Chemical Composition of 52 Thai Herbal Plants Determined by UV–Visible Spectrophotometry and Gas Chromatography–Mass Spectrometry (GC–MS)

Donthiya Panak, Phumon Sookwong
Department of Chemistry, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
Email: donthiya_p@cmu.ac.th

Abstract

This study aimed to investigate the chemical composition and antioxidant activities of Thai herbal plants (wan). A total of 52 species were evaluated for antioxidant activity, total phenolic content (TPC), and total flavonoid content (TFC) using UV–Visible spectrophotometry. Nine selected species were further analyzed for their chemical constituents using Gas Chromatography–Mass Spectrometry (GC–MS). The DPPH radical scavenging assay demonstrated percentage inhibition ranging from 17.85% to 94.34%, corresponding to 0.34–50.45 mg AAE/g. Total phenolic content ranged from 1.37–113.74 mg GAE/g, while total flavonoid content ranged from 0.09–139.63 mg QE/g. Correlation analysis revealed a strong positive relationship between TPC and antioxidant activity (R^2 = 0.8544), whereas TFC showed a moderate correlation (R^2 = 0.412). The correlation between TPC and TFC was relatively weak (R^2 = 0.328), suggesting that phenolic compounds as a whole contribute more substantially to antioxidant capacity than flavonoids alone. The results indicated that Wan Khamin Chan, Wan Phaya Ha Roi, and Wan Kwak Thong demonstrated comparatively higher antioxidant capacity and total phenolic content among the investigated species. GC–MS analysis indicated that the predominant constituents were terpenes and terpenoids, particularly sesquiterpenes. Additional compounds identified included phenolic compounds, flavonoids, fatty acid derivatives, phytosterols, and hydrocarbons, demonstrating the chemical diversity and potential bioactivity of Thai herbal plants (wan).

Introduction

Herbal plants are natural resources that provide many benefits, including disease treatment, body care, and health promotion. In traditional and alternative medicine, herbs have long been used to help maintain health and relieve various illnesses. In recent years, people have become more interested in natural remedies and herbal medicine as safer alternatives for health care. **"Wan"** is a group of Thai herbal plants widely recognized in traditional knowledge and cultural practices. The term "Wan" is not a specific botanical name but a general term used for plants believed to have medicinal properties or auspicious significance. Many Wan plants have underground rhizomes or tubers and are found in several plant families such as *Zingiberaceae*, *Araceae*, and *Amaryllidaceae*. Due to their diverse chemical constituents, these plants are considered valuable sources of bioactive compounds and are commonly used in traditional Thai medicine.

Methodology

Extraction for UV-Vis Spectroscopy



52 Thai herbal plants



Freeze-dry and ground into powder



Using 0.5 g of wan powder
Add 10 mL of MeOH80%

Shaking incubator
25 °C and 160 rpm for 3 hours



Filtered through cotton-packed syringe and collected in vial



Determination of **Antioxidant Activity**, **TPC** and **TFC** using **UV-VIS spectrometry**

- **Determination of Antioxidant Activity using DPPH assay**

Using 0.2 mL of extracts
add 3 mL of DPPH solution → Mixed and stand for 30 minutes in the dark → Measure absorbance at 517 nm

- **Determination of Total Phenolic Content (TPC)**

Using 0.2 mL of extracts
Add 2.5 mL of 10% v/v Folin-Ciocalteu's Reagent
Add 2 mL of 7.5% w/v Na_2CO_3 → Mixed and stand for 2 hours in the dark → Measure absorbance at 765 nm

Extraction for GC-MS

- **non-polar**
  Using 1 g of wan powder
  Add 10 mL of hexane
- **polar**
  Dregs from hexane extraction
  Dried at 40 °C for 1 hour
  Add 10 mL of MeOH



Vortexed for 1 min, sonicated at 50 °C for 30 min → Centrifuged at 4000 rpm for 5 min → Supernatant colloected and hexane extraction repeated



Evaporated until less than 1 mL → Adjusted with hexane to 1 mL and Filtered with syringe filter



TMS-Derivertization (only polar fraction)
MeOH extract Add 100 µL of BSTFA, 100 µL of pyridine vortexed for 30 second and Derivatization on shanking incubator at 60 °C for 2 hour



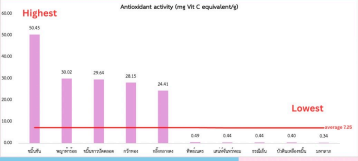
Analysis with **GC-MS** Agilent-6850/5973

- **Determination of Total Flavonoid Content (TFC)**

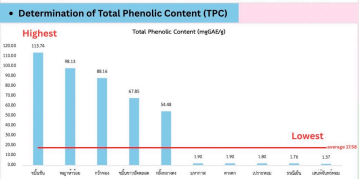
Using 0.5 mL of extracts
Add 1.5 mL of methanol
Add 0.1 mL of 10% w/v $AlCl_3$
Add 0.1 mL of 1mM CH_3COOK
Add 2.8 mL of DI water → Mixed and stand for 30 minutes in the dark → Measure absorbance at 415 nm

Results and Discussion

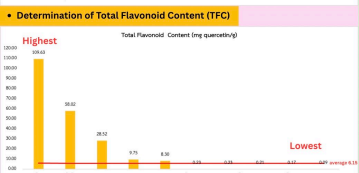
- **Determination of Antioxidant activity**



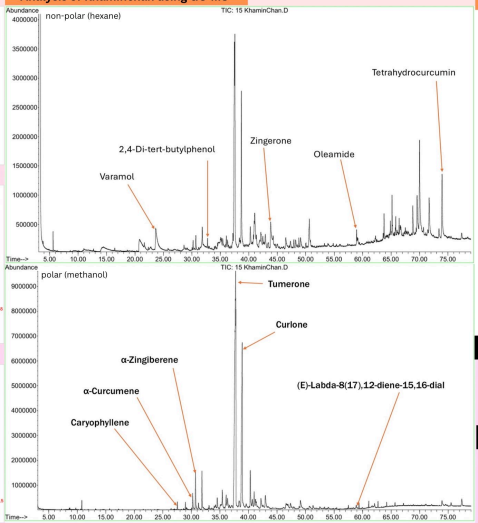
- **Determination of Total Phenolic Content (TPC)**



- **Determination of Total Flavonoid Content (TFC)**



Analysis of Khaminchan using GC-MS



Compound	Chemical group	Activity
Turmerone	Sesquiterpene	Anti-inflammatory, antioxidant and antimicrobial activities.
Curlone	Sesquiterpene	Antioxidant and anti-inflammatory properties.
Caryophyllene	Sesquiterpene	Anti-inflammatory and antimicrobial activity.
α-Curcumene	Sesquiterpene	Antioxidant and antimicrobial activity.
Zingiberene	Sesquiterpene	Antioxidant and antimicrobial properties.
Tetrahydrocurcumin	Phenolic compound	Strong antioxidant and anti-inflammatory activity.
Zingerone	Phenolic compound	Antioxidant and antimicrobial activity.
2,4-Di-tert-butylphenol	Phenolic compound	Antioxidant and antimicrobial properties.
Oleamide	Fatty acid amide	Shows antimicrobial and anti-inflammatory activity.

Conclusions

The results of this study demonstrate that Thai herbal plants (wan) contain a wide variety of chemical constituents and exhibit different levels of antioxidant activity. Plants with higher total phenolic content generally showed stronger antioxidant capacity, suggesting that phenolic compounds play an important role in antioxidant activity. In addition, GC–MS analysis revealed the presence of several bioactive compounds, particularly terpenes, terpenoids, and phenolic compounds, which are commonly associated with biological activities in herbal plants. These findings highlight the chemical diversity of Thai herbal plants (wan) and support their potential as natural sources of bioactive compounds. The obtained data can serve as a scientific basis for selecting promising species for further studies and for the development of herbal medicines or health-related products in the future.

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- Department of Chemistry, Faculty of Science, China Mai University

References

- Brand-Williams, W., Cuvelier, M. E., & Berset, C. (1995). Use of a free radical method to evaluate antioxidant activity. LWT – Food Science and Technology, 28(1), 25–30. https://doi.org/10.1016/S0023-6438(95)80008-5
- Xiang, Q., Liu, X., Liu, S., Ma, Y., Xu, C., & Bai, Y. (2019). Effect of plasma-activated water on microbial quality and physicochemical characteristics of mung bean sprouts. Innovative Food Science and Emerging Technologies, 52, 49–56. https://doi.org/10.1016/j.ifset.2018.11.012
- Tian, M., Xu, X., Liu, Y., Xie, L., & Pan, S. (2016).Effect of Se treatment on glucosinolate metabolism and health-promoting compounds in the broccoli sprouts of three cultivars. Food Chemistry, 190, 374–380. https://doi.org/10.1016/j.foodchem.2015.05.098