

Optimization of an ultrasound-assisted extraction condition for flavonoid compounds from cocoa shells (*Theobroma cacao*) using response surface methodology

ABSTRACT

This study investigates the ultrasound-assisted extraction of flavonoids from Malaysian cocoa shell extracts, and optimization using response surface methodology. There are three variables involved in this study, namely: ethanol concentration (70-90 v/v %), temperature (45-65 °C), and ultrasound irradiation time (30-60 min). All of the data were collected and analyzed for variance (ANOVA). The coefficient of determination (R^2) and the model was significant in interaction between all variables (98% and $p < 0.0001$, respectively). In addition, the lack of fit test for the model was not of significance, with $p > 0.0684$. The ethanol concentration, temperature, and ultrasound irradiation time that yielded the maximum value of the total flavonoid content (TFC; 7.47 mg RE/g dried weight (DW)) was 80%, 55 °C, and 45 min, respectively. The optimum value from the validation of the experimental TFC was 7.23 ± 0.15 mg of rutin, equivalent per gram of extract with ethanol concentration, temperature, and ultrasound irradiation time values of 74.20%, 49.99 °C, and 42.82 min, respectively. While the modelled equation fits the data, the T-test is not significant, suggesting that the experimental values agree with those predicted by the response surface methodology models.

Keyword: Cocoa shell; Flavonoids; Response surface methodology; Ultrasound-assisted extraction