

# Optimization of saponins, phenolics, and antioxidants extracted from fenugreek seeds using microwave-assisted extraction and response surface methodology as an optimizing tool

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## ABSTRACT

Fenugreek is a multiregional plant mostly found in Asia, the Middle East, and some European countries. Thus, this study aimed to optimize the microwave-assisted extraction (MAE) process parameters such as irradiation time (2–4 min), ethanol concentration (40–80%), microwave power (500–700 W), solid-to-liquid ratio (1:8–1:12 g/mL), and a fixed extraction temperature (70 °C) for fenugreek seed powder. Response surface methodology (RSM) was applied to optimize MAE process parameters to achieve optimal total saponin content (TSC), total phenolic content (TPC), 2,2-diphenyl-1-picrylhydrazyl (DPPH), and 2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) antioxidant capacities of fenugreek seed extract. The levels of independent variables were first evaluated using one-factor-at-one-time method, after which the suitable levels (–1, 0, and +1) were selected for the optimization process. The optimal conditions of MAE parameters were found to be 2.84 min, 572.50 W, 63.68%, and 0.09 g/mL. Based on the suggested optimum conditions, the obtained responses were  $195.89 \pm 1.07$  (mg diosgenin equivalent/g d.w.),  $81.85 \pm 0.61$  (mg gallic acid equivalent/g d.w.),  $92.86 \pm 0.56\%$ , and  $95.85 \pm 0.81\%$ . Analysis of variance revealed that all the responses including TSC, TPC, DPPH, and ABTS antioxidant capacities were significantly influenced ( $P < 0.05$ ) by irradiation time, solvent concentration, microwave oven power, and feed-to-solvent ratio. Hence, the results obtained from liquid chromatography–quadrupole–time-of-flight mass spectrometry indicated the presence of steroid saponins, triterpenoid saponins, phenolics, and other natural antioxidants.

## KEYWORDS

Fenugreek seed; Saponin; Phenolic; Antioxidant; Microwave-assisted extraction; Optimization

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