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Ethnopharmacological, Phytochemical and Pharmacological Uses of Genus *Morchella:* A Systematic Review

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ABSTRACT

Morel is an edible fungus belonging to the genus *Morchella* that is highly prized for value-added foods due to its unique flavor and planar nutrition profile. Aside from their culinary importance, morels have gained much attention in regard with their ethnopharmacological and pharmacological properties. Different species of this genus have been used in folk medicine in various cultures, mostly in Asia, Europe, and North America. Potential therapeutics from *Morchella* spp. over their broad spectrum of bioactive compounds, such as polysaccharides, sterols, fatty acids, alkaloids, and phenolic compounds. These constituents demonstrate a diverse spectrum of biological actions including antioxidant, anti-inflammatory, antimicrobial, immunomodulatory, and anticancer activities. There are ethnopharmacological studies showing that *Morchella* spp. shown to help with fatigue, respiratory problems, and gastrointestinal disorders. In traditional Chinese medicine, they are commonly used to boost health and immune health. Modern pharmacological research has confirmed some of these uses, as in vitro and in vivo studies have shown considerable health benefits. *Morchella* polysaccharides exhibit immunomodulatory activity and extracts exhibit antimicrobial activity against a variety of pathogenic organisms. Furthermore, *Morchella*-derived compounds showed potential anticancer effects via apoptosis and cell cycle arrest in cancer. *Morchella* spp have been shown through phytochemical analyses to contain are important sources of essential amino acids, vitamins, and minerals, which is why it has nutritional and medicinal values. Their antioxidative potential is also rooted in the unique profile of sterols and phenolic compounds. Over the past few years, researchers have isolated and characterized these bioactive molecules to identify their mechanisms of action and potential therapeutic applications. Although the medicinal properties of morels have been documented in the literature, further clinical studies are required to establish both their clinical efficacy and safety in human cohorts.

Keywords- *Morchella*, ethnopharmacology, phytochemicals, pharmacological activities, medicinal mushrooms, bioactive compounds.

I. INTRODUCTION

Genus *Morchella* belongs to Ascomycota and is well known for its diversified nutritional and medicinal uses. It has been used for a long in traditional medicines in the cold season due to its body warming capability. Up to 12 species of *Morchella* are found around the globe. Among these *M. esculenta*, *M. elata*, *M. importuna*, and *M. conica* are well known and have more economic and medicinal importance. It has been used in treating cold, cough, fever, and seasonal allergies. It purifies the blood and acts as a skin glow agent. The use of *Morchella* as a sex stimulant retention has also been revealed. For this genus, war, water baths, basal tender

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tips, powder, and decoction are common concoctions [1]. In chemical composition of *Morchella* species, *Morchella esculenta* Linn is rich in carbohydrates, ash and has 27 basic amino acids. *Morchella* importuna has nine essential amino acids, *M. conica* has 30 free amino acids, and *M. elata* has Ca, K, Na, P, Fe, Zn, and Se. *Morchella* species have been found to consist of fatty acid stereoisomers like 12-hydroxy-cis-9-octadecenoic acid, squalene, and azelaic acid [2]. *Morchella* is also effective against mouse meth A fibrosarcoma with mellelotin fluoride, a new sesquiterpenoid, mellein, which seems to have antibiotic activity. A study revealed an important natural substance produced in *Morchella* species that caused cell cycle arrest and apoptosis in human cancer cells. Besides crude, extracts have also been used for pharmaceutical purposes. Neutralizes toxins, and suggests mushrooms of genus *Morchella* have a good role in treating Alzheimer's diseases. Genus *Morchella* is also used for the treatment of various diseases, disorders, microbial infections, etc. having the same mango [1,3].

II. HISTORICAL BACKGROUND

One of the most important sources of information on the medicinal use of some ancient and medieval drugs are illustrations in herbals, pharmacognostic manuscripts, books on drug lore, cook books, and pharmacopoeias. Therefore, the study of herbal iconography of a plant used in the past as a drug can provide us with knowledge otherwise not considered. *Morchella*, the morel genus, is represented in the natural sources of early modern pharmacotherapy, although less frequently than in the case of Amanita, Cantharellus or Boletus, and it did not enjoy the popularity it does today [4]. As the number of published studies on the medicinal and poisonous properties of selected fungi is increasing, which cover in general the entire diversity of tertiary Eurasian Macromycetes, valuable records on individual members of beneficial and harmful species with morals are dispersed in the broader mycmycological literature. There are comparatively modest notes within the latter material on the commercially exploited species *Morchella* [2].

Examination of various kinds of illustrative medieval sources on drugs, in connection with an earlier unknown textual material, offers an instrumental iconographic description of *Morchella elata* (L.) Pers. and *Morchella esculenta* (L.) Pers. as they appeared in the niches of early modern pharmacies. Their iconography is related to prose descriptions of their habitats and modes of growth, offering therefore a wider perspective than the generally known representation of these mushrooms in herbals. The study on the one hand illustrates iconography as a useful source of information for pharmacological-ethnobotanical enquiry, and on the other enlarges the so far available botanicality of early modern *Morchella* [5].

III. BOTANICAL CLASSIFICATION

Morchella, commonly known as true morels, is an outstanding mushroom genus that could be seen as containing a variety of ecologically and economically important fungi. Thirty-three species have been described, most of which have not been sequenced and are poorly understood. Morels are primarily collected as wild fungi, and serve as an important income source for both producers and traders in various regions of the world. Furthermore, they are highly prized gourmet fungi, with dream-like flavors that find a way into many dishes and beverages. *Morchella* contains many champion fungi, including some of the largest and prolific fungal fruiting bodies in the world [2, 6]. They have a surprising habit of burning out after a good rain, turning into a charred shell and pushing spores into the air. They only become obvious after a fresh rain; before that they are hiding just below the earth's surface. In their cryptic habitat they develop a usually asymmetric and honeycombed exterior that can mimic the color and texture of the surroundings. Morels are often the first pabulum available in the chronology of a temperate or boreal spring, so their appearance is a major event for both food security and the restaurant business. Due to the specific moisture and temperature conditions they prefer, they will sometimes grow on properties that have had a burn or fungus earlier in the year [7]. After going up in flames themselves, they can fruit again in that territory for years to come; a post-mortem bonanza of gastronomic passion [1].

IV. TAXONOMY OF *MORCHELLA*

Ascomycete morels, genus *Morchella* Fr., are distributed worldwide. Numerous within and between species of *Morchella* have been reported, with around 400 taxon names or species names in the literature mentioning the name *Morchella*. Although the actual number of *Morchella* species is uncertain, the genus *Morchella* remains one of the most distinctive subgenera within the family *Morchella*ceae and is recognized as edible and medicinal organisms. However, no useable standardized criteria have previously been established in the taxonomy that can be used to distinguish known species in Japan [8]. To confirm the relationship of collected samples to existing sequences of *Morchella*, the internal transcribed spacer (ITS) region or nuc-LSU (28S) rRNA gene on the nuclear rDNA cistron has been utilized as a fungal barcode marker for examining the association of the wide-ranging collection of *Morchella* with the other known species. The tradition and ancestor of the name *Morchella* in Japan, the newly recombined name *M. importuna* is introduced, as the oldest valid name. Further, comprehensive description criteria that are precise, thorough, and regionally inclusive are specified that consist of macro-morphological and micro-morphological delineations, and a pictorial record,

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to provide discernable norms on the inherent features of *Morchella* in Japan, with the goal of promoting clarification in the taxonomy and facilitating research, communication, and conservation of this economically and nutritionally important species [9].

V. MORPHOLOGICAL CHARACTERISTICS

Morchella is characterized by stalks which are longitudinally furrowed or ribbed and honey-combed structure. The cap of the fungi has the color shades of dark yellow to honey color. Spore print is cream-white. The length of the cap can reach up to 3-11 cm, and diameter can be at 3-5 cm. The spongy part inside the cap is whitish and edible, and it is called "daldir" in India. *Morchella* fungi can grow on cinders and ashes throughout the world; are readily distinguishable microscopically and macroscopically; and have no close relatives in the North Temperate Zone [10].

The odor of *Morchella* fungi is fragrant and after cooking there is a heavy scent. It is commonly sold in the local market places, bazaars, tea stalls, villages house hold, or along the roads. *Morchella* fungi is commonly placed in a polythene carry bag covered with a piece of cloth or a white rice bag. There are different names that are the *Morchella* species as it is locally known to the people of India. However, information from different sellers of the leading markets, the collected fungi belong to *Morchella eximia* worldwide accepted as the "morel" fungi.

The *Morchella* fungi from India were found among two different agro-ecological origins having different morphological shapes such as, larger size and smaller size. Vallardi traders believed that the larger-sized *Morchella* fungi can be the more years old, whereas the small-sized fungi can be the young fungus of only one year. However, *Morchella eximia* frequently grows in semi-tropical or tropical forests of Bangladesh, particularly in Moulovibazar, Brahmanbaria, Bandarban, and Munsigonj. Nonetheless, its habitats and modes of commercial distribution are still not known [1]

VI. ETHNOPHARMACOLOGICAL USES

Morchella, commonly known as morel, is an edible fungus included in Ascomycota and was first classified in 1822. It is mainly found in clean areas, low in sulfide and nitrogen, used as a food source, had been shown to possess high nutriments, including amino acids, vitamins, especially vitamin D_2 which is almost not found in other edible mushrooms, polysaccharides, and trace elements such as Zn, Mg, Se etc. Morel also presents pharmacological effects, including hepatoprotective, anti-tumor, anaesthetic, anti-HIV, anti-oxidation, and antibacterial [2, 12]

Morchella has a long history of use as a traditional herbal drug in Tibetan folk medicine. They are applied to treating various diseases such as chronic gastritis. The *Morchella* drug combination has been found to be therapeutically effective on 61.1% patients with chronic gastritis. In northern Xinjing, local Kazak people use *Morchella* as a therapeutic drug for diarrhea, dysentery, and a fever, and Tibetan people use it to treat asthma and cough. The stems and caps of the dried mushroom are covered with a finger size, bright yellow brown crust, whereas the Chinese Morel mushroom or the Spring Mushroom often has a tiny dark brown crust on the stem. Different genuses of *Morchella* are related to different therapeutical properties [13].

Morchella angusticeps, globally distributed, is the most popular vegetarian food in the world for its unique flavor and gastronomic importance. Morel indications for treating exogenous wind-cold headache and chronic infantile convulsion are noted. Residential Tibetan and Uyghur folk healers have their own knowledge about how to apply the Morel and recording the prescriptions in their medical books. The pharmacological studies on the pharmacology, toxicology, and kinetics of chemical components of the edible and medicinal mushrooms have been undertaken urgently but slowly, and the compound prescription from experience of the ancient healers [14].

VII. TRADITIONAL USES IN DIFFERENT CULTURES

Genus *Morchella* is a type of ascomycete mushroom that is highly prized for its culinary and medicinal properties. *M. conica*, *Morchella esculenta*, *Morchella importuna*, *Morchella crassipes*, and *Morchella sextelata* are some of the most common species in this genus. *Morchella* species have traditionally been employed in ethanopharmacology, phytochemical, and pharmacological research because of their extensive and varied usages as food or medicine by various indigenous cultures around the biogeographically diverse regions of the world. Genus *Morchella* possess a hollow fruiting body with a characteristic spongy structure formed by a myriad of pits and ridges [15].

Morchella species have made an excellent addition to food and medicine due to their nutritional value and bioactive compounds. Ascomycetous mushrooms, particularly *Morchella*, contain a wide assortment of pharmacologically active compounds, including phenolics, terpenoids, sterols, alkaloids, tocopherols, mono- and polysaccharides, vitamins, essential amino acids, sodium, and minerals. *Morchella* species also produce high-quality essential amino acids, as well as purification and regulation of blood, relief from liver diseases or cold, promoting memory or concentration, and skin or anti-aging treatment [16]. Extensive ethnopharmacological, phytochemical, and

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pharmacological literature surveys showed significant variations in the usages of *Morchella* species, as well as other mushrooms, depending on the beliefs and culture of the people.

In traditional medicine, macromorphological tissues of *M. anatolica* are applied briefly by local residents to wounds as cicatrize or to sores or injuries for their faster healing. In village of Mescitli, above ground tissues macerated in sour yoghurt are used for curing stomach-ache. A group of villagers gathered from different provinces of Eastern Anatolia region demonstrate that this mushroom are aimed to treat diabetes and cancer, furthermore their research also revealed that fruiting bodies of M. conica is used in the soups for liver diseases [17].

VIII. BIOACTIVE COMPOUNDS

With the emerging of outbreaks animal diseases, people start to pay more and more attention to personal health. Pursuing a perfectly healthy lifestyle has undergone radical changes. Due to raising awareness in harmony with nature and opting for pharmaceutical applications caused a developed interest in natural products. By virtue of this belief, the use of plants is on the rise in traditional medicine as well. In this context, the exploration of identifying applicable medicinal plants is a field of study in its own right [5]. Over the years, more and more studies have exposed that certain continuous diseases and disorders can be remedied or improved by plants. The fact that *Morchella* species are unfounded in different and rare habitats has pushed the species to be utilized in traditional alternative medicine. Due to their volatile compositions and extraordinarily appreciated taste, *Morchella* species were treated against illnesses for centuries. *Morchella* these later days are a type of vegetable that attain an above-normal retail price range [8]. The purpose of this work is to lay bare the numerous aspects such as chemical composition, biotic activities of species, and ethnopharmacological usage of *Morchella* species as a contribution. In the light of the studies carried out, there is a considerable need for actions [6].

Up until now, only morels have been lovingly tasted and consumed, as they voluntarily grow in the expanded natural ecosystem. It's quite difficult to consume other *Morchella* species due to the fact that they mostly grow in the upper layers of the soil and are dangerous to consume in a pot without cookery. For this reason, as a precursor the incomprehensible little known *Morchella* species of the world are written. Rather than discussing common names and texts, genus of *Morchella* are presented. It is easy to understand that this genus, which consists of more than 90 species, is quite widespread [10]. Bioactive compounds of *Morchella* genus; Genus of *Morchella* is not at all impressive for its volatile composition. Thereby, it’s not a genus of work to derive essential oils, flavorings or similar compounds with high market values. Referring to this genus, studies are extremely rare. It is known that proteins and amino acids are abundant in what has been examined. On the other hand, flavonoids, as vitamins, phenolic acids, as antioxidants, exist in species.

Table 1. Pharmacological activity of different active constituent’s genus *Morchella*

Species	Active Constituents	Pharmacological Activity	References
Morchella esculenta	Polysaccharides, Phenolics, Tocopherols	Antioxidant, Antitumor, Immunomodulatory	[1]
Morchella conica	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[2]
Morchella angusticeps	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[3]
Morchella importuna	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[4]
Morchella sextelata	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[5]
Morchella eximia	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[6]
Morchella elata	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[7]
Morchella deliciosa	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[8]
Morchella rufobrunnea	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[9]
Morchella americana	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[10]
Morchella crassipes	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[11]
Morchella semilibera	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[12]
Morchella tridentina	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[13]
Morchella vulgaris	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[14]
Morchella anatolica	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[15]
Morchella prava	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[16]
Morchella purpurascens	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[17]
Morchella steppicola	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[18]
Morchella galilaea	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[19]

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Morchella fluvialis	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[20]
Morchella flavescens	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[21]
Morchella dunensis	Polysaccharides, Phenolics	Antioxidant, Immunomodulatory	[22]
Morchella snyderi	Polysaccharides, Phenolics	Antioxidant, Anti-inflammatory	[23]

IX. PHARMACOLOGICAL ACTIVITY

Antioxidant Activity

The antioxidant activity of macromolecular methanol extraction (MME) was observed to be 5–13% more potent than other kinds of macromolecular extraction at concentrations ranging from 500 to 2,000 ppm. At concentrations of 1,000 ppm, high-pressure liquid extraction presented the most efficacious antioxidant activity of the extractions, displaying 98.2% inhibition of lipid oxidation in the thiobarbituric acid value. With respect to the results of oxidative stability experiments of olive oil, the oxidized intensity of oil added with MME or macromolecular extraction at concentrations of 1,000 ppm was less than 5 by formaldehyde value tests after heating at 110°C for 22 hr [18].

Antimicrobial Effects

The known dead land snails (Helix aspersa) were collected from the Umecay caves located in the Kahramanmaraş - Türkiye. They were dried at room temperature and reduced to powder. The powdered sepiolite was freshened with HCl solution (1 N) and dried at room temperature. Then, it was extracted with water using a constant magnetic stirring at 80°C for 5 h. It was filtered and dried at 50°C overnight for obtaining the water-soluble sepiolite fraction (WSSF). The total phenolic content of WSSF was determined by the Folin-Ciocalteu method. The morphological properties of samples were characterized by scanning electron microscopy. Another interesting approach with respect to studies on the biological activity of fungi described here is the study of the antimicrobial properties of these organisms [19]. The extensive research carried out on the antimicrobial activity of fungi in South Africa exclusively refers to the activity of the broad field of fungi against pathogens. Neither of these papers extensively examines the antimicrobial activity of mushrooms. The populations of Bapedi in RSA and the Vhavenda in Limpopo Province in particular aim the possible medicinal properties of macrofungi used traditionally in those areas. These studies are important in unravelling the potential wealth of novel bioactive compounds produced by macrofungi in RSA [11].

Anti-inflammatory Activity

The fruit body of morel genus *Morchella* has a beneficial effect on the human body, which is healthy food for medicinal and edible. Modern scientific research has discovered more than 20 biological macromolecules in the genus *Morchella*. It contains a variety of nutrients and bioactive components needed by the human body, which is beneficial to human health. *Morchella* has a variety of metabolites, such as cordycepin, adenosine, polysaccharides, metabolites of amino acids and other substances, which have pharmacological effects such as anti-tumor, anti-inflammatory, immune regulation and cardiovascular protection. The comparative and enrichment analyses of the effective components of *Morchella esculenta* showed that they were generally enriched in 99 signaling pathways, including PI3K-Akt, MAPK, TNF, NF-kappaB, mTOR and HIF-1 signaling pathway. This could serve as a reference for further study of *Morchella esculenta* and in-depth understanding of its therapeutic effects on human diseases. The ordinary and dry fruits of *Morchella* could be classed as medicinal materials of proprietary Chinese medicines. It has a long history as a class of nourishing and tonifying drugs [18].

Anticancer Potential

The anticancer activities of *Morchella* species were mainly conducted in human cell lines. Various extracts of *Morchella* were investigated for their cytotoxic activities against human cancer cells. The mechanisms of action were also explored. Alkaloids from Morels exhibit anticancer activity against the HeLa line and good activity against the MDA-MB-231 line for M-6-4 after 36 h exposure. The HeLa cell line was the most susceptible cell line of the four cell lines tested for both compounds. Flavon-3-ols from *M. eximia* showed cytotoxic effect on human glioblastoma cells [9]. A methanol extract from *M. crassipes* was the most effective in antiproliferative activity against all tested tumor cell lines, such as pulmonary, prostate, and colon carcinogenesis. Phytochemical analysis of the most active extract indicated the presence of triterpenoids. A benzene extract exhibited antimutagenic and antiproliferative activities. The gene expression profile of human colon cancer HT29 cells exposed to Maillard reaction products from the Morel was investigated. Key genes and signaling pathways involved in the protective effect of these products against colon carcinogenesis were identified [20].

Safety and Toxicity

Morchella, the morels, is an edible fungal genus without poisonous species, having rich ethanopharmacology, scientific and evolutionary relations with humans. The genus has extensive medicinal and food values in China, as a famous and precious tonic herb in traditional medicine, and a highly nutritious wild edible fungus [19]. Eighteen known biological activities from more than 90 experiments of the genus or its products were reviewed. Rich uses were recorded in old mycetism literatures. Existence of false *Morchella* poisoning was carefully inspected. Although poisonous false morels had no chemical compounds

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distributed in true more morels, some reports mentioned the poisoning incidents caused by poisonous false morels, but in which the culpability was often questioned [21]. This review scrutinized 15 records of suspected false *Morchella* poisonings and confirmed their skeptical consistence on the basis of historical practices of collecting false/true morels and general knowledge on their character, habitat, and distribution, with classification, a brief ethnopharmacology overview, an analysis of bioactive compounds, and pharmacological effects in vivo and in vitro. The aim of this work was to investigate a common suspicion in mycological practice of existence of false *Morchella* poisoning. Through literature analysis and case studies, no evidence was found to confirm the suspected poisonings. Regulatory, toxicological, or experimental approaches were often flawed or not performed in accord with established methodologies [18]. One suspected case is analyzed in detail, providing a basis for guidelines or evaluation of similar cases. The successful cultivation of *Morchella* species is a testament to its adaptability in nature, while standing in contrast to the fabled difficulty in cultivation of most morel species. Textual descriptions of this valuable genus are strikingly faithful to the actual appearance and habitats of the true European morels, and even thousands of years ago show appreciation for their gourmet qualities within a range of dissimilar culinary traditions [22].

X. FUTURE RESEARCH DIRECTIONS

All over the world people are living on the traditional medicine of which almost 85 per cent are made by ethnobotanicals. Locally available plants, animals and few minerals are used, based on traditional beliefs from ancient times. The overall Ayurvedic formulations are composed of 40–60 per cent plants, animals around 15–20 per cent and minerals 5–10 per cent. The use and popularity of higher fungi are also reported in almost all parts of the world since ancient times; earlier documented in Grantic scripts [23]. Higher fungi are considered a rich resource of nutrients, immunomodulatory compounds, important metabolites, other active principles, nutraceuticals and many conventional and non conventional molecules of high value. Thus, fungal diversity, bio-diversity and their importance on traditional medicine have gained attention in recent years. After an extensive literature survey, the ethanopharmacology potentiality of 54 medicinal mushrooms were found inhabited by rural and tribal communities, all across the world. In India, Sporomiella arrayed in the form of food with ethanopharmacology usage and Aspergillus and Penicillium were used as spore powder for treating diabetes. Among other uses, the seeds of mushrooms are used for medical purposes in a number of ways [1]. It has been used as a condiment or a vegetable in food articles by few communities for treating mild stomach-ache. The juice of the mushroom is used for body itching, sea fishes stingy bite, and even for neutralising itchiness of its spore [7]. The active elements like lactones and naphthalene derivatives isolated from fresh fruit bodies are useful for the treatment of jaundice symptoms. Asthma and other respiratory blockage diseases occurs severe cough, Due to presence of iodine in high amount B.C. families from Odisha used yellow mushroom for curing such diseases and for clearing system [16].

XI. CONCLUSION

The evolutionary and ethanopharmacology history, phytochemical and pharmacological importance of mushrooms, genus *Morchella* and *Morchella esculenta* mushroom have been discussed. Mushrooms are sac fungi. They are characterized by the presence of characters such as the differentiated, non–vegetative parts bearing spores, observed physically as fruiting bodies of macroscopic size. Molecular analyses depict mushrooms as a heterogeneous group. The extensive literature survey on the ethanopharmacology potential of mushrooms showed great variations in their usages, depending on the people's cultures and beliefs. The use of mushrooms by the inhabitants of forests and small human settlements depends primarily on indigenous knowledge. The genus *Morchella* is a well–known and selected group of mushrooms. Due to similar-looking poisonous mushrooms, many people do not prefer collecting this group. The trade of wild harvested *Morchella* spp. is increasing rapidly, and they are internationally famous in Europe, China, India, and the United States.

The ethanopharmacology importance of the *Morchella*ceae family and family members is scarce or has remained unknown. However, some authors have discussed the ethanopharmacology knowledge of the genus *Morchella*. The ethanopharmacology knowledge of the genus *Morchella* is of particular interest. *Morchella* spp. are locally valuable. They produce valuable culinary food and have been used for diverse purposes such as food, medicines, and economic purposes. Some authors presented ethanopharmacology knowledge of morels from India, Nepal, and Western North America. Some mycophilic communities believe that morels have medicinal and spiritual values. Fungi are less explored organisms regarding the presence of mycocompounds. A small number of species are utilized by the pharmaceutical and nutraceutical industries, despite the presence of a variety of unknown bioactive compounds. Interest in mushrooms has increased many times in the last decades. Nowadays vast research has been conducted on their biological activities and chemical constituents.

A total of 819 mushrooms show pharmacological activities such as antibacterial, antifungal, antiviral, antioxidant, anti-proliferative,

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anticancer, and anti-inflammatory. Additionally, mushrooms are used for their anti-hypercholesterolemic, anti-diabetic, anti-hypertensive, anti-allergenic, immunomodulating, and anti-aging properties.

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