



Acta Botanica
Mexicana

Wild edible mushrooms in markets throughout the Valles Centrales region of Oaxaca, Mexico: commercialization and traditional knowledge

Hongos silvestres comestibles en mercados a lo largo de la región de los Valles Centrales de Oaxaca, México: comercialización y conocimiento tradicional

Samantha Ortiz-Alonso¹ , Marko Gómez-Hernández^{2,4} , Etelvina Gándara³ 

Abstract:

Background and Aims: The importance of fungi extends beyond their role in ecosystem functioning to also being a non-timber forest resource of cultural importance. Wild edible mushrooms are part of diets and provide a source of income for many human communities worldwide. The main objective of this study was to evaluate and compare commercialization topics related to wild edible mushrooms in traditional markets throughout the Valles Centrales region of Oaxaca, Mexico.

Methods: Nine traditional markets were selected for their historical relevance as commercial exchange routes. The ethnographic method employed to obtain data included participant observation and semi-structured interviews conducted with mushroom vendors. Descriptive, linear regression, and non-metric multidimensional scaling analyses were conducted.

Key results: A total of 60 mushroom vendors and 22 wild edible mushroom species were recorded across the markets. Women are the main participants (78%) in mushroom commercialization within markets. Vendors between the ages of 12 and 35 are the least involved in this activity (12%). Central de Abastos and Villa de Etla recorded the highest variety of mushrooms (16 and 14 species, respectively). Mushrooms in the *Amanita caesarea* complex are the most sold species. The composition of mushroom species sold in markets is similar when vendors harvest in environmentally comparable areas. Wild mushroom sales are declining in three of the nine studied markets.

Conclusions: Traditional markets in the Valles Centrales region function as key socio-ecological interfaces where macrofungal diversity and market dynamics intersect. The documentation of 22 mushroom species in the nine markets highlights the persistence of complex traditional knowledge systems embedded in commercialization strategies. The conservation of wild edible mushrooms cannot be addressed solely through ecological approaches. Safeguarding fungal resources requires strengthening traditional knowledge systems, fostering community organization, and promoting fair market practices.

Keywords: biodiversity, ethnomycology, fungal resources, mushroom vendors, traditional markets.

Resumen:

Antecedentes y Objetivos: La importancia de los hongos se extiende más allá de su papel en el funcionamiento de los ecosistemas. También constituyen un recurso forestal no maderable de relevancia cultural. Los hongos silvestres comestibles forman parte de la dieta y fuente de ingresos para numerosas comunidades humanas alrededor del mundo. El objetivo principal de este estudio fue evaluar y comparar aspectos de la comercialización de hongos silvestres comestibles en mercados de la región de los Valles Centrales de Oaxaca, México.

Métodos: Se seleccionaron nueve mercados por su relevancia histórica como rutas de intercambio comercial. El método etnográfico empleado para la obtención de datos incluyó observación participante y entrevistas semiestructuradas a vendedores de hongos. Se realizaron análisis descriptivos, de regresión lineal y de escalamiento multidimensional no métrico.

Resultados clave: Se registraron 60 vendedores y 22 especies de hongos silvestres comestibles. Las mujeres son las principales comerciantes de hongos (78%). Los vendedores entre las edades de 12 y 35 son los menos involucrados en esta actividad (12%). La Central de Abastos y Villa de Etla registraron la mayor variedad de hongos (16 y 14 especies, respectivamente). Los hongos del complejo *Amanita caesarea* son los más vendidos. La composición de especies comercializadas es similar cuando los vendedores recolectan en áreas ambientalmente comparables. La venta de hongos silvestres está decayendo en tres de los nueve mercados estudiados.

Conclusiones: Los mercados tradicionales de Valles Centrales funcionan como interfaces socioecológicas donde convergen la diversidad de macrohongos y las dinámicas de mercado. La documentación de 22 especies en los nueve mercados resalta la persistencia de complejos sistemas de conocimiento tradicional integrados en las estrategias de comercialización. La conservación de los hongos silvestres comestibles no puede abordarse únicamente desde enfoques ecológicos. La salvaguarda del recurso fúngico requiere fortalecer los sistemas de conocimiento tradicional, fomentar la organización comunitaria y promover prácticas comerciales justas.

Palabras clave: biodiversidad, etnomicología, mercados tradicionales, recursos fúngicos, vendedores de hongos.

Affiliations on the next page.

⁴Author for correspondence: mrk.gmz@gmail.com

Received: April 4, 2026.

Reviewed: April 24, 2026.

Accepted by Martín Esqueda: August 28, 2026.

Published Online first: September 24, 2026.

Published: Acta Botanica Mexicana 133 (2026).

To cite as: Ortiz-Alonso, S., M. Gómez-Hernández and E. Gándara. 2026. Wild edible mushrooms in markets throughout the Valles Centrales region of Oaxaca, Mexico: commercialization and traditional knowledge. Acta Botanica Mexicana 133: e2582. DOI: <https://doi.org/10.21829/abm133.2026.2582>



This is an open access article under the Creative Commons 4.0 Attribution-Non commercial Licence (CC BY-NC 4.0 International)

e-ISSN: 2448-7589

Introduction

Macromycetes (macroscopic fungi) are characterized by the production of sporomes visible to the naked eye, commonly known as mushrooms. Their relevance in terrestrial ecosystems can be attributed to three main ecological functions: as pathogens, they help regulate populations of plants, animals, and other fungi (Deacon, 2006); mycorrhizal macromycetes form mutualistic associations with vascular plants, enhancing nutrient uptake and providing resistance to parasites (Pilz and Molina, 2002); and they are the main decomposers of organic matter in terrestrial ecosystems, playing key roles in both the carbon and nitrogen cycles (Alarcón-Gutiérrez and Ramírez-Guillén, 2022).

These ecologically important organisms also represent a valuable non-timber forest resource; wild mushrooms have been consumed by humans worldwide for centuries due to their nutritional, hallucinogenic, and medicinal properties (Moreno-Fuentes, 2018; Peña et al., 2023). In modern societies, harvesting wild edible mushrooms for both personal consumption and commercialization have become a highly prized activity within many communities (Wang, 1987; Boa, 2004). Reports from 10 countries show the existence of approximately 2120 species of wild edible mushrooms worldwide, which are known to be used as food and a source of economic income in more than 80 countries (Boa, 2004). Today, wild edible mushrooms are regarded as some of the most important non-timber forest products in the world, generating an estimated annual revenue of US \$2 billion (Boa, 2004; Voces et al., 2012).

Mexico has a rich and long-standing tradition of using wild mushrooms among various ethnic groups since pre-Hispanic times (Garibay-Orijel and Ruan-Soto, 2014), ranking second globally in wild mushroom consumption, with around 450 documented species, following China with ca. 1020 species (Pérez-Moreno et al., 2021). Over 62 studies have recorded the relevance of wild mushrooms as a food source across several regions of Mexico (Garibay-Orijel and Ruan-Soto, 2014). For example, in La Malinche National

Park, Tlaxcala, 91 edible mushroom species were recorded, of which 74 were actively harvested by locals (Montoya et al., 2004). Cerro El Zamorano, located between Guanajuato and Querétaro, was found to host 130 macrofungal species, of which 55 are edible (Landeros et al., 2006). A study in Villa Guerrero, Jalisco, reported 36 edible mushroom species, and 20 were considered edible by locals (Haro-Luna et al., 2019). In Tlaltenango, Zacatecas, the use of ten wild edible mushroom species was recorded (Haro-Luna et al., 2022). In three Chinantec communities of Oaxaca, 36 mushroom species are reported, of which 31 are used as food (López-García et al., 2020). In Mexico, the harvesting and commercialization of wild edible mushrooms during the rainy season are considered an extra-agricultural activity. A portion of the collected mushrooms is used for personal consumption, while the majority are sold in local markets, generating supplemental income for rural families (Pellicer-González et al., 2002; Garibay-Orijel et al., 2006).

Local traditional markets in Mexico are essential platforms for cultural exchange and trade, addressing the socioeconomic, cultural, and dietary needs of the community. They encompass a variety of informal economic activities, including the extraction of wild species (timber and non-timber products) and the sale of goods sourced from diverse geographical locations (Hirth, 2013). These markets have been documented in several ethnomycological and ethnobotanical studies focused on the gathering, use, and sale of wild edible mushrooms, reflecting their biocultural relevance and the importance of traditional knowledge in Mexico (Camou-Guerrero et al., 2016; Linares and Bye, 2016). A survey on the commercialization of wild edible mushrooms in traditional markets across countries with diverse ethnic compositions found that Mexican markets offer more than 300 species (Pérez-Moreno et al., 2021). Additionally, research has shown that the southeastern states of Oaxaca, Tabasco, and Veracruz are known for the trade of wild mushrooms in 25 “tianguis” (itinerant open-air markets) (Ruan-Soto et al., 2006).

¹Instituto Politécnico Nacional, Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional Unidad Oaxaca, Calle Hornos 1003, colonia Noche Buena, 71233 Santa Cruz Xoxocotlán, Oaxaca, Mexico.

²Secretaría de Ciencias, Humanidades, Tecnología e Innovación-Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional, Unidad Oaxaca,

Instituto Politécnico Nacional, Calle Hornos 1003, colonia Noche Buena, 71233 Santa Cruz Xoxocotlán, Oaxaca, Mexico.

³Benemérita Universidad Autónoma de Puebla, Facultad de Ciencias Biológicas, Av. San Claudio S/N, Ciudad Universitaria, 72592 Puebla, Puebla, Mexico.



Oaxaca is one of the most biodiverse states in Mexico, showcasing the greatest diversity of recorded macromycete species (1630 species) (Raymundo et al., 2022). The most extensive inventory of useful wild mushrooms in Mexico was conducted in the Sierra Norte region of Oaxaca, reporting a total of 159 species, of which 113 are edible (Garibay-Orijel et al., 2009). It has been observed that people from mountainous areas harvest mushrooms during the rainy season and bring them to markets in the Valles Centrales region for sale (Hernández-Santiago et al., 2016). The commercialization of wild edible mushrooms in local markets of Oaxaca represents a dynamic interface between ecology and culture that not only supports household economies but also reinforces cultural identity and biocultural heritage (Garibay-Orijel et al., 2006). These practices are sustained by traditional knowledge, including species identification, harvesting techniques, conservation of fungal resources, and culinary uses (Haro-Luna et al., 2019).

In the Central de Abastos and Tlacolula markets, located within the Valles Centrales region of Oaxaca, a total of 20 species of wild edible mushrooms, belonging to 12 genera, were recorded; the study revealed that mushroom harvesting is typically conducted by family leaders, while sales are primarily handled by women (Jiménez-Ruiz et al., 2013). A study conducted in Oaxaca, Tabasco, and Veracruz found mushroom sales in four markets of Oaxaca; women accounted for 81.82% of sellers, of whom 68.18% were indigenous women (Ruan-Soto et al., 2006). In the market of Chalcatongo de Hidalgo, located in the Mixtec region, a total of 34 edible species were recorded; interviewed people emphasized the need to regulate harvesting to conserve mycological biodiversity (López-Hernández et al., 2022). The commercialization of wild edible mushrooms in traditional markets of Oaxaca reflects a biocultural strategy that combines ecological sustainability and economic resilience, making it of great interest and relevance; however, there is a lack of studies on this issue in most traditional markets and regions.

The antiquity of traditional markets in Oaxaca reflects long-term cultural continuity, often extending from pre-Hispanic times through the colonial period to the present. These markets maintain their cultural significance by operating on specific days, known as “día de plaza” (market

day), when vendors from nearby rural communities gather to sell their goods, playing a vital role in the local economy and the preservation of cultural traditions (Cook and Diskin, 1990; Arellanes and Casas, 2011). The present study was conducted in nine traditional markets throughout the Valles Centrales region of Oaxaca, Mexico. The main objective of the study was to document, assess, and compare the traditional knowledge regarding the acquisition, commercialization, and use of wild edible mushrooms in traditional markets of the Valles Centrales region. Specifically, this study aimed to: (1) identify the mushroom species sold in traditional markets, together with their traditional names and local uses; (2) examine differences among markets in the harvesting and commercialization of wild edible mushrooms; and (3) analyze vendors’ biocultural perceptions of mushrooms and the strategies they employ to address the erosion of traditional knowledge.

Materials and Methods

Study area

The present study was carried out in the Valles Centrales region of Oaxaca, Mexico (Fig. 1), which consists of seven districts: Ocotlán de Morelos, Zimatlán de Álvarez, Villa de Zaachila, Villa de Etla, Heroica Ciudad de Ejutla de Crespo, Tlacolula de Matamoros, and Oaxaca de Juárez. The Valles Centrales region has a population of 1,107,557 habitants, with Spanish being the predominant language; however, several indigenous languages are also spoken, being Zapotec the most widely represented, followed to a lesser extent by Mixtec, Mazatec, Mixe, and Chinantec. The most populous municipality in the region is Oaxaca de Juárez, with 270,955 inhabitants (INEGI, 2021). The study assessed nine traditional markets in the Valles Centrales lowlands (Fig. 1), selected for their historical significance as commercial exchange routes (Table 1). All markets include both permanent commercial stands and temporary or mobile stalls. The predominant climate in the region is semi-warm and temperate sub-humid (COPLADE, 2017).

Ethnomycological data obtainment

From June to October 2024, 40 visits were made to the nine markets in Valles Centrales. The markets in Zimatlán, Ayoquezco, and Ejutla were visited only four, three, and



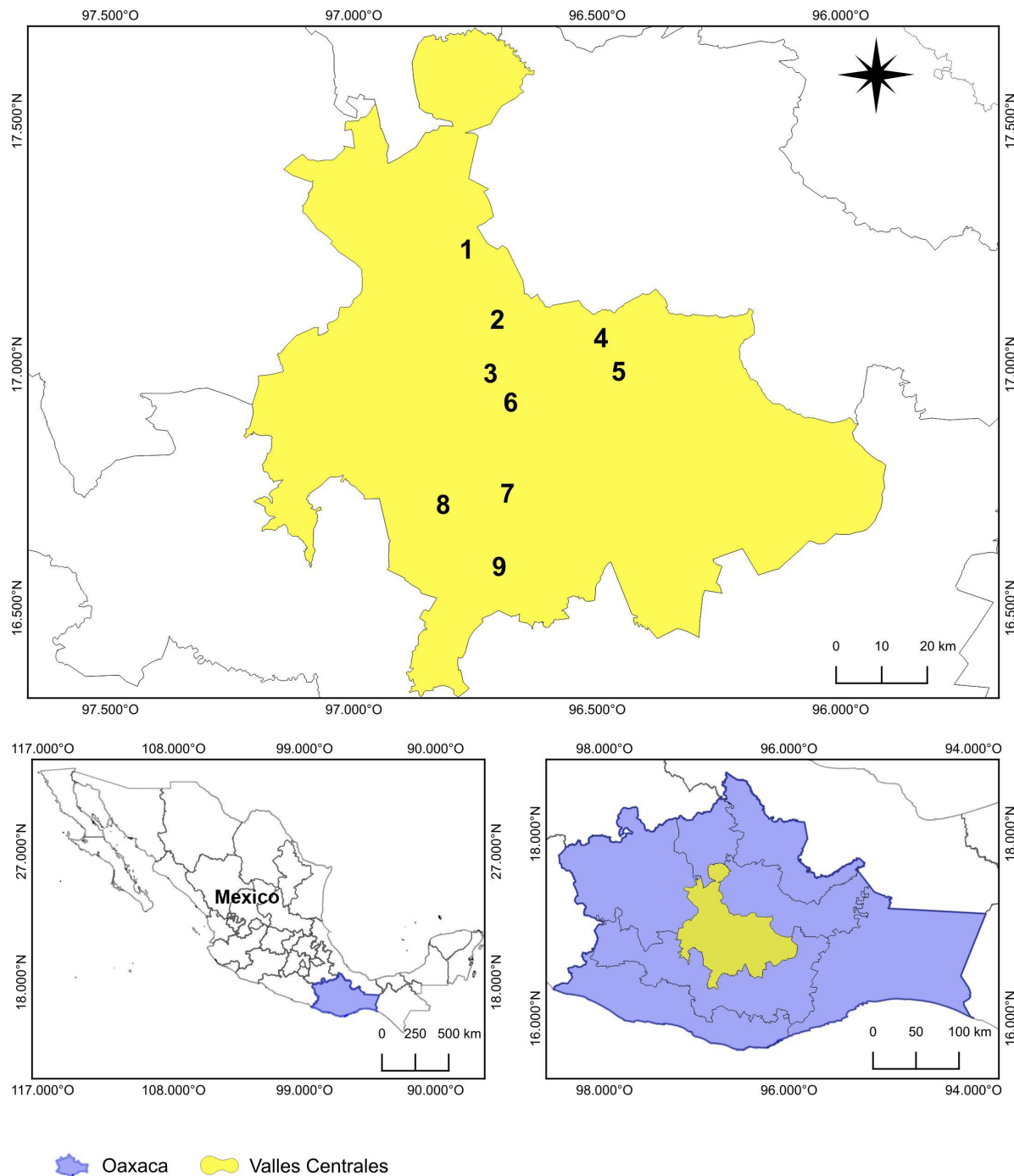


Figure 1: Locations of the studied markets along the Valles Centrales region of Oaxaca, Mexico. The markets are 1) Villa de Etla, 2) Oaxaca de Juárez, 3) Villa de Zaachila, 4) Teotitlán del Valle, 5) Tlaxiaco de Matamoros, 6) Zimatlán de Álvarez, 7) Ocotlán de Morelos, 8) Ayoquezco de Aldama, and 9) Heroica Ciudad de Ejutla de Crespo.

three times, respectively, because local people mentioned that mushrooms were no longer sold at these markets. All other markets were visited five times each. The method employed in the present study included field notes, and

semi-structured interviews conducted with mushroom vendors across the markets. The interviews were conducted in Spanish. In the few cases in which a vendor spoke an indigenous language, support was provided by vendors



from the same community within the market, who assisted with translation. The interviews enabled the obtaining of information on species diversity, harvesting techniques, marketing details, conservation of the fungal resource, local traditional knowledge, and local perceptions of wild mushrooms (Appendix 1). The ages of mushroom vendors were grouped into four age ranges to compare vendors' participation across different life-course stages (Table 2). The "teen" category (12-18 years) was defined for analytical purposes, using 12 years as the lower age threshold in accordance with the legal definition of adolescence in Mexico (Cámara de Diputados del H. Congreso de la Unión, 2014), while extending the upper limit to 18 years to provide a consistent age class for comparative analyses; young adults (19-35 years) were distinguished as individuals in an early stage of adult life, commonly associated with increasing economic participation and household responsibilities; the 36-50-year category was used to represent middle-aged adults, a life stage often associated with consolidated productive and family roles; finally, vendors over the age of 51 were classified as older adults, enabling a comparison with younger groups and highlighting the generational gap in interest towards mushroom sales activities. Interviews were conducted following the International Society of Ethnobiology's Code of Ethics (International Society of Ethnobiology, 2006). Authorizations to carry out the study in the markets

were given verbally by local authorities from each municipality, and by interviewed vendors within the markets. To interview teenagers, consent was given by their parents.

Macromycete specimens were obtained from every mushroom stand and identified based on their macromorphological and micromorphological characteristics, aided by identification keys and reference literature (e.g. Guzmán, 1977; Largent and Thiers, 1977; Largent, 1986).

Data analyses

Linear regression analysis was performed in R v. 3.2.3 (R Core Team, 2017) to evaluate the relationship between the number of mushroom species collected and the distance from each community to the harvesting areas. A simple linear regression model was fitted using the built-in "lm(formula, data)" function, which fits ordinary least squares models using the formula syntax `dependent_variable ~ independent_variable`. The statistical significance of the relationship was assessed through the estimated regression coefficient and associated *p*-value. This analysis offers insight into the biocultural dynamics that influence mushroom availability and highlights the role of local ecological knowledge in sustaining the diversity of wild mushrooms traded.

Non-metric multidimensional scaling (NMDS) analysis was performed in R v. 3.2.3 (R Core Team, 2017) to determine differences among the studied markets in the

Table 1: Historical background, antiquity, and current characteristics of the nine studied markets in the Valles Centrales region of Oaxaca, Mexico.

Market	Historical Context and Current Characteristics	Estimated Antiquity	References
Tlacolula de Matamoros	The market has a pre-Hispanic origin and has been documented as a major regional trading center since the sixteenth century. It is considered one of the oldest and most continuous indigenous markets in Oaxaca. The market consists of both permanent commercial stands and temporary/mobile stalls. The vendors mainly come from nearby communities and sell clothing, handicrafts, farm products, prepared food, products supplied by large-scale horticultural companies, and wild products such as plants and mushrooms.	Approximately 425-500 years	Chance (1976); Cook and Diskin (1976)
Teotitlán del Valle	Continues to uphold a traditional market day grounded in the pre-Hispanic trade networks of the Zapotec people. It is primarily composed of permanent stalls, although it also includes itinerant vendors. Most vendors are members of the local community. They sell handicrafts, farm products, prepared foods, and wild products, including plants, fruits, vegetables, and mushrooms.	Approximately 400-500 years	Chance (1976)



Table 1: Continuation.

Market	Historical Context and Current Characteristics	Estimated Antiquity	References
Ayoquezco de Aldama	The traditional market day has been documented since the late colonial period. It is composed exclusively of itinerant stalls. Most vendors are members of the local community, although some also come from nearby communities. They sell farm products, prepared foods, mezcal, handicrafts, and wild products, including plants, fruits, and vegetables.	Approximately 200-300 years	Cook and Diskin (1976)
Villa de Etla	The market has been documented since the early colonial period, around 1530, with the establishment of Spanish administrative and religious institutions. The market is composed primarily of itinerant stalls. Vendors are both local residents and individuals from neighboring communities. They mainly sell clothing, farm products, products supplied by large-scale horticultural companies, prepared foods, mezcal, handicrafts, and wild products, including plants, fruits, vegetables, and mushrooms.	Approximately 495 years	Gerhard (1993)
Zimatlán de Álvarez	Hosts a traditional market associated with the colonial period and served as an important regional agricultural exchange node. It is mainly composed of permanent stalls. Most vendors are members of the local community, but some come from nearby communities. They primarily sell farm products, prepared foods, products supplied by large-scale horticultural companies, and wild products, including plants, fruits, and vegetables.	Approximately 300-400 years	Chance (1976)
Villa de Zaachila	The traditional market reflects strong continuity of Zapotec commercial practices and is closely linked to the colonial period. The market includes both permanent commercial stands and mobile stalls. The vendors mainly come from nearby communities and sell handicrafts, farm products, prepared food, products supplied by large-scale horticultural companies, and wild products such as plants, fruits, and mushrooms.	Approximately 300-400 years	Chance (1976); Gerhard (1993)
Heroica Ciudad de Ejutla de Crespo	Functions as a key regional exchange center in the southern Valles Centrales of Oaxaca since the colonial period. It is composed primarily of itinerant stalls. Vendors include both local residents and individuals from neighboring communities. They mainly sell clothing, electronic goods, farm products, prepared food, products supplied by large-scale horticultural companies, handicrafts, and wild products such as plants, fruits, and vegetables.	Approximately 300-400 years	Chance (1976); Cook and Diskin (1976)
Ocotlán de Morelos	Has a long-standing tradition of regional exchange; however, the current formal market structure results from a twentieth-century reorganization. The market includes both permanent and itinerant stalls. Vendors are both local residents and individuals from neighboring communities. They primarily sell farm products, products supplied by large-scale horticultural companies, prepared food, handicrafts, and wild products such as plants, fruits, mushrooms, and vegetables.	Approximately 100-150 years (formal market structure)	Chance (1976)
Oaxaca de Juárez (Central de Abastos)	Founded and inaugurated in September 1978 as a wholesale and central supply market for the city and surrounding areas. This market was included in the study because it is a relevant regional convergence point, despite being a relatively recent construction. It is composed primarily of permanent commercial stands. Vendors include both local residents and individuals from neighboring communities and other cities. They sell clothing, electronic goods, farm products, prepared food, products supplied by large-scale horticultural companies, handicrafts, and wild products such as plants, fruits, vegetables, and mushrooms. All vendors are located within an area of approximately 221,500 m ² .	Approximately 48 years	Municipal historical records



composition of mushroom species available at each site. A species-by-market matrix was constructed using the abundance of each mushroom species recorded in each market. Pairwise compositional dissimilarities among markets were calculated and then ordinated using NMDS with 10,000 random starts to reduce the probability of convergence on a local optimum. The resulting ordination plot was used to visualize similarities and differences in species composition among markets, with shorter distances between points indicating greater compositional similarity. The markets of Zimatlán, Ayoquezco, and Ejutla were not included in the analyses since no species were recorded there.

Results and Discussion

Traditional markets

The diversity and commercialization processes of wild edible mushrooms across traditional markets in Oaxaca showed strong spatial, cultural, and socio-economic heterogeneity. The presence of 22 edible wild mushroom species in only six of the nine surveyed markets indicates that the mushroom trade is unequally distributed (Appendix 2). Instead, it is concentrated in markets closely linked to forested areas and communities where traditional knowledge about mushrooms is still preserved. Studies in various regions of Mexico have reported similar trends, where closeness to temperate forests and the persistence of traditional practices strongly influence market diversity (Garibay-Orijel et al., 2006; Pérez-Moreno et al., 2008).

Tlacolula de Matamoros market

The market in Tlacolula de Matamoros is the most emblematic market in the Valles Centrales region. A total of 12 mushroom vendors were recorded at this market, all originating from Cuajimoloyas (Table 2). Of these, ten vendors sold mushrooms in bundles, placed in baskets, buckets, or bags. Meanwhile, two older adult vendors carried full baskets of mushrooms. The dominance of the *Amanita caesarea* complex and *Boletus* aff. *edulis* in the market (Figs. 2A, B) reflects both sporome availability and consumer preference for culturally prestigious and gastronomically valued species (Garibay-Orijel et al., 2007). The community of Cuajimoloyas is known for its mushroom fair and its vast traditional knowledge of the use of natural resources. Nevertheless, the com-

munity is experiencing a loss of cultural identity, leading to the erosion of traditional knowledge of wild edible mushroom species that are integral to their culture (pers. observ.). Currently, most local vendors tend to use scientific names for mushrooms instead of traditional ones; for example, they use the name “amanita” for species in the *Amanita caesarea* complex and “boletus” for species in the genus *Boletus* L. (Table 2). This phenomenon may result from the continuous participation of mycologists in the Cuajimoloyas mushroom fair, which has gradually led to the replacement of traditional nomenclature and harvesting practices with scientific knowledge and approaches. According to Toledo and Barrera-Basols (2008) and Valle de Frutos (2010), replacing traditional terminology with scientific discourse may improve market integration, but it can also weaken cultural identity and hinder the intergenerational transmission of ancestral knowledge.

Teotitlán del Valle market

In the market of Teotitlán del Valle, only one stand selling mushrooms was found, and it belonged to a family from Cuajimoloyas (Table 2). Unlike mushroom vendors in the Tlacolula market, who also come from Cuajimoloyas, when this family goes to sell at the Teotitlán market, they receive mushrooms from several mushroom collectors in the community. This communal organization of mushroom harvesting and sale illustrates an alternative model of resource management based on collective participation. This system reinforces social cohesion, redistributes economic benefits, and ensures the continuity of supply. Such collective strategies have been identified as key mechanisms for sustaining non-timber forest products while maintaining cultural values (Shackleton et al., 2011). The only species recorded in Teotitlán is part of the *A. caesarea* complex. People perceive them as the same species and highly value them for their nutritional properties (Fig. 3). Vendors reported that trade in this market involves both selling and bartering products. The “trueque” (barter) remains a key mechanism of exchange in traditional markets of Oaxaca and other regions of Mexico, operating alongside monetized transactions and reflecting the persistence of culturally rooted exchange practices (Molina-Luna and Arellanes, 2016). In the Central Valles of Oaxaca, barter is actively used by indigenous and rural vendors as a subsistence strategy that enables households to obtain complementary



Table 2: Wild mushroom vendors recorded in each studied market along the Valles Centrales region of Oaxaca, Mexico. Gender is coded as: F= female, M= male; age range corresponds to: T=teens, Y= young adults, A= middle-aged adults, O= older adults (see Materials and Methods section); uses of mushrooms include: E= economic, F= food, M= medicinal, R= ritual. The list includes harvesting locations, additional products sold by the vendors, and the type of trade in each market.

Market	Number of vendors	Gender	Age range	Harvesting locations	Additional products sold	Type of trade	Uses
Tlacolula de Matamoros	12	2 M 10 F	9 A, 3 O	Cuajimoloyas	Vegetables, fruits, flowers	Sale	F
Teotitlán del Valle	2	1 M 1 F	2 A	Cuajimoloyas	Native potatoes	Sale, Barter	F
Ayoquezco de Aldama	3	1 M 2 F	1 A, 2 O	Ayoquezco de Aldama	Vegetables, native fruits, firewood	Sale, Barter	F
Villa de Etla	9	2 M 7 F	4 A, 5 O	Las Guacamayas, San Juan Bautista, Guelache, San Juan del Estado, Santiago Tenango	Medicinal plants, native fruits, vegetables, flowers	Sale	F, M
Zimatlán de Álvarez	3	3 F	2 A, 1 O	Magdalena Mixtepec, El Peral, La Ciénega de Zimatlán	Fruits, vegetables, ocote	Sale	F
Heroica Ciudad de Ejutla de Crespo	4	2 M 2 F	1 Y, 2 A, 1 O	San Andrés Paxtlán, Miahuatlán de Porfirio Díaz	Medicinal plants, vegetables, fruits	Sale	F
Villa de Zaachila	12	2 M 10 F	1 T, 2 Y, 3 A, 6 O	San Miguel Peras, Santa Inés del Monte, La Lobera, La Cumbre	Flowers, native fruits, vegetables	Sale	F, E
Ocotlán de Morelos	1	1 M	1 A	San José del Pacífico	Peaches, maguey worms	Sale	F, R
Oaxaca de Juárez (Central de Abastos)	14	2 M 12 F	1 T, 2 Y, 8 A, 3 O	La Cumbre, Nuevo Zoquiápam, Santiago Tlazoyaltepec, Buena Vista Tlazoyaltepec, Santa Inés del Monte, San Miguel Peras, Santiago Comaltepec	Medicinal and edible plants, flowers, fruits	Sale	F, E, M

foods and goods without requiring cash, while reinforcing culturally embedded norms of mutual aid and trust within market networks (Molina-Luna and Arellanes, 2016).

Ayoquezco de Aldama market

In the market of Ayoquezco de Aldama, known mostly for its agricultural activities, three people were identified who had sold mushrooms but no longer do so (Table 2). They stated that although mushrooms grow in the region, the tradition of foraging for them is no longer maintained due to the time and effort required to find and collect them, and only the elderly tend to collect mushrooms for personal consumption. This decline in interest for wild edible mushroom harvesting and commercialization is likely driven by

several factors, including the abandonment of agricultural and forestry activities, urbanization, changing food preferences, academic interests, and the lack of intergenerational transmission of traditional knowledge among younger generations, as observed in several rural communities of Mexico (Reyes-García et al., 2013; Hernández-Santiago et al., 2016; López-García et al., 2024). Similar to vendors in Teotitlán, the three interviewees reported that product trade in this market involves both selling and bartering. Bartering or “trueque” is a key activity that enhances market resilience by buffering households against cash constraints and price volatility, while simultaneously sustaining cultural heritage and the continued circulation of locally managed biodiversity (Farfán-Heredia et al., 2018).





Figure 2: A. Species within the *Amanita caesarea caesarea* (Scop.) Pers. complex; B. *Boletus* aff. *edulis* Bull., Herb. These are the main species sold at the Tlacolula de Matamoros market.

Villa de Etla market

The market in Villa de Etla offers a great variety of wild edible mushroom species (Appendix 2), including exclusive species such as *Albatrellopsis ellisii* (Berk. ex Cooke & Ellis) Teixeira (Fig. 4A, B). Nine mushroom vendors were documented, coming from nearby communities (Table 2). Five of the vendors were older adults aged 60 to 70 years, highlighting the importance of elderly people as key knowledge holders. All vendors in the market reported learning about mushrooms from their families, mainly parents or grandparents. The mushrooms sold in the market of Villa de Etla are obtained from both cultivated and natural sources, sometimes collected in their gardens, as is the case with *Pleurotus* aff. *djamor* (Rumph. ex Fr.) Boedijn. The careful harvesting practices described by vendors, such as the use of knives to avoid damaging the species, reflect an implicit understanding of sustainable collection.

Zimatlán de Álvarez market

In the market of Zimatlán de Álvarez, no mushroom sales were observed. Three women who used to sell mushrooms were identified, coming from surrounding communities (Ta-

ble 2). The older vendor mentioned that years ago, mushroom sales in Zimatlán were common; however, due to urbanization and the loss of traditional knowledge, the number of local mushroom collectors drastically declined, along with demand for wild mushrooms. In the past, collectors harvested various mushroom species and sold full buckets for \$500 MXN each. Today, those who harvest mushrooms prefer to sell them at other markets, such as the Central de Abastos in Oaxaca de Juárez, where they have better sales opportunities than they would in Zimatlán. Currently, those who used to sell wild mushrooms at this market now sell pine wood, fruits, vegetables, and flowers. Consumers prefer cultivated mushrooms (Fig. 5), referring to them as “good” mushrooms. Locals commented that this change in their preferences has been driven by the growing belief that most wild mushrooms are toxic, causing people to distrust which mushrooms are safe to consume.

Villa de Zaachila market

The market in Villa de Zaachila offers a notable variety of wild edible mushrooms, and 12 mushroom vendors coming from nearby communities were recorded (Table 2). The tradition-



Figure 3: Species within the *Amanita caesarea caesarea* (Scop.) Pers. complex were the only mushrooms recorded in the Teotitlán del Valle market.

al method for collecting mushrooms is by hand, using a knife when necessary. All vendors in Zaachila demonstrated a strong tradition of mushroom harvesting and selling them right after collecting to ensure fresh products. It is noteworthy that all mushrooms in this market are generically referred to as “nanacate,” a term derived from Nahuatl (nanacatl = meat or mushroom). This is interesting because the vendors and collectors come from Zapotec communities, whose traditional language greatly differs from Nahuatl. The use of the term “nanacate” in Zapotec communities reinforces findings that demonstrate the widespread cultural and linguistic influence of Nahuatl in Mexico, as well as the cultural exchange that transcends ethnic boundaries, illustrating the dynamic and syncretic nature of Mexican mushroom-related traditions (Montemayor, 2007).

Heroica Ciudad de Ejutla de Crespo market

In the market of the Heroica Ciudad de Ejutla de Crespo, four people who used to sell wild edible mushrooms

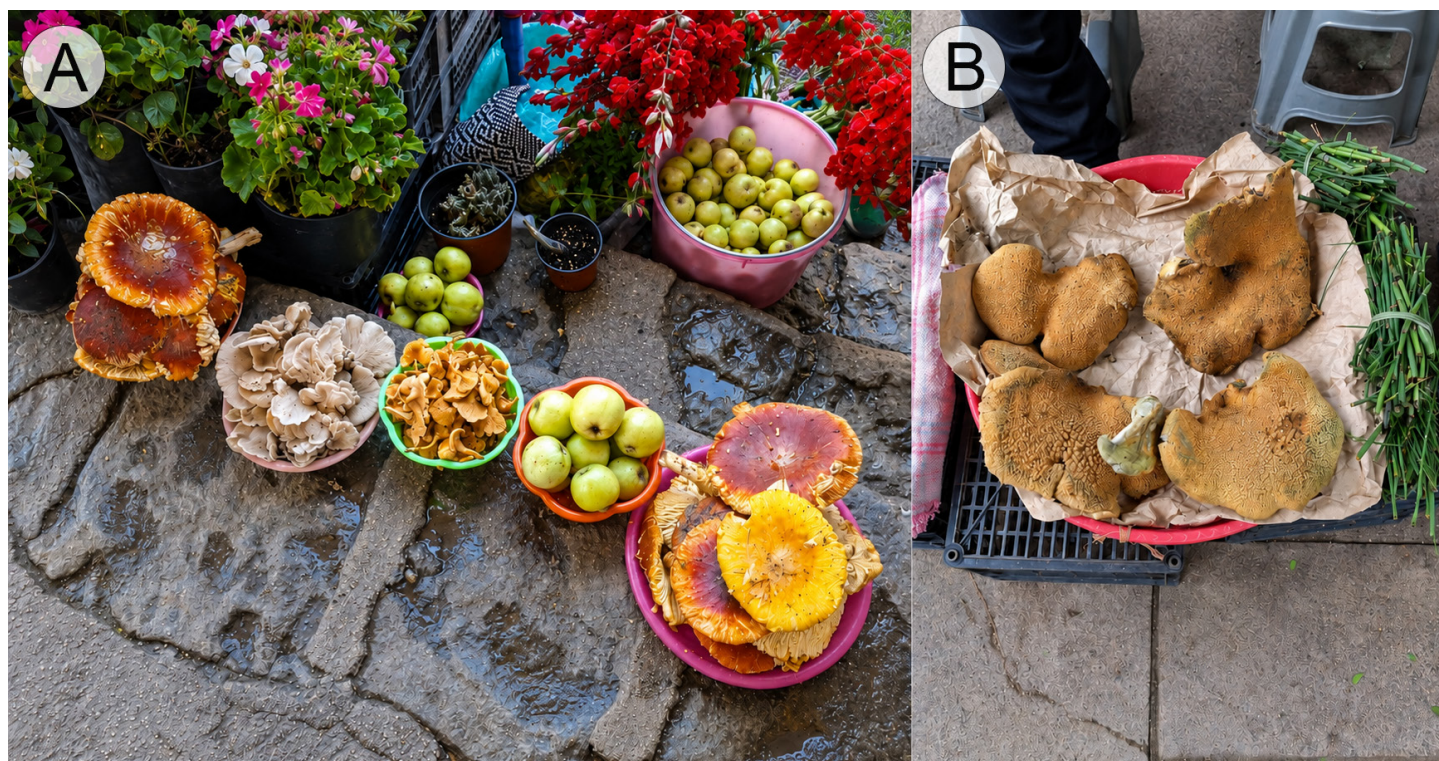


Figure 4: A. A great variety of wild edible mushroom species are sold in the market at Villa de Zaachila; B. including exclusive species *Albatrellus ellisi* (Berk. ex Cooke & Ellis) Teixeira.



Figure 5: No wild mushroom sales were observed in the market of Zimatlán de Álvarez; locals prefer cultivated mushrooms.

were recorded (Table 2). The vendors stated that the lack of rain in the region has significantly affected wild mushroom growth, reducing the availability of the fungal resources during the season. Additionally, the locals do not have a strong tradition of consuming mushrooms, so demand is limited. Vendors mentioned only one species of edible mushroom, locally referred to as “corralito”. They described it as a small brown mushroom; however, since they did not have a specimen available during the visits, it was not possible to identify the specific species. Information from vendors indicates that reduced rainfall, limited local demand for mushrooms, damaged roads, and regulatory or cultural restrictions shape both availability and commercialization routes. This situation has led vendors to diversify their goods with other products, such as flowers, medicinal plants, and chiles (Table 2).

Ocotlán de Morelos market

In the Ocotlán de Morelos market, only one vendor of wild edible mushrooms was identified, and he originated from San José del Pacífico in the Sierra Sur region (Table 2). The only

species sold belong to the *A. caesarea* complex (Appendix 2), and locals perceive them as a single species. The vendor mentioned that, although San José del Pacífico maintains a deep cultural relationship with mushrooms, especially psychedelic mushrooms, there are restrictions that limit their collection and commercialization outside their communities. In the Sierra Sur region, mushrooms of the genus *Psilocybe* (Fr.) P.Kumm. are known for their hallucinogenic effects and are part of the cultural and spiritual identity in some communities (Heim and Wasson, 1958). However, interviews conducted with inhabitants of San José del Pacífico in a previous study indicated that much of this traditional knowledge in the Sierra Sur is at risk of being lost due to poor fungal resource management, including the sale of *Psilocybe* mushrooms for non-spiritual purposes, charlatanism, gentrification, and a lack of communal organization for sustainable mushroom use. Gentrification has created a concerning phenomenon in which outsiders purchase land at low prices within the region, promoting commercial use of land for tourism or recreational activities rather than respecting its cultural and spiritual significance.

Some vendors explained that the limited availability of wild edible mushrooms in Ocotlán de Morelos is primarily due to collectors preferring to sell them in nearby markets, such as Miahuatlán de Porfirio Díaz, where they can fetch higher prices. Additionally, many collectors are forced to take alternative routes to other communities because the main roads to Ocotlán are damaged by the rain. This infrastructure issue complicates the supply chain and increases transportation costs, making local sales less viable. In this community, peaches, agave worms, and mushrooms are closely related products. Some vendors sell all three items; however, once the season for peaches and agave worms ends, they stop selling mushrooms because the transportation costs exceed the benefits.

Central de Abastos market in Oaxaca de Juárez

The Central de Abastos market functions as a regional node where biological diversity, traditional practices, and market forces converge. The high diversity of species, the coexistence of collectors and resellers, and the wide price range reflect complex value chains typical of large urban markets. While this centralization creates economic opportunities, it may also intensify harvesting pressure in source communities and increase inequalities between collectors and



intermediaries (Martínez-Carrera et al., 2022). A total of 14 vendors were recorded in this market, originating from several localities (Table 2). Seventeen mushroom species were found (Appendix 2), which are highly valued not only for their culinary qualities but also for their cultural importance and demand in both local and international cuisine (Garibay-Orijel et al., 2006; Martínez-Carrera et al., 2022).

In addition to grams, traditional measures are used at the Central de Abastos to sell mushrooms, including plates, jícaras, buckets, and small bags, with prices ranging from \$50 to \$170 MXN. Both direct vendors, who collect mushrooms themselves, and resellers, who purchase from collectors and sell at higher prices, are frequent in this market. Resellers find a strong market at this central location due to the influx of buyers and tourists who appreciate the variety of local mushrooms; however, this also leads to higher prices for consumers (Fig. 6). The Central de Abastos is a key space for the fungal economy of Oaxaca, not only because of its variety of species and prices, but also because it represents a meeting point between tradition and commerce. We found not only wild mushrooms but also a variety of cultivated *Pleurotus* (Fr.) P.Kumm. mushrooms, which allows vendors to reach more diverse clients. Vendors mentioned that the usual method for collecting mushrooms is by hand, and they typically store them in buckets, often in the morning before heading to the markets. Some of them prefer to take an additional day to gather more mushrooms.

Mushroom vendors and trading

A total of 60 mushroom vendors were recorded across the studied markets (Table 2), with 3.33% being teens, 8.34% young adults, 53.33% middle-aged adults, and 35% older adults. The commercialization of wild mushrooms in the markets reflects complex interactions between gender roles, traditional ecological knowledge, regional mobility, and cultural sensitivity. The predominance of women (78%) among mushroom vendors is consistent with ethnomycological studies across Mexico and other regions of Mesoamerica, where women play a central role in the collection, processing, and sale of non-timber forest products, including macrofungi (Garibay-Orijel et al., 2006; Pérez-Moreno et al., 2008). This gendered participation is

closely linked to women's roles in household food security and local market economies, where mushroom sales provide a supplementary income rather than serving as a primary livelihood (Garibay-Orijel et al., 2012).

The fact that most vendors engage in multiple economic activities (agriculture, household labor, and the sale of other products) underscores the significance of mushroom commercialization within diverse livelihood strategies. Seasonal availability of mushrooms and climatic variability make relying on macrofungi alone economically risky, highlighting the necessity for income diversification (Boa, 2004; Shackleton et al., 2011). This multifunctional livelihood strategy is common in rural and peri-urban communities of Oaxaca, where households balance subsistence production with wage labor, small-scale businesses, migration, and market-oriented activities (Gijón-Cruz et al., 2018).

All mushroom vendors come from communities in the mountainous areas of Sierra Norte, Sierra Sur, and Valles Centrales, which indicates strong rural-urban linkages. The closest community to the market where mushrooms are sold is located no more than 30 km away, while the farthest communities are situated 44 km and 70 km from the markets. This reflects the high cultural and economic value attributed to wild mushrooms, along with vendors' willingness to invest time and resources in their commercialization. Similar spatial patterns have been observed in other Mexican regions, where urban markets act as hubs connecting forest-based resources with consumers (Garibay-Orijel and Ruan-Soto, 2014). However, increased travel distances may affect sustainability, as higher market demand can intensify harvesting pressure in source areas.

Wild mushrooms are mainly harvested for culinary use, but they are also collected for medicinal and ritual purposes, reinforcing their cultural significance (Domínguez et al., 2015; Hussain et al., 2023). However, most vendors were reluctant to discuss the use of medicinal and sacred mushrooms, which reflects the sensitive nature of traditional knowledge. As reported in other ethnobiological studies, secrecy often functions as a protective mechanism against biopiracy, regulatory restrictions, and loss of cultural control (Toledo and Barrera-Bassols, 2008;





Figure 6: Reseller's mushroom stand in the Central de Abastos market of Oaxaca de Juárez, with a great variety of wild mushroom species.

Montoya et al., 2012). Concerns about trust with outsiders, economic competition, and the fear of regulation can shape the type and depth of information shared (Montoya et al., 2012), introducing potential biases into wild mushroom commercialization research. These limitations are not merely methodological challenges but also reflect broader socio-political contexts that influence traditional resource use. Recognizing these dynamics is crucial for interpreting results and for designing future studies that emphasize ethical engagement, long-term collaboration, and culturally appropriate research methods.

Loss of traditional knowledge

The loss of traditional knowledge about wild edible mushrooms in the Valles Centrales region of Oaxaca seems to be a multifaceted process driven by social, economic, environmental, and infrastructural factors. The results showed that 12 of the 14 vendors recorded from Cuajimoloyas use the names “amanita” and “boletus” for mushrooms in the *Amanita caesarea* complex and mushrooms in the genus *Boletus*, respectively, rather than local names. The observed replacement of local mushroom names by scientific terminology reflects a complex process of linguistic and biocultural transformation. The increasing use of names such as “amanita” may facilitate communication with researchers, tourists, institutional actors, and broader commercial networks, thereby improving taxonomic precision and market recognition. However, this shift may also weaken local nomenclatures that encode culturally specific criteria of classification, including color, morphology, habitat, seasonality, taste, and social memory.

Ethnobiological studies have shown that folk taxonomies are not merely informal labels, but structured knowledge systems through which communities organize ecological experience (Berlin, 1992; Toledo and Barre-ra-Bassols, 2008). Similarly, ethnomycological research in Oaxaca has emphasized that mushroom names are linked to use, identity, oral transmission, and biocultural continuity (Ríos-García et al., 2023; López-García et al., 2024). Thus, scientific names may support external communication, but their dominance can contribute to the erosion of traditional ecological knowledge and linguistic diversity

(Kik et al., 2021). The presence of resellers who prioritize profit over tradition in large markets reflects socio-economic pressures, including urban migration, globalization, and a lack of cultural appreciation (Valencia, 2006; García, 2021). The increasing influence of resellers in markets such as Central de Abastos illustrates a commodification process where economic value takes precedence over cultural continuity, weakening the links among collectors, consumers, and traditional practices.

The generational gap identified among mushroom vendors may lead to a loss of ethnomycological knowledge (López-García et al., 2025). The dominance of vendors aged 36 and older, along with the limited participation of younger generations (Table 2), could indicate a disruption in intergenerational transmission. Previous studies have shown that traditional knowledge is primarily transmitted through everyday practice, observation, and participation from an early age (Estrada Martínez et al., 2012; Reyes-García et al., 2013). When younger generations disengage due to migration, formal education systems that undervalue local knowledge, or alternative economic opportunities, the cultural loss accelerates.

The case of Cuajimoloyas and San José del Pacífico

The contrasting cases of Cuajimoloyas and San José del Pacífico exemplify how communal organization shapes the resilience of traditional practices. In Cuajimoloyas, mushroom harvesting operates as a collective activity that reinforces social cohesion, shared identity, and sustainable resource management. The integration of traditional knowledge with selected modern techniques allows for diversification and market adaptation without fully displacing ancestral practices. Conversely, San José del Pacífico shows a fragmented social structure and reduced communal activities, leading to a weaker collective identity and inconsistent management of fungal resources. The perception in this locality that selling wild mushrooms is illegal further discourages knowledge transmission and commercialization, highlighting how regulatory ambiguity and local interpretations of legality can suppress traditional practices even in culturally significant regions (Montoya, 1992).



Relationship between the community-collecting area distance and the number of species collected

Accessibility and distance to collecting areas further modulate the availability of wild mushrooms in markets. The linear regression analysis showed a significant negative relationship between distance from communities to collecting areas and the number of species collected ($F = 6.5$, $p = 0.013$), underscoring the importance of logistical constraints in shaping harvesting strategies. At distances between approximately 10 and 30 km, there is a greater dispersion in the number of species, which can explain the higher variability in the number of species collected at shorter distances. At distances greater than 40 km, there is less dispersion in the number of species, which can explain the fewer species collected at greater distances (Fig. 7). Although more distant areas may be ecologically better conserved, poor road conditions and time limitations can restrict effective harvesting, resulting in fewer mushroom species brought to markets. Once collectors arrive at the harvesting sites, they have only a few hours to collect the sporomes, which limits the number of species they can gather. Vendors need to arrive early at markets to secure visible selling spaces, which introduces additional temporal pressure, mainly for people who harvest and sell the mushrooms on the same day, thereby favoring rapid, selective collection over diversified harvesting. Along with economic and logistical factors, microclimatic and environmental conditions in collecting areas can significantly influence the diversity of available mushrooms (Boa, 2004; Deacon, 2006). Therefore, environmental factors play a crucial role in the commercialization of mushrooms. Understanding these relationships is crucial for identifying patterns in the use of the fungal resource, the impact of accessibility on market supply, and the pressures that may affect traditional foraging practices in the rural communities of Oaxaca.

Similarity in the composition of mushroom species regarding environmental similarities between collecting areas

Beyond transport strategies, the similarity in mushroom species composition among vendors from different communities is closely linked to shared environmental condi-

tions in their collecting areas. Vendors in the markets of Oaxaca de Juárez and Villa de Zaachila offer a wide variety of mushroom species, though many are quite similar. Most vendors in these two markets come from communities in Santiago Tlazoltepec, San Miguel Peras, Santa Inés del Monte and La Cumbre (Fig. 8), localities that share geographic proximity and similar environmental conditions. They are part of the mountainous system of the Sierra Sur where pine and oak forests predominate. The composition of species recorded for vendors from the communities of Nuevo Zoquiapám and Arroyo Las Guacamayas in the markets of Oaxaca de Juárez and Villa de Etlá, respectively, was also similar, and their localities are in close proximity to one another, sharing an ecological transition zone between the Valles Centrales region and the Sierra Norte, characterized by oak forests (Zamora-Martínez et al., 2014; INEGI, 2017).

It has been observed that a wide range of similar macrofungal species can be found in vegetation types that provide similar microclimatic conditions, host-tree diversity, resources, and soil characteristics (Zamora-Martínez et al., 2014; Gómez-Hernández et al., 2019), which may explain the observed results. Moreover, several studies suggest that factors such as microclimate, vegetation structure, temperature, altitude, slope, and tree species distribution can influence both the diversity and composition of macro-mycete species in conserved and urbanized environments (Brown et al., 2005; Heilmann-Clausen et al., 2005; Gómez-Hernández et al., 2019).

Similarity in the composition of mushroom species sold among the studied markets

The NMDS analysis (distances = Bray-Curtis, dimensions $k = 2$, stress = 0.13) indicated that the Central de Abastos and Zaachila markets are the most similar regarding the composition of mushroom species they sell, followed by the Villa de Etlá market. The analysis provides further insight into how ecological, cultural, and economic factors interact to shape species composition sold in the markets, reflecting overlapping supply networks, shared source communities, and similar consumer preferences for culturally valued species (Fig. 9). Teotitlán del Valle showed the greatest difference in species composition compared to the other markets because only one mushroom species is sold in this



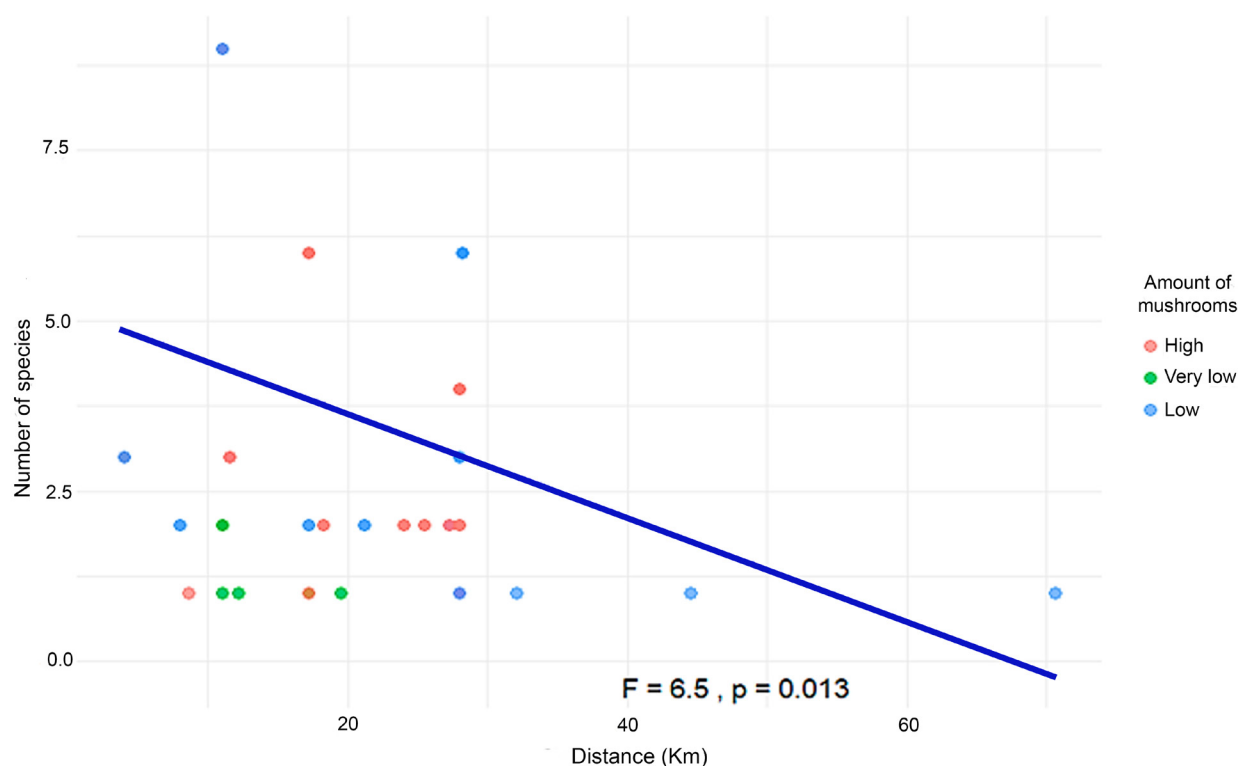


Figure 7: Linear regression analysis. There is a significant negative relationship between the distance from communities to collecting areas (km) and the number of species collected. Dots represent the vendors recorded across the markets and the amounts of mushrooms collected at different distances.

market. Vendors stated that they sell only species from the *A. caesarea* complex because it is the mushroom that people request. Vendors in Teotitlán come from the community of Cuajimuloyas, where the famous “Feria Regional de los Hongos” takes place. This event has resulted in a more selective demand for the harvesting and sale of certain mushrooms, such as the *A. caesarea* complex. According to Jiménez-Ruiz (2013), some of the most commonly sold mushroom species in the Valles Centrales region belong to the *A. caesarea* complex.

Patterns and contrasts from an integrative perspective

The studied markets can be interpreted as a regional continuum of fungal commercialization. At one extreme, the Central de Abastos represents an urban, diversified, and commercially intensified node, where high species richness and multiple vendor types coexist with price differentiation and reseller participation. At the other extreme, Ayoquezco, Zimatlán, and Ejutla represent markets where mushroom trade has become residual, remembered, or

seasonally constrained. Between these extremes are Tlacolula, Zaachila, Villa de Etla, Teotitlán, and Ocotlán, which maintain different combinations of direct selling, communal collection, linguistic identity, barter, specialization, and seasonal dependence. This continuum suggests that the persistence of wild edible mushroom commercialization is not determined by a single variable. Markets remain active when ecological availability, local knowledge, consumer trust, transport feasibility, and cultural valuation coincide. Markets decline when one or more of these factors weaken, when younger generations stop learning, when consumers fear wild species, when roads fail, when rainfall decreases, when collectors prefer more profitable markets, or when urbanization reduces local demand and forest-based livelihoods.

These findings have broader implications for the study and conservation of biocultural heritage in traditional markets. First, traditional markets should be recognized as living institutions that conserve, transform, and redistribute ethnomycological knowledge. They are not passive outlets for forest products but active arenas where species



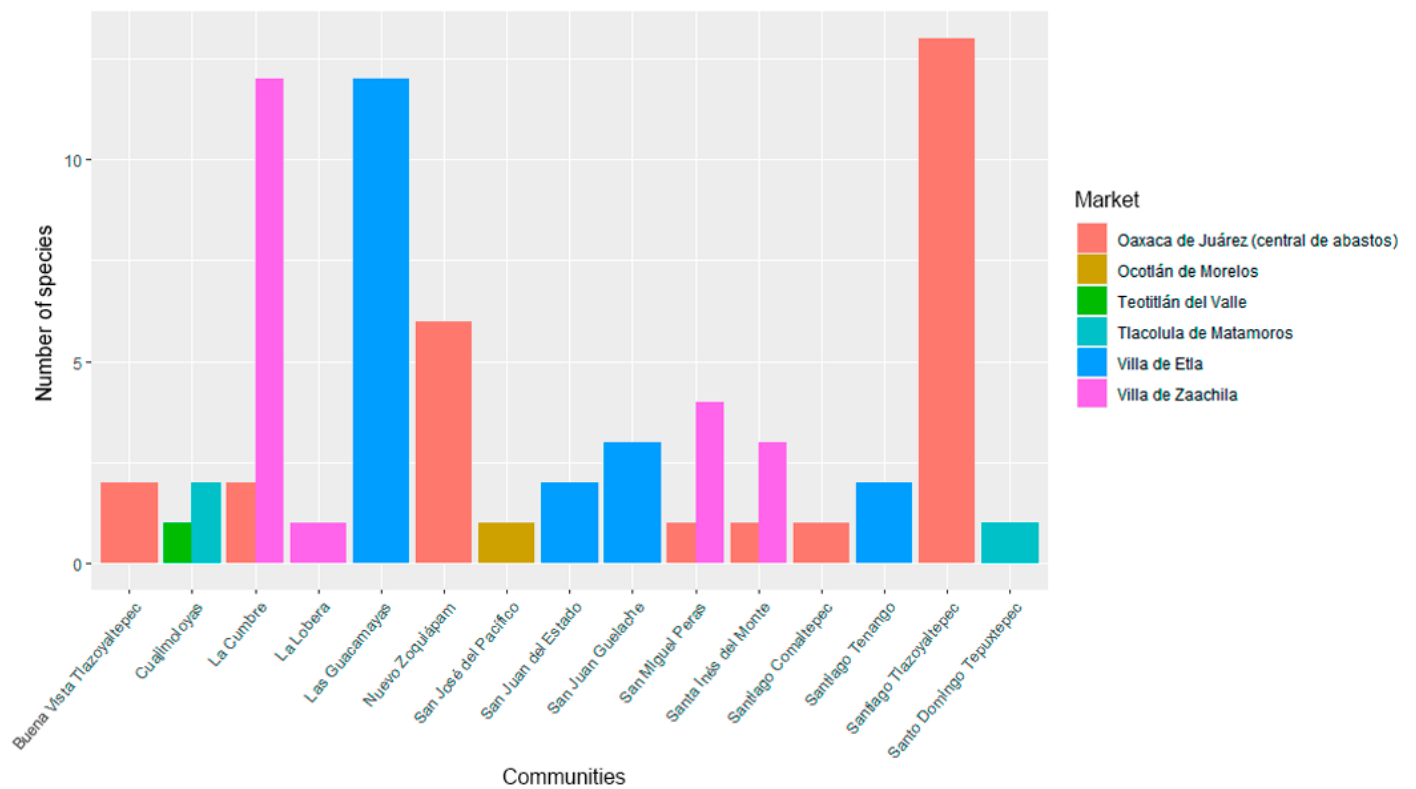


Figure 8: Communities of origin for the mushroom vendors recorded in the six studied markets, along with the variation in the number of species from each community sold in each market.

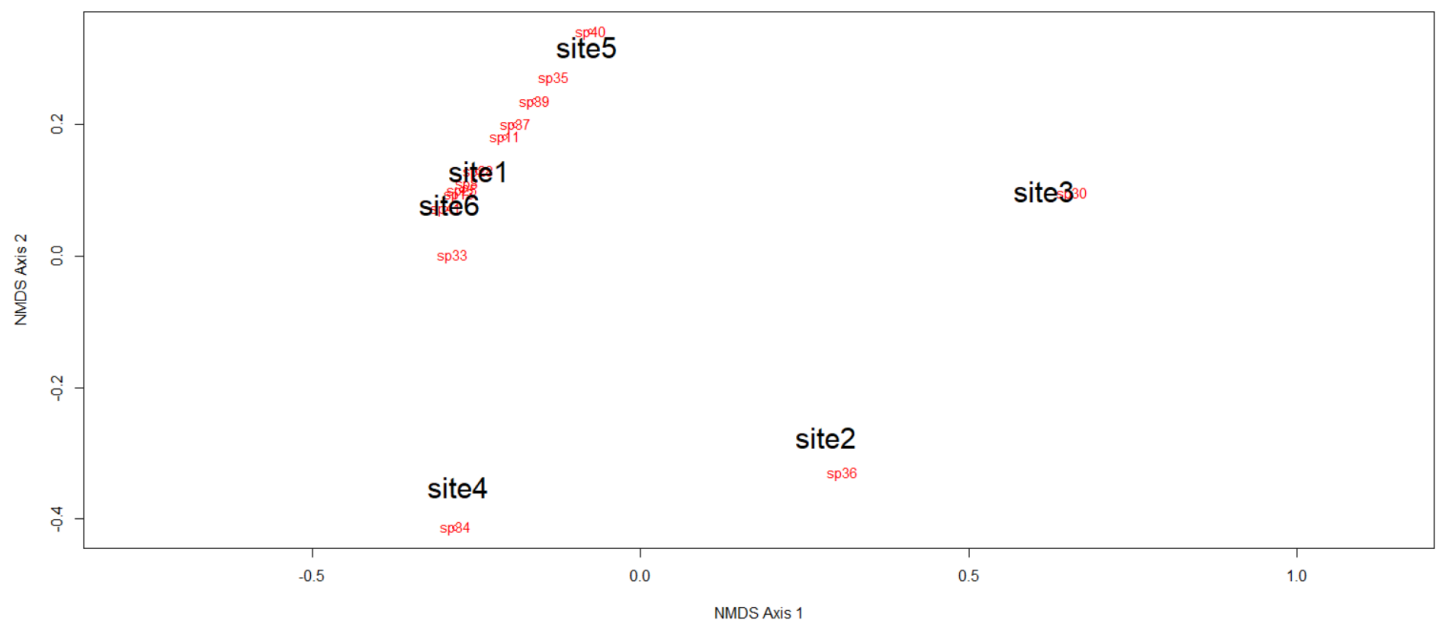


Figure 9: Non-metric multidimensional scaling analysis. “Sites” correspond to the markets 1) Central de Abastos, 2) Ocotlán de Morelos, 3) Teotitlán del Valle, 4) Tlacolula de Matamoros, 5) Villa de Etla, and 6) Villa de Zaachila. The closer the sites are to each other, the greater the similarity in the composition of the mushroom species they sell.



are named, valued, compared, exchanged, and reinterpreted. Second, the regional mushroom economy depends on women, older adults, family lineages, and rural collectors, whose knowledge and labor are often undervalued in formal economic analyses. Third, the persistence of barter and traditional measures such as plates, jícaras, buckets, bundles, and small bags demonstrates that market practices retain local logics of measurement and exchange even under increasing monetization. Fourth, the expansion of cultivated mushrooms and scientific nomenclature shows that traditional systems are not static; they are hybridizing with institutional mycology, tourism, urban gastronomy, and commercial standardization. Finally, the decline observed in some markets warns that preserving fungal diversity must be linked to the conservation of transmission contexts, including forests, family harvesting practices, weekly markets, and culturally meaningful forms of exchange.

The traditional markets in the Valles Centrales region of Oaxaca reveal a complex and uneven fungal economy in which wild edible mushrooms connect ecological seasonality, indigenous and rural knowledge, household subsistence, urban demand, and regional trade. The comparison among markets shows that some spaces remain strong centers of biocultural circulation, while others are undergoing decline, specialization, or substitution by cultivated products. The strongest markets are those where mushroom availability is supported by active source communities, consumer recognition, and viable commercial routes. The weakest are those affected by knowledge erosion, low demand, climatic uncertainty, infrastructure problems, and changing food perceptions.

Study limitations

When interpreting the results of this study, it is essential to consider its limitations. Climatic variability, especially the reduced rainfall during the fieldwork period, likely influenced mushroom fruiting and availability in several regions. Macrofungi are highly sensitive to changes in humidity and temperature, and shifts in precipitation patterns can significantly affect sporome production (Deacon, 2006). As a result, the diversity observed in certain markets may underestimate the actual potential diversi-

ty that would be present under more favorable climatic conditions. Despite most fungal specimens were identified to the species level, taxonomic uncertainty represents an important limitation. Accurate identification of wild mushrooms is inherently challenging due to morphological plasticity, cryptic species, and the need for microscopic or molecular analyses. While efforts were made to ensure reliable identification, some degree of taxonomic ambiguity is unavoidable in market-based studies, as has been observed in previous ethnomycological research (Pérez-Moreno et al., 2008).

The subjective nature of the information related to traditional knowledge may complicate data interpretation. Differences in perceptions among collectors, vendors, age groups, and genders can lead to inconsistencies in reported uses, names, and harvesting practices. Such subjectivity is intrinsic to ethnobiological research and reflects the dynamic and context-dependent nature of traditional knowledge systems (Toledo and Barrera-Bassols, 2008). Additionally, the limited involvement of vendors in interviews, driven by distrust of outsiders and concerns about sharing sensitive information, restricted the depth of the data obtained. Similar challenges have been widely reported in studies addressing culturally and economically valuable resources, highlighting the importance of long-term engagement and trust-building with mushroom collectors and vendors.

Conclusions

Traditional markets in the Valles Centrales region of Oaxaca differ markedly in the diversity, composition, and commercialization of wild edible mushrooms, reflecting interactions among ecological, logistical, socioeconomic, and cultural factors. The 22 recorded species and associated local knowledge suggest that these markets remain important reservoirs of ethnomycological knowledge, although their persistence is uneven across the region. Mushroom availability and composition were associated with accessibility to harvesting areas and environmental similarities among source localities, while commercialization was concentrated in markets, maintaining stronger links with forest communities and consumer demand. The predominance of middle-aged and older vendors, together with declining



mushroom sales in some markets and changes in traditional nomenclature and consumer preferences, indicates an ongoing erosion of knowledge transmission. These findings highlight the biocultural importance and vulnerability of wild mushroom commercialization in Oaxaca.

Author contributions

Conceptualization: SOA, MGH, EG; Investigation: SOA, MGH, EG; Formal analysis: SOA, MGH, EG; Methodology: MGH, EG; Project administration and Supervision: MGH, EG; Resources: MGH, EG; Validation: MGH; Writing-original draft: SOA, MGH, EG; Writing-review & editing: SOA, MAG, EG.

Funding

This study was supported by the Consejo Nacional de Ciencia, Humanidades y Tecnología scholarship (number 1311048), awarded to the first author SOA.

Acknowledgements

To Raúl Rivera García for assisting with the linear regression analysis; Graciela Eugenia González Pérez for providing valuable ideas to improve the manuscript; Eva Hannay Peláez Navarrete for assisting with data collection; and to the mushroom vendors for sharing their ancestral knowledge.

Data availability statement

The dataset supporting the results of this study has been deposited in SciELO Data and can be accessed at DOI: <https://doi.org/10.48331/SCIELODATA.JGCFWY>

Declaration of use of Artificial Intelligence

Grammarly (an artificial intelligence-based digital writing assistant) and ChatGPT (an artificial intelligence-powered virtual assistant) were used to translate and draft the manuscript in English, improve its language and style, and format the literature cited. The authors assume final responsibility for the content of their manuscript, including any sections produced using an AI tool, and are therefore accountable for any breaches of publication ethics.

Literature cited

- Alarcón-Gutiérrez, E. and F. Ramírez-Guillén. 2022. Los hongos en los ecosistemas. *Crónica y Portal Comunicación Veracruzana*, Instituto de Biotecnología y Ecología Aplicada. https://elportal.mx/salud-y-ciencia/inacol-es-ciencia/19/10/2022/los-hongos-en-los-ecosistemas-2/?utm_source=chatgpt.com (consulted December, 2022).
- Arellanes, Y. and A. Casas. 2011. Los mercados tradicionales del Valle de Tehuacán-Cuicatlán: Antecedentes y situación actual. *Nueva Antropología* 24(74): 93-123.
- Berlin, B. 1992. *Ethnobiological classification: Principles of categorization of plants and animals in traditional societies*. Princeton University Press. Princeton, New Jersey USA. 354 pp.
- Boa, E. 2004. Wild edible fungi: A global overview of their use and importance to people. *Non-Wood Forest Products* 17. Food and Agriculture Organization of the United Nations (FAO). Rome, Italy. 147 pp.
- Brown, N., S. Bhagwat and S. Watkinson. 2005. Macrofungal diversity in fragmented and disturbed forests of the Western Ghats of India. *Journal of Applied Ecology* 43(1): 11-17. DOI: <https://doi.org/10.1111/j.1365-2664.2005.01107.x>
- Cámara de Diputados del H. Congreso de la Unión. 2014. Ley General de los Derechos de Niñas, Niños y Adolescentes. Diario Oficial de la Federación, México. https://www.diputados.gob.mx/LeyesBiblio/pdf/LGDNNA.pdf?utm_source=chatgpt.com (consulted November, 2023)
- Camou-Guerrero, A., A. Casas, A. I. Moreno-Calles, J. Aguilera-Lara, D. Garrido-Rojas, S. Rangel-Landa, I. Torres-García, E. Pérez-Negrón, L. Solís-Rojas, J. Blancas, S. Guillén, F. Parra and E. Rivera-Lozoya. 2016. Ethnobotany in Mexico: history, development and perspectives. In: Lira, R., A. Casas and J. Blancas (eds.). *Ethnobotany of Mexico: interactions of people and plants in Mesoamerica*. Springer. New York, USA. Pp. 21–39. DOI: https://doi.org/10.1007/978-1-4614-6669-7_2
- Chance, J. K. 1976. The urban Indian in colonial Oaxaca. *American Ethnologist* 3(4): 603-632. DOI: <https://doi.org/10.1525/ae.1976.3.4.02a00040>
- Cook, S. and M. Diskin. 1976. *Markets in Oaxaca*. University of Texas Press. Austin, Texas, USA. 329 pp.
- Cook, S. and M. Diskin. 1990. Análisis e historia en la economía de mercado campesino del Valle de Oaxaca. In: Diskin, M. and S.



- Cook (eds.). Mercados de Oaxaca. Consejo Nacional para la Cultura y las Artes – Instituto Nacional Indigenista. México, D.F., México. Pp. 25-53.
- COPLADE. 2017. Diagnóstico Regional Valles Centrales. Coordinación General del Comité Estatal de Planeación para el Desarrollo de Oaxaca. Gobierno del Estado de Oaxaca. Oaxaca, México. https://www.oaxaca.gob.mx/coplade/wp-content/uploads/sites/29/2021/04/DR-Valles-Centrales.pdf?utm_source=chatgpt.com (consulted December, 2023).
- Deacon, J. 2006. Fungal biology. 4th ed. Blackwell Publishing. Oxford, UK. 384 pp.
- Domínguez, D., J. I. Arsaluz-Reyes, C. Valdés-Valdés and N. P. Romero-Popoca. 2015. Uso y manejo de hongos silvestres en cinco comunidades del municipio de Ocoyoacac, Estado de México.. Tropical and Subtropical Agroecosystems 18(2): 133-143. DOI: <https://doi.org/10.56369/tsaes.1905>
- Estrada Martínez, E., D. Cibrián Tovar and R. Ortega Paczka. 2012. Contexto socioeconómico del conocimiento micológico tradicional en la Sierra Nevada, México. Revista Mexicana de Ciencias Forestales 3(12): 57-70. DOI: <https://doi.org/10.29298/rmcf.v3i12.508>
- Farfán-Heredia, B., A. Casas, A. I. Moreno-Calles, E. García-Frapolli and A. Castilleja. 2018. Ethnoecology of the interchange of wild and weedy plants and mushrooms in Phurépecha markets of Mexico: economic motives of biotic resources management. Journal of Ethnobiology and Ethnomedicine 14: 5. DOI: <https://doi.org/10.1186/s13002-018-0205-z>
- García, K. P. 2021. *Lactarius indigo* (Schwein.) y Fr. (Russulaceae): etnomicología, química y farmacología. Tesis de Maestría en Ciencias Biológicas, Universidad Nacional Autónoma de México. Cd. Mx., México. 72 pp.
- Garibay-Orijel, R. and F. Ruan-Soto. 2014. Listado de los hongos silvestres comestibles como alimento tradicional en México. In: Moreno-Fuentes, A. and R. Garibay-Orijel (eds.). La etnomicología en México. Estado del arte. Red de Etnoecología y Patrimonio Biocultural (CONACYT), Universidad Autónoma del Estado de Hidalgo, Instituto de Biología, Universidad Nacional Autónoma de México, Sociedad Mexicana de Micología, Asociación Etnobiológica Mexicana A.C., Grupo Interdisciplinario para el Desarrollo de la Etnomicología en México and Sociedad Latinoamericana de Etnobiología. México, D.F., México. Pp. 91-112.
- Garibay-Orijel, R., A. Ramírez-Terrazo and M. Ordaz-Velázquez. 2012. Women care about local knowledge, experiences from ethnomycology. Journal of Ethnobiology and Ethnomedicine 8(25): 1-12. DOI: <https://doi.org/10.1186/1746-4269-8-25>
- Garibay-Orijel, R., J. Cifuentes, A. Estrada-Torres and J. Caballero. 2006. People using macro-fungal diversity in Oaxaca, Mexico. Fungal Diversity 21: 41-67.
- Garibay-Orijel, R., J. Caballero, A. Estrada-Torres and J. Cifuentes. 2007. Understanding cultural significance, the edible mushrooms case. Journal of Ethnobiology and Ethnomedicine 3: 4. DOI: <https://doi.org/10.1186/1746-4269-3-4>
- Garibay-Orijel, R., J. Córdova, J. Cifuentes, R. Valenzuela, A. Estrada-Torres and A. Kong. 2009. Integrating wild mushrooms use into a model of sustainable management for indigenous community forests. Forest Ecology and Management 258(2): 122-131. DOI: <https://doi.org/10.1016/j.foreco.2009.03.051>
- Gerhard, P. 1993. A guide to the historical geography of New Spain. Revised ed. University of Oklahoma Press. Norman, Oklahoma, USA. 402 pp.
- Gómez-Hernández, M., K. G. Ramírez-Antonio and E. Gándara. 2019. Ectomycorrhizal and wood-decay macromycete communities along development stages of managed *Pinus patula* stands in Southwest Mexico. Fungal Ecology 39: 109-116. DOI: <https://doi.org/10.1016/j.funeco.2018.12.007>
- Gijón-Cruz, A. S., C. R. Espinosa-Rojas and R. G. Reyes-Morales. 2018. Analysis of subsistence and well-being strategies through a model of household economics in the Tlacolula Valley of Oaxaca State, Mexico. China-USA Business Review 17(5): 221-233. DOI: <https://doi.org/10.17265/1537-1514/2018.05.001>
- Guzmán, G. 1977. Identificación de los hongos: comestibles, venenosos, alucinantes y destructores de la madera. Editorial Limusa. México, D.F., México. 452 pp.
- Haro-Luna, M. X., F. Ruan-Soto and L. Guzmán-Dávalos. 2019. Traditional knowledge, uses, and perceptions of mushrooms among the Wixaritari and mestizos of Villa Guerrero, Jalisco, Mexico. IMA Fungus 10: 16. DOI: <https://doi.org/10.1186/s43008-019-0014-6>
- Haro-Luna, M. X., J. Blancas-Vázquez, F. Ruan-Soto and L. Guzmán-Dávalos. 2022. Sociocultural drivers of



- mycological knowledge: insights from Wixarika and Mestizo groups in western Mexico. *Journal of Ethnobiology and Ethnomedicine* 18: 68. DOI: <https://doi.org/10.1186/s13002-022-00564-2>
- Heilmann-Clausen, J., E. Aude and M. Christensen. 2005. Cryptogam communities on decaying deciduous wood: Does tree species diversity matter? *Biodiversity and Conservation* 14(9): 2061-2078. DOI: <https://doi.org/10.1007/s10531-004-4284-x>
- Heim, R. and R. G. Wasson. 1958. Les champignons hallucinogènes du Mexique: études ethnologiques, taxinomiques, biologiques, physiologiques et chimiques. Archives du Muséum National d'Histoire Naturelle, 7e série, Tome VI. Muséum National d'Histoire Naturelle. Paris, France. 445 pp.
- Hernández-Santiago, F., J. Pérez-Moreno, B. Xoconostle-Cázares, J. J. Almaraz-Suárez, E. Ojeda-Trejo, G. Mata and I. Díaz-Aguilar. 2016. Traditional knowledge and use of wild mushrooms by Mixtecs or Nuu savi, the people of the rain, from Southeastern Mexico. *Journal of Ethnobiology and Ethnomedicine* 12: 35. DOI: <https://doi.org/10.1186/s13002-016-0108-9>
- Hirth, K. G. 2013. Los mercados prehispánicos. La economía y el comercio. *Arqueología Mexicana* 21(122): 30-35.
- Hussain, S., H. Sher, Z. Ullah, M. S. Elshikh, D. A. Al Farraj, A. Ali, and A. A. Mehmood Abbasi. 2023. Traditional uses of wild edible mushrooms among the local communities of Swat, Pakistan. *Foods* 12(8): 1705. DOI: <https://doi.org/10.3390/foods12081705>
- INEGI. 2017. Anuario estadístico y geográfico de Oaxaca 2017. Instituto Nacional de Estadística y Geografía. Aguascalientes, México. https://www.inegi.org.mx/contenidos/productos/prod_serv/contenidos/espanol/bvinegi/productos/nueva_estruc/anuarios_2017/702825094843.pdf?utm_source=chatgpt.com (consulted November, 2024).
- INEGI. 2021. Censo de población y vivienda 2020. Comunicado de prensa núm. 24/21. Instituto Nacional de Estadística y Geografía. Aguascalientes, México. <https://www.inegi.org.mx/programas/ccpv/2020/> (consulted January, 2024)
- International Society of Ethnobiology. 2006. International Society of Ethnobiology Code of Ethics (with 2008 additions). <https://www.ethnobiology.net/what-we-do/core-programs/ise-ethics-program/code-of-ethics/> (consulted December, 2022).
- Jiménez-Ruiz, M., J. Pérez-Moreno, J. J. Almaraz-Suárez and M. Torres-Aquino. 2013. Hongos silvestres con potencial nutricional, medicinal y biotecnológico comercializados en Valles Centrales, Oaxaca. *Revista Mexicana de Ciencias Agrícolas* 4(2): 199-213.
- Kik, A., M. Adamec, A.Y. Aikhenvald, J. Bajzekova, N. Baro, C. Bown, R. K. Colwell, P. Drozd, P. Duda, S. Ibalim, L. R. Jorge, J. Mogina, B. Ruli, K. Sam, H. Sarvasy, S. Saulei, G. D. Weiblen, J. Zrzavy and V. Novotny. 2021. Language and ethnobiological skills decline precipitously in Papua New Guinea, the world's most linguistically diverse nation. *Proceedings of the National Academy of Sciences of the United States of America* 118(22): e2100096118. DOI: <https://doi.org/10.1073/pnas.2100096118>
- Largent, D. L. 1986. How to Identify Mushrooms to Genus I: Macroscopic Features. 3rd ed. Mad Rivers Press. Eureka, California, USA. 166 pp.
- Largent, D. L. and H. D. Thiers. 1977. How to Identify Mushrooms to Genus. II: Field Identification of Genera. Mad River Press. Eureka, California, USA. 32 pp.
- Landeros, F., J. Castillo, G. Guzmán and J. Cifuentes. 2006. Los hongos (macromicetos) conocidos en el Cerro el Zamorano (Querétaro-Guanajuato), México. *Revista Mexicana de Micología* 22: 25-31.
- Linares, E. and R. Bye. 2016. Traditional markets in Mesoamerica: A mosaic of history and traditions. In: Lira, R., A. Casas and J. Blancas (eds.). *Ethnobotany of Mexico: interactions of people and plants in Mesoamerica*. Springer. New York, USA. Pp. 151-177. DOI: https://doi.org/10.1007/978-1-4614-6669-7_7
- López-García, A., M. Gómez-Hernández and E. Gándara. 2024. Variation in traditional knowledge of culturally important macromycete species among three indigenous communities of Oaxaca, Mexico. *Journal of Ethnobiology and Ethnomedicine* 20: 38. DOI: <https://doi.org/10.1186/s13002-024-00679-8>
- López-García, A., M. Gómez-Hernández and E. Gándara. 2025. Folk taxonomy of wild mushrooms in communities of the indigenous groups Chatino, Chontal, and Chinantec in Oaxaca, Mexico. *Journal of Ethnobiology and Ethnomedicine* 21: 30. DOI: <https://doi.org/10.1186/s13002-025-00779-z>
- López-García, A., J. Pérez-Moreno, M. Jiménez-Ruiz, E. Ojeda-Trejo, J. Delgadillo-Martínez and F. Hernández-Santiago. 2020. Conocimiento tradicional de hongos de importancia



- biocultural en siete comunidades de la región chinanteca del estado de Oaxaca, México. *Scientia Fungorum* 50: e1280. DOI: <https://doi.org/10.33885/sf.2020.50.1280>
- López-Hernández, A., L. J. Arellano, I. Uribe and J. C. Aparicio. 2022. Recolección, comercialización y consumo de hongos silvestres en la región mixteca de Oaxaca, México. *Etnobiología* 20(2): 173-197.
- Martínez-Carrera, D., Y. Mayett-Moreno and M. R. Maimone-Celorio. 2022. Los hongos comestibles, funcionales y medicinales: aportación a la dieta, la salud, la cultura, al ambiente y al sistema agroalimentario de México. Biblioteca Básica de Agricultura, Colegio de Postgraduados. San Luis Huixtla, México. 584 pp.
- Molina-Luna, N. G. and Y. Arellanes. 2016. Intercambio de productos en mercados semanales de los Valles Centrales de Oaxaca, México. *Etnobiología* 14(2): 92-99.
- Montemayor, C. 2007. Diccionario del náhuatl en el español de México. Universidad Nacional Autónoma de México, Programa México Nación Multicultural-Gobierno del Distrito Federal. México, D.F., México. 440 pp.
- Montoya, A. 1992. Análisis comparativo de la etnomicología de tres comunidades ubicadas en las faldas del volcán La Malintzi, estado de Tlaxcala. Tesis de Licenciatura. Escuela Nacional de Estudios Profesionales Iztacala, Universidad Nacional Autónoma de México. Tlalnepantla, México. 155 pp.
- Montoya, A., E. A. Torres-García, A. Kong, A. Estrada-Torres and J. Caballero. 2012. Gender differences and regionalization of the cultural significance of wild mushrooms around La Malinche volcano, Tlaxcala, Mexico. *Mycologia* 104(4): 826-834. DOI: <https://doi.org/10.3852/11-347>
- Montoya, A., A. Kong, A. Estrada-Torres, J. Cifuentes and J. Caballero. 2004. Useful wild fungi of La Malinche National Park, Mexico. *Fungal Diversity* 17: 115-143.
- Moreno-Fuentes, A. 2018. La etnomicología. Red temática del patrimonio biocultural (CONAHCYT, México). http://patrimoniobiocultural.com/archivos/publicaciones/articulos/LA_ETNOMICOLOGIA.pdf (consulted January, 2021).
- Pellicer-González, E., D. Martínez-Carrera, M. Sánchez, M. Aliphath and A. Estrada-Torres. 2002. Rural management and marketing of wild edible mushrooms in México. In: Sánchez, J. E., G. Huerta and E. Montiel (eds.). *Proceedings of the IV International Conference on Mushroom Biology and Mushroom Products*. Cuernavaca, México. Pp. 433-443.
- Peña, E. R., Y. M. Niño and L. Enao. 2023. Importancia cultural de hongos silvestres comestibles en cuatro municipios de Boyacá (Colombia). *Ciencia en Desarrollo* 14(1): 31-46. DOI: <https://doi.org/10.19053/01217488.v14.n2.2023.15082>
- Pérez-Moreno, J., M. Martínez-Reyes, A. Yescas-Pérez, A. Delgado-Alvarado and B. Xoconostle-Cázares. 2008. Wild mushroom markets in central Mexico and a case study at Ozumba. *Economic Botany* 62(3): 425-436. DOI: <https://doi.org/10.1007/s12231-008-9043-6>
- Pérez-Moreno, J., P. E. Mortimer, J. Xu, S. C. Karunarathna and H. Li. 2021. Global perspectives on the ecological, cultural and socioeconomic relevance of wild edible fungi. *Studies in Fungi* 6(1): 408-424. DOI: <https://doi.org/10.5943/sif/6/1/31>
- Pilz, D. and R. Molina. 2002. Commercial harvests of edible mushrooms from the forests of the Pacific Northwest United States: issues, management and monitoring for sustainability. *Forest Ecology and Management* 155(1-3): 3-16. DOI: [https://doi.org/10.1016/S0378-1127\(01\)00543-6](https://doi.org/10.1016/S0378-1127(01)00543-6)
- R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. <http://www.R-project.org/> (accessed in November 2024)
- Raymundo, T., R. Valenzuela, H. H. León-Avendaño, A. D. Gay-González, J. García-Jiménez and S. Bautista-Hernández. 2022. Hongos. In: Gómez-Hernández, C. V., K. C. Nájera-Cordero and J. Cruz-Medina (eds.). *La biodiversidad en Oaxaca. Estudio de Estado. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)*. Cd. Mx., México. Pp. 45-61.
- Reyes-García, V., M. Guèze, A. C. Luz, J. Paneque-Gálvez, M. J. Macía, M. Orta-Martínez, J. Pino and X. Rubio-Campillo. 2013. Evidence of traditional knowledge loss among a contemporary indigenous society. *Evolution and Human Behavior* 34(4): 249-257. DOI: <https://doi.org/10.1016/j.evolhumbehav.2013.03.002>
- Ríos-García, U., A. Carrera-Martínez, M. Martínez-Reyes, F. Hernández-Santiago, F. R. Evangelista, I. Díaz-Aguilar, J.



- W. Olvera-Noriega and J. Pérez-Moreno. 2023. Traditional knowledge and use of wild mushrooms with biocultural importance in the Mazatec culture in Oaxaca, Mexico, cradle of the ethnomycology. *Forest Systems* 32(1): e007. DOI: <https://doi.org/10.5424/fs/2023321-19884>
- Ruan-Soto, F., R. Garibay-Orijel and J. Cifuentes. 2006. Process and dynamics of traditional selling wild edible mushrooms in tropical México. *Journal of Ethnobiology and Ethnomedicine* 2: 3. DOI: <https://doi.org/10.1186/1746-4269-2-3>
- Shackleton, S., C. Shackleton and P. Shanley. 2011. Non-timber forest products in the global context. *Tropical Forestry* 7. Springer. Heidelberg, Germany. DOI: <https://doi.org/10.1007/978-3-642-17983-9>
- Toledo, V. M. and N. Barrera-Bassols. 2008. La memoria biocultural: la importancia ecológica de las sabidurías tradicionales. *Perspectivas Agroecológicas* 3. Icaria Editorial. Barcelona, España. 232 pp.
- Valencia, I. A. 2006. Uso tradicional de los hongos silvestres en San Pedro Nexapa, Estado de México. Tesis de Licenciatura en Biología. Facultad de Ciencias, Universidad Nacional Autónoma de México. México, D.F., México. 121 pp.
- Valle de Frutos, S. 2010. Los procesos de transculturación desde la identidad de nuestra América y la Europa mediterránea. *Cuadernos Americanos* 2(132): 55-63. http://rilzea.cialc.unam.mx/jspui/handle/CIALC-UNAM/A_CA323 (consulted March, 2023)
- Voces, R., L. Díaz-Balteiro and O. Alfranca. 2012. Demand for wild edible mushrooms: The case of *Lactarius deliciosus* in Barcelona (Spain). *Journal of Forest Economics* 18(1): 47-60. DOI: <https://doi.org/10.1016/j.jfe.2011.06.003>
- Wang, Y. C. 1987. Mycology in ancient China. *The Mycologist* 1(2): 59-61.
- Zamora-Martínez, M. C., A. González, F. Islas, E. N. Cortés and L. I. López. 2014. Distribución geográfica y ecológica de 13 especies de hongos silvestres comestibles en Oaxaca. *Revista Mexicana de Ciencias Forestales* 5(21): 76-93. DOI: <https://doi.org/10.29298/rmcf.v5i21.359>



Appendix 1: Interview conducted with mushroom vendors in the studied markets along the Valles Centrales region of Oaxaca, Mexico.

SOCIAL DATA

1. Gender
2. Age
3. Occupation
4. Natal locality
5. Spoken languages
6. Did you have the opportunity to study? A) Yes B) No
7. Level of education: no formal education, elementary school, middle school, high school, undergraduate, and higher academic level.

MUSHROOM DIVERSITY

1. How many types of wild edible mushrooms do you use to find during the season?
2. Which mushrooms do you find most frequently during the season?
3. During which months do you find the greatest variety of mushrooms?
4. Which mushrooms do you sell during the season?

COLLECTION METHODS

1. Where do the mushrooms you sell originate from?
2. Who is responsible for collecting the mushrooms?
3. How do you collect them?
4. How do you transport them?
 - a) Basket
 - b) Paper bag
 - c) Plastic bag
 - d) Other
5. How do you store them? And for how long?

MARKETING

1. Do you collect the mushrooms you sell or buy them from collectors?
2. What's the criterion for assigning the mushrooms' price?
 - a) Availability during the season
 - b) Difficulty in collecting
 - c) People's request
 - d) Other
3. How much does this contribute financially to your family's livelihood relative to the percentage of sales?
4. Do you participate in any other economic activities during the mushroom season?

FUNGAL RESOURCE

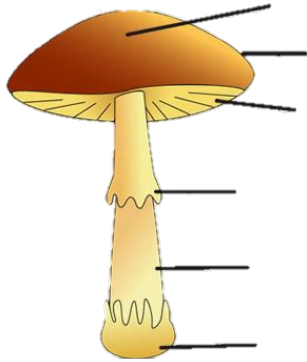
1. Have you noticed any changes in mushroom availability where you've been collecting wild mushrooms over time?
2. Have these changes caused you to modify any collection methods?
3. In what year have you seen the greatest decline in mushrooms? Why?
4. Are you familiar with any methods for mushroom preservation?

TRADITIONAL KNOWLEDGE

1. Name the varieties of wild mushrooms you know:
2. What uses for mushrooms do you know?
3. Where do they grow?
 - a) Tree



- b) Ground
- c) Other
- 4. Near which plants do they grow?
- 5. Where did you gain your knowledge about the use of mushrooms?
 - a) Family
 - b) Community
 - c) Other
- 6. What parts of the mushroom can you name?



PERCEPTIONS

- 1. What significance do mushrooms hold?
 - a) Economic
 - b) Cultural
 - c) Spiritual
 - d) Other
- 3. What are some other uses for mushrooms?
- 4. Do you know any myths surrounding wild mushrooms?

Appendix 2: Wild edible mushroom species and local names recorded in each studied market along the Valles Centrales region of Oaxaca, Mexico.

Scientific name	Local name	Market	Photo
<i>Agaricus</i> sp.	Hongo de casahuate	Villa de Etla	
<i>Albatrellopsis ellisii</i> (Berk. ex Cooke & Ellis) Teixeira	Hongo de barriga	Villa de Etla	
<i>Amanita caesarea</i> (Scop.) Pers. complex	Hongo de ocotal, empeyupe, yema de huevo, yupe, hongo de manzana, caserola, San Miguel, hongo rojo o amarillo, amanita	Central de Abastos, Tlacolula de Matamoros, Teotitlán del Valle, Villa de Zaachila, Villa de Etla, Ocotlán de Morelos	 

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Boletus</i> aff. <i>edulis</i> Bull.	Hongo de pan, esponja, boletus	Tlacolula de Matamoros	
<i>Cantharellus cibarius</i> Fr.	Hongo de mantequilla	Central de Abastos, Villa de Etlá	
<i>Clavulina</i> sp.	Hongo de barbita, cuerno de venado	Villa de Etlá	
<i>Craterellus tubaeformis</i> (Fr.) Quéf.	Patita de pollo, hongo de tazajo	Central de Abastos Villa de Zaachila Villa de Etlá	

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Gymnopus</i> sp.	Hongo pájaro	Central de Abastos	
<i>Hydnum repandum</i> L.	Hongo gusano, melena de león	Central de Abastos	 
<i>Hydnum rufescens</i> Pers.	Hongo mantequilla, trompeta	Central de Abastos, Villa de Etla	
<i>Hygrophoropsis aurantiaca</i> (Wulfen) Maire ex Martin- Sans	Hongo mantequilla, flor guía, hongo de aserrín, hongo de sal	Central de Abastos, Villa de Zaachila, Villa de Etla	

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Hygrophorus russula</i> (Schaeff. ex Fr.) Bataille	Hongo hoja púrpura, hongo, hongo pájaro, hongo ardilla	Central de Abastos, Villa de Zaachila, Villa de Etla	 
<i>Hypomyces lactifluorum</i> (Schwein.) Tul. & C. Tul.	Cresta de gallo, hongo enchilado, trompa de cucho	Central de Abastos, Villa de Zaachila	
<i>Infundibulicybe gibba</i> (Pers.) Harmaja	Hongo hoja, cegueza	Central de Abastos, Villa de Zaachila	

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Laccaria amethystina</i> Cooke	Hongo pájaro	Central de Abastos, Villa de Etla	 
<i>Laccaria</i> sp.	Corralito	Central de Abastos	 
<i>Laccaria</i> sp.	Hongo pájaro o paraguas, patita de pollo, corralito	Central de Abastos, Villa de Zaachila, Villa de Etla	

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Lactarius</i> sp.	Corral, hongo de leche	Central de Abastos	
<i>Macrolepiota procera</i> (Scop.) Singer	Hongo de composta	Villa de Etna	
			
<i>Pleurotus</i> aff. <i>djamor</i> (Rumph. ex Fr.) Boedijn	Hongo guanacastle, nanacate, hongo natural	Central de Abastos, Villa de Etna	

Appendix 2: Continuation.

Scientific name	Local name	Market	Photo
<i>Ramaria</i> sp.	Cuerno de venado, hongo venado, cresta de venado, hasta de venado, hongo frijol, cresta de gallo	Central de Abastos, Villa de Zaachila, Villa de Etla	
<i>Tricholoma</i> <i>mesoamericanum</i> Justo & Cifuentes	Hongo de venado, hongo japonés	Central de Abastos	