1,1,4,7-Tetramethyldecahydro-1H-cyclopropa[e]azulen- 7-ol from the Stembark Chisocheton pentandrus

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1,1,4,7-Tetramethyldecahydro-1H-cyclopropa[e]azulen-7-ol from the Stembark Chisocheton pentandrus

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Abstract: A new aromadendrane-type sesquiterpenoid, namely dehydrosphatulenol (**1**), has been isolated from the stembark of Chisocheton pentandrus. The chemical structure of **1** was characterized on the basis of spectroscopic evidences including mainly one dimension and two dimension Nuclear Magnetic Resonance, and Mass Spectroscopy as well as through a comparison with those related compounds previously reported.

Keywords: aromadendrane Chisocheton pentandrus; Meliaceae; sesquiterpenoid

1. Introduction

Chisocheton plants have been known to be a rich source of secondary metabolites including various sterols, limonoids, terpenoids, and alkaloids with biologically properties such as antifungal, antibacterial, antiviral, anti-inflammatory, cytotoxic, and antiplasmodial agents [1–4]. In our previous research for novel cytotoxic constituents from Indonesia Chisocheton, we isolated and described limonoids, dysobinol from the seed C. macrophyllus [5], pentandricine from stem bark C. pentandrus [6], four new apo-euphane-type triterpenoid from the bark of C. patens [1] and a triterpenoid from C. cumingianus and C. celebicus [7,8]. In the further search for anticancer candidate compounds from C. pentandrus, we found a new aromadendrane-type sesquiterpenoid, namely dehydrospatulenol (**1**) from the stembark of C. pentandrus. In this communication, the isolation and structural determination of the new aromadendrane-type sesquiterpenoid are described.

2. Results

Extraction and Isolation

The dried stem bark of C. pentandrus (3.8 kg) was extracted with MeOH at room temperature to give a crude MeOH extract (560 g) after solvent was removed. The crude MeOH extract (560 g) was partitioned between n-hexane and water to give the n-hexane fraction (96.6 g) after evaporation of the solvent. The n-hexane soluble fraction was separated by column chromatography (CC) using gradient n- hexane/EtOAc to give eight fractions (A–H). Fraction A (3.3 g) was separated by medium pressure

pressure liquid chromatography (MPLC) on silica using isocratic of MeOH:H_2O (8:2) to give 12 liquid omatography (MPLC) on silica using isocratic of MeOH:H_2O (8:2) to give 12 subfr ns subfractions (A1–12) . Subfraction A9 (1.5 g) was subjected to column chromatography (CC) using (A1–12). Subfraction A9 (1.5 g) was subjected to column chromatography (CC) using CH $2Cl_2$ to give CH_2Cl_2 to give three subfractions (A9.1–9.3). Compound **1** (335 mg) (Figure 1) was obtained by further three subfractions (A9.1–9.3). Compound **1** (335 mg) (Figure 1) was obtained b er purification of
purification of subfraction A9.3 (0.6 silica gel eluted with *n*-hexane as a mobile phase.
subfraction A9.3 (0.6 g) on silica gel eluted with n-hexane as a mobile phase.

Dehydrosphatulenol (**1**), colorless oil, $[\alpha]_{D\ o}$ +7.2 (*c* , 0.17, CH OH), ^{1}H NMR (CDCl , 500 MHz), Dehyd atulenol (**1**), colorless oil,δ[ ]$_{23}D_3$ +7.2 (c, 0.17, $CH_{33}OH$), 1H NMR (CDCl3, 500 MHz) Table 1. 13C NMR (CDCl3, 125 MHz), C (ppm), see Table 1. HR-TOFMS *m/z* 223.2064 [M + H]+ see Table 1. 13C NMR (CDCl3, 125 MHz), C (ppm), see Table 1. HR-TOFMS m/z 223.2064 [M + H]+ (calcd. for $C_{15}H_{26}O$, *m/z* 222.2084). (calcd. for $C_{15}H_{26}O$, m/z 222.2084).

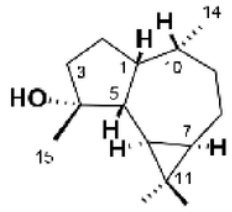

Figure 1. Chemical structure of compound **1**.
Figure 1. Chemical structure of compound **1**.

Table 1. NMR data for compound 1 (500 MHz for ^{1}H and 125 MHz for ^{13}C, in $CDCl_3$).

C	$C\delta_C$	c	δ_H (ΣH., Hmult(SH..., multJ=Hz)., J= Hz)
1	39.7		1.72 (1H, m)
2	29.1		1.15 (1H, m), 1.68 (1H, m)
3	37.8		1.45 (1H, m), 1.59 (1H, m)
4	76.6		-
5	58.2		1.69 (1H, m)
6	22.3		0.10 (1H, t, 9.3)
7	28.6		0.51 (1H, ddd, 6.0, 9.6)
8	18.8		1.29 (1H, m), 1.52 (1H, m)
9	25.8		1.49 (1H, m), 1.54 (1H, m)
10	38.5		1.85 (1H, m), 1.85 (1H, m)
11	18.4		0.88 (3H, s)
12	16.3		0.92 (3H, s)
13	28.7		0.84 (3H, d, 6.8)
14	16.1		0.84 (3H, d, 6.8)
15	32.1		1.04 (3H, s)

3. Discussion

3. Discussion

Compound **1** was obtained as a colorless oil with $[\alpha]_{D23o}$ +7.2 (*c*, 0.17, CH_3OH) and the High Resolution ne of Flight-Mass Spectroscopy (HRTOF-MS) spectra showed a p udomolecular ion peak at 223.2064 [M + H]-, corresponding to the molecular formu 3 C H O (calculated *m/z* 222.2084). Compound **1** was ob ned as a colorless oil with [ ]D +7.2 (^{15}c, 0^{26}.17, CH_3OH) and the High The ^{1}H NMR spectrum of **1** showed four methyls at δ 0.82 (3H, *d*, *J* = 6.82 Hz, Me-14), 0.88 (3H, s, Me-Resolution ne of Flight-Mass Spectroscopy (HRTOF-MS) spectra showed a pseudomolecular ion
12), 0.92 (3H, s, Me-13), and 1.04 (3H, s, Me-15), each 3H, four methylene proton at δH 1.15 and 1.68
peak at 223.2064 [M + corresponding to the molecular formula $C_{15}H_{26}$ calculated m/z 222.2084).
1*m*, H-2), 1.29 and 1.52 (2H, *m*, H-8), 1.49 and 1.54 (2H, *m*, H-9), 1.45 an 9 (2H, *m*, H-3), five The H NMR spectrum of **1** sh four methyls at H 0.82 (3H, d, J = 6.82 Hz, Me-14), 0.88 (3H, s, methine protons at δ 0.01 (1H, *t*, *J* = 9.3 Hz, H-6), 0.51 (1H, *ddd*, *J* = 6.05 and 9.6 Hz, H-7 69 (*m*, Me-12), 0.92 (3H, s, Me H-13), and 1.(H, s, Me-15), each 3H, four methylene oton at H 1.15 and 1.68 H-5 72 (1H, *m*, H-1), and 1.85 (1H, *m* , *overlap*, H-10). The ^{13}C NMR (Table 1) and Distortionless (2H, m, H-2), 1.29 and 1.52 (2H, m, H-8), 1.49 and 1.54 (2H, m, H-9), 1.45 and 1.59 (2H, m, H-3), five
Enhancement by Polarization Transfer (DEPT) spectra revealed 15 carbon resonances due to two sp_3 quaternary carbons at δ_C 18.4 (C-11) and 76.6 (C-4) and five sp_3 methines at δ_C 22.3 (C-6), 28.6 (C-7),

methine protons at H 0.01 (1H, t, J = 9.3 Hz, H-6), 0.51 (1H, ddd, J = 6.05 and 9.6 Hz, H-7), 1.69 (1H, m, H-5), 1.72 (1H, m, H-1), and 1.85 (1H, m, overlap, H-10). The ^{13}C NMR (Table 1) and Distortionless Enhancement Polarization Transfer (DEPT) spectra revealed 15 carbon resonances due to two sp^3 quaternary carbons at C 18.4 (C-11) and 76.6 (C-4) and five sp^3 methines at C 22.3 (C-6), 28.6 (C-7), 38.5 (C-10), 39.7 (C-1), and 58.2 (C-5). In addition, there were four sp^3 methylene at C 18.8 (C-8), 25.8 (C-9), 29.1 (C-2), and 37.8 (C-3) and four methyls at C 16.1 (C-14), 16.3 (C-12), 28.7 (C-13), and 32.1 (C-15). Among them, one sp^3 quaternary carbon (C 74.60) was ascribed bearing an oxygen atom.

A comparison of the NMR data of **1** with a ledol isolated from *Renealmia chrysotrycha* [9] revealed that the structures of the compound are closely related. The main difference was the position of an oxygenated sp^3 quaternary carbon. In order to clarify the position of the hydroxyl group, Heteronuclear Multiple Bond Correlation (HMBC) and H-H Corelated Spectroscopy (COSY) experiments were conducted and the results are shown in Figure 2 and supplementary materials. The HMBC spectrum of **1** showed correlation from the proton signal of Me-15 (H 1.04) and methylene proton at C 1.45 to proton at C 74.60, indicating a tertiary alcohol was located at C-4. The HMBC spectrum also showed correlations of proton methine H-6 (H 0.10), proton methine H-7 (H 0.51), Me-12 (H 0.88), and Me-13 (H 0.92) to sp^3 quaternary carbon C-11 (C 18.4), suggesting that a cyclopropane ring is located at C-6, C-7, and C-11, respectively. Furthermore, in the HMBC spectrum, a proton methyl with doublet multiplicity signal at H 0.82 (H-14) was correlated with correlated with methine carbon C -10, indicating a secondary methyl located at C-10. The H- H COSY spectrum of the isolated compound showed correlation in H1–H2, H1–H10, H5–H6, H6–H7, H7–H8, H8–H9, and H14–H10, supporting the presence of an aromadendrane structure in **1**.

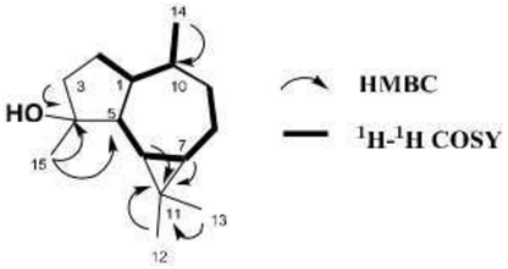

Figure 2. Selected ^{1}H-^{1}H Corelated Spectroscopy (COSY) and Heteronuclear Multiple Bond Correlation (HMBC) correlations for **1**.

The ring-junction between cycloheptane and cyclopropane is cis. This was confirmed by the ~9 Hz vicinal coupling constant ($^3J_{HH}$) of H-6 and H-7 from the experimental data and literature [9]. In the Nuclear Overhauser Effect- one dimension (NOE-1D) spectrum, there was correlation between H-6 with H-7. In addition, there are also correlation between H-6 with CH_3-14 and CH_3-13 when the signal H-6 was irradiated. As there was no correlation signal in the NOE-1D spectrum between CH_3-14 with H-1 and H-5 with H-5, this indicates that the configuration of methine H-1 and H-5 is cis to each other. The proton CH_3-15 showed no NOE interaction with H-5, this indicates the stereochemistry of CH_3-15 at the β-side of the molecule. Based on the literature, another sesquiterpenoid was isolated from Chisocheton penduliflorus [10], compound **1** was determined as a new aromadendrane-type sesquiterpenoid, 1,1,4,7-tetramethyldecahydro-1*H*-cyclopropa[*e*]azulen-7-ol, namely dehydrospathulenol (**1**).

4. Materials and Methods

4.1. General Experimental Procedures

The optical rotation was measured with an Autopol IV automatic polarimeter. The mass spectra was measured with a Water Xevo QTOFMS (Waters, Milford, MA, USA). NMR data were recorded on a Bruker Topspin spectrometer at 600 MHz for ^{1}H and 150 MHz for ^{13}C using Tetramethylsilane (TMS) as an internal standard (Bruker, Billerica, MA, USA). Medium performance liquid chromatography was undertaken using a Buchi Pump Controller C-610, Buchi Pump Modules C-605 with FLH-R10030B SiliCycle column-ISO04 (Siliasep™, Buchi, Swizerland). Silica gel 60 was used for

were recorded on a Bruker Topspin spectrometer at 600 MHz for ^{1}H and 150 MHz for ^{13}C using Tetramethylsilane (TMS) as an internal standard (Bruker, Billerica, MA, USA). Medium performance liquid chromatography was undertaken using a Buchi Pump Controller C-610, Buchi Pump Modules C-605 with FLH-R10030B SiliCycle column-ISO04 (Siliasep™, Buchi, Swizerland). Silica gel 60 was used for column chromatography (Merck, Darmstadt, Germany). Thin layer chromatography plates were precoated with silica gel GF_{254} (Merck, Darmstadt, Germany, 0.25 mm) and detection was achieved by spraying with 10% H_2SO_4 in EtOH, followed by heating and irradiation under UV–Vis light at wavelengths of 254 and 364 nm.

4.2. Plant Material

The stem bark of C. pentandrus was collected in Halimun Salak Mountain National Park, Sukabumi, West Java Province, Indonesia. The plant was identified by the sta of the Bogoriense Herbarium, Bogor, Indonesia. A voucher specimen (MSF-G01) was deposited at the herbarium.

5. Conclusions

A new aromadendrane-type sesquiterpenoid, namely, dehydrospathulenol (**1**), was isolated from the stembark of Chisocheton pentandrus. This examination confirms that Chisocheton pentandrus is capable of producing sesquiterpenoid-type compounds.

Supplementary Materials: The following are available online, Figure S1: H-NMR Spectrum of **1** (500 MHz in $CDCl_3$), Figure S2: ^{13}C-NMR Spectrum (125 MHz in $CDCl_3$), Figure S3: DEPT-135 Spectrum of **1** (in $CDCl_3$), Figure S4: HSQC Spectrum of **1**, Figure S5: HMBC Spectrum of **1**, Figure S6: H- H-COSY Spectrum of **1**, Figure S7: NOE-1D Spectrum of **1** (500 MHz in $CDCl_3$), Figure S8: HRESI-TOF-MS Spectrum of **1**, Figure S9: TLC profile of **1**.

Author Contributions: Conceptualization, K.A.; Data curation, D.G.K.; Formal analysis, M.H.H.; Investigation, M.S.F.; Methodology, N.; Supervision, U.S.

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Conflicts of Interest: The authors declare no conflict of interest.

References

1. Supratman, U.; Naibaho, W.; Salam, S.; Maharani, R.; Hidayat, A.T.; Harneti, D.; Nurlelasari; Shiono, Y. Cytotoxic triterpenoid from the bark of Chisocheton patens Blume (Meliaceae). Phytochem. Lett. **2019**, 30, 81–87. [CrossRef]
2. Mohamad, K.; Hirasawa, Y.; Litaudon, M.; Awang, K.; Hamid, A.; Hadi, A.; Takeya, K.; Ekasari, W.; Widyawaruyanti, A.; Zaini, N.C.; et al. Ceramicines B–D, new antiplasmodial limonoids from Chisocheton ceramicus. Bioorg. Med. Chem. **2009**, 17, 727–730. [CrossRef] [PubMed]
3. Joshi, M.N.; Chowdhury, B.L.; Vishnoi, S.P.; Shoeb, A.; Kapil, R.S. Antiviral activity of (+)-odorinol. Planta Medica **1987**, 53, 254–255. [CrossRef] [PubMed]
4. Agbedahunsi, J.M.; Fakoya, F.A.; Adesanya, S.A. Studies on the anti-inflammatory and toxic e ects of the stem bark of Khaya ivorensis (Meliaceae) on rats. Phytomedicine **2004**, 11, 504–508. [CrossRef][PubMed]
5. Nurlelasari; Katja, D.G.; Harneti, D.; Wardayo, M.M.; Supratman, U.; Awang, K. Limonoids from the seeds of Chisocheton macrophyllus. Chem. Nat. Compd. **2017**, 53, 83–87. [CrossRef]
6. Supriatno; Nurlelasari; Herlina, T.; Harneti, D.; Maharani, R.; Hidayat, A.T.; Mayanti, M.; Supratman, U.; Azmi, M.N.; Shiono, Y. A new limonoid from stembark of Chisocheton pentandrus (Meliaceae). Nat. Prod. Res. **2018**, 32, 1–7. [CrossRef]
7. Katja, D.G.; Farabi, K.; Nurlelasari; Harneti, D.; Mayanti, T.; Supratman, U.; Awang, K.; Hayashi, H. Cytotoxic constituents from the bark of Chisocheton cumingianus (Meliaceae). J. Asian Nat. Prod. Res. **2016**, 19, 194–200. [CrossRef] [PubMed]

8. Katja, D.G.; Farabi, K.; Harneti, D.; Mayanti, T.; Supratma, U. Cytotoxic triterpenoid from the stembark of Chisocheton celebicus (Meliaceae). Makara J. Sci. **2017**, 21, 8–12. [CrossRef]
9. Kaplan, M.A.C.; Pugialli, H.R.L.; Lopes, D.; Gottlieb, H.E. The stereochemistry of ledol from Renealmia chrysotrycha. Phytochemistry **2000**, 55, 749–753. [CrossRef]
10. Phongmaykin, J.; Kumamoto, T.; Ishikawa, T.; Suttisri, R.; Saifah, E. A new sesquiterpene and other terpenoid constituents of Chisocheton penduliflorus. Arch. Pharm. Res. **2008**, 31, 21–27. [CrossRef] [PubMed]

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