ESSENTIAL OILS, PHYTOCHEMICALS AND BIOACTIVITY STUDIES OF
Curcuma aeruginosa Aff. AND Kaempferia rotunda Linn.

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To my beloved mother and father
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ABSTRACT

The essential oils, phytochemicals and bioactivities of *Curcuma aeruginosa* Aff., known as temu hitam and *Kaempferia rotunda* Linn. or kunyit putih have been studied. Hydrodistillation of the fresh rhizomes of *C. aeruginosa* and *K. rotunda* gave 77.1% and 89.3% oils respectively. These oils were analyzed by GC and GC-MS. The chemical compositions were identified by comparison of the mass spectral data of Wiley Library and Kovats Indices with literature values. A total of 42 components were identified from *C. aeruginosa* with epicurzerenone (19.47%) as the major constituent followed by 1,8-cineole (15.89%), trans-β-farnesene (9.75%), β-elemene (6.61%) and camphor (5.84%). *K. rotunda* essential oil was found to have 33 components with high concentration of benzyl benzoate (31.48%), bornyl acetate (5.56%), camphor (5.45%) and camphene (5.04%). Extractions by soxhlet apparatus were carried out on the dried samples to get the crude extracts. Fractionation and purification on the crude extracts of both species resulted in the isolation of sesquiterpenoids, cyclohexane oxide, esters and fatty acid. The structures of the isolated compounds were identified by spectroscopic techniques including IR and NMR (1D and 2D) spectroscopies and mass spectrometry. Seven sesquiterpenoids were isolated from *C. aeruginosa* and identified as curzerenone, furanodienone, germacrone, dehydrocurdione, curcumene, curcumenol and curzeone. Four compounds were successfully isolated from *K. rotunda* and characterized as benzyl benzoate, crotepoxide, lignoceric acid and stigmasterol. The crude extracts, essential oils and several pure phytochemicals were screened for antibacterial and antityrosinase activities. Disc diffusion method followed by minimum inhibition concentration (MIC) and minimum bactericidal concentration (MBC) against Gram positive and Gram negative bacteria were used for antibacterial assay. All the essential oil, crude extracts and compounds of *C. aeruginosa* and *K. rotunda* exhibited weak to inactive activity against the entire tested microorganisms. Modified dopachrome method with L-DOPA as the substrate was chosen to screen the antityrosinase activity. Among all the tested samples, the essential oil of *C. aeruginosa* possessed the highest activity with 15.62% inhibition against the mushroom tyrosinase. This inhibition value was far lower compared to the standard kojic acid which showed 81.81% inhibition.
ABSTRAK

Kajian ke atas minyak pati, fitokimia dan bioaktiviti *C. aeruginosa* Aff., yang dikenal sebagai cekur hitam dan *K. rotunda* Linn. atau kunyit putih telah dijalankan. Penyulingan hidro terhadap rizom segar *C. aeruginosa* dan *K. rotunda* masing-masing telah memberikan 77.1% dan 89.3% minyak pati. Minyak ini dianalisis menggunakan GC dan GC-MS. Komposisi bahan kimia telah dikenal pasti melalui perbandingan data spektrum jisim daripada perpustakaan Wiley dan nilai Indeks Kovats daripada literatur. Sebanyak 42 komponen telah dikenal pasti daripada *C. aeruginosa* dengan epikurzerenon (19.47%) sebagai komponen utama diikuti oleh 1,8-sineol (15.89%), *trans*-β-farnesena (9.75%), β-elemena (6.61%) dan kamfor (5.84%). Minyak pati *K. rotunda* terdiri daripada 33 komponen dengan komponen utamanya benzil benzoat (31.48%), bornil asetat (5.56%), kamfor (5.45%) dan kamfena (5.04%). Pengestrakan soxhlet telah dijalankan ke atas rizom kering untuk mendapatkan ekstrak mentah. Pemeringkatan dan penulenan ke atas ekstrak mentah bagi kedua-dua spesies telah mengasingkan sebatian seskuiterpenoid, sikloheksana oksida, ester dan asid lemak. Struktur semua sebatian telah dikenal pasti menggunakan teknik spektroskopi termasuk spektroskopi IR dan NMR (1D dan 2D) serta spektrometri jisim. Tujuh sebatian seskuiterpenoid telah diasingkan daripada *C. aeruginosa* dikenal pasti sebagai kurzerenon, furanodie non, germakron, dehidrokurdion, kurkumenon, kurkumenol dan kurzeon. Empat sebatian telah berjaya diasingkan daripada *K. rotunda* dikenalpasti sebagai benzil benzoat, krotepoksida, asid lignoseric dan stigmasterol. Ekstrak mentah, minyak pati dan beberapa fitokimia tulen telah disaring untuk aktiviti antibakteria dan anti-tirosinase. Kaedah penyebaran cakera diikuti dengan kepekanan kepekanan perencatan minimum (MIC) dan kepekanan bakterisida minimum (MBC) terhadap bakteria Gram positif dan Gram negatif telah digunakan untuk saringan antibakteria. Kesemua sampel minyak pati, ekstrak mentah dan fitokimia *C. aeruginosa* dan *K. rotunda* menunjukkan keaktifan yang lemah sehingga tidak aktif terhadap seluruh mikroorganisma yang diuji. Kaedah pengubahsuaiian dopakrom dengan L-DOPA sebagai substrat dipilih sebagai kaedah untuk menguji aktiviti anti-tirosinase. Antara semua sampel yang diuji, minyak pati *C. aeruginosa* memiliki aktiviti tertinggi dengan 15.62% perencatan berbanding tirosinase cendawan. Nilai ini adalah jauh lebih rendah daripada piawai asid kojik dengan 81.81% perencatan.