

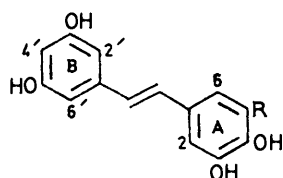
Polyhydroxystilbenes from the Heartwood of *Schotia brachypetala*

By Siegfried E. Drewes* and Ian P. Fletcher, Department of Chemistry, University of Natal, Pietermaritzburg, South Africa

From the heartwood of *Schotia brachypetala* *trans*-3,3',4,5,5'-pentahydroxystilbene has been isolated as the major component and *trans*-3,3',4,5'-tetrahydroxystilbene as the minor component. The methyl ethers of both stilbenes have been synthesized *via* a Wittig reaction. Traces of the *cis*-pentahydroxystilbene also occur in the wood.

SCHOTIA BRACHYPETALA (the 'weeping boerboon') occurs as a medium-sized tree in the eastern and north-eastern parts of South Africa. Little is known about the orange-red heartwood except that it contains tannins and the wood dust is irritating to the eyes.¹

Paper chromatography of the heartwood extract showed one major component (bright blue under u.v. light) and several minor components. The main constituent crystallized out readily in the exceptionally high yield of 16.7% (based on dry wood weight) and was shown to be *trans*-3,3',4,5,5'-pentahydroxystilbene² (1). It was accompanied by a small amount (<1%) of *trans*-3,3',4,5'-tetrahydroxystilbene. Other components also present in the wood, but identified only by co-chromatography with authentic reference compounds and by typical colour reactions, were catechin, epicatechin, and *cis*-3,3',4,5,5'-pentahydroxystilbene (trace).



(1) R = OH
(2) R = H

3,3',4,5,5'-Pentamethoxystilbene was synthesized by a Wittig reaction from 3,5-dimethoxybenzyl bromide and 3,4,5-trimethoxybenzaldehyde. A similar Wittig reaction between 3,5-dimethoxybenzyl bromide and 3,4-dimethoxybenzaldehyde gave 3,3',4,5'-tetramethoxystilbene, which was demethylated by pyridine hydrochloride³ to give the corresponding tetrahydroxy-compound. Both coupling reactions were done in dimethylformamide with sodium methoxide as base and gave exclusively the *trans*-stilbene.

Irradiation of the natural *trans*-pentahydroxystilbene with a medium-pressure mercury lamp caused its isomerization to the *cis*-form in 35% yield. Paper chromatographic and u.v. spectral analysis showed that this *cis*-isomer was identical with a very minor component present in freshly-extracted heartwood of *S. brachypetala*. Natural stilbenes occur almost exclusively in the more stable *trans*-form but cases have been reported of naturally occurring *cis*-stilbenes.^{4,5}

¹ E. Palmer and N. Pitman, 'Trees of South Africa,' A. A. Balkema, Cape Town, 1961, p. 179.

² Preliminary communication, S. E. Drewes, *Phytochemistry*, 1971, **10**, 2837.

³ F. W. Bachelor, A. A. Loman, and L. R. Snowdon, *Canad. J. Chem.*, 1970, **48**, 1554.

Attempts to photoisomerize the *trans*-3,3',4,5'-tetrahydroxystilbene gave no single pure product.

EXPERIMENTAL

N.m.r. spectra were measured with a Varian T60 instrument and mass spectra with a Varian CH7 spectrometer at 70 eV.

3,3',4,5,5'-Pentahydroxystilbene (1).—The powdered heartwood (630 g) of a mature trunk (40 cm) of *S. brachypetala* was extracted (Soxhlet) with methanol-water (95:5) for 24 h. Removal of the solvent afforded a residue which crystallized in buff prisms (105 g, 16.7%), m.p. 243–245°, from methanol-water at 0°. Traces of 3,3',4,5'-tetrahydroxystilbene in these crystals were removed by paper chromatography in water-saturated butan-2-ol on Whatman No. 3 sheets. In this system the penta- and tetra-hydroxystilbenes had R_F values of 0.63 and 0.77, respectively. Pure pentahydroxystilbene had m.p. 245° (lit.,⁶ 245°) (Found: C, 64.6; H, 4.85. Calc. for $C_{14}H_{12}O_5$: C, 64.6; H, 4.65%), λ_{max} . 326 (ϵ 30,000) and 226 nm (24,000).

Chemical shifts (τ values) for aromatic and olefinic protons of compounds (1) and (2) and their derivatives in $CDCl_3$

Stilbene	Olefinic protons	Ring A 2, 6(5)	Ring B 2', 6'	Ring B 4'
<i>trans</i> -Pentahydroxy *	3.19 (s)	3.40 (s)	3.50 (d)	3.72 (t)
<i>trans</i> -Pentamethoxy	3.00 (s)	3.26 (s)	3.33 (d)	3.60 (t)
<i>trans</i> -Penta-acetoxy	3.06 (s)	2.80 (s)	2.94 (d)	3.16 (t)
<i>cis</i> -Pentahydroxy *	3.72 (s)	3.57 (s)	3.66 (d)	3.80 (t)
<i>cis</i> -Penta-acetoxy	3.48 (s)	2.93 (s)	3.03 (d)	3.20 (t)
<i>trans</i> -Tetrahydroxy *	3.13 (s)	(2.83— 3.20)	3.43 (d)	3.70 (t)
<i>trans</i> -Tetramethoxy	2.99 (s)	(2.83— 3.27)	3.33 (d)	3.63 (t)

* Solvent C_2D_5OD .

Methylation with diazomethane gave pale yellow rods of the *penta-O-methyl derivative*, m.p. 134–135° (Found: C, 68.7; H, 6.3. $C_{19}H_{22}O_5$ requires C, 69.1; H, 6.7%). The penta-acetate had m.p. 174° (lit.,⁶ 173–174°) (Found: C, 61.0; H, 4.7. Calc. for $C_{24}H_{22}O_{10}$: C, 61.3; H, 4.7%), m/e 470 (M^+ , 66%), 428 ($M - 42$, 24.4), 386 ($M - 2 \times 42$, 26.9), 344 ($M - 3 \times 42$, 100), 302 ($M - 4 \times 42$, 42.3), and 260 ($M - 5 \times 42$, 42.3).

3,3',4,5,5'-Penta-acetoxybibenzyl.—3,3',4,5,5'-Penta-acetoxy-stilbene (1 g) in methanol (70 ml) was hydrogenated over PtO_2 (150 mg) for 6 h to give white prisms (800 mg), m.p. 123° (ethanol) (Found: C, 60.9; H, 5.15. $C_{24}H_{24}O_{10}$ requires C, 61.0; H, 5.1%), m/e 472.

3,3',4,5,5'-Pentamethoxybibenzyl.—The pentamethoxy-stilbene (1 g) in methanol was similarly hydrogenated to give white needles (850 mg), m.p. 77° (ethanol) (Found: C, 68.3; H, 7.3. $C_{19}H_{24}O_5$ requires C, 68.6; H, 7.3%).

⁴ J. Cunningham, E. Haslam, and D. Haworth, *J. Chem. Soc.*, 1963, 2875.

⁵ D. E. Hathway, *Biochem. J.*, 1962, **83**, 80.

⁶ F. E. King, T. J. King, D. H. Godson, and L. C. Manning, *J. Chem. Soc.*, 1956, 4477.

3,3',4,5'-Tetrahydroxystilbene (2).—From the crude crystals of the pentahydroxystilbene (14 g), pure tetrahydroxystilbene (150 mg), m.p. 227° (lit.,⁶ 229°), was recovered by preparative paper chromatography as already described (Found: C, 68.4; H, 4.95. Calc. for $C_{14}H_{12}O_4$: C, 68.8; H, 4.95%).

Synthesis of 3,3,4,5,5'-Pentamethoxystilbene.—3,5-Dimethoxybenzyl bromide and 3,4,5-trimethoxybenzaldehyde were prepared by standard procedures. To triethyl phosphite (4.5 ml) the benzyl bromide (4.4 g) was added and the mixture was refluxed for 1 h. Dimethylformamide (10 ml) was added to the cold solution followed by sodium methoxide (1.9 g) and the 3,4,5-trimethoxybenzaldehyde (4.9 g). After stirring for 14 h at 25° the mixture was poured into cold water (50 ml); the precipitate was filtered off, dried, and recrystallized from methanol to yield yellowish needles (7.2 g, 88%), m.p. 135° (Found: C, 68.8; H, 6.7. $C_{19}H_{22}O_5$ requires C, 69.1; H, 6.7%), identical with the natural product.

Synthesis of 3,3',4,5'-Tetrahydroxystilbene.—3,3',4,5'-Tetramethoxystilbene was similarly prepared by a Wittig reaction. The white needles, m.p. 67–68°, were obtained from benzene–light petroleum (Found: C, 71.6; H, 6.75. Calc. for $C_{18}H_{20}O_4$: C, 72.0; H, 6.7%). It was demethylated to the free phenolic form with pyridine hydrochloride³

to give an amorphous product, m.p. 228° (lit.,⁶ 229°) (Found: C, 69.15; H, 4.95. Calc. for $C_{14}H_{12}O_4$: C, 68.85; H, 4.95%).

Synthesis of cis-3,3',4,5,5'-Pentahydroxystilbene.—*trans*-Pentahydroxystilbene (400 mg) in ethanol (100 ml) was irradiated under N_2 with a medium-pressure mercury lamp (250 W) for 6 h. Removal of the solvent left a residue which was chromatographed on Whatman No. 3 paper with acetic acid–water (98:2) as solvent. The band of R_F 0.21 was cut out and extracted. Pale brown needles (150 mg), m.p. 128–130°, were obtained from ethanol–water (Found: C, 64.6; H, 4.65. $C_{14}H_{12}O_5$ requires C, 64.6; H, 4.65%), λ_{max} 304 (ϵ 9000) and 228 nm (21,000). The product had R_F values of 0.83 and 0.21 in water-saturated butan-2-ol and acetic acid–water (98:2), respectively, and was chromatographically identical with material giving a blue fluorescent spot (u.v. light) present in *S. brachypetala* heartwood. This material had λ_{max} 304 and 228 nm. Acetylation of the *cis*-pentahydroxystilbene gave a yellow oil.

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