CHEMICAL CONSTITUENTS AND BIOLOGICAL ACTIVITIES OF *GARCINIA CUNEIFOLIA, MESUA BECCARIANA* AND *MESUA FERREA*

By

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Chairman: **Associate Professor Gwendoline Ee Cheng Lian, Ph. D.**

Faculty: **Science and Environmental Studies**

Investigations on the stem bark of ***Garcinia cuneifolia, Mesua beccariana*** and ***Mesua ferrea*** (Guttiferae) have resulted in the isolation of eight compounds. The structures of these compounds were elucidated by using spectroscopic techniques such as nuclear magnetic resonance (NMR), mass spectroscopy (MS), infra red (IR), ultraviolet (UV) and also by comparison with previous reports.

The stem bark of *G. cuneifolia* collected from Sarawak, yielded three new compounds: a new xanthone, cuneifolin, a new triterpenoid benzoate lactone, 3-benzoyloxyoleane-19-en-13,28-olide and a new aromatic compound, 3-methoxy-4-heptyloxy cinnamic acid. Beside that, there are two more known compounds have been isolated, rubraxanthone and stigmasterol. From the stem bark of *M. beccarianna*, a new

hexatrione, 6-(19-hydroxy-20-oxo-19-phenyl-propyl)-3-methyl-8,8-bis-(11,16-methyl-but-10,15-enyl)-2,5*H*-naphthalene-1,4,7-trione, and a suggested compound, 10[2,4,6-tris-(14,25,36-methyl-but-13,24,35-enyl)-(3,17;5,28)terphenyl-1-yloxy]-butyric acid methyl ester, together with two known triterpene, friedelin and stigmasterol were isolated. *M. ferrea* gave the common steroidal triterpenes friedelin and stigmasterol.

The essential oil was obtained by hydrodistillation using fresh flowers of *M. ferrea* (collected from UPM, Serdang) and analysed using GC-MS spectrometry. The main essential oil component is germacrene D (48.96%).

Both the crude extracts of *G. cuneifolia* and *M. beccariana* (stem bark) were not active towards CEM-SS cells line, except for the hexane extract of *M. beccariana*, which showed weak cytotoxic effect. Two pure compounds, stigmasterol and friedelin, together with the essential oil from the flower of *M. ferrea* were found to be inactive towards this bioactivity.

The antimicrobial activity test against five types of bacteria i.e., *Bacillus subtilis* mutant, *Bacillus subtilis* wild type, *Staphylococcus aureus* (MRSA), *S. typhimurium* and *Pseudomonas aeruginosa* (ATCC 60690) were also carried out on the crude extracts, pure compounds and essential oil. The crude ethyl acetate and methanol extracts of the stem bark of *G. cuneifolia* were found to have significant activity. However, both stigmasterol and friedelin, gave no activity against all the pathogenic

bacterial used. The results showed that all the samples tested gave no activity against *S. typhimurium*. The methanol extract of *M. beccariana* produced significant activity against *Bacillus subtilis*, ATCC 60690 and MRSA. The oil of *M. ferrea* showed the result was only active towards MRSA.

The crude hexane, ethyl acetate and methanol extracts of *G. cuneifolia* were screened for larvicidal activity. The crude hexane extract of *G. cuneifolia* showed moderate activity against larvae *Aedes aegypti*, followed by ethyl acetate and methanol extracts. The crude hexane extract of *M. beccariana* has the highest activity towards the larvae, followed by the chloroform extract. The acetone extract showed weak activity towards the larvae. Lastly, the crude methanol extract gave no activity towards the larvae of *Aedes aegypti*. The result also showed that the larvae of *Aedes aegypti* is highly susceptible to the essential oil of the flowers of *M. ferrea*.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

KANDUNGAN KIMIA DAN AKTIVITI BIOLOGI DARIPADA *GARCINIA CUNEIFOLIA*, *MESUA BECCARIANA* DAN *MESUA FERREA*

Oleh

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Januari 2005

Pengerusi : Profesor Madya Gwendolin Ee Cheng Lian, Ph. D.

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Kajian ke atas ekstrak mentah kulit batang *Garcinia cuneifolia, Mesua beccariana dan Mesua ferrea* (Guttiferae) telah menghasilkan lapan komponen. Struktur sebatian-sebatian ini telah dapat dikenalpasti dengan menggunakan kaedah spektroskopi seperti NMR, MS, IR dan UV dan juga perbandingan dengan kajian-kajian yang lepas.

Kulit batang *G. cuneifolia* yang diperolehi dari Sarawak telah menghasilkan tiga sebatian baru: satu xanthone baru, cuneifolin, satu benzoate lakton triterpenoid baru, 3-benzoyloxyoleane-19-en-13,28-olida dan satu sebatian aromatik baru, acid sinamik-3-metoksi-4-heptiloksi. Selain itu, satu xanthone lain, rubraxanthone dan juga triterpena, stigmasterol juga dihasilkan dari pokok yang sama. Daripada kulit batang *M. beccarianna*, satu hexatrione baru, 6-(19-hydroxy-20-oxo-19-phenyl-propyl)-3-methyl-8,8-bis-(11,16-methyl-but-10,15-enyl)-2,5*H*-naphthalene-1,4,7-trione, dan satu

komponen lagi, ester metal asid butirik 10[2,4,6-Tris-(14,25,36-methyl-but-13,24,35-enyl)-(3,17;5,28)terphenyl- 1-yloxy], bersama-sama dengan dua triterpena, friedelin dan stigmasterol telah dipisahkan. *M. ferrea* pula menghasilkan dua steroidal triterpena biasa, friedelin dan stigmasterol.

Minyak pati bunga segar *M. ferrea* (diperolehi daripada UPM, Serdang) telah diperolehi dengan teknik penyulingan hidro dan dianalisa dengan menggunakan kaedah spektrometri GC-MS. Komponen utama minyak pati ini ialah germacrene D (48.96%).

Kesemua ekstrak *G. cuneifolia* dan *M. beccariana* (kulit batang) didapati tidak aktif terhadap sel CEM-SS, kecuali ekstrak mentah heksana daripada *M. beccariana* dimana menunjukkan kesan sitotoksik yang lemah. Dua komponen tulen, stigmasterol dan friedelin bersama dengan minyak pati bunga *M. ferrea* telah didapati tidak aktif terhadap bioaktiviti ini.

Aktiviti antimikrobial terhadap lima jenis bakteria: *Bacillus subtilis* mutan, *Bacillus subtilis* jenis liar, *Staphylococcus aureus* (MRSA), *S. typhimurium* dan *Pseudomonas aeruginosa* (ATCC 60690) juga telah dijalankan ke atas ekstrak-ekstrak mentah, komponen tulen dan minyak pati. Ekstrak mentah EA dan metanol daripada kulit batang *G. cuneifolia* telah memberikan aktiviti yang signifikan. Kedua-dua stigmasterol dan friedelin tidak memberikan aktiviti terhadap semua bakteria patogen yang digunakan. Semua sampel yang dikaji juga tidak menunjukkan aktiviti terhadap *S. typhimurium*. Metanol ekstrak daripada *M. beccariana* telah menghasilkan aktiviti signifikan terhadap

B. subtilis, ATCC 60690 dan MRSA. Pati minyak daripada bunga *M. ferrea* hanya memberikan aktiviti terhadap MRSA.

Ekstrak-ekstrak mentah heksana, etil asetat dan metanol daripada *G. cuneifolia* telah dikaji untuk ujian insektisida. Ekstrak mentah heksana bagi *G. cuneifolia* memberikan aktiviti sederhana terhadap larva *Aedes aegypti*, diikuti oleh ekstrak mentah EA dan metanol. Ekstrak mentah heksana bagi *M. beccariana* mempunyai aktiviti yang paling cergas terhadap larva nyamuk ini, diikuti pula dengan ekstrak mentah kloroform. Ekstrak mentah aseton pula menunjukkan aktiviti lemah terhadap larva ini. Tetapi ekstrak mentah metanol tidak memberikan aktiviti terhadap larva *A. aegypti*. Kajian ini juga menunjukkan *A. aegypti* paling senang dihapuskan oleh minyak pati bunga *M. ferrea*.

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I certify that an Examination Committee met on 17 January 2005 to conduct the final examination of Mong Xiao Hui on her Master of Science thesis entitled "Chemical Constituents and Biological Activities of *Garcinia cuneifolia*, *Mesua beccariana* and *Mesua ferrea* (Guttiferrae)" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

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MONG XIAO HUI

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