

UNIVERSITI TEKNOLOGI MARA

**SUPERCRITICAL CARBON DIOXIDE
EXTRACTION OF *Curcuma
longa* L. RHIZOME AND ACUTE
TOXICITY EVALUATION OF THE
EXTRACT**

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ABSTRACT

This study was carried out due to the increase in demand of herbal extracts as health supplement, which may contribute to hepatotoxicity if consumed in high amount regularly. Usage of solvent for extraction in conventional extraction methods will also lead to the presence of residues which can be harmful with regular consumption. Therefore, in this study, green extraction method of supercritical carbon dioxide (SC-CO₂) extraction and ultrasonic assisted extraction (UAE) used to extract bioactive compounds from turmeric. The properties of the extracts obtained were compared based on the percentage yield, curcuminoids content, flavour profile, total phenolic content, colour and heavy metal constituents. Turmeric extracted using SC-CO₂ (temperature of 40°C and pressure of 3263 psi) produced 5.62% extraction yield (% dry weight basis), 0.0082% concentration of curcuminoids, 11.91 mg Gallic Acid Equivalent per 100 g of total phenolic content, flavour profile (turmerone and curcumerone), lighter in colour (L = 39.25) and more yellowish (b* = 19.67), higher than UAE extract (temperature of 40°C and frequency of 40 kHz). The content of heavy metals in SC-CO₂ extract namely Zn, Pb, Cd, Fe, Mn, Cr, Ca, Cu and Al were 0.77, 0.052, 0.016, 0.20, 0.081, 0.052, 1.80, 0.056 and 0.22 mg/100 g, respectively, which significantly (p<0.05) lower than those contents in the UAE extract. Due to the quality of extract that it produced, SC-CO₂ extraction method was selected for the optimisation study using Response Surface Methodology (RSM). The optimum extraction condition obtained was at 90°C and 4807 psi, which had resulted in 7.54% yield with desirability value of 1.0. The SC-CO₂ extract also contained 0.023 mg/100 g curcuminoids. Acute toxicity study was also conducted to evaluate any toxicity symptoms to the rats when given high dosage of the turmeric extract. There was no mortality or signs of abnormality on body weight of experimental rats, water and food intake, no alteration in the haematological and biochemical values, as well as the histological parameters at the dosage of 2000 mg/kg of body weight. The study was significance in term of producing turmeric extract using non-conventional extraction method with establishment of optimised SC-CO₂ method and evaluation of safe consumption of the extract at higher dosage (2000 mg/kg b. wt.).

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CHAPTER ONE

INTRODUCTION

1.1 Research Background and Problem Statement

The increasing number of researches on the efficacy of bioactive compounds against several diseases directly indicate the interest in the search for bioactive compounds of natural origin in the past two decades (Herrero, Castro-Puyana, Mendiola, and Ibañez, 2013). Plants, agricultural by-products and marine products are the most promising sources to obtain bioactive compounds (Herrero et al., 2013). Bioactive compounds are not as important as essential nutrient since body can function without it, however they are crucial in maintaining human health (Patil, Jayaprakasha, Murthy, and Vikram, 2009).

The growing health awareness brought a rise in demand for safe and natural products, in particular, foods and pharmaceutical products. Driven from the interest in the use of plant-based extract products, more people are turning to alternative medicines rather than conventional therapeutic medicines (Perveen, Khan, and Sarriff, 2018). According to Herrero, Cifuentes, and Ibañez (2006), new types of food-derived products called nutraceuticals have been developed and are usually employed as food supplements. These food-derived or supplement developed products are usually being extracted from botanicals or medicinal plants which are known to contain one or many chemical constituents (Heng, Tan, Yong, and Ong, 2013).

Among many plants, spices are the most distinguished herbs that attract the interest of many researchers due to its beneficial effects. Black pepper, ginger, cloves, turmeric, nutmeg, mace, cinnamon and cardamom are the most crucial spices for the early and current international commerce (Konar, Harde, Kagliwal, and Singhal, 2013).

Among many spices known, the extract from turmeric or scientifically named *Curcuma longa* L. has been used mainly in pharmaceutical and cosmetics industries (Braga and Meireles, 2007; Singh, Joshi, and Nayak, 2013) and commonly used in a wide variety of cuisines in Southern Asia.

Turmeric or *Curcuma longa* is the rhizomatous herbaceous perennial plant of the ginger family, *Zingiberaceae* (Li, Yuan, Deng, Wang, and Yang, 2011) and it has