Effect of Ultrasound on the Extraction of Gallic Acid from Labisia Pumila (Kacip Fatimah)

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Keywords: Labisa pumila, Gallic acid, Ultrasound-Assisted Extraction (UAE) , power intensity, duty cycle

ABSTRACT

Labisia pumila, is a genus of small woody and leafy plants belonging to the Myrsinaceae family that can widely found in the tropical forest of South East Asian countries (Lee Suan Chua et al., 2012). It has a creeping stems and is mainly found in the lowland and hill forests in Southeast Asia, particularly Malaysia, Indonesia, Thailand, Laos, Cambodia, and Vietnam (Farouk et. al., 2008) and mostly obtained from the natural tropical forest (Md Ariff et. al., 2013). Labisia pumila be recognized as a small herbaceous under a shrub that roots from the stem with a few leaves pointing upwards with the spike like panicle of small clusters of white or pink flower (Pattiram, P. D et al 2011). Labisia pumila contains a phenolic compounds (Siti Nadiah Mohd Abdah,2013) and it has been proven to have multiple biological effects, such as high antioxidant properties (Lee Suan Chua et al., 2012) and anti inflammatory activity (R.Vijayalakshmi and R.Ravindhran, 2012). The main functions of antioxidants function is to delay the oxidation processes of other molecules by inhibiting the initiation or propagation of oxidizing chain reactions by free radicals. The important phenolic compounds that helps for the process is known as Gallic acid(3,4,5-Trihydroxybenzoic acid). The antioxidant activity of benzoic acids have been reported higher than vitamin C and E agaist reactive oxygen species(Lee Suan Chua et al., 2012).The chemical formula of gallic acid is $C_7H_6O_5$ with an exact molecular mass of 170.12 g/mol. Their chemical structures are shown in Figure 1.The increasing demand of herbal based product has created great opportunities for global marketing. Therefore, it is vital to identify a best extraction technique to maximize the performance of the process. Recently, ultrasound-assisted extraction (UAE) widely reported for the extraction of medicinal plants and herbs due to its economic and green technology. Kamaljit Vilkhu et. al., (2006) was reported that, ultrasound can enhance existing extraction processes and enable new commercial extraction opportunities and processes. UAE involve mechanical vibrations which is sound waves with high power and intensity. Ultrasound can increase in the permeability of the cell wall, mechanical stressing and cavitation effect during the extraction process (Manish Devgun *et. al*, 2012). This study was carried out to determine the performance of UAE in the extraction of gallic acid from *Labisia Pumila* (Kacip Fatimah). The extraction was conducted by using ultrasonic processor Q700 (700 watts, 20kHz) provided by QSonica, Newtown, U.S.A with a replaceable flat tip ultrasonic probe (sonotrode) made of titanium alloy that had a tip diameter of 12.7 mm and 127 mm length. The sonication regiments (power intensity and duty cycles) were varied to find the maximum gallic acid concentration. The ultrasound power level was varied by adjusting the power setting (knobe) of the sonotrode and duty cycle. The setup of the experiments have been shown in Figure 2. The sonication intensity was calculated using Equation 1:

$$I=P/A \quad (1)$$

where A (cm^2) was the area of the sonotrode tip. The A value was 1.27 cm^2. The amplitude was set at position 1,5,10,20,40 and 80 and for the power level tested, sonication duty was set at 5,10,20,40,80 and 100% (A duty cycle of 5%, for example,was obtained by sonicating for 1 s followed by a rest period of 19s). Throughout the experiment, the sample-to-water ratio and temperature was fixed 1:10 and 40°C, respectively for an hour. The measurements of separation and determination of gallic acid were performed using an High Performance Liquid Chromatography (HPLC) system Agilent Series 1100 equipped with Diode Array Detection (DAD) and a column Phenomenex Prodigy 5ε (250 X 4.60 mm). The wavelength for detection of gallic acid was set at 270 nm. Separation was achieved by flow rate of 1 ml/min with 3.0% Phosphoric acid (90%) / Acetonitrile(10%), in an isocratic programme. The injection volume was 10 εl. Each sample and standard were filtered with nylon syringe filter (pore size of 0.45 εm). As a result, at the 40% of duty cycle and low power intensity (8.66 W/cm^2) showed that the maximum gallic acid extraction with 1.2 and 1.3 fold increment respectively. This extraction has been successfully done without any chemical aid.

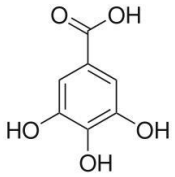

Figure 1. The chemical structures of gallic acid

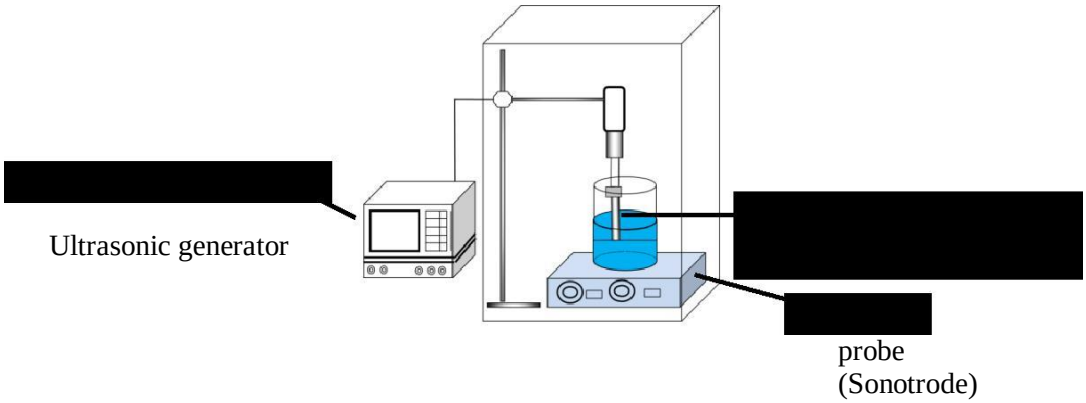

Figure 2. Schematic diagram of ultrasound-assisted extraction

Acknowledgement
This research was made possible with a scholarship from the Ministry of Agriculture & Agro Based , Malaysia, EPP#1 NKEA National Research Grant Scheme (NRGS) RDU 130703 and support from Universiti Malaysia Pahang (UMP).

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