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Wild mushroom consumption in the P'urhépecha Plateau at Michoacán, México: social, ethnomycological and nutritional issues

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Abstract

Among Mesoamerican cultures, P'urhépecha settlers inhabiting Michoacán State in Central Mexico preserve ancestral tradition on mushrooms eating. Most mycological knowledge available for this ethnical group has been addressed in the Pátzcuaro's Lake zone, whereas P'urhépecha communities in other cultural and ecological relevant geographic areas remain unstudied. Thus, this work describes the ethnomycological knowledge of a scarcely analyzed Arantepacua P'urhépecha community at Michoacán Plateau region. Through structured interviews and field collections, data on the use, knowledge, biomass extraction and nomenclature of wild mushrooms were obtained. A list of P'urhépecha names to design 16 wild mushrooms species and 11 fruitbody components is documented and studied community used Spanish popular names to describe 21 wild mushrooms species and 11 fruitbody structures. Most valuable consumed mushroom species for Arantepacua settlers belong to the *Amanita, Boletus, Hypomyces* and *Ramaria* genera. Gender roles on mushrooms collect and cooking, new terms in P'urhépecha dialect to refer the parts of a fruitbody and vegetative mycelium, as well as local recipes and nutritional relevance of the mushroom species consumed by studied community are addressed and discussed. The ethnomycological knowledge documented contributes new terms in P'urhépecha to name the parts of an agarical fruitbody, the mycelium and empirical knowledge about mycorrhizal associations. This was the first P'urhépecha ethnomycological study made outside the Lake Pátzcuaro basin.

Keywords Traditional knowledge, Wild edible mushrooms, Popular mushroom names, Nutritional value, Mushroom recipes

Introduction

Use and knowledge of fungi have accompanied mankind since the very beginning of civilization. Moreover, mushrooms have been in the diet of our closest extinct relatives, the Neanderthals, at least 50,000 years ago [40]. The mushroom group is not a taxonomical fungal identity, but an operative one characterized by species which produces a sexual reproduction structure perceptible to the naked eye. This macroscopic sexual structure constitutes the edible part, named generally as fruitbody or sporocarp. Species mostly from Ascomycota and

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Basidiomycota phyla are included within mushroom fungi, being this later group the popularly identified as edible, since it includes the button (*Agaricus* spp.) and the oyster (*Pleurotus* spp.) mushrooms, as well as most fungi commercialized as food at an industrial level [31]. Over time, and based on macroscopic morphological characteristics of fruitbodies, civilization around the world begins to classify fungi species as edible, medicinal, toxic, or hallucinogen. Among edible ones, social groups empirical experience developed through the time has incorporated finest differentiation levels, to distinguish which are better tasting [21]. The edible mushrooms constitute a good seasonal supply of dietary fiber, high-quality protein, unsaturated fatty acids, vitamins, micronutrients and are a good source of bioactive compounds [19], contributing to sustain good health for rural and ethnic communities worldwide.

Mushrooms are considered as a fundamental natural resource for Mesoamerican cultures including the Aztecs and Mayans, the most Mexican ethnical groups studied, who knew and used approximately 50 mushrooms species, mainly edible ones, but also medicinal and hallucinogenic. However, it has been well documented that at Spanish arrival to the American continent wild fungi used by tribal original settlers began to be neglected [5]. The eroding process of such traditions has been continued in the last decades by different acculturation processes in México, Asia and worldwide [8], as well as by the continuous and excessive deterioration of the environment and climate change. Nevertheless, nowadays numerous indigenous and rural communities, particularly at central México and Asia, have preserved a rich traditional mycological knowledge and actively practice the use of wild mushrooms [21], allowed them to acquire rich empirical knowledge on it. This is particularly evident in different native groups from México besides Aztecs and Mayans, such as the Nahuas, P'urhépechas, Otomies and Mazahuas [21]. For instance, they know how to differentiate edible and medicinal mushrooms from toxic ones, and they are generally assigned a large variety of vernacular names, remarking mainly their fruitbodies morphological characteristics. Besides its anthropological and cultural relevance, this knowledge and its heritage of pre-Columbian cultures can be used to develop adequate conservation and management strategies for non-timber forest products (NTFPs) as viable production alternatives for regional development, since it enriches the diet in marginal rural and urban areas [38].

Nowadays the P'urhépecha people only reside in Michoacán State at central Mexico, and there are currently four regions where these ethnical group are concentrated, Japandarhu (Place of the Pátzcuaro lake), Eráxamani (Ravine of the eleven villages), Juátarisi (The Plateau) and the Cienega de Zacapu; formerly the region of Jurhío (place of the hot land or land of the sun) was added [16]. This region is no longer considered part of the P'urhépecha territory due a past of several diseases like malaria ("colds": *manárakua*) and terrible fevers ("alenturas": *jurhéri*) which generally caused the death of travelers and inhabitants. It was said that these were due to local food that was not good, and in addition, because people "out of malice" frequently presented the food already altered. And linked to the diseases was the hot and dry climate that made very difficult to grow food and farm, so the remaining P'urhépecha returned to the other regions with temperate climate, stable rainy season and therefore less diseases [22]. Mapes et al. [20] and Díaz-Barriga [6] made the first ethnomycological research of the P'urhépechas in the Lake Pátzcuaro basin, in the lake area. Such studies address traditional knowledge of only one of the four regions of the P'urhépecha geographical distribution, but it has been documented significative intracultural variation on natural resources knowledge of Mexican ethnical groups [32], an unaddressed issue in the ethnomycological knowledge of P'urhépechas. Thus, the objective of this research was to document and evaluate the use and traditional knowledge of wild mushrooms in the indigenous community of Arantepacua, belonging to the P'urhépecha Plateau region. Social, cultural, nutritional and ecological relevance of the obtained results is discussed.

Methods

Study area

The study was carried out in the community of Arantepacua, municipality of Nahuátzen, Michoacán, México, which is located at 19°35′37″ N, 101°58′05″ W, at an altitude of 2310 masl (Fig. 1). The orography is determined by the sub-province of the Transversal Volcanic System, within which the Sierra de Nahuátzen is located and conformed, among others, by the El Pilón, Las Flores, El Juanillo, and Los Cuates hills [16]. However, the San Marcos or Quinceo, locally called Itzol-juata, which means waterhole in the local dialect, is the main hill at northwest of Arantepacua, significantly contributing to its climatic protection. The vegetation at the community is dominated by coniferous forests, with pine (*Pinus* spp.), oyamel or "sacred fir" (*Abies religiosa* (Kunth) Schltdl. & Cham.) and juniper (*Juniperus* spp.). Evergreen trees prevail, and the mixed forest, with oak (*Quercus* spp.), Texas madrone (*Arbutus xalapensis* HBK), spoon tree (*Clethra Mexicana* DC), white cedar (*Cupressus lusitanica* Mill.) and alder (*Alnus acuminate* HBK).

The population of Arantepacua is 2321 inhabitants, which 1103 are males and 1218 females. Of the males, 566 are over 18 years old and 658 are females [16]. The

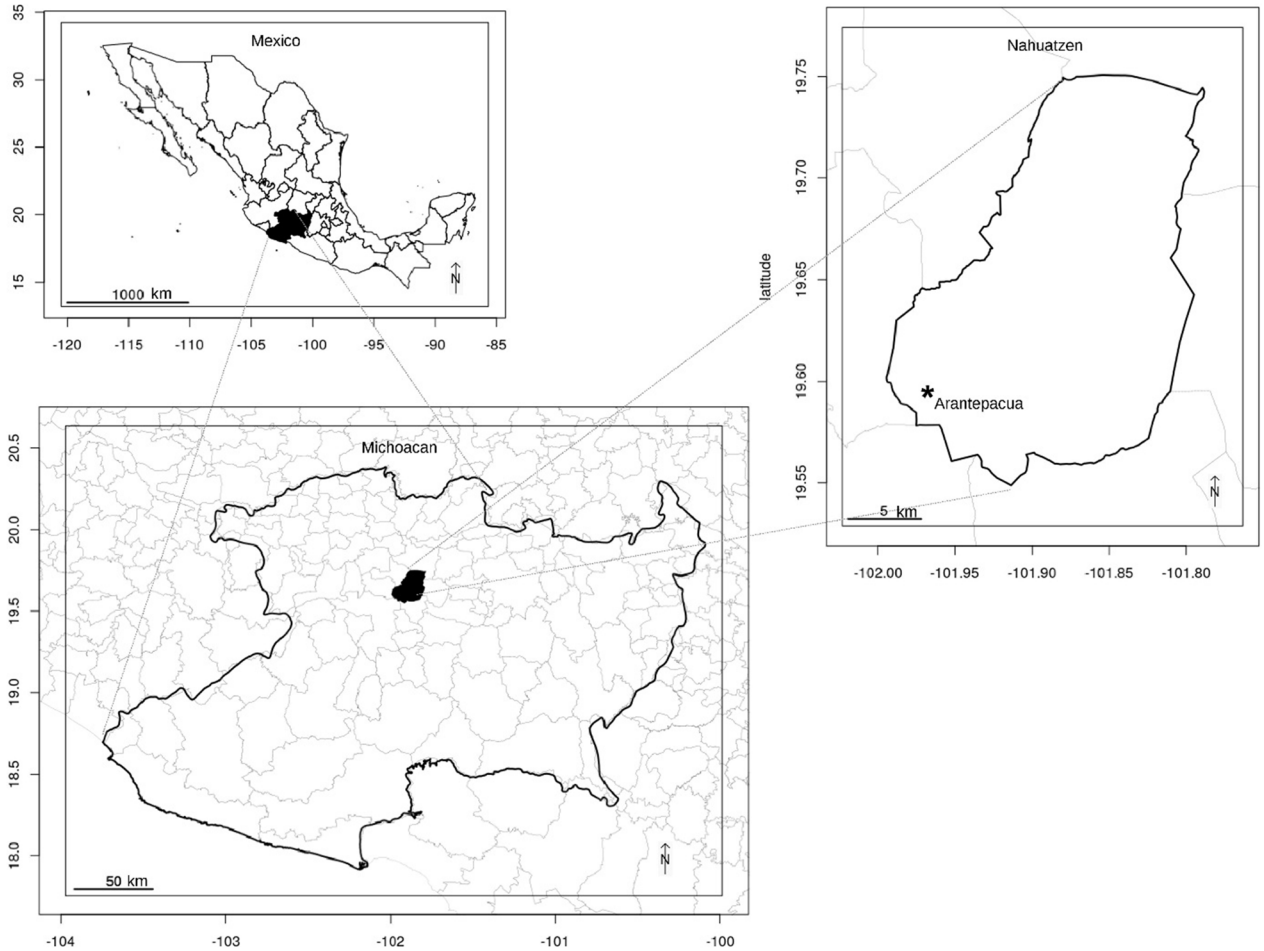

Fig. 1 Location of the community of Arantepacua, municipality of Nahuátzen, at Michoacán, México

community economy is based on forest production, mainly from pine species to produce furniture and others; this is followed by agricultural activities, being the main crops of corn (*Zea mays* L.), wheat (*Triticum* sp.), potato (*Solanum* sp.), broad bean (*Vicia faba* L.) and oats (*Avena* sp.). The livestock economy is based on bovine, wool, horse and goat-wool cattle. Land tenure is communal and occupies a majority area, the private property represents the second place, and the ejido property covers 7.4% of the total surface [16].

Questionaries' design, information gathering and field work

First, we present ourselves the aims and goals of the investigation and ask permission to the community's council to work in the location.

To gather ethnomycological knowledge, two different questionnaires were designed (Additional file 1). The first one was used to interview local authorities as qualified community informants, including headmasters, secretaries and other land tenure personnel; the aim of this first interview allows to identify those families, groups or individuals with deeper knowledge on local fungi. Once identified, the second questionnaire was applied to interview such key settlers, to gather information regarding mushroom recollection practices and use, Spanish vernacular and P'urhépecha names, uses of recollected fruitbodies, as well as the cultural–religious perception of the identified fungal species among other social, demographic, economic and cultural information (see Additional file 1). The non-probabilistic "snowball" method that allows to find strings of the desired information was used [24], which recommends stopping the survey when no new ethnomycological data are being added. The surveys were supported with mycological guides [6, 7] and photographs/images of mushrooms from fungal species previously described in the Michoacán state, but also from found at center and south of México, to increase the chance of positive and right identification by the settler. During the survey, any reference to species

names or structural fruitbody components was avoided to no guide or induce the settler answers. After concluded the surveys, we realized that most women (86% of all) only speak indigenous dialect and not Spanish, and most women and men do not know writing the dialect (95% of all), so we selected five settlers from the studied community to supporting the P'urhépecha to Spanish translation and write in both Spanish and P'urhépecha the names of the identified fruitbody and its structural components. Additionally, field trips of fruitbody recollections led by local settlers were carried out in the rainy season (June–October) of 2005 and 2006. Such field work aided to corroborate the identity of the species identified in the surveys and to add fungal species no registered or identified in the survey.

Fig. 2 Interviews and field trips with P'urhépecha settlers of Arantepacua community. Photographs taken by Mariano Torres-Gómez in the rainy season of 2005 and 2006

Data analysis

The data obtained were analyzed in Microsoft Excel (2016) program using basic statistics like means, ranges, percentages, comparison between households, age, sex, extracted volumes, number of species known and used, etc.

Taxonomic identification

The recollected specimens were taxonomically determined according to their macro- and microscopic characteristics using dichotomous keys and specialized bibliography [1, 13, 14]. Subsequently, specimens were herbalized following the standard methods of the field guide for macromycetes by Cifuentes et al. [3] and deposited in the Herbarium of the Faculty of Biology of the Universidad Michoacana de San Nicolás de Hidalgo (EBUM).

Results

Diversity of mushroom species identified and consumed at Arantepacua P'urhépecha community

Forty structured surveys were carried out on family units (households) of the Arantepacua community, encompassing a total of 241 people of 2321 inhabitants (more than 10% of the population) of which 140 were men and 101 were women, being 95% of them above 18 years old (Fig. 2). The inhabitants of Arantepacua identify a total of 16 wild mushrooms species, with a range of recognized species between six and 14, and an average of seven, depending on the surveyed settler. A list of used species is presented with the scientific, P'urhépecha and common name of each specie, as well as the literal English translation to highlight the meaning and characteristics they use to name them and to identify mushrooms (Table 1). Taxonomically, the identified species correspond to seven orders, 10 families and 12 genera. According to specialized bibliography, 14 out of the 16 identified species were assigned as edible and two as toxigenic. The field trips allowed to identify additional seven mushroom species recorded as edible, but unknown to the community inhabitants and therefore not consumed/used.

The most recognized and valuated species for their culinary attributes are *Amanita basii*, *Amanita fulva s.l.*, *Boletus edulis s.l.*, *Hypomyces lactifluorum* and *Ramaria flava s.l.* Except for *Ustilago maydis*, all other species are searched for and recollected within the Itzol-juata hill, a volcanic cone on the slopes of the community, covered by pine-oak trees.

Ethnomycological knowledge novelties

The inhabitants of the region use a nomenclature to describe all the parts of a fruitbody of a typical agaric (Fig. 3; Table 2), also identify and name the vegetative mycelium mats. Moreover, settlers clearly correlate the emergence of fruitbodies from *Amanita* spp. from pine roots, which suggest they have a notion on plant-fungi mycorrhizal symbiosis. Elderly people comment that they have seen and recollected the same species of wild edible mushrooms as their grandparents did but claim that the mushroom abundance has declined in the past 9–10 years, ensuring this is due deforestation and land use change, mainly for agriculture and livestock.

Socioeconomic differences on the use of wild mushrooms among P'urhépecha communities

Each family gathers five to seven kilograms per harvest and carries out five to six field recollections per season (June–October), with a total of 13 to 16 kg collected per family, each season. This is important also from the perspective that often rural and indigenous people in México, Korea and worldwide tend to substitute meat and expensive food with NTFP's like mushrooms and

Table 1 List of names in P'urhépecha and taxonomic identities of wild mushrooms species

Scientific name	P'urhépecha name	Common Spanish names (literal English translation)
Amanita basii Guzmán & Ram.-Guill	Cucuchikua	Amarillos, yemitas, pan amarillo (Yellow ones)
Amanita bisporigera G.F.Atk. (toxic)	Cucuchikua jeramba	Hongo loco (Mad fungi)
Amanita fulva s.l. Fr	Cucuchikua	Señoritas (Little ladies)
Boletus edulis s.l. Bull	Panaterekua	Panadero, pancitas, cemitas (Bread mushroom)
Clitocybe gibba (Pers.) P. Kumm	Tiquinche	Montoncitos (Tiny piles)
Gymnopus confluens (Pers.) Antonín, Halling & Noordel	Paxakua	Montoncitos, uachitas (Tiny piles)
Gymnopus dryophilus (Bull.) Murrill	Paxakua	Montoncitos, uachitas (Tiny piles)
Helvella crispa (Scop.) Fr	Sirat angantsi	Orejas de ratón, orejitas (Mouse ears)
Helvella lacunosa Afzel	Sirat angantsi	Orejas de ratón, orejitas (Mouse ears)
Hypholoma fasciculare (Huds.) P. Kumm. (toxic)	Paxakua jeramba	Hongo loco (Mad fungi)
Hypomyces lactifluorum (Schwein.) Tul. & C. Tul	Charhamasi	Trompa de puerco, trompitas (Pork snout)
Lycoperdon perlatum Pers	Tataratsikua	Trompita de venado (Deer snour)
Lyophyllum decastes s.l. (Fr.) Singer	Paxakua	Montoncitos, uachitas (Tiny piles)
Ramaria flava s.l. (Schaeff.) Quél	Kuinit antsiri	Patas de pájaro, escobetillas (Bird feet)
Russula brevipes Peck	Xalama	Trompa blanca (White snout)
Ustilago maydis (DC.) Corda	Shidiqui or Tsentique	Huitlacoche, cuitlacoche, hongo de milpa (Crop fungi)

Note English translation is literal from the common name and not from the names used by English speakers

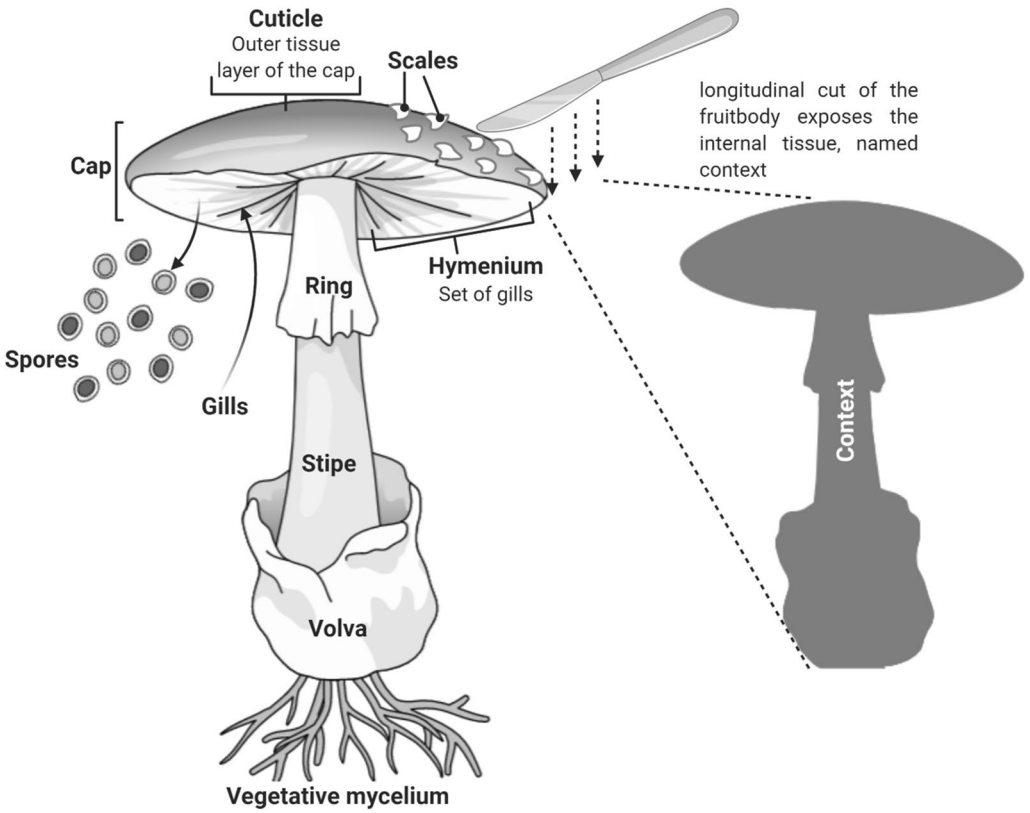

Fig. 3 Diagrammatic representation showing the structure and components of an Agarical fruitbody named by P'urhépecha settlers at Arantepacua community, Michoacán, México. This figure aids to identify structures included in Table 2. The figure is not at scale. Created with figures of Mindthegraph.com and assembled with Biorenders.com

Table 2 P'urhépecha nomenclature of fruitbody parts

Fruitbody structure	P'urhépecha nomenclature	Spanish/English translation
Scales	Hiotacoro	Los Puntitos/Dots
Cuticule	Shikuiri	La Piel/Skin
Cap	Kalakua anapú or Kupalakua	La Sombrilla o El Copete/Umbrella or Tuft
Context	Jatalakua	La Carne/Meat
Gills	Quetzikua anapú	La Parte de Abajo/Underside
Himenium	Jatalakua	La Carne/Meat
Espores	Shunupalakua or Eguaka	La Semilla o El Polvito/Seed or Dust
Stipe	Jantukuti anapú	La Patita/Foot
Ring	Tepakua	La Parte Gruesa/Thick part
Volva	Tazuntulikua	La Bolsita/Bag
Micelium	Shirangua	La Raíz/Root

moreover, if the mushrooms are sold, they also obtained economic income to support the households [17] and [38].

Recipes of wild mushroom for consumption

After collected, fruitbodies are washed by hand in tap water to remove possible insect larvae and all traces of soil and pine debris named *huinumo*. Afterward mushrooms are left on a towel or drying cloth, while the other ingredients are gathered and prepared (mostly wild herbs and vegetables). In general, fruitbodies with a hard or meaty texture are grilled with salt, lemon, herbs, vegetables and hot peppers (Table 3), while those with a soft texture are cooked in multiple stews accompanied with "tortillas" corn-based wrapper, "jalapeño" pepper (*Capsicum annuum* L.) and "quelites," a group of several herb species used in many traditional gastronomies by rural and indigenous people in México which are recollected from the same hill as the mushrooms. Alternatively, softy mushrooms are also cooked in "tamales," another corn-based Mexican traditional dish. Detailed documentation on the recipes and cooking techniques of P'urhépecha communities is scarce. It has been previously reported that P'urhépecha settlers from Pátzcuaro and surrounding communities cook the collected mushrooms as soups or combined with "chili" (*Capsicum annuum* and *C. pubescens*), and other spices and vegetables. To the best of our knowledge, this is the first report on the preparation of wild mushrooms as "tamales," a traditional maize flour-based dish widely cooked by Mesoamerican cultures [36].

Nutritional and nutraceutical value of the wild mushroom species consumed by P'urhépecha

The species of wild mushroom eaten by P'urhépecha settlers here documented represents a good seasonal source of protein and carbohydrate with low amounts of fat (Table 4). It is well known that a mushroom-based diet generates a nutritional and medicinal boost for human health.

Table 3 Recipes of P'urhépecha settlers

Species used	Recipe
Cucuchikuas (*Amanita* spp.) Paxakuas (*Gymnopus* spp. / *Lyophyllum* spp.)	Dough of the tortilla with salt, chili, onion, and vegetables. Which is mixed with the mushrooms. This recipe is named Atapakua
Paxakuas (*L. decastes*, *G. confluens* and *G. driophylus*)	Eaten in tamales or cooked with vegetables
Cucuchikuas (*A. basii/A. fulva*)	Stewed with tomato, chili, onion, and garlic
Kuinit antsiri (*Ramaria* spp.)	Prepared with egg, chili, salt, tomato, and onion; also chopped into broths
Sirat angantsi (*Hellvella* and *Morchella* species)	After boiled they are eaten with pumpkin flower, cheese, green tomato, chili, and tortillas
Charhamasi (*H. lactifluorum*)	Consumed minced with meat. It is also prepared in meatballs. Stewed with herbs and butter
Iarín terekua (*N. lepideus*)	First cooked and then stewed with vegetables
Panaterekua (*B. edulis s.l.*)	Only eat the part of "the pores" (tubes and context) and are roasted with salt and chili
Tataratsikua (*L. perlatum*)	This species is eaten young and tender with salt on the grill

Table 4 Nutritional value of some wild edible species used by P'urhépecha settlers

Species[a]	Nutritional composition (g/100 g dw)				Energy
	Ash	Protein	Fat	CHOs	
B. edulis	5.26 ± 0.44	10.65 ± 0.47	2.23 ± 0.02	81.86 ± 0.41	390.09 ± 1.32[b]
C. gibba	20.68 ± 0.15	14.59 ± 0.27	4.29 ± 0.00	60.45 ± 0.23	np
L. perlatum	3.62 ± 0.37	1.94 ± 0.18	0.05 ± 0.01	5.74 ± 1.87	31.18 ± 6.90[c]
R. flava	6.90 ± 0.33	14.47 ± 0.04	2.09 ± 0.12	np	np
R. brevipes	16.43 ± 0.42	31.63 ± 0.16	3.46 ± 0.01	40.81 ± 0.40	253.84 ± 0.11[b]

[a] see complete names in Table 1, the energy (kcal/100 g) is calculated both on [b]dry weigh and [c]fresh weight bases. np = not provided, dw = dry weight. References: *B. edulis* [15],*C. gibba* [25],*L. perlatum* and *R. flava* [18] and *R. brevipes* [34]

Discussion

Diversity of mushroom species identified and consumed at Arantepacua P'urhépecha community

The most valuated species for consumption in Arantepacua here described matches with most studies conducted in rural and indigenous communities both in Michoacán State [2, 33, 41] and with other States in México and some worldwide. In general, the edible *Amanita* spp. are the most wanted and searched species in temperate forests of México [27]. The coincidences or differences regarding the preferences of each ethnical group toward edible fungi species must be strongly guided by the ecological characteristics of the natural areas that surrounds each community; similar climatic and vegetation characteristics harbors similar fungal community. This might help to explain the coincidences on *Amanita* spp. preferences on the Mexican indigenous groups settled in temperate forests, which harbor the same of closely related fungal species. However, each ethnical group must have experienced specific interactions with their surrounding ecological variables with undermines edible fungal preferences, but this kind of study remains as a pendent task.

Previous ethnomycological studies in Michoacán state and P'urhépecha communities differ, among other subjects, on data-gathering approaches and area covered, but each one has allowed to build a better description of the social, cultural and economic role of mushrooms in this ethnic group. On this regard, the number of fungal edible species found in this work is greater than the 10 edible species previously documented for both a P'urhépecha community settled in the Lake Pátzcuaro basin [2] and at Tancítaro municipality [41]. Also, this same number of edible species is commercialized at local markets in Zitácuaro [11]. Even higher numbers are registered for the Comachuén P'urhépecha [33] and Capácuaro [12] communities, with 15 and 23 edible fungal species, respectively.

In Morelia city, the capital of the State, Gómez-Peralta et al. [10] registered at least 15 species of edible wild in four markets and nine in "tianguis" (traditional street markets), whose vendors come from rural areas, some of which are P'urhépecha regions of the State. In a wider survey conducted over 21 communities in the Lake Pátzcuaro basin, Mapes et al. [20] registered 43 species of edible fungi. Tacking together, the comparison of the present work with previously reported data indicates through a four-decade period since first P'urhépecha ethnomycological register [6, 20]; the Arantepacua P'urhépecha community maintain a rich traditional knowledge about the fungi that grows in their forests, despite the acculturation processes suffered by most of the country's ethnic groups [35] and most likely in most ethnic groups worldwide.

Regarding the number of identified and consumed edible species of fungi, evidence here presented shows that rural areas of Michoacán State, and particularly the P'urhépecha communities, have preserved similar ethnomycological knowledge of other rural and indigenous areas of México surveyed in last twenty years. As example, Reyes-López et al. [29] found the consumption of eight edible species by the settlers from the Teziutlán municipality at Puebla, while Pérez-Moreno et al. [26] found that 156 species are consumed and traded in 14 markets at the Izta-Popo National Park and its surroundings. In foreign communities' like the district of Chhattisgarh in Korea, you can find around eight mushrooms species used and sold in local markets in 43 villages of five Tehsil [17].

Ethnomycological knowledge novelties

Mushroom nomenclature used by the indigenous settlers of the Arantepacua community, is that the P'urhépecha names assigned to the parts of an agarical fruitbody are different to those registered in other studies of the same ethnicity [6, 20], even for those from the neighboring P'urhépecha community of Comachuén [33]. The reasons for such nomenclature differences are unknown and beyond the scope of this study, but might reflect changes in the indigenous language, including the loss of words

or its modifications. This possibility might be considered for comparison with previous ethnomycological studies in same ethnicity conducted more than twenty years ago. Geographical and cultural barriers might be explored for differences with more recent studies on this regard.

Identifying and naming (both in ethnic dialect and Spanish) the fungal vegetative mycelium mats associated with fruitbodies it's remarkable for being the first time this mushroom structure is documented for any P'urhépecha community, even for other ethnical group in México and maybe worldwide. Also, the association of *Amanita* spp. fruitbodies emergence with pine tree roots suggests that settlers have a notion on ectomycorrhizal symbiosis, commonly established between species within the *Amanita* genus and *Pinus* spp. or other conifers. The ectomycorrhizal symbiosis between different tree and fungal species is a key association for the forest ecosystems function and resilience to perturbation [4], climate change and food security worldwide [37]. The whole ethnomycological knowledge Arantepacua settlers, specifically vegetative mycelium identification and probably a notion of mycorrhizal symbiosis, might be considered cultural ecosystem services (CES), as they contribute to the cognitive development and reflection of the community [23]. By other side, it deserves to be clarified if both vegetative mycelium and mycorrhiza notion by Arantepacua settlers has implications for their perception of fungi relevance in the forest maintenance as other communities in Europe, India and Asia have.

Socioeconomic differences on the use of wild mushrooms among P'urhépecha communities

The amount of wild edible fruitbodies gather by Arantepacua settlers registered in the present study are like the amount previously documented for the communities of Jesús del Monte and San Miguel del Monte, Michoacán [9], with 14 to 16 species. However, the inhabitants of Arantepacua recollect edible wild mushrooms only for self-consumption, while other neighbor P'urhépecha communities like Paracho de Verduzco, Pátzcuaro, Tzintzuntzan and Cherán, also do it for sale (Torres-Gómez M, personal observation). It has been documented that edible fungi are an important extra economic income in the rainy season for many people of rural and indigenous communities worldwide, especially in Asia, India and Europe [17, 38].

The mushroom gathering is conducted mainly by men in the studied community, which carry out field trips specifically aimed to find and recollect the most valuated species, but coincidentally gathering is also practiced, when settlers cross the forest area on the way to work or conducted other tasks. Inhabitants identify mushrooms mainly by shape, color and growth pattern as well as in Korea [17] and other parts of the world. Grandparents (≥ 60 years), who correspond to 15% of the community, are the main transmitters of mycological knowledge to new generations trough oral mean. The women are responsible of preparing and cooking the collected mushrooms, being texture and fruitbody shape relevant factors that determines how they are cooked. The social role of men as the fungi gatherers is common among the P'urhépecha communities of the Plateau and the Patzcuaro's Lake basin, partially since they might gather fungi when walk among and between surrounding forests to their workplace outside community. By contrast, in the Michoacán communities of Jesús del Monte and San Miguel del Monte the main collectors of mushrooms are women and girls, who contribute to the household economy through their sale by "door to door" method [9]. This last social strategy agrees other ethnic groups and rural communities in the world, where women are the gatherers and sellers like in India, Korea and other locations in Asia [17].

There is no evidence of hallucinogenic mushrooms consumption by Arantepacua inhabitants, despite knowing about them. The settlers Celestino Cunete and Severiano Jiménez, 52 and 51 years old, respectively, indicate that their grandparents commented on the consequences of not differentiating between "good" and "bad" mushrooms, "because there are some when eaten can make you sing, tell stories and drool."

The social, cultural and economic factors that determine whether a rural or indigenous community trade or not the wild edible fungi gathered around their natural areas has not been assessed, but there is a relevant anthropological issue to be addressed in future studies worldwide.

Nutritional and nutraceutical value of the wild mushroom species consumed by P'urhépecha

Some of such species, like *R. flava*, contains significant amounts of Lysine and other essential amino acids [18], being are a valuable supplement in the human diet. Such nutritional characteristics places make these mushrooms excellent food for its use in low-calorie diets. Beyond its nutritional qualities, mushroom species here reported contains several bioactive metabolites that contribute to maintain good health by preventing both infectious and degenerative diseases, because this mushroom has been considered as good functional food [17, 28]. As example, carbohydrate content of *L. perlatum* and other species of the same genera here described is high in glucans which show bioactive properties such as immune-modulating, antitumor, and hepato-protective effects [30]. Also, the diversity of compounds present in the fruitbody of here documented species or species of the same genera

provides a good source of antioxidants that help to prevent chronic-degenerative diseases [39]. Moreover, the conservation of forest and therefore wild mushrooms, its relevant for the continuous providing of healthy food for P'urhépecha and any rural and indigenous community in the world.

Conclusions

The ethnomycological knowledge documented contributes new terms in P'urhépecha to name the parts of an agarical fruitbody. Additionally, we present the first reference of mycelium nomenclature in this dialect, as well for context, also we found empirical knowledge about mycorrhizal associations. An additional contribution is the fact of finding a recollection dynamic different from other native communities of the country and worldwide, being the men who bring the mushrooms home when they are for eating and women recollect for selling like other places in the world like India and Korea. This was the first P'urhépecha ethnomycological study outside the Lake Pátzcuaro basin, and the evidence indicates that the diversity of ethnomycological knowledge in the region has not yet been fully described.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s42779-023-00169-4.

Additional file 1. Questionaries' Design, Information Gathering and Field Work.

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Author contributions
MTG, GVM, MGP helped in conceptualization, writing, methodology, validation, supervision; MTG contributed to investigation and resources. All authors read and approved the final manuscript.

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Availability of data and materials
All fugal material is deposited in the herbarium EBUM, UMSNH.

Declarations

Ethics approval and consent to participate
We extend our statement on ethics approval and consent. All participations were noticed to get the permissions to be in the community and to make this study possible. Personal gratitude to Sr. M. Crisostomo and his family to agree to be in Fig. 2. Every single visit (to the community or to the forest) was supervised by a local authority. The ethics committee that approved the study was Universidad Michoacana de San Nicolás de Hidalgo (UMSNH) and the local/traditional authorities of Arantepacua.

Consent for publication
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Competing interests
None of the manuscript authors have a competing interest.

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