Chapter 1

Introduction

1.1 Background

Sesame is a crucial oilseed crop cultivated primarily for its seeds, which are either consumed directly or processed into sesame oil as a culinary staple (Muthoni & Shimelis, 2025). These seeds are rich in bioactive compounds such as sesamin, sesamolin, and sesamol, which are closely associated with antioxidant, anti-inflammatory, and glucose-regulating effects that help improve cardiovascular health and prevent chronic diseases (Dalibalta et al., 2020). Furthermore, sesame seeds are rich in vitamin E and unsaturated fatty acids, which further contribute to these beneficial effects, thereby highlighting their nutritional and therapeutic relevance. As such, much of the focus on *Sesamum indicum L.* has been on seed-derived products (Pal et al., 2020).

In contrast, non-seed parts of sesame, such as leaves, stems, and pods, are largely underutilized and discarded after harvest, with applications limited to animal feed or compost. Consequently, this practice results in considerable amounts of unused biomass, contributing to economic inefficiencies and potential environmental burdens associated with agricultural waste, such as soil erosion, especially in Taiwan. The limited utilization underscores a missed opportunity to extract additional value from sesame cultivation, highlighting the need for a more sustainable and value-added approach that extends beyond seed-based cultivation (Areti et al., 2024; Shao et al., 2020; Yuan et al., 2023).

Recent studies show that the non-seed parts of oilseed crops contain high levels of polyphenols and secondary metabolites with potent antioxidant properties. Such compounds have been implicated in mitigating oxidative stress and in providing protective effects against chronic diseases, including cancer and diabetes. This is particularly significant, given the growing demand for natural bioactive compounds in the pharmaceutical industry as a sustainable therapeutic agent with low toxicity and

high biocompatibility (Dincheva et al., 2025). Nevertheless, the chemical composition and potential health benefits of unused sesame plant components remain poorly characterized, particularly with respect to varietal and regional differences, which limit their application (Oleszek et al., 2023; Strieder et al., 2025; Wang et al., 2024).

Given these insights, this research aims to investigate whether the non-seed parts of sesame, namely the leaves, stems, and pods, contain phytoconstituents and if their profiles differ across various Taiwanese black sesame varieties, such as Chiayi 1 (CY1), Chiayi 2 (CY2), and Tainan 1 (TN1). In addition, this study aims to determine whether these non-seed parts contain measurable levels of total phenolic content and total flavonoid content, along with antioxidant activity. The primary outcomes of this study include (1) a molecular network generated from LC-MS/MS spectral similarities, which identifies the phytoconstituents present in each plant part and how they differ across varieties, and (2) the determination of TPC, TFC, and antioxidant activity in non-seed sesame parts. In turn, this research can provide foundational knowledge in the development of bioactive products derived from non-seed parts of sesame, thereby promoting their economic value.

1.2 Objective

Primary Objective:

To investigate the presence, composition, and bioactive potential of phytoconstituents in the non-seed parts of *Sesamum indicum L.* and determine how these profiles vary among different Taiwanese black sesame varieties.

Secondary Objectives:

- *Prepare extracts from sesame pods, stems, leaves, and seeds using ultrasound-assisted extraction (UAE), followed by concentration via rotary evaporation*
- *Perform preliminary phytoconstituent screening via TLC and HPTLC*
- *Perform LC-MS/MS-based molecular networking to categorize identified compounds*

- *Perform chemical assays, including determination of total phenolic content (TPC), total flavonoid content (TFC), and antioxidant activity of the extracts using DPPH and ABTS assays, including IC_{50} evaluation*

1.3 Hypothesis

This research hypothesizes that:

- The non-seed parts of sesame (leaves, stems, and pods) contain phytoconstituents.
- The phytoconstituent composition of non-seed sesame parts differs among Taiwanese black sesame varieties.
- The phytoconstituents within the non-seed parts of sesame contain measurable levels of total phenolic and total flavonoid content and can exhibit antioxidant activity.