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# CULTIVATION AND BIOACTIVE POTENTIAL OF *HERICIUM ERINACEUS*: A COMPREHENSIVE REVIEW

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**Abstract**

*Hericium erinaceus*, commonly known as lion's mane mushroom, is an edible and medicinal basidiomycete widely recognized for its neuroprotective, metabolic, and gastrointestinal health benefits. The species contains diverse bioactive constituents, including indolinone derivatives, benzofuranones, phenolics, erinacines, and hericenones, which contribute to its therapeutic activities. Due to increasing demand and the limitations of wild harvesting, controlled cultivation systems have been developed, although challenges remain regarding substrate optimization and management of spent mushroom substrate (SMS). Optimizing substrate composition, environmental parameters, and supplementation strategies has been central to improving yield and morphological quality. Recent studies have revealed that this species synthesizes diverse bioactive metabolites, including erinacines and hericenones, which contribute to its neuroprotective, antioxidant, and immunomodulatory properties. The increasing demand for natural therapeutic compounds has further stimulated research on strain improvement, controlled cultivation systems, and post-harvest processing to preserve functional compounds This review summarizes the medicinal significance, cultivation systems, substrate innovations, and sustainability considerations associated with *H. erinaceus* production.

**Introduction**

*Hericium erinaceus*, also known as lion's mane, monkey's head, or roedeer mushroom, is a distinctive white-spined fungus belonging to the family Hericiaceae. It has been traditionally used in East Asian medicine for improving memory, treating metabolic disorders, and managing gastrointestinal diseases (Khan et al., 2013; Wang et al., 2014; He et al., 2017). Modern phytochemical and pharmacological studies have confirmed its richness in indolinone and benzofuranone derivatives, phenolic compounds, and diterpenoids such as erinacines and hericenones, which exhibit strong neuroprotective and antidiabetic activities (Lee et al., 2020). With rising global interest in functional foods, the cultivation of *H. erinaceus* has expanded significantly, prompting research into substrate formulation, environmental control, and sustainable production practices.

**Cultivation Systems**

Cultivation of *H. erinaceus* is carried out either through extensive or intensive systems. Extensive cultivation, commonly practiced in China, relies on wooden logs or stumps inoculated with fungal mycelium. Although this method is low-cost and technically simple, production is highly dependent on environmental conditions and often requires several months to more than a year for fruiting, resulting in inconsistent yields and high labor inputs (Stamets, 1993). Intensive cultivation systems, by contrast, utilize sterilized substrates packed in polypropylene bottles or filter bags, allowing controlled regulation of temperature, humidity, lighting, and ventilation (Oei, 2003). These systems shorten the production cycle and improve biological efficiency, while ensuring uniform fruit body morphology and reduced contamination risks.

**Substrate Composition and Optimization**

A wide variety of lignocellulosic substrates have been investigated for the cultivation of *H. erinaceus*. Beech sawdust supplemented with wheat bran or corn meal is one of the most widely used formulations due to its favorable structure and nutrient composition. Substrates based on corn cobs, cotton chaff, wheat bran, and corn meal, with small additions of gypsum and sugar, have been reported to support vigorous mycelial growth and high yields. Supplementation with rice straw, soybean meal, sunflower husks, vegetable oils, manganese, ammonium salts and simple carbohydrates has been shown to accelerate primordium formation and enhance fruiting performance (Kirchhof, 1996; Ko et al., 2005; Hu et al., 2008). Coniferous substrates such as *Pinus taeda* and *Pinus ponderosa* require pre-treatment with resin-degrading fungi, including *Aureobasidium pullulans*, *Ceratocystis* spp., and *Ophiostoma piliferum*, to remove inhibitory tars before use (Royse, 1995). These findings highlight the metabolic versatility of *H. erinaceus* and underscore the importance of substrate selection in optimizing yield and quality.

**Environmental and Sustainability Consideration**

Mushroom cultivation is widely recognized as an environmentally sustainable enterprise due to its minimal water requirements, modest land footprint, and efficient utilization of agricultural residues as substrates. Nevertheless, the rapid expansion of the mushroom industry has intensified concerns regarding the accumulation and disposal of spent mushroom substrate (SMS), which remains one of its most persistent environmental challenges. While SMS can be recycled as animal feed, compost, or soil amendments, a substantial proportion remains unutilized, leading to localized soil contamination, nutrient leaching, and greenhouse gas emissions during uncontrolled decomposition (Gao et al., 2021). Recent advances in circular bioeconomy approaches emphasize the valorization of SMS through its conversion into biofertilizers, biochar, biogas, and feedstock for secondary microbial fermentation, thereby transforming a waste product into a valuable resource. Additionally, integrating SMS-derived products into sustainable agriculture can improve soil structure, enhance microbial diversity, and reduce dependence on synthetic fertilizers. Such innovations not only address waste management bottlenecks but also position mushroom cultivation as a model system for low-carbon, resource-efficient food production.

**Conclusion**

*Hericium erinaceus* is a valuable medicinal mushroom with growing importance in the global functional food and nutraceutical industries. Advances in intensive cultivation and substrate optimization have improved productivity; however, issues related to substrate availability and SMS management continue to pose significant challenges. Future research should prioritize the development of low-cost, eco-friendly substrates, optimization of cultivation conditions for enhanced metabolite production, and sustainable valorization pathways for SMS. Strengthening these areas will support the long-term viability and environmental resilience of *H. erinaceus* cultivation.

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