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Effect of Extraction Temperature and Time on The Extraction  
of Phenolic Compounds and Antioxidant Capacity of Phaleria  
Macrocarpa Fruit

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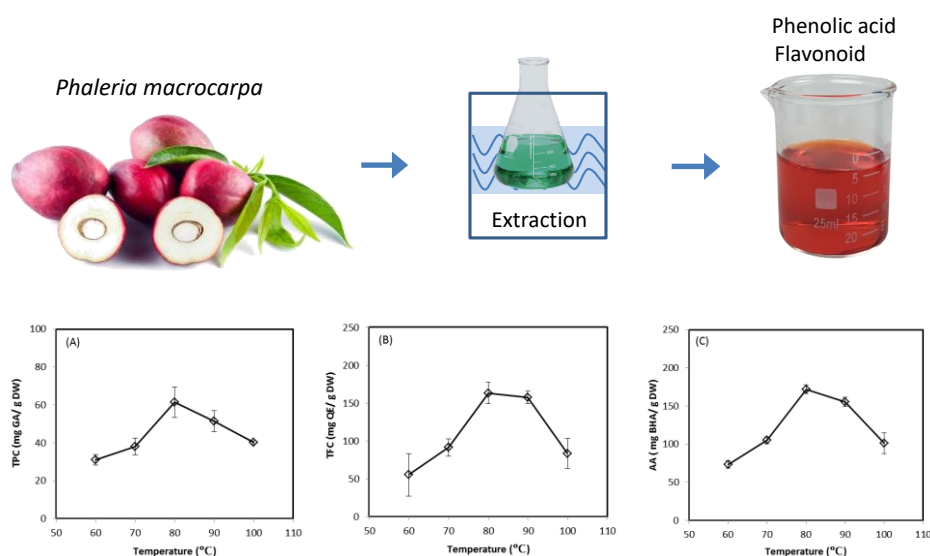


## Research Highlights

*Phaleria macrocarpa* (ver. name: ‘mahkota dewa’) is a plant which has many medically useful antioxidant activities (Anggraini & Lewandowsky, 2015). The polyphenols responsible for this antioxidant activity has to be extracted before it can be routinely used (Shwter et al., 2016). This study investigates the extraction of polyphenols from *P. macrocarpa* fruits and its antioxidant activity (DPPH-RSA) under influence of extraction time and temperature. By employing maceration technique, the *P. macrocarpa* fruits extract showed the maximum total phenolic content (TPC), total flavonoid content (TFC) and DPPH-RSA with value of 69.5 mg QE/g DW, 183.2 mg GA/g DW and 171.8 mg BHA/g DW, respectively at optimum extraction conditions of 60 min and 80 °C (Fig. 1). Excellent and positive Pearson correlation coefficient with  $R^2 > 0.91$  between the TPC, TFC and antioxidant activities was observed.

## Research Objectives

The aim of this study is to investigate the influence of extraction time (30-240 min) and temperature (60-100°C) on the extraction of polyphenols from *Phaleria macrocarpa* fruits using one-factor-at-time approach. The Pearson correlation coefficients analysis was used to study the relationship between the TPC, TFC and DPPH-RSA in the *Phaleria macrocarpa* extracts.



**Fig. 1.** Effect of extraction temperature on the extraction of TPC (A), TFC (B) and DPPH-RSA (C) from *P. macrocarpa* fruit.



## Methodology

Extraction of polyphenols from *Phaleria macrocarpa* was performed via maceration in a stainless-steel tube immersed in a water bath. The extraction temperature and time were set according to the experimental design and the best extraction conditions were determined using one-factor-at-time approach. Each extraction was performed in duplicate. After extraction, the supernatant was separated from the plant material by centrifugation. The total phenolic content (TPC) of extract was determined according to Singleton, Orthofer, and Lamuela-Raventós (1999) method and the total flavanoid content (TFC) was studied according to the aluminum chloride colorimetric assay (Nguang, Yeong, Pang, & Gim bun, 2017). The DPPH radical-scavenging activity (DPPH-RSA) was performed by using method applied by Mokrani and Madani (2016). The Pearson correlation analysis performed using Microsoft Excel.

## Results

The TPC, TFC and DPPH-RSA increases with extraction time and reached maximum at 60 min with the value of 67.1 mg GA/g DW, 183.2 mg QE/g DW and 161.9 mg BHA/g DW, respectively. After 60 min, reduction in TPC, TFC and DPPH-RSA was observed. The initial increase of extraction yield can be explained by Fick's second law of diffusion, whereby the solute concentration in plant and solvent may achieved a final equilibrium state after a sometime (Pang, Lau, Yusoff, & Gim bun, 2017). Therefore, 60 min was the point of the equilibrium achieved which extracted the highest yields. The decrease of yield at a longer extraction duration was due to degradation polyphenols (Muhamad, Yusoff, & Gim bun, 2015).

The temperature, 80 °C has yielded the maximum TPC, TFC and DPPH-RSA which were 69.5 mg GA/g DW and 183.2 mg QE/g DW and 171.8 mg BHA /g DW, respectively. Heating process enhanced the extraction as it softens the cell wall of plant, improves the solubility of compound, and promotes the mass transfer of solute (Dorta, Lobo, & Gonzalez, 2012; Pinelo, Del Fabbro, Manzocco, Nuñez, & Nicoli, 2005; Spigno & De Faveri, 2007).. However, excessive heating may lead to compound degradation, hence reducing the yield (Muhamad, Yusoff, & Gim bun, 2015).





## Findings

A significant and positive correlations between TPC and TFC with antioxidant activity showed that the polyphenols of *P. macrocarpa* extract contributed to its antioxidant activity. The best extraction conditions was achieved at 60 min and 80 °C via maceration of the *P. macrocarpa* fruits with the maximum TPC, TFC and DPPH-RSA value of 69.5 mg QE/g DW, 183.2 mg GA/g DW and 171. 8 mg BHA/g DW, respectively.

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