A Biflavanoid Proanthocyanidin Carboxylic Acid and Related Biflavanoids from *Acacia luederitzii* Engl. var. *retinens* (Sim) J. Ross & Brenan

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Summary The structure and stereochemistry is described of the first member of a new class of natural biflavanoid proanthocyanidins which contain a single carboxyl group the acid is associated with chemically related biflavanoids and their precursors

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THE stereochemistry of three diastereoisomeric 4 6-linked biflavanoid proanthocyanidins with flavan-3,4-diol terminal groups, and of related C–C 4 6- (or 4 8-) linked units with flavan 3-ol (catechin) end-groups from *Acacia mearnsii* was first examined by Drewes, Roux, Saayman Feeney, and Eggers[1,2] Contemporary studies by Weinges *et al*[3] extended the range of stereochemical species for 4,8-linked units of the latter type, and very recently Pelter *et al*[4] isolated 4 6 linked analogues Previously Mayer *et al*[5] and subsequently also Weinges *et al*[6] demonstrated the natural occurrence of variations of doubly-linked proanthocyanidins of similar structure, joined by C–C, benzyl ether, and acetal bridges Drewes and Ilsley[7] isolated a dioxan-linked (double-linked) biflavanoid from *A mearnsii*

Another variation is the presence of a carboxyl group in the terminal unit of a C–C singly-linked bimolecular proanthocyanidin from the wood of *Acacia luederitzii* var *retinens* The compound (I or II) is easily isolated and gives resorcinol, β-resorcylic acid, p-hydroxybenzoic acid, a trace of phloroglucinol, and protoactechuic acid after fusion with alkali[8] With 3N-HCl : propan-2-ol (1 : 4) under pressure[9] it yields the known[10] anthocyanidin guibourtinidin chloride (III), establishing the 3 4′,7-trihydroxy-substitution pattern of the upper unit and by process of elimination, the phloroglucinol–catechol combination of the terminal (lower) unit The presence of an aromatic carboxyl group (ν_{max} 1714 cm^{-1}) is shown by its reaction with sodium bicarbonate The compound also forms a methyl ester of the hexamethyl ether $\{[\alpha]_D^{22} -110\cdot0^\circ$ (*c* 0·8, acetone), M^+ 688$\}$ which is readily converted into the diacetate $\{[\alpha]_D^{22} -121\cdot5^\circ$ (*c* 0·5), M^+ 772$\}$.

The n.m.r. spectra of these derivatives show the typical A_2B_2 system of the B-ring and ABC proton coupling system of the A-ring in the benzoid region. However, an anticipated singlet at high field in this region, characteristic of 4,8-linked[3] or 4,6-linked[2,4] biflavanol units with a phloroglucinol-derived D-ring and due to 6-H and 8-H respectively, is absent. This indicates that the carboxyl function is located on the D-ring. Rationalization of the mass spectra of the methyl ether and its diacetate both lead to the same fragment *m/e* 327 [(IV), base peak in each instance] resulting from initial loss of a methoxy-radical from the carboxylic ester, followed by two successive reverse Diels–Alder fissions. Generation of this common fragment confines the carbonyl group to the D-ring when considered in conjunction with the above n.m.r. evidence.

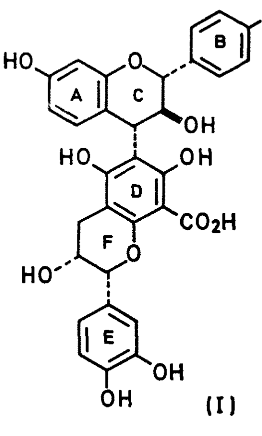
The relative configuration of the methyl ether diacetate derivative of the proanthocyanidincarboxylic acid (I or II) was established as 2,3-*trans*-3,4-*trans* : 2′,3′-*cis* (J(2,3) 10·0; J (3,4) 10·0; J (2′,3′) < 1 Hz) and the heterocyclic protons allocated by use of spin-decoupling techniques as before.[1,2] These allocations are in agreement with those of the spectrum of the full acetate of the (+)-catechin–(−)-epicatechin proanthocyanidin isolated by Weinges *et al.*[3] From the large coupling constants the C-ring has a stabilized half-chair conformation as from previous considerations.[1,2]

On two-dimensional chromatograms the proanthocyanidin carboxylic acid is accompanied by an overlapping mixture of unidentified phenolic polymers and of closely related proanthocyanidins of the more conventional type, containing no carboxyl function. The latter are separable with extreme difficulty by a succession of partition distribution and chromatographic procedures.[1,2] Amongst the products have been recognized proanthocyanidin units of 2,3-*trans*-3,4-*trans* : 3′,4′-*cis* (V) and 2,3-*trans*-3,4-*trans* : 2′3′-*trans* (VI and VII) configuration. These were examined by procedures similar to those above, and are apparently identical (V, VI) or similar (VII) to new proanthocyanidins isolated concurrently by Pelter *et al.*[4] from the wood of *Julbernadia globiflora*. The proanthocyanidins form hexamethyl ethers (M^+ 630) and hexamethyl ether diacetates (M^+ 714).

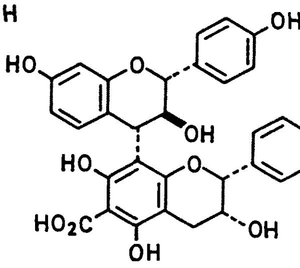
The free phenolic forms of (V), (VI), and (VII) afford the same products on alkali fusion as the carboxylic acid (I), but with phloroglucinol in relatively higher yield.

The association of the stereochemically related pair (I) (or II) and (V) suggests that the former has a 4,6-linkage (I) rather than the alternative 4,8-linkage (II).

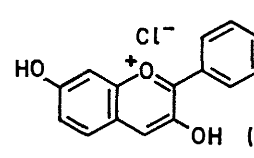
The proguibourtinidins (I) (or II), (V), (VI), and (VII) are accompanied by their apparent precursors (+)-2,3-*trans*-3,4-*trans*-guibourtacacidin (isolated previously from *A. cultriformis*[11]), (+)-catechin and (−)-epicatechin. On the presumption that they are the direct precursors of the proanthocyanidins *via* a benzyl carbonium ion mechanism,[1,2] their absolute configurations may be presumed as indicated [(I) or (II), (V), (VI), and (VII)].



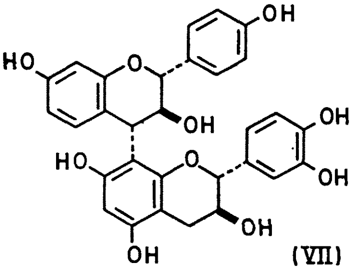
(I)



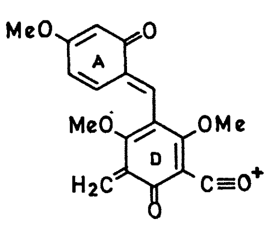
(II)



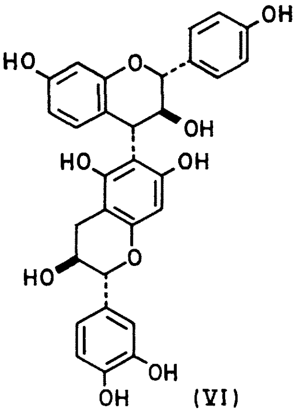
(III)



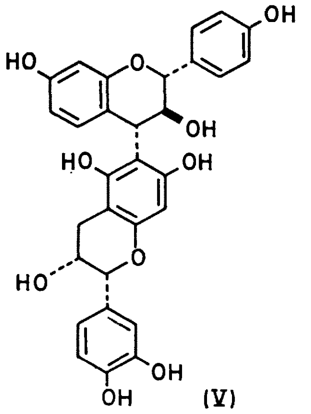
(VIII)



(IV)



(VI)



(V)

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