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REVIEW ARTICLE

A Review on Medicinal Properties and Historical use of Reishi Mushroom

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Abstract: Mushrooms, terrestrial fungi with epigeous fruiting bodies, adopt a unique lifestyle due to their lack of chlorophyll, setting them apart from non-motile organisms like plants. Over time, mushrooms have played a significant role in human history as both a source of food and medicine. They are abundant in biologically active compounds and nutrients, finding applications in various fields such as food, pharmaceuticals, agriculture, cosmetics, and more. Mushrooms, including *Ganoderma lucidum* (Reishi), demonstrate diverse effects like immunomodulation and possess potential therapeutic properties, including antitumor, hepatoprotective, hypocholesterolemic, antiviral, antibacterial, antidiabetic, and antiparasitic activities. With a nutritive value falling between vegetables and meat, mushrooms are rich in vitamins, minerals, and proteins, making them a low-fat and low-calorie food choice. *Ganoderma lucidum*, in particular, is known to contain nearly 400 essential bioactive compounds, such as fatty acids, proteins/peptides, triterpenoids, nucleotides, sterols, polysaccharides, steroids, and trace elements, contributing to various pharmacological effects. The cultivation of Reishi mushrooms on stable mediums and solid substrates has become crucial to meet the demand in foreign markets. This article aims to highlight key aspects of Reishi mushrooms, emphasizing their bioconstituents and associated health benefits.

Keywords: *Ganoderma lucidum*; Reishi Mushroom; Bioactive constituents; Ganoderic acid; Natural remedies.

1. Introduction

Due to the resurgence of old infections, the persistent nature of incurable infections, and the frequent emergence of new infections, infectious diseases continue to be a leading cause of death and morbidity globally. This review delves into the potential therapeutic value of *G. lucidum* (Reishi) in addressing these challenges. Reishi, a basidiomycete lamellaless fungus belonging to the polyporaceae family, thrives in environments with low light levels, such as densely wooded mountains with high humidity. It is primarily found on dried trunks of specific trees like plum, guercus serrata, or pasonia, making it a rare species with only a few (2-3) occurrences among 10,000 aged trees. Reishi holds unparalleled distinction in the health food industry, combining the wisdom and knowledge of both East and West over the past 5,000 years. Extensive scientific research spanning more than 30 years attests to its efficacy as a health food with high potency and no reported side effects. In a world with approximately 1.5 million fungal species, of which around 82,000 are described, the Basidiomycota division stands out for its biologically active compounds. Among the 5,000 edible macrofungi, the *Ganoderma* species, including *Ganoderma formosanum, Ganoderma tsugae, Ganoderma pfeifferi*, and particularly *Ganoderma lucidum*, have been a focal point of research due to their diverse health qualities and medicinal properties. [1-4]

Ganoderma lucidum, known as Reishi (shown in Figure 1), exhibits a broad spectrum of pharmacological effects, substantiated by various studies, including antimicrobial, antitumor, anti-inflammatory, antioxidant, antidiabetic, cardioprotective, immunomodulation, neuroprotective, antimutagenic, anti-androgenic, and cholesterol-lowering properties, as well as anti-HIV activity, among other pharmacological benefits. Despite its woody texture and bitter taste, G. lucidum is not commonly used in cooking; however, it finds application in various forms. Rooted in ethnomedicinal knowledge, it has been widely utilized for over two millennia in Traditional Chinese Medicine, manifesting in distinct teas in Japan, China, and other Asian countries. Referred to as the "plant of immortality" or the "herb of spiritual potency," it was believed to prolong lifespan due to its medicinal properties. In Chinese culture, it symbolizes kindness, satisfaction, fortune, immortality, success, and good health [13]. Currently listed in the Chinese Pharmacopoeia, the American Herbal Pharmacopoeia, and Therapeutic Compendium, G. lucidum is readily available in local markets, supermarkets, and is used as medicine in traditional healthcare [4-6]. The Reishi industry is experiencing significant growth, aligning with the global acceptance of eastern traditional medicine, with commerce exceeding $2.16 billion. The market for dietary supplements, including vitamins, botanicals, and minerals, is thriving, with global sales reaching $109 billion and anticipated future growth [7]. This main aim of this article is to highlight key aspects of Reishi mushrooms, emphasizing their bioconstituents and associated health benefits

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Figure 1. Reishi mushroom

2. Pharmacognosy of Reishi Mushrooms

2.1. Types

Although there are more than 2000 known species of Reishi, in-depth studies have focused on only six types known for their potential health benefits: black, red, blue, purple, white, and yellow. Among these, Black and Red Reishi mushrooms have demonstrated significant health-enhancing effects, gaining global recognition in the health supplement market. Black Reishi mushrooms, characterized by sizes up to 10 inches in diameter with uneven shapes, are commonly used as a herbal tonic. Red Reishi, on the other hand, is considered superior due to its high polysaccharide content, and it is known for reaching approximately six inches in diameter. Purple Reishi, a rare variation with a purple-colored heart, has received limited research attention and testing due to the scarcity of actual specimens [8]. The categories of reishi along with its uses are shown in Table 1 and its systematic classification is shown in Figure 2.

Table 1: Categories of Reishi and potential uses.

Appearance(colour)	Taste	Use
Black	Brackish	Enhance lung function.
Red	Bitter	Refine memory and improves internal organs function.
Blue	Sour	Remediate liver function and eyesight.
Purple	Sweet	Aid complexion and intensify function of eyes joints.
White	Hot	Defend kidney
Yellow	Sweet	Strengthen spleen role

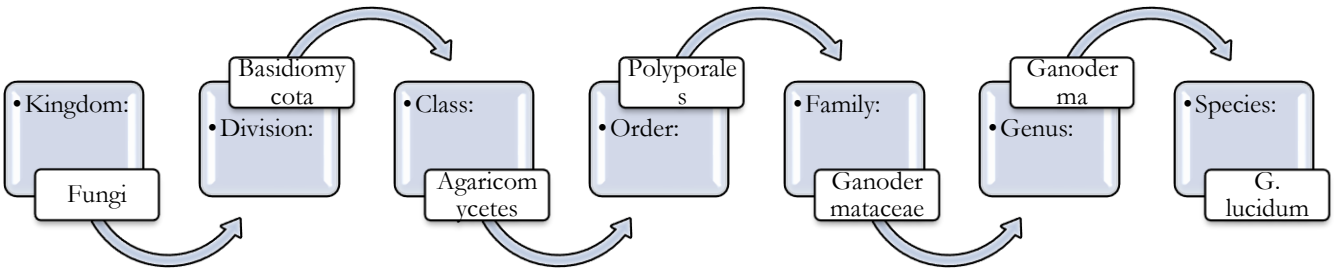

Figure 2: Taxonomy of Reishi mushroom

2.2. Macroscopical and microscopical characteristics

The macroscopic features of the Reishi mushroom include small, stalked, and capped frutingbodies with an intermediate structure that tends to be woody. The breakdown of these structures occurs naturally, resulting in powders consisting of three distinct mycelial types. The cap is flat or kidney-shaped, ranging from 2 to 20 cm wide and approximately 4 to 8 cm thick. The reproductive hyphae exhibit laconic branches with colorless brackets or high walls under microscopic examination. [9]

The powdered form of Reishi mushrooms varies from dark brown to light brown. The exterior of the cap appears red with closely packed yellow mycelia spreading over a wide area. The spore membrane typically possesses one or two pores, exhibiting a creamy yellow surface, and the tube measures between 2 and 20 mm. Microscopically, the spores are curved with a spotted surface and are approximately 8 µm long. The stem of the Reishi mushroom shares a shade identical to the cap, ranging from 3 to 14 cm in length. The bitter crack of the mushroom exposes separate membranes, and the dark brown vertical tube of the cap is approximately 200 µm wide. The interior of the basidiospore appears dark brown. The unpleasant smell and taste of Reishi mushrooms are often described as resembling mold and fungus. Attached hyphae are colorless, elongated, and enclosed in narrow tension. Reishi mushrooms are distributed in a saprophytic manner and are commonly found near coniferous trees. The basidioplate is oval or spatulate, exhibiting a patchy and thin-walled structure under microscopic observation. [10]

2.3. History

In ancient times, the Romans viewed mushrooms as sacred food for major festivals, serving them to divine beings. Greeks and Vikings consumed mushrooms to enhance their quality, believing in its influence over their pre-war life. Ganoderma, often regarded as the king of supernatural herbs, held significant importance in China (221-206 BC). Native Americans incorporated mushrooms, including hallucinogens, in age-old practices to overcome mental and physical barriers. G. lucidum, with a belief spanning 2000 years that it can enhance well-being and longevity, is considered a blend of otherworldly control and an eternal source. Japanese culture attributes a 10,000-year history to this mushroom. Traditional medical uses of G. lucidum, particularly in Far Eastern countries, trace back over 4,000 years. Its healing properties find mention in the pharmacopoeia Shen Nong Ben Cao Jing from the Qin lineage (221-206 BC). The use of G. lucidum in traditional medicine is evident in art from the Yuan Dynasty (1280-1368 AD), extending to various forms like furniture, figurines, canvases, and women's accessories. G. lucidum is employed in traditional medicine for conditions such as neurasthenia, deficiencies from prolonged illness, sleep disorders, appetite loss, restlessness, chronic hepatitis, high cholesterol, fungal infections, coronary heart infections, hyperglycemia, atrial disease, fibrillation, severe mountain sickness, fatigue, cancer, and bronchial inflammation in the elderly. The study of medicinal mushrooms in Western science began over 30 years ago and continues to reveal exciting new discoveries, including anti-inflammatory, cytotoxic, and anti-cancer effects on liver cancer cells. [11,12]

2.4. Habitat

Mushroom(G.Lucidum) comes from the class Basidiomycetes that derieved from family Ganodermataceae. Fruiting body of Ganoderma lucidum can be found growing on variety of deciduous trees such as oak, pyrus, quercus, magnolia, plums etc., found in Fareast countries including China, Japan, Korea, upper parts of Himalayas. As the name suggests, the fruiting bodies of these macrofungi can be recognized by the shiny appearance of their growing sites (lucidum means "shiny" in Latin). The fruiting body is striped, half, sometimes semicircular, thick, corky, with yellowish edges. In mature areas, the edges may become brownish. Temperature is considered to be the most important factor for the growth of mushroom mycelium. Mushroom cultivation is controlled. Reishi can grow at temperatures between 30 and 34^{o} C. However, the optimum temperature is 370°C and the plants grow at a rate of 7-8 mm/day. Due to the widespread use of Ganoderma, efforts to produce Ganoderma have been intensified in countries such as China, Japan, Taiwan, and South Korea to meet market demand [13]

2.5. Cultivation and production

Reishi mushrooms are commonly cultivated in various regions, including China, Taiwan, Japan, Korea, Malaysia, North America, and tropical and temperate areas of India. In 2002, the global production of Ganoderma mushrooms reached 4,444 plants, equivalent to around 4,900-5,000 tons. China remains the primary contributor, producing 3,800-4,400 tons annually, with the remaining 4,300 tons distributed across ten countries. Despite being largely cultivated, the global trade value of Ganoderma mushrooms is estimated at $2 billion, and the Indian market for dietary supplements containing Ganoderma is anticipated to reach approximately Rs 120 million annually. The United States stands out as the largest market for these medicinal mushrooms. As a natural product, G. lucidum is available in the market at a price range of Rs 600-700 per kilogram. Presently, commercial production primarily employs methods like log cultivation, utilizing short pieces of wood, tree stumps, sawdust bags, and bottles as substrates [14]

3. Chemical constituents

The chemical composition of G. chinensis fruiting bodies was explored, focusing on spore biological activity against various diseases and inflammatory conditions. Reishi spores were isolated from the ethyl acetate fraction, containing ganoderic acid, methyl ganodeate, ganodermic acid, and peroxide ester sterols, involved in the mevalonic acid metabolic pathway. G. lucidum possesses around 400 bioactive compounds in its shiny fruiting bodies, mycelia, and spores. Notable components include high molecular weight polysaccharides in the mycelium, triterpenoids, alkaloids, proteins, coumarins, flavonoids, phenols, lignocellulose, and nucleosides. The major bioactive compounds include amino acids, enzymes, nitrogenous compounds, terpenoids (specifically triterpenes), carbohydrates, sterols, and proteins. The amino acid profile includes 18 types, with leucine exhibiting antioxidant or hypoglycemic effects. Enzymes such as β-N-acetyl hexosaminidase and metalloproteases were identified. Nitrogenous compounds

comprised nucleotides and nucleosides, while terpenoids, particularly triterpenes, exhibited anti-inflammatory and anticancer properties. Carbohydrates, specifically polysaccharides, played a crucial role, showcasing diverse biological functions like anti-inflammatory, hypoglycemic, antitumor, and immunostimulatory effects. Sterols, proteins, phenolic constituents, and additional compositions like meroterpenoids, alkaloids, nucleosides, and germanium were also identified. The multifaceted chemical makeup of G. lucidum contributes to its wide range of therapeutic and biological effects. [15]

4. Pharmacological actions

Ganoderma polysaccharides, proteins (LZ-8), and triterpenoids enhance immune function, increasing cellular activity and survival of immune cells. G. lucidum protects against oxidative damage, suppressing reactive oxygen species. Extracts show significant scavenging activity against free radicals. Polysaccharides, proteoglycans, proteins, and triterpenoids demonstrate hypoglycemic properties, reducing blood glucose levels and promoting glycogen synthesis.

Ganoderic acids T-Q and lucidenic acids exhibit anti-inflammatory effects by reducing gene expression responsible for inflammation and regulating cytokine levels. G. lucidum shows antiviral potential against EV71, influenza, and HIV, with triterpenoids and ganoderic acid displaying inhibitory effects. It demonstrates antibacterial and antifungal effects against various pathogens, inhibiting both Gram-positive and Gram-negative bacteria. Polysaccharide peptides and triterpenes contribute to anti-aging properties, acting as antioxidants and potential cosmetic ingredients. Ganopoli, α-tocopherol, and polysaccharide extracts benefit cardiovascular health, reducing blood pressure and serum cholesterol levels. G. lucidum effectively normalizes blood pressure within a short duration. Polysaccharides from G. lucidum exhibit significant antiviral ability against herpes simplex virus. G. lucidum extract protects hepatocytes, inhibits lipid peroxidation, and reduces apoptosis, benefiting liver health. Ganoderic acid in G. lucidum inhibits hepatitis B virus replication, suppressing hepatitis surface genes. G. lucidum is believed to have neuroprotective effects, reducing environmental stress, aiding in insomnia, and potentially slowing Alzheimer's disease progression. [16]

5. Safety considerations

The geographical origin is a crucial factor influencing the safety of mushrooms [17]. Most reports suggest that, at appropriate doses, G. lucidum generally lacks obvious toxicity or safety concerns. New experiments, including clinical trials and epidemiological studies, are necessary to identify molecular targets, understand the relationship between G. lucidum intake and various diseases, and explore its therapeutic properties, particularly in combination with radiotherapy and chemotherapy. The establishment of modern, updated standards for safety and efficacy is imperative. G. lucidum possesses numerous beneficial properties, and scientific research on its anti-aging, antioxidant, and antimicrobial attributes has made significant strides [18]. Ongoing research on G. lucidum-related products has unveiled valuable data on chemical constituents, organic properties, pharmacological effects, and, with technological advancements, promises to uncover unexplored facets of this mushroom

6. Conclusion

Ganoderma lucidum, commonly known as Reishi, has a rich history of being utilized for both regenerative and culinary purposes. The longevity benefits attributed to Reishi have spurred various investigations, attempting to unveil its broader health-promoting characteristics. Geographical origin has now become a crucial consideration for consumers seeking safe and high-quality mushrooms. Establishing well-defined dosage ranges for active ingredients is essential to ensure both safety and efficacy. The limited availability of certain Reishi preparations as medicines may be linked to challenges associated with mass production. Current efforts in the search for active ingredients have leaned towards G. lucidum extracts rather than fungal cultures. The mycelium, in particular, harbors numerous biologically active compounds warranting further exploration. Ongoing and future research endeavors are crucial to validate and expand our understanding of Reishi's potential benefits, addressing contemporary needs.

References

[1] Unlu A, Nayir E, Kirca O, Ozdogan M. Ganoderma lucidum (reishi mushroom) and cancer. J buon. 2016 Jul 1;21(4):792-8.

[2] Batra P, Sharma AK, Khajuria R. Probing Lingzhi or Reishi medicinal mushroom Ganoderma lucidum (higher Basidiomycetes): a bitter mushroom with amazing health benefits. International journal of medicinal mushrooms. 2013;15(2).

[3] El Sheikha AF. Nutritional profile and health benefits of Ganoderma lucidum "Lingzhi, Reishi, or Mannentake" as functional foods: Current scenario and future perspectives. Foods. 2022 Apr 1;11(7):1030.

[4] Bulam S, Üstün NŞ, Pekşen A. Health benefits of Ganoderma lucidum as a medicinal mushroom. Turkish Journal of Agriculture-Food Science and Technology. 2019 Dec 10;7:84-93.

[5] Benkeblia N. Ganoderma lucidum polysaccharides and Terpenoids: profile and health benefits. J Food Nutr Diet. 2015;1:1-6.

[6] Kumar SP, Kanthal LK, Durga S, Satyavati K. Phytochemical Evaluation and Screening of Cardiotonic, Antibacterial and Anthelmintic Activities of Sida cordifolia L. Int J Pharm Sci Nanotechnol. 2014 Aug 31;7(3):2567-73.

[7] Yadav D, Negi PS. Bioactive components of mushrooms: Processing effects and health benefits. Food Research International. 2021 Oct 1;148:110599.

[8] Ma G, Yang W, Zhao L, Pei F, Fang D, Hu Q. A critical review on the health promoting effects of mushrooms nutraceuticals. Food Science and Human Wellness. 2018 Jun 1;7(2):125-33.

[9] Jin X, Beguerie JR, Sze DM, Chan GC. Ganoderma lucidum (Reishi mushroom) for cancer treatment. Cochrane Database of Systematic Reviews. 2012(6).

[10] Zhang JJ, Li Y, Zhou T, Xu DP, Zhang P, Li S, Li HB. Bioactivities and health benefits of mushrooms mainly from China. Molecules. 2016 Jul 20;21(7):938.

[11] Pinya S, Ferriol P, Tejada S, Sureda A. Mushrooms reishi (Ganoderma lucidum), shiitake (Lentinela edodes), maitake (Grifola frondosa). InNonvitamin and Nonmineral Nutritional Supplements 2019 Jan 1 (pp. 517-526). Academic Press.

[12] Deepalakshmi K, Mirunalini S. Therapeutic properties and current medical usage of medicinal mushroom: Ganoderma lucidum. International Journal of Pharmaceutical Sciences and Research. 2011 Aug 1;2(8):1922.

[13] Kumar K, Mehra R, Guiné RP, Lima MJ, Kumar N, Kaushik R, Ahmed N, Yadav AN, Kumar H. Edible Mushrooms: A comprehensive review on bioactive compounds with health benefits and processing aspects. Foods. 2021 Dec 4;10(12):2996.

[14] Chen AW, Seleen J. Potential benefits of Ling Zhi or Reishi mushroom Ganoderma lucidum (W. Curt.: Fr.) P. Karst.(Aphyllophoromycetideae) to breast cancer patients. International Journal of Medicinal Mushrooms. 2007;9(1).

[15] Jong SC, Birmingham JM. Medicinal benefits of the mushroom Ganoderma. Advances in applied microbiology. 1992 Jan 1;37:101-34.

[16] Ahmad R, Riaz M, Khan A, Aljamea A, Algheryafi M, Sewaket D, Alqathama A. Ganoderma lucidum (Reishi) an edible mushroom; a comprehensive and critical review of its nutritional, cosmeceutical, mycochemical, pharmacological, clinical, and toxicological properties. Phytotherapy Research. 2021 Nov;35(11):6030-62.

[17] Roupas P, Keogh J, Noakes M, Margetts C, Taylor P. The role of edible mushrooms in health: Evaluation of the evidence. Journal of functional foods. 2012 Oct 1;4(4):687-709.

[18] Rathore H, Prasad S, Sharma S. Mushroom nutraceuticals for improved nutrition and better human health: A review. PharmaNutrition. 2017 Jun 1;5(2):35-46.

Author's short biography

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I am presently in my final year of B.Pharmacy, and I previously authored an article in the pharmaceutical field. Recently, my curiosity about plants and their applications has led me to explore herbal or natural materials. As I gathered a wealth of information, my curiosity deepened. These articles have significantly contributed to enhancing my understanding of the current developments in this specific field.