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## Useful wild fungi of La Malinche National Park, Mexico

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This study presents a list of 93 fungi species collected from La Malinche National Park, Tlaxcala, Mexico. The fungi were gathered mainly during the rainy seasons of 1988-2002. Of the species identified, 10 were *Ascomycota*, 82 *Basidiomycota* and one *Myxomycota*. This study provides information about the habitat, phenology and life forms of the species studied. Furthermore, an ethnobiological technique known as free listing was used to identify the most important species of fungi for 84 people living on the volcano called La Malinche. *Boletus pinophilus* was the species the respondents mentioned most frequently. No differences were observed between males and females in terms of the fungi they were familiar with. There were, however, some differences in the species mentioned by the people of Javier Mina and San Isidro Buensuceso, two towns on the slopes of La Malinche.

**Key words:** biodiversity, ethnomycology, Mexican fungi, non-timber forest products.

### Introduction

La Malinche National Park (Volcán la Malintzi, 4,460 m) is located in the southern part of the state of Tlaxcala – with the southern face abutting the state of Puebla (Acosta and Kong, 1991) – and is part of the Mexican Transvolcanic Belt. This park is one of the most important areas of vegetation in this geographical zone because it has conifer forests that are home to a great variety of wild mushrooms (Acosta and Kong, 1991) (Fig. 1). Located between northern latitudes 19° 55' and 19° 08' and between western longitudes 97° 20' and 97° 08', the park covers 133,000 hectares, of which 33,000 belong to the state of Puebla and 100,000 to Tlaxcala. The park's climate is temperate subhumid, with a rainy season in the summer [C(w<sub>2</sub>)(w)]; the

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pressure/temperature ratio is 41.9 and there is little annual variation in average monthly temperatures, with fluctuations between 5 and 7°C. The annual mean temperature is 15.3°C. May is the hottest month (mean temperature = 17.7°C) and January is the coldest (mean temperature = 11°C), (INEGI, 1987). The rainy season is from May to November. As Ern (1976) described it, the area's type of vegetation consists of coniferous forest, including *Pinus montezumae* Lamb, *P. teocote* Schl. & Chamb., *P. hartwegii* Lindl (the latter is found only in the highest parts), mixed with *Alnus jorullensis* HBK., *Quercus laurina* H. & B. and *Q. crassifolia*. Sometimes, one might also find *Abies religiosa* (HBK.) Chamb. & Schl., mixed with a few individual specimens of *P. montezumae*, *P. hartwegii*, *Salix cana* Mart. & Gal., *S. paradoxa* HBK. and *Juniperus monticola* Mart.

The forests of the state of Tlaxcala, and particularly those on La Malinche volcano, support a huge diversity of wild mushrooms (Santiago-Martínez *et al.*, 1990; Acosta and Kong, 1991; Kong, 1998), many of which the local people find very useful (Fig. 2). The species of mushrooms found in this region, and how they are used, have been insufficiently documented to date.

Only a few studies of local mushrooms and their uses have been published in Tlaxcala. Herrera and Guzmán (1961) reported *Morchella esculenta* and *Laccaria laccata* from La Malinche in their study of the edible mushrooms from the markets of central Mexico. González-Fuentes (1987) listed 46 edible species growing in Tlaxcala and described nine that were of economic significance to the local people. Finally, Montoya (1998) identified 71 mushroom species, providing their traditional names and presenting information on their uses in the state of Tlaxcala. This study, however, did not specifically enumerate the species of La Malinche.

Given the scarcity of information in this area, the objective of this work is to identify the species of useful wild mushrooms that grow in La Malinche National Park and to determine their cultural significance to local inhabitants.

## **Materials and methods**

To collect mushrooms, the authors made weekly field trips to La Malinche during the rainy seasons of 1988 to 2002 (May to October). Most of these field trips were made to the volcano's eastern and western slopes during an ecological study of edible wild mushrooms found in La Malinche National Park. The study materials were wild mushrooms used by the locals and also some mushrooms reported as edibles in the available literature. The authors collected both mature and young examples of each species, taking them to the



**Fig. 1.** View of La Malinche volcano, Tlaxcala state. **Fig. 2.** Trini, young mushroom picker in La Malinche National Park. Rainy season of 1999.

laboratory wrapped in wax paper. The mushrooms were then photographed, sorted, dehydrated for 48 hours in an electric mushroom dryer and deposited in TLXM herbarium (Holmgren and Holmgren, 1995).

To identify the mushrooms under study, several different taxonomic keys were used, depending on the genus studied, primarily: Romagnesi (1967), Marr and Stuntz (1973), Singer (1975), Jenkins (1986), Bon (1987), Abott and Currah (1988), Tulloss (1998) and Moser (1983). The classification used is based on that proposed by Kirk *et al.* (2001). The mycorrhizal status of some species was based on Molina *et al.* (1992). Abbreviations of collector names are as follow: *AM* for Adriana Montoya, *AK* for Alejandro Kong, *AET* for Arturo Estrada-Torres, *ECC* for Enrique Conde Cano, *LHD* for Lorena Hernández Díaz, *LJS* for Lorena Juárez Sánchez, *HV* for Nuri Hernández Valencia, and *OHT* for Oscar Hernández Totomoch. Primarily interviewing of various people in Ixtenco, Francisco Javier Mina, Los Pilares and San Isidro Buensuceso identified information about the traditional uses of each species.

### ***The cultural significance of wild mushrooms***

One indicator of the cultural significance of mushrooms was how often the 84 people chosen at random for this study (Bernard, 1988) mentioned them, using a free listing technique (Weller and Romney, 1988). This technique indicates that the factors mentioned by a majority of respondents can be of major significance to a community. For this current study, 44 people from San Isidro Buensuceso were chosen to take part, as well as 40 from Francisco Javier Mina. Structured interviews (Alexiades, 1996) were conducted, primarily with husband and wife pairs. Each person was asked, independently, to list 20 names of mushrooms they were familiar with. The information obtained was used to determine the frequency of mention for each species of edible mushrooms collected (Weller and Romney, 1988; Bernard, 1988). A Chi-Square analysis was carried out to compare: a) the number of times each species was mentioned by men and by women and b) the number of times each species was mentioned by those interviewed in the two towns studied. We assumed that there are no differences between sexes nor between the two communities, that is to say, there is a relationship of 1:1 in the frequency of mention between men and women and between the inhabitants of each town. In terms of the comparison between the two localities the Chi-Square analysis was done based on a ratio of 52.4:47.6, owing to the differences in the size of the samples used.

## Results and discussion

A total of 44 genera and 93 species of useful fungi were identified, which are shown in Appendix 1 in taxonomic order. The mushrooms studied were distributed taxonomically as follows: five genera and 10 species belonging to Phylum *Ascomycota*; 38 genera and 82 species belonging to Phylum *Basidiomycota*; and one genus and one species to Phylum *Myxomycota*. The mushrooms identified were distributed among 30 families, of which most of the species belonged to the following families: *Russulaceae*, with 15 (five of *Lactarius* and ten of *Russula*); *Ramariaceae*, with 13 (one of *Gautieria* and 12 of *Ramaria*); *Pluteaceae*, with nine (eight of *Amanita* and one of *Pluteus*); and *Helvellaceae* with five (species of *Helvella*). Of the species identified in this study, 67 were mycorrhizal, 20 were Saprobitic, five were parasitic and one was a holozoic.

Twenty species were found exclusively in forests of *Abies religiosa*, 36 in forests of *Pinus-Alnus* and one associated with *Quercus*. Sixteen species were found in the *Abies-Pinus* forests, two in *Pinus-Quercus* forests and two in mixed forests. Two species were found in *Pinus* and also in *Quercus* forests, eight in *Abies* and also in *Pinus* forests, one in *Pinus-Alnus* and in *Pinus-Quercus* forests, two in open areas and three in cultivated agricultural land (one in *Quercus* trunks).

Mushrooms begin to fruit in May and June and finish in October to November, depending on the prevailing conditions. Certain species begin to fruit at the beginning of the season, such as: *Agaricus campestris*, *Amanita fulva*, *A. tuza*, *Clitocybe odora* and *Hypomyces lactifluorum*. Others appear in the later months of the rainy season, such as: *Amanita rubescens*, *Armillaria mellea*, *Cantharellus cibarius*, *Gomphus floccosus*, *Gymnopus dryophilus*, *Helvella* spp., *Hygrophorus chrysodon*, *Lactarius indigo*, *Morchella* spp., *Tricholoma equestre* and *Ustilago maydis*. Still others can be found during almost the entire rainy season, such as: *Boletus pinophilus*, *Hygrophoropsis aurantiaca*, *Laccaria trichodermophora*, *Lyophyllum* spp., *Melanoleuca melaleuca*, *Pholiota lenta*, *Russula* spp. and *Suillus* spp. Some species begin to appear only when the rains are well under way, such as *Amanita caesarea*. Events such as forest fires can also stimulate the growth of certain mushrooms for longer periods, as is the case with *Hebeloma mesophaeum* and *Morchella elata*. With respect to the phenology of those species, it is necessary to carry out a large number of systematic studies over several years to be able to determine the exact time of their fruiting and how long they last.

Of the 93 species found, 91 are reported as edible in current literature. Seventy-four species are actually used for food in La Malinche National Park

and 17 are not known locally as edibles. *Lycoperdon perlatum* and *Ustilago maydis* are used for traditional medicinal purposes. *Ustilago maydis* is also used for cosmetic purposes. *Fomitopsis pinicola* is used to decorate Nativity scenes at Christmas time. Woodcutters and other people who work in the forest also use *Fomitopsis pinicola* as kindling, to light fires (for preparing meals or to provide warmth) and *Amanita muscaria* is used as insecticide (Montoya *et al.*, 2002).

The different species that grow during the rainy season can add considerable variety to the diet of the local people. Not only can people choose among different tastes and consistencies, the different species also add important nutrients (such as proteins and vitamins) to their diets (Moreno-Zárate, 1990; Longvah and Deosthale, 1998). This is of great importance to people in the rural areas.

The mushrooms also make an important contribution to the income earned by the families in the local communities. Various mushrooms growing on La Malinche during the rainy season can be sold for high prices, such as *Boletus pinophilus*. This income can be supplemented by selling other mushrooms that fetch lower prices but are available in greater abundance, such as *Hebeloma mesophaeum*.

### ***List of species***

*Ascomycota*

*Ascomycetes*

*Hypocreales*

*Hypocreaceae*

*Hypomyces lactifluorum* (Schwein.) Tul. & C. Tul.

Parasitic on *Russula*, in forests of *Pinus* and *Quercus*. Collected in June and July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Apizaco, market of Apizaco, collected in the slopes of La Malinche Volcano, LMNP. Quercus forest, 21-VII-1989, AM 353; Municipality of Huamantla, market of Huamantla, collected in La Malinche National Park, *Pinus-Alnus* forest, 07-VII-1997, AM 1589.

*Pezizales*

*Helvellaceae*

*Helvella acetabulum* (L.) Quél.

Mycorrhizal, in *Abies-Pinus* forest collected in September and October. Considered edible by only a few people in La Malinche National Park (LMNP).

## Fungal Diversity

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolochocho, west slope of the Malintzi volcano, La Malinche National Park, 27-X-1998, AM 1707B; *Ibid.* 06-IX-2000, AM 06-IX-2000-2.

### *Helvella crispa* (Scop.) Fr.

Mycorrhizal, in *Abies* forests. Collected from the end of August until the middle of October. Considered edible by only a few people in La Malinche National Park (LMNP).

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolochocho, West slope of the Malintzi volcano, La Malinche National Park, 01-IX-1997, OHT 19; *Ibid.* 10-VII-1997, AM 1612; *Ibid.* 10-X-1998, AM 1686B; *Ibid.* 11-XI-1998, AM 1707A, *Ibid.* 06-IX-2000, AM 06-IX-2000-1.

### *Helvella elastica* Bull.

Mycorrhizal, in *Abies-Pinus* forests. Collected from the middle of August until October. Considered not edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 22-IX-1999, AM 1735B.

### *Helvella infula* Fr.

Mycorrhizal, in *Abies* forests. Collected from the beginning of September until the middle of October. Considered edible by only a few people in La Malinche National Park (LMNP).

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 27-X-2000, AM 1736A; Municipality of San Luis Teolochocho, west slope of the Malintzi volcano, La Malinche National Park, 02-IX-1999, AM 1735C.

### *Helvella lacunosa* Afzel.

Mycorrhizal, in *Abies* and *Pinus-Alnus* forests. Collected from the middle of August until October. Considered edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, *Abies* forest, 01-IX-1999, AM 1720B; Municipality of San Luis Teolochocho, west slope of the Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 28-VIII-2000, AM 1742A; *Ibid.* *Abies* forest, 01-IX-1997, OHT 20.

## *Morchellaceae*

### *Morchella elata* Fr.

Saprobic, in *Abies* and *Pinus-Alnus* forests in recently burned areas. Edible and for sale.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolochocho, west slope of the Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 15-IX-

1997, OHT 31; *Ibid.* 05-X-1998, AM-05-X-1998; *Ibid.* *Abies* forest 14-X-1998, AM 14 X-1998-1; *Ibid.* 05-X-1998, AM 05-X-1998.

*Morchella esculenta* (L.) Pers.

Saprobic, in *Abies* forests. Collected from the middle of August to November. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 14-X-1998, AM 14-X-1998; *Ibid.* 13-VIII-2000, AM 13-VIII-2000, *Ibid.* 28-VIII-2000, AM 28-VIII-2000.

*Pezizaceae*

*Sarcosphaera crassa* (Santi) Pouzar.

Saprobic, in *Abies* forests. Collected from the beginning of July to the end of October. Considered edible by few persons in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 11-XI-1998, AM 11-XI-1998, *Ibid.* 07-VII-2000, AM 07-VII-2000.

*Pyronemataceae*

*Geopora* sp.

Mycorrhizal, in *Pinus-Alnus* forests. Not considered edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 19-VI-2000, AM 1738.

*Basidiomycota*

*Basidiomycetes*

*Agaricales*

*Agaricaceae*

*Agaricus augustus* Fr.

Saprobic, in *Pinus-Alnus* forests. Collected at the beginning of July. Considered edible by only a few people in LMNP, for sale in the Huamantla market.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, around of lodging IMSS, La Malintzi, National Park of La Malinche, 3000 m alt., 04-VII-2002, AM 1760.

*Agaricus campestris* L.

Saprobic, in open areas. Collected from June to the beginning of July. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, near Francisco Javier Mina, open areas, without date, HV 01; *Ibid.* 03-VII-1998, AM 1644, *Ibid.* 07-VII-2002, AM 1750.



*Bolbitiaceae*

*Hebeloma mesophaeum* Fr.

Mycorrhizal, in *Pinus-Alnus* forests. This mushroom has been cited in other Mexican studies as *Hebeloma fastibile*. The authors of those studies found that the mushroom has the same traditional names (Guzmán, 1997) as those described in Tlaxcala (Montoya *et al.*, 2002). Several samples studied in the State of Mexico appear to have the same characteristics as the samples collected on LMNP. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 03-VII-1998, AM 1643.

*Cortinariaceae*

*Cortinarius glaucopus* (Schaeff.) Fr.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in June. Considered edible by only few people in LMNP. This species is found for sale in the Tlaxcala market.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 13-VI-2000, AM 13-VI-2000; *Ibid.* 28-VI-2000, AM 28-VI-2000; *Ibid.*, 07-VII-2000, AM 07-VII-2000-2.

*Entolomataceae*

*Entoloma clypeatum* (L.) P. Kumm.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 26-X-1998, AM 1706A; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 21-VI-2000, AM 1714A.

*Hydnangiaceae*

*Laccaria amethystina* Cooke.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 09-IX-2000-1, AM 1745.

*Laccaria trichodermophora* G.M. Muell.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from June to October. Edible and for sale.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 01-IX-1997, OHT 18; *Ibid.* 19-VIII-2000, AM 19-VIII-2000-1; *Ibid.* 25-VII-2001, AM 1715A; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 01-09-1999, AM 1720A.

### *Lycoperdaceae*

*Calvatia cyathiformis* (Bosc) Morgan.

Saprobic, outside forests, in open areas. Collected in June. Edible and for sale.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, near Francisco Javier Mina, slopes of the Malintzi Volcano, 03-VII-1989, AM 329; *Ibid.* 03-VII-1998, AM 330.

*Lycoperdon perlatum* Pers.

Saprobic, in *Pinus-Alnus* forests. Edible and for sale. Also used for traditional medicine by the people of the region (Montoya *et al.*, 2002).

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 09-IX-2000, AM 1743; Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 10-VII-1997, OHT 14.

### *Marasmiaceae*

*Armillaria mellea* (Vahl) P. Kumm.

Parasitic on *Quercus* trunks. Collected in July. Considered edible by only a few people in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 3000 m alt., 05-VII-2001, AM 1742.

### *Pleurotaceae*

*Pleurotus opuntiae* (Durieu. & Levillé) Sacc.

Parasitic, in agricultural areas, on maguey plants. Collected in June. Edible and for sell.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Huamantla, near Altamira, La Malinche Volcano, 22-06-1991, AM 974A.

### *Pluteaceae*

*Amanita caesarea* (Scop.) Pers.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to September. Edible and for sale. From a taxonomic point of view, this species belongs to a complex that includes at least 7 taxa used in Mexico (Guzmán and Ramírez-Guillén, 2001). In this study, this species was identified in a larger sense,

considering the necessity of defining with great precision the characteristics of the mushrooms of this group, collected on La Malinche volcano.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 3300 m alt., 05-VIII-1998, AM1664A; *Ibid.* 23-IX-1998, 1686A. Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 3000 m alt., 07-X-97, AM 1598.

*Amanita calypratoides* Peck.

Mycorrhizal, found near roadsides, *Pinus-Alnus* forest. Collected in September. Considered edible by only few people in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 3000 m alt., 14-IX-1998, AM 1682.

*Amanita franchetii* (Boud.) Fayod.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to October. Considered edible by only few people in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 3300 m alt., 19-VI-2000, AM 1741A; *Ibid.* 14-VII-2000, AM 14-VII-2000-2.

*Amanita fulva* (Schaeff.).

Mycorrhizal, in *Pinus-Alnus* forests. Collected in June and July. Considered edible by only few people in LMNP. This species was found for sale in the Tlaxcala market. This species, belongs to a complex of species difficult to separate (Tulloss, 1994). The species is named in a larger sense in this paper.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 3000 m alt., 21-V-2000, AM 1740A; *Ibid.* 14-VII-2001, AM14-07-2000-1.

*Amanita muscaria* (L.) Hook.

Mycorrhizal, in *Pinus-Alnus* and *Abies* forests. Collected from July to October. Considered poisonous by all people interviewed in LMNP, the main use of this species is as insecticide (to kill flies).

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 3300 m alt., 27-VII-1994, AM 1463; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 3000 m alt., 10-07-1997, OHT 13. Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 31-VIII-1989, AM 502; *Ibid.* *Abies* forest, 17-VII-1991, AM 1007.

*Amanita rubescens* (Pers.) Gray.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from August to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 22-IX-1999, 1735A; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 14-X-1998, AM 1697A.

*Amanita tuza* Guzmán.

Mycorrhizal, growing near roadsides in *Pinus-Alnus* forest or in agricultural areas near *Pinus-Alnus* forests. Collected in July. Not considered edible by the persons interviewed.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, without date, LJS 01; *Ibid.* 15-VII-1998, LJS 05; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 17-VI-2001, AM 1747.

*Amanita vaginata* (Bull.) Vitt.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in September. Considered edible by only few people in LMNP. It is thought that this species belongs to a complex of species and requires a precise study to define the number of taxa growing in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 08-VII-1995, AM 1529; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 05-VIII-1998, AM 1665.

*Pluteus atricapillus* (Batsch) Fayod.

Saprobic, in *Abies-Pinus* forests. Collected from June to October. Considered not edible by the persons interviewed.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 03-IX-1998, AM 1671.

*Strophariaceae*

*Pholiota lenta* (Pers.) Singer.

Saprobic, in *Pinus-Alnus* forests. Collected from June to October. Considered not edible by the persons interviewed. This species is collected and also found for sale in the Tlaxcala market.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 3000 m alt., 19-VIII-1999, AM 1712; *Ibid.* without date, LJS 06; Municipality of Tlaxcala, Tlaxcala market, collected in LMNP, 17-X-1998, AM 1702.

*Stropharia coronilla* (Bull.) Fr.

Saprobic, in *Pinus-Alnus* forests. Collected from June to October. Considered not edible in LMNP. This species is collected and also found for sale in the Tlaxcala market.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Huamantla, Huamantla Market, collected in LMNP, 27-IX-1990, AM 849.

*Tricholomataceae*

*Clitocybe gibba* (Pers.) P. Kumm.

Saprobic, in *Abies* forests. Collected from August to October. Edible and for sale.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 08-VIII-1990, AM 809; Municipality of Huamantla, market of Huamantla, collected in La Malinche National Park, 22-VIII-1990, AM 822; Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, without date, ECC 03; *Ibid.* 06-IX-2000, AM 06-IX-2000.

*Clitocybe odora* (Bull.) Fr.

Saprobic, in *Abies* forests. Collected from June to August. Considered not edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 08-X-1994, AM 08-X-1994.

*Floccularia albolaripes* (G.F. Atk.) Redhead.

Mycorrhizal, in *Abies-Pinus* forest. Considered not edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 02-IX-1988, AET 2300; *Ibid.* 30-V-1990, AET 2942.

*Gymnopus dryophilus* (Bull.) Murrill.

Saprobic, in *Pinus-Alnus* forests. Collected from July to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 09-IX-2000, AM 1744.

*Hygrophorus chrysodon* (Batsch) Fr.

Mycorrhizal, in *Abies* forests. Collected from August to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 13-VIII-2000, AM 13-VIII-2000-1.

*Hygrophorus hypothejus* Fr.

Mycorrhizal, in *Abies*-*Pinus* forest. Collected from August to October. Considered not edible in LMNP.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 05-X-1989, AET 2848; *Ibid.* 25-VI-1999, AET 3024.

*Hygrophorus purpurascens* (Alb. & Schwein.) Fr.

Mycorrhizal, in *Pinus*-*Alnus* forests. Collected from June to October. Considered edible by only a few people in LMNP.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 09-IX-2000, AM 1746; *Ibid.* 25-VI-2000, AM 25-VI-2000.

*Lyophyllum decastes* (Fr.) Singer.

Saprobic, in *Pinus*-*Alnus* forests. Collected from June to October. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 21-VI-2000, AM 1741, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 07-VI-2002, AM 1751.

*Lyophyllum fumosum* (Pers.) P.D. Orton.

Saprobic, in *Pinus*-*Alnus* forests. Collected in June and July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 21-VI-2000, AM 1740.

*Lyophyllum* sp. 1.

Saprobic, in *Abies* and *Pinus*-*Alnus* forests. Collected in July and August. Edible and for sale. With the genus *Lyophyllum*, it is necessary to make more detailed taxonomic studies throughout Mexico because the specimens collected on LMNP have a lot of variations and it is difficult to identify them precisely with foreign sources. It seems the same thing happens in other states of Mexico, for example, in the state of Mexico (Estrada-Martínez\*, pers. comm.). This species has a great significance, partly because of its abundance and because people really like its taste. Therefore, more taxonomic studies are required.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 15-VII-1998, AM 15-VII-1998.

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\*Corresponding author: Estrada-Martínez, E. Herbario de la División de Ciencias Forestales, Universidad Autónoma de Chapingo, Estado de México, México. October 2002.

*Melanoleuca melaleuca* (Pers.) Murrill.

Saprobic, in *Abies* and *Pinus-Alnus* forests. Collected from June to October. Considered edible by only few people in LMNP. This species can be found in the Tlaxcala market.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 3120-3180 m alt., *Pinus-Alnus* forest, 13-VII-1998, AK 2953; *Ibid.* without date, LJS 03; *Ibid.* *Abies* forest 06-IX-2000, AM 06-IX-2000-4.

*Tricholoma equestre* (L.) P. Kumm.

Mycorrhizal, in *Abies-Pinus* forests. Collected from August to October. Edible and for sale.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi Volcano, La Malinche National Park, 04-X-1999, AET2306.

*Auriculariales*

*Auriculariaceae*

*Auricularia auricula* (Hook. F.) Underw.

Saprobic, in *Abies* forests. Collected in June and in August. Considered not edible in LMNP.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, without date LHD 53; *Ibid.* 21-V-1994, AM 1403; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 19-VIII-2000, AM 19-VIII-2000.

*Boletales*

*Boletaceae*

*Boletus atkinsonii* Peck.

Mycorrhizal, in *Pinus-Alnus* and *Pinus-Quercus* forests. Collected since June to September. Edible and for sell.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 03-IX-1998, AM 1672; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, *Pinus-Quercus* forest, 04-VII-1997, AM 1595.

*Boletus luridiformis* Rostk.

Mycorrhizal, in *Abies-Pinus* forests. Collected in August and in October. Eaten by only a few people in LMNP. Most people consider it poisonous because it turns blue when touched.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 18-VII-1988, AET 2118.

*Boletus luridus* Schaeff.

Mycorrhizal, in mixed forest (*Abies-Pinus-Alnus-Arbutus*). Collected in July. Considered not edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 07-VII-2000, AM 07-VII-2000-1.

*Boletus pinophilus* Pilát. & Dermek.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from June to September. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 04-X-1989, AM 542; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 01-IX-1997, OHT 22.

*Leccinum aurantiacum* (Bull.) Gray.

Mycorrhizal, in mixed forest (*Pinus-Abies-Alnus-Quercus*). Considered not edible in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 10-VII-1997, AM 1606.

*Gomphidiaceae*

*Chroogomphus jamaicensis* (Murrill) O.K. Mill.

Mycorrhizal, in *Pinus-Alnus* forests. Edible. Collected from June to October.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 01-IX-1997, OHT 21.

*Hygrophoropsidaceae*

*Hygrophoropsis aurantiaca* (Wulfen) Maire.

Saprobic, in *Abies* and *Pinus-Alnus* forests. Collected from June to September. Considered not edible in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 20-VII-1998, AM 1656.

*Rhizopogonaceae*

*Rhizopogon* aff. *michoacanicus* Trappe & Guzmán.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in August. Considered edible by only few people in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, southwest of Los Pílares, Malintzi volcano, La Malinche National Park, 04-VII-1989, AM 397.



*Rhizopogon* sp.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from May to August. Considered edible by only few people in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 15-VI-2000, LJS 20; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 13-VIII-2000, AM 13-VIII-2000-3.

*Suillaceae*

*Suillus glandulosipes* Thiers & A.H. Sm.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in June. Edible.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 28-VI-2000, AM 28-VI-2000-1.

*Suillus granulatus* (L.) Snell.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in July. Edible.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, southwest of Los Pilares, La Malintzi volcano, La Malinche National Park, 28-VII-1989, AM 377 A; Municipality of Huamantla, market of Huamantla, 19-IX-1990, AM 845.

*Suillus pseudobrevipes* A.H. Sm. & Thiers.

Mycorrhizal, in *Pinus-Quercus* forests. Collected from June to October. Edible.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 15-VII-1998, AM 1648; *Ibid.* 13-VI-2000, AM 13-VI-2000; *Ibid.* 27-V-1992, AM 1122; Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, 24-X-1996, AM 1580.

*Suillus tomentosus* (Kauffman) Singer.

Mycorrhizal, in *Pabies-Pinus* forests. Collected in July. Edible.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 17-VII-1991, AM 1009.

*Cantharellales*

*Cantharellaceae*

*Cantharellus cibarius* Fr.

Mycorrhizal, in *Abies* and *Pinus-Alnus* forests. Collected in September and in October. Edible and for sale.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocho, west slope of the Malintzi volcano, La Malinche National Park, *Abies* forest, 01-IX-1997, OHT 25; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, *Pinus-Alnus* forest, 27-VII-1990, AME 738.

*Phallales*

*Gomphaceae*

*Clavariadelphus truncatus* Donk.

Mycorrhizal, in *Abies* forests. Collected in August and September. Considered edible by only few people in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 22-IX-1999, AM 1735C; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 02-IX-1999, AM1720C.

*Gomphus floccosus* (Shwein.) Singer.

Mycorrhizal, in *Abies* forests. Collected from August to October. Edible and for sale. Although this species was described as slightly toxic by Lincoff and Mitchel (1977), it appears people in LMNP do not have any problem eating it; surprisingly it is the most popular species in San Isidro Buensuceso.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 25-VII-2001, AM 1747C.

*Ramariaceae*

*Gautieria mexicana* (Fisher) Zeller & Dodge.

Mycorrhizal, in *Pinus-Alnus* forests. Considered edible by only few people in LMNP. A study of hypogeous mushrooms that grow in LMNP was done by Urive-Arróyave (1998). That author concluded that the spores of the *Gautieria mexicana* samples studied had several differences in size compared to the spores reported in the literature.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 26-VI-1997, AM 1591.

*Ramaria bonii* Estrada.

Mycorrhizal, in *Abies-Pinus* forests. Collected in July. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 10-VII-1997, AM 1599; *Ibid.* 10-VII-1997, AM 1604.

*Ramaria cystidiophora* var. *fabiolens* Marr & Stuntz.

Mycorrhizal, in *Abies-Pinus* forests. Collected in July. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 04-VIII-1989, AET 2618; Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 25-VI-2001, AM 1715D.

*Ramaria flavobrunnescens* (G.F. Atk.) Corner.

Mycorrhizal, in *Abies-Pinus* forests. Collected in July. Edible and for sale.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 02-IX-1988, AET 2499; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 13-VIII-2000, AM 1715B.

*Ramaria gracilis* (Fr.) Quél.

Mycorrhizal, in *Pinus-Alnus-Arbutus* forests. Collected in June. Edible and for sale.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 30-VII-1990, AM 760.

*Ramaria rasilispora* var. *scatesiana* Marr & Stuntz.

Mycorrhizal, in *Abies-Pinus* forests. Collected in June. Edible and for sale.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 15-IV-1998, AET 2534; *Ibid.* 31-VIII-1989, AET 2757; *Ibid.* 04-X-1989, AET 2843; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 07-VI-2002, AM 1748.

*Ramaria rubiginosa* Marr. & Stuntz.

Mycorrhizal, in *Abies-Pinus* forests. Collected in July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolochoico, west slope of the Malintzi volcano, La Malinche National Park, 31-VII-2002, AM 1747B.

*Ramaria rubricarnata* (Pers.) Quél.

Mycorrhizal, in *Abies* forests. Collected in July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolochoico, west slope of the Malintzi volcano, La Malinche National Park, 17-VII-2002, AM 1762.

*Ramaria rubripermanens* Marr & Stuntz.

Mycorrhizal, in *Abies* forests. Collected in July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 15-IX-1998, AET 2353; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 18-V-1990, AME 608, *Ibid.* 30-V-1990, AME 636; *Ibid.* 25-VII-2001, AM 1715C; Municipality of San Luis Teolochoico, west slope of the Malintzi volcano, La Malinche National Park, 25-VII-2001, AM 1747A.

*Ramaria cf. testaceoflava* (Bres.) Corner.

Mycorrhizal, in *Abies* forests. Collected in July. Edible and for sale.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 17-VII-2002, AM 1763.

*Ramaria versatilis* Quéf.

Mycorrhizal, in *Quercus* forests. Collected in July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 25-VII-2001, AM 1766.

*Ramaria* sp. 1 (Subgenus *Laeticolora*).

Mycorrhizal, in *Abies* forests. Collected in July. Edible and for sell.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 10-IX-1998, AM 1681.

*Ramaria* sp. 2 (Subgenus *Laeticolora*).

Mycorrhizal, in *Abies-Pinus* forests. Collected in July. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 09-IX-1992, AET 3434.

## *Polyporales*

### *Fomitopsidaceae*

*Fomitopsis pinicola* (Sw.) P. Karst.

Saprobic, on *Pinus-Alnus* forest. Used as kindling and to decorate Nativity scenes at Christmas time by the people of the region (Montoya *et al.*, 2002).

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 19-VII-1991, AM 1032; *Ibid.* 28-VIII-1991, AM 1065.

### *Hapalopilaceae*

*Climacocystis borealis* (Fr.) Kotl. & Pouzar.

Parasitic, in *Pinus-Alnus* forests. Collected in August. Considered edible by only a few people in LMNP.

*Specimens examined*: MÉXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 23-VIII-1991, AK 2099.

*Russulales*

*Russulaceae*

*Lactarius chelidonium* var. *chelidonioides* (Smith) Hesler et Smith.

Mycorrhizal, on *Abies-Pinus* forest. Not considered edible in LMNP.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 19-VIII-1992, AK 2433.

*Lactarius deliciosus* (L.) Fr.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to October. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 13-VII-1988, AK 701; Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 30-VII-1990, AK 1640; *Ibid.* 18-IX-1994, AK 2797; *Ibid.* 01-IX-1999, AM 1730.

*Lactarius indigo* (Sch.) Fr.

Mycorrhizal, in *Pinus* and *Quercus* forests. Collected in October. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Santa Ana Chiautempan, near San Pedro Tlalcuapan, La Malintzi volcano, 17-X-1998, AM 1706.

*Lactarius rubrilacteus* Hesler & A.H. Sm.

Mycorrhizal, on *Abies-Pinus* forest. Considered not edible in LMNP.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of Huamantla, Cañada Grande, west slope of La Malintzi volcano, La Malinche National Park, 19-IX-1992, AET 3467.

*Lactarius salmonicolor* Heim et Leclair.

Mycorrhizal, in *Abies* forests. Collected from July to November. Edible and for sale.

*Specimens examined*: MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 19-IX-1999, AM 1709A, *Ibid.* 30-VIII-2000, AM 1742B.

*Russula acrifolia* Romagn.

Mycorrhizal, in *Abies* and *Pinus-Alnus* forests. Collected from August to October. Considered not edible in LMNP. This species has been confused with *Russula nigricans* (Bull.) Fr. and has been described as edible in several states in central Mexico. Most of the samples described in the literature as *Russula nigricans* have the same characteristics as *Russula acrifolia* Kong (2002).

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 27-VII-1990, AM 723, *Ibid.* 27-V-1992, AK 2257.

*Russula albonigra* Krombh.

Mycorrhizal, in *Pinus-Alnus* forests. Collected in October. Considered not edible in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 01-X-1989, AM 531.

*Russula americana* (Sing.) Sing.

Mycorrhizal, in *Abies* forests. Collected from July to October. Considered not edible in LMNP. This species is, however, used as food in the community of El Rosario, Tlaxcala, and its traditional name is ‘sangre de toro’ (bull’s blood).

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 18-IX-1994, AK 2795.

*Russula brevipes* Pk.

Mycorrhizal, in *Abies* forests. Collected from July to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 08-VI-1999, AM 08071999, *Ibid.* 13-VIII-2000, AM 13-07-2000.

*Russula cyanoxantha* (Schaeff.).

Mycorrhizal in *Quercus-Pinus* forest. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 07-IX-1994, AK 2767.

*Russula delica* Fr.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to October. Edible and for sale.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 01-X-1989, AM 535, *Ibid.* 27-V-1992, AK 2255, *Ibid.* 24-VI-94, AK 2705.

*Russula olivacea* (Schaeff.) Fr.

Mycorrhizal, in *Abies* forests. Collected in August. Considered edible by only few people in MLNP. It is found for sale in the Tlaxcala market.

## Fungal Diversity

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 13-VIII-2000, AM 13-VIII-2000-2.

### *Russula romagnesiana* Schaeffer.

Mycorrhizal, in *Abies* forests. Collected from August to October. Considered edible by only a few people in LMNP.

*Specimens examined:* MÉXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 22-VII-1994, AK 2747, *Ibid.* 18-IX-1994, AK 2798.

### *Russula sanguinaria* (Schumacher) Rauschert.

Mycorrhizal, in *Abies* forests. Collected from August to October. Considered not edible in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 21-IX-1998, AK 2998.

### *Russula xerampelina* (Schaeff.) Fr.

Mycorrhizal, in *Pinus-Alnus* forests. Collected from July to October. Although it is considered edible by only few people in LMNP, it is found for sale in the local markets.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of San Luis Teolocholco, west slope of the Malintzi volcano, La Malinche National Park, 06-IX-2000, AM 06-IX-2000.

## *Ustilaginomycetes*

### *Ustilaginales*

#### *Ustilaginaceae*

### *Ustilago maydis* (DC.) Corda.

Parasitic, in agricultural areas, on corn. Collected from June to September. Edible and for sale, also with cosmetic and medicinal uses.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Huamantla, Huamantla Market, collected in LMNP, 19-VI-1996, AM 973.

## *Myxomycota*

### *Myxomycetes*

#### *Physarales*

#### *Physaraceae*

### *Fuligo septica* Wiggers.

Fructify on stumps of *Pinus* in *Pinus-Alnus* forest. Collected in June. Considered edible by only few people in LMNP. Holozoic, collected in June. Eaten by very few people in LMNP.

*Specimens examined:* MEXICO, TLAXCALA, Municipality of Trinidad Sánchez Santos, 4 to 7 km west of Francisco Javier Mina, Malintzi volcano, La Malinche National Park, 29-VI-1989, AM 313.

### ***Cultural significance***

Table 1 presents the information obtained using the free listing technique. The species most frequently mentioned by the respondents in descending order were *Boletus pinophilus*, *Amanita caesarea*, *Lyophyllum decastes*, *Cantharellus cibarius*, *Gomphus floccosus*, *Ramaria* spp., *Laccaria trichodermophora*, *Morchella* spp., *Hebeloma mesophaeum* and *Russula delica*. Those, therefore, are the species with the biggest cultural importance in the area under study based on their frequency of mention. Other evidence suggests and supports the idea that the species mentioned above play a role of great cultural importance for the people in this area:

### ***Economic importance***

- (a) The mushroom collectors of Javier Mina sell their mushrooms in Mexico City, as well as in the nearby city of Puebla and locally (sale on both a large and small scale).
- (b) Some of the mushrooms are sold dehydrated (for example, *Boletus pinophilus* and *Morchella* spp.).
- (c) There is a very precise process for selecting the mushrooms for purchase and sale as has previously been showed by Pellicer-González *et al.* (2002) in other localities from central Mexico.
- (d) The mushroom collectors of Francisco Javier Mina sell some of the mushrooms at high prices (*Amanita caesarea*, *Boletus pinophilus* and *Morchella esculenta*). In San Isidro, the sales price per kilo of some species (*Boletus pinophilus* and *Gomphus floccosus*) is also high in local terms (USD \$3 to \$4 per kg).

### ***Taste***

The taste of *Boletus pinophilus* is very pleasant and much valued. The people of La Malinche often compare the flavor to the taste of pork (and to fried pork skin).



**Table 1.** Number of times each item was mentioned by people interviewed in San Isidro Buensuceso (SIBS) and in Francisco Javier Mina (JM), Tlaxcala. Columns 6 and 7 present  $X^2$  calculated values to comparisons between sexes and between localities, and were discussed in the text.

Scientific name	SIBS	SIBS	JM	JM	TOT	M/W	JM/ SIBS
	W	M	W	M			
<i>Boletus pinophilus</i>	21	20	18	19	78	0.00	0.00
<i>Amanita caesarea</i>	13	17	19	20	69	0.24	2.21
<i>Cantharellus cibarius</i>	20	17	13	16	66	0.00	0.36
<i>Lyophyllum decastes</i>	17	17	17	14	65	0.06	0.00
<i>Gomphus floccosus</i>	23	19	10	10	62	0.01	5.84
<i>Hebeloma mesophaeum</i>	12	8	19	17	56	0.47	6.24
<i>Laccaria trichodermophora</i>	15	15	11	14	55	0.06	0.10
<i>Ramaria</i> spp.	18	16	11	10	55	0.04	1.95
<i>Morchella</i> spp.	16	7	14	15	52	0.94	1.39
<i>Russula delica</i>	11	9	10	14	44	0.02	0.86
<i>Hygrophorus chrysodon</i>	9	7	7	10	33	0.00	0.20
<i>Clitocybe gibba</i>	16	11	2	3	32	0.28	13.11
<i>Lactarius indigo</i>	7	4	10	10	31	0.12	3.55
<i>Lactarius salmonicolor</i>	7	5	9	8	29	0.14	1.41
<i>Lyophyllum</i> sp. 1 (cuaresmeño)	0	0	11	13	24	0.06	26.43
<i>Amanita rubescens</i>	0	0	19	14	23	0.48	36.49
<i>Suillus</i> spp.	8	7	3	2	20	0.05	4.10
<i>Armillaria mellea</i>	13	7	0	0	20	1.26	18.17
<i>Agaricus campestris</i>	7	2	7	3	19	3.36	0.19
<i>Chroogomphus jamaicensis</i>	7	4	3	3	17	0.24	1.03
<i>Lycoperdon perlatum</i> , <i>Calvatia cyathiformis</i>	8	4	3	1	16	1.56	3.28
<i>Helvella crispa</i>	7	5	1	2	15	0.00	4.58
<i>Amanita tuza</i>	9	6	0	0	15	0.26	13.63
<i>Lyophyllum</i> aff. <i>fumosum</i>	0	0	5	9	14	0.64	15.43
<i>Pleurotus opuntiae</i>	3	3	1	3	10	0.10	0.23
<i>Entoloma clypeatum</i>	0	0	4	6	10	0.10	11.01
<i>Amanita franchetii</i>	0	0	3	6	9	0.44	9.93
<i>Helvella lacunosa</i>	2	1	0	6	9	1.78	1.32
<i>Hypomyces lactifluorum</i>	1	0	2	5	8	0.12	5.10
<i>Boletus atkinsonii</i>	4	1	1	1	7	0.58	1.01
<i>Gymnopus dryophilus</i>	1	0	3	4	7	0.12	5.10
<i>Tricholoma equestre</i>	0	0	4	0	4	2.26	4.41
<i>Hygrophorus Russula</i>	0	0	1	1	2	0.50	2.20

SIBS = San Isidro Buen Suceso; JM = Javier Mina; TOT = Total; W = Women; M = Men.

### **Traditional knowledge**

- (a) Common names: The mushrooms of La Malinche have several common names. With the exception of *Lyophyllum decastes*, most mushrooms

- have only a few common names (two or three), which means that the people of each community identify them in a homogeneous way.
- (b) Where the mushrooms grow: The local people know precisely in what parts of the forests each type of mushroom is found, the plants it associates with and the type of vegetation it tends to fruit in.
  - (c) Fruiting season: The mushroom gatherers know the time of fruiting for each species.
  - (d) Use: In the case of *Boletus pinophilus* and *Amanita caesarea*, the people who collect them: clean the fruiting bodies *in situ* so that they can bury the remnants; cover the place where they collected the specimens; some collectors strike the cap to help disperse the spores; and know the effect of fire on the fruiting bodies of *Boletus pinophilus*: ‘if the forest burns, ‘pantes’ (common name for boletes) will grow but they won’t mature, they will remain as buttons’ (Montoya *et al.*, 2002).

The indicator of cultural importance described in this study – frequency of mention – contributes information on the popularity of the species found in the National Park of La Malinche, which supports other information obtained in this area. Although few studies have been done on the cultural importance of mushrooms, based on the conclusions of this study, it is possible to suggest other indicators that might help to specify exactly what this cultural importance is: sales prices, which species buyers prefer, the age mushrooms are eaten, how often they are eaten, traditional knowledge and beliefs about each species, number of names per species, agreement among people on where and when each species grows, etc.

The  $X^2$  analysis (Table 1, column 6), based on all the interviews done in both towns, showed that the frequency of mention for all the mushroom species was the same for both sexes ( $X^2_{0.005} = 3.84$ ). This result suggests that each species of mushroom named in the free listing technique has the same value of significance for men as for women, independently of the preference that they have for each mushroom. Also, it could be showing that both, women and men, has the same access to the mycological resource.

When we look at the results of the  $X^2$  analysis comparing the frequency of mention between the two towns (Table 1, column 7), however, we get a significant difference ( $X^2_{0.005} = 3.84$ ) for 30.30% (10) of the fungi species mentioned. Mushrooms such as *Armillaria mellea* and *Amanita tuza* were known only in San Isidro Buensuceso, while *A. franchetii*, *A. rubescens*, *Entoloma clypeatum*, *Gymnopus dryophilus*, *Lyophyllum* sp. 1, *L. fumosum* and *Tricholoma equestre* were mentioned only in Javier Mina. On the other hand, *Hebeloma mesophaeum* was mentioned more frequently in Javier Mina, while

*Gomphus floccosus* and *Clitocybe gibba*, were mentioned more frequently in San Isidro Buensuceso.

These results clearly suggest that the residents of the two towns prefer different species, as some were mentioned in one community but not in the other. As well, some that were mentioned in both towns had different values of importance in each town, given the order in which they were mentioned. Taking into account the results of the free listing technique, *Gomphus floccosus* is the species with highest importance value in San Isidro Buensuceso, while in Javier Mina, it was not listed among the top 10. Another example is *Hebeloma mesophaeum*, which ranked third in importance in Javier Mina, but tenth in San Isidro Buensuceso. Similarly, *Clitocybe gibba* appeared among the 10 most appreciated species in San Isidro Buensuceso, but ranked only 25th in Javier Mina. The access to different vegetation areas could be an explanation of higher values of significance for some mushroom species. Fir forests are found in lower altitude in the west part of the park. There are also more ravines where conditions are more favorable for the growing of fir-trees in that area. This means, there are more places to find mushrooms associated with these trees, such as *Gomphus floccosus* and *Clitocybe* spp. In the same way, in the area of Javier Mina, pine forests are more extensive in the lower part of the mountain. This fact could explain the preference of people of this town for species such as *Boletus pinophilus*, *Hebeloma mesophaeum* or *Amanita caesarea*.

In this way, free-listing technique is a useful tool in a preliminary assessment of the perception of significance of the different species of useful edible mushrooms.

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### **References**

- Abbot, S.P. and Currah, R.S. (1988). The genus *Helvella* in Alberta. Mycotaxon 33: 229-250.
- Acosta, R. and Kong, A. (1991). Guía de las excursiones botánicas y micológicas al Cerro El Peñón y Cañada Grande del estado de Tlaxcala. IV Congreso Nacional de Micología, Universidad Autónoma de Tlaxcala, Sociedad Mexicana de Micología, Jardín Botánico Tizatlán, Gobierno del estado de Tlaxcala, Tlaxcala. Folleto de divulgación No. 8.

- Alexiades, M.N. (1996). *Selected Guidelines for Ethnobotanical Research: a field Manual*. The New York Botanical Garden, Bronx, New York, U.S.A.
- Bernard, H.R. (1988). *Research methods in cultural Anthropology*. SAGE Publications, Inc., Newbury Park, USA.
- Bon, M. (1987). *The mushroom and toadstools of Britain and North Western Europe*. Domino Books, New Jersey, USA.
- Ern, H. (1976). Descripción de la vegetación montañosa en los estados mexicanos de Puebla y Tlaxcala. *Willdenowia* 10: 1-128.
- González-Fuentes, I. (1987). *Los hongos del estado de Tlaxcala*. Bachelor thesis. Escuela Nacional de Estudios Profesionales Iztacala, Universidad Nacional Autónoma de México, México.
- Guzmán, G. (1997). *Los nombres de los hongos y lo relacionado con ellos en América Latina*. Instituto de Ecología A.C., Xalapa, México.
- Guzmán, G. and Ramírez-Guillén, F. (2001). The *Amanita caesarea*-complex. *Bibliotheca Mycologica* 187. Cramer, Berlin, Germany.
- Herrera, T. and Guzmán, G. (1961). Taxonomía y ecología de los principales hongos comestibles de diversos lugares de México. *Anales del Instituto de Biología, Universidad Nacional Autónoma de México* 32: 33-135.
- Holmgren, P.K. and Holmgren, N.H. (1995). Additions to Index Herbariorum (Herbaria). 8th edn., 4th series. *Taxon* 44: 251-266.
- INEGI. (1987). *Anexo cartográfico del estado de Tlaxcala*, México, D.F., México.
- Jenkins, T.D. (1986). *Amanita of North America*. Mad. River. Press, Eureka, USA.
- Kirk, P.M., Cannon, P.F., David, J.C. and Stalpers, J.A. (2001). *Ainsworth & Bisby's Dictionary of the Fungi*. 9th edn. CAB International Publishing, Kew, Surrey, Commonwealth Mycological Institute, UK, 655p.
- Kong, A. (1998). Ectomycorrhizal Agaricales of Tlaxcala, Mexico. *McIlvainea* 13: 13-24.
- Kong, A. (2002). *El género Russula (Fungi, Russulales) en el Parque Nacional la Malinche*. M.Sc. thesis. Facultad de Ciencias, Universidad Nacional Autónoma de México, México.
- Lincoff, G. and Mitchel, D.H. (1977). *Toxic and hallucinogenic mushroom poisoning. A handbook for physicians and mushroom hunters*. Van Nostrand Reinhold Company, New York, U.S.A.
- Longvah, T. and Deosthale, G. (1998). Compositional and nutritional studies on edible wild mushrooms from northeast India. *Food Chemistry* 63: 331-334.
- Marr, C.D. and Stuntz, D.E. (1973). *Ramaria*. *Bibliotheca Mycologica*. Lehre, Germany.
- Molina, R., Massicotte, H. and Trappe, J.M. (1992). Specificity phenomena in mycorrhizal symbioses: Community-ecological consequences and practical implications. In: *Mycorrhizal functioning: an integrative plant-fungal process* (ed. M.F. Allen). Chapman and Hall, Inc., Routledge, USA: 357-423.
- Montoya, A. (1998). Ethnomycology of Tlaxcala, México. *McIlvainea* 13: 6-12.
- Montoya, A., Estrada-Torres, A. and Caballero, J. (2002). Comparative Ethnomycological survey of three localities from La Malinche Volcano, Mexico. *Journal of Ethnobiology* 22: 103-131.
- Moreno-Zárate, C. (1990). *Hongos comestibles: Un componente de la productividad del bosque en Santa Catarina del Monte, México*. M.Sc. thesis. Colegio de postgraduados, Montecillo, Estado de México, México
- Moser, M. (1983). *Keys to Agarics and Boleti (Polyporales, Boletales, Agaricales, Russulales)*. Roger Phillips, London, UK.

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- Pellicer-González, E., Martínez-Carrera, D., Sánchez, M., Aliphath, M. and Estrada-Torres, A. (2002). Rural management and marketing of wild edible mushrooms in Mexico. *In: Proceedings of the fourth International Conference-Mushroom Biology and mushroom products* (eds. J.E. Sánchez, G. Huerta and E. Montiel). Cuernavaca, México.
- Romagnesi, H. (1967). *Les Russules d' Europe et de' Africa du Nord*. Bordas, París, France.
- Santiago-Martínez, G., Kong, A., Montoya, A., Estrada-Torres, A. (1990). Micobiota del estado de Tlaxcala. *Revista Mexicana de Micología* 6: 227-243.
- Singer, R. (1975). *The Agaricales in Modern Taxonomy*. Cramer, Vaduz, Germany.
- Tulloss, R.E. (1994). Type studies in *Amanita* section *Vaginatae* I: Some taxa described in this century (Studies 1-23). *Mycotaxon* 52: 305-396.
- Tulloss, R.E. (1998). *Syllabus for a Seminar on Amanita*. 4th edn. Roosevelt, New Jersey, USA.
- Uribe-Arróyave, I. (1998). *Contribución al conocimiento de los hongos hipogeos del estado de Tlaxcala*. Bachelor thesis. Escuela Nacional de Ciencias Biológicas, Instituto Politécnico Nacional, D.F., México.
- Weller, C.S. and Romney, A.K. (1988). *Systematic data collection*. Sage Publications. Newbury Park, USA.

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