Comparative study on the chemical composition and applications of *Citrus-aurantium* and *Citrus hystrix*

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ABSTRACT

Bitter orange (*Citrus aurantium*) and kaffir lime (*Citrus hystrix*) are plants in the *Citrus* genus of the Rutaceae family. In this study, essential oils were extracted from the peels using a Clevenger-type distillation apparatus, which is an effective method for extracting high-quality essential oils without the use of chemicals. The extracted essential oils of bitter orange and kaffir lime were clear and colorless, with yields of 4.30% and 1.93%, respectively. Gas chromatography-mass spectrometry (GC-MS) analysis revealed that the essential oil from bitter orange peel contained 16 identified chemical components, with the highest concentration being *L*-Limonene (89.58%). The essential oil from kaffir lime peel contained 31 identified chemical components, with the most abundant being 1S-α-Pinene (26.89%). Comparing the two essential oils, 8 compounds were found exclusively in bitter orange oil, 23 compounds were unique to kaffir lime oil, and 8 compounds were common to both oils. Functional group analysis was performed using Fourier-transform infrared spectroscopy (FT-IR). The signal patterns in the IR spectra of both essential oils were similar.

INTRODUCTION

Figure 1. *Citrus aurantium* and *Citrus hystrix.*

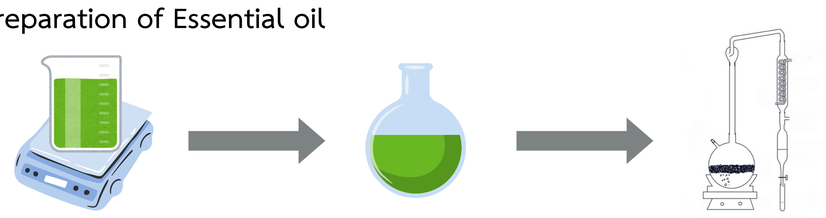
Bitter orange (*Citrus aurantium*) and kaffir lime (*Citrus hystrix*) are aromatic citrus plants with a variety of benefits in food, medicine, and cosmetics. Bitter orange is commonly used to enhance the aroma of food and beverages, while kaffir lime has a uniquely fragrant rind, and its leaves are a popular ingredient in Thai cuisine. Both plants also have medicinal properties, such as aiding digestion and acting as antioxidants. This study focuses on extracting essential oils from their peels for further development into various products.

OBJECTIVES

1.To extract essential oils from the peel of bitter orange and kaffir lime using hydro-distillation.
2.To analyze and identify the molecular compounds in both essential oils.
3.To utilize the extracted essential oils for the production of perfumes.

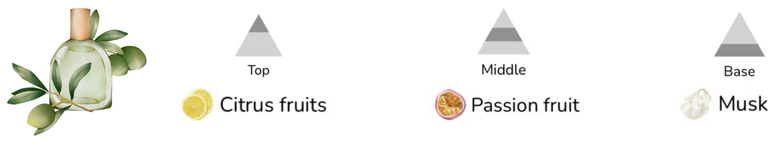
METHODOLOGY

- Preparation of Essential oil



- GC-MS Analysis and FTIR

- Perfume ingredients



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[2] Andrade, M.A., Barbosa, C.H., Shah, M.A., Ahmad, N., Vilarinho, F., Khwaldia, K., Silva, A.S., Ramos, F., 2023. Citrus by-products: valuable source of bioactive compounds for food applications. Antioxidants 12, 38.

RESULTS AND DISCUSSION

- Essential oil extraction

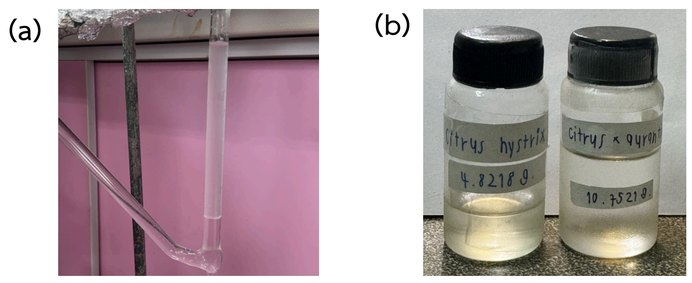

Figure 2. (a) Essential oil from distillation and (b) Essential oil from *Citrus hystrix* and *Citrus aurantium.*

- GC-MS Analysis

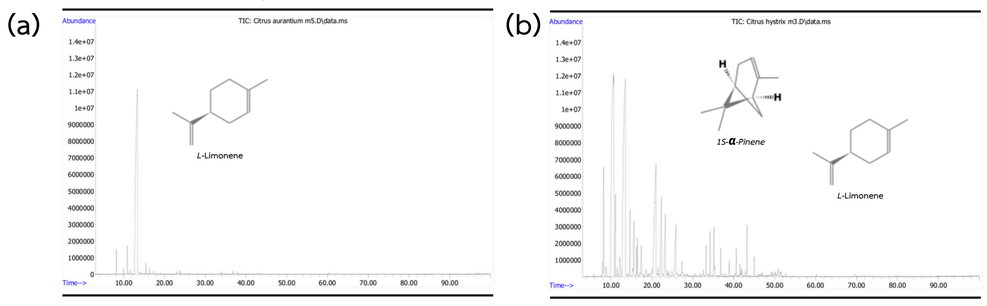

Figure 3. (a) GC–MS Chromatogram of essential oils from *Citrus aurantium* and (b) *Citrus hystrix*.

- FTIR

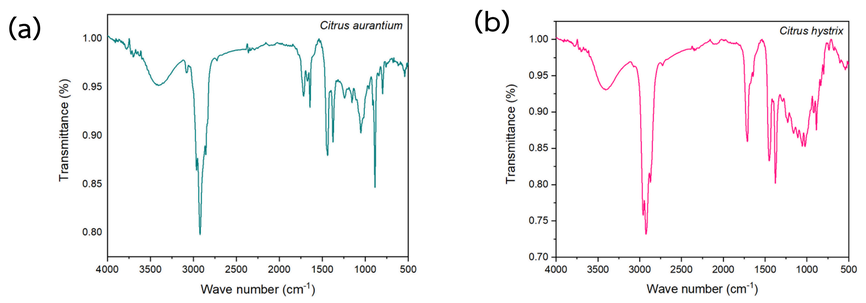

Figure 4. FT–IR Spectrum of essential oils from *Citrus aurantium* (a) and *Citrus hystrix* (b).

- Perfume Testing

Formula	Perfume formulation									
	Ethanol 96% (%)	Essential oils (%)	Passion fruit (%)	Rose (%)	Mint (%)	Musk (%)	Herb (%)	Jasmine (%)	Agarwood (%)	Lavender (%)
Formula 1	50	*Citrus aurantium* (10)	-	-	-	20	-	5	8	7
Formula 2	50	*Citrus aurantium* + *Citrus hystrix* (10.50 : 2.50)	-	-	-	30	-	-	-	7
Formula 3	50	*Citrus aurantium* (12.5)	15	5	5	5	7.5	-	-	-
Formula 4	50	*Citrus aurantium* + *Citrus hystrix* (10.50 : 2.50)	-	-	-	18	-	10	3	6

Figure 5. Perfume formulation.

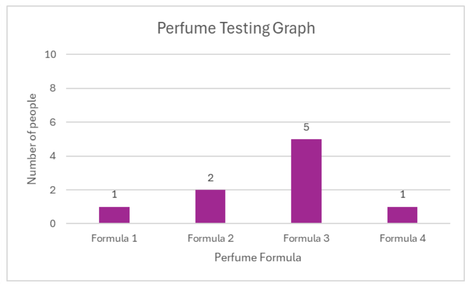

Figure 6. Perfume Testing Graph.

CONCLUSION

- The essential oil extraction yield from *Citrus aurantium* was 4.30%, while from *Citrus hystrix* was 1.93%.
- *Citrus aurantium* contained 16 compounds, with the the most abundant being *L*-Limonene (89.58%).
- *Citrus hystrix* contained 31 compounds, with the most abundant being 1S-α-Pinene (26.89%).
- Comparing the two essential oils, 8 compounds were found unique in *Citrus aurantium* oil, 23 compounds were unique to *Citrus hystrix* oil, and 8 compounds were common to both oils.
- The signal patterns in the IR spectra of both essential oils were similar.
- A consumer survey (10 persons) to test the scent, the order of satisfaction was formula 3 > formula 2 > formula 1,4