

Abstract

Mushrooms assume a notable role in shaping the composition and functionality of the gut microbiota, a pivotal determinant of overall health. These kinds of fungi are rich sources of dietary fiber, notably beta-glucans. Beta-glucans, remain indigestible in the colon where they undergo fermentation by the gut microbiota, thus enhancing populations of beneficial bacterial communities important for health such as *Bifidobacterium* and *Lactobacillus*.

Furthermore, mushrooms contain bioactive compounds such as terpenoids, amino acids and polyphenols, exerted regulatory effects on the gut immune response, dampening inflammation, and bolstering the mucosal barrier. Hence, the consumption of mushrooms emerges as a strategic dietary intervention for fostering a resilient and diverse gut microbiota, with promising implications for overall health and disease mitigation.

The gut microbiota is known to contribute to the organism's defence against invading pathogens, to boost the immune function, to regulate various metabolic pathways, and to overall promoting the host's health. The interconnection of the multifaceted properties of mushroom constituents with their potential prebiotic actions within the context of their interaction with the gut microbiota, is intricate and has been a subject of intensive scientific research of the last decade. The distinct metabolome of different mushrooms varieties as well as the heterogeneity of gut microflora adds to the complexity of the host microbiota-mushroom interplay.

In this doctoral thesis, the impact of the *in vitro* fermentation of full body edible mushrooms of the Greek habitat by the gut microbiota of healthy elderly volunteers was conducted. The scientific research was carried out through comprehensive metataxonomic and metabolomic analyses. The methodologies employed throughout the doctoral dissertation encompassed Next Generation Sequencing (NGS) for metataxonomics analysis and Nuclear Magnetic Resonance (NMR) for untargeted metabolomics analyses.

Through a thorough mapping of the alterations in the composition of the gut microbiota and the metabolites alterations resulting from *in vitro* fermentation of the studied edible mushrooms by the gut microbiota, the following outcomes were assessed: a) the identification of the most promising mushroom that promotes effectively the growth of health-beneficial bacteria, b) the clarification of the role of the gut microbiome metabolic activity in human health, and c) the potential elucidation of the interplay between the gut microbiome and the host organism at metabolomics level.

The results of the present doctoral dissertation have led to:

- The identification and quantitative assessment of 37 metabolites of the gut microbiota metabolism resulting from the fermentation of the studied edible mushrooms, shedding light on their role in the host organism.
- The establishment of *Pleurotus Eryngii* as a privileged substrate due to its positive impact on the growth of beneficial bacterial populations and the production of beneficial metabolites following fermentation with the specific species.
- The identification and relative changes in microbial communities associated with the presence of the *Pleurotus Eryngii* substrate.

Entirely, the outcomes of this doctoral dissertation provide substantial evidence supporting the promotion of host health through the consumption of *Pleurotus Eryngii* mushroom.