



## Traditional use of *Gymnopus nubicola* as food resource in a Kichwa community, Pichincha, Ecuador

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### Abstract

*Gymnopus nubicola* is characterized by a strong smell and pleasant flavour, by a dark reddish brown to brick red pileus, adnexed, whitish to cream lamellae, inamyloid, hyaline, ellipsoid to lacrimoid basidiospores. Indigenous communities of Kichwa nationality, that inhabit vegetal formations called “páramos” of the Ecuadorian Andes, call it *kallambas* or *kallambitas* and use the mushrooms for direct alimentation. Sporadically it is sold in popular markets close to the communities. *Gymnopus nubicola* is hereby reported for the first time as an edible mushroom in the world.

**Keywords** – Andean ‘kichwa’ communities – mushrooms – edible – ‘kallambas’ – Ecuador

### Introduction

Recent researches reported the edibility of several species of mushrooms in South America. Henkel et al. (2004) reported 17 taxa as the highest appreciated food of the Patamona in French Guyana, including *Amanita perpheae* Simmons, T.W. Henkel & Bas, *Lentinula* cf. *boriana* (Mont.) Pegler and unidentified taxa of *Clavulina* and *Pleurotus*. In the Venezuelan Amazon, Zent et al. (2004) described the mycophagous behavior of the Hoti community, reporting 11 taxa of macrofungi. Among them, *Auricularia* spp., *Lenzites* spp., *Polyporus* spp., and *Macrocybe titans* (H.E. Bigelow & Kimbr.) Pegler, Lodge & Nakasone were identified.

Gamboa-Trujillo (2005) already reported that mushrooms are consumed by several ethnicities in Ecuador. In the Andean highlands (‘páramos’), the Kichwa communities are established in forests of the “Sierra” region. This isolated location allowed the preservation of their

behavior, language, commerce and cultural contact among communities regardless of the influence of Spanish colonization. However, subsistence activities such as hunting, fishing, seed gathering and cultivation (Proel 2007) and mushroom collecting, consuming and selling in popular markets are disappearing (Gamboa-Trujillo 2005).

The aim of this work is therefore to improve the knowledge about ethnomycology in Ecuador, with the discussion of the traditional use as food resource of an edible species used by the Kichwa communities in the Andes.

## Materials & Methods

Popular markets in the cities of Cayambe (Pichincha province) and Otavalo (Imbabura province) and communities in the locality of Cangahua (canton Pedro Moncayo, Cayambe) were visited, mostly during the rainy season (September to December 2010 and 2011, and January 2011 and 2012), corresponding to the fructification period of edible mushrooms in the Ecuadorian highlands. Informal interviews were performed with sellers of the Kichwa community, for the purpose of obtaining data about fresh weight of the basidiomas, prices in the market, forms of consumption and days in which the mushrooms are harvested and brought to popular markets for selling, according to Chang and Lee (2004).

The macroscopic characteristics of the species, such as size, color, substrate and habitats, were taken during collection in the 'páramo'. Microscopic analyzes were performed at the Herbario Alfredo Paredes (QAP), Universidad Central del Ecuador, and at the Departamento de Micología, Universidade Federal de Pernambuco. Basidiospores data follows the methodology proposed by Tulloss et al. (1992), slightly modified by Wartchow (2012) and Wartchow et al. (2012). Measurements and statistics are based on 20 basidiospores. The specimens were identified according to Halling (1996) and the fungal specimens were deposited at the herbaria QAP, URM and JPB (Thiers 2013).

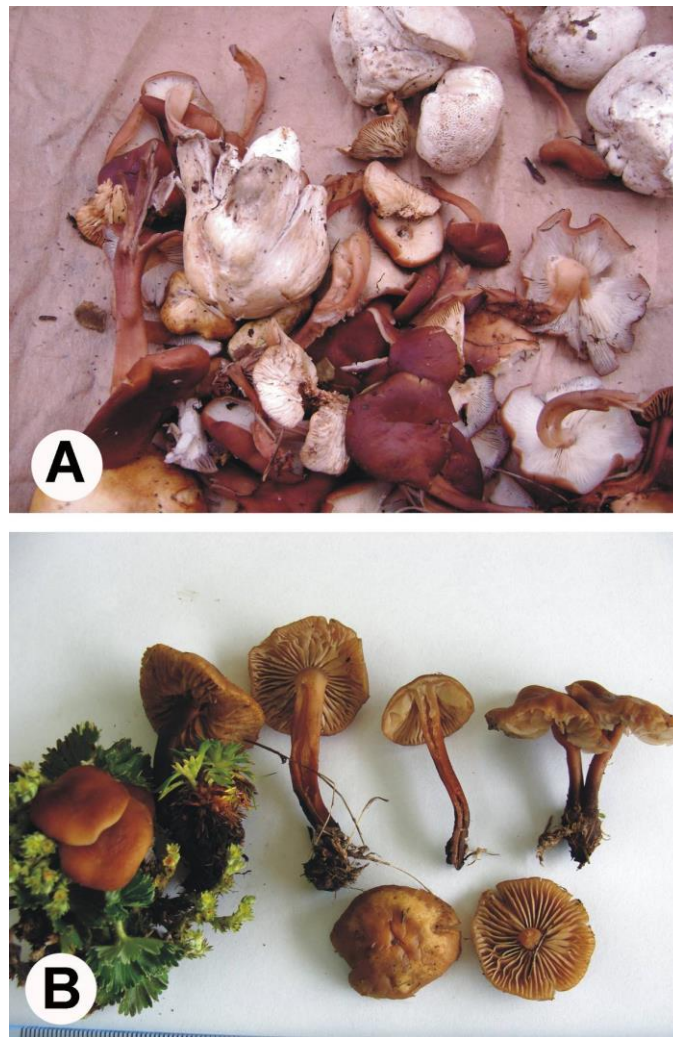
## Results

Among the collected species, *Gymnopus nubicola* Halling (Marasmiaceae) (Fig. 1A, B) was identified. It is morphologically characterized by the brick red, 20–30 (–48) mm, convex pileus; whitish to cream lamellae; inamyloid, hyaline, ellipsoid to lacrimoid, thin-walled basidiospores 5–6.8 (–7) × (2.5–) 3–3.5 (–4) μm, L = 5.4 μm; W = 3.1 μm, Q = (1.68–) 1.72–2.34, Qm = 1.89; very inconspicuous cheilocystidia; pileipellis made of repent to most frequently interwoven branched hyphae, not coralloid nor diverticulate (a 'dryophila-type'); and clamps connections abundant in all tissue (Halling 1996). The basidiomata have a strong and pleasant odour, similar to *Lentinula edodes* (Berk.) Pegler ('shiitake').

*Gymnopus nubicola* was described from Ecuador (Halling 1996) and now is for the first time reported as an edible species in the world. In Ecuador, it is distributed in the vegetal formation called 'páramos', on soil, at an altitude of 2555 m a.s.l., together with *Lachemilla orbiculata* (Ruiz & Pav.) Rydb. (Rosaceae) and *Azorella pedunculata* (Spreng.) Mathias & Constance (Apiaceae). These plant species are very abundant in this ecosystem and are locally denominated as "almohadillas".

The harvest of this species is generally performed during the rainy season (winter) (September to December) and, according to folk's information, its occurrence is associated with major incidence of lightning and thunder (Gamboa-Trujillo 2005). This belief is also observed for other mushrooms, such as *Agaricus pampeanus* Speg. (Gamboa-Trujillo 2005).

In the region where *G. nubicola* is harvested, women, men and even children have great experience in searching edible mushrooms, distinguishing them from the non-edible species by colour, odour and stage of growth. Younger basidiomata are the preferable ones, because they are usually not rotten and have more pleasant texture. This information is transmitted to their children, which acquire experience in recognizing, in the field, mushrooms in good condition to eat (Fig. 2A, B), and are taught that it is important to wash and cook the mushrooms before eating. According to



**Fig. 1** – A, Sale of *Gymnopus nubicola* with *Calvatia* sp. ('supe'). B, Details of basidiomata of *Gymnopus nubicola* at laboratory. This picture is copyright of Paúl Gamboa-Trujillo.

the police department and the staff of the Raúl Maldonado Hospital in the city of Cayambe, no record of poisoning after eating wild mushrooms was reported until 2012. This shows the importance of these folks acquiring experience in occasional harvest of wild mushrooms since childhood.

This mushroom is known as 'kallamba' by the the Kichwas in the Ecuadorian Andes. 'Kallamba' is a vernacular name in Kichwa language that corresponds to the general term 'hongo' in Spanish and "mushroom" in English. *Gymnopus nubicola* does not have a traditional epithet, differently from *Agaricus pampeanus* and *A. argyropotamicus* Speg., which are also sold in popular markets and are known by the binomial traditional name 'kallamba de finados' (Day of the Dead's mushrooms), because basidiomata production is in November, when the Day of the Dead is celebrated (Gamboa-Trujillo 2005, Fig. 3A).

The fourth author (Aules E.) reports the harvesting and preparation of the basidiomata in the following way:

*"Las kallambitas son cojidas en el páramo, allá lejos en el cerro por eso cuando vamos a tolar o a cosechar las papas y las cebollas y nos encontramos con las kallambitas les cogemos en un balde o el costa, después les llevamos a la casa y les lavamos bien con agua de la asequeña sacando los animalitos que saben estar dentro del sombrerito, de ahí les ponemos en agua hervida con sal y les mezclamos con papas y también nos comemos con huevos duros.... esto nos han enseñado nuestros papás y abuelos y nunca nos hizo daño ...."*



**Fig. 2** – A, Children playing with *Gymnopus nubicola*. B, Children accompanying their parents during mushrooms harvesting in the “páramos”. This picture is copyright of Paúl Gamboa-Trujillo.

“The mushrooms (*kallambitas*) are collected in the highlands (*páramos*), far away on the hills. For this reason, when we go to harvest the potatoes and onions, we find the mushrooms (*kallambitas*), collect them in a basket or a bag, then we carry them home and wash them with river water. After that, small animals that are inside the hat are taken out, and then we put the mushrooms in boiled water with salt and mix them with potatoes or boiled eggs... it was taught to us by our parents and grandparents, and never caused us any harm ...”.

In general, the community harvests *G. nubicola* in plastic or aluminum containers, but this edible species used to be collected in baskets of natural fibre of *Arundo donax* L. (Poaceae), known as ‘carrizo’. According to the interviewed people, the current use of plastics bags or metal pots accelerates the process of decomposition of the mushrooms, but the replacement of the baskets by metal or plastic containers is due to the fact that the baskets are not frequently made anymore and, thus, are highly priced.

*Gymnopus nubicola* is offered for sale on Fridays on the market of Juan Montalvo in Cayambe and Saturdays on the popular market in Otavalo. The basidiomata are frequently commercialized in plastic bags with other species of edible mushrooms, such as *A. pampeanus* and *A. argyropotamicus* (Fig. 3A), rarely with an edible unidentified *Calvatia* sp. which carries the vernacular name ‘supe’ (Fig. 1A). Each portion of *G. nubicola* is sold in a quantity of approximately 150 g and costs USD 1 (1 kg approximately USD 6,6). The collection and commercialization of *G. nubicola* constitute an additional economic resource for several families in that region, because the main products sold are portions (‘guangos’, aprox. 500 g) of onions (at USD 0.75) (Fig. 3B) and 14 kg of potatoes (USD 3) during the higher production season. Mushroom selling is important for several families, because there is no cost in collecting them in the wilderness, differently of onions and potatoes that must be planted, requiring time and money. The sellers also report that the sale of the mushrooms helps them to pay for the bus ticket (USD 0.25) or to have lunch (USD 1.50). In case of the absence of people interested in buying mushrooms, the mushrooms are taken back home to be consumed.



**Fig. 3** – A, *Agaricus pampeanus* and *Agaricus argyropotamicus* sold in plastic containers in the same as *Gymnopus nubicola*. B, Selling of onion and *Gymnopus nubicola* in Otavalo, Imbabura province. This picture is copyright of Paúl Gamboa-Trujillo.

Few people remain selling natural products. According to interviewed people, the sale of wild mushrooms, as well as other natural products rich in proteins, fibres and minerals, decrease each year due to the preferable consumption of industrialized food, of easier access.

## Discussion

Usually, species of Marasmiaceae are infrequently reported as edible. In Africa, Antonín (1998) described *Marasmius heinemannianus* Antonín from the Atacora province, Benin, and it is also consumed and sold in markets. The species is well known by the local people by the name ‘bawafobi’ (Antonín 1998). More recently, two species of *Gymnopus* were referred as edible in Africa. Van Dijk et al. (2003) reported *Gymnopus* cf. *allegretti* (De Seynes) A.W. Wilson, Desjardin & E. Horak (as *Collybia* cf. *allegretii*) to be edible by the Bantu and Bagyeli people in Cameroon, where it is known by the name ‘mbomini’. Later, Antonín et al. (2005) described a collection of *G. tamatavae* (Bouriquet) Antonín, Buyck & Randrianjohan that is reported as frequently offered for sale in Madagascar, but no vernacular name was informed by these authors.

In Latin America, the only species reported so far was *G. dryophilus* (Bull.) Murrill. It is offered for sale in popular markets in Mexico, in the states of Tlaxcala, Puebla and Morelos, where is sold with basidiomata of *Lactarius* spp., *Russula* spp., *Laccaria* spp., *Helvella* spp. and *Clitocybe* spp. (Montoya et al. 2001, Pérez-Moreno et al. 2008). *Gymnopus dryophilus* is known by the vernacular name ‘paraguitas’ (small umbrellas) and ‘popotitos’ (skinny people) (Montoya et al. 2001) and also ‘orejitas’ (small ears) due to the cartilaginous consistency of the basidiomata (Pérez-Moreno et al. 2008). On the other hand, the Ecuadorian Kichwa’s vernacular name for *G. nubicola* (‘kallamba’) is not related to any object or part of human body, but means only mushroom.

Similar to Ecuador, in Mexico, the mushrooms are collected mostly by women, but occasionally by their husbands and children during the rainy season (July) (Montoya et al. 2001, Pérez-Moreno et al. 2008). However, in Mexico the mushrooms are harvested in *Pinus* and *Quercus* forests, while in Ecuador it is collected in ‘páramo’, herbaceous vegetation in the Andes.

Regarding to price for sale, Montoya et al. (2001) reported macrofungi prices as varying from USD 0.40 to 8 per kilo (*G. dryophilus* not included), similar to the observed for *G. nubicola* in our study. Currently, there is no information about preparation and price of these edible species of Marasmiaceae, being this the first record of a traditional recipe and value for a species of the family.

Apparently, baskets made of natural fibres are still widely used for harvest and selling by local people in Madagascar and Mexico (Montoya et al. 2001, Antonín et al. 2005, Pérez-Moreno et al. 2008), contrary to the observed in our study.

In our study, it was observed that the local people who sell mushrooms acquire experience through knowledge flow from generation to generation and that this knowledge has not been deeply investigated for many years possibly because selling these organisms is not frequent. Besides that, the trade of wild mushrooms is decreasing due the replacement for industrialized food as alimentation resource. This kind of food is considered to be one of the most important factors causing most common diseases like cancer and diabetes in urban areas (Horrihan et al. 2002). Those diseases are still less frequent (J.P. Gamboa-Trujillo, pers. observ.) in Kichwa populations probably due to the use of natural food, such as vegetables, fruits, mushrooms and wild animals, free of chemical preservatives and artificial compounds.

The preservation of the ‘páramos’ in Ecuador is important to the protection of fungal resources mainly the edible wild macrofungi, which constitute an important part of mycophagous and mycophylous customs of indigenous communities. Hence, it is suggested that local government stimulates projects using edible macrofungi for sustainable development of local economy and as a way to contribute to the conservation of the native mycobiota and of the traditional knowledge.

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