

Antiproliferative Activity and GC MS Analysis from the Leaves Extract of Different *Cultivars Carica Papaya*

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มีการอ้างอิงในช่วง 1 เม.ย.- 30 ก.ย. 68 จำนวน 1 บทความ

Phytochemical Analysis of *Citrus grandis* (Tubtim Siam) Leaves and Peels Extracts and Their Biological Potential

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Abstract Pomelo (*Citrus grandis*) is renowned for its sweet, tangy flavor, with the Tubtim Siam cultivar being especially popular in Thailand for its vibrant reddish-pink flesh. While citrus leaves and peels are typically discarded, they may contain valuable bioactive compounds. This research examines the phytochemical profile, antioxidant, antimicrobial, and anticancer properties of *C. grandis* (Tubtim Siam) extracts obtained from its leaves and peels. Phytochemical screening revealed the presence of alkaloids, flavonoids, terpenoids, and coumarins in all extracts, with coumarins absent in the water extract of leaves (LE) and anthraquinones undetected in all samples. The antioxidant activity, evaluated through the DPPH radical scavenging assay, revealed that the ethanolic peel extract (PE) exhibited the strongest antioxidant potential (IC₅₀ 0.532 ± 0.02 mg/mL), correlating with high levels of total phenolics (96.71 ± 2.04 mg GAE/g) and flavonoids (958.06 ± 63.28 mg QE/g). The extracts exhibited limited antimicrobial and anticancer effects. GC-MS analysis of the PE extract identified 22 bioactive compounds, including naringenin (21.37%), meranzin hydrate (11.17%), isooraptene (5.39%), D-limonene (2.01%), and elemicin (1.64%). Notably, this study identified six compounds newly reported in Tubtim Siam extracts through GC-MS analysis, including 3,5-dihydroxy-6-methyl-2,3-dihydropyran-4-one, 4-(1-aminoethyl)phenol, limonene glycol, *p*-methoxytodadiol, 4-(1*E*)-3-hydroxy-1-propenyl-2-methoxyphenol, and *N*-(4-methoxyphenethyl)-benzamide. These findings highlight the potential of *C. grandis* as a valuable reservoir of biologically active compounds, supporting its therapeutic applications and emphasizing the need for further research into its bioactive properties.

Keywords: *Citrus grandis*, phytochemicals, phenolic compounds, antioxidant activity, GC-MS analysis.

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Received: 08 Jan. 2025
Accepted: 13 May 2025

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Introduction

Plant-based natural products have long been integral to traditional medicine and remain a focal point of scientific research due to their broad therapeutic potential. These substances possess a variety of biological activities that play an important role in promoting human health. Among them, natural antioxidants have garnered particular attention for their ability to mitigate oxidative stress, a major contributor to aging and the development of chronic diseases such as cancer, diabetes, and cardiovascular disorders [1]. Flavonoids and phenolic compounds, abundant in many plants, are known to neutralize free radicals, regulate enzyme activities, and modulate signaling pathways involved in inflammation and apoptosis [2]. In parallel, the antimicrobial properties of plant-derived extracts provide

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