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LIGNOIDS FROM THE FRUIT OF THREE *VIROLA* SPECIES*

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Abstract—The fruits of *Virola peruviana* contain, besides 11-phenyl-1-(2′,6′-dihydroxyphenyl)-undecan-1-one and the neolignan 2,3-dimethyl-1,4-diveratryl-n-butan-1-ol, 3,4-methylenedioxycinnamyl alcohol. In contrast, the fruits of *V. flexuosa* and *V. multinervia* both contain oxidative dimers of cinnamyl alcohols such as asarinin, cubebin, dihydrocubebin and sesamin. The former contains additionally fargesin and *O*-methylpiperitol, besides 7,4′-dimethoxyflavone, and the latter contains additionally hinokinin.

INTRODUCTION

Virola flexuosa A. C. Smith, *V. multinervia* Ducke and *V. peruviana* (A. DC.) Warb. are three Amazonian species of the Myristicaceae. The red bark resin of the former is employed medicinally against fungal infection of the skin [2]. A 1,3-diaryl-2-hydroxypropane and a 1,3-diarylpropane were isolated from the trunk wood [3]. The second species contains traces of tryptamines in bark and root [4], as well as the same 1,3-diaryl-2-hydroxypropane, and several 1,3-diarylpropanes and isoflavones in the trunk wood [3, 5, 6]. The resin of the third species is used to relieve toothache and possibly for the preparation of hallucinogenic snuff [2]. It thus should contain tryptamines which indeed, together with fatty alcohols, the (2*S*,6*S*)- (here designated series **1**) and (2*S*,6*R*)- (series **2**) 2,6-diarylfurofuran lignans yangambin (**1a**) and epiyangambin (**2a**), are constituents of the bark [7].

RESULTS

The present work reports on the micromolecular composition of the fruits of the three species. *V. flexuosa* was found to contain in seed and pericarp (+)-sesamin (**1b**) and (+)-asarinin (**2b**). The former contains additionally (+)-dimethoxyaschantin (**1c**) and fargesin (**2c**), while the latter contains additionally the dibenzylbutandiol (−)-dihydrocubebin (**3**), an optically inactive dihydrocubebin (**4**), the dibenzylbutyrolactol (−)-cubebin (**5**) and 7,4′-dimethoxyflavone (**6**). *V. multinervia* was found to contain in seed **1b**, **2b**, **3** and **5** besides the dibenzylbutyrolactone (−)-hinokinin (**7**). Finally, *V. peruviana* was found to contain in seed and pericarp the neolignan 2,3-dimethyl-1,4-diveratrylbutan-1-ol (**8**). The former contains additionally 11-phenyl-1-(2′,6′-dihydroxyphenyl)-undecan-1-one (**9**), while the latter contains additionally 3,4-methylenedioxycinnamyl alcohol (**10**).

Compounds **1b** [8, 9], **2b** [8, 10], **1c** [11], **2c** [12], **3** [10, 13], **5**, **7** [14], **8** [15] and **10** [16] were identified by comparison of their spectra, mps and, when pertinent, optical rotations with literature data. Compound **4**, although spectroscopically identical with **3**, was optically inactive. Compound **9** was recognized to be homologous with 9-phenyl-1-(2′,6′-dihydroxyphenyl)-nonan-1-one [17] and compound **6** was apparently isolated for the first time from a natural source.

DISCUSSION

2,6-Diarylfurofurans seem to be typical constituents of *Virola* seeds. Interestingly, *V. peruviana*, exempt of isolable quantities of such compounds, accumulates the potential precursor, a cinnamyl alcohol. An analogous situation has been described for several Lauraceae species, where absence of detectable quantities of pyrones and neolignans corresponds to the accumulation of the potential precursor, a cinnamic acid [18].

EXPERIMENTAL

Isolation of the constituents. Specimens of *Virola flexuosa*, *V. multinervia* and *V. peruviana* (all from the margins of the Madeira river near km 10 of the road leading from Humaitá to Prainha) were identified by Dr. William A. Rodrigues, INPA, Manaus. Fruits were dried and separated into seeds, teguments and pericarps which were extracted separately with $CHCl_3$. The extracts were crystallized from MeOH. The fats were separated by filtration and the solns were evapd. The residues were

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submitted to column chromatography (silica gel, C_6H_6–EtOAc, 9:1 up to 7:3). The fractions were purified by prep. TLC (silica gel, C_6H_6–EtOAc, 9:1, 8:2 or 7:3) and crystallization from MeOH.

V. flexuosa. Seeds (16 g), teguments (20 g) and pericarps (25 g) gave extracts (resp. 6 g, 5.5 g, 8 g) which yielded resp. **1b** (118 mg), **2b** (115 mg), **1c** (45 mg), **2c** (69 mg); **1b** (15 mg), **2b** (32 mg), **5** (22 mg); and **1b** (24 mg), **2b** (8 mg), **5** (218 mg), **6** (18 mg), **4** (6 mg), **3** (58 mg).

V. multinervia. Seeds (600 g) gave an extract (40 g) which yielded **7** (10 mg), **1b** (30 mg), **2b** (40 mg), **3** (300 mg) and **5** (110 mg).

V. peruviana. Seeds (50 g) and pericarps (50 g) gave extracts (resp. 30 g, 15 g) which yielded resp. **9** (5 mg), **8** (10 mg); and **10** (30 mg), **8** (170 mg).

7,4'-Dimethoxyflavone (**6**). Mp 146–147° (MeOH). UV $\lambda_{\max}^{\text{MeOH}}$ nm: 255 (ε7100), 320 (ε21000), no modifications in presence of $AlCl_3$ or NaOH. IR $\nu_{\max}^{\text{KBr}}$ cm^{-1}: 1645, 1629, 1604, 1515, 1444, 1260. ^{1}H NMR (80 MHz, $CDCl_3$): δ6.67 (*s*, H-3), 8.14 (*d*, $J = 8.5$ Hz, H-5), 6.97 (*dd*, $J = 8.5$ and indet., H-6), 6.94 (*br s*, H-8), 7.87 and 7.01 (AA'BB', *J ca* 9 Hz, H-2', H-6' and H-3', H-5'), 3.93 and 3.89 (2*s*, 2OMe). ^{13}C NMR (20 MHz, $CDCl_3$): δ162.6 (C-2), 106.1 (C-3), 177.8 (C-4), 114.1 (C-4a), 127.8 (C-5), 106.1 (C-6), 165.6, 163.1, 162.3 (C-7, C-8a, C-4'), 100.5 (C-8), 124.1 (C-1'), 127.0 (C-2'), 114.4 (C-3'), 114.4 (C-5'), 127.0 (C-6'), 56.7 (2OMe). MS m/z (rel. int.): 282 $[M]^+$ (100), 150 (7), 132 (49).

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