SLAMPP Con 2025

Sustainability through Innovations in Mycology and Plant Pathology

Proceedings of the First International Conference in Mycology and Plant Pathology

Organized by

Sri Lanka Association for Mycology and Plant Pathology

08 February 2025

Riviera Resort, New Dutch Bar Road, Kallady, Batticaloa, Sri Lanka

SLAMPPCon2025
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Abstract No: SLAMPPCon 2025-023

Biofilm exudates optimize network interactions for improved yield and quality of oyster mushrooms

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Oyster mushroom (*Pleurotus ostreatus*) offers a sustainable approach to converting lignocellulosic waste into valuable products. This study explores the effect of biofilm exudates (BFEx, i.e. biochemicals produced by in-vitro developed fungal-bacterial biofilm) on network interactions, yield, and quality of oyster mushrooms. Three treatments i.e. (a) recommended substrate Department of Agriculture (DOA) Sri Lanka, (b) DOA recommended substrate and BFEx, and (c) control (no amendments) were compared, each with autoclaved and non-autoclaved forms. Mushroom bags spawned with oyster mushrooms were incubated in the dark under aerated conditions for 20-30 days at 24-27 °C and 90-100% humidity. Substrate pH, temperature, and moisture content were measured. Mushroom samples were collected at the harvest, the yield was measured, and Biological Efficiency (BE), the yield percentage relative to the substrate's dry weight, was calculated. The protein contents were analysed using FTIR (Fourier Transform Infrared Spectroscopy). Means of absorbance were compared using one-way ANOVA followed by Tukey's HSD test ($p < 0.05$). Pearson correlation analysis was performed for the parameters in each treatment. The results revealed that the application of BFEx significantly increased the yield, biological efficiency, and protein content of the mushrooms. Despite pathogens, mushrooms grown on non-autoclaved substrates thrived with BFEx, showing its biocontrol potential. The biological efficiency was significantly and positively correlated with substrate temperature in both (a) and (b) treatments (0.1435, 0.3618; $p < 0.05$) and substrate moisture in only the treatment (a) (0.1706; $p < 0.05$). The mushroom yield was significantly and positively correlated with substrate pH and moisture only with the BFEx application (0.4271, 0.2329; $p < 0.05$), indicating the potential of increasing yield by optimizing those parameters further. Correlation-based network analysis revealed that the mushroom yield and biological efficiency are possibly regulated by the network interactions involving several parameters, indicating the potential of increasing yield and quality by optimizing those parameters. In conclusion, the application of BFEx potentially enhances network interactions in the mushroom ecosystem leading to increased mushroom yield and quality. Further investigations are needed to confirm these findings in large-scale farming systems.

Keywords: biofilm exudates, mushroom farming, network interactions