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Comparative Evaluation of Protein and Bioactive Compounds in Ganoderma Fruiting Body and Mycelium

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Abstract

Mushrooms of the genus *Ganoderma* are widely recognized for their medicinal and biotechnological importance due to their potential applications in functional foods, pharmaceuticals and nutraceutical products. They are rich in bioactive compounds, including proteins and other metabolites like triterpenoids and phenolic compounds. *Ganoderma* proteins are of particular interest because of their nutritional value and their association with immunomodulatory and antioxidant activities, while triterpenoids such as ganoderic acids exhibit anti-inflammatory and anticancer properties. The composition and concentration of these metabolites can vary significantly, depending on fungal species, cultivation substrate and conditions. Recent advances in submerged fermentations and controlled cultivation systems have enabled enhanced production of mycelial mass and targeted metabolites, offering sustainable alternatives to traditional fruiting body cultivation. In this study, comparative analyses were performed between the fruiting bodies and the mycelial mass of *G. resinaceum* AMRL 325 and *G. adspersum* AMRL 315, two wild and naturally occurring in Greece mushrooms, maintained at the Edible Fungi Laboratory of the Institute of Technology of Agricultural Products (Hellenic Agricultural Organization – Dimitra). Fruiting bodies were cultivated on a solid-state substrate composed of beech wood sawdust and corn cob (75% w/w d.w. agricultural residues; 25% supplements), while mycelial mass was produced via submerged fermentation in a glucose-based medium (45 g/L initial concentration). Results indicated noticeable differences in the biochemical composition between the fruiting body and the mycelial mass. In both species, the fruiting bodies exhibited higher protein content compared to that of the mycelia; 25.40 and 27.23% w/w d.w., compared to 20.5 and 13.6% w/w d.w. in mycelial mass of *G. resinaceum* and *G. adspersum*, respectively. Conversely, triterpenoid content was substantially higher in the mycelial mass, reaching ~ 32 mg UAE/g, whereas fruiting bodies showed lower values (12 and 9 mg UAE/g). Higher antioxidant activity was demonstrated in the mycelium with total phenolic content, reaching 415 mg GAE/L and 515 mg GAE/L for *G. resinaceum* and *G. adspersum*, respectively, compared to 153 mg GAE/L and 223 mg GAE/L in fruiting bodies. Consistently, DPPH radical scavenging activity of the mycelium was 32 and 20% for each strain, whereas fruiting bodies exhibited markedly lower activity (2 and 10%). Furthermore, total serum oxidizability assays confirmed the enhanced antioxidant potential of submerged cultures, as mycelial aqueous extracts significantly prolonged oxidation resistance time, nearly doubling the values observed for fruiting body extracts. These results indicate that solid-state cultivation is particularly favorable for the

production of protein-rich *Ganoderma* fruiting bodies, whereas submerged fermentation enhances phenolic content and antioxidant activity in the mycelial mass. Overall, this study highlights the potential of both solid-state and submerged cultivations for sustainable production of protein-rich and antioxidant-active *Ganoderma* products.

Keywords: Ganoderma resinaceum, Ganoderma adspersum, protein, mycelial mass, fruiting bodies

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