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STRUCTURE OF HEPTAPHYLLINE, A CARBAZOLE ALKALOID FROM CLAUSENA HEPTAPHYLLA Wt. & Arn.*

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The isolation and structure determination of two pyranocoumarins, clausenin and clausenidin, from the roots of Clausena heptaphylla Wt. & Arn. was reported in an earlier communication[1]. We now describe the isolation and structure elucidation of a new alkaloid heptaphylline. The oil obtained by hot extraction of the roots with hexane after chromatographic separation on silica gel provided in low yield a yellow crystalline weakly basic alkaloid, (Rf 0.35; TLC-silica gel, benzene:chloroform 1:1) m.p. 170-171°. It analysed for the molecular formula $C_{18}H_{17}NO_2$ (Found : C, 77.1; H, 6.1; N, 5.1; M.W. by mass spec. 279. $C_{18}H_{17}NO_2$ requires C, 77.4; H, 6.1; N, 5.0%) and exhibited UV absorption at 234, 278, 298 and 346 mμ (log ϵ 4.42, 4.53, 4.58 and 4.09). IR bands at 3300, 2740, 1645 (weak), 1618 (strong) and 1590 cm^{-1} suggested the presence of a hydroxyl or -NH group, a chelated carbonyl group ($>C=O$ or CHO) and an aromatic ring system. A deep blue ferric colour confirmed the presence of a phenolic hydroxyl group. The NMR spectrum of heptaphylline ($CDCl_3$ + $CD_3SO\,CD_3$; Varian A-60) led to the following assignments. Two narrowly split methyls (J = 1 c/s) at δ 1.66 and 1.83 p.p.m., a benzylic methylene doublet at δ 3.6 (J = 6 c/s) and a broad triplet at δ 5.35 (J = 6 c/s) due to a vinyl proton indicated the attachment of a γ,γ-dimethylallyl group to an aromatic ring. Signals at δ 11.6 and 11.4 which disappeared on deuteration could be attributed to an -NH and a phenolic OH groups. A sharp one proton singlet at δ 9.9 must be due

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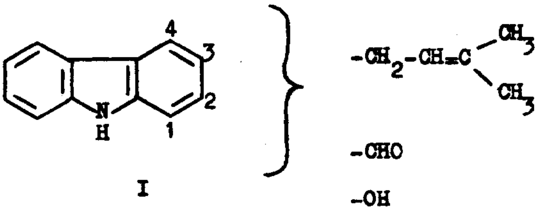
to an aldehyde group. The aromatic portion of the spectrum between δ 7.1 - 8.3 indicated a total of five protons. One of these aromatic protons does not carry any ortho or meta hydrogens as seen by the sharp singlet peak at δ 8.25. Thus the NMR spectrum accounts for all the seventeen protons present in the alkaloid.

Heptaphylline gave a crystalline 2,4-dinitrophenylhydrazone, m.p. 315-316° (Found : C, 62.5; H, 4.6; N, 15.6. $C_{24}H_{21}N_5O_5$ requires C, 62.7; H, 4.6; N, 15.3%). The presence of a formyl group was confirmed by the reducing action on ammoniacal silver nitrate. The nature of the carbon skeleton of heptaphylline could not be established by classical methods due to the small amount of material at our disposal. The presence of a carbazole nucleus was suspected from the close resemblance of its UV spectrum with murrayanine[2] and this was further indicated by the green colour reaction with conc. H_2SO_4 and HNO_3. A partial structure (I) could then be written for heptaphylline. On treatment with polyphosphoric acid, it gave the corresponding isomeric chroman, cycloheptaphylline, m.p. 250° (Found : C, 77.1; H, 6.4; M.W. by mass spec. 279) (Rf 0.8; TLC-silica gel; benzene: chloroform 1:1)[3]. The NMR spectrum showed a sharp singlet at δ1.42 due to gem-dimethyl groups and two sets of triplets at δ 2.0 and 2.95 (J = 7 c/s) due to the Ar-CH_2-CH_2- grouping. While there was no change in the UV spectrum, the IR spectrum now showed peaks at 3280, 2720, 1670 (strong, unchelated carbonyl of the aldehyde), 1620, 1610, 1600 and 1580 cm^{-1}. This shows clearly that the hydroxyl



I

group should be placed in between the formyl and the γ,γ-dimethylallyl groups. Depending on the placement of the formyl group at the 1, 2, 3 or 4 positions in the carbazole ring, four structures could possibly be written for heptaphylline. A unique choice could be made on the basis of the UV spectrum since it resembles

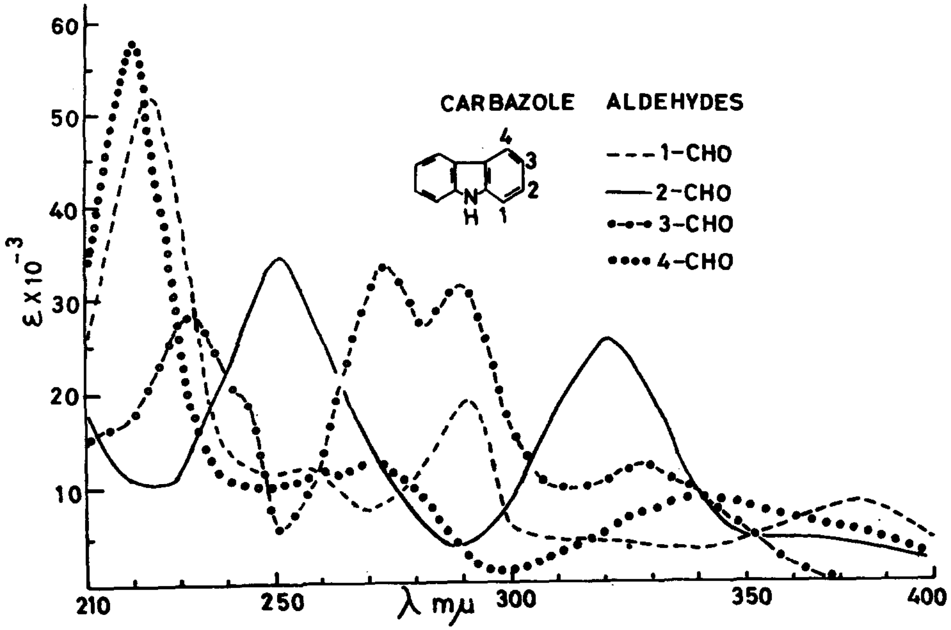

CARBAZOLE ALDEHYDES
4
3
2
1
N
H
1-CHO
2-CHO
3-CHO
4-CHO
ε X 10⁻³
60
50
40
30
20
10
210
250
300
350
400
λ mμ

FIG. 1

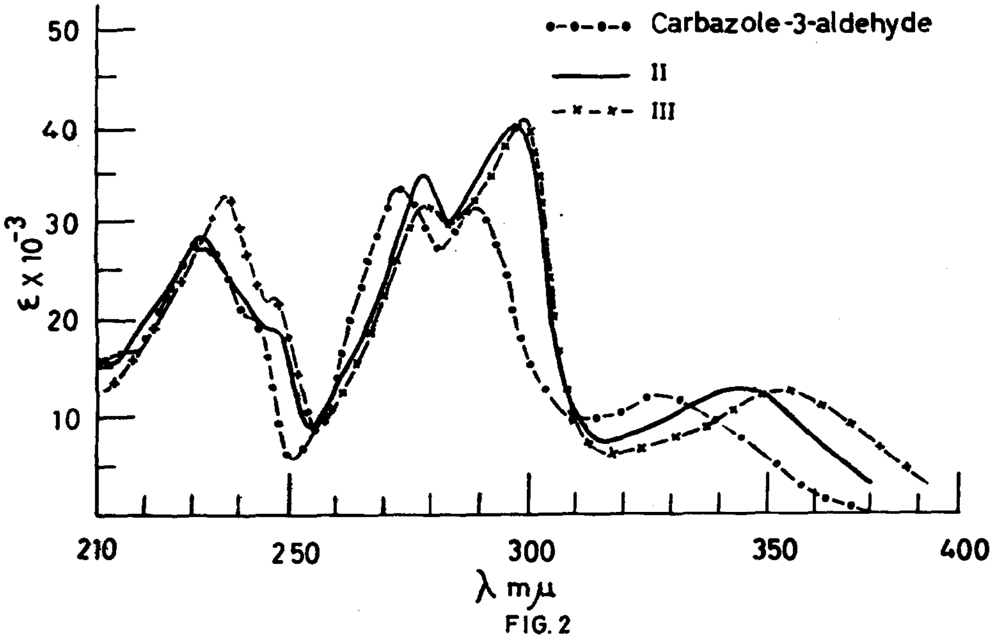
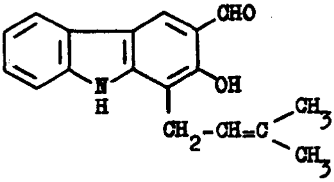
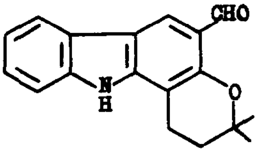

Carbazole-3-aldehyde
II
III
ε X 10⁻³
50
40
30
20
10
210
250
300
350
400
λ mμ

FIG. 2

closely the spectrum of carbazole-3-aldehyde (Fig. 1)[4] and (Fig. 2). Heptaphylline should therefore be represented as (II) and cycloheptaphylline as (III).



II



III

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4. We are grateful to Professor G. Büchi and E.W. Warnhoff for permission to to publish these curves.