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THE STRUCTURE OF MEXICANIN H*

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In a previous communication (1) we described the isolation of Mexicanin H, a constituent of Helenium mexicanum. Now we have found evidence mainly on spectroscopic grounds which led us to establish structure (II) for this interesting product.

The properties of Mexicanin H, $C_{15}H_{18}O_4$, m.p. 150-151°, $[\alpha]_D$ -44.6°, have not previously been discussed in detail. It gave positive Legal, Tollens and Zimmerman tests. The IR spectrum had a strong band at 1745 cm^{-1} and a weak band at 1650 cm^{-1} Mexicanin H showed a UV maximum at 212 mμ (ϵ, 12800). These spectral properties are attributed to a cyclopentanone and an exocyclic methylene group conjugated with a five membered lactone; those functions are commonly present in several sesquiterpene lactones (2).

Catalytic hydrogenation of Mexicanin H (II) with Pd-C in AcOEt afforded a dihydroderivative (III) (m.p. 153-154°) which had a strong IR band at 1760 cm^{-1} (cyclopentanone and γ-lactone). The isoderivative (IV) (m.p. 183-184°) (λ max 219 mμ, ϵ, 8000) was obtained also from the above hydrogenation. It had IR bands at 1750 cm^{-1} (double strength, cyclopentanone and γ-lactone) and at 1680 cm^{-1} (weak, C=C double bond).

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For simplicity, in the development of our structural arguments, the NMR spectrum* of Mexicanin H (II) (Fig. 1) will be considered on the basis that II is a pseudoguaianolide related to Helenalin and other lactones isolated from H. mexicanum (1, 3, 4, 5) later to be demonstrated.

The exocyclic methylene group conjugated with the lactone is responsible for two low field doublets at 6.33 and 5.80. The presence of a broad single proton multiplet centered at 4.80 was interpretable as representing the proton attached to the carbon bearing the lactone ether. The complexity of this signal afforded evidence which indicated that the lactone closure was probably at C-8. In the methyl region, a doublet centered at 1.23 is ascribed to the secondary methyl group attached at C-10. Mexicanin H (II) was recovered unchanged under basic acetylation conditions and since its NMR** spectrum did not indicate the presence of hydroxyl groups, the fourth oxygen atom of II must be present as an oxygen bridge. The characteristic singlet corresponding to the angular methyl group of the pseudoguaianolides is not present in the NMR spectrum of Mexicanin H (II). However the chemical shift of a quadruplet centered at 3.74 (2H) attributed to a $-CH_2O-$ function indicated that the angular substituent at C-5 of Mexicanin H (II) is involved in an ethereal bridge attached to a secondary carbon atom. The proton of the latter is responsible for a signal centered at 4.57. A broad signal centered at 3.22 is ascribed to the allilyc hydrogen at C-7.

If we assume that the keto group of Mexicanin H (II) is attached at

* NMR spectra were taken in a Varian A-60 spectrometer in $CDCl_3$ solution with TMS as internal standard by Mr. E. Díaz. All chemical shifts are given in ppm as δ values (cps/60).

** The NMR spectrum of Mexicanin H (II) did not change after addition of D_2O.

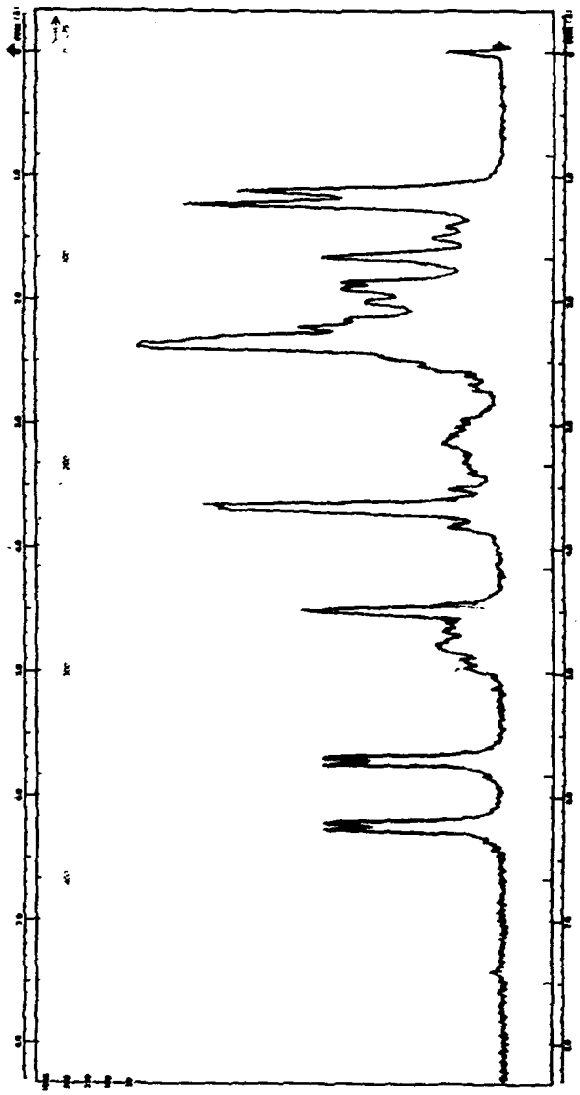
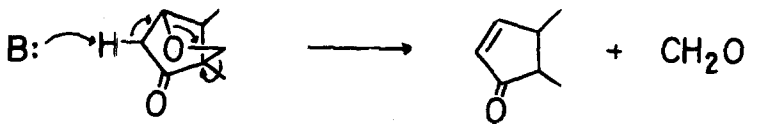


Fig. 1 NMR spectrum of mexicanin H (II).

C-4 as in other sesquiterpene lactones isolated from H. mexicanum (1,3,4,5), the oxygen bridge should be linked to C-2 in order to explain the appearance of two signals centered at 7.75 and 6.19 displayed in the NMR spectrum of the crude product obtained from the alkaline treatment of Mexicanin H (II). The chemical shift of these signals corresponds to those of the vinylic protons at C-2 and C-3 of the ABX system present in Mexicanin E (I) (5). The following mechanism accounts for this transformation:



Mexicanin E (I) could not be isolated from the basic treatment of Mexicanin H (II), since I is sensitive to alkalies (6) and in spite of the mild conditions used, it may partially undergo further transformations which preluded its isolation.

The structure of Mexicanin H (II) was fully elucidated when its mass spectrum* was compared with that of Mexicanin E (I) (Fig. 2). Mexicanin H (II) gives a very small parent peak at m/e 262 which corresponds to its molecular weight. (Peaks with mass above 235 are represented ten times greater in Fig. 2). Under the electron impact Mexicanin H (II) lost 30 mass units (CH_2O) and thence its fragmentation pattern exhibited peaks at the same mass units with almost the same intensities as those shown in the mass spectrum of Mexicanin E (I). In the light of the evidence presented above Mexica-

* Mass spectra were run in a Hitachi Perkin Elmer RMU-6D mass spectrometer by Mr. E. Cortés.

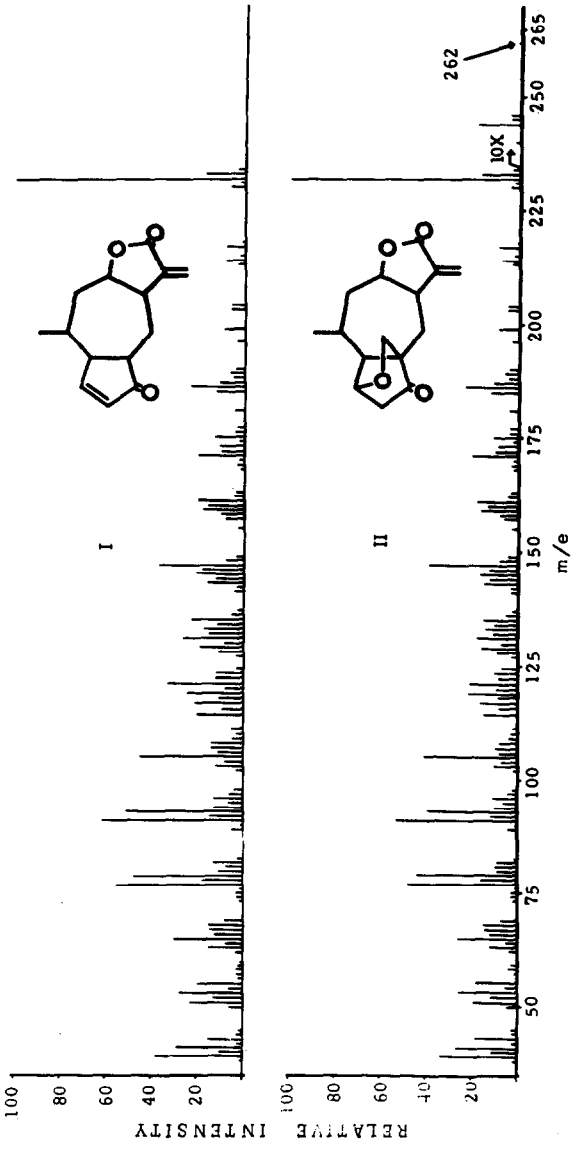
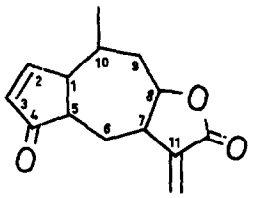
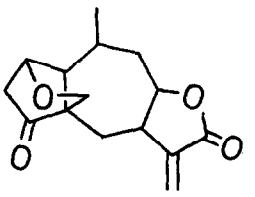


Fig 2. Mass spectra of mexicanin E (I) and mexicanin H (II).

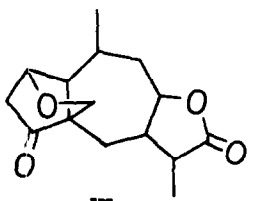
nin H can be rationalized in terms of structure (II) and appears to bear a close biogenetic relationship with Mexicanin E. Mexicanin H may represent an intermediary step in the transformation of pseudoguaianolides to norguaianolides.



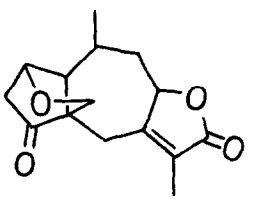
I



II



III



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