Optimization of Ultrasound-Assisted Extraction of Squalene from Rice Bran Using Response Surface Methodology

Suttipong Mengyoo[1], Natta Laohakunjit[1*], Nattapon Kaisangsri[2], Apiradee Uthairatanakij[3], Orrapun Selamassakul[2], Withawat Mingvanish[4]
[1]Division of Biochemical Technology, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[2]Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[3]Division of Postharvest Technology, School of Bioresources and Technology, King Mongkut's University of Technology Thonburi, Bangkok, Thailand
[4]Department of Chemistry, Faculty of Science, King Mongkut's University of Technology North Bangkok, Bangkok, Thailand

Corresponding Author Email: nutta.lao@kmutt.ac.th

Abstract

Rice bran, a lipid-rich by-product of rice milling, contains various bioactive compounds, including squalene. The dried rice bran used in this study contained 23.29% crude fat. This study aimed to optimize squalene extraction from KDML105 rice bran using ultrasound-assisted extraction (UAE) with ethanol. The optimization was performed using a face-centered central composite design (FCCD) combined with response surface methodology (RSM). The process variables were solid-to-solvent ratio (1:8-1:12 g/mL), ultrasonic power (160-240 W), and extraction time (30-60 min). The optimal conditions were a solid-to-solvent ratio of 1:10 g/mL, an ultrasonic power of 160 W, and an extraction time of 30 min. Under these conditions, an extraction yield of 20.36% and squalene content in the crude extract of 18.39 µg/g bran were obtained. Saponification was performed to reduce lipid matrix interference, resulting in a squalene content of 581.75 µg/g bran, which was approximately 31.6 times higher than that of the crude extract. The extracts also showed antioxidant-related properties, with 2,2′-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) and 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical scavenging activities ranging from 279.62 to 424.00 mg TEAC/100 g crude extract and 159.17 to 183.15 mg TEAC/100 g crude extract, respectively. Total phenolic content (TPC) ranged from 446.81 to 564.28 mg GAE/100 g crude extract. However, ABTS, DPPH, and TPC were not significantly affected by the extraction variables within the studied range and were therefore considered supporting indicators of extract quality. These findings suggest that UAE with ethanol is a promising approach to recovering a squalene-rich extract with antioxidant properties from rice bran.

Keyword: rice bran; squalene; ultrasound-assisted extraction; response surface methodology; KDML105