	x	x	x	x		x
Coprinellus	*atramentarius*	x	x	x	x	x	x	x
Schizophyllum	*commune*	x	x	x	x	x	x	x
Pholiota	*adiposa*					x		
Pholiota	*squarrosa*			x		x		x

Protostropharia	*semiglobata*	x		x	x	x	x	x
Tapinella	*panuoides*			x	x	x		x
Tapinella	*atrotomentosa*			x		x		x
Gymnopus	*alkalivirens*					x		
Gymnopus	*confluens*		x	x	x	x		x
Gymnopus	*fusipes*		x	x	x	x	x	
Omphalotus	*olivascens*	x	x	x	x	x		
Omphalotus	*subilludens*			x	x	x	x	x
Leucopaxillus	*gentianeus*	x		x	x	x		x
Leucopaxillus	*albissimus*			x	x	x		
Resupinatus	*applicatus*	x	x	x	x	x		x
Clitocybe	*dealbata*			x	x	x		
Clitocybe	*gibba*		x	x	x	x	x	x
Lepista	*nuda*	x	x	x	x	x	x	x
Lepista	*sordida*					x		
Tricholoma	*sejunctum*			x		x		x
Tricholoma	*sulphureum*			x	x	x	x	x

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Tricholoma	*virgatum*					x	x	x
Tricholoma	*vaccinum*					x	x	x
Tricholoma	*flavovirens*					x		x
Tricholoma	*magnivelare*			x	x	x		
Tricholomopsis	*rutilans*					x		x
Tricholomopsis	*decora*					x		
Auricularia	*nigricans*			x	x	x	x	x
Exidia	*glandulosa*		x			x	x	x
Exidia	*recisa*		x	x	x	x		x
Caloboletus	*inedulis*					x		
Boletellus	*coccineus*			x	x	x		x
Boletellus	*ananas*		x					x
Hortiboletus	*rubellus*			x	x	x		x
Boletus	*variipes*			x	x	x		x
Hortiboletus	*campestris*				x	x		
Boletus	*paulae*					x		x
Boletus	*subluridellus*			x		x		x

Boletus	*subvelutipes*			x	x	x	x	x
Boletus	*amigdalinus*	x						
Boletus	*luridellus*					x		x
Boletus	*barrowsi*	x	x	x	x		x	
Boletus	*pinophilus*		x	x	x	x	x	x
Porphyrellus	*cyaneotinctus*				x	x		x
Sutorius	*eximius*			x	x	x	x	x
Aureoboletus	*russellii*		x	x	x	x	x	x
Butyriboletus	*frostii*		x		x	x		x
Suillellus	*luridus*			x	x	x	x	x
Leccinum	*manzanitae*	x		x	x			
Leccinum	*aurantiacum*		x	x	x	x	x	x
Harrya	*chromapes*		x	x	x	x		x
Tylopilus	*felleus*		x		x			
Tylopilus	*plumbeoviolaceus*			x	x	x		x
Tylopilus	*tabacinus*					x		x
Tylopilus	*alboater*			x				

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Strobilomyces	*confusus*				x	x	x	x
Strobilomyces	*strobilaceus*	x	x	x	x	x	x	x
Boletinellus	*merulioides*					x		x
Phlebopus	*portentosus*					x		x
Phlebopus	*brassiliensis*					x		
Gyroporus	*castaneus*		x	x	x	x	x	x
Gyroporus	*subalbellus*					x		x
Gyroporus	*castaneus*		x	x	x	x		x
Hygrophoropsis	*aurantiaca*	x	x	x		x		x
Rhizopogon	*occidentalis*	x		x				
Rhizopogon	*luteolus*					x	x	
Scleroderma	*areolatum*				x	x		
Scleroderma	*verrucosum*			x		x		x
Scleroderma	*texense*					x		
Scleroderma	*cepa*			x	x	x		
Scleroderma	*citrinum*		x			x		
Pisolithus	*arhizus*			x	x	x	x	x

Suillus	*brevipes*			x	x	x		x
Suillus	*cothurnatus*			x		x		x
Suillus	*granulatus*		x	x	x	x	x	x
Suillus	*spraguei*	x		x	x			
Suillus	*pseudobrevipes*	x		x	x	x		
Suillus	*tomentosus*		x	x	x	x	x	x
Suillus	*luteus*					x	x	x
Cantharellus	*cibarius*	x	x	x	x	x	x	x
Cantharellus	*lateritius*					x		x
Cantharellus	*cinnabarinus*				x	x		x
Craterellus	*fallax*			x	x	x		
Craterellus	*cornucupioides*		x	x		x		x
Hydnum	*repandum*		x	x	x	x	x	x
Clavariadelphus	*truncatus*			x	x	x	x	x
Clavariadelphus	*ligula*			x				
Gomphus	*clavatus*				x	x		x
Turbinellus	*floccosus*		x			x	x	x

Table 3 cont. ...

...Table 3 cont.

Genus	**Species**	**BCN**	**Sonora**	**Chih.**	**Durango**	**Coahuila**	**Nuevo León**	**Tam.**
Ramaria	*formosa*			x				
Ramaria	*flava*				x			x
Ramaria	*botrytoides*		x			x		x
Tremella	*foliacea*			x	x	x		x
Tremella	*lutescens*		x	x	x	x	x	x
Tremella	*fuciformis*	x		x	x	x		x
Hebeloma	*crustuliniforme*			x		x		
Galerina	*marginata*				x	x		
Gymnopilus	*fulvosquamulosus*					x		
Gymnopilus	*penetrans*			x				
Hypholoma	*capnoides*					x		
Hypholoma	*fasciculare*	x	x	x	x	x		x
Psilocybe	*mexicana*			x		x		
Deconica	*coprophila*	x	x	x	x	x	x	x
Gymnopilus	*aeruginosus*		x	x	x	x	x	
Phaeolus	*schweinitzii*	x	x	x	x	x	x	x
Ganoderma	*applanatum*		x	x	x	x	x	x

Ganoderma	*curtisii*					x		x
Ganoderma	*resinaceum*				x	x		x
Ganoderma	*lobatum*				x	x		
Ganoderma	*colossus*					x		
Ganoderma	*oerstedii*					x		
Ganoderma	*brownii*			x	x	x		
Humphreya	*coffeata*					x		x
Cymatoderma	*caperatum*	x	x	x	x			
Phlebia	*tremellosa*		x	x	x	x		
Byssomerulius	*incarnatus*	x	x	x	x	x		
Hexagonia	*hydnoides*					x		x
Pycnoporus	*sanguineus*					x		x
Trametes	*versicolor*	x	x		x	x	x	x
Lentinus	*crinitus*				x	x	x	x
Neolentinus	*lepideus*					x		
Albatrellus	*ellisi*				x			
Laetiporus	*sulphureus*					x		x
Amylosporus	*campbellii*					x		

Table 3 cont. ...

...Table 3 cont.

Genus	Species	BCN	Sonora	Chih.	Durango	Coahuila	Nuevo León	Tam.
Heterobasidion	*annosum*					x		
Hericium	*erinaceus*	x	x	x	x	x		x
Hericium	*coralloides*			x				
Lactarius	*rufus*			x	x	x		x
Lactarius	*scrobiculatus*			x	x	x		x
Lactarius	*torminosus*				x	x		x
Lactarius	*vellereus*	x	x	x				
Lactarius	*chrysorrheus*			x	x	x	x	
Lactarius	*piperatus*					x		x
Lactarius	*uvidus*				x	x		x
Lactarius	*deliciosus*			x	x	x	x	x
Lactarius	*indigo*			x	x	x	x	x
Lactarius	*volemus*			x		x		x
Lactarius	*zonarius*		x	x	x	x	x	x
Russula	*emetica*	x	x	x	x	x	x	x
Russula	*nigricans*			x	x	x		x

Russula	*albonigra*				x	x		
Russula	*cyanoxantha*			x	x	x	x	x
Russula	*brevipes*	x	x	x	x	x	x	x
Russula	*virescens*				x	x	x	x
Russula	*rosea*				x			
Russula	*foetens*			x	x	x		x
Stereum	*ostrea*	x	x	x	x	x	x	x
Tremellodendron	*schweinitzii*			x	x	x		x
Hydnellum	*scrobiculatum*				x	x		x
Phellodon	*niger*				x	x		
Sarcodon	*scabrosus*		x	x	x	x		x
Sarcodon	*imbricatus*				x	x		x
Hypomyces	*lactifluorum*	x	x	x	x	x	x	x
Aleuria	*aurantia*			x	x	x		x

as food after fruiting bodies are boiled several times, water should be discarded every time. After this procedure, people in the Sierra Madre Occidental in the state of Chihuahua use this species as food, as the toxins are degraded in this way.

3) Some species, such as *Deconica coprophila, Panaeolus antillarum, Panaeolus cinctulus* and *Protostropharia semiglobata*, can cause gastrointestinal upsets. Other species, like *Corpinellus atramentarius*, should never be used as food if mixed with alcoholic drinks as their toxins interact with alcohol and cause intoxications.

Species with Unknown Edibility

There are very many mushroom species in temperate forests that are little known regarding their edibility (e.g., *Russula* spp., *Lactarius* spp., *Amanita* spp., *Boletus* spp., *Laccaria* spp.). Many other species are ecologically important and abundant; some are mycorrhizal with many hosts and others may be saprotrophic or parasites of some trees but are not recommended as some or many species belong to known toxic groups, including *Cortinarius* spp., *Tricholoma* spp., *Inocybe* spp., *Hypholoma* spp., *Clitocybe* spp., *Conocybe* spp., *Tapinella* spp., *Omphalotus* spp. and *Turbinellus* spp.

Small Edible Species

Some species are known to be edible but they are very small and it is often difficult to collect a sufficient amount for them to be used as food (e.g., *Laccaria laccata*); others are edible but their stem is rather fibrous in consistency and only the pileus can be used for food (*Neolentinus lepideus, Aureoboletus russelli*) (Figs. 5–7). Some species have been considered as edible for a long time but there are some recent reports regarding the presence of toxins in *Armillaria mellea* and *Desarmillaria tabescens*. Some species are considered edible in some countries, such as Brasil, even if they have a hard leather or corky consistency (*Lentinus crinitus, L. tigrinus*). Others are rather thin, soft or leathery (e.g., *Hexagonia papyracea*). A few species have a woody consistency and some people cut them into small pieces and grind them to prepare infusions (e.g., *Inonotus obliquus* in the USA), others are edible but not very popular due to their cartilaginous consistency, e.g., *Auricularia mesenterica*, *A. nigricans* and *Tremella foliacea.*

Medicinal Species

There are very many scientific reports regarding some species' medicinal usage, including *Coriolus versicolor, Picnoporus sanguineus, Ganoderma curtisii, G. oerstedii, G. applanatum, G. titans, G. resinossum, G. lobatum, Neolentinus lepideus* and *Calvatia cyathiformis* (Fig. 12). All these species are abundant in the temperate forests in the North of Mexico and some strains of these species have been obtained and studied in order to reveal the effects of their secondary metabolism on cancerous liver cells *in vitro* as well as in laboratory mice with good results, thus becoming a very promising research line (Ramírez et al., 2006).

Fig. 5. Edible species: 1. *Amanita jacksonii;* 2. *A. cochiseana;* 3. *A. bassi;* 4. *A. rubescens* group; 5. *Boletus barrowsii;* 6. *Butiriboletus frostii;* 7. *Boletus chipewaensis;* 8. *B. pseudopinophilus;* 9. *Boletus* group a *edulis;* 10. B. group b *edulis;* 11. *Boletus rubriceps;* 12. *Boletinellus merulioides*.

Forests and Mushrooms

Results showed that most mycorrhizal species were associated either with pines, oaks, spruce, fir, *Arbutus* spp. or *Arctostaphyllos* spp. in temperate forests, in altitudes ranging from 550–3650 m, saprotrophic, parasitic and pathogenic species are also present. There is a high diversity of mushrooms species at lower altitudes, i.e., 500–700 m, most of them are saprotrophic (*Leucocoprinus birnbaumii, Lepiota rubrotincta, Psathyrella* spp., *Agaricus xanthodermus, Chlorophyllum molybdites*) but some mycorrhizal species also grow associated to oaks, pines and elms (*Hortiboletus rubellus, Pisolithus tinctorius, Inocybe rimosa, I. geophylla, Sclerodermaareolatum. S. cepa* and *S. verrucosum*) amongst many others. These are also present in piedmont forestsassociated with Oaks and many other hosts.

Distribution of Species

1) Most edible or poisonous species are located in altitudes from 1500–3000 m. Many of them form mycorrhizas with a wide range of hosts (refer to hosts list) and some are saprotrophic or parasitic species (Figs. 5–7; Table 2). Some of the main edible species are: *Amanita cochiseana* (from the caesarea group),

Fig. 6. Edible species: 1. *Lactarius indigo;* 2. *Lactarius deliciosus;* 3. *Flammulina velutipes;* 4. *Harrya chromapes;* 5. *Hypomyces lactifluorum growing on Russula brevipes;* 6. *Gomphus clavatus;* 7. *Hydnum repandum;* 8. *Hortiboletus rubellus;* 9. *Russula virescens;*10. *Morchella conica;* 11. *Aureoboletus russellii;* 12. *Tuber* sp.; 13. *Boletus edulis group;* 14. *Strobilomyces strobilaceus;*15. *Polyporus tenuicolus;* 16. *Lycoperdon piriforme.*

Fig. 7. Edible species: 1. *Hericium erinaceus*; 2. *Russula brevipes*; 3. *Hericium coraloides*; 4. *Lycoperdon perlatum*; 5. *Calvatia cyathiformis*; 6. *Hortiboletus campestris*; 7. *Lactarius volemus*; 8. *Albatrellus ellisii*; 9. *Suillus granulatus*; 10. *Cantharellus cibarius*.

Fig. 8. Toxic species: 1. *Amanita pantherina*; 2. *Amanita muscaria*; 3. *Amanita verna*; 4. *Amanita bisporigera*; 5. *Amanita flavorubescens*; 6. *Amanita flavoconia*; 7. *Cortinarius* sp., 8. *Cortinarius sanguineus*; 9. *Hygrophoropsis aurantiaca*; 10. *Tapinella panuoides*; 11. *Sutorius eximius*; 12. *Boletus subvelutipes*; 13. *Agaricus xanthodermus*; 14. *Chlorophyllum molybdites*; 15. *Tapinella atrotomentosus*; 16. *Hypholoma fasciculare*.

Fig. 9. Toxic species: 1. *Cortinarius violaceus;* 2. *Cortinarius brunneus*; 3. *Cortinarius aureoturviantus*; 4. *Cortinarius semisanguineus;* 5. *Cortinarius* sp.; 6. *Leucocoprinus birmbaumii*; 7. *Scleroderma areolatum*; 8. *Scleroderma verrucosum*; 9. *Omphalotus subilludens*; 10. *Collybia alkalivirens*; 11. *Stropharia semiglobata*; 12. *Paneolus papilonaceus*; 13. *Paneolus cinctulus*; 14. *Amanita plumbea*; 15. *Gymnopilus aeruginacens*; 16. *Cortinarius pinetorum.*

Fig. 10. Toxic species: 1. *Amanita abrupta;* 2. *Amanita muscaria var. flavivolvata*; 3. *Amanita vaginata*; 4. *Cortinarius phoeniceus;* 5. *Cortinarius violaceus*; 6. *Omphalotus olivacens*; 7. *Omphalotus subilludens*; 8. *Boletus plumbeoviolaceus*; 9. *Tylopilus alboater*; 10. *Tylopilus felleus*; 11. *Amanita phalloides;* 12. *Amanita perspasta;* 13. *Cortinarius paleaceus;* 14. *Inocybe gerardii;* 15. *Inocybe calamistrata;* 16. *Boletus satanas.*

A. jacksonii, A. calyptrodema, Cantharellus cibarius, Craterellus cornucupiodes, C. fallax, Tricholoma magnivelare, Lactarius deliciosus, L. indigo, Russula delica, R. brevipes, Boletus pseudopinophilus, B. barrowsi, B. chippewaensis, B. appendiculatus, Leccinum aurantiacum, L. manzanitae, Hydnum repandum, Gomphus clavatus, Hortiboletus rubellus, Suillus tomentosus, S. granulatus, S. luteus, S. brevipes, S. pseudobrevipes, Lepista nuda, Albatrellus ellisii, Harrya chromapes, Hericium erinaceus, H. coraloides, Agaricus campestris and *A. bitorquis*. Native truffles have been found, *Tuber regiomontanum* for example, and considering the diversity of Oaks and Pines occurring in the North of Mexico it is possible that many species have not yet been discovered. Many other interesting hypogeous species from different genera have been reported recently (Cázares et al., 1992; Guevara et al., 2014).

2) There are quite a number of toxic species and many are mycorrhizal with oaks and conifers, i.e., *Amanita verna, A. bisporigera, A. virosa, A. muscaria, var. flavivolvata, A. phalloides* (Figs. 8–11; Table 2). Also, there are saprotrophic or parasitic toxic species: *Hypholoma fasiculare, H. capnoides, Mycena pura, Gymnopilus aeruginacens., Cortinarius sanguineus, C. semisanguineus, C. violaceus, Hebeloma crustuliniforme, Inocybe fastigiata, I. geophylla, I. rimosa* and *I. lacera.*

3) Medicinal species are mostly associated to Oak forests and they are either saprotrophic or parasitic: *Coriolus versicolor y Ganoderma curtissi, G. oerstedii, G. resinaceum* and *G. applanatum* (Fig. 12; Table 2).

Fig. 11. Toxic species: 1. *Amanita magniverrucata;* 2. *Amanita novinupta*; 3. *Amanita rubescens*; 4. *Amanita verna;* 5. *Amanita bisporigera*; 6. *Amanita fulva*; 7. *Tricholoma flavovirens*; 8. *Entoloma lividum*; 9. *Entoloma mexicana*; 10. *Scleroderma citrinum*; 11. *Boletus luridellus*; 12. *Paneolus antillarum;* 13. *Suillelus luridus;* 14. *Boletus amigdalinus;* 15. *Cortinarius magnivelarum;* 16. *Sarcodon imbricatus;* 17. *Xerocomus* sp.*;* 18. *Lepiota cristata;* 19. *Russula emetica;* 20. *Pluteus petasatus.*

Risks of Intoxication by Toadstools and Mushrooms in City Gardens and Nearby Forests

It is interesting to mention that eating poisonous species may occur and is mainly associated with species of some genera, i.e., *Amanita, Cortinarius, Russula, Leucocoprinus, Lepiota, Chlorophyllum* and *Scleroderma*. In the field, some toxic species like *Amanita verna* have be confused with edible species like *Agaricus campestris or A. bitorquis* as they grow in lawns placed very close to pine and oak forests where the toxic species *Amanita verna, A. virosa and A. bisporigera* grow. Also, oak species (*Quercus fusiformis, Quercus rysophylla* and *Q. polymorpha*) have recently been planted extensively in many city gardens in the north of Mexico. These trees form mycorrhizal associations in nurseries with many ectomycorrhizal fungi and, once established in their final destination in the citygardens, they produce fruiting bodies that may cause intoxications (e.g., *Scleroderma texense, S. areolatum,*

Fig. 12. Medicinal species: 1. *Ganoderma oerstedii;* 2. *Auricularia nigricans*; 3. *Ganoderma brownii*; 4. *Ganoderma lobatum*; 5. *Ganoderma curtisii*; 6. *Ganoderma collosus*; 7. *Calvatia craneiiformis*; 8. *Pycnoporus sanguineus*; 9. *Coriolus versicolor*; 10. *Ganoderma resinaceus*; 11. *Lycoperdon piryforme*; 12. *Calvatia cyathiformis.*

S. cepa, Inocybe fastigiata, I. calamistrata, Cortinarius violaceus, Amanita muscaria, Boletus luridellus and *Suillelus luridus*). Some saprotrophyc species, namely *Chlorophyllum molybdites, Lepiota rubrotincta, Leucocoprinus birmbaumii* and *Agarcius xanthodermus*, have also been collected.

Altitudinal Distribution

The species identified in this study are located in altitudes from 500 to 3500m in the east, while in central and west states, most species are located in altitudes from 1500–2500m in Oak forests. Most toxic fatal species like *Amanita verna* grow in high altitude forests and are associated with *Quercus* spp. and *Pinus* spp., forming mycorrhizas as well as some saprotrophic species or pathogens (*Hypholoma fasciculare, Armillaria mellea* and *Desarmillaria tabescens*). Some toxic saprotrophic species grow in lower altitudes ca. 500–1500 (*Chlorophyllum molybdites*). Medicinal species follow the same pattern, with some species growing in *Quercus-Pinus* forests (e.g., *Ganoderma applanatum* and *Neolentinus lepideus* and *Coriolus versicolor*) and other species growing in lower altitudes (500–2000) (*Ganoderma resinosum*). Thus, most toxic species are located in altitudes from 500 to 3200 m (*Amanita bisporigera, A. phalloides, A. virosa, A. rubescens, Tricholomopsis rutilans, Inocybe fastigiata, I.*

calamistrata, Pholliota squarrosa, P. adiposa, Cortinarius violaceus, C. paleaceus, C. pinetorum, Mycena pura and *Hypholoma fasciculare*).

Importance of Species

All species are ecologically important but there was a lack of information regarding toxic species (*Amanita phalloides, A. verna, A. bisporigera* and *A. virosa*) occurring in these extensive temperate forests. They should be known in order to avoid poisoning with possible fatal events in people living in rural forestry communities. Identification of edible, toxic and medicinal species is very important as many research lines can be established from each one of these groups (Garza et al., 2014). Mycorrhizal species have relevance both because they promote seedling growth and because many species are edible and can be collected and sold (e.g., *Amanita caesarea* group, now called *cochiseana*) (Sánchez et al., 2015), *A. jacksonii, Boletus edulis* group, *Tricholoma magnivelare, Lactarius deliciosus*, *Cantharellus cibarius* and some others (Burk, 1983; Barros et al., 2008; Garza et al., 2012). In the case of some of the medicinal species, we have carried out research searching for secondary metabolites with antimicrobial and anticancer activity in liver cells *in vitro* with very promising results (Garza et al., 2006).

Discussion

This study confirms the presence of a high diversity of edible, toxic and medicinal mushroom species in temperate forests in the North of Mexico. Oak and mixed oak pine forests had the higher diversity of species, as reported previously by (Pérez et al., 1986; Lafferriere and Gilbertson, 1992; Moreno et al., 1994; Quiñónez et al., 1999; Garza et al., 2002; North, 2002; García et al., 2014; Quiñonez and Garza 2015; Sánchez et al., 2015; García et al., 2017) and some species had been reported from Oak forests in several states. Many of the species found in this study have also been reported in Oak forests in Northeastern North America (Bessette et al., 1997; Bessette et al., 2007; Binion et al., 2008). Many of the fungal species have evolved from the Artic regions towards the south, those species from the West in the Sierra Madre Occidental are related to those species found in Southern parts of North America (e.g., California). According to Salinas et al. (2017), characteristics such as location, climate, physiography, soil types, geological age, karstic landscape, and wide range of elevations are important attributes for plant endemisms, including species in the Fagaceae in the Sierra Madre Oriental. These field characteristics and those from forests and trees themselves, together with management and conservation activities, are very important for the development of fungal growth in temperate forests in the North of Mexico (Garza et al., 1985; Garza et al., 2014; Quiñónez et al., 2014; Quiñonez and Garza, 2015). Regarding mushroom intoxications, individual health and susceptibility or immune response can play an important role in mushroom intoxications. Some individuals can develop allergic reactions even when eating edible cultivated species like the common champignon *Agaricus campestris* or *Pleurotus ostreatus*. When eating edible mushrooms, it is always recommended to eat only a little bit and when wanting to eat wild edible mushrooms one should always

count on the identification help of an expert, otherwise it is never recommended to risk a fatal reaction for a few mushrooms. Toxic species grow beside edible species as they can share tree hosts in the forests.

References

Allen, M.F., Egerton-Warburton, I., Tresede, K., Cario, C., Lnidahl, A., Lansing, J., Querejeta, J., Karen O., Harney, S. and Zink, T. 2005. Biodiversity of mycorrhizal fungi in Southern California, USDA forest Service Gen. Tech. Rep. PSW-GTR-195.

Barros, L., Ferreira, M.J., Queiros, B., Ferreira, I.C.F.R. and Baptista, P. 2008. Wild and commercial mushrooms a source of nutrients and nutraceuticals, Food Chem. Toxicol., 46: 2742–2747.

Bessette, A.E., Bessette, A.R. and Fischer, D.W. 1997. Mushrooms of Northern United States. Syracuse University Press, Syracuse, Beutler.

Bessette, A.E. Roody, W.C. Bessette, A.R. Dunaway, D.C. 2007. Mushrooms of southern United States. Syracuse University Press, Syracuse, Beutler.

Binion, D., Stephenson, S., Roody, W., Burdsall, H., Vasilyeva, L. and Miller, O.K. 2008. Mushrooms associated with oaks of Eastern North America. West Virginia University Press, Morgantown.

Boa, E. 2004. Wild Edible Fungi a Global Overview of Their Use and Importance to People, Food and Agricultural Organization, Rome.

Burk, W.R. 1983. Puffball usages among North American Indian. J. Ethnobiol., 3: 55−62.

Cázares, E., García, J. and Castillo, J. 1992. Hypogeous fungi from northern México. Mycologia, 84: 341−359.

Challenger, A. 1998. Utilización y conservación de los ecosistemas terrestres de México. Pasado, Presente y Futuro. Conabio.

Duffy, T. 2008. Toxic Fungi of Western North America. Published by Mykoweb.

Fischer, D. and Bassette, A. 1992. Edible wild mushrooms of North America. University of Texas Press, Austin.

Frank, J., Barry, S., Madden, J. and Southwork, D. 2007. Oaks belowground: Mycorrhizas, truffles and small mammals. USDA, Forest Service, Tech. Rep. PSW-GTR_217.

García, G., Valenzuela, R., Raymundo, T., García, L., Guevara, L., Garza, F., Cázares, E. and Ruiz, E. 2014. Macrohongos asociados a encinares (*Quercus* spp.) en algunas localidades del estado de Tamaulipas, México. Capitulo 5. En Biodiversidad Tamaulipeca 2, SEP, Instituto Tecnológico de Ciudad Victoria, Tam., Volye, 1: 103−140.

García, J. and Garza, F. 2001. Conocimiento de los hongos de la Familia Boletaceae de México. Revista Ciencia UANL Volume IV, # 3 Julio–Septiembre 2001, 336−343.

Garza, L., Ramírez, X.S., Garza, F., Salinas, M.C., Waksman, N., Alcaraz, Y. and Torres, O. 2006. Evaluación de la actividad biológica de extractos acuosos de macromicetos del Noreste de México. Revista Ciencia UANL, Volume IX, # 2.

Garza, F., García, J. and Castillo, J. 1985. Macromicetos asociados al bosque de *Quercus rysophylla* en algunas localidades del centro del estado de Nuevo León. Rev. Mex. Mic., 1: 423−437.

Garza, F. 1986. Hongos ectomicorrícicos en el estado de Nuevo León. Rev. Mex. Mic., 2: 197−205.

Garza, F., García, J., Estrada E. and Villalón, H. 2002. Macromicetos, ectomicorrizas y cultivos de *Pinus culminicola* en Nuevo León. Revista Ciencia UANL Volume V, # 2, Abril-Junio, 204−210.

Garza, F., Cázares González, E., Carrillo Parra, A., Garza Ocañas, L. and Quiñónez Martínez, M. 2012. Economía micológica en bosques templados y plantaciones: Un enfoque educativo-productivo para el desarrollo socioeconómico rural, el manejo sustentable y la conservación de los hongos silvestres comestibles de México. Capitulo 4 En: Economía en el manejo sustentable de los recursos naturales. U.A.N.L., 77−111.

Garza, F., Carrillo, A., Garza, L., Quiñónez, M., García, J. and Guevara, G. 2014. Técnicas para el manejo de hongos ectomicorrícicos: Del bosque al laboratorio y viceversa. En Técnicas en el manejo sustentable de los recursos naturales, UANL, FCF, 71−119.

González, S., González, M., Tena, J.A., Raucho, I. and López, I. 2012. Vegetación de la Sierra Madre Occidental, México: una síntesis. Acta Bot. Mex., 100: 351−403.

Groves, J.W. 1979. Edible and poisonous mushrooms of Canada. Research Branch Agriculture, Canada.

Guevara, G., Garza, F. and Cázares, E. 2004. Estudio del ITS nuclear de algunas especies del género Cantharellus de México. Revista Ciencia, UANL, 371−378.

Guevara, G. and Garza, F. 2005. Estudio de la subunidad mayor del ADN ribosomal nuclear de algunas especies del género *Cantharellus* de México. Rev. Mex. Micol., 20: 21−26.

Guevara, G., Cázares, E., Bonito, G., Healy, R., Stielow, B., Garcóa, J., Garza, F., Castellano, M. and Trappe, J. 2014. Hongos hipogeos de Tamaulipas, México. Capitulo 4. En Biodiversidad Tamaulipeca 2, SEP, Instituto Tecnológico de Ciudad Victoria, Tam., 1: 87−101.

Guzmán, G. 1998. Inventorying the fungi of México. Biodiver. Conserv., 7: 369−384.

Hall, I.R., Stephenson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber press.

Hallen, H. and Adams, G. 2002. Don´t pick poison when gathering mushrooms for food in Michigan. Michigan State University, Department of Plant Pathology. Bulletin # E-1080.

Halling, R. and Muller, G. 2002. Agarcis and Boletes of Neotropical Oakwoods. pp. 1−10. *In*: Watling, R., Frankling, J.C., Ainsworth, A.M., Isaac, S. and Robinson, C.H. (eds.). Tropical Mycology.

Hawsksworth, D.L. 2001. The magnitude of Fungal Diversity: 1.5 million species estimates revisited. Mycol. Res., 105: 1422−1432.

Heads, S., Miller, A., Crane, J., Thomas, M., Ruffatto, D., Methven, A., Raudabaugh, D. and Wang, Y. 2017. The oldest fossil mushroom. Plos. One 12: e0178327.

Hybbett, D. 2006. A phylogenetic overview of Agaricomycotina. Mycologia, 98: 917−925.

Kendrick, B. 1994. Evolution in action from mushrooms to truffles. Mc Ilvanea, 11: 34− 37.

Laferriere, E.J. and Gilbertson, R.L. 1992. Fungi of Nabogame, Chihuahua, México. Mycotaxon, 44: 73−87.

Leonard, P.L. 2010. A Guide to Collecting and Preserving Fungal Specimens for the Queensland Herbarium. Queensland Government. Department of environmental and research management. Brisbane.

Lindequist, U., Niedermeyer, T.H.J. and Jülich, W.D. 2005. The pharmacological potential of mushrooms, Evid. Based Complement. Altern. Med., 2: 285–299.

Lyncoff, G. and Mitchell, D.H. 1977. Toxic and Hallucinogenic Mushroom Poisoning—A Handbook for Physicians and Mushrooms Hunters. Van Nostrand Reinhold Company, New York.

Moreno-Fuentes, Aguirre-Acosta, A.E., Villegas, M. and Cifuentes, J. 1994. Estudio fungístico de los macromicetos en el municipio de Bocoyna, Chihuahua, México. Rev. Mex. Mic., 10: 63−76.

Morrone, J., Escalante, T. and Rodriguez, G. 2017. Mexican biogeographic provinces: Map and shapefiles. Zootaxa, 4277: 277−279.

Müller, G., Haling, R., Carranza, J., Mata, M. and Schmidt, J.P. 2006. Saprotrophic and ectomycorrhizal macrofungi of Costa Rican Oak forests. pp. 55−68. *In*: Kappelle, M. (ed.). Ecology and Conservatrion of Neotropical Montane Oak Forests. Springer Verlag, Berlin.

North, M.P. 2002. Seasonality and abundance of truffles from Oak woodlands to red Fir Forests. USDA Forest Service Tech. Rep. PSW-GTR-183.

Olimpia Mariana García-Guzmán, O., Garibay-Orijel, R., Hernández, E., Arellano-Torres, E. and Oyama, K. 2017. Word-wide meta-analysis of *Quercus* forests ectomycorrhizal fungal diversity reveals southwestern Mexico as a hotspot. Mycorrhiza, 27: 811−822.

Peinado, M., Bartolome, C., Delgadillo, J. and Aguado, I. 1994. Pisos de vegetación de la Sierra de San Pedro Martir, Baja California, México. Acta Bot. Mex., 29: 1−30.

Pérez-Silva, E. and Aguirre-Acosta, E. 1986. Flora Micológica del estado de Chihuahua, México I. Inst. Biol., 57: 17−32.

Quiñonez, M., Garza, F., García, J., Saenz, J. and Mendoza, J. 1999. Guía de Hongos de la región de Bosque Modelo. Universidad Autónoma de Chihuahua, Facultad de Zootecnia, Gobierno del Estado de Chihuahua.

Quiñónez, M., Garza, F., Sosa, M., Lebgue, T., Lavin, P. and Bernal, S. 2008. Índices de diversidad y similitud de hongos ectomicorrizógenos en bosques de Bocoyna, Chihuahua, México. Revista Ciencia Forestal en México. Volyme 33(103).

Quiñonez, M., Ruan, F., Aguilar, I., Garza, F., Lebgue, T., Lavin, P.A. and Enriquez, I. 2014. Knowledge and use of edible mushrooms in two municipalities of the Sierra Tarahumara, Chihuhua, México. J. Ethnobiol. Ethnomed., 10: 1−13.

Quiñonez, M. and Garza, F. 2015. Hongos silvestres comestibles de la Sierra Tarahumara de Chihuahua. Fomix-Conacyt, Universidad Autónoma de Ciudad Juárez.

Ramírez Gómez, XS., Garza Ocañas, L., Garza Ocañas, F. and Salinas Carmona, M.C. 2006. Evaluación de la citotoxicidad selectiva, actividad antioxidante e immunomoduladora de macromicetos del Noreste de México. Revista Ciencia UANL. Volume IX (1).

Retallack, G. and Landing, E. 2014. Afinities and arquitectura of Devonian trunks of *Prototaxites loganii*. Mycologia, 106: 1143−1158.

Salinas, M.M., Estrada, A.E. and Villarreal, J.A. 2017. Endemic vascular plants of the Sierra Madre Oriental, México Phytotaxa, 328: 1–52.

Sánchez, N., Soria, I., Romero, L., López, M., Rico, R. and Portillo, A. 2015. Los hongos Agaricales de las áreas de encino del estado de Baja California, México. Estudio de Diversidad Volumen IUniversity of Nebraska, Lincoln, 215−226.

Sánchez, S., Tulloss, R.E. Guzman, L., Valos, N-Da, Cifuentes, J., Valenzuela, R., Estrada, A., Ruan, F., Diaz, R., Hernández, N., Torres, M., Leo, H. and Moncalvo, J.M. 2015. In and out of refugia: historical patterns of diversity and demography in the North American Caesar's mushroom species complex. Mol. Ecol., 24: 5938–5956.

Sarukhán, J., Urquiza-Haas, T., Koleff, P., Carabias, J., Dirzo, R., Ezcurra, E., Cerdeira-Estrada, S., and Soberón, J. 2015. Strategic actions to value, conserve, and restore the natural capital of Megadiversity Countries: The case of Mexico. *In*: Bioscience A Forum for Integrating the Life Sciences. Am. Inst. Biol. Sci., 65(2).

Singer, R., Araujo, I. and Ivory, M. 1983. The ectotrophycally mycorrhizal fungi of the Neotropical Lowlands, Especially Central Amazonia Forests 2, J. Cramer, Vaduz.

Villarreal, J.A., Encina, J.A. and Carranza, M.A. 2008. Los encinos (*Quercus*: Fagaceae) de Coahuila, México. J. Bot. Res. Inst. Texas, 2: 1235–1278.