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Abstract

The COVID-19 pandemic has intensified interest in natural bioactive compounds with the potential to enhance immune function and provide antiviral protection. Medicinal mushrooms represent a rich reservoir of biologically active metabolites, including polysaccharides, β -glucans, lectins, terpenoids, ergosterol, phenolic compounds, and fungal immunomodulatory proteins. These compounds possess diverse pharmacological properties such as immunomodulatory, antiviral, anti-inflammatory, antioxidant, and antimicrobial activities that contribute to host defense against infectious diseases. Several medicinal mushroom species, including *Ganoderma lucidum*, *Lentinula edodes*, *Cordyceps sinensis*, *Grifola frondosa*, *Hericium erinaceus*, *Trametes versicolor*, and *Agaricus brasiliensis*, have demonstrated significant effects on innate and adaptive immunity through the activation of macrophages, dendritic cells, natural killer cells, and T lymphocytes. Recent investigations have revealed that mushroom-derived metabolites such as colossolactone E, colossolactone VIII, colossolactone G, ergosterol, heliantriol F, and velutin exhibit promising inhibitory activity against SARS-CoV-2 targets, particularly viral proteases involved in replication. Furthermore, mushroom polysaccharides have shown the ability to regulate cytokine production, reduce oxidative stress, and mitigate excessive inflammatory responses associated with severe COVID-19. These multifunctional properties position medicinal mushroom bioactives as promising candidates for the development of nutraceuticals, functional foods, and complementary therapeutic interventions. This chapter reviews the major bioactive compounds derived from medicinal mushrooms, their mechanisms of immune regulation, and their emerging antiviral applications in the prevention and management of COVID-19 and related viral diseases.

Keywords: Medicinal Mushrooms; Human Immunity; SARS-CoV-2; COVID-19; Immunomodulation; β -Glucans; Antiviral Activity; Bioactive Compounds.

Introduction

Medicinal mushrooms have been widely recognized for their nutritional and therapeutic value and have been incorporated into traditional healthcare systems for centuries [1]. Modern scientific investigations have revealed that mushrooms contain a diverse array of bioactive compounds, including polysaccharides, β -glucans, lectins, terpenoids, sterols, and proteins that contribute to their pharmacological activities [2, 3]. These compounds exhibit antioxidant, anti-inflammatory, antimicrobial, anticancer, and antiviral properties [4], making medicinal mushrooms valuable sources of natural therapeutic agents. The increasing interest in functional foods and nutraceuticals has further accelerated research into mushroom-derived bioactives and their potential applications in human health and disease management [5].

The outbreak of Coronavirus Disease 2019 (COVID-19), caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), created an urgent need for novel preventive and therapeutic strategies [6]. Although vaccines and antiviral drugs have significantly contributed to disease control, emerging viral variants and immune-related complications continue to present challenges [7,8]. Clinical studies have demonstrated that disease severity is strongly associated with immune dysfunction, excessive inflammation, and impaired antiviral responses [9]. Consequently, natural products capable of modulating immune responses and supporting antiviral defense mechanisms have attracted considerable attention as complementary approaches in combating COVID-19 [10].

The human immune response against SARS-CoV-2 involves a complex interaction between innate and adaptive immune mechanisms [11]. Viral recognition by pattern-recognition receptors activates signaling pathways that stimulate interferon production, cytokine release, and recruitment of immune cells [12, 13]. However, severe COVID-19 cases are frequently characterized by cytokine storms, lymphocyte depletion, and uncontrolled inflammatory responses that contribute to tissue injury and organ dysfunction [14]. Therefore, agents capable of restoring immune homeostasis while enhancing antiviral immunity may offer significant benefits in reducing disease severity and improving clinical outcomes [15].