Hericium Erinaceus as a functional food and a way to mitigate the negative effects of climate change

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Climate Change and Food Security

According to the World Meteorological Organization (WMO) report, 2024 was the warmest year on record, with temperature records being broken for ten consecutive years (WMO, 2025). Climate change significantly impacts agricultural production, further exacerbating food insecurity. As the global population grows, the demand for food crops increases, but climate change disrupt their stable small-scale cultivation, reducing both yield and quality (Bedasa and Bedemo, 2023). Rising global rainfall, increasing carbon dioxide levels, and higher average temperatures have led to more frequent extreme weather events such as floods and droughts, posing a serious threat to global cereal and crop production (Bibi and Rahman, 2023). These extreme conditions directly reduce agricultural output and contribute to rising global hunger, with major crop yields estimated to decline by 3.1% to 7.4% for each one-degree Celsius increase in global average temperature (Molotoks et al., 2021). Since the 19th century, temperatures have risen by 0.9°C and climate change not only affects crop and livestock production but also disrupts hydrological balance (Eftekhari, 2022). According to the Food and Agriculture Organization (FAO), global hunger sharply increased between 2019 and 2021 and remained high through 2023. Factors such as population growth, urbanization, desertification, and the expansion of herders into farmland have further complicated food production. Modern society faces major challenges, including food insecurity, malnutrition, and environmental pollution. The situation worsened with the COVID-19 pandemic, which struck at a time when around 820 million people were already experiencing chronic hunger, and over 2 billion were malnourished (Adedokun et al., 2022; Niazi and Ghafoor, 2021). To address these challenges, alternative food sources must be explored. One promising solution is the cultivation of edible mushrooms, which offer a highly nutritious next-generation food source (El-Ramady et al., 2022). Additionally, mushroom farming not only enhances food security but also provides an efficient method for managing agro-industrial waste (Adedokun et al., 2022; Niazi and Ghafoor, 2021).

Mushrooms as a Sustainable Nutrition Source

Mushroom farming is a promising approach to utilizing unwanted agro-waste and is one of the most cost-effective ways to address malnutrition deficiencies while enhancing food security (Khan et al., 2024). Humans have been consuming edible mushrooms for over two thousand years, particularly due to their organoleptic and medicinal properties (Jacinto-Azevedo et al., 2021). Based on their role in the human diet and health, mushrooms are categorized as edible, medicinal, poisonous, or undefined. Some edible mushrooms also possess medicinal properties, placing them in both categories (Marçal et al., 2021). Edible and medicinal mushrooms are increasingly popular as alternative sources of income and nutrition for rural and impoverished communities (Bandara et al., 2021). Their cultivation is now recognized as an effective method for recycling agro-waste, transforming it into a highly nutritious food source with excellent protein conversion efficiency, while also providing valuable medicinal benefits for the vegetarian population (Thakur, 2020). The nutritional and health benefits of edible mushrooms are attributed to their high protein and insoluble fiber content, all nine essential amino acids, and low lipid and bioactive compound levels (Jacinto-Azevedo et al., 2021). Polysaccharides, dietary fiber, proteoglucans, and vitamins such as riboflavin and thiamine make edible mushrooms an important food source (El-Ramady et al., 2022). Additionally, edible mushrooms are rich in bioactive compounds like terpenoids, phenolic compounds, steroids, lectins, and vitamins, which offer immunomodulatory, anticarcinogenic, antiviral, antioxidant, and anti-inflammatory benefits. Regular consumption can help lower cholesterol levels and protect against diseases, including cancer (Assemie and Abaya, 2022).

Hericium erinaceus: A Functional and Neuroprotective Food

Hericium erinaceus **(Figure 1.)**, also known as Lion's Mane, is a highly beneficial mushroom with potent bioactive effects. It has significant neuroprotective potential, promoting nerve growth factor (NGF) production, modulating inflammation, reducing oxidative stress, and protecting nerve cells from apoptosis (Szućko-Kociuba et al., 2023). Chemical studies have identified several bioactive compounds in *H. erinaceus*, including diterpenoids (erinacines), aromatic compounds (hericerins, erinacerins, and erinaceolactones), sterols, polysaccharides, and glycoproteins (Xie et al., 2022). Research suggests that *H. erinaceus* has therapeutic potential for gastrointestinal disorders like gastritis and inflammatory bowel diseases and its compounds may also have antineoplastic effects against gastric and colorectal cancer (Gravina et al., 2023). Additionally, its neuroprotective properties make it a promising treatment and preventive option for neurodegenerative diseases such as Parkinson's, Alzheimer's, and Huntington's diseases (Qiu et al., 2024). Among all bioactive compounds in *H. erinaceus*, hericenones and erinacines are the most recognized. Erinacine A, found in the fermented mycelium, induces nerve growth factor (NGF) synthesis and has shown effectiveness in treating age-related neurological diseases in animal models. Erinacines A and S reduce β-amyloid deposition and enhance insulin-degrading enzyme expression. Erinacine E is used for neuropathic pain, while erinacine Q acts as a precursor for other erinacines and striatins. Erinacine A can also cross the blood-brain barrier, supporting its use in neurohealth development (Tsai et al., 2021). Hericenones, isolated from the fruiting bodies of *H. erinaceus*, are phenolic compounds with various biological activities. Hericenones A and B show cytotoxicity against cancer cells, while hericenones C-E and H stimulate NGF synthesis, with hericenone E being the most active due to its fatty acid chain structure (Szućko-Kociuba et al., 2023; Qiu et al., 2024). However, further research is needed to explore its metabolic profile and oral bioavailability in humans for drug development (Tsai et al., 2021). In conclusion, *Hericium erinaceus* has significant potential as a functional food that promotes health and contributes to the sustainability of the food system, potentially mitigating the effects of climate change.

Figure 1. *Hericium erinaceus* (Lion's Mane mushroom)

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