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Radicinin: revision of its structure obtained from NMR measurements / D. D. Clarke F. F. Nord N. S. Bhacca Laboratory of Organic Chemistry and Enzymology Fordham University Bronx 58, New York Spectroscopy Applications Laboratory Varian Associates Palo Alto, California

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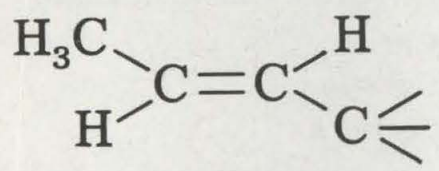
Letter to the Editors

Radicinin: Revision of Its Structure Obtained from NMR Measurements[1]

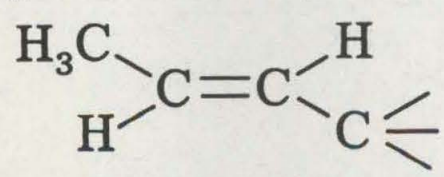
Radicinin, a metabolite of the formula $C_{12}H_{12}O_5$ was isolated from the carrot plant pathogen *Stemphylium radicinum* and described in earlier communications (1, 2). Hansen isolated a metabolite from *S. radicinum* that inhibited the growth of *Lepidium sativum* and named it Stemphylone (3). From the physical and chemical properties described for stemphylone it would appear to be identical with radicinin.

We tentatively proposed structure I for this compound. The group



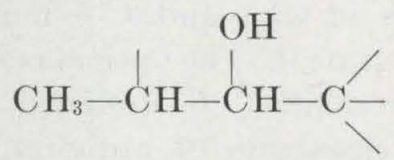
was firmly established by degradative studies. The infrared absorption spectrum of radicinin showed the presence of two carbonyl bands, one at 5.66 μ which was assigned to a lactone ring and one at 6.02 μ which was assigned to a conjugated carbonyl group. The free hydroxyl group is hydrogen bonded to a carbonyl group as indicated by its weak absorption at 2.9 μ, and this hydroxyl group cannot be a part of the conjugated system because the acetate of radicinin has an ultraviolet absorption spectrum almost identical with radicinin. The presence of an additional methyl group was indicated by the Kuhn-Roth analysis. In addition, radicinin is optically active.

Recently we examined the proton magnetic resonance spectrum of radicinin in order to attempt to assign a definite position to the methyl group which remains to be placed in the partial formula I. The NMR spectrum of radicinin in $CDCl_3$ is shown in Fig. 1. The pair of tall doublets at $\delta = 1.97$ and the resonances at $\delta = 6.02$ and 6.96 could be assigned to the moiety

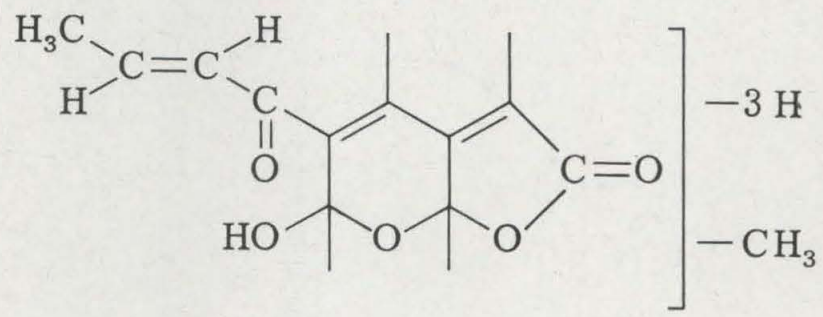


which had already been definitely established. However, the chemical shifts for these protons do not seem to be consistent with this group being part of the extended conjugated carbonyl system required by structure I. Consequently, a modification of the structure of radicinin is required.

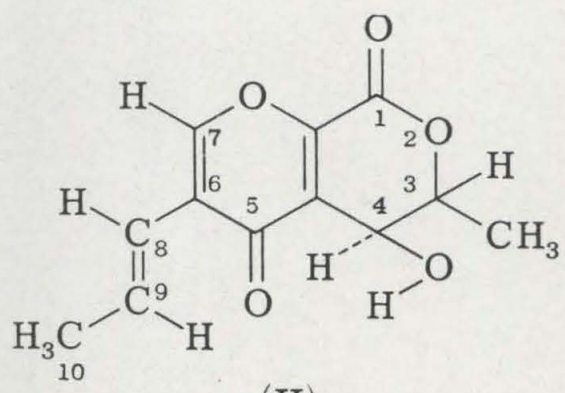
The doublet at $\delta = 1.64$ could be assigned to the remaining methyl group. The protons of this methyl group are spin coupled (7 cps.) to a proton whose resonance appears at $\delta = 4.32$, which in turn is spin coupled (12 cps.) to another proton which resonates at $\delta = 3.98$. The somewhat broad signal at $\delta = 3.78$ is due to a hydroxyl proton, a fact which is confirmed by examining the NMR spectrum after shaking with D_2O. This hydroxyl proton is weakly spin-coupled to the methine proton resonating at $\delta = 3.92$. These resonances suggest the presence of the group



In addition, there is a lone olefinic proton whose chemical shift is $\delta = 5.85$.



(I)



(II)

When the NMR and the previously obtained infrared data were combined, we arrived at structure II. The γ-pyrone formulation is consistent with the 6.02 μ carbonyl absorption, and the cross conjugation between the carbonyl group of the lactone

[1] Communication No. 395.

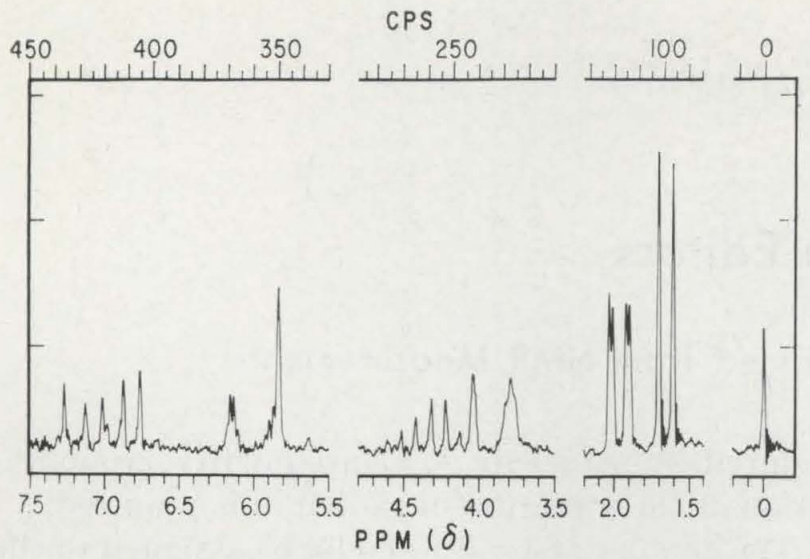


FIG. 1. NMR spectrum of radicinin in $CDCl_3$ at 60 Mc. (Tetramethylsilane as internal standard).

and that of the γ-pyrone ring would seem to explain the 5.66 μ carbonyl band. The hydroxyl group is in a suitable position for hydrogen bonding and is not part of the aromatic system.

The signals at $\delta = 4.32$ and $\delta = 3.98$ may now be assigned to the protons at C-3 and C-4, respectively. They show a characteristic 12 cps. axial-axial spin coupling (4). Therefore, the asymmetric centers at C-3 and C-4 must be of the erythro configuration. The optical configuration of these centers remains to be assigned.

The NMR spectrum of radicinin acetate was also examined. The protons resonating at $\delta = 4.32$ and 3.98 in the parent compound were shifted to $\delta = 4.75$ and 5.20, respectively, which further serves to confirm the assignment of the protons at C-3 and C-4 as being axial. Work is now in progress to establish the absolute configuration of the asymmetric centers and to examine the U-V, I-R and NMR spectra of model compounds related to II.

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