



OPTIMIZATION OF EXTRACTION TEMPERATURE AND TIME ON PHENOLIC COMPOUNDS AND ANTIOXIDANT ACTIVITY OF MALAYSIAN PROPOLIS *Trigona Spp.* AQUEOUS EXTRACT USING RESPONSE SURFACE METHODOLOGY

(Pengoptimuman Suhu dan Masa Pengekstrakan pada Sebatian Fenolik dan Aktiviti Antioksidan daripada Ekstrak Akues Propolis Kelulut (*Trigona Spp.*) Malaysia menggunakan Kaedah Gerak Balas Permukaan)

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Abstract

Propolis is a natural product with rich bioactive constituents for medicinal, pharmaceutical, food, and cosmetic uses. It is considered a diet supplement to enhance health and prevent disease. The optimum extraction conditions used to obtain the highest yield of total phenolic content (TPC), total flavonoid content (TFC), and antioxidant capacities for *Trigona* propolis aqueous extract was analyzed using response surface methodology and the central composite design. The effects of extraction temperature (X_1 : 30 - 60 °C) and extraction time (X_2 : 24 - 72 hours) on TPC (Y_1), TFC (Y_2), and antioxidant activities (DPPH (Y_3), ABTS⁺ radical scavenging assay (Y_4), and ferric reducing antioxidant power (Y_5)) were investigated. The experimental data were satisfactorily fitted into a second-order polynomial model with regard to TPC ($R^2 = 0.9461$, $p = 0.0003$), TFC ($R^2 = 0.9110$, $p = 0.0015$), DPPH ($R^2 = 0.9482$, $p < 0.0001$), ABTS ($R^2 = 0.9663$, $p < 0.0001$), and FRAP ($R^2 = 0.9058$, $p = 0.0018$). The optimum extraction temperature and time were 43.75 °C and 52.85 hours. The predicted response values for TPC, TFC, DPPH, ABTS, and FRAP were 104.30 mg GAE/100g, 6.95 mg QE/g, 3.24 mMTE/g, 2.59 mMTE/g, and 4.34 mMTE/g, respectively. The experimental values were close to the predicted values 100.41 ± 2.74 mg GAE/100g, 6.74 ± 0.08 mg QE/g, 3.17 ± 0.08 mMTE/g, 2.76 ± 0.14 mMTE/g, and 4.60 ± 0.14 mMTE/g. As a result, the models generated are suitable, and RSM was successful in