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Bioactivity, pharmacological research, and application of birch fungus

Abstract

Birch fungus, known as birch brown porcupine fungus (*Inonotus obliquus*), is a rare medicinal fungus that grows in the Frigid Zone. This study reviews the bioactive components of birch mushrooms, including polysaccharides, triterpenoids, polyphenols, flavonoids, etc., and discusses in detail their pharmacological effects in antitumor, hypoglycemic, anti-inflammatory, antioxidant and immunomodulatory aspects. This paper also outlines the application prospects of birch mushrooms in the fields of medicinal nutraceuticals and functional foods, aiming to provide reference for the in-depth research and development of birch mushrooms.

Keywords: birch antler, bioactivity, pharmacological effect, application prospect

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Introduction

Birch fungus (*Inonotus obliquus*) is a parasitic fungus that grows predominantly on birch trees. This unique fungus has garnered significant attention in recent years due to its diverse range of bioactive compounds and their corresponding health benefits. This review aims to provide an extensive overview of the bioactivity and pharmacological research conducted on birch fungus, along with its potential applications in various medical fields.

Bioactive compounds in birch fungus

The medicinal properties of birch fungus can be attributed to its rich chemical composition. Key bioactive compounds include:

Polysaccharides

Beta-glucans are known for their immunostimulatory and antitumor activities. Polysaccharides is one of the active ingredients in Birch fungus which is rich in content and has important pharmacological effects. Studies have shown that Birch fungus polysaccharides have anti-tumor, immunomodulatory, hypoglycemic, hypolipidemic and other biological activities. The anti-tumor effects of polysaccharides are mainly achieved by enhancing the immune function and inducing apoptosis of tumor cells.[1]

Triterpenoids

Triterpenoids are another important class of active ingredients in birch mushrooms with a wide range of physiological activities, such as anticancer, anti-inflammatory, antibacterial and antiviral. Among them, birch fucoidan and embolic acid are two representative triterpenoids showing significant antitumor activity.[2] Including lanosterol derivatives like trametenolic acid, which exhibit potent pharmacological effects.

Polyphenols and flavonoids

Polyphenols and flavonoids are the natural antioxidants found in Chaga and are known for their free radical scavenging, anti-aging, and cardiovascular system protection properties. The polyphenolic compounds in Birch Mushroom have a potent antioxidant capacity that scavenges free radicals and reduces cellular damage caused by oxidative stress. This action is important in preventing cellular aging and the development of chronic diseases. It also exerts pharmacological effects by inhibiting inflammatory responses and modulating immune function. Flavonoids also exhibit superior antioxidant properties, protecting cells by inhibiting lipid peroxidation and enhancing the activity of antioxidant enzymes. For example, baicalin and its derivatives are well known for their antioxidant and anti-inflammatory properties.

Minerals and vitamins

Birch fungus (*Inonotus obliquus*) is rich in a wide range of minerals and vitamins with important health benefits. Minerals such as zinc, selenium, potassium, magnesium and iron support immune function, antioxidants, heart health, energy metabolism and red blood cell production, respectively. While vitamin D promotes calcium absorption, vitamin B complex is involved in energy metabolism and nerve health, and vitamin C boosts immunity and promotes collagen synthesis. Birch fungus contains essential minerals like zinc, selenium, and vitamins that contribute to overall health. In summary, the nutrients in Birch Mushroom provide important support for maintaining health and preventing disease.

Pharmacological effects

Extensive research has been conducted on the pharmacological properties of birch fungus, resulting in several promising findings:

Antioxidant activity

Antioxidants play a crucial role in protecting cells against oxidative stress, which is associated with numerous chronic diseases. Studies have demonstrated that the phenolic compounds and polysaccharides in birch fungus exhibit strong antioxidant activity, effectively scavenging free radicals.

Antitumor effects

Birch fungus has shown notable antitumor properties through various mechanisms such as:

1) Apoptosis induction: Promoting programmed cell death in cancer cells.

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2) Cell cycle arrest: Preventing the growth and division of tumor cells.

3) Angiogenesis inhibition: Suppressing the formation of new blood vessels that tumors need for growth.[3]

Immunomodulatory effects

The immune-enhancing properties of birch fungus are primarily mediated by its beta-glucan content. These compounds stimulate the immune system, enhancing both innate and adaptive immunity, and thus helping the body fight off infections and possibly even cancerous cells.

Anti-inflammatory effects

Chronic inflammation plays a critical role in the pathogenesis of many diseases, including arthritis, cardiovascular diseases, and certain cancers. Compounds found in birch fungus, such as scutellarein, have been shown to exert anti-inflammatory effects by inhibiting the production of pro-inflammatory cytokines and enzymes like COX-2.

Hypoglycemic effects

Birch fungus has also demonstrated hypoglycemic properties, potentially benefiting individuals with type 2 diabetes. The polysaccharides in the fungus can improve insulin sensitivity and glucose metabolism, thereby helping to control blood sugar levels.[4]

Applications of birch fungus

Given its broad spectrum of bioactivities and pharmacological effects, birch fungus has been explored for a variety of medicinal applications:

1) Cancer treatment: As an adjunct therapy to enhance the effectiveness of conventional cancer treatments while reducing side effects.

2) Immunotherapy: To boost the immune system in patients with weakened immunity or autoimmune disorders.

3) Cardiovascular health: Due to its anti-inflammatory and antioxidant properties, birch fungus could be used to support heart health.

4) Diabetes management: As a complementary treatment to help regulate blood sugar levels in diabetic patients.

5) Nutraceuticals: Incorporated into dietary supplements aimed at improving overall health and well-being.[5]

Future perspectives

While considerable progress has been made in understanding the bioactivity and medicinal properties of birch fungus, further research is needed to fully elucidate its mechanisms of action and optimize its therapeutic use.[6] Ongoing studies should focus on:

1) Clinical trials: Conducting large-scale, randomized controlled trials to validate the efficacy and safety of birch fungus in treating various medical conditions.[7]

2) Mechanism of action studies: In-depth investigations into the molecular pathways through which birch fungus exerts its pharmacological effects.

3) Standardization: Developing standardized extraction and formulation methods to ensure consistency in the bioactive compound profiles of birch fungus products.

4) Bioavailability enhancement: Enhancing the bioavailability of birch fungus components to improve their absorption and utilization in the body.[8]

Conclusion

Birch fungus is a remarkable natural medicine with a wide range of biological activities and pharmacological properties. Its potential applications in medicine range from cancer treatment to diabetes management and more. Ongoing research and clinical validation are essential to realize the full potential of this extraordinary fungus and bring its benefits to the wider medical community. Birch fungus (*Inonotus obliquus*) exhibits a wide range of pharmacological and biological activities, including significant antioxidant, anti-inflammatory, immunomodulatory and anti-tumor effects. It is rich in polyphenols, flavonoids and other active ingredients that are effective in scavenging free radicals, inhibiting inflammatory responses and enhancing immune function. In addition, birch mushrooms have been shown to inhibit the growth of many types of cancer cells. These properties give birch velvet a wide range of potential applications in traditional medicine and modern health care, and future research will further explore its mechanism of action to promote its clinical applications.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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