CHAPTER 4
EXTRACTION FOR MAHOGANY SEED OIL

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4.1 INTRODUCTION TO MAHOGANY SEEDS

Plants are rich in a diverse array of bioactive compounds. Many of them are phenolics or oxygen-substituted derivatives, especially tannins. Among the 391,000 plant species, some of them have been used as herbal medicines. The history of herbal-based pharmacological disease treatment began centuries ago. Various parts of the herbs, such as seeds, fruits, roots, leaves, bark, and flowers, have traditionally been used to address health issues and promote overall well-being.

Mahogany, or commonly called as big leaf mahogany and scientifically known as *Swietenia macrophylla,* is widely recognized in the industrial sector, particularly within the furniture industry, primarily due to its strong and good quality timber. Its seeds are brown, flat and winged. In addition to its valuable wood quality, the seeds of mahogany are rich in bioactive compounds potentially applied in pharmaceutical industries. The bioactive compounds offer opportunities for further exploration in therapeutic and medicinal uses. The bioactive components in the seeds include linoleic acid (omega-6), oleic acid (omega-9), and β-sitosterol (Mohammed et al., 2015). They possess antioxidant, antimicrobial, and antidiabetic properties. Its seed oil can

also be used to heal wounds. Studies reported the seed extract possessed a non-cytotoxic effect on fibroblasts (Hartati et al., 2018). Mahogany seed oil has traditionally been used for treating skin conditions, aiding wound healing, and supporting overall health. More recently, it has gained attention in the cosmetic and nutraceutical industries for its ability to nourish skin and hair, reduce oxidative stress, and act as a natural ingredient in formulations aimed at wellness and beauty. Nowadays, this plant has been recognized as a versatile species with significant economic value.

The extraction method recommended for mahogany seed oil is subcritical water extraction (SWE). SWE is a green extraction technique that uses water at elevated temperatures (around 100 °C–374 °C) and pressures (up to 218 atm) to maintain it in the liquid state. The conditions of subcritical water can be illustrated using the diagram as shown in Figure 4.1. Water is used as the extractant; the operation can be done in a non-toxic, non-flammable, and renewable condition. Under these conditions, water behaves differently than its condition at room temperature. Therefore, subcritical water is a powerful solvent for extracting a wide range of bioactive compounds. It behaves like an organic solvent because of the decrease in dielectric constant at subcritical conditions. Since subcritical water is less polar, it can solubilize both polar and moderately non-polar compounds. The decrease of viscosity and surface tension also improves mass transfer process during extraction. Water possesses distinct quality, and therefore, it is also termed as "universal solvent".

The efficiency of compound extraction by SWE can be estimated using thermodynamic model. A thermodynamic model is utilized to measure the dissociation constant, K_D of seed oil, to improve the efficiency of extraction. The thermodynamic elution of analytes from the sample matrix is the prevailing mechanism for SWE. The extraction rates increase proportionally with the flow rate of hot water. Binding affinity is typically measured and reported by K_D, which is used to evaluate and rank the order of strengths in bimolecular interactions. The lower the K_D value, the greater the binding affinity of the ligand for its specific target.

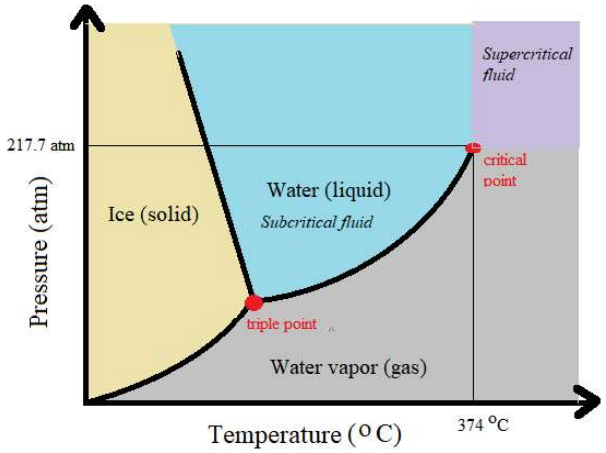

Figure 4.1 The change of temperature and pressure for subcritical water

Mahogany products are widely found in local or international markets, especially in the form of medicinal products, personal care products, and wound healing gel products. This proves that people around the world truly believe in the magnificence of mahogany for its exceptional natural properties. The number of studies on mahogany is also increasing. Researchers continuously review the hidden potentials of this plant. There is almost no research highlighting the usage of thermodynamic model in determining the K_D value of mahogany seed oil in SWE.

4.2 SUBCRITICAL WATER EXTRACTION AND THERMODYNAMIC MODEL

It is essential to ensure that the extraction aligns with the thermodynamic behavior of the solute before applying the thermodynamic model. SWE is chosen as it has shorter handling time and lower solvent consumption. Additionally, SWE reduces the loss of heat-sensitive compounds and does not use toxic organic solvents. This technique could easily alter the extraction parameters, such as temperature, pressure, and co-solvent, to achieve higher selectivity in the extraction of polar, moderately polar, and nonpolar compounds.