

竹屑栽培大球盖菇对竹林地土壤健康的影响*

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摘要:【目的】竹林地栽培大球盖菇 (*Stropharia rugosoannulata*) 已成为推动林下经济发展的重要途径。竹屑作为栽培基质,可以有效解决竹材滞销问题。然而,目前缺乏关于竹屑作为栽培基质对竹林地土壤影响的系统性评估。【方法】本试验通过开展 4% 菜籽饼发酵竹屑栽培大球盖菇的田间试验,采用土壤化学和酶分析、微生物组测序和代谢组学技术,评价了栽培大球盖菇后土壤相关指标变化情况。【结果】使用 4% 菜籽饼发酵竹屑栽培大球盖菇后显著提高了竹林地养分积累和酶活性,有机碳、速效氮、全氮、全钾以及蔗糖酶、脲酶、过氧化物酶、多酚氧化酶、中性蛋白酶含量显著提升;细菌和真菌 α 多样性显著提升,并显著改变了土壤细菌和真菌的整体群落结构和组成;代谢组学分析表明,栽培大球盖菇后土壤代谢物谱显著变化,差异代谢物显著富集到 5 条代谢途径,如甘油酯类代谢、植物次生代谢产物的生物合成、淀粉和蔗糖代谢、亚麻酸代谢、精氨酸脯氨酸代谢途径。此外,关联分析显示,栽培大球盖菇后 4 个细菌属及 7 个真菌属与有机碳 (SOC)、全氮 (TN)、速效氮 (AHN)、全磷 (TP)、全钾 (TK)、PH 显著性相关,6 个细菌门及 8 个真菌属与蔗糖酶 (SSC)、脲酶 (UE)、过氧化物酶 (POD)、多酚氧化酶 (PO)、中性蛋白酶 (NPT)、磷酸酶 (ACP) 显著性相关,且真菌多样性对土壤养分变化的响应大于细菌多样性。【结论】4% 菜籽饼发酵竹屑栽培大球盖菇有利于竹林土壤健康。本研究为竹屑的有效利用和维持林地生态平衡提供了新的认识。

关键词: 代谢物; 微生物群落结构; 丰度; 竹林; 土壤理化性质

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The Effect of Cultivating *Stropharia Rugosoannulata* with Bamboo Sawdust on the Soil Health of Bamboo Forest

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Abstract: 【Objective】The cultivation of *Stropharia rugosoannulata* in bamboo forests has emerged as a significant approach to promoting economic development within forested areas. Utilizing bamboo sawdust as a cultivation medium effectively addresses the issue of unsellable bamboo. However, a systematic assessment of the impact of bamboo sawdust on the soil properties of bamboo forest land is currently lacking. 【Method】In this study, a field experiment was carried out on the cultivation of *S. rugosoannulata* with 4% rapeseed cake fermentation and bamboo sawdust. Soil chemical and enzyme analysis, microbiome sequencing and metabolomics techniques were used to evaluate the changes of soil related indexes. 【Result】The use of 4% rapeseed cake to ferment bamboo sawdust to cultivate *S. rugosoannulata* significantly increased the nutrient accumulation and enzyme activity, organic carbon, available nitrogen, total nitrogen, total potassium, and the contents of sucrase, urease, peroxidase, polyphenol oxidase and neutral protease. The α diversity of bacteria and fungi increased significantly, and the overall community structure and composition of soil bacteria and fungi were significantly changed. Metabolomics analysis showed that soil metabolites were significantly enriched in 5 metabolic pathways, such as glycerol metabolism, biosynthesis of plant secondary metabolites, starch and sucrose metabolism, linolenic acid metabolism, and arginine proline metabolism. Furthermore, correlation analysis showed that four bacterial genera and seven fungal genera were significantly correlated with soil organic carbon (SOC), total nitrogen (TN), available nitrogen (AHN), total phosphorus (TP), total potassium (TK), and pH after cultivating *Agaricus bisporus*. Six bacterial phyla and eight fungal genera were significantly correlated with invertase (SSC), urease (UE), peroxidase (POD), polyphenol oxidase (PO), neutral protease (NPT), and phosphatase (ACP). Moreover, the response of fungal diversity to soil nutrient changes was greater than that of bacterial diversity. 【Conclusion】The cultivation of *S. rugosoannulata* with 4% rapeseed cake fermented bamboo sawdust is beneficial to the soil health of bamboo forest. This study provides a new understanding for the effective utilization of bamboo saw

dust and the maintenance of forest ecological balance.

Key words: metabolite; microbial community structure; abundance; bamboo forest ; physical and chemical properties of soil.