

## ABSTRACT

( The chemical constituents of essential oils and extractives from resin, bark and heartwood of *Agathis borneensis* were studied using gas chromatography-flame ionization detector (GC-FID) and gas chromatography-mass spectrometer (GC-MS). The essential oils were extracted using hydrodistillation method while the extractives were extracted using solvent with increasing polarity; hexane, dichloromethane, ethyl acetate and methanol. The major components in the resin oil were  $\alpha$ -pinene (31.15 %),  $\delta$ -limonene (17.92 %),  $\beta$ -pinene (11.36 %) and terpinen-4-ol (8.41 %). While,  $\beta$ -pinene (9.14 %), terpinen-4-ol (8.99 %),  $\alpha$ -pinene (8.95 %) and  $\alpha$ -terpineol (8.93 %) were the major constituents in the bark oil. Heartwood oil was dominated by hexadecanoic acid (66.85 %) with monoterpenes as minor constituents such as  $\gamma$ -terpinene and terpinen-4-ol.)

Hexane extractive of heartwood was dominated by hexadecanoic acid and oleic acid. Other compounds belong to sterol group such as stigmast-5-en-3-ol oleate,  $\gamma$ -sitosterol and stigmasta-3,5-dien-7-one were also detected in this extractive. The dichloromethane extractive of heartwood also comprised hexadecanoic acid and oleic acid as the major components, with stigmastanol and stigmasta-3,5-dien-7-one as minor components. On the other hand, phenolic compounds, sterols and some flavonoids were detected in ethyl acetate extractive of the heartwood. Among the major compounds identified were (Z)-6-octadecenoic acid, hinokiresinol, sugiresinol and 2',3-dihydroxychalcone. Methanol extractive of heartwood consist of sterols, flavonoids, ethers and amides as the main components, including campesterol, hinokione, methyl hexadecanoate, methyl elaidate and (Z)-octadecenamide. The analyses on the extractives from resin of *A. borneensis* were also carried out using GC-MS. The hexane and dichloromethane extractives of resin composed mainly of terpenes group such as manoyl oxide, verbenol, (-)-terpinen-4-ol, limonene-1,2-diol and verbenone. These extractives also contained several alcohols such

as tetradecanol, nonadecanol and docosanol. Ethyl acetate and methanol extractives were derivatized using N-methyl-N-(tertbutyldimethylsilyl)-trifluoroacetamide (MTBSTFA) before the GC-MS analysis. The members of acid and sterol groups were the abundance components in these extractives. The bioactivities study of the essential oils and extractives from *A. borneensis* were carried out against brine shrimp, termites, fungi (*Chaetomium globosum*, *Schizophyllum commune*, *Trametes versicolor*, *Aspergillus niger*, *Aspergillus flavus*, *Fusarium* sp., *Trichoderma* sp., *Botryotrichum* sp. and *Candida albican*) and bacteria (*Staphylococcus aureus*, *Escherichia coli*, *Entrobacter aerogenes*, *Bacillus cereus* and *Salmonella typhi*). No bioactivity was observed for the essentials oils and extractives against brine shrimp and termites. However, the antifungal and antibacterial tests showed several extractives and bark essential oil have potential as antifungal and antibacterial agents. Methanol extractive from heartwood showed the highest 1,1-diphenyl-2-picryl-hydrazyl (DPPH) free radical scavenging activity compared to the other extractives.

**Keyword:** *A. borneensis*, essential oils, extractives, GC-MS, brine shrimp, termite, fungi, bacteria, DPPH

**KANDUNGAN KIMIA DAN AKTIVITI BIOLOGI MINYAK PATI  
DAN EKSTRAKTIF DARIPADA Agathis borneensis**

**ABSTRAK**

*Kandungan kimia minyak pati dan ekstrakatif dari resin, kulit dan teras kayu A. borneensis telah dikaji menggunakan kromatografi gas-pengesan pengionan nyalaan (KG-PPN) dan kromatografi gas-spektrometer jisim (KG-SJ). Minyak pati telah diekstrak menggunakan kaedah penyulingan hidro manakala ekstrakatif diekstrak menggunakan pelarut dengan peningkatan kepolaran; heksana, diklorometana, etil asetat dan metanol. Komponen utama minyak pati dari resin adalah  $\alpha$ -pinena (31.15 %),  $\delta$ -limonena (17.92 %),  $\beta$ -pinena (11.36 %) dan terpinen-4-ol (8.41 %). Manakala,  $\beta$ -pinena (9.14 %), terpinen-4-ol (8.99 %),  $\alpha$ -pinena (8.95 %) dan  $\alpha$ -terpineol (8.93 %) adalah kandungan utama minyak dari kulit. Minyak teras kayu didominasi oleh asid heksadekanoik (66.85 %) dengan monoterpena seperti  $\gamma$ -terpinena dan terpinen-4-ol sebagai komponen minor. Ekstraktif heksana dari teras kayu didominasi oleh asid heksadekanoik dan asid oleik. Sebatian lain tergolong dalam kumpulan sterol seperti stigmast-5-en-3-ol oleat,  $\gamma$ -sitosterol dan stigmasta-3,5-dien-7-on juga dikenalpasti dalam ekstrakatif ini. Ekstraktif diklorometana dari teras kayu juga mengandungi asid heksadekanoik dan asid oleik sebagai komponen utama, serta stigmastanol dan stigmasta-3,5-dien-7-on sebagai komponen minor. Sebaliknya, sebatian fenolik, sterol dan beberapa flavonoid telah dikesan dalam ekstrakatif etil asetat dari teras kayu. Antara sebatian utama yang telah dikenalpasti adalah asid (Z)-6-oktadekenoik, hinokiresinol, sugiresinol dan 2',3'-dihidroksikalkon. Ekstraktif metanol dari teras kayu mengandungi sterol, flavonoid, eter dan amida sebagai komponen utama termasuklah kampesterol, hinokion, metil*

heksadekanoat, metil elaidat dan (Z)-oktadekenamida. Analisis terhadap ekstraktif dari resin A. borneensis juga telah dilakukan menggunakan KG-SJ. Ekstraktif heksana dan diklorometana mengandung kumpulan terpena seperti manol oksida, verbenol, (-)-terpinen-4-ol, limonena-1,2-diol dan verbenon. Ekstraktif ini juga mengandung alkohol seperti tetradekanol, nonadkanol dan dokosanol. Ekstraktif etil asetat dan metanol telah diterbitkan menggunakan N-metil-N-(tertbutildimetilsilil)-trifluoroasetamida (MTBSTFA) sebelum analisis KG-SJ. Ahli kumpulan asid dan sterol adalah komponen dengan kelimpahan yang tinggi dalam ekstraktif tersebut. Kajian aktiviti biologi minyak pati dan ekstraktif daripada A. borneensis terhadap anak udang, anai-anai, kulat (Chaetomium globosum, Schizophyllum commune, Trametes versicolor, Aspergillus niger, Aspergillus flavus, Fusarium sp., Trichoderma sp., Botryotrichum sp. dan Candida albican) dan bakteria (Staphylococcus aureus, Escherichia coli, Entrobacter aerogenes, Bacillus cereus dan Salmonella typhi) telah dilakukan. Tiada aktiviti biologi terhadap anak udang dan anai-anai dicerapi. Bagaimanapun, ujian antikulat dan antibakteria meunjukkan beberapa ekstraktif dan minyak pati dari kulit berpotensi sebagai agen antikulat dan antibakteria. Ekstraktif metanol dari teras kayu menunjukkan aktiviti pemerangkapan radikal bebas 1,1-difenil-2-pikril-hidrazil (DPPH) yang tinggi berbanding dengan ekstraktif lain.

**Kata kunci:** A. borneensis, minyak pati, ekstraktif, KG-SJ, anak udang, anai-anai, kulat, bakteria, DPPH