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NEOLIGNANS FROM *VIROLA CARINATA**

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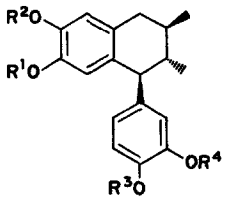
Key Word Index—*Virola carinata*; Myristicaceae; (+)-guaiacin; (−)-galcatin; (−)-isootobaphenol; 7,4′-dimethoxyflavanone.

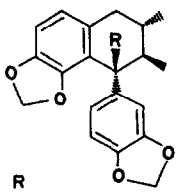
Abstract—The wood of *Virola carinata* (Benth.) Warb. contains besides the known neolignans (+)-guaiacin and (−)-galcatin, (−)-isootobaphenol [(2R,3S,4S)-4-guaiacyl-2,3-dimethyl-6,7-methylenedioxytetralin], in addition to 7,4′-dimethoxyflavanone.

Until 1972 [4] it seemed that each of the plant families containing 4-aryltetralins was characterized by different representatives of this neolignan type (Table 1). Since, however, the compounds **1b–1f** derive from guaiacin (**1a**) by ubiquitous biogenetic processes, it could have been anticipated that **1a** should have the widest distribution and that no family specificity should exist for the rest of the compounds. Both points are brought into focus by the present report on *Virola carinata*. The wood of this Amazonian Myristicacea [13] contains, besides (+)-guaiacin (**1a**) and (−)-galcatin (**1e**), the previously unknown (−)-isootobaphenol (**1c**) whose description completes the list of all possible simple guaiacin derivatives. An additional constituent, 7,4′-dimethoxyflavanone, was already available by synthesis [14].

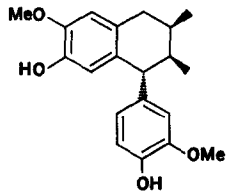
The identifications of **1a** [4] and **1e** [2,6,15] relied upon comparisons with published data. Structure **1c** was allotted to isootobaphenol upon recognition of the identity of its monomethyl ether with (−)-galcatin and the observation of a negative Gibbs test [16]. IR and, more conclusively, UV spectra [17] revealed the additional compound as a flavanone. Indeed, the ^{1}HMR spectrum contains the pertinent signals due to the aliphatic ABX system [17], and defines unequivocally the substitution of the two mono-methoxylated aromatic rings.



	R^1	R^2	R^3	R^4	
(1a)	H	Me	H	Me	(+)-guaiacin
(1b)	H	Me	$-CH_2-$		(+)-otobaphenol
(1c)	$-CH_2-$		H	Me	(−)-isootobaphenol
(1d)	Me	Me	$-CH_2-$		(+)-isogalcatin [12] =isootobain
(1e)	$-CH_2-$		Me	Me	(−)-galcatin
(1f)	Me	Me	Me	Me	(−)-galbulin



	R	
(2a)	H	(−) – otobain
(2b)	OH	(−) – hydroxyotobain



(3) isoguaiacin

EXPERIMENTAL

Isolation of the constituents. Virola carinata was collected at km 8 of the Manaus–Itacoatiara highway and identified by the botanist W. A. Rodrigues (voucher specimen INPA, 46.523). A trunk section was separated into bark (1.5 kg) and wood (8.8 kg) which were powdered and extracted separately with $CHCl_3$. The exts. were chromatographed on SiO_2. The bark ext. (45 g) gave, by elution with C_6H_6, in order **1e** (1.1 g), **1a** (8 mg) and **1c** (160 mg). The wood ext. (37 g) gave, by elution with C_6H_6 **1e** (1.2 g), and with C_6H_6–MeOH 99:1 first sitosterol and subsequently 7,4′-dimethoxyflavanone (60 mg).

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Table 1. Occurrence of 4-aryltetralin neolignans

Plant	Compound	Ref.
Himantandraceae		
Himantandra baccata Bail.	**1f**, **1e**	[2,3]
Lauraceae		
Machilus edulis King	**1a**	[4]
Myristicaceae		
Myristica otoba Humb. et Bonpl.	**1b**, **1d**, **2a**, **2b**	[5–9]
Virola cuspidata (Benth.) Warb.	**2b**	[10]
V. carinata (Benth.) Warb.	**1a**, **1c**, **1e**	—
Zygophyllaceae		
Guaiacum officinale L.	**1a**, **3**	[11]

(+)-Guaiacin (**1a**), mp and lit. [4] mp 198–200° (C_6H_6). UV, ^{1}HMR, MS and $[\alpha]_D$ identical with data given in lit. [4].

(−)-*Isootobaphenol* (**1c**). Mp 130–132° (*n*-hexane–MeOH) [C, 73.45; H, 6.76; $C_{20}H_{22}O_4$ requires C, 73.60; H, 6.79%]. ν_{max}^{KCl} (cm^{-1}): 3390, 1601, 1510, 1490, 1380, 1240, 1170, 1140, 1050. λ_{max}^{EtOH} (nm): 237, 292 (ϵ 12250, 6100). ^{1}HMR ($CDCl_3$, τ): 3.16 (*d*, *J* 8.8 Hz, H-5′), 3.37 (*dd*, *J* 8.8, 1.8 Hz, H-6′), 3.47 (*d*, *J* 1.8 Hz, H-2′), 3.51 (*s*, H-5), 3.82 (*s*, H-8), 4.18 (*s*, O_2CH_2), 4.52 (*s*, OH), 6.12 (*s*, OMe), 6.61 (*d*, *J* 10.0 Hz, H-1), 7.30 (*d*, *J ca* 6 Hz, 2H-4), 8.2–8.6 (*m*, H-2, 3), 8.95 (*d*, 5.6 Hz, Me), 9.16 (*s*, Me). Gibbs test [16] negative. $[\alpha]_D^{20}$ −4° (MeOH). *Acetate*, mp 125–128° (*n*-hexane–MeOH). ν_{max}^{KCl} (cm^{-1}): 1760, 1610, 1510, 1485, 1230, 1040. ^{1}HMR ($CDCl_3$, τ): 3.03 (*d*, *J* 9 Hz, H-5′), 3.28 (*dd*, *J* 9, 2Hz, H-6′), 3.33 (*d*, *J* 2 Hz, H-2′), 3.45 (*s*, H-5), 3.82 (*s*, H-8), 4.27 (*s*, O_2CH_2), 6.18 (*s*, OMe), 6.51 (*d*, *J* 10 Hz, H-1), 7.2–7.4 (*m*, 2 H-4), 7.57 (*s*, OAc), 8.1–8.5 (*m*, H-2, 3), 8.89 (*d*, *J* 6.0 Hz, Me), 8.98 (*d*, *J* 6.0 Hz, Me). *Methyl ether*, identical by mp, mmp and spectra with (−)-galcatin.

(−)-*Galcatin* (**1e**). Mp and lit. [2] mp 117–118° (*n*-hexane–MeOH). IR, UV [15], ^{1}HMR [6] and $[\alpha]_D$ [2] identical with data given in lit. MS (*m/e*): 340 (100%) M, 324 (10), 283 (13), 254 (18), 253 (92), 202 (16), 192 (7), 190 (20), 187 (13), 178 (5), 176 (3), 165 (23), 164 (57), 149 (48), 142 (12), 135 (10), 121 (16), 113 (13), 104 (10).

7,4′-*Dimethoxyflavone*, mp and lit. [14] mp 93–95° (*n*-hexane–EtOH) (Found C, 71.49; H, 5.51. $C_{17}H_{16}O_4$ requires C, 71.82; H, 5.67%). ν_{max}^{KCl} (cm^{-1}): 1630, 1510, 1340, 1260, 1220, 1190, 1140, 1120, 1090, 1085, 1045, 820. λ_{max}^{EtOH} (nm): 228, 279, 320 (ϵ 28050, 24000, 11350); $\lambda_{max}^{EtOH+NaOH}$ (nm): 243, 279, 356 (ϵ 21300, 15600., 9250). ^{1}HMR ($CDCl_3$, τ): 2.41 (*d*, *J* 9.0 Hz, H-5), 2.88–2.97 and 3.14–3.23 (AA′BB′, H-2′,6′ and H-3′,5′), 3.50 (*dd*, *J* 9.0, 2.0 Hz, H-6), 3.49 (*d*, *J* 2.0 Hz, H-8), 4.78 (*dd*, *J* 6.5, 4.5 Hz, H-2), 6.12 (*s*, OMe), 6.21 (*s*, OMe), 6.86 (*dd*, *J* 14.0, 4.5 Hz, H-3 eq.), 7.08 (*dd*, *J* 14.0, 6.5 Hz, H-3 ax.).

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Note added in proof. For additional 4-aryltetralin neolignans see Gisvold, O. and Thaker, E. (1974) *J. Pharm. Sci.* **63**, 1905; Murphy, S. T., Ritchie, E. and Taylor, W. C. (1975) *Australian J. Chem.* **28**, 81.