SHORT REPORT

A C G publications

Rec. Nat. Prod. (2013) 7:2 124-128

records of natural products

A New Diterpenoid from the Seeds of *Caesalpinia sappan* Linn

Yong-Jiang Xu[*1,2], Jianbing Zhang[2], Chun-Ping Tang[3] and Yang Ye[3]

[1]*Key Laboratory of Insect Development and Evolutionary Biology, Institute of Plant Physiology and Ecology, Shanghai Institute for Biological Science, Chinese Academy of Sciences, Shanghai 200023, People's Republic of China*

[2]*Department of Epidemiology and Public Health, Yong Loo Lin School of Medicine, National University of Singapore. 11759, Singapore*

[3]*State Key Laboratory of Drug Research, & Natural Products Chemistry Department, Shanghai Institute of Materia Medica, Chinese Academy of Sciences, Shanghai 201203, People's Republic of China*

(Received July 19, 2012; Revised January 24, 2013; Accepted January 31, 2013)

Abstract: A new cassane-type diterpene, named Phangininoxy A (**1**) and one known Phanginin A (**2**) were isolated from the exact of seeds of *Caesalpinia sappan* Linn. Their structures were elucidated by spectroscopic methods, mainly 1D and 2D NMR.

Keywords: *Caesalpinia sappan*; cassane; diterpene; NMR.

1. Plant Source

Chromatographic separation of the CH_2Cl_2 extract of seeds of *Caesalpinia sappan* Linn have led to the isolation of a new diterpene, named Phangininoxy A (**1**) and one known diterpene Phanginin A (**2**) (Figure 1).

The seeds of *C. sappan* Linn were collected in Guangxi province, P. R. China, in October 2007, and identified by Jin-Gui Shen of Shanghai Institute of Materia Medica. A voucher specimen was deposited at the herbarium of Shanghai Institute of Materia Medica, Chinese Academy of Sciences.

* Corresponding author: E- Mail: yjxutju@gmail.com, Phone +65-93973987.

The article was published by Academy of Chemistry of Globe Publications
www.acgpubs.org/RNP © Published 3/15/2013 EISSN: 1307-6167

2. Previous Studies

Caesalpinia sappan L is a large perennial shrub or small tree of the Fabaceae family. The plants are widely distributed in Southeast Asia [1]. Several species of the genus Caesalpinia were used in different systems of traditional medicine for the treatment of a variety of diseases, including liver disorders, fevers, ulcers of the mouth and throat [2].

So far, diterpenoids [3-7] and flavones [8-10] were isolated from the genus Caesalpinia as their major secondary metabolites. These compounds exhibit various biological activities including antioxidant, cytotoxic, anti-inflammatory, antimalarial, and antiviral activities [11-13].

3. Present Study

Air-dried seeds (1.0 kg) of *C. sappan* were extracted with CH_2Cl_2 at room temperature. The crude extracts were evaporated under reduced pressure to afford brownish CH_2Cl_2 (0.13 Kg) extract. The crude extract was further purified by QCC using petroleum ether as eluent and increasing polarity with acetone to give nine fractions (C1–C4). Fraction C2 (870 mg) was further purified by CC with petroleum ether-acetone (3:1, v/v) to give **2** (56 mg). Fraction C3 (3.12 g) was subjected to CC with ether-acetone (2:1, v/v) to afford four subfractions (C3a–C3d). Subfraction C3b (84.5 mg) was separated by preparative HPLC (C-18 column; CH_3CN/H_2O, from 5% to 95% in 30 min; flow 3 mL/min; 220 nm), **1** (26.3 mg) was obtained.

Phangininoxy A (**1**). White amorphous powder. IR(KBr): 3423, 2923, 2867, 1718, 1635, 1457, 1265, 1126, 900 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): 7.26 (*d, J* = 1.5 Hz, H-16), 6.20 (*d, J* = 1.5 Hz, H-15), 5.45 (*s*, H-20), 5.19 (*d, J* = 4.8 Hz, H-11), 4.20 (*dd, J* = 2.8 and 12.7 Hz, H-19b), 4.08 (*d, J* = 12.7 Hz, H-19a), 3.65 (*s*, 18-OMe), 2.76 (*m*, H-14), 2.58 (*m*, H-2b), 2.25 (*m*, H-1b), 2.19 (*m*, H-5), 2.12 (*m*, H-3), 2.01 (*m*, H-8), 1.85 (*dd, J* = 4.7 and 12.5 Hz, H-9), 1.75 (*m*, H-2a), 1.72 (*m*, H-6), 1.70 (*m*, H-7b), 1.32 (*m*, H-1a), 1.25 (*m*, H-7a), 0.96 (*d, J* = 7.1 Hz, H-17). ^{13}C NMR (100 MHz, $CDCl_3$): 174.3, C-18; 147.8, C-12; 143.1, C-16; 128.9, C-13; 109.1, C-15; 104.4, C-20; 71.0, C-11; 69.9, C-19; 51.5, OMe; 46.1, C-5; 44.8, C-4; 43.2, C-9; 40.7, C-10; 38.3, C-8; 37.6, C-3; 33.7, C-1; 31.7, C-14; 28.0, C-7; 23.6, C-6; 20.3, C-2; 13.9, C-17. HREIMS: *m/z* 358.1776 $[M]^+$ (calcd for $C_{21}H_{26}O_5$, 358.1781).

Phanginin A (**2**). White amorphous powder. ^1H NMR (400 MHz, $CDCl_3$): 7.19(*s*, H-16), 6.20(*s*, H-15), 5.03(*s*, H-20), 4.38(*d, J* = 11.6 Hz, H-19a), 3.75(*d, J* = 11.6 Hz, H-19e), 3.65(*s*,-OMe), 2.58 (*m*, H-14), 0.96(*d, J* = 7.0 Hz, H-17). ^{13}C NMR (100 MHz, $CDCl_3$): 175.6, C-18; 149.3. C-12; 140.3, C-16; 122.4, C-13; 109.7, C-15; 97.3, C-20; 61.6, C-19; 51.5, -OMe; 45.5, C-4; 45.1, C-5; 42.2, C-9; 38.5, C-10; 37.7, C-1; 36.6, C-8; 35.4, C-3; 31.4, C-14; 29.4, C-7; 23.5, C-6; 22.4, C-11; 20.8, C-2; 16.7, C-17. EIMS: *m/z* 360$[M^+]$, 342, 254, 198, 145, 108.

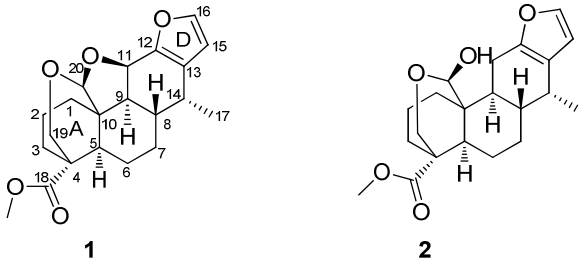

Figure 1. Structures of isolated compounds from *C. sappan* L

Compound **1** was obtained as white amorphous powder. Its molecular formula was determined as $C_{21}H_{26}O_5$ by HR-EI mass spectrum (*m/z* 358.1776 $[M]^+$, calcd. 358.1781). The IR spectrum displayed absorption bands for ester (1718 cm^{-1}) and furan ring (1635 and 1457 cm^{-1}) groups. The ^{13}C NMR and DEPT spectrum of **1** revealed 21 carbon signals, which were ascribed to an ester carbonyl δ_C 174.3, a 1,2-disubstituted furan ring (δ_C 109.1, 128.9, 143.1 and 147.8), two methyls, six methylenes, six methines, and two quaternary carbons. The ^1H NMR spectrum of **1** indicated a methyl at δ_H 0.96 (*d*, *J* = 7.1), a methoxyl at δ_H 3.65 (*s*), a hemiacetal proton at δ_H 5.45 (*s*), and two furan ring protons at δ_H 6.20 (*d*, *J* = 1.5) and 7.26 (*d*, *J* = 1.5).

By comparison of the spectroscopic data of **1** with those of known compound-Phanginin A (**2**) [6], **1** has the same substructure as **2** concerning the A-D rings. One major difference between these two compounds was the chemical shift of C-11. In comparison with the corresponding resonance δ_C 22.4 in compound **2**, the C-11 in compound **1** shifted up-field to δ_C 71.0, which was indicative of an oxymethine and not a methylene. The connection between C-11 and C-20 via the oxygen atom to form a five-membered ring was confirmed by the key HMBC correlations between H-20 (δ_H 5.45) and C-11 (δ_C 71.0). Thus the planar structure of **1** was established.

Considering its biogenetic relationship, such elucidation was wholly consistent with those of naturally-occurred cassane-type diterpene. As for the relative stereochemistry of C-11, coupling constant (*J* = 4.8 Hz) of H-11 (δ_H 5.19) indicated that H-11 is oriented similar direction of H-9, and H-9 located at axial position (splitting pattern *dd*, *J* = 4.7 and 12.5 Hz). The relative configuration of **1** was further confirmed by a ROESY experiment. The key correlations of H-9 (δ_H 1.85) with H-20 (δ_H 5.45) and H-11 (δ_H 5.19) indicated the stereochemistry of H-11 (α) and H-20 (α), respectively (*Fig. 1*). Therefore the structure of **1** was established.

References

[1] Z. Y. Wu (1988). *Flora of China* Third Edition, Science Press, Beijing, **39**, 96.

[2] State Administration of Traditional Chinese Medicine, (1999) 'Chinese Materia Medica', Shanghai Science and Technology Press: Shanghai, **4**, 368-369.

[3] C. Y. Ragasa, J. G. Hofileña and J. A. Rideout (2002). New furanoid direrpenes from

Caesalpinia pulcherrima. *J. Nat.Prod.* **65**, 1107-1110.

[4] D. M. Li, L. Ma, G. M. Liu and L. H. Hu (2006). Cassane Diterpene-lactones from the Seed of *Caesalpinia minaxHance*. *Chem*. *Biodiversity*. **3**, 1260-1265.

[5] K. Pudhom, D. Sommit, N. Suwankitti and A. Petsom (2007). Cassane furanoditerpenoids from the seed kernels of Caesalpinia bonduc from Thailand. *J. Nat. Prod*. **70**, 1542-1544.

[6] O. Yodsaoue, S. Cheenpracha, C. Karalai, C. Ponglimanont, S. Chantrapromma, H. K.Fun and A. Kanjana-Opas (2008). PhanginінA-K, Diterpenoids from the seeds of *Caesalpinia sappan* Linn. *Phytochemistry*. **69**, 1242-1249.

[7] Y. H. Yin, L. Ma and L. H. Hu (2008). Cassane-Type Diterpenoids from the Seeds of Caesalpinia magnifoliolata. *Helv*. *Chim*. *Acta*. **91**, 972-977.

[8] P. Chen and J. S. Yang (2007). Flavonol galactoside caffeiate ester and homoisoflavones from *Caesalpinia millettii* HOOK. et ARN. *Chem. Pharm. Bull*. **55**, 655-657.

[9] M. Namikoshi, H. Nakata and T. Saitoch (1987). Homoisoflavonoids and Related compounds. Part1. Homoisoflavonoids from *Caesalpinia sappan*. *Phytochemistry*. **26**, 1831-1833.

[10] M.T. T. Nguyen, S. Awale, Y. Tezuka, Q. L. Tran and S. Kadota (2004). Neosappanone A, a xanthine oxidase (XO) inhibitory dimericmethanodibenzoxocinone with a new carbon skeleton from Caesalpinia sappan. *Tetrahedron Lett*. **45**, 8519-8522.

[11] R. A. Dickson, P. J. Houghton and P. J. Hylands (2006). Antibacterial and antioxidant cassane diterpenoids from Caesalpinia benthamiana. *Phytochemistry*. **68**, 1436-1441.

[12] R. W. Jiang, S. C. Ma and P. P. But (2001). New antiviral cassane furanoditerpenes *from Caesalpinia minax*. *J. Nat. Prod*. **64**, 1266-1272.

[13] T. Z. Linn, S. Awale, Y. B. Tezuka, A. H. Anskota, S. K. Kalauni, F. Attamimi, J. Y. Ueda, P. B. Asih, D. Syafruddin, K. Tanaka and S. Kadota (2005). Cassane- and norcassane-type diterpenes from *Caesalpinia crista* of Indonesia and their antimalarial activity against the growth of Plasmodium falciparum. *J. Nat. Prod*. **68**, 706-710.

[14] D. Tazooa, K. Krohn, H. Hussain, S. F. Kouam and E. Dongoa (2007). Laportoside A and laportomide A: A New Cerebroside and a new ceramide from Leaves of *Laportea ovalifolia*, *Z. Naturforsch.* **62B**, 1208-1212.

[15] K. Z. Antoine, H. Hussain, E. Dongo, S. F. Kouam, B. Schulz and K. Krohn (2010). Cameroonemide A: A new ceramide from *Helichrysum cameroonensei*, *J. Asian Nat. Prod. Res.* **12**, 629-633.

[16] K. O. Eyong, K. Krohn, H. Hussain, G. N. Folefoc, A. E. Nkengfack, B. Schulz and Q. Hu (2005). Newbouldiaquinone and Newbouldiamide: A new naphthoquinone-anthraquinone coupled pigment and a new ceramide from *Newbouldia laevis, Chem. Pharm. Bull.* **53**, 616-619**.**

[17] M. Y. Bouberte, K. Krohn, H. Hussain, E. Dongo, B. Schulz and Q. Hu (2006). Tithoniamarin and Tithoniamide: A new isocoumarin dimer and a new ceramide from *Tithnonia diversifolia*, *Nat. Prod. Lett.* **20**, 842-849.

[18] M. Y. Bouberte, K. Krohn, H. Hussain, E. Dongo, B. Schulz and Q. Hu (2006). Tithoniaquinone A and Tithoniamide B: A New Anthraquinone and a New Ceramide from the leaves of *Tithnonia diversifolia, Z. Naturforsch*. **61B**, 78-82.

[19] R. S. Miemanang, K. Krohn, H. Hussain and E. Dongo (2006). Paullinoside A and puallinomide A: A new cerebroside and a new ceramide from leaves of *Pullinia pinnata*, *Z. Naturforsch.* **61B**, 1123-1127.

[20] U. Höller, A. D. Wright, G. F. Matthée, G. M. König, S. Draeger, H-.J. Aust and B. Schulz (2000). Fungi from marine sponges: diversity, biological activity and secondary metabolites, *Mycol. Res.* **104**, 1354–1365.