



## Review Article

# Exploring the Cognitive and Other Unique Health Benefits of Lion's Mane Mushroom: A Systematic Review

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## ABSTRACT

Impaired cognitive functioning is a common issue among individuals with serious mental illnesses, leading to challenges in work performance and ultimately impacting their quality of life. Lion's Mane Mushroom (also known as *Hericium erinaceus*) has gained attention for its potential health benefits. This systematic review explores the cognitive and other unique health benefits of Lion's Mane Mushroom (LMM), focusing on its bioactive compounds and their possible contributions to overall health and wellness. This review includes a variety of studies, encompassing human clinical trials, preclinical trials on cell lines, and animal research. The bioactive compounds such as erinacines, hericenones, hericenones C and D, and polysaccharides in LMM offer various health benefits, such as enhancing cognitive function, exhibiting immunostimulatory properties, and demonstrating antioxidant effects. One of the main bioactive compounds, Erinacines, exhibits promising health benefits for strengthening cognitive function. Overall findings from the included studies in this review article suggest that LMM may have anti-inflammatory and antioxidant properties, support nerve growth, offer protection against neurodegenerative conditions, and potentially improve cognitive performance. Despite these positive indications, further robust and standardized human clinical trials are required to validate these potential benefits conclusively.

**Keywords:** Lion's mane mushroom, erinacines, hericenones, polysaccharides (beta-glucans), immunostimulant, cognitive function.

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## Introduction

Scientifically known as "*Hericium erinaceus*," Lion's Mane Mushroom (LMM) is a fascinating edible fungus with culinary and medicinal applications [1]. Belonging to the Basidiomycota division, Agaricomycetes class, and Russulales order within the *Hericiaceae* family, this mushroom is easily recognizable by its unique, hedgehog-like appearance, featuring long, cascading spines [2]. Known by various other names such as Monkey Head Mushroom, Bearded Tooth, Yamabushitake (in

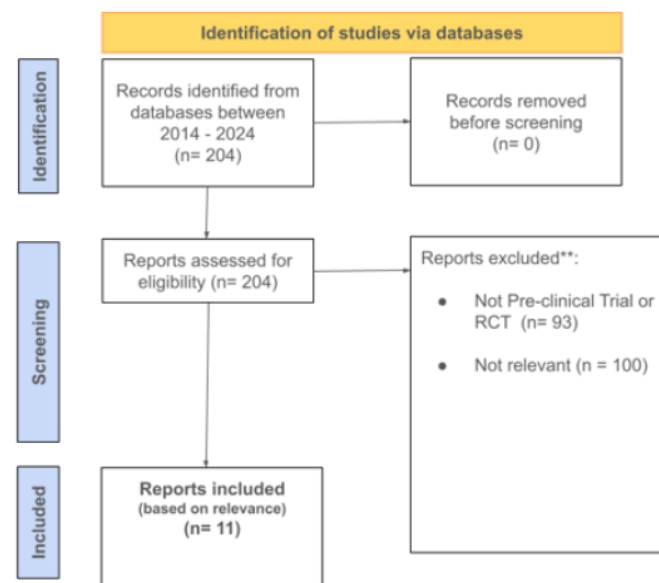
Japanese), and Houtou (in Chinese), *Hericium erinaceus* has long been celebrated for its proven potential benefits. It was first described in the late 18th century by a French mycologist named Jean Baptiste François Pierre Bulliard and first documented during China's Tang Dynasty (618-907 AD), where it was valued for its potential to promote longevity and boost brain function. It was also incorporated into traditional Korean and Japanese medicine [2][3].

Various bioactive compounds found in LMM have been associated with specific health benefits [2]. The Erinacines found in the mycelium are diterpenoid compounds known for their neuroprotective properties, aiding in improving cognitive function and nerve health. Hericenones C and D are compounds found in the sporophores and are known for their potential to stimulate nerve growth factor (NGF) synthesis [4]. Hericenones, structurally similar to Hericenones and found in the mushroom's fruiting bodies, have also been shown to have neuroprotective and NGF-stimulating effects [5]. Polysaccharides, one of the main bioactive compounds found in LMM, have various biological activities including immunostimulatory properties, anti-cancer properties, blood lipid-lowering effects, antioxidant properties, gastro-protective effects, hypoglycemic activity, and anti-aging properties [5]. Other bioactive compounds found in *H. erinaceus* include phenolic compounds (with oxidative stress reduction properties), isoindolinones (neuroprotective and neurodegenerative properties), terpenoids (which contain both erinacines and hericenones and which contribute to the neuroprotective and neurogenerative properties of the mushroom [6].

In the United States, LMM is among the top-selling supplements, with various manufacturers extracting unique bioactive compounds to create varying dosage forms of differing strengths such as capsules, powders, gummies, and liquid extracts in the form of a tincture [8]. Given the growing popularity of LMM as a dietary supplement in the United States, evaluating the existing preclinical and clinical studies by exploring its health benefits is crucial [9]. A recent review article underscores the importance of strengthening regulations to ensure the quality and safety of adult dietary supplements in the United States, emphasizing the need for greater oversight, and developing product standardization within the industry [10]. Therefore, the objective of this article was to conduct a comprehensive, systematic review (SR) of both animal and human studies to assess the potential health benefits of LMM.

## Method

This systematic review (SR) on Lion's Mane Mushroom (*Herichium erinaceus*) was conducted using comprehensive searches on Google Scholar and PubMed databases. The search strategy employed the keywords "*Herichium erinaceus*" and "Lion's Mane Mushroom." Inclusion criteria were set to encompass pre-clinical and clinical trials published within the last decade (2014-2024). Studies were selected based on their relevance to the primary objective of evaluating the efficacy of the benefits of LMM. The selection process involved screening titles, and abstracts, and conducting a full-text review to ensure alignment with the review's objectives.



**Figure 1:** Flow Chart of Study Selection Process and Article Screening.

## Results and Discussion

This SR encompasses a range of studies, including human clinical trials (in-vivo) and preclinical trials conducted on cell lines (in-vitro), humans, and animals. Table 1 summarizes the cognitive benefits of LMM based on human trials. In an in-vivo study by Li et al. (2021), the researchers investigated the effects of *Herichium erinaceus* (HE) mycelium on anxiety and sleep disturbance in rodents. The results showed that HE mycelium at 150 mg/kg reduced anxiety and improved Non-rapid eye movement

**Table 1:** Cognitive Benefits of LMM: A Comprehensive Review of preclinical and clinical studies. [\[11\]](#),[\[12\]](#),[\[13\]](#),[\[14\]](#),[\[15\]](#),[\[16\]](#)

Study/Year	Daily Dose	Participants/Duration	Outcomes
Li et al. (2020)	1050 mg LMM containing 5 mg/g erinacine A	68, 52 weeks	✓ Erinacines - A <i>Hericium Erinaceus</i> may reduce cognitive decline in mild AD patients but further research is needed to confirm its benefits.
Saito et al. (2019)	3200 mg of the powdered fruiting body	31, 12 weeks	✓ LM is a safe and convenient method for preventing dementia, potentially improving brain neural networks and cognitive functions.
Nagano et al. (2010)	2000 mg of the powdered fruiting body	30, 4 weeks	✓ LMM intake may reduce depression and anxiety through a mechanism different from its NGF-enhancing action.
Docherty et al. (2023)	1800 mg of the powdered LMM	43, 28 days	✓ <i>Hericium erinaceus</i> may improve performance speed and reduce stress in young adults, but further research is needed.
Mori et al. (2009)	3000 mg of the powdered LMM	30, 16 weeks	✓ The study indicates that <i>Yamabushitake</i> may effectively improve mild cognitive impairment.
Bizjak et al. (2024)	3.44 mg erinacine A	33, 8 weeks	✓ <i>Hericium Erinaceus</i> supplementation may improve cognitive health in the elderly and support neurotropic and neuroprotective effects, though further research is needed.

disturbances in mice, suggesting its dual role in anxiety relief and sleep improvement [\[17\]](#). After analyzing the results of the six clinical trials (Table 1) on LMM and its impact on cognitive benefits, the majority of the studies suggest that LMM shows promising benefits in reducing cognitive decline, improving cognitive functions, enhancing mood, and supporting cognitive health in both young adults and the elderly. The bioactive compounds found in LMM contribute to its efficacy in different ways. Erinacines are diterpenoid compounds found in the mycelium of the mushroom, with 15 known types (A-K and P-S). They are recognized for their neuroprotective and neuro-regenerative properties, including the stimulation of Nerve Growth Factor (NGF) synthesis, which is essential for the growth, maintenance, and survival of neurons. Erinacines also protect neurons from damage and have shown potential in treating neurodegenerative diseases like Alzheimer’s and Parkinson’s. Additionally, erinacines can reduce the deposition of amyloid- $\beta$  plaques, which are associated with Alzheimer’s disease [\[18\]](#)[\[19\]](#).

Hericenones are aromatic compounds found in the fruiting bodies of mushrooms, with eight known types (A-H). They work synergistically with erinacines to promote nerve growth by stimulating the biosynthesis of the Nerve Growth Factor (NGF).

Additionally, hericenones protect neurons from damage and support cognitive health. Isoindolinones are a class of compounds found in *Hericium erinaceus* that have demonstrated potential neuroprotective effects. They can induce the expression of neurotrophins such as Nerve Growth Factor (NGF) and brain-derived neurotrophic factor (BDNF), which are crucial for neuron growth and survival. [\[18\]](#)[\[20\]](#).

Several systematic review and meta-analysis studies have provided substantial evidence supporting the health benefits of LMM. These outcomes align with our research, which indicates that LMM may benefit overall health, particularly in improving cognitive function, reducing anxiety and depression, and providing neuroprotection. A systematic review published in 2023 found significant improvements in cognitive function and reductions in anxiety and depression symptoms. The review covered 16 dietary ingredients that included LMM. In the review, LMM demonstrated potential benefits in cognition, mood, perceived feelings, sleep, and mental energy [\[21\]](#). Another review article from 2024 highlighted the anti-inflammatory and antioxidant properties of LMM, thus contributing to overall health benefits. The study demonstrated that the active compounds found in *Hericium erinaceus*, such as erinacines and hericenones, are primarily

responsible for their neuroprotective effects. The study did emphasize the need for further research and standardization of dietary supplements based on *Herichium erinaceus* to ensure their effectiveness and safety [22]. Similarly, another SR published in 2024 highlighted the neuroprotective effects of LMM, showing its potential in preventing neurodegenerative diseases [23][24]. While some studies suggest a potential for LMM to improve cognitive function, further larger-scale studies are recommended to confirm whether its effect on brain function is statistically significant or not and to better understand the mechanisms behind any detected

In another study by Diling et al. (2017), mice were administered 100 mg/kg/day of crude protein extract from *Herichium erinaceus* over 14 days. The findings indicated that the fungal protein exhibited immunomodulatory activities, suggesting its potential use as a drug or functional food ingredient for immunotherapy [32]. Polysaccharides, the primary bioactive compounds, are composed mainly of glucose, galactose, and fucose. These compounds exhibit a range of biological activities, including immunomodulation by enhancing the immune system through cytokine production, anti-cancer properties by inhibiting tumor growth and inducing

**Table 2:** Anti-inflammatory and Immunomodulatory/Immunostimulatory Effects of LMM: A Comprehensive Review of preclinical and clinical studies. [25], [26], [27], [28], [29]

Study (Year)	Participants/Duration	Daily Dose	Outcomes
Xie et al. (2021)	13, 21 days	3000 mg	✔ Daily <i>Herichium erinaceus</i> supplementation improved gut microbiota diversity thereby suggesting health benefits such as anti-inflammatory effects.
Sheng et al. (2017)	32, 21 days	75, 150, 300 mg/kg	✔ <i>Herichium erinaceus</i> -derived polysaccharides significantly improved immune responses and cytokine regulation by interacting with the intestinal immune system.
Qin et al. (2016)	20, 14 days	250 mg/kg/day and 500 mg/kg/day	✔ The results indicate the application of HE-EE as a protective agent in the treatment of IBD.
Diling et al. 2017	30, 30 days	100 mg/kg/day	✔ <i>Herichium erinaceus</i> fungal protein shows potential for immunotherapy due to its immunomodulatory properties.
Ren et al. (2018)	40, 30 days	200 mg /kg	✔ The HE polysaccharide treatment significantly reduced inflammation and colitis symptoms.

effects.

Table 2 presents a compilation of the anti-inflammatory, antioxidant, and immunostimulating properties observed in preclinical (cells, animals) and clinical trials (humans), showing a mix of data from different types of studies. LMM has shown anti-inflammatory effects in both in-vivo and in-vitro studies [27], [30], [31]. Some research suggests that LMM may reduce inflammation and oxidative stress, which could be beneficial for conditions such as cancer and inflammatory bowel disease (IBD). In a study by Xie et al. (2021), a 30-day supplementation of 1000 mg of *Herichium erinaceus* dry powder was administered to 13 human participants. The results showed a significant increase in gut microbiota diversity, an enhancement in some short-chain fatty acid-producing bacteria, and a reduction in pathobionts [25]. Other benefits include immunomodulatory and immunostimulatory effects.

apoptosis in cancer cells, antioxidant effects by scavenging free radicals to protect cells from oxidative stress, and gastro-protective benefits by safeguarding the gastrointestinal tract and improving gut health [33].

### Limitations of this Study

One limitation of this study is the timeframe of articles published from 2000 to 2024, potentially excluding relevant studies conducted before this period. Furthermore, the meta-analysis only included five clinical trials and a total of 184 participants, which may limit the generalizability of the findings due to a relatively small sample size.

## Conclusion

In conclusion, Lion's Mane Mushroom (*Heridium erinaceus*) emerges as a promising natural supplement with remarkable potential to enhance cognitive function, mitigate inflammation, and bolster antioxidant defenses. The bioactive compounds erinacines, hericenones, and polysaccharides contribute to its medicinal properties, particularly in cognitive health, immune modulation, and anti-inflammatory effects. The synthesized evidence from preclinical and clinical trials provides a solid foundation for its medicinal versatility, offering valuable insights into its efficacy in improving cognitive function, reducing anxiety, and enhancing overall well-being. However, this present SR reveals inherent limitations in the current body of research, signaling the imperative need for more comprehensive studies to uncover the precise mechanisms of action, potential side effects, and broader health benefits. A call for standardized clinical trials addressing these gaps is essential to fully elucidate Lion's Mane Mushroom's true therapeutic value, determine optimal dosages, long-term efficacy, and safety profiles, and establish its role in promoting overall well-being.

## Conflict of interest

The authors declare no conflict of interest.

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