

## Some Applications of *Hericium erinaceus* Mushrooms: A Review

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### Article History

Received: 29.08.2024

Accepted: 04.10.2024

Published: 11.10.2024

**Abstract:** The Lion's Mane mushroom, which has the scientific name *Hericium erinaceus*, can be defined as a medicinal fungus type. For very long time, it has been utilized in the conventional medicine in Asia for a variety of purposes. In the past few years, there had been a great deal of interest directed towards potential benefits to the health, which could be provided by this unique type of mushroom in particular, when it comes to the treatment of various diseases. The concentration will be focused on examining the way that *Hericium erinaceus* as well as its bioactive elements could be utilized for therapeutic purposes within the area of disease control. This review states the possible *Hericium erinaceus* advantages in cases that are related to some health issues, such as metabolic problems, gastrointestinal diseases, neurodegenerative disorders, and immune system problems. In addition to that, the present paper discusses the work that is used for providing the therapeutic effects. It is stated that some of the characteristics of the *Hericium erinaceus* include having anti-inflammatory, neuro-protective, anti-oxidant, and immune-modulatory effects. Even though more studies are needed for detailed understanding of all the mechanisms that are involved in its activities, presenting evidences that strongly suggest possible *Hericium erinaceus* uses as one of the natural cures for a variety of illnesses, it is known as well in some cases as lion's mane mushroom, which fungus type that comes with extensive history and many potential advantages. As a result of its distinctive morphology, including bio-active compounds, in addition to its conventional uses have combined to the generation of much interest in a variety of areas. More research is needed for full understanding of the way that it works for the therapeutic applications and its potential implementations in the area of nutrition, cooking, and medicine. The cultivation of *Hericium erinaceus* might be viewed as an activity of conservation and business production.

**Keywords:** *Hericium erinaceus*, mushroom, fungi, agaricomycetes.

## INTRODUCTION

Edible fungi have been characterized by their palatable taste and high nutritional value, encouraging the consumers for more than two thousand years to consume them [1, 2]. The increasing need for food due to the increase in the world population has encouraged interest in eating fungi, including oyster mushrooms. What increases the importance of its medicinal value besides its high nutritional value is the shortness of its life cycle and the possibility of its continuous production throughout the year, as it is characterized by its high content of proteins and essential amino acids [3-5]. Necessary for the human body, B vitamins are nominated to occupy a middle position between beef, sheep, chicken, and fish on the one hand and vegetables on the other [6-8]. In addition to its content of carbohydrates, fiber, and a small percentage of fat, it contains good amounts of potassium, magnesium, and phosphorous and medium amounts of iron, calcium, manganese, sodium, copper, and zinc [9].

*Hericium erinaceus* has important values for its usage traditionally and possible health advantages. This distinctive mushroom had attracted a great deal of interest as a result of its bio-active compounds, in addition to their potential therapeutic applications [10, 11]. *Hericium erinaceus* was utilized historically as medicine within medicine systems like those found in some countries of East Asian like Japan, Korea, and China, for hundreds of years. It has been admired due to the fact that had assumed curative capabilities and had been used within a variety of the herbal remedies.

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**Citation:** Batool Shakir Abed Almjilawi, Rukaibaa Ali Chechan, Asaad Sh. M. Alhesnawi (2024). Some Applications of *Hericium erinaceus* Mushrooms: A Review. *South Asian Res J Agri Fish*, 6(5), 92-100. 92

The traditional uses include remedies for ulcers, digestion, swelling and conditions that are related to nervous system [12, 13].

In the past few years, due to the fact that researchers studied bio-active compounds that are discovered in *Hericium erinaceus* in addition to the health benefits that can be offered by them. Those bio-active parts such as the poly-saccharides, hericenones, erinacines, and other secondary metabolites have shown a variety of the pharmacological and physiological activities. Lion's mane mushroom's unique composition makes it in contrast to other edible mushroom types [14]. Which had resulted in sparked interests in its possible therapeutic applications [15].

There are many health advantages that can be potentially associated with *Hericium erinaceus* and were studied in great detail. Those advantages include its potential capability in brain protection, which has been associated with enhanced functions of the brain in addition to potentially treating disorders of the nervous system [16]. This mushroom's effects on the immune system have been under study as well. It might be utilized for its capability in the adjustment of immunity as well as fighting against infections off. *Hericium erinaceus* had exhibited anti-inflammatory as well anti-oxidant effects. Which is why it can be considered as one of the valuable preventive and therapeutic tools that fight against health issues related to the inflammations and oxidative stresses [17]. The increase of the attentions towards natural remedies as well as surge in the functional foods, has led to increasing the importance of this mushroom kind the areas that include nutrition, cooking, and medicine. The concept of it having potential therapeutic impacts, besides being one of the important parts of meal cooking, has made it one of the study topics that deserve being studied more [18]. Gaining more insight should be provided on *Hericium erinaceus*'s value and history due to morphology, distribution, taxonomy, traditional uses, and bio-active components besides techniques of cultivations and culinary uses that will be examined in the upcoming sections [19].

**1. *Hericium Erinaceus*'s Natural Habitat and Geographical Distribution [19, 20, 21]:** *Hericium erinaceus*, also referred to as pom-pom mushroom, is an edible fungus type. Its appearance is distinctive with shaggy ball-like white structure consisting of fibers; making it an interesting food and potential beneficial health boosting food [20].

**2. Geographical Distribution:** *Hericium erinaceus* exists in many places around the world, particularly within temperate areas of the Northern Hemisphere. It is naturally present in Europe, North America and Asia. In North America, it can be seen on the eastern side as well as western parts which include United States and Canada. In Europe, it is spread out among countries such as France, Germany, Poland and Russia [19]. In Asia we have Japan, China Korea and other North East Asia countries [21].

**3. Natural Habitat:** Lion's mane mushrooms are often saprophytic, which means they get their nutrients by decaying organic matter. They usually grow on hardwood trees, especially on those that are dying or dead ones. The natural habitat of *Hericium erinaceus* is in forests, small woods and places with enough humidity and moisture [22]. It likes deciduous trees more, like oak, beech, maple and birch. But sometimes it also lives on coniferous trees. The mushroom connects to the tree trunk or branches, creating elongated or globular mass similar to a lion's mane. It typically comes out in late summer or fall, but this could change according to climate and environment [19]. We should emphasize that because of its fame as both medicinal and culinary mushroom, *Hericium erinaceus* is grown professionally in controlled settings like mushroom farms where conditions are set up for it.

#### 4. Traditional Names of *Hericium erinaceus*

*Hericium erinaceus* has many traditional names, including these few [10, 16, 18, 19]:

- **Lion's Mane Mushroom:** This is the most popular name for *Hericium erinaceus*, and it also describes the mushroom's look. Its long spines cascading is similar to a lion's mane.
- **Yamabushitake:** This name is from Japan and it means "mountain priest mushroom." It comes because of the mushroom's historical use by Buddhist monks during their rituals.
- **Monkey Head Mushroom:** Its name comes from the mushroom's look, similar to a bunch of monkey heads or brains.
- **Pom Pom Mushroom:** The soft, white spines of the mushroom's shape are like a pom-pom or fluffy ball. So, it is known as such because of this likeness in appearance.
- **Hedgehog Mushroom:** The name Hedgehog Mushroom comes from its fruiting body, which looks spiky.
- **Satyr's Beard:** This name is common in some European countries. It probably comes from the mushroom's look similar to a beard, as well as its connection with satyrs in myth stories.

Lion's Mane Mushroom is the main name used for *Hericium erinaceus* in many situations, however it could have distinct customary names according to different cultures and areas.

## 5. Morphology and Taxonomy of *Hericium erinaceus*

- **Taxonomy:** Here is the classification of *Hericium erinaceus*:

Phylum: Basidiomycota

Kingdom: Fungi

Order: Russulales

Class: Agaricomycetes

Family: Hericiaceae

Genus: *Hericium*

Species: *Hericium erinaceus*



**Figure 1:** *Hericium erinaceus* shape in forest [23]

- **Morphology:** *Hericium erinaceus*, has a unique look that differentiates it from numerous other mushrooms. These are the crucial features of its morphology [24-26]:
- **Fruit Body:** Usually, the fruiting body of *Hericium erinaceus* is round or globular in form, but it can also appear irregular or lobate.
- **Size:** The fruit body's size can be quite diverse, from a few centimeters to over 30 centimeters in diameter.
- **Color:** The fruit body of the mushroom, appears white or creamy white in color. As it matures, there may be yellowish or brownish shades on its surface.
- **Spines:** Structure: The fruiting body of *Hericium erinaceus*, has long spines that resemble teeth hanging from its surface. This appearance is why it's named "Lion's Mane". These spines are white in color but can turn creamy or light brown as the mushroom matures.
- **Texture:** The fruiting body of *Hericium erinaceus* has a soft and fleshy texture.

## 6. Basidiocarps

*Hericium erinaceus* forms separate fruiting bodies known as basidiocarps. These are the reproductive parts of the fungus. Normally, they can be seen growing on decaying wood, especially hardwood trees such as oak, beech and maple [27]. It's necessary to understand that *Hericium erinaceus*' morphology may alter slightly because of environmental elements, age and other related factors. But, the general features talked about earlier give a decent summary of its taxonomy and morphology [28].

## 7. Discovery of *Hericium erinaceus*

The discovery of *Hericium erinaceus*, like many other fungi, does not have a specific known date or event associated with it. Fungi have been a part of human knowledge and utilization for thousands of years, especially in traditional medicine and culinary practices in various cultures. *Hericium erinaceus* has been used in traditional Chinese and Japanese medicine for centuries, primarily for its potential health benefits. The first written documentation of its medicinal use can be traced back to ancient Chinese texts, such as the "Shen Nong Ben Cao Jing" (Divine Farmer's Materia Medica Classic) from the Han dynasty (around 200 CE) [29, 30].

Over time, *Hericium erinaceus* gained recognition beyond its traditional uses, and scientific studies began exploring its properties and potential benefits. However, pinpointing a specific discovery or discovery date for this mushroom is challenging due to its long history of use and gradual accumulation of knowledge about its properties.

The scientific knowledge and recording of *Hericium erinaceus* has not always been the same, changing as more research is done to understand its bioactive compounds, uses in therapeutic applications and how it can be cultivated.

### 8. Food Application of *Hericium erinaceus* [31-33]:

*Hericium erinaceus* or Lion's Mane Mushroom, it is recognized as a culinary element for its special flavor and texture. It can be seen in many food types, especially those from Asian culture. These are the main methods that *Hericium erinaceus* is utilized in foods:

- **Stir-fries and sautés:** Chopped Lion's Mane Mushroom, either sliced or shredded, can be cooked in a pan with other vegetables, tofu or meat by stir-frying or sautéing it. This mushroom soaks up flavors nicely and has a gentle sweet-nutty taste that gives the dish an enjoyable texture.
- **Soups and broths:** Lion's Mane Mushroom, when added to soups and broths, imparts its distinct flavor and texture. It is an interesting addition to the creamy as well as clear soups, leading to the provision of a gentle taste that passes resemblance to the seafoods.
- **Mushroom-based sauces:** Powdered or finely chopped *Hericium erinaceus* can be added to gravies, marinades, or sauces, which results in the addition of deep and strong taste to the mixture, enhancing its general flavor. This sauce tastes earthy and rich when adding this mushroom, which makes tasty with different dishes.
- **Meat substitutes:** Lion's Mane Mushroom, has meat-like and fibrous texture, which may be utilized in some dishes as meat substitute. After being cooked, its appearance pays resemblance to shredded chicken or pulled meat, making it versatile for cooking meals that do not contain any animal products.
- **Mushroom-based burgers and patties:** Mixing breadcrumbs with the *Hericium erinaceus*, in addition to spices and herbs may be used for creating vegan or vegetarian burger patties. Which leads to providing good texture and enhancing the burger's umami flavor.
- **Mushroom-based side dishes:** Lion's mane, which is one of the special ingredients that can have be prepared in several ways. It can be roasted or sautéed and grilled on its own as a side dish with some seasonings, such as garlic and some other herbs that are added for enhancing the flavor enhancement. It can be served with meats like beefsteak or chicken; seafood types like prawns; or even used in dishes that include mixed vegetable. For cooking this type of mushroom, the size and freshness should be taken into account as it might impact how long one needs to prepare them. In the special shops, Lion's Mane Mushroom is becoming increasingly available. You can get it either fresh or dried which makes including this kind of mushroom in various cooking dishes easy.

### 9. Medicinal Application of *Hericium erinaceus*

It is believed that *Hericium erinaceus* has several potential medicinal properties. Although research continues, these are some of the potential medicinal uses of *Hericium erinaceus* [34-38]:

- **Cognitive function and brain health:** Lion's Mane might help with improving cognitive ability and keeping the brain healthy. A few research studies propose that it could possess qualities to protect against damage to nerves and aid in their growth, which are similar to what happens in illnesses such as Alzheimer's or Parkinson's diseases.
- **Nerve regeneration and repair:** The compounds in *Hericium erinaceus* that are bioactive can boost the making of nerve growth factor (NGF) inside the body. NGF is very important for promoting nerves to repair and regenerate, which might be helpful for people who have damage or injuries to their nerves.
- **Digestive health:** this Mushroom has long been used for relieving the digestive system. It could be helpful in the protection of gastric mucosa, improvement of gut barrier functions and management of gut microbiota, which might be beneficial for people who have some digestive disorders such as ulcers, irritable bowel syndrome (IBS), or gastritis.
- **Support of the immune system:** it has been suggested by some studies that Lion's Mane Mushroom could be having immune-modulatory effects, which indicates that it could be helpful in supporting and balancing the immune system. For example, it can lead to increasing immune cells' actions in addition to triggering the production of the beneficial cytokines, which could have a potential in the improvement of immunity function in the human organisms.
- **Anti-inflammatory characteristics:** *Hericium erinaceus* includes substances that display anti-inflammatory behaviors. Long-term inflammations are related to many health problems, and this mushroom's anti-inflammatory properties could have potential benefits in the management of disorders that are related to the inflammations.
- **Antioxidant activities:** This mushroom includes a great amount of the anti-oxidants that are very good in decreasing the damages that are triggered by the free radicals in the human system. The anti-oxidants are vital for the maintenance of good health as well as the reduction of the risks that are associated with the acquisition of chronic diseases.

## 10. Therapeutic Potential of *Hericium erinaceus*

It is highly regarded for its potential therapeutic benefits, particularly in supporting cognitive function and nerve health. While research on the therapeutic potential of *Hericium erinaceus* is still ongoing, several studies have shown promising results. Here are some of the potential therapeutic benefits associated with *Hericium erinaceus* [11, 18, 39, 40]:

Neurodegenerative Disorders, Alzheimer's Disease, Parkinson's Disease, Gastrointestinal Diseases, Gastric Ulcers, Inflammatory Bowel Disease, Immune-related Conditions, Cancer Autoimmune Disorders, Metabolic Disorders, Diabetes and Obesity.

## 11. Mechanisms of Action

Antioxidant Activity, Anti-inflammatory Effects, Neuroprotective Properties, and Immunomodulatory Effects, however, below are the most effective usages of *Hericium erinaceus*:

- **Cognitive function:** It supports the cognitive function and improve the memory and concentration, it enhances the production of nerve growth factor (NGF), that helps protection and regeneration of the brain cells, to prevent Alzheimer's or Parkinson's disease.
- **Nerve regeneration and protection:** It may help stimulate the production of myelin, a protective sheath around nerve fibers that aids in signal transmission. This property of Lion's Mane mushroom makes it potentially beneficial for individuals with nerve damage, peripheral neuropathy, or conditions affecting the nervous system.
- **Mood and mental well-being:** Some studies suggest that Lion's Mane mushroom may have antidepressant and anxiolytic (anti-anxiety) effects. By modulating neurotransmitters such as serotonin, dopamine, and norepinephrine, it may help improve mood, reduce anxiety, and enhance overall mental well-being.
- **Immune functions:** Lion's Mane includes polysaccharides which can help in the improvement of immunity functions. They can achieve that through the enhancement of immune cell activities. Concerning the changing the responses of immune system, those elements could be helpful in then strengthening of the protection of the body from the viruses, infections, and other pathogens.

## 12. Bio-active Compounds and Possible Health Benefits:

*Hericium erinaceus* includes many bio-active compounds, which have given it some potential health benefits. Some of those compounds that have been discovered include [11, 19, 34, 41, 42]:

- **Polysaccharides:** Those are immune-modulating complex carbohydrate types. Which can lead to enhancing the immune system, leading to the increase of immune cell production and exhibiting anti-inflammatory and anti-oxidant actions.
- **Beta-Glucans:** It has been stated by many researches that those are highly beneficial in the shaping of immune system, due to the fact that they are capable of activating the immune cells, improving the immune responses and boosting the immune system's general functions.
- **Erinacines and Hericenones:** Those are special bio-active compounds that are members of the terpenes' group. It has been discovered from the studies that those substances could result in encouraging the brain to make greater amounts of the nerve growth factor (NGF), which has high importance for the growth, survival and upkeep of the neurons. Through promoting the production of the NGF, Lion's Mane could potentially help the cognitive function as well as the nerve re-generation efforts.
- **Antioxidants:** Antioxidants like the flavonoids and phenols that are present in the Lion's Mane mushroom could be helpful for the cells in resisting the process of oxidative stress, which leads to creating free radicals that are damaging to the cells. Potential health benefits that are related to those bio-active components that are present in Lion's Mane mushroom are:
- **Cognitive function:** The hericenones and erinacines might be helpful for the production of NGF more, which might be helpful for the health of the brain, improving the memory and have a potential in guarding from the neurodegenerative diseases.
- **Nerve re-generation:** *Hericium erinaceus*, which contains the hericenones and erinacines, could be helpful in myelination and nerve regeneration. Which could be beneficial for people with nerve harm or the ones who have conditions affecting the nervous system.
- **Immune function:** *Hericium erinaceus* includes beta-glucans and poly-saccharides, which could be helpful in boosting the immune functions, fortifying the defense systems of the body, and promoting good immune conditions.
- **Anti-inflammatory and Anti-oxidant effects:** Which are present in Lion's Mane could be helpful in decreasing the oxidative stress, inflammations and a potential of the chronic diseases that are associated with those cases.
- **Digestive health:** *Hericium erinaceus*'s anti-inflammatory and alleviating abilities are beneficial for gut health, relieving with gastro-intestinal system, and helping in the maintenance of balanced digestion processes.

There is an importance in considering the fact that the research into *Hericium erinaceus*'s health benefits are continuous. The results could be different from one person to another. Prior to the use of any natural supplements for remedial purposes, consulting a healthcare professional is always advised.

### 13. *Hericium Erinaceus*' Nutritional Characteristics

*Hericium erinaceus* is known due to the fact that it has distinctive appearance, the nutritional components of its exact can be different based on the conditions of growth and maturity. None-the-less, some general *Hericium erinaceus*'s nutrition aspects can be listed below [43-46]:

- **Macronutrients:** *Hericium erinaceus* are usually low in carbohydrates and calories, which is beneficial for various diet choices. They usually include moderate dietary fiber and protein levels.
- **Vitamins:** *Hericium erinaceus* includes several types of vitamin B, which are highly significant for boosting the levels of energy and necessary in the functioning of the brain, in addition to the health in general.
- **Minerals:** There are numerous important minerals in *Hericium erinaceus*, for example, copper, selenium, potassium, zinc, and phosphorus. The impact of those minerals is keeping the cellular function in its normal levels, in addition to helping the immune system and maintaining good health in general.
- **Anti-oxidants:** Those mushrooms include many antioxidant types, which are crucial for promoting better health and reducing inflammation, such as hericenones and polysaccharides, they can be helpful in protecting the body from the oxidative stress because of the free radicals.
- **Beta-glucans:** Are polysaccharide types that could impact immune system. Studies have been carried out on the beta-glucans due to their potential in helping the improvement of the body's defense system and combatting harmful pathogens.
- **Nerve growth factors (NGFs):** Which can be described as special bio-active compounds in *Hericium erinaceus*, which were studied due to the potential in encouraging the regeneration of nerves and maintaining the wellness of the brain. They might positively impact the cognition and could be beneficial for the neurological conditions.

It should be mentioned that although Lion's Mane has numerous health advantages, additional research is still required for the complete comprehension of its healing impacts and nutritional characteristics. Like all of the dietary supplements, registered dietitians or health-care professionals need to be consulted before the addition of those mushrooms into the food plan, especially in the cases of administering medications.

### 14. *Hericium erinaceus*' commercial production and challenges:

*Hericium erinaceus*'s Commercial production has been rising due to the fact that it is increasing in popularity and could have health benefits. However, there are numerous difficulties associated the cultivation of this type [47, 48]:

- **Methods of Cultivation:** Substrates are necessary for *Hericium erinaceus*'s growth. They could be made from a variety of the materials such as the hardwood sawdust, farm leftovers, or logs. Typically, the approach of the cultivation includes ensuring the sterility of the substrate, addition of the spawn (i.e., mycelium), and maintenance of good environmental conditions like correct degree of temperature, levels of humidity and air movement. Making approaches for the efficient cultivation of those mushrooms, at the same time as keeping the expenses as low as possible isn't easy due to the fact that it requires special knowledge, in addition to the adjustment for the purpose of getting high production results with constant quality.
- **Spawn production:** The creation of the spawn of *Hericium erinaceus*, the foundation for introducing into substrate could be representing a level of difficulty. Spawn production represents the growing mycelium on good medium and ensuring the fact that it is vigor, pure, and spread out equally. Keeping up with a good quality spawn and the increase of its production could be tough; it requires specific facilities and sterile conditions.
- **Long cycle of cultivation:** *Hericium erinaceus* require a more extended cultivation period in comparison to other particular mushroom types. From inoculation time, it often requires months until they're ready for harvest. Such prolonged growing cycle requires meticulous handling and more patience throughout every step in that process. The duration of the growth impacts the amount that can be produced and the duration through which the commercial growers can turn their crops over.
- **Control of Contamination:** one of the regular problems in mushroom growing, *Hericium erinaceus* can be contaminated by other organisms such as various fungi and bacteria. For the purpose of avoiding such problems, there is an importance in keeping sterility and using accurate sterilization approaches, in addition to the management if the conditions of the environment, which helps the promotion of healthy mycelium growth throughout the reduction contamination chances throughout cultivation process.
- **Quality control and consistency:** For the commercial productions, there is a high significance in having consistency when it comes to quality, yield, and bio-active compound content. Variations could happen as a result of various environmental conditions, substrate composition and methods of cultivation that could have an impact on growth as well as bio-active compound amounts from *Hericium erinaceus*. Consistent standardization and quality require carefully monitoring along with the approaches for the quality controlling following good manufacturing and agricultural practices.

- **Market demand and competition:** As a result of Lion's Mane popularity, the market has been witnessing growing demand for products that have good quality. However, supplying those items at reasonable prices could be views as a difficult challenge, due to the fact that more producers begin to participate in that market. It could be highly important to make product distinctions according to some features, such as quality, certifications or added values through the processing for staying relevant within a lively marketplace.
- **Research and regulation:** Although there are growing levels of interest in Lion's Mane, there is still much more to understand about their cultivation, their bio-active compounds, and the way of achieving optimal procedures of production. There should be more researches done for handling difficulties and enhancing the commercial production. Sometimes, the regulations and certifications that are related to the growing of mushroom or the quality of the product could differ amongst regions that might pose commercial operation complications [19, 47, 48].

Overall, commercial production of *Hericium erinaceus* faces challenges related to cultivation techniques, spawn production, long cultivation cycles, contamination control, quality control, market competition, and the need for ongoing research and regulation. Overcoming these challenges requires expertise, investment in infrastructure, continuous improvement, and a strong understanding of the market and consumer preferences.

## CONCLUSION

This four-page paper provides an overview of the therapeutic applications of *Hericium erinaceus* in the treatment of various diseases. It explores its potential benefits in neurodegenerative disorders, gastrointestinal diseases, immune-related conditions, and metabolic disorders. The mechanisms of action underlying its therapeutic effects, such as antioxidant, anti-inflammatory, neuroprotective, and immunomodulatory properties, are discussed. The paper concludes by highlighting the need for further research and clinical studies to fully understand the potential of *Hericium erinaceus* as a natural treatment option for diseases.

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