Modulation of Ultrasound-Assisted Extraction Effect on the Molecular Composition of Fungi

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Background

Fungal polysaccharide-protein complexes (PSPs) have the potential to be a valuable tool for environmental remediation in wetland ecosystems due to their ability to remove heavy metals and pollutants from contaminated water and soil. Furthermore, they possess antimicrobial properties that can combat harmful microorganisms in wetland habitats. As interest in fungal PSPs increases, it is worth investigating the effect of bioactivities of PSPs under ultrasound-assisted extraction (UAE) conditions.

Objective

To optimize the UAE method to extract PSPs from fungi and achieve the optimized bioactivity effect

Methodology

This study investigated four variables, including ultrasound power intensity, fungal particle size, solid-liquid ratio, and temperature, in the UAE process of two fungi. The polysaccharide and protein contents of the extracts were measured versus time of UAE and fitted to models by linear regression. The antioxidant activity of the extracted PSPs in cell culture was also tested.

Result and discussion

The optimal UAE conditions for extracting polysaccharides and proteins in both fungi were 16.25W/cm^2 power with 300.5 µm fungal particle sizes and a 1:30 solid-to-liquid ratio (Fig. 1). However, the optimal temperatures for extracting polysaccharides and proteins were different, with polysaccharides requiring a higher temperature (70℃) and proteins preferring a lower temperature (55℃) (Fig. 2). For both fungi, the polysaccharide and protein contents (wt%) in the extracted PSPs were correlated to the US energy density (MJ/m^3) by the Power Law of extraction: $y=\beta x^n$, where y is the polysaccharide/protein content and x is the US energy density. However, this correlation was only valid below the US power intensity of 20 W/cm^2. Within the same US power intensity range (< 20 W/cm^2), the study also observed a constant ratio of polysaccharide to protein content (wt% of polysaccharide/wt% of protein) in the extracted PSPs against the increasing US power intensity. Altogether, this study provided new and interesting results on the UAE processes and the relationships between the efficiency, product quality and the process conditions for bioactivities of fungi, which can facilitate the exploration for the potential use of fungal PSPs in environmental applications.

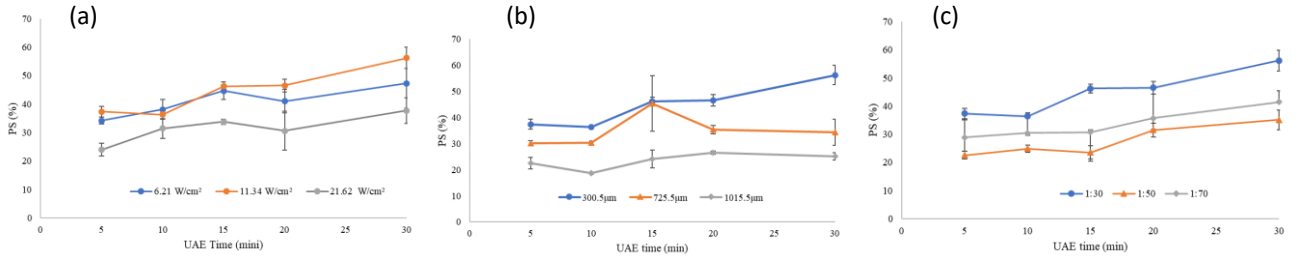

Fig. 1. Time courses of percentage polysaccharide extracted in UAE of *Grifola frondosa* with four process variables: (a) ultrasound intensity; (b) solid particle size; (c) solid-liquid ratio. Error bars for standard deviation or SD at n=3.

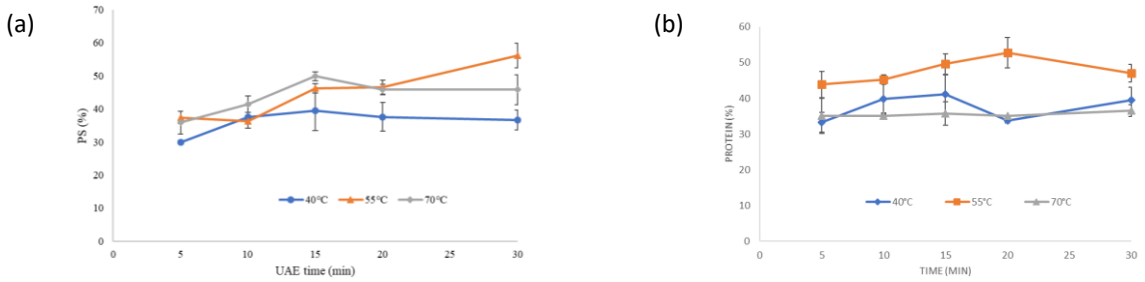

Fig. 2. Time courses of percentage (a) polysaccharide and (b) protein extracted in UAE of *Grifola frondosa*. Error bars for standard deviation or SD at n=3.

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