

Table 3. *Hydrogen-bond distances (Å) and angles (°)*

Standard deviations are given in parentheses.

N(3)···O(4 ⁱ)	2.825 (2)	O(12)···O(2 ⁱⁱ)	2.710 (2)
N(3)—H(3)	0.84 (2)	O(12)—H(12)	0.91 (3)
H(3)···O(4 ⁱ)	2.00 (2)	H(12)···O(2 ⁱⁱ)	1.83 (3)
N(3)—H(3)···O(4 ⁱ)	168 (2)	O(12)—H(12)···O(2 ⁱⁱ)	163 (3)
C(2)—N(3)···O(4 ⁱ)	123.0 (1)	C(11)—O(12)···O(2 ⁱⁱ)	120.1 (1)
C(4)—N(3)···O(4 ⁱ)	110.5 (1)	H(12)···O(2)—C(2 ⁱⁱ)	138 (1)
H(3)···O(4)—C(4 ⁱ)	131.6 (7)	O(12)···O(2)—C(2 ⁱⁱ)	133.0 (1)
N(3)···O(4)—C(4 ⁱ)	129.2 (1)		

Symmetry code: (i) $-x, 1-y, 1-z$; (ii) $1-x, -\frac{1}{2}+y, \frac{1}{2}-z$.

using an RNA model fragment. After some modification with A-form RNA (Arnott & Hukins, 1972), reasonable fitting was successful without abnormal contacts.

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3,4-Dihydro-8-hydroxy-3-(4-hydroxyphenyl)isocoumarin, Hydrangenol

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Abstract. $C_{15}H_{12}O_4$, monoclinic, $P2_1$, $a = 5.600$ (3), $b = 5.185$ (2), $c = 20.827$ (11) Å, $\beta = 97.52$ (2)° (Mo $K\alpha$ radiation, $T = 293$ K), $V = 599.5$ Å³, $Z = 2$, $M_r = 256.26$, $D_x = 1.419$ Mg m⁻³, $F(000) = 268$, $\mu(\text{Mo } K\alpha) = 0.11$ mm⁻¹; $R_1 = 3.7\%$ for 786 observed reflections. The 4-hydroxyphenyl ring C is equatorially substituted at C(3) of the slightly distorted sofa form of the lactone ring B. The conformation of the molecule is characterized by two planes of ring A and ring C which are approximately perpendicular (78.8°) to each other. The hydroxyl H at O(8) is hydrogen bonded to the C(1) carbonyl group with distances O(8)—H(8) = 0.96 (6) and O(1)···H(8) = 1.82 (12) Å, the angle O(8)—H(8)···O(1) being 138 (4)°. Intermolecular

hydrogen bonds of the type O—H···O form endless chains with alternate molecules along **b**.

Introduction. Many plants are known to cause a cell-mediated type of allergy (contact allergy, allergic contact dermatitis). *Hydrangea (Hydrangea macrophylla* subsp. *macrophylla*) is a member of this class, though cases of allergic reaction to it are not frequently encountered. In addition to the three cases reported by Apted (1973) and Burry (1973), a new case has been discovered recently (Hausen, Bäurle & Schmalte, 1982).

Many of the constituents (Fig. 1) of hydrangea species are stilbene (I) derivatives (Asahina & Asano,

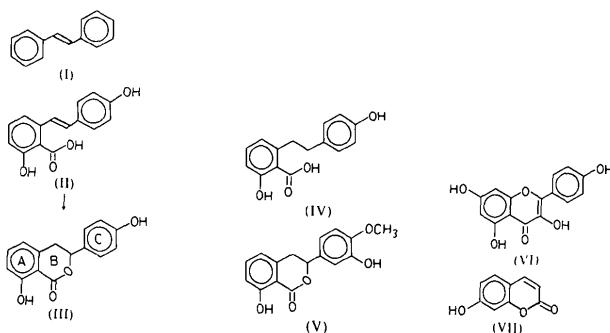


Fig. 1. Stilbene (I) and frequent constituents (II–VII) of hydrangea species; (III) shows the title compound.

1930a,b; Gorman, 1977). The chemical structure of hydrangenol (III), found by epicutaneous test to be the most potent of four allergens, has been determined by X-ray diffraction analysis and further substantiated by mass spectrometry and ^1H NMR spectra. The correct chemical formula (as a phenolic substance) of (III) and the name hydrangenol were proposed previously by Asahina (1909).

The structural relationships of (III) with hydrangeic acid (II), lunularic acid (IV) and phylloolulcin (V) provide a reason for determining their sensitizing capacity as well. The flavone kaempferol (VI) and the coumarin umbelliferone (VII) were found not to be sensitizing.

Experimental. A sample of hydrangenol was separated and concentrated by thin-layer-chromatography techniques and crystallized from acetone and water (v/v 1:1) at 255 K. Due to the observation of crystal deterioration upon standing in air, (III) was recrystallized from acetone. A colourless crystal ($0.18 \times 0.30 \times 0.06$ mm) was sealed in a 0.2 mm \varnothing glass capillary, found to be of good quality by examination of rotation and Weissenberg photographs, and used for data collection.

Cell parameters, space group and symmetry agreed with those of a white-coloured deteriorated crystal showing diffuse reflections. Cell dimensions were obtained from 2θ values of 14 reflections using a Syntex P_2 , four-circle diffractometer, graphite monochromator, 1646 reflections, $2\theta \leq 44^\circ$, θ - 2θ scan, and variable scan rate 1 to $29.2^\circ \text{ min}^{-1}$. The reflections were corrected for Lorentz-polarization but no absorption correction was made. Data reduction, carried out with REDUZ (Eck, 1976), revealed 824 independent reflections; 36 had intensities less than $3\sigma(I)$ and were excluded from the refinement.

The structure solution was performed with MULTAN 80 (Main, Fiske, Hull, Lessinger, Germain, Declercq & Woolfson, 1980). The density was estimated to be 1.43 Mg m^{-3} with $M_r = 258$ for $Z =$

$2(\text{C}_{14}\text{H}_{10}\text{O}_5)$. The values of the statistical averages for the normalized structure factors as well as the $N(z)$ test established the space group $P2_1$.

Several trials with MULTAN resulted in partial structure solutions of two-ring systems (e.g. chroman) as fragments of chemical evidence. The refinement of these models and calculation of Fourier syntheses, carried out with SHELX (Sheldrick, 1976), did not show any acceptable solution, the R values being between 45 and 55%; $R = (\sum |F_o| - |F_c|) / \sum |F_o|$. Due to the similar oriented fragments, visible in the ac projection, a renormalization was carried out with 12 oriented atomic positions. The resulting E map based on 167 E 's ≥ 1.20 with phases in the most consistent set, proposed as the true solution by MULTAN (combined figure-of-merit = 2.40), showed a flavone-like molecule model. After refinement of positional and isotropic temperature parameters of four supposed O and 15 C atoms ($R = 23\%$) one position had to be rejected. The corresponding difference map showed another atomic position at the phenyl ring C. Bond lengths and angles as well as temperature parameters led to the conclusion that the structure must be an isocoumarin derivative. Refinements of anisotropic temperature factors for the C and O atoms led to $R = 6.9\%$. All 12 H-atom positions were found subsequently in the difference maps. In the final stage all positional parameters [except y of O(2)] and the anisotropic temperature parameters of non-H atoms (196 parameters in all) were refined (isotropic temperature factors of H fixed at $U = 0.03 \text{ \AA}^2$, unit weights). The phenyl ring was treated as a rigid body ($\text{C}-\text{C} = 1.395 \text{ \AA}$, $\text{C}-\text{C}-\text{C} = 120^\circ$). Because second-

Table 1. Final positional parameters ($\times 10^4$) and B_{eq} of hydrangenol with e.s.d.'s in parentheses

B_{eq} (\AA^2) are given in the form $4(b_{11}/a^*2 b_{22}/b^*2 b_{33}/c^*2)^{1/3}$.

	x	y	z	B_{eq}
C(1)	4099 (9)	1573 (14)	2156 (3)	2.9 (0.3)
O(2)	5710 (6)	965 (12)	2673 (2)	3.2 (0.2)
C(3)	6670 (9)	-1684 (14)	2718 (3)	3.0 (0.3)
C(4)	7607 (10)	-2369 (17)	2089 (3)	3.2 (0.3)
C(5)	5547 (9)	-3446 (15)	960 (3)	3.2 (0.3)
C(6)	3689 (10)	-2979 (15)	457 (3)	3.4 (0.3)
C(7)	1982 (10)	-1139 (14)	507 (3)	3.3 (0.3)
C(8)	2117 (9)	402 (14)	1058 (3)	2.9 (0.3)
C(9)	3954 (9)	-59 (15)	1578 (2)	2.6 (0.3)
C(10)	5670 (9)	-1977 (14)	1519 (2)	2.7 (0.3)
O(1)	2844 (7)	3478 (11)	2201 (2)	3.8 (0.2)
O(8)	442 (7)	2270 (12)	1085 (2)	3.9 (0.2)
C(11)	8557 (6)	-1790 (11)	3303 (1)	2.9 (0.3)
C(12)	8461 (6)	-3760 (11)	3756 (1)	3.6 (0.3)
C(13)	10272 (6)	-3977 (11)	4281 (1)	3.7 (0.3)
C(14)	12179 (6)	-2226 (11)	4353 (1)	3.1 (0.3)
C(15)	12275 (6)	-256 (11)	3901 (1)	3.5 (0.3)
C(16)	10464 (6)	-39 (11)	3376 (1)	3.3 (0.3)
O(14)	13898 (8)	-2527 (13)	4880 (2)	4.1 (0.2)

dary extinction was suspected, the reflections 100 and 002 were omitted in the last cycles of refinement. The positional parameters and B_{eq} of O and C are given in Table 1.* The mass spectra of the transparent crystals as well as for the white crystals revealed the same molecular peaks with $M_r = 256$. The ^1H NMR spectrum of the white specimen (Rathmann, 1981) is in agreement with the result (III) of the X-ray analysis.

Discussion. Bond distances and angles of (III) involving non-H atoms [excepting H(8)] are presented in the ORTEP drawing (Johnson, 1971) of Fig. 2. Hydrangenol (III) is an isocoumarin which is linked with a hydroxyphenyl ring C. This ring is equatorially substituted at C(3) of the six-membered ring B. Atom C(3) is chiral with configuration *S* in the enantiomer used for the refinement. The deviations* of atoms of ring B from the aromatic plane A compared with some corresponding deviations of 3,4-dihydroisocoumarin-3-carboxylate (MDCH) (Michel & Durant, 1976) show MDCH to have configuration *R*. Atom C(3) deviates -0.74 \AA in (III) and 0.67 \AA in MDCH. In (III) O(2) deviates significantly (-0.12 \AA) from the plane C(1)–C(9)–C(10)–C(4), so the sofa conformation of ring B is slightly distorted, which is visible in the *ab* projection of the structure* and in the ORTEP stereodrawing of the *bc* projection (Fig. 3). Torsion angles of ring B with some values compared with those in MDCH are listed in Table 2. The asymmetry parameter $\Delta C_s(3)$ (Duax & Norton, 1975) of the sofa

* Lists of structure factors, anisotropic thermal parameters of the C and O atoms, deviations of atoms from planes A and B, a figure showing the *ab* projection of the structure, and positional parameters of the H atoms have been deposited with the British Library Lending Division as Supplementary Publication No. SUP 38002 (10 pp.). Copies may be obtained through The Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

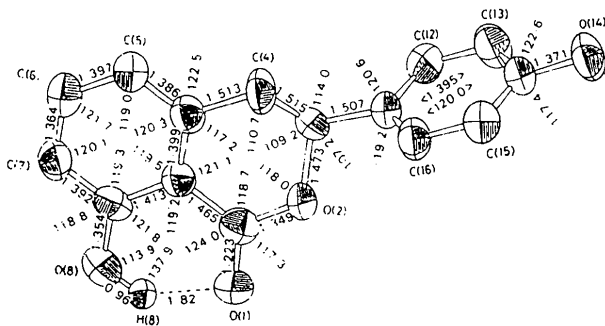


Fig. 2. Perspective view of the molecule of (III) and atom numbering with bond distances (Å) and bond angles (°). The standard deviations range from 0.005 to 0.007 Å and from 0.2 to 0.5°; for H(8) being 0.06, 0.12 Å and 3.9°. Thermal ellipsoids are drawn at the 65% probability level.

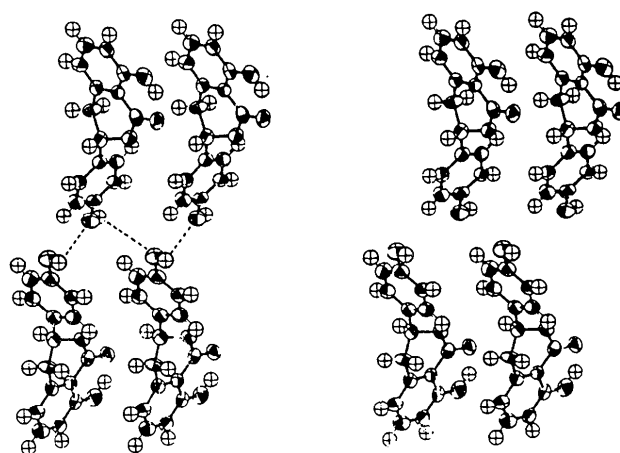


Fig. 3. ORTEP stereodrawing of the *bc* projection showing the packing arrangement in the structure of hydrangenol. H atoms are shown as spheres of arbitrary size. C and O atoms as 65% probability ellipsoids. Projections of intermolecular hydrogen bonds are indicated on the left by dashed lines.

Table 2. Some torsion angles (°), calculated with XANADU (Roberts & Sheldrick, 1975), some of them compared with the corresponding angles of MDCH

	Hydrangenol (III)	MDCH
C(1)–O(2)–C(3)–C(11)	175.5 (0.6)	189.5
C(3)–C(4)–C(10)–C(5)	–149.6 (0.6)	210
O(2)–C(3)–C(4)–C(10)	–54.9 (0.6)	–56.5
C(3)–C(4)–C(10)–C(9)	29.8 (0.6)	30
C(1)–C(9)–C(10)–C(4)	2.7 (0.6)	–
O(2)–C(1)–C(9)–C(10)	–9.5 (0.6)	–
C(9)–C(1)–O(2)–C(3)	–19.3 (0.6)	–
C(1)–O(2)–C(3)–C(4)	51.6 (0.6)	–

conformation in (III) is 7.5°. Another sofa conformation is observed in 5,7,4'-trimethoxyflavanone (Mariezcurrera, 1978), while in a similar structure of 4'-bromoflavanone (Cantrell, Stalzer & Becker, 1974) ring B adopts the half-chair conformation. The angle between planes of ring A and ring C of hydrangenol is 78.8°. Intermolecular hydrogen bonds form chains along *b* between the hydroxyl groups bonded to C(14) of the phenyl rings C (Fig. 3). Distances for the hydrogen bonds are O(14)···O(14') = 2.887 (6), O(14)–H(14) = 0.83 (5) and H(14)···O(14') = 2.25 (9) Å.

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Structure of *ent*-9,15-Dioxo-8,9-seco-14,16-kauradiene-3 α ,7 β -diol Diacetate (Shikoccin Monoacetate)

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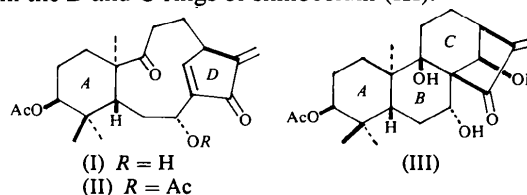
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Abstract. C₂₄H₃₂O₆, orthorhombic, *P*2₁2₁2₁, *a* = 13.218 (2), *b* = 19.053 (3), *c* = 9.205 (1) Å, *V* = 2318.2 (5) Å³, *Z* = 4, *D*_x = 1.193 Mg m⁻³, λ (Cu *K* α) = 1.54178 Å, μ (Cu *K* α) = 0.700 mm⁻¹. The structure was solved by a direct method, and refined by full-matrix least squares to *R*(*F*) = 0.082 for 1679 reflexions collected with a four-circle diffractometer. The *A* ring has a distorted chair form, and the ten-membered *B/C* ring has approximate *C*₂ symmetry. Intramolecular nonbonding contacts of 3.010 (12) and 3.074 (12) Å were observed for C(9)⋯C(14) and O(9)⋯C(14), respectively. The conformation of the ten-membered ring is stabilized by the interactions between the C(9) carbonyl group and the conjugated groups of the planar *D* ring.

Introduction. Several new kaurene-type diterpenes were isolated from *Rabdosia shikokiana* (Makino) Hara var. *occidentalis* (Murata) Hara (Labiatae) (Node, Ito, Fuji & Fujita, 1982). The major diterpenoid, shikoccin (I),

was shown to possess marginal *in vivo* antitumor activity (Nagao, Ito, Kohno, Kuroda & Fujita, 1982). The original aim of the present X-ray study of shikoccin monoacetate (II) was to establish the structure of shikoccin (I). The monoacetate (II) was obtained from shikoccin (I) on treatment with acetic anhydride in pyridine. It was also obtained by acetylation of another minor diterpenoid, shikoccidin (III), whose stereochemical structure has been determined by the X-ray method (Fujita, Ito, Uchida, Fuji, Taga & Osaki, 1979). A structural point of interest in the present monoacetate (II) is the conformation of the ten-membered ring which was converted from the *B* and *C* rings of shikoccidin (III).



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