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BIPHENYLS FROM THE HEARTWOOD OF TAIWAN SASSAFRAS

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Key Word Index—*Sassafras randaiense*; Lauraceae; magnolol; 2,2′-dihydroxy-5,5′-diallylbiphenyl; randainal; 2,2′-dihydroxy-5-allylbiphenyl-5′-propenal; randaiol; 2,2′,5′-trihydroxy-5-allylbiphenyl.

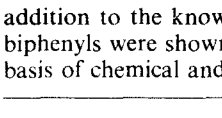
Abstract—Two new biphenyls, randainal and randaiol, have been isolated from the heartwood of Taiwan sassafras in addition to the known biphenyl magnolol which was found previously in the bark of *Magnolia* species. The two biphenyls were shown to be 2,2′-dihydroxy-5-allylbiphenyl-5′-propenal and 2,2′,5′-trihydroxy-5-allylbiphenyl on the basis of chemical and spectroscopic evidence.

INTRODUCTION

Screening tests of the acetone extractives of 116 species of heartwoods of Taiwan plants show that Taiwan sassafras, *Sassafras randaiense* (Hay.) Rehd. contains strong biological activity [1]. Literature reveals that no work on the heartwood of this plant has been done except the report that the root of this plant [2], contains safrol, pinene, phellandrene, (+)-camphor, eugenol and cadinene. This prompted us to investigate this plant.

RESULTS AND DISCUSSION

From the *n*-hexane soluble part of the methanol extract of the heartwood of Taiwan sassafras, sitosterol, a known biphenyl, magnolol **1** [3] and two new biphenyls, randainal **2** and randaiol **3** were isolated. Structures **2** and **3** have been assigned to the two new biphenyls respectively by chemical and spectroscopic methods.



1 (Magnolol) R = $-CH_2-CH=CH_2$
2 (Randainal) R = $-CH=CH-CHO$
3 (Randaiol) R = $-OH$

EXPERIMENTAL

General procedures. Mps are uncorr.; NMR spectra were determined in $CDCl_3$ using TMS as int. standard. TLC was performed with Si gel G and prep. TLC with Kiesel gel PF_{254}.

Plant material. Taiwan sassafras, *Sassafras randaiense* (Hay.) Rehd. (Lauraceae) was collected in the Yi-lan area, Taiwan in Sept. 1970, and identified by Professor J.-C. Liao, Department of Forestry, this University.

Extraction of Taiwan sassafras. Air-dried heartwood shavings (5.4 kg) were percolated with MeOH at room temp. for 10 days. The marc was again extracted ×3. The extract (130 l.) was evaporated under red. pres. to yield a brown solid (226 g), which was extracted with *n*-hexane, followed with $CHCl_3$ and MeOH. From the *n*-hexane-soluble part (22.3 g) of the MeOH extract two crystalline compounds were isolated which were characterized as magnolol (14 g, 0.26 %) and sitosterol. The $CHCl_3$-soluble part when subjected to Si gel CC afforded two crystalline compounds, whose structures were deduced to be 2,2′-dihydroxy-5-allylbiphenyl-5′-propenal (750 mg, 0.014 %) and 2,2′,5′-trihydroxy-5-allylbiphenyl (150 mg, 0.003 %), named as randainal and randaiol, respectively.

Isolation of magnolol (**1**). *2,2′-dihydroxy-5,5′-diallylbiphenyl.* The *n*-hexane-soluble part (22.3 g) was chromatographed on a column of Si gel eluting with 5 % EtOAc–*n*-hexane giving prisms (14 g, 0.25 %), mp 100–102°, $C_{18}H_{18}O_2$. (Found: C, 81.40; H, 6.43. Calc. for $C_{18}H_{18}O_2$: C, 81.17; H, 6.81 %.) IR ν_{max} cm^{-1}: 3300–3100, 1220 (OH), 1640, 1410, 990, 910 ($CH_2=CH-$), 1610, 1500, 880, 820 (1,2,4-trisubstituted arom.). ^1H NMR (90 MHz, $CDCl_3$): δ 3.31 (4H, *d*, $J = 6$ Hz, $2 \times C\underline{H}_2CH=CH_2$), 5.03 (4H, *m*, $2 \times CH_2CH=C\underline{H}_2$), 5.88 (2H, *m*, $2 \times CH_2C\underline{H}=CH_2$), 6.31 (2H, *br s*, $2 \times O\underline{H}$), 6.80–7.17 (6H, *m*, arom.). MS *m/z* 267 (21.4 %), 266 $[M]^+$ (100), 248 (9.9), 239 (3.1), 225 (16.0), 207 (9.9), 197 (15.3), 184 (19.1), 133 (7.6), 91 (4.6), 77 (4.6), 55 (3.8).

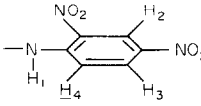
The diacetate of **1** formed a colourless syrup, IR ν_{max} cm^{-1}: 1760, 1200 (–COMe), 1640, 1410, 990, 910 ($CH_2=CH-$), 1610, 1500, 880, 820 (1,2,4-trisubst. arom.). ^1H NMR: δ 2.02 (6H, *s*, $2 \times OCOC\underline{H}_3$), 3.38 (4H, *d*, $J = 6$ Hz, $2 \times C\underline{H}_2CH=CH_2$), 5.05 (4H, *m*, $2 \times CH_2CH=C\underline{H}_2$), 5.93 (2H, *m*, $2 \times CH_2C\underline{H}=CH_2$), 6.95–7.22 (6H, *m*, arom.). From the data presented above **1** appeared to be magnolol which was confirmed by comparison with the data of an authentic specimen [4].

Isolation of sitosterol. Further elution with 10 % EtOAc–*n*-hexane yielded needles, mp 138–140° (Me_2CO), Liebermann–Burchard test, positive. From the IR and NMR spectra, this compound appeared to be sitosterol, which was confirmed by comparison with the data of an authentic specimen.

Isolation of randainal (**2**), *2,2′-dihydroxy-5-allylbiphenyl-5′-propenal.* The $CHCl_3$-soluble part of the MeOH extract was chromatographed on a column of Si gel eluting with 30 % EtOAc–*n*-hexane to afford needles (750 mg, 0.014 %), mp 137–139°. (Found: C, 77.03; H, 5.49. $C_{18}H_{16}O_3$ requires: C, 77.14; H, 5.71 %). IR ν_{max} cm^{-1}: 3500–3100, 1220 (OH), 2720, 1650 (α,β-conj. –CHO), 1610, 985, 900 (monosubst. alkene), 1600, 1500, 820 (1,2,4-trisubstituted arom.), 965 (*trans*-disubstituted alkene). ^1H NMR $[(CD_3)_2CO]$ spectra were similar to that of **1**: δ 3.36 (2H, *d*, $J = 6$ Hz, $C\underline{H}_2CH=CH_2$), 5.12 (2H, *m*, $CH_2-CH=C\underline{H}_2$), 6.05 (1H, *m*, $CH_2C\underline{H}=CH_2$), 6.72 (1H, *dd*, $J_{1,2} = 15$ Hz, $J_{2,3} = 7$ Hz, $H_1-C=C(\underline{H}_2)-C(=O)-H_3$), 6.93–7.16 (4H, *m*, arom.), 7.56–7.84 (3H, *m*, arom. and $\underline{H}C=CH-CHO$), 9.74

(1H, *d*, $J_{2,3}$ = 7 Hz, H_1–C=C–C–H_3). MS *m/z* 281 (22.9%), 280 $[M]^+$ (86.3), 279 $[M-1]^+$ (11.1), 262 (25.6), 254 (100), 239 (24.8), 236 (13.7), 225 (17.9), 207 (23.1), 181 (24.8), 147 (23.1), 133 (17.9), 115 (38.5), 91 (26.5), 77 (46.2), 55 (70.9), 41 (62.4).

The diacetate of **2** formed a pale yellow syrup; its NMR spectra showed acetoxy groups as singlets (3H) at δ 2.01 and 2.07 which were similar to those of magnolol diacetate, indicating the OH groups in both compounds are in the same positions. Methylation of **2** with CH_2N_2 gave a yellow syrup; its NMR spectra ($CDCl_3$) showed two methoxy groups at δ 3.78 and 3.85. The 2,4-dinitrophenylhydrazones of **2** and its diacetate formed as brown-red needles, mp 232–234° and orange-red needles, mp 198–200°, respectively. The IR and NMR spectra of the latter compound are as follows: IR ν_{max} cm^{-1}: 3300 (NH), 1770, 1750, 1200, 1180 (OCOMe), 1620 (C=N), 1510, 1340 (NO_2), 1010, 920 (monosubstituted alkene), 980 (*trans*-disubstituted alkene). ^1H NMR ($CDCl_3$): δ 2.03 (3H, *s*, $OCOCH_3$), 2.07 (3H, *s*, $OCOCH_3$), 3.43 (2H, *d*, J = 6 Hz, $CH_2CH=CH_2$), 5.10 (2H, *m*, $CH_2CH=CH_2$), 6.03 (1H, *m*, $CH_2CH=CH_2$), 6.97–7.95 (9H, *m*, arom. and HC=CHCH=N–), 7.98 (1H, *d*, $J_{3,4}$ = 9 Hz,



) 8.45 (1H, *dd*, $J_{3,4}$ = 9 Hz, $J_{2,3}$ = 2 Hz, H_3), 9.45 (1H, *d*, $J_{2,3}$ = 2 Hz, H_2), 10.27 (1H, *s*, NH_1). From the above data **2** contains one more alkene and an aldehyde group, but one fewer allyl group than **1**, so the structure for **2** must be 2,2'-dihydroxy-5-allylbiphenyl-5'-propenal.

Isolation of randaiol (**3**), *2,2',5'-trihydroxy-5-allylbiphenyl.* The $CHCl_3$-soluble part of the MeOH extract was chromatographed on a column of Si gel followed by prep. TLC with 30% EtOAc in $CHCl_3$ to afford a yellow syrup, IR ν_{max} cm^{-1}: 3600–3100, 1200 (OH), 1600, 1480, 810 (1,2,4-trisubstituted arom.) 1620, 985, 905 (monosubstituted alkene). ^1H NMR [$(CD_3)CO$]: δ 3.36 (2H, *d*, J = 6 Hz, $CH_2CH=CH_2$), 5.01 (2H, *m*, $CH_2CH=CH_2$), 6.00 (1H, *m*, $CH_2CH=CH_2$), 6.65–7.13 (6H, *m*, arom.), 8.00 (3H, *brs*, 3 × OH). MS *m/z* 242 $[M]^+$ ($C_{15}H_{14}O_3$), i.e. $C_{12}H_6(OH)_3CH_2CH=CH_2$. These data indicated that **3** contains one more OH group but one fewer allyl group than **1**. The triacetate of **3** formed a syrup. ^1H NMR ($CDCl_3$): δ 2.03, 2.04 and 2.23 (each 3H, *s*, $OCOCH_3$), 3.37 (2H, *d*, J = 6 Hz, $CH_2CH=CH_2$), 5.07 (2H, *m*, $CH_2CH=CH_2$), 5.97 (1H, *m*, $CH_2CH=CH_2$), 7.00–7.23 (6H, *m*, arom.). MS *m/z* 368 $[M]^+$ (3.3%), 3.26 $[M-42]^+$ (55), 284 $[M-84]^{+l}$ (63.1), 242 $[M-126]^+$ (100). From the above data the structure of **3** appeared to be 2,2', 5'-trihydroxy-5-allylbiphenyl. Both **2** and **3**, as far as we are aware, are not described in the literature.

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DAPHNETICIN, A COUMARINOLIGNOID FROM *DAPHNE TANGUTICA*

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Key Word Index—*Daphne tangutica*; Thymelaeaceae; daphneticin; coumarinolignoid; 1'-(3,5-dimethoxy-4-hydroxy)phenyl-2'-hydroxymethylethylene-dioxy-1'–O,2'–O:8,7-coumarin.

Abstract—A new coumarinolignoid, daphneticin, has been isolated from the roots of *Daphne tangutica* and its structure elucidated on the basis of chemical and NMR spectroscopic evidence.

INTRODUCTION

Daphne tangutica Maxim (*D. retusa* Hemsl.) has been used in Chinese traditional medicine as an abortifacient and as a remedy for the treatment of rheumatism and toothache. In the course of a screening programme, we have found that a dichlormethane extract of the drug showed a strong *in vitro* inhibition (60%) of the Walker-256-Carcinoma Ascites cells [1]. Fractionation of this extract on a silica gel column with toluene–acetone mixtures yielded four lignans, three coumarins, a diterpene ester [1] and a new coumarinolignoid designated daphneticin. The structure of daphneticin is reported in the present communication.

RESULTS AND DISCUSSION

Daphneticin, mp 235–238°, $C_{20}H_{18}O_8$, showed a molecular ion at 386.1006 and had no optical rotation. The UV absorption at 317, 260 and 242 nm, a δ-lactone absorption band at 1730 cm^{-1} in the IR spectrum and two character-