Morels (*Morchella* spp.) in Kumaun Himalaya

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Abstract

Morels, also known as sponge mushrooms, belong to the genus *Morchella* Dill. The present paper deals with the most commonly exploited species of this genus in the Darma valley, district Pithoragarh, Kumaun Himalaya with an aim to improve upon the knowledge base about these macrofungi for further exploration.

Keywords: Morels, *Morchella* spp., Kumaun Himalaya, Edible fungi, Medicinal fungi, Sponge Mushrooms.

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Introduction

Wild edible fungi have been collected and consumed by people for thousands of years. The archaeological record reveals edible species associated with people living 13,000 years ago in Chile. China features prominently in the early and later historical records of wild edible fungi. The Chinese have for centuries valued many species, not only for nutrition and taste but also for their healing properties. These values and traditions are as strong today as they were centuries ago and are confirmed by the huge range of wild fungi collected from forests and fields and marketed widely[1]. It is not surprising that today China is the leading exporter of cultivated mushrooms. In addition to being an important source of food, many of the fungal species have wide use as medicine thus, wild useful fungi contribute towards diet, income and human health. In addition many of the species play a vital ecological role through symbiotic relationships (mycorrhizas) with trees, which enable them to grow in nutrient deficient soils. Needless to say health of the forest wherein these species of wild fungi grow is inadvertently related to the health of the forests. Income from wild edible fungi is an important source of revenue for rural communities, especially in developing countries like India. This apart, where market for the same are not available, they form a significant source of dietary input or nutrition.

Morels (*Morchella* spp.) are saprophytic fungi that are found in both conifer and broad-leaved temperate forests. All species are edible and delicious with the possible exception of truffles which are considered the most delectable of mushrooms[2]. Occurrence of 18 species of *Morchella* are reported from 28 countries, wherein altogether 14 species are reported to be edible or used as food, and 5 are used medicinally[3]. They are highly prized for their culinary uses, particularly as a gourmet food and are used in gravies, sauces and soups. Morels are not only delicious; they are also healthy and nutritious food. They contain 42 percent protein on a dry weight basis, are low in calories and rich in minerals[4]. This apart, its metabolites have varied uses, viz. as adaptogens and immunostimulants and are considered to be one of the most useful antitumour agents for clinical uses. It has been estimated that total world production of morels is about 150 tonnes dry weight, equivalent to 1.5 million tonnes of fresh morels. India and Pakistan are the major producing countries, each producing

Morchella esculenta

about 50 tonnes of dry morels, all of which is exported[5]. It is important to take note of the fact that the most common of all the morels, ***Morchella esculenta* (Linn.) Pers.** is said to be poisonous if eaten raw[6].

Characteristic features of Morels

Despite an extensive body of literature and intense interest, the taxonomy of morels, is poorly known. Even the number of morel species is a matter of debate. Though *Morchella* as a genus is fairly easy to recognize, species differentiation within the genus is markedly difficult, and a variable number of species are recognized by various workers. The genus *Morchella* was reviewed in India by Waraitchi in the year 1976, who presented a key for all the species known from India. According to him, six species under the genus have been identified, which include ***M. esculenta***, ***M. conica* (Pers.) Fr.** (syn. *M. elata* Fr.), ***M. deliciosa* (Fr.) Jct.**, ***M. angusticeps* Peck**, ***M. crassipes* (Vent.) Pers.** and ***M. semilibera* (DC.)Fr.** (Table 1). Fortunately for amateur mycologists, morel species can at least be grouped by colour, either yellow or black. *Morchella* has a wide distribution in India and is very common in the temperate zones or forests in Himachal Pradesh, Punjab, Jammu & Kashmir and Uttaranchal.

In general, the mushrooms produced by the morel fungi has a

Table 1 : Characteristic features of common edible species of genus *Morchella*[17]

Species	Habitat	Characteristic features
***Morchella semilibera* (DC.) Fr.**	On the ground in oak or beech woods and usually fruiting about a week before the larger morels appear.	Pileus with conspicuous ridges and in age obtusely conic with a flaring margin, pits elongated, dull yellowish brown, the ribs of the pits discolouring darker than the depressions; stipe 8-10 cm long, 1-2 cm thick at apex, in age clavate and up to 4 cm thick at the base, pallid to yellowish, at times with pinkish discolouration in age, ribbed near the apex, granular furfuraceous.
***Morchella angusticeps* Peck** (Black morel)	On sandy soils in woods. Widely distributed and often associated with *Populus* spp.	Pileus 1-5 cm high, narrowly conic, pallid to greyish young but the borders of the pits darkening finally to black. Heads with greatly elongated pits; stipe equal, nearly as thick as the head, pallid to buff in large forms, the pits blackish like the ribs by maturity.
***Morchella deliciosa* (Fr.) Jct.** (Delicious morel)	On the ground in grassy places, usually at the edge of woods, widely distributed but rare.	Pits or depressions of the pileus grey to fuscous, ridges pallid; fruit bodies typically small. Pileus 2-3 cm long, pit elongated, ridges much lighter than the pits, irregularly anastomosing; stipe up to 2/3 times as thick as the pileus, often enlarged at the base and somewhat lacunose, whitish or yellowish.
***Morchella crassipes* (Vent.) Pers.**	On the ground in open places, at the edge of woods.	Pits large and shallow, ridges thin; stipe enlarged and at times lacunose at the base. Pileus sub-conic, usually elongated and 6-12 cm long and 5-6 cm broad or at times larger; pits roundish or irregularly elongated; ribs irregularly anastomosing, edges sharp; stipe stout, up to 10-11 cm long, 4 cm at apex and 5-7 cm at base, yellowish or whitish.
***Morchella esculenta*(Linn.) Pers.** (Common morel)	Usually in or near lightly burned grassy areas and swampy ground.	Pileus not distinctly longitudinally ridged, up to 7-9 cm long and 4-5 cm wide, pits rounded, irregular or at times longitudinally elongated, yellowish, becoming light brownish when dry, ridges irregularly anastomosing, edges rounded, lighter than the pits; stipe only slightly enlarged at the base.
***Morchella conica* (Pers.) Fr.** syn. *M. elata* Fr. (White morel)	On soil, in open forest, often a year or two after a forest fire.	Pileus can be up to 4-10 cm but may occasionally be larger; cone to spindle-shaped with pronounced vertical ridges with cross-connections, producing a series of rectangular hollows up to 1cm long; honey coloured with ridges darkening to brown with age; stipe 2-4 cm, hollow, circular, often enlarged at base or top, white to yellow with a rough surface.

characteristic appearance, although the mushrooms of several closely related fungi have somewhat similar appearances. They look like a pine-cone perched on a stem. The fertile cap (pine-cone portion) is honeycombed with pits and ridges. The cap and stem are hollow and the cap rises continuously from the stem. The stem colour ranges from white to pale brown, and the colour of the cap ranges from pale yellow-brown through tan, brown and grey-brown. The pits are typically the same colour as the ridges or slightly darker[7]. The optimum growth is obtained in the temperate coniferous forests preferably in loamy soils rich in humus. After the onset of rainy season, the hyphal mass, till now buried in the humus layer (the duff), grows out into the open forming the fruiting body — the ascocarp (or the apothecium), which varies from 2-15cm in height. This apothecium of *Morchella* spp. has a stalk or stipe (the colour of the stalk varies among different species; it is cream coloured in case of ***M. esculenta***); the fertile portion is called "pileus". The pileus is essentially discoid, but it is folded over the stipe apex and is highly contorted. These distortions greatly increase the surface area of the pileus. The asci (the reproductive structures) line the large pits, which are separated by sterile ridges. The detailed distinctive features of each *Morchella* spp. are being presented in Table 1. Interestingly, there is a belief, among the locals that the sprouting of the morels, locally termed as *Gucchi*, has strong correlation with the thunder and lightening[7-9].

False Morels

The false morels are a group of fungi related to the true morels which fruit in the same places at about the same time. In false morels the fruit bodies are wrinkled rather than honeycombed. ***Ptychoverpa bohemica* (Krombh.) Boud.** has irregular wrinkles running more or less vertically down the brown head and has a pale tan stalk. This species has caused gastro-intestinal problems for a number of people who have consumed it and so it should be avoided. The real killer, however, and the best known of the false morels is ***Gyromitra esculenta* (Pers.) Fr.** The head of this species has a brain-like appearance. Over the years hundreds of people have died after eating it. False morels contain a toxin called gyromitrin which is converted to a chemical called mono methyl hydrazine or MMH, which is toxic. MMH is water soluble with a low boiling point and volatilizes off below 90°C. If morels are parboiled the toxin will be discarded with the water or evaporate during cooking. Early symptoms of toxicity are stomach cramps, accompanied by vomiting, watery and/or bloody diarrhoea, weakness, lassitude and severe headache. This is followed by loss of balance, jaundice (as the liver deteriorates), and then in some cases, convulsions, with the victims eventually becoming comatose, end result being death. Finally, there is evidence that mono methyl hydrazine increases the incidence of tumours in experimental animals. Thus, more insidious long-term effects of false morels cannot be too quickly discounted. Hence, inexperienced collectors should familiarize themselves with species in related genera: *Verpa*, *Helvella*, and *Gyromitra*, some with common names like false morel, spring morel and early morel. These pretenders can easily be avoided with a little study[10].

Medicinal uses

Medicinal mushrooms have been used as a dietary supplement or medicinal food throughout the world for over 2,000 years. In the late 1980s, their extractable ingredients received great attention as products for improving biological function. There is intense industrial interest currently in a novel class of compounds extractable either from the mycelium or fruiting body of mushrooms. Compounds extracted from these and others called "mushroom nutriceuticals" exhibit either medicinal and/or tonic qualities and have immense potential as dietary supplements for use in the prevention and treatment of various human diseases. The application of modern analytical techniques has revealed many medicinal mushrooms to contain numerous bioactive compounds including polysaccharides [Lentinan from ***Lentinula edodes* (Berk.) Pegler**], immunomodulatory proteins [lZ-8 from ***Ganoderma lucidum* (Curtis) P. Karst;** Fip-fve from ***Flammulina velutipes* (Curt. ex Fr.) Karst.**, Flip-vvo from ***Volvariella volvacea* (Bill.ex Fr.)Sing.**] and protein-bound polysaccharide [PSK and PSP from ***Coriolus versicolor* (Fr.) Quel;** PSPC from ***Tricholoma* spp.**]. Many of these compounds have anti-cancer and anti-tumour properties that appear to be based on an enhancement of the host immune system rather than direct cytocidal effect[11].

It has been noted that the extracellular secretions of the mushrooms combat bacteria and viruses and are active against myriads of protozoans causing diseases including *Plasmodium falciparum*, which causes malaria. It would be interesting to evolve novel medicines using these mushrooms, when increasing number of antibiotics have lost their usage because the bacterias have developed resistance against them. In this regards the morels hold greater promise in providing protective shield against a variety of infectious diseases[12].

Morels collection

Recently author has visited twelve villages of the *Darma* valley in Pithoragarh district of Uttaranchal for conducting studies, among the villagers. It was estimated that on an average a family gathers about 2-3 kg of fresh morels (***M. esculenta***), which more often is consumed by the family itself in absence of the market. In few cases, when middlemen do arrive for procurement of medicinal plants (chiefly, ***Picrorhiza kurroa*** **Royle ex Benth.**) from the villagers, few do sell it for the amount, which ranges from Rs. 2000-2500/kg (dry wt.) when elsewhere, the price hovers well above Rs. 4500/kg (dry wt.). Since the collection of the same is too cumbersome and tedious, the villagers of this valley prefer collecting medicinal plants and the collection of morels is of secondary importance. Hence collection of morels is solely carried out by the deprived brethrens of the village. According to Singh and Rawat[13], the total money earned in a season provides 20-30 per cent of the annual cash income in 140 villages, and an annual income of US$ 150 from yet another survey of 1600 families in 40 villages[14]. It is believed that India, Pakistan, Nepal, Afghanistan and possibly Iran collect around 2000 tonnes fresh weight of morels in a year[3]. The benefits to rural livelihoods are significant and widespread and large numbers of rural folks thus earn significant amounts of money. India annually exports around 50-60 tonnes of dry morels[15].

Conclusion

The morels are strictly banned from exploitation, in the pretext that its regeneration would be affected in the case of harvesting from the wild. Because removing unopened fruiting bodies prevents dispersal of spores[16]. Most species of edible fungi are picked without causing any damage since their fruiting bodies and edible parts are all above ground. If the soil is left compacted or the leaf litter is disturbed, this does affect production, since the mycelium present in the upper layers of soil or the litter mass gets damaged.

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