X-Ray Crystal Structure of Canellal, a Novel Antimicrobial Sesquiterpene from *Canella winterana*

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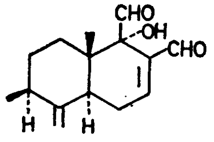
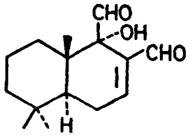
Summary Canellal (**1**), a novel antimicrobial sesquiterpene dialdehyde, has been isolated from the trunk bark of *Canella winterana*; its structure and stereochemistry were determined from spectral and single-crystal *X*-ray analyses.

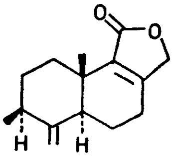
As part of a programme of screening higher plants for biologically active compounds, the ethanolic extract of *Canella winterana* (*C. alba,* Canellaceae) was found to exhibit consistent activity against a variety of bacteria and fungi. We report here the isolation and structure elucidation of canellal (**1**), one of the antimicrobial† constituents of this plant.



(**1**)



(**2**)



(**3**)

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† The *in vitro* activity of canellal has been tested against *Candida albicans* (MIC 6 μg ml^{-1}), *Saccharomyces cerevisiae* (MIC 1·6 μg ml^{-1}), and *Tricophyton mentagrophytes* (MIC 3 μg ml^{-1}). Also, Professor Isao Kubo of the Department of Chemistry, Columbia University, has kindly informed us that he isolated the same compound from *Warburgia ugandensis* and it showed a potent anti-feedant activity against army worms, *Spodoptera littoralis*.

Canellal (**1**) was isolated from the dried trunk bark by extraction with ethanol (95%) followed by chromatography on silica gel to give needles, $C_{15}H_{20}O_3$,‡ m.p. 127—128 °C, $[\alpha]_D^{25}$ −193° (*c* 0·2, $CHCl_3$). The chemical ionization mass spectrum (ammonia) showed major peaks at *m/e* 266 ($M{\cdot}NH_4^+$, base peak), 249 ($M{\cdot}H^+$, 25%), and 231 ($M{\cdot}H^+ - H_2O$, 11%). The 60 MHz ^1H n.m.r. spectrum ($CDCl_3$) exhibited signals at δ 0·87 (3H, s, quaternary C*Me*), 1·06 (3H, d, *J* 7·0 Hz, sec. C*Me*), 4·00 (1H, br, s, exchangeable, OH), a pair of broadened 1H singlets at δ 4·70 and 4·87 (exocyclic $=CH_2$), an olefinic 1H multiplet at δ 7·13, and two 1H aldehydic signals at δ 9·33 and 9·53; ^{13}C n.m.r.: δ 15·1 and 18·8 (q, 2 × Me), 27·7, 31·0, and 31·9 (t, 3 × $-CH_2-$), 38·4 and 40·4 (d, 2 × $\geqslant CH$), 77·8 (s, C–OH), 106·0 (t, exocyclic $=CH_2$), 140·3 (s, $=C$–CHO), 151·8 (s, $>C=CH_2$), and 155·3 (d, $C=C$–CHO).

The spectral data obtained for canellal (**1**) pointed to a structure probably related to warburganal (**2**)[1] but with the carbon skeleton of colorata-4(13),8-dienolide (**3**).[2] This assumption was supported by biogenetic considerations because all three compounds (**1**), (**2**), and (**3**) have been obtained from plants belonging to the same family. The complete structure and stereochemistry of (**1**) were established unequivocally by a single-crystal *X*-ray analysis (Figure). Crystals of (**1**) belong to the monoclinic system, space group $P2_1$, $a = 7{\cdot}440(5)$, $b = 6{\cdot}223(5)$, $c = 14{\cdot}452(7)$ Å, $\beta = 93{\cdot}19(5)°$, $Z = 2$. The structure was solved by direct non-centrosymmetric phase-determining methods using MULTAN.[3] Full-matrix least-squares refinement of atomic positional and thermal (anisotropic C and O, isotropic H) parameters has converged at *R* 0·037 over 1149 statistically significant $[I > 2{\cdot}0\sigma(I)]$ reflections measured on an Enraf-Nonius CAD-3 automated diffractometer (Ni-filtered Cu-K_α radiation, $\lambda = 1{\cdot}5418$ Å; θ–2θ scans). Although the *X*-ray analysis yielded only the relative stereochemistry, the close correspondence between the c.d. (MeOH) curve of canellal (**1**) ($\Delta\epsilon_{284}$ −2·06 and $\Delta\epsilon_{224}$ −0·76) and that of warburganal (**2**) ($\Delta\epsilon_{285}$ −2·06 and $\Delta\epsilon_{228}$ −0·78) implies that structure (**1**) also represents the absolute configuration.

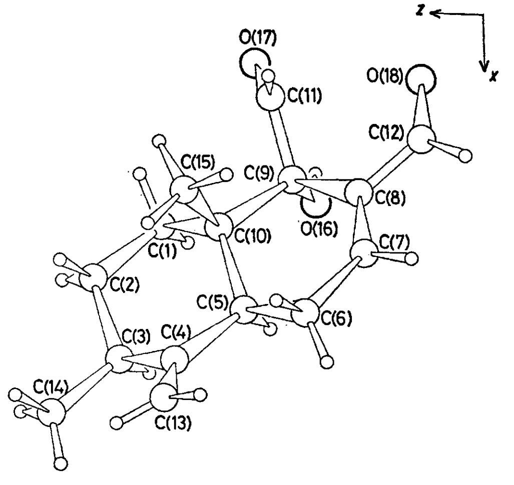

FIGURE. Molecular structure of canellal; small circles denote hydrogen atoms.

While the unrearranged carbon skeleton of warburganal (**2**) is relatively common among sesquiterpenes like polygodial,[4] tadeonal,[5] bemarivolide,[6] and ugandensolide,[6] that of canellal (**1**) has previously been encountered in only one other compound, namely colorata-4(13),8-dienolide (**3**).[2]

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‡ Canellal (**1**) gave satisfactory elemental analyses.

§ The atomic co-ordinates for this work are available on request from the Director of the Cambridge Crystallographic Data Centre, University Chemical Laboratory, Lensfield Road, Cambridge CB2 1EW. Any request should be accompanied by the full literature citation for this communication.

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