

**EXTRACTABLE ORGANIC COMPOUND IN
SMOKE PARTICULATE MATTER FROM BURNING OF
THREE TROPICAL WOOD SPECIES**

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**MASTER OF SCIENCE
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**EXTRACTABLE ORGANIC COMPOUND IN
SMOKE PARTICULATE MATTER FROM
BURNING OF THREE TROPICAL WOOD
SPECIES**

TAN HOCK SENG

**Thesis submitted in Fulfilment of the
Requirement for the
Degree of Master of Science in the Faculty
of Science and Technology
Universiti Malaysia Terengganu
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Abstract of thesis presented to the senate of Universiti Malaysia
Terengganu in fulfillment of the requirement for the degree of Master of
Science

**EXTRACTABLE ORGANIC COMPOUND IN SMOKE
PARTICULATE FROM BURNING OF THREE TROPICAL
WOOD SPECIES**

TAN HOCK SENG

May 2012

Main Supervisor : Professor Dr. Norhayati Mohd Tahir, Ph.D.

Co-Supervisor : Professor Dr. Mohd. Radzi Abas, Ph.D.

Faculty : Science and Technology

Characterization of extractable organic compounds focusing on *n*-alkane and polycyclic aromatic hydrocarbon (PAH) in fresh waxes and smoke particulate matter from three tropical wood species viz. *Rhizophora apiculata* (RA), *Melaleuca leucadendron* (ML) and *Hevea brasiliensis* (HB) had been carried out. In addition, differences in distribution and concentration of *n*-alkane and PAH compounds in smoke particulate generated during three combustion stages (smoldering, flaming and

charring) were also investigated. *n*-alkane and PAH compounds in these smoke particulate were extracted with dichloromethane-methanol (3:1 v/v) using ultrasonic agitation. Extracts obtained were fractionated into aliphatic and PAH compound using liquid-solid column chromatography. Identification and quantification of these compounds were carried out using Gas Chromatography Mass Spectrometer (GCMS). Results indicated that the major *n*-alkane characterized in the wood waxes and woods smoke particulate were straight chain *n*-alkanes in the range of C₁₂-C₃₅ with C_{max} in the range of C₂₅-C₃₃ except for smoke particulate of *Rhizophora apiculata* wood without bark by combustion stages which exhibited C_{max} at C₁₃. In general, all samples exhibited carbon preference index (CPI) values higher than one except for ML wood which obtained lower than the rest of the wood. In addition, all wood smoke particulate showed presence of PAH compounds and domination of pyrene and phenanthrene for total wood smoke whilst pyrene, phenanthrene and naphthalene for wood smoke by combustion stages. Furthermore, fresh wood waxes also exhibited presence of two to three rings PAH compounds which could be biologically produced in the plant itself. PAH diagnostic ratios calculated for wood smoke particulate studied showed all diagnostic ratios except for Flan/(Flan+Py) and Indeno/(Indeno+BgP), were consistent with the ratios suggested for wood combustion source as reported in literatures. In the case of the latter two diagnostic ratios, the

values were generally lower than the range normally reported for wood combustion.

SEBUTAN ORGANIK TEREKSTRAK DALAM ZARAHAN ASAP HASIL PEMBAKARAN TIGA SPESIES KAYU TROPIKA

TAN HOCK SENG

MAY 2012

Penyelia Utama : Profesor Nurhayati Mohd Taib, Ph.D.

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Fakulti : Sains dan Teknologi

Pencapaian sebutan organik mampu diekstrak dengan menumpu pada n-alkana dan poliglik asid merk hidrokarbon (PAH) dalam tiga ekstrak asap hasil pembakaran tiga spesies kayu tropika iaitu *Antyphone spicata* (AA), *Albizia leonensis* (AL) dan *Alnus glandulosa* (AG) telah dibuat. Selain itu, perbezaan antara sebutan n-alkana dan PAH dalam setiap jenis kayu yang terbakar semasa tiga peringkat pembakaran (membakar, menyala dan berarang) telah dikaji. Sebutan n-alkana dan PAH dalam ekstrak asap telah diekstrak dengan diklorometana (3:1 v/v)

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

SEBATIAN ORGANIK TEREKSTRAK DALAM ZARAHAN ASAP HASIL PEMBAKARAN TIGA SPESIES KAYU TROPIKA

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Pencirian sebatian organik mampu diekstrak dengan menumpu pada *n*-alkana dan polisiklik aromatik hidrocarbon (PAH) dalam lilin epikutikular dan zarah asap dari tiga spesies kayu tropika iaitu *Rhizophora apiculata* (RA), *Melaleuca leucadendron* (ML) dan *Hevea brasiliensis* (HB) telah dibuat. Selain itu, perbezaan antara sebatian *n*-alkana dan PAH dalam zarah asap kayu yang terhasil semasa tiga peringkat pembakaran (membara, berapi dan berarang) telah dikaji. Sebatian *n*-alkana dan PAH dalam zarah asap telah diekstrak dengan diklorometana-metanol (3:1 v/v)

menggunakan pergolakan ultrasonik. Ekstrak terhasil dipisahkan kepada sebatian alifatik dan PAH menggunakan turus kromatografi cecair-pepejal. Pencirian dan penentuan sebatian ini ditentukan menggunakan Kromatografi Gas-Spektrometer Jisim (GCMS). Hasil kajian menunjukkan *n*-alkana utama yang dicirikan dalam lilin kayu dan zarah asap kayu adalah *n*-alkana rantai lurus berjulat C_{12} - C_{35} dengan karbon maksima (C_{max}) dalam julat C_{25} - C_{33} kecuali zarah asap kayu *Rhizophora apiculata* tanpa kulit mengikut peringkat pembakaran memberikan C_{13} sebagai C_{max} . Secara umumnya, semua sampel menunjukkan nilai indeks pemilihan karbon (IPK) lebih besar dari satu kecuali kayu ML yang memprolehi nilai lebih rendah daripada zarah asap kayu lain yang dikaji. Di samping itu, semua zarah asap kayu menunjukkan kehadiran sebatian PAH dan dominasi oleh sebatian pirena dan phenanthrene yang bagi zarah asap pembakaran seluruh kayu manakala pirena, phenanthrene dan naftalena untuk asap kayu secara pembakaran berperingkat. Di samping itu, lilin epikutikular kayu juga menunjukkan kehadiran sebatian PAH bergelang dua ke tiga dimana sebatian ini mungkin terhasil secara biologi dalam pokok. Nisbah diagnostik PAH yang dikira untuk zarah asap kayu yang dikaji menunjukkan semua nisbah diagnostik PAH, kecuali nisbah $Flan/(Flan+Py)$ dan $Indeno/(Indeno+BgP)$, adalah konsisten dengan nisbah yang disarankan untuk pembakaran dari sumber kayu bakar seperti yang dilaporkan dalam makalah. Namun dalam kes dua nisbah yang

dinyatakan, nilai yang diperolehi pada umumnya lebih rendah daripada julat yang biasa dilaporkan untuk pembakaran kayu.

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