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C_{23} -Carbazole Alkaloids From The Bark of *Murraya koenigii* (L.) Spreng (14pt / Bold / Align Centre)

C₂₃-Carbazole Alkaloids Daripada Kulit Kayu Murraya koenigii (L.) Spreng (11pt / Italic / Align Centre)

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Abstract (12pt / Bold / Align Centre / English)

Murraya koenigii (Rutaceae), locally known as curry leaf tree, is a medicinally important herb of Indian origin and now is widely distributed throughout southern Asia. The bark of Malayan *Murraya koenigii* was investigated for phytochemical content. The isolation of chemical constituents from its hexane extract was carried out by using various chromatographic techniques. Spectroscopic methods, including NMR, IR, UV, MS spectra data, were used for the structural characterization. Four C_{23} -carbazole alkaloids were isolated and identified as mahanimbine, murrayamine-J, murrayazolinol and bicyclomahanimbine. (10pt / Regular / Left Indent: 0.25 in / Right Indent: 0.25 in)

Keywords carbazole alkaloid, curry leaf, *Murraya koenigii*, Rutaceae, NMR (10pt / Regular / Keywords: Bold)

Abstrak (12pt / Bold / Malay)

Murraya koenigii (Rutaceae), nama tempatan dikenali sebagai pokok kari, adalah herba perubatan yang penting yang berasal dari India dan kini telah tersebar secara meluas di seluruh selatan Asia. Kulit *Murraya koenigii* telah dipilih untuk kajian kandungan fitokimia. Pengasingan bahan kimia daripada ekstrak heksana telah dijalankan dengan menggunakan pelbagai teknik kromatografi. Kaedah spektroskopi, termasuk NMR, IR, UV, data spektra MS, telah digunakan untuk pencirian struktur. Empat alkaloid karbazola- C_{23} telah diasingkan dan dikenalpasti sebagai mahanimbina, murrayamina-J, murrayazolinol dan bisiklomahanimbina. (10pt / Regular / Left Indent: 0.25 in / Right Indent: 0.25 in)

Kata kunci alkaloid karbazola, daun kari, *Murraya koenigii*, NMR, Rutaceae (10pt / Regular / Keywords: Bold)

INTRODUCTION (12PT / CAPITAL / ALIGN LEFT)

The plant *Murraya koenigii*, commonly known as curry leaf tree, belonging to the family Rutaceae are aromatic shrubs or a small tree of up to 6 m in height. It is native to India and is now distributed throughout Southern Asia (Tachibana *et al.*, 2001). Traditionally, it is used in Indian culinary practices (Abu Bakar *et al.*, 2007), treatment on rheumatism, traumatic injury, dysentery, diarrhea and snake bite (Dineshkumar *et al.*, 2010; Sim & Teh, 2011). The plant is also reported to have antioxidant, antidiabetic, anticarcinogenic, anti-dysenteric, stimulant, hypoglycaemic and antimicrobial activities (Khanum *et al.*, 2000; Ningappa *et al.*, 2008; Ningappa & Srinivas, 2008; Yadav *et al.*, 2002). (11pt / Left Justify)

Previous studies on the *Murraya* species included reports of coumarins, terpenoids and many investigations on carbazole alkaloids (Obadiah *et al.*, 2012). Carbazole alkaloids are the major constituents of the plant and are known to possess cytotoxic, antioxidative, antimutagenic and anti-inflammatory activities (Adebajo *et al.*, 2006; Tachibana *et al.*, 2001; Ramsewak *et al.*, 1999). Biologically active carbazole alkaloids are also reported to have antimicrobial properties (Ramsewak *et al.*, 1999).

In continuation of our studies on carbazole of *Murraya koenigii*, we report the isolation and elucidation of four C_{23} -carbazole alkaloids from the bark of the plant which have been identified as mahanimbine,

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murrayamine-J, murrayazolinol and bicyclomahanimbine. (11pt / Left Justify / First Line Left Indent: 0.25 in)

MATERIALS AND METHODS (12PT / CAPITAL / ALIGN LEFT)

General Methods (11pt / Align Left)

Nuclear Magnetic Resonance spectra (NMR) were recorded using Joel (500 MHz). Deuterated chloroform (CDCl_3) was used as the NMR solvent. Chemical shifts (δ) were reported in ppm and coupling constants (J) in Hz. Mass spectra (MS) were determined by using the GC-mass spectrometry (GC-MS Agilent 5975 Series). The ultra violet spectrum (UV) were obtained in methanol on a Perkin Elmer uv-visible spectrophotometer and the wavelength of the spectrum was determined in the range of 200 to 1000 nm. The infrared spectra (IR) were recorded on a Nicolet 6700 FTIR spectrophotometer, with methanol as dilution solvent of the sample. (11pt / Left Justify)

Column chromatography were prepared by using Silica Gel 60F₂₅₄, 70-230 mesh ASTM and 230-400 mesh ASTM as stationary phase. Silica Gel 60F₂₅₄ containing Gypsum was used as the stationary phase for the preparative thin layer chromatography (TLC). Analytical TLC was performed on commercially precoated aluminium supported silica gel 60F₂₅₄ TLC sheets. (11pt / Left Justify / First Line Left Indent: 0.25 in)

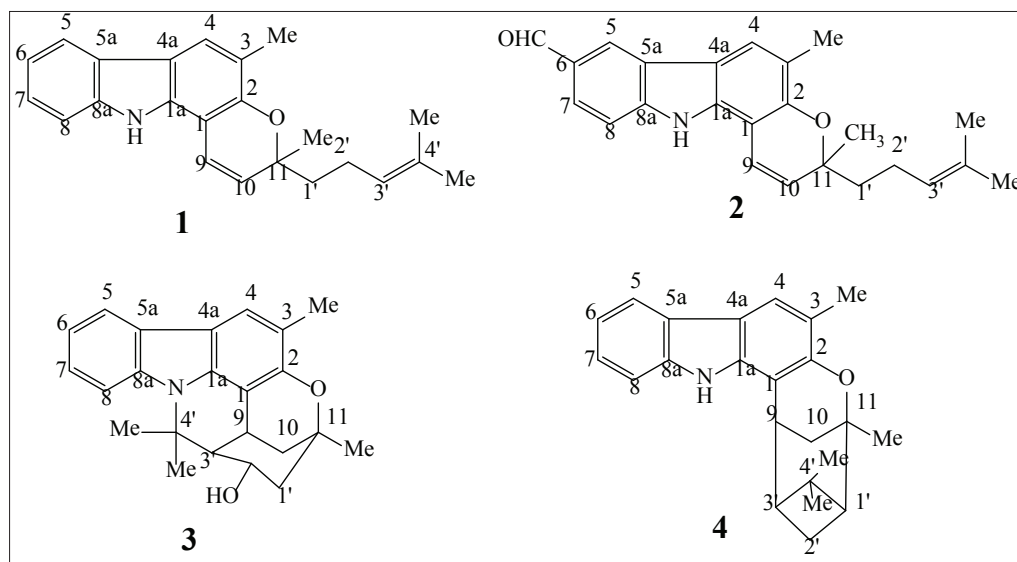


Figure 1 The four compounds yielded from column chromatography (10pt / Centre Align)

REFERENCES (12PT / CAPITAL / LEFT ALIGN)

Abu Bakar, N.H., Sukari, M.A., Rahmani, M. Sharif, M., Khalib, K. & Yusuf, U.K. (2007). Chemical constituents from stem barks and roots of *Murraya koenigii* (Rutaceae). *The Malaysian Journal of Analytical Sciences*, 11(1): 173-176. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)

Adebajo A.C., Ayoola O.F., Iwalewa E.O., Akindahunsi A.A. & Omisore N.O.A. (2006) Anti-trichomonal, biochemical and toxicological activities of methanolic extract and some carbazole alkaloids isolated from the leaves of *Murraya koenigii* growing in Nigeria. *Phytomedicine*, 13,: 246-254. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)

Bhattacharyya, L., Chatterjee, S.K., Roy, S. & Chakraborty, D.P. (1989). Murrayazolinol - a minor carbazole alkaloid from *Murraya koenigii* Spreng. *Journal of the Indian Chemical Society*, 66 (2): 140-141. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)

Dineshkumar, B., Mitra, A. & Mahadevappa, M. (2010). Antidiabetic and hypolipidemic effects of mahanimbine (carbazole alkaloid) from *Murraya koenigii* (Rutaceae) leaves. *International Journal of Phytomedicine*, 2: 22-30. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)

Joshi, B.S., Kamat, V.N., Gawd, D.H., (1970). Structures of girinimbine, mahanimbine, isomahanimbine, koenimbidine and murrayacine. *Tetrahedron*, 26 (6): 1475-1482.

Table 1 ¹H NMR [500 MHz, d_H (*J*, Hz)] values of Compound 1,2,3 and 4 in CDCl₃ (10pt)

Position	d _H , J Hz			
	1 _a	2 _b	3 _c	4 _d
NH	7.81 (<i>br s</i>)	8.35 (<i>br s</i>)		7.42 (<i>br s</i>)
1				
1a				
2				
3		6.81 (<i>d</i> , 8.6 Hz)		
4	7.69 (<i>s</i>)	7.83 (<i>d</i> , 8.6 Hz)	7.49 (<i>s</i>)	7.67 (<i>s</i>)
4a				
5	7.94 (<i>d</i> , 8.1 Hz)	8.46 (<i>d</i> , 1.7 Hz)	7.90 (<i>d</i> , 7.5 Hz)	7.92 (<i>d</i> , 8.0 Hz)
5a				
6	7.21		7.16	7.16
	(<i>td</i> , 7.5, 1.2 Hz)		(<i>td</i> , 6.9, 1.2 Hz)	(<i>td</i> , 8.0, 1.2 Hz)
7	7.33	7.89	7.25	7.28
	(<i>td</i> , 6.9, 1.2 Hz)	(<i>dd</i> , 8.6, 1.7 Hz)	(<i>td</i> , 7.0, 1.2 Hz)	(<i>td</i> , 8.0, 1.2)
8	7.35 (<i>d</i> , 7.5 Hz)	7.47 (<i>d</i> , 8.6 Hz)	7.47 (<i>d</i> , 8.0 Hz)	7.37 (<i>d</i> , 7.5 Hz)
8a				
9	6.60 (<i>d</i> , 9.8 Hz)	6.66 (<i>d</i> , 9.7 Hz)	3.32 (<i>m</i>)	3.29 (<i>d</i> , 9.2 Hz)
10	5.65 (<i>d</i> , 9.7 Hz)	5.71 (<i>d</i> , 9.7 Hz)	1.22 (<i>m</i>)	2.06 (<i>m</i>)
11				
3-Me	2.37 (<i>s</i>)		2.36 (<i>s</i>)	2.34 (<i>s</i>)
6-CHO		10.07 (<i>s</i>)		
11-Me	1.48 (<i>s</i>)	1.47 (<i>s</i>)	1.50 (<i>s</i>)	1.44 (<i>s</i>)
			1.76	2.50
1'	1.79 (<i>t</i> , 8.1)	1.74 (<i>m</i>)		
			(<i>dd</i> , 16.1, 6.9 Hz)	(<i>t</i> , 7.4 Hz)
2'	2.20 (<i>m</i>)	2.16 (<i>m</i>)	3.83 (<i>m</i>)	1.65 (<i>m</i>)
	5.15			2.70
3'		5.10 (<i>t</i> , 6.3 Hz)	2.17 (<i>m</i>)	
	(<i>tt</i> , 7.5, 1.2 Hz)			(<i>t</i> , 7.5 Hz)
4'				
4'-Me'	1.62 (<i>s</i>)	1.58 (<i>s</i>)	1.29 (<i>s</i>)	0.74 (<i>s</i>)
4'-Me''	1.72 (<i>s</i>)	1.66 (<i>s</i>)	1.93 (<i>s</i>)	1.56 (<i>s</i>)

a: Joshi, Kamat, & Gawd (1970); b: Wu, Wang, Wu, Ito, & Furukawa (1996); c: Bhattacharyya, Chatterjee, Roy, & Chakraborty (1989); d: Kureel, Kapil, & Popli (1969) (Table note: 9pt)

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author name)

- Ⓚ Khanum, F., Anilakumar, K.R., Sudarshana Krishna, K.R., Viswanathan, K.R. & Santhanam, K. (2000). Anticarcinogenic effects of curry leaves in dimethylhydrazine-treated rats. *Plant Foods for Human Nutrition*, 55: 347–355. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)
- Ⓚ Kureel, S.P., Kapil, R.S. & Popli, S.P. (1969). Terpenoid alkaloids from *Murraya koenigii* Spreng - II: Constitution of cyclomahanimbine, bicyclomahanimbine and mahanimbidine. *Tetrahedron Letter*, 44: 3857-3862. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)
- Ⓚ Ningappa, M.B., Dinesha, R. & Srinivas, L. (2008). Antioxidant and free radical scavenging activities of polyphenol-enriched curry leaf (*Murraya koenigii* L.) extracts. *Food Chemistry*, 106: 720–728. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)
- Ⓚ Ningappa, M.B., & Srinivas, L. (2008). Purification and characterization of approximately 35 kDa antioxidant protein from curry leaves (*Murraya koenigii* L.). *Toxicology in Vitro*, 22, 699–709.
- Ⓚ Ramsewak R., Nair M.G., Strasburg G.M., DeWitt D.L. & Nitiss J.L. (1999) Biologically active carbazole alkaloids from *Murraya koenigii*. *Journal of agricultural and food chemistry*, 47: 444-447. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)
- Ⓚ Roy, S. & Chakraborty, D.P. (1974). Mahanimbine from *Murraya koenigii* Spreng. *Phytochemistry*, 13: 2893.
- Ⓚ Sim, K.M., Teh & H.M. (2011). A new carbazole alkaloid from the leaves of Malayan *Murraya koenigii*. *Journal of Asian Natural Products Research*, 13 (10): 972-975. (10pt / Left Indent: 0.25 in / First Line Left Indent: -0.25 in)