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Unlocking the therapeutic potential of medicinal mushrooms: A comprehensive review

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Abstract

Medicinal mushrooms have garnered significant attention in recent years due to their potent bioactive compounds and potential health benefits. This paper explores the diverse range of medicinal mushrooms, their active constituents, and their traditional and modern applications in healthcare. We delve into the therapeutic properties of popular medicinal mushrooms such as Reishi, Shiitake, Lion's Mane and Maitake, examining their effects on various health conditions including immune modulation, cancer, neuroprotection, and cardiovascular health. Additionally, we discuss the mechanisms of action behind these therapeutic effects, safety considerations, and future directions for research and clinical application. Through this comprehensive review, we aim to provide a deeper understanding of the medicinal properties of mushrooms and their potential in promoting human health and well-being.

Keywords: Medicinal mushrooms, bioactive compounds, therapeutic applications, immune modulation, cancer therapy

1. Introduction

Medicinal mushrooms have long been revered for their medicinal properties and have played a significant role in traditional medicine practices across cultures. Medicinal mushrooms have been valued for centuries in traditional medicine systems, particularly in Asian cultures such as Traditional Chinese Medicine (TCM) and Ayurveda (Hobbs, 1995) [3]. From the ancient civilizations of China and Japan to indigenous communities in North America, various species of mushrooms have been utilized for their therapeutic benefits. With advancements in scientific research, the pharmacological effects of medicinal mushrooms are being increasingly elucidated, paving the way for their integration into modern healthcare practices (Chang and Wasser, 2012) [1].

Recent studies have identified a plethora of bioactive compounds in medicinal mushrooms, including polysaccharides, β -glucans, triterpenoids, phenolic compounds, and proteins, among others. These compounds exhibit a wide range of pharmacological activities, such as immunomodulation, antioxidant, anticancer, anti-inflammatory, antimicrobial, and neuroprotective effects (Wasser, 2002) [11]. As a result, medicinal mushrooms are being explored for their potential therapeutic applications in various health conditions, including cancer, immune disorders, chronic inflammation, neurological diseases, and metabolic disorders (Jin *et al.*, 2016) [4].

Through this paper, we aim to provide a comprehensive overview of medicinal mushrooms, synthesizing existing research literature to highlight their therapeutic potential. By understanding the historical use, bioactive compounds, pharmacological effects, and therapeutic applications of medicinal mushrooms, we hope to stimulate further research and exploration in this fascinating field.

2. Historical perspective of medicinal mushrooms

Medicinal mushrooms have been an integral part of traditional medicine systems for millennia, with their use dating back thousands of years. Across various cultures and civilizations, specific mushroom species have been revered for their therapeutic properties and incorporated into healing practices. Here, we delve into the historical significance of some prominent medicinal mushrooms and their roles in ancient medical traditions.

2.1 Reishi (*Ganoderma lucidum*)

Reishi mushroom, known scientifically as *Ganoderma lucidum*, holds a prominent place in traditional Chinese medicine (TCM) and Japanese healing practices. Referred to as the "Mushroom of Immortality" or the "Divine Fungus," Reishi has been used for centuries to promote longevity, vitality, and overall health. Ancient texts such as the "Shennong Ben Cao Jing" (Shennong's Herbal Classic) from China and the "Kojiki" (Record of Ancient Matters) from Japan document the therapeutic use of Reishi for enhancing vitality and treating various ailments (Lin, 2005; Deng *et al.*, 2009) ^[6, 2].

2.2 Shiitake (*Lentinula edodes*)

Shiitake mushroom, scientifically known as *Lentinula edodes*, has been a staple in traditional East Asian medicine for centuries. Originating in China, Shiitake mushrooms were prized for their immune-boosting properties and used to treat conditions ranging from colds and flu to cardiovascular diseases and liver disorders. The earliest recorded use of Shiitake dates back to the Ming Dynasty (1368-1644) in China, where it was considered a symbol of longevity and health (Lin & Teng, 2012) ^[7].

2.3 Lion's Mane (*Hericium erinaceus*)

Lion's Mane mushroom, scientifically known as *Hericium erinaceus*, has a long history of use in traditional Chinese medicine for its cognitive-enhancing and neuroprotective properties. Referred to as the "Monkey Head Mushroom" or "Yamabushitake" in Japan, Lion's Mane has been used to treat neurological disorders, improve memory, and enhance cognitive function. Ancient Chinese texts mention the use of Lion's Mane for promoting mental clarity and longevity (Mori *et al.*, 2009) ^[9].

2.4 Maitake (*Grifola frondosa*)

Maitake mushroom, scientifically known as *Grifola frondosa*, has been valued in traditional Japanese and Chinese medicine for its immune-enhancing properties. Referred to as the "Dancing Mushroom" or "Hen of the Woods", Maitake has been used historically to strengthen the immune system, regulate blood sugar levels, and improve overall health. Ancient texts in both Japan and China mention the medicinal use of Maitake for promoting longevity and vitality (Kodama *et al.*, 2002; Mayell, 2001) ^[5, 8].

3. Bioactive Compounds

Reishi mushrooms are rich in bioactive compounds, including polysaccharides, triterpenoids, peptides, and phenolic compounds. Polysaccharides, particularly β -glucans, are considered the primary bioactive constituents responsible for the immunomodulatory and anticancer effects of Reishi. Triterpenoids, such as ganoderic acids, exhibit hepatoprotective, antioxidant, and anti-inflammatory properties, contributing to the overall therapeutic potential of Reishi mushrooms (Lin, 2005) ^[6].

Shiitake mushrooms contain a variety of bioactive compounds, including polysaccharides (β -glucans), lentinan, eritadenine, and various phenolic compounds. Lentinan, a β -glucan polysaccharide, is one of the most studied compounds in Shiitake mushrooms and has demonstrated immunomodulatory and anticancer effects. Eritadenine has been shown to lower cholesterol levels and improve

cardiovascular health, while phenolic compounds contribute to the antioxidant properties of Shiitake mushrooms (Lin & Teng, 2012) ^[7].

Lion's Mane mushrooms are rich in bioactive compounds, including β -glucans, hericenones, erinacines, and various polysaccharides. Hericenones and erinacines are unique compounds found in Lion's Mane that exhibit neuroprotective effects and have shown potential in promoting nerve regeneration and enhancing cognitive function. β -glucans contribute to the immunomodulatory properties of Lion's Mane, while polysaccharides play a role in its overall therapeutic effects (Mori *et al.*, 2009) ^[9].

Maitake mushrooms contain bioactive compounds such as polysaccharides (β -glucans), grifolan, and various phenolic compounds. β -glucans, particularly the D-fraction, are considered the primary bioactive constituents responsible for the immunomodulatory and anticancer effects of Maitake. Grifolan, another polysaccharide, has also demonstrated immunostimulatory effects. Phenolic compounds contribute to the antioxidant properties of Maitake mushrooms (Kodama *et al.*, 2002; Mayell, 2001) ^[5, 8].

4. Therapeutic Properties

A. Immune Modulation

Several medicinal mushrooms have been shown to enhance immune function by stimulating the activity of immune cells such as macrophages, natural killer cells, and T lymphocytes. Compounds like beta-glucans play a key role in activating innate and adaptive immune responses, making mushrooms like Reishi and Shiitake (*Lentinula edodes*) valuable adjuncts in supporting immune health (Wasser, 2002; Lin, 2005) ^[11, 6].

B. Anti-Cancer Effects

Research has demonstrated the anti-cancer potential of certain medicinal mushrooms, with compounds like triterpenoids and polysaccharides exhibiting cytotoxic effects against cancer cells and inhibiting tumor growth and metastasis. Mushroom extracts have also been shown to enhance the efficacy of conventional cancer treatments and alleviate chemotherapy-induced side effects (Jin *et al.*, 2016; Deng *et al.*, 2009) ^[4, 2].

C. Neuroprotection

Mushrooms such as Lion's Mane (*Hericium erinaceus*) contain compounds that stimulate nerve growth factor (NGF) production, promoting neuronal growth and repair. These mushrooms show promise in the treatment of neurodegenerative disorders such as Alzheimer's and Parkinson's disease (Mori *et al.*, 2009; Nagano *et al.*, 2010) ^[9, 10].

D. Cardiovascular Health

Studies have highlighted the cardio-protective effects of medicinal mushrooms, including their ability to lower cholesterol levels, reduce blood pressure, and prevent atherosclerosis. Compounds like beta-glucans and antioxidants help maintain vascular health and reduce the risk of cardiovascular diseases (Lin & Teng, 2012) ^[7].

5. Mechanisms of Action

The therapeutic effects of medicinal mushrooms are mediated by a variety of mechanisms, including modulation

of immune function, regulation of inflammatory pathways, inhibition of tumour growth, and protection against oxidative stress and DNA damage. Compounds like beta-glucans interact with immune receptors such as toll-like receptors (TLRs) to activate immune cells and promote cytokine production, while triterpenoids exert anti-inflammatory effects by inhibiting NF-kappaB signaling (Lin, 2005; Wasser, 2002) ^[6, 11].

6. Safety Considerations

While medicinal mushrooms are generally considered safe for consumption, certain precautions should be taken, especially in individuals with underlying health conditions or compromised immune systems. Potential side effects include allergic reactions, gastrointestinal discomfort, and drug interactions. It is important to consult with a healthcare professional before incorporating medicinal mushrooms into one's diet or treatment regimen (Chang & Wasser, 2012) ^[1].

7. Future Directions

The growing body of research on medicinal mushrooms opens up exciting avenues for future exploration. Further studies are needed to elucidate the specific mechanisms of action behind their therapeutic effects and identify novel bioactive compounds. Clinical trials are also warranted to evaluate the efficacy of mushroom-based interventions in treating various diseases and improving health outcomes. Additionally, efforts to standardize mushroom extracts and develop quality control measures will help ensure their safety and efficacy in clinical practice (Jin *et al.*, 2016; Deng *et al.*, 2009) ^[4, 2].

8. Conclusion

In conclusion, medicinal mushrooms represent a rich source of bioactive compounds with diverse pharmacological properties. From immune modulation to anti-cancer effects and neuroprotection, these fungi offer promising avenues for enhancing human health and well-being. While much progress has been made in understanding their therapeutic potential, further research is needed to unlock their full therapeutic potential and integrate them into mainstream healthcare practice. By harnessing the power of medicinal mushrooms, we can tap into nature's pharmacy to promote longevity, vitality, and resilience against disease.

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