



Ethnomedicinal aspects of morels with special reference to *Morchella esculenta* (Guchhi) in Himachal Pradesh (India): A Review

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Abstract

Medicinal mushrooms are macro fungi containing various bioactive compounds. Due to their deliciousness, aroma, and nutritional values, they are considered as a source of healthy functional food that is beneficial for body and improves health. These fungi have low-fat contents with a high amount of dietary fibers. Among morel mushrooms, *Morchella esculenta* (common name – Guchhi) is well known for its excellent taste and aroma, and health benefits, worldwide. Medicinal mushrooms have been used in traditional medicines for centuries. Health benefits of such mushrooms are related to the presence of active polysaccharides content. The polysaccharide-protein complex present in their extracts has various therapeutic applications to improve human health. These mushrooms have various antioxidants and anti-cancerous properties which are mainly due to the presence of polysaccharides and phenolic compounds. These are also a good source of ascorbic acid and vitamin D. Local people use fruiting bodies of these mushrooms to treat various ailments such as stomach pain, pneumonia, respiratory problems, and wound healing. Due to their high price, they play an important role in the economy building of poor farmers in India. These mushrooms are also important from an ethnomedicinal and culinary point of view in various regions of India, especially in the state of Himachal Pradesh, for many years. This review highlights various medicinal, sociological aspects and traditional uses of medicinal mushrooms with special reference to the usage of morels in the state of Himachal Pradesh.

Keywords – Antioxidants – Anti-cancerous – Health effects – Medicinal mushrooms

Introduction

The term mushroom is widely used for macro fungi which may be either epigeous or hypogeous. Mushrooms (higher Basidiomycota and some Ascomycota) are macromycetes fruiting bodies that are large enough to be seen with the naked eye and picked up with hands (Miles & Chang 2004). Throughout the history of mankind, fungi have been treated with fear and magnetism, sometimes well-regarded and hated, but always considered secretive. The collection of various varieties of wild mushrooms from different regions of the world, especially, for culinary purposes has been a traditional practice in many countries. People have also been hunting these mushrooms for traditional medicinal uses or even for performing some sacred rituals (Singh 1999). Medicinal mushrooms have been used to prevent and cure various diseases in many countries such as China, Japan, India, and eastern European countries (Wasser 2014). Various wild mushrooms

have been used as nutritionally valuable functional foods. In China, mushrooms are used in traditional medicines because they are useful and have countless medicinal properties. Phytochemical and pharmacological studies reveal that mushrooms contain various secondary metabolites having desirable pharmacological properties (Martel et al. 2017). Their extracts are used to treat various diseases as well as supplements in our daily diet. Medicinal mushrooms possess a number of attributes that make them efficient in treating diseases (Gargano et al. 2017). Mushrooms have a long-standing history in Indian cuisines and culture. These have been one of the most important sources of income for rural folks, and some tribes, who are involved in the collection of these from the wild habitat (Kumar & Sharma 2011).

Among various mushrooms, the most commonly collected and traded species genera are *Russula*, *Lactarius*, *Cantharellus*, *Amanita*, *Boletus*, *Morchella*, *Tuber*, and *Cordyceps* (Boa & Boa 2004, Semwal et al. 2014). If we see globally, cultivated edible mushrooms viz. *Lentinula*, *Pleurotus*, *Auricularia*, *Agaricus*, and *Flammulina* accounts for 85% of the world's total supply (Royse et al. 2017). Though morel mushrooms such as *Morchella* as a genus can be easily recognized, its species differentiation within the genus is a more difficult task as most species have similar morphology. Six species of these genera namely *M. esculenta*, *M. conica*, *M. deliciosa*, *M. angusticeps*, *M. crassipes*, *M. hybrida*, and *M. semilibera* have been reported in Himachal Pradesh, India (Prasad et al. 2002). These are commonly known as common morel, morel, yellow morel, true morel, and sponge morel. *Morchella esculenta* (L.) Pers. (Morchellaceae), generally known as morel mushroom or sponge morel, is a wild comestible mushroom. This is one of the most substantial and economically important wild mushrooms and it is an extremely valued and popular mushroom because of its fragrance and delicacy. The specific epithet "*esculenta*" is derived from the Latin word, which means "Edible". *Morchella esculenta* is well known for its nutritional and medicinal efficacy because it contains many bioactive ingredients, including polysaccharides, proteins, trace elements, dietary fibers, and vitamins (Litchfield et al. 1963). This mushroom is found everywhere in the world and is broadly used as a functional food due to its nutritional properties. Although, its direct consumption can lead to gastrointestinal irritation. This can be removed by boiling or blanching the mushroom during its processing (Shameem et al. 2017a). This mushroom is generally found during early summers (March-April) and rainy seasons (July-September). Morels are completely diverse from other wild mushrooms because they are spongy and possess honeycombed heads. They also possess a very pungent smell when they are collected fresh from their wild habitat (Castellano et al. 1999). They are a rich source of proteins, B-complex, vitamins, and minerals. Few studies revealed that their fruiting bodies are useful in the treatment of illnesses such as cold, headache, and Hepatitis B. These are also useful in reducing fatigue, insomnia, blood cholesterol, and maintaining blood sugar levels (Mohmand et al. 2011).

Morels are usually found as a "mycorrhizal" relationship with hardwood and coniferous trees, and generally, grow in March and July (Hamayun et al. 2006, Wagay & Vyas 2011). Due to their rare existence and a high price, they are referred to as "growing gold of mountains. *Morchella esculenta* is commonly found in thick coniferous forests having loamy soil rich in humus. It naturally grows at a low temperature on high altitudes at a height of about 2500-3500 meters above sea level (Ali et al. 2011). In India, the forests of Jammu and Kashmir (Wani et al. 2020) and Himachal Pradesh are its natural habitats. Although several workers firmly believe that, besides their growth on Himalayan ranges, the climate of Mount Abu (Rajasthan) is also suitable for its growth. Researchers collected fruiting bodies of morels grown under pear (*Pyrus* sp.) tree in the western aspects of the undulating hilly lands (slope > 33%) during July. They understood the requirement of less sunlight and a cool climate for the growth of this mushroom (Manikandan et al. 2011).

Due to various traditional and edible values of morels, many researchers explored medicinal properties such as anti-oxidants, anti-microbial, anti-inflammatory, and anti-cancerous potential of their mycelial culture. *Morchella esculenta* has a very good anti-oxidant potential with a wide range of bioactive compounds which generally contribute to their pharmacological aspects. Keeping in view, scientific efforts are required for the large-scale collection of this valuable morel mushroom

not only for its culinary and medicinal use but also to boost the economy of the people (Paliwal et al. 2013). The following important aspects are presented highlighting various properties of mushrooms (Fig. 1).

Medicinal properties of morel mushrooms

Mushrooms possess many nutritional and medicinal bio-components that substantiate their use to maintain public health all over the globe. They are a rich source of many bioactive compounds having anti-tumor, hypocholesterolemic, immunosuppressive, anti-oxidant, anti-microbial, and anti-inflammatory properties. Chemically, these compounds are polysaccharides, complexes (polysaccharide–proteins, and polysaccharide–peptide), ribonucleases, proteases, and lectins.

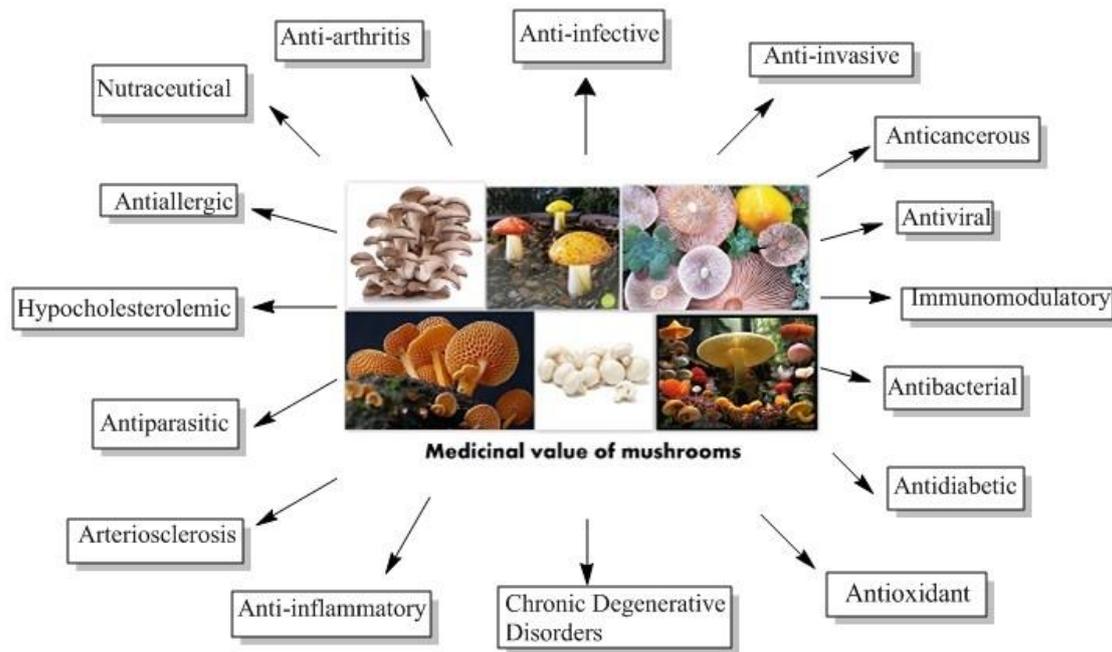


Fig. 1 – Medicinal properties of mushrooms.

Other compounds of therapeutic importance are several secondary metabolites of low molecular weight such as lactones, terpenoids, alkaloids and antibiotics with different chemical groups, and metal chelating agents (Cheung 2010). Compounds such as α - β -unsaturated polysaccharides, glycoproteins, peptides, phenolic derivatives, hydrolytic, lipids, and oxidative enzymes extracted from the crude extracts of mycelia and fruiting body of medicinal mushrooms have exhibited healing properties (Fig. 2). The mushrooms having medicinal values are often called ‘mushroom nutraceuticals’. Various mushrooms are consumed in the form of capsules or tablets as nutritional supplements which are made from their extract or dried biomass of mycelium. It has been observed that with regular intake of such nutraceuticals prepared from mushrooms, there is an enhancement in the immune response of body with the improvement of disease condition (Taskin 2013).

Bioactive compounds of *Morchella esculenta*

The fruiting body of *Morchella esculenta* contains various bioactive compounds such as tocopherols, carotenoids, phenolic compounds, and organic acids. Among phenolic compounds, p-Coumaric acid, p-Hydroxybenzoic acid, and protocatechuic acid are most common (Heleno et al. 2013). Yellow morel contains various aromatic compounds such as aldehydes, acids, ketones, esters, and terpene. Methanolic extracts of *M. esculenta* possess potential with antimutagenic and antimutagenic effects (Stojković et al. 2013). Taskin (2013), has found that most important major

aromatic compound is phenol which possesses alcohol (50.9%), ester (15.6%), and carbamic acid (11.37%). Mycelia of these mushrooms contain the highest amount of lovastatin (1438.42mg/kg) (Lo et al. 2012). Polysaccharides fractions of *M. esculenta* viz; MEP-1, MEP-2, and MEP-3 were isolated. These polysaccharides are primarily the polymers of glucose, mannose, galactose, and arabinose with an average molecular mass of 43,625 Daltons (Yang et al. 2015).

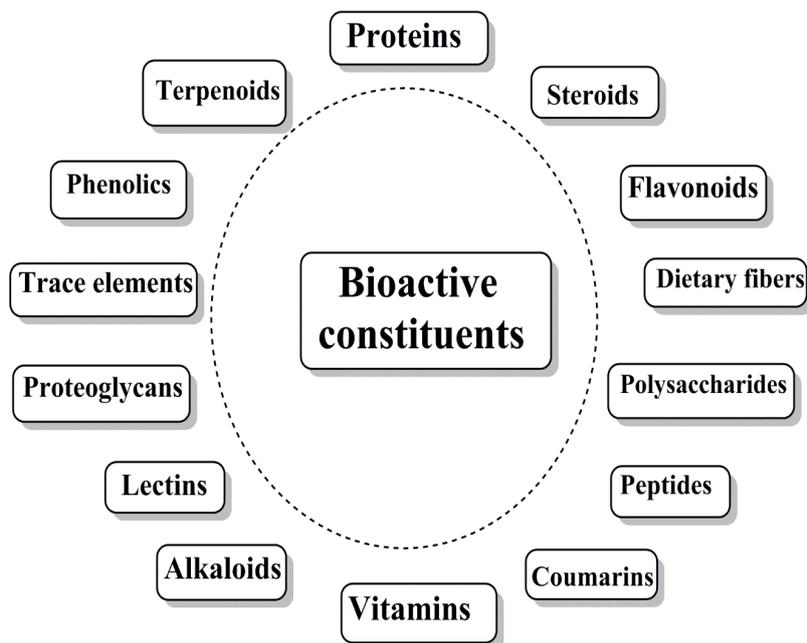


Fig. 2 – Bioactive components of morel mushrooms

Antioxidant Properties of *M. esculenta*

Antioxidants are chemical compounds that protect cells from damage caused by free radicals and ROS (Reactive Oxygen Species). They can randomly damage cells that undergo mutations and cause cancer (Wani et al. 2010). *Morchella esculenta* is a good source of natural antioxidant and phenolic compounds. It is also a very rich source of protein which contributes to its use as food and nutraceuticals (Badshah et al. 2015). Some researchers have correlated the anti-oxidative, anti-inflammatory activity, with phenolic contents found in mushrooms. These researchers demonstrated that the phenolic compounds are the main antioxidants in mushrooms (Cheung et al. 2003, Taofiq et al. 2015). Due to the presence of active metabolites, these mushrooms are a good source of antioxidants with potent inhibitory activity of nuclear factor kappa-light-chain enhancer of activated B-cells (Kim et al. 2011). Extracellular and crude polysaccharides of *M. esculenta* have noble antioxidant activity, and are also a worthy source of immunoenhancing drugs (Fu et al. 2013, Li et al. 2013). In one study, exopolysaccharides (EPS) SO-01 was extracted from *M. esculenta* and its antioxidant activity was determined in animal model (Meng et al. 2010).

Methanolic extracts of *Morchella esculenta* exhibits antioxidant activity with 90% scavenging of free radicals (Deepak &Wagay 2011). The ethanolic extract of morels has a good reducing effect with the 83% inhibition of superoxide generation per 100 mg/ml of extract (Elmastas et al. 2006). Polysaccharides present in morels have the natural antioxidant potential and have a role in lowering oxidative stress (Cai et al. 2018, Li et al. 2018). Mycelia extracts of morels have huge potential to as antibiotics (Kalyoncu 2010). Morel mushrooms mycelium is an excellent source of antioxidants that are capable of imparting protection against many diseases (Nitha et al. 2010). Their study suggests that aqueous and methanolic extracts of these mushrooms may be used as novel nephroprotective agents (Nitha & Janardhanan 2008). The soyabean crude residue (SCR) obtained after fermentation of *M. esculenta* is a good source of antioxidants as a functional food (Li et al. 2016). Besides antioxidant activity, this mushroom also possesses antimicrobial activity (Ahmad et al. 2014).

Other pharmacological aspects of *M. esculenta*

Morchella esculenta possesses excellent anti-inflammatory activity as fruiting bodies of this mushroom are cytotoxic to human cancer cells *In vitro* and can be used as a functional food (Lee et al. 2018, Zhao et al. 2018). Cytokinin production in *M. esculenta* suggests the use of this mushroom as future producers of pharmacologically active compounds (Vedenicheva et al. 2018). Bioactive compounds from these mushrooms have significant inhibitory activities against some pathogenic strains (Shameem et al. 2017b).

Local names of *M. esculenta* in different localities of Himachal Pradesh

Indigenous people of Himachal Pradesh especially from Kullu, Kinnaur, Mandi, Chamba, and Shimla districts, commonly call these morels with different names such as Guchhi, Dhunghloo, Chaeu, Jamchu, Chunchroo, Chuahar khukh, Rangmuts, Jangmuts, and Bhuntu (Semwal et al. 2014, Lakhanpal 2010).

Conventional uses of *M. esculenta*

People residing in rural areas have immense traditional knowledge about these mushrooms and they pass this from one generation to another. These people use the fruiting bodies of these mushrooms in the prevention and treatment of various diseases. Local people use these mushrooms and their parts for therapeutic applications which are based on their traditional knowledge. The traditional uses of morels are highlighted in Table.1. Information given in table below was taken from the book written by (Lakhanpal 2010).

Table 1 Uses of morels in traditional medicines

S. No.	Aliment	Method	Uses
1	Stomach pain	Aqueous extract of the fruiting bodies are given to the patient, or fruiting bodies ground in water or raw milk Relieves from pain	Relieves from pain
2	Pneumonia	Pneumonia Decoction is prepared of old fruiting bodies of Guchhi as “Garam kandha” is given to the patients.	Cures congestion
3	Dehydration/ blood stools	Aqueous extract of fruiting bodies by adding little salt/sugar.	Recovers water loss from the body
4	Respiratory problem	A decoction is prepared by adding 2/3 fruiting bodies to three glasses of water. Boil till water remained ¼.	Help in reducing respiratory problems.
5	Fever, cough, and cold	Boiled soup or raw Guchhi is eaten by adding a little salt and desi butter.	Heavy sweating is there which lowers the body temperature.
6	Healing of wounds	The paste is prepared by grinding the fruiting bodies with desi butter and then applied on wounds.	Heals the wounds as it provides warmness to the wound
7	Pregnant women/ Lactating Mother	Soup, dry vegetables (cooked) given to the ladies.	Provides strength, warmness to the body and is considered very nutritious. It provides energy to the body, which is indirectly given to the body.
8	1-12 months kids	The fruiting body is ground with honey/raw milk -3 spoons/day; soup once per day.	Growth of kids
9	Asthmatic patients	Simple frying of fresh and rehydrated fruiting bodies is given to the patients.	Helps in proper functioning of lungs.
10	In acne	The paste is prepared while grinding in water	Due to warmth, it will dry acne and cures it
11	Sex appeal	A decoction is prepared in apple wine	Provides warmness to the body
12	Weakness	The decoction is prepared by adding milk and while serving add two spoons of honey.	Provides strength to the body.

Methods of dryness of *M. esculenta* in North Indian states

These mushrooms are collected during the rainy season and therefore, need to be properly dried. The people of Himachal Pradesh dry these mushrooms either under the sun or hang them with a wire over the traditional “chulhas” in their kitchens. This method of drying is helpful in long-term preservation and to protect fruiting bodies from insects and molds. One of the traditional methods of drying these morels is making a garland of fruiting bodies and hangs it on the wall or house rafters (Fig. 3). A similar procedure is adopted for drying these morels in Jammu and Kashmir State where the collected mushrooms are kept for drying in small trays on dung and mud-coated floors, on stone slabs, straw mats, on terraces, hanged in balconies and under-roofs after being strung in a thread. The drying process, under favorable climatic conditions, takes around ten to fifteen days (Lakhanpal 2010).



Fig. 3 – Drying process of fruiting bodies of Morels.

Toxic effects of *Morchella esculenta*

Although, it is a medicinal important mushroom, it also has toxic effects. In the past, various reports have come about the toxicity of this mushroom. *M. esculenta* has cerebellar effects within 6-12 hours after consumption (Pfab et al. 2008). In another study, researchers found that neurological symptoms induced cerebellar syndrome; this condition is quite different from the other conditions that appear after consumption of little cooked morels (Saviuc et al. 2010). The prominent features of the neurological syndrome include tremor, dizziness/inebriation, and gait ataxia/postural instability with similarity to cerebellar ailments, as observed by several other workers after the consumption of half-cooked or uncooked morels (Carrasco 2003). A compound named *monomethylhydrazine* found in this mushroom is responsible for food poisoning and leads to gastrointestinal symptoms such as weakness, jaundice, loss of coordination, sometimes coma, and death (Gecan & Cicnowicz 1993). Morels also induce gastrointestinal irritation in some people, when they are consumed with alcoholic beverages and triggers indicators ranging from a hot flushed feeling in humans to palpitations, nausea, vomiting, diarrhea, gastrointestinal distress, chills, muscle spasms, sweating, weakness, severe cramps, disoriented and headache (Groves 1964, Beug et al. 2006).

Sociobiological and ethno-mycological aspects

Native people of Himachal Pradesh have various myths and stories about wild *Morchella*. People firmly believe that it only grows in the influence of strong lightning and thundering. Mostly, elder men and women of rural areas visit those places from where they have already collected these mushrooms in the past year. There is a common myth among people that its sporophore does not increase in size, once it is spotted; hence collected when these are very small (Lakhanpal 2010). Collecting morels for culinary purposes has been a traditional practice since ancient times due to their beautiful form and delicious taste. However, today’s people have started their collection for the selling purpose instead of consuming themselves because of its high price (Raman et al. 2018).

These mushrooms are consumed in a variety of ways and recipes differ from one community to another. One of the commonest methods of its consumption is by preparing 'Pulao', with rice or a dried vegetable or vegetable with gravy. Local people in the Kullu district of Himachal Pradesh boil their fruiting bodies in milk before consumption (Nautiyal et al. 2001).

Conclusion & prospects

Among morel mushrooms, *Morchella esculenta* (common name Guchhi) is well known for its excellent taste and aroma worldwide. *Morchella esculenta* is mostly found in thick coniferous forests containing loamy soil rich in humus. In India, it grows in the forests of Jammu and Kashmir, and Himachal Pradesh. Mycelium of *M. esculenta* mushrooms obtained from pure cultures is an ideal choice for developing safe health products. Extracts of this mushroom can be helpful in the treatment of various diseases. Several bioactive compounds can be derived from extracts of these morels and chemically defined molecules obtained from these may be used to develop functional foods and pharmaceutical drugs. Due to the presence of different attributes such as nutritional, anti-oxidative, anti-inflammatory, and immunostimulatory properties in *M. esculenta*, this mushroom is considered one of the most valuable edible mushrooms all over the world. Still, there are lots of challenges in using morels as functional food and therapeutic agents. Since it is mostly obtained from wild habitats, therefore, more studies are still required to grow morels artificially at a large scale.

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Conflict of Interest

None.

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