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Medicinal value of Edible *Morchella esculanta* (Guchhi): A Review

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ABSTRACT

The review explores the medicinal properties of *Morchella esculenta*, a highly prized edible mushroom. Morchella is a genus of edible mushrooms closely related to anatomically simplex cup fungi. It is also called morel, true morel; it normally grows in hilly, cold climates between the elevations of 2500 and 3500 m in forest environments in the growing season of March to July. Because of its distinctive flavor, taste, and texture, it is utilized in many different cuisines all over the world.*Morchella esculenta* is a rich source of various bioactive compounds, including polysaccharides, proteins, flavonoids, and phenolic compounds, that have been shown to possess potent antioxidant, anti-inflammatory, immunomodulatory, anti-cancer, anti-diabetic, and anti-microbial activities. These properties make it a promising therapeutic agent for various diseases and health conditions. In traditional hill societies, it is used for stomach aches, coughs, healing wounds, etc. Further to lowering blood cholesterol levels, and managing diabetes and heart disease, it can improve sleep quality and reduce fatigue. It can be poisonous only if eaten raw in a large amount of freshly collected. The review also discusses the traditional uses of *Morchella esculenta* in different cultures and the current state of research on its medicinal potential. Overall, this review highlights the importance of further exploration of this edible mushroom as a potential source of natural medicines.

Keywords:-Antioxidant, Anti-Inflammatory, Edible mushrooms, Medicinal properties, *Morchellaesculenta*.

INTRODUCTION

Around more than 2,000 species of mushrooms exist in nature, which is known to us. Out of these around 25 species of mushroom are generally acknowledged as food and only a few of those species are cultivated commercially (Valverde et al., 2015). Mushrooms are highly appreciated by humans fortheir edible and medicinal purpose.Mushrooms are enriched with many essential bio-polymers such as polynucleotides, polysaccharides, and proteins (Zhao et al.,2020). It is challenging to compare edible and medicinal mushrooms. Many edible mushrooms have medicinal properties. The bioactive polysaccharides extracted from medicinal mushrooms have promising medicinal effects on cancer, cardiovascular diseases, diabetes, respiratory problem, etc. *Morchella esculanta* is one such important and economically beneficial wild type of mushroom. The present scientific name of Morchella esculantacame in a publication by Christian Hendrik Persoon in 1801. It is one of the most expensive mushrooms found in the world. In India, primarily found in forests of Jammu and Kashmir, Himachal Pradesh, and Uttarakhand. It is commonly known by names like Guchhi, Yellow morel, True morel, *etc*.(Dörfelt, 2013).This mushroom is found in coniferous forests at a height of about 2500-3500m (Ali et al., 2011).*Morchella esculanta* shows mycorrhiza or saprobic relationship with hardwood and coniferous trees. It grows in the region of high altitude villages of Central Himalayas having cold environments. They possess a pungent smell when obtained from their wild habitat, which helps us to easily distinguish them from wild-type mushrooms. Itflourishes well in loamy soil conditions which is rich in humus (Kumar, 2020), decaying leaves and even on the rotten log of wood. Fresh morels mushroom season is limited to a few weeks of spring (Wagay and Vyas, 2011). It can't be grown on a commercial scale so it is collected from the wild region. This mushroom is quite expensive because of its rich nutritional value with unique flavor, so it is known as the "growing gold of mountains". *Morchella esculenta* belongs to the family Morchellaceae of phylum Ascomycota. It has a honeycomb-like appearance. It consists of two parts the upper part and the lower part. The top part is called pileus, which has around 70-80% of the total plant weight. And the bottom part is called the stalk or stipe which possesses about 20-30% of the total weight of the plant. Stipe has a slightly

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enlarged base supporting the upper part of the mushroom. Morel is whitishto pale grey in the young stage and becomes greyish brown at maturity. This true morel looks similar to false Morel (poisonous mushroom). *Morchellaesculanta* consists of two words Morchella which originated from the German word"morchel" which means "mushroom" and esculanta is originated from a Latin word that means "edible". This means *Morchellaesculantais* an edible mushroom (Raman, et al., 2018).Edible morel must be always cookedthoroughly; otherwise, they may cause severe stomach pain or infection, or sickness. These are a great source of Vitamins (like B1, B3, B5, B6, B9,C,D), minerals (like Ca, Zn,Mn, Mg, Na, Fe,Cu,P) and also contact bioactive substances including polysaccharides, protein, vitamin, dietary fibers, etc. It is used to treat a variety ofailments, including arthritis, anemia, and cancer. Morel exhibits many activities: antioxidant, anti-inflammatory, antitumor, and antibacterial. *Morchella esculenta* is helpful in weight management as well as for pregnant women as it is full of nutrition. The fruiting body of morel shows antioxidant activity, by removing the reactive oxygen species which harm the body. Morel's mycelia contain beta-carotene and linoleic acid which exhibits antioxidant activity. Morel has been shown to have anti-inflammatory activities (Nitha et al., 2007, Nitha et al., 2013). Extracts which are obtained from *Morchella esculanta* are potentially tumor-resistant (Li et al., 2013) and show antibacterial activity against bacteria like Escherichia coli, *Salmonella typhinurium* (Heleno et al., 2013).Native people of hilly areas use it for wound healing also. It helps in sleep-related issues, in improving blood cholesterol, heart-related diseases, breathing issues, etc.there may be a reference to a drug named Chhatrak (kumbhiguchhi in the Sutrasthana of Charak Samhita, below the Chaturtha Shakvargadravya which is taken to be as a variety of Mushroom.Therefore right evaluation of Morchella esculenta (Wild Morel-Guchhi Mushroom) could serve as a vital tool for a higher understanding of both the medicine and its toxicity, to be able to offer scientific statistics and statistical validation of its protection and efficacy. Besides all its medicinal properties, *Morchella esculenta* has various adverse effects on our bodies. It should be consumed in raw form or uncooked. One should avoid consuming Gucchi mushrooms with alcohol, as they contain some sort of toxins that could cause some allergic reactions. Nowadays Gucchi mushroom is also used in various recipes as a vegetable, in salads, in Currys, *etc*. (Table 2).The mushroom is harvested in the rainy season and then dried properly by the locals using different traditional methods, by making garlands and hanging it on windows,on the balcony, or chullas, under direct sunlight, *etc*. Moisture content present in *Morchella esculenta* after harvesting is the major problem in its capitalization. It takes months for villagers to collect enough Gucchi mushrooms, dry them and then bring them to the market for selling. The shelf life of the mushroom also gets reduced if moisture is present in it. This edible mushroomis primarily exported from India to other countries like Europe and the United States of America. In India, itis the most expensive vegetable costing between 2000-3000 INR per kilogram, depending based on its weight. The total world production of *Morchella esculanta* is about 1.5 million tonnes of its fresh weight.

Systematic position ofGucchi Mushroom

Kingdom	Fungi
Division	Ascomycota
Class	Discomycetes
Order	Pezizales
Family	Morchellaceae
Genus	*Morchella*
Species	*esculanta*

The structure of *Morchella esculanta* consists of two parts i.e. Pileus and stalk. Pileus is the upper part of the morel mushroom. Pileus possesses about 70-80% of the total weight of the plant. It is usually egg-shaped with a bluntly conical or convex apex, sometimes it is round, less cylindrical, or irregular having pits arranged randomly. Pileus is about 3-9 cm long and 2-5 cm wide. It is yellowish, brown or black.Stalk is the lower part of the morel mushroom. It is a hollow structure having 1to4cm of height and 1-3cm of width. It possesses about 30% weight of the plant. The stalk of the mushroom is pale in color when young but at maturity becomes greyish brown and usually swollen at the

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base(Raman et al., 2018).

Bioactive constituents of *Morchella esculanta*

The fruiting body of *M. esculanta* possesses various bioactive components which include organic acids, carotenoids, phenolic compounds and tocopherols, and polysaccharides.The polysaccharides are the long-chain carbohydrate polymer produced from monomeric units of carbohydrates i.e. monosaccharides. These monomeric units are linked through glycosidic bonds. These are the macromolecules having various physiological properties. Polysaccharides present in *M.esculanta* possess various bioactivities like anti-inflammatory, anti-tumor, immune-regulation, anti-diabetic and many more.

Phenolic compounds are the secondary metabolites. These consist of a benzene ring having hydroxyl group attached.Phenols apply defensive impacts against oxidative tension and irritation caused by airborne fine particles. Phenolic compounds found in the fruiting body of *M esculanta* are widely reported to have anti-microbial, anti-cancer, anti-inflammatory properties. These phenolic compounds provide protection to the mushroom from the UV radiation and other environmental stress.The most common phenolic compounds which are found in the fruiting body are p-coumaric acid, *p*-Hydroxybenzoic acid, and protocatechuic acid.

The tocopherols are the major type of Vitamin E which is fat solublephenols. Tocopherols helps an individual in order to protect the cells from the damage caused by the free radicals. Tocopherols possess various properties like anti-oxidant, scavenger of free radicals, etc. According to researchers there three forms of tocopherols (α,γ and δ)are present in the morels.

Caretonoids are the tetra-terpenoids and these are organic pigments other than green colour pigment i.e chlorophyll which are produced by the plants, algae, fungi. Caretonoids have various medicinal properties like anti-diabetic, anti-cancerous, anti-bacterial,*etc*. Lycopene and beta-carotene are two carotenoids that are identified in the fruiting body (Ajmal et al., 2015).Itis used as a good source of protein supplement, which compared to other vegetables, can be more readily digested.

Minerals and B-complex vitamins are abundant in *M. esculenta*. It can lower blood cholesterol levels as well as fatigue and sleep issues. The plant offers an effective alternative for treating anemia and controlling blood sugar.Various organic acids like malic acid, fumaric acid, succinic acid are found in the morels mushroom. These organic acids carries various acidic properties.The main function of organic acids is that they ruin the development of destructive microorganisms by decreasing the pH within the digestive tract of the individual.Out of these succinic acid is most abundant. It helps the mushroom in fighting against diseases and for long term preservation.

Medicinal Properties of *Morchella esculanta*

These mushrooms are used all over the world to maintain public health using biochemical compounds and many nutritional components. These mushrooms contain many nutrients and medicinal organic ingredients which are used to maintain public health around the world.Various bioactive components, including polysaccharides, polyphenolic compounds, proteins and protein hydrolysates, lead to the biological activities of the *Morchella esculanta* mushroom. Various bioactive properties are possessed by this mushroom-like antitumor, antibacterial, antioxidant, anti-inflammatory, immuno-regulation, antiallergic,antiarthritis and many more. The powdered form can also be used as a disinfectant, to heal wounds and used to curestomachache.

Antioxidant property of mushrooms

Oxidation is a normal process that takes place in the body. It can help fight pathogens, thus reducing the risk of infection. When there is an imbalance between free radicals and antioxidants in the body, oxidative stress or damage can be seen which include cell death, and tissue injury causing various diseases like atherosclerosis, diabetes and tumor, which can harm them. *Morchella esculanta* possesses various bioactive components which show strong antioxidant properties.Chemical compounds that protect the cell from injury caused by free radicals and ROS (reactive oxygen species) are anti-oxidants. They may unintentionally injure cancer-causing cells that go through mutations (Wani et al. 2010).The mycelia of *M.esculenta* are the best source of antioxidant, beta-carotene and linoleic acid is present in it which shows antioxidant activity and is capable of fighting against several

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diseases (Nitha et al. 2013).The methanolic extract shows antioxidant activity with 90% cleaning of free radicals (Deepak &Wagay 2011). Sugars present in morals have essential antioxidant capabilities and play a function in reducing oxidative stress (Raman et al., 2015).

Anti-bacterial property of mushrooms

The mycelia of Morchella esculanta show antimicrobial activity (Kalyoncu et al., 2010, Alves et al., 2012). Past research also demonstrates that methanolic, chloroform or ethanol extracts of M.esculanta possess antimicrobial properties (Badshah et al., 2012). This antimicrobial activity can be seen against bacteria like *Staphylococcus aureus*, *Salmonella typhimurium*, *Escherichia coli* and *Enteobacter cloacae*, *Listeria monocytogenes* (Heleno et al., 2013).

Anti-inflammatory properties of mushroom

The possible causes of inflammation could be pathogens, chemical or radiation effects, the bite of insects, or due to various chronic diseases. Various bioactive compounds possessed by *Morchellaesculanta* show anti-inflammatory properties. The methanolic and ethanol extracts of the whole plant body and cultured mycelia act as anti-inflammatories and help in reducing pain (Nitha et al., 2007). It helps in the inhibition of both types of acute and chronic inflammation. For many reasons, such as insect bites, poisonous drugs, or many chronic diseases leads to inflammation.

It is possible to eat the fruiting body and alsoit is delicious, healthful, and very nutrient-dense. It is abundant in protein, carbohydrates, vitamins especially vitamin B and a trace dosage of vitamins A, C, and D and it also possesses various minerals like zinc, copper, iron and manganese and possesses low calories (Negi, 2006).Earlier studies done by the researchers have also described a variety of aromatic compounds such as aldehydes, acids, ketones, esters and terpene. Among these aromatic compounds phenol is highlypresent (which is about 50.8%), followed by alcohol (15.5%), ester and carbamicacids (11.3%) (Ramam et al., 2015).

Traditional uses

In rural areas, where it is found local people prepare the fruiting body combined with rice and vegetables is thought to be just as nutrient-dense as fish or meat. Because of its unique taste and flavor different recipes are prepared by chefs in big hotels.Traditionally the local people use it to heal wound, as tonic, to reduce joint pain, to overcome gastric problems and indigestion.

Production and Collection of *Morchella esculanta*

Wild morels have become an available industry since man-made cultivation of Gucci mushrooms is quite challenging.All over the world, the total production of Morchella is 150 tons (dry weight). Among all, India and Pakistan are the two majorly Morels producing countries. Both of these countries produce about 50 tonnes (dry weight) of mushrooms from which the most frequentlyfound species is *Morchellaesculenta* (Ajmal et al., 2015). The collection of *Morchella esculenta* the toughest task, as it involves concentration and dedication. The local people collect it during spring and early summer and sell it in the local market.It grows best when it rains, but it can take months to collect enough to dry and market. It is collected when the ascocarp attains a height of 6-8cm and 4-7.5cm in diameter (Hamayunet al., 2006). Many pharmaceutical companies also purchase it from local people for medicinal purposes (Ajmal et al., 2015).

Drying and storage of *Morchella esculanta*

These mushrooms are harvested in the rainy season. The main problem with the capitalization of *Morchella esculanta* is the moisture content present which reduces the life of the mushroom, so to reduce this problem the mushroom should be dried and stored properly. The local people in rural areas dry them in the direct sunlight, straw mats, in small trays of dung or mud-coated floors or hang them by making garlands over the “chulhas” in the kitchen or walls or house rafters (for about 15 days).These drying methods protect the fruiting bodies of mushrooms from insects and molds and are very effective for long-term storage (Thakur et al., 2021). The most suitable way to preserve the mushroom is to keep them with ventilation (Ajmal et al., 2015).

Adverse effects of *Morchella esculanta*

Morchella esculanta is quite a beneficial mushroom but despite this,it also has toxic effects (Raman et al., 2018).These mushrooms can make a person sick if eaten raw,overcooked or consumed with alcoholic beverages, as they contain a small amount of toxin i.e. hydrazine which may irritate eyes, noseand throat, seizures, or coma in humans. Various reports from the past by researchers come out

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with the toxicity of this mushroom, leading to neurological symptoms including cerebral syndrome. The neurological syndromes include dizziness, postural instability, and tremors. Morels may also trigger gastrointestinal irritation when consumed with alcohol which causes symptoms like nausea, muscle spasms, weakness, sweating, headache, severe cramps, diarrhea, and chills (Thakur et al., 2021).

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Conclusion

Mushrooms are the most important and beneficial plants that occur naturally and have various features. Mushrooms can be easily grown in hilly areas because of the abundant moisture present there but can also be grown artificially by providing favorable environmental conditions with controlled temperature and humidity. The flavor and essential substances present in mushrooms are of great importance in pharmacology.The various extracts contained inmushrooms can be used to cure several types of ailments. *M.esculenta*(Guchhi)is the most popular mushroom known for its taste and pleasant odor, all over the world. It constitutes numerous bioactive components like phenolic compounds, tocopherols, organic acids, carotenoidsor polysaccharides exhibiting a broad range of medicinal and pharmacology properties including antioxidant, anti-inflammatory, antitumor, antibacterial, etc. It can also be used for healing wounds, gastrointestinal problems, asthma, cough, and cold. It is used in various recipes by native people and chefs in five-star hotels because of its unique and delicious taste. It is a very costly mushroom because of which it is named the "growing gold of the mountains". It plays a major role in the country's economy. In India, around 50 tons (dry weight) of mushroom is produced annually. This mushroom holds a promising future in every aspect whether it is economic or medicinal aspect. But for that extensive efforts should be made to grow it on a large scale by improving the technology.

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