

Valorization of Food By-Products Via Solid Submerged Fermentation for Sustainable Mycoprotein Production

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ABSTRACT

Background: The growing demand for sustainable protein sources has intensified interest in alternative production systems with reduced environmental impact. Mycoprotein is a promising option in this context. This study explored solid submerged fermentation (SSmF) as a bioprocess for producing mycoprotein from *Pleurotus* spp. using food by-products. Brewers' spent grain (BSG), banana peel (BP), peanut peel (PL), and cocoa bean shells (CBS) were selected due to their high availability and low cost.

Methods: The C/N ratios of the by-products were determined using an elemental analyzer (vario EL cube). *P. ostreatus* (PO), *P. ostreatus black pearl* (POB), and *P. eryngii* (PE) were cultivated under SSmF with malt extract broth (MEB), either alone or supplemented with 10% (w/v) of each by-product. Incubations were carried out in the dark at 25 °C with agitation at 200 rpm for 15 days. Fermentations were monitored by measuring sugars consumption, dried biomass yield, and protein content. In a final trial, PO was cultivated in a 3L-bioreactor using 10% BSG in MEB.

Results: The C/N ratios obtained were: BSG (10.8 ± 1.7), BP (37.9 ± 5.9), CBS (13.6 ± 1.2), PL (32.5 ± 5.6). On MEB, PO achieved the highest biomass yield (16.0 g/L) and protein content (16.5%), compared with POB (12.4 g/L; 9.9%) and PE (18.4 g/L; 8.3%). When cultivated with by-products, PO showed lower biomass yields: PL (0.66 g/L), CBS (3.46 g/L), BP (0.83 g/L), and BSG (9.80 g/L). These differences highlight the strong influence of substrate composition on fungal growth, with BSG supporting yields closest to the corresponding control (14.3 g/L).

Conclusions: The results emphasize that the intrinsic metabolic characteristics of *Pleurotus* spp. are determinant for the accumulation of biomass and protein. In addition, nutrient balance, particularly the C/N ratio, strongly influences substrate utilization by PO and the resulting biomass yield. Overall, SSmF demonstrates strong potential as a bioprocess for valorizing food by-products into mycoprotein.

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