CHAPTER

4

MAHOGANY SEED EXTRACTION USING SUBCRITICAL WATER

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4.1 INTRODUCTION

Plants have served as the earliest form of medicine for humanity as long as history has been recorded. Across civilizations, plant-based remedies have been used for a myriad of purposes, including to treat wounds, alleviate pain and manage chronic conditions. Even with the rapid progress in modern pharmaceuticals, the relevance of medicinal plants remains popular. Today, there is a renewed scientific interest in natural products, not only for cultural significance but also for pharmacological potential in combating diseases such as cancer, diabetes, and cardiovascular disorders.

Malaysia, with its equatorial climate and rich rainforest ecosystem, is home to more than 1,300 recorded species of medicinal plants in Peninsular Malaysia alone (Khatun et al., 2011). These plants are deeply rooted in the local traditional medical practices, and ongoing research continues to highlight their biological activities and therapeutic potential. The knowledge, previously passed down through generations, is now being validated using modern analytical techniques and extraction technologies.

Among the many promising species, Mahogany, or commonly known as sky fruit or big-leaf mahogany (Figure 4.1) and scientifically know as *Swietenia macrophylla*, has emerged as a subject of scientific interest due to its wide-ranging health benefits. This species belongs to the Meliaceae family and is known for its towering presence, growing up to 40 meters tall with broad leaves and upward-pointing fruits (Moghadamtousi et al., 2013). The seeds of mahogany, once used traditionally in Southeast Asia for managing ailments like hypertension, diabetes and inflammation, are now being investigated for their rich content of bioactive compounds, namely limonoids, flavonoids and polyphenols (Dewanjee et al., 2009; Goh et al., 2010).

Figure 4.1 Fruits and seeds of mahogany, scientifically know as *Swietenia macrophylla*

These compounds are of particular interest because of their antioxidant activity. Antioxidants, are known to counter oxidative stress, a biological condition characterized by the accumulation of free radicals that can damage cellular structures and contribute to the development of chronic and degenerative diseases. Oxidative stress is increasingly recognized as a major contributor to the pathophysiology of diabetes, a condition that has reached epidemic levels globally.

Given these alarming situations, there is a growing need to explore plant-derived antioxidants that are safe, effective and sustainably sourced. Several studies have demonstrated that the antioxidant and therapeutic potential of plant extracts are closely related to their phenolic content (Pinto et al., 2021). Phenolic

compounds, including flavonoids and tannins, not only scavenge free radicals but also modulate key enzymes and inflammatory pathways, making them ideal candidates for the prevention and management of chronic diseases.

However, the full potential of these plant compounds can only be realized if they are extracted efficiently. Traditional extraction methods, while effective to a degree, are often labour-intensive, time-consuming, and reliant on large volumes of organic solvents. This has prompted the scientific community to turn to more sustainable and efficient extraction techniques.

Subcritical water extraction (SWE) is an innovative method that utilizes water at elevated temperatures (100–374°C) and pressures to extract a broad range of bioactive compounds. Unlike conventional extraction methods, SWE requires no harmful organic solvents and is often faster, more selective and environmentally friendly. The ability to tune the polarity of water by adjusting the temperature enables SWE to specifically target compounds of varying chemical nature, from polar polyphenols to slightly non-polar phytochemicals.

Although SWE has been applied successfully to botanical materials such as papaya seeds (Rodrigues et al., 2019) and coriander seeds (Saim et al., 2008), its application to mahogany remains largely unexplored. This gap presents a unique opportunity to develop cleaner, faster and more sustainable methods for extracting health-promoting compounds from this valuable seed.

In this chapter, the application of subcritical water extraction in the context of mahogany seed is explored to investigate how this technique can be optimized to maximize the extraction of phenolic compounds with antioxidant activity. The aim is to contribute not only to the scientific understanding of mahogany medicinal properties but also to the broader goal of developing green technologies in natural product extraction.