SOME β-CARBOLINE ALKALOIDS OF AILANTHUS MALABARICA DC[1].

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From the bark and roots of Ailanthus malabarica DC. we have isolated and characterised eight β-carboline alkaloids of which four are new. Their structures are elucidated by spectroscopic studies.

INTRODUCTION

Ailanthus malabarica DC (Simarubaceae) is a large tree growing in the Western Ghats of India. The resinous exudate obtained by incision of the trunk bark is used as an incense and the wood is utilized as a source of match-stick.

Chemical constituents of the bark were investigated by Rastogi et al[2,3] who reported the isolation of a bitter principle malanthin for which no definite structure has been assigned. The exudate from the trunk-bark was examined by Chawla and Sukh Dev[4] and they found novel triterpenoids malabaricol, epoxymalabaricol and malabaricane diol.

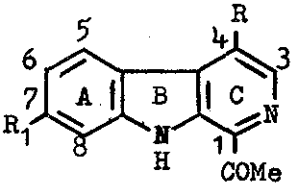
In the present communication we report the isolation of eight alkaloids, all belonging to the β-carboline class, from the bark and roots of A. malabarica. The plant collected at

Agumbe (Karnataka) was extracted with hot methanol and the crude bases were isolated in the usual way i.e. by acid-base extraction. Its tlc on silica gel (chloroform : 2% methanol) showed ten discrete uv fluorescent spots indicating that the crude alkaloid was a complex mixture. Chloroform solution of the crude alkaloids (10 g) was chromatographed on silica gel (170 g) using chloroform with increasing amount of ethyl acetate as the eluent. Fractions (50 ml) were collected and the chromatographic separation was monitored by tlc.

STRUCTURES OF THE ALKALOIDS

1-Acetyl-β-carboline (I) : The fractions (26-30) showed a yellow fluorescence and gave pale yellow needles (12 mg) m.p. 203-5°. The alkaloid exhibited λ_{max} (ethanol) 242, 250, 262, 283, 305 and 375 nm (log ε, 4.03, 4.07, 4.09, 4.28, 3.92 and 3.85), resembling β-carboline containing a carbonyl function at C-1 position (Fig.1). Its mass spectrum (M^+, m/e 210, 80%) suggested the molecular formula $C_{13}H_{10}N_2O$. The prominent ion at m/e 167 by the loss of 43 units from the molecular ion (m^* at m/e 134) indicated an acetyl group. The presence of a carbonyl function was supported by its ir band at 1670 cm^{-1}. The structure of the alkaloid as (I) was deduced from its nmr spectrum ($CDCl_3$) : δ 10.3 (1H, br, exchanged with D_2O, NH), 8.55 (1H, d, $J_{3,4}$ = 5 Hz, H-3), 8.15 (1H, d, $J_{4,3}$ = 5 Hz, H-4), 8.15 (1H, q, $J_{5,6}$ = 7 Hz, $J_{5,7}$ = 1.5 Hz, H-5), 7.2 - 7.63 (3H, m, H-6, 7, 8), 2.91 (3H, S, -COMe). The nmr spectrum indicated that the ring A of β-carboline was unsubstituted and the downfield chemical shift of the NH proton at 10.3 ppm from the normal value around 9.0 ppm suggested the acetyl sub-

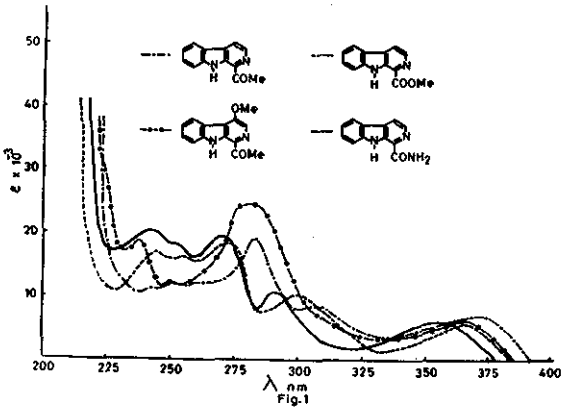
stituent at C-1.



I : $R = R_1 = H$

II : $R = OMe$; $R_1 = H$

III : $R = H$; $R_1 = OMe$



1-Acetyl-4-methoxy-β-carboline (II) : The next eluted fractions (32-34) showed a violet fluorescence and crystallized as colourless plates (10 mg) m.p. 208°, exhibiting λ_{max} (ethanol) 221, 238, 251, 280, 309 (infl.) and 367 nm (log ε, 4.49, 4.27, 4.1, 4.38, 4.83 and 3.97). (Fig.1) and ν_{max} (KBr) 1670 cm^{-1}. Its mass spectrum showed the molecular ion peak at m/e 240, indicating the molecular formula $C_{14}H_{12}N_2O_2$ for the alkaloid and the ion at m/e 197 could be due to the loss of an acetyl group. Its nmr spectrum ($CDCl_3$) showed the following signals : δ 10.3 (1H, br, exchanged with D_2O, NH), 8.3 (1H, q, $J_{5,6}$ = 7 Hz, $J_{5,7}$ = 1.5 Hz, H-5), 8.2 (1H, S, H-3), 7.2 - 7.66 (3H, m, H-6, 7, 8), 4.24 (3H, S, OMe), 2.84 (3H, S, -COMe). The upfield shift of the C-3 proton from the normal value[5] of 8.5 to 8.2 indicated the methoxyl substituent at C-4. Both the alkaloids (I) and (II) are new additions to the series of simple β-carbolines[6]. The m.p. and spectral data of (II) are different from those described for acetylharmine (III), recently isolated from Banisteriopsis caapi[7].

1-Carbomethoxy-β-carboline (IV) : The following fractions (38-46) showed a yellow uv fluorescence and crystallized as colourless needles (55 mg) m.p. 167°. The uv, λ_{max} (ethanol) 224, 256, 274, 300 and 365 nm together with the mass spectrum m/e 226 (M^+, 43%), 194 (12), 168 (85), 166 (100) and 140 (22) indicated that the alkaloid should be 1-carbomethoxy-β-carboline (IV). The nmr spectrum was consistent with this formulation and the isolated alkaloid was found to be identical in its m.m.p. and ir spectra with an authentic sample[8,9,10].

4,8-Dimethoxy-1-vinyl-β-carboline (Dehydrocrenatidine) (V) : The subsequent chromatographic fractions (47-50) gave a yellow fluorescence and afforded brownish yellow plates (120 mg) m.p. 157° which exhibited λ_{max} (ethanol) 228, 252, 266 and 355 nm (log ε, 4.56, 4.58, 4.33 and 3.93) (Fig.2). The mass spectrum (M^+, m/e 254) indicated a molecular formula $C_{15}H_{14}N_2O_2$ for the alkaloid. In the nmr spectrum it showed the following signals ($CDCl_3$) : δ 8.83 (1H, br, exchanged with D_2O, NH), 8.1 (1H, S, H-3), 7.91 (1H, q, $J_{5,6}$ = 7.5 Hz, $J_{5,7}$ = 1.5 Hz, H-5), 6.8 - 7.5 (2H, m, H-6, 7), 5.55_A, 6.2_B, 7.0_X (ABX, J_{AX} = 11 Hz, J_{BX} = 17.5 Hz and J_{AB} = 1.5 Hz, $-CH=CH_2$), 4.12 (3H, S, 4-OMe), 3.95 (3H, S, 8-OMe) suggesting the structure (V) for the alkaloid. No details of the m.p. or spectral data for 4,7-dimethoxy-1-vinyl-β-carboline and (V) are given in the references cited[6,11]. Hydrogenation of (V) with Pd-C gave crenatidine (VIII)[8] identical with an authentic sample.

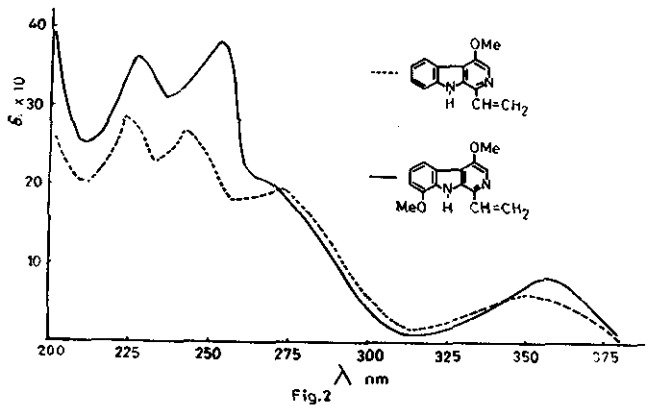


Fig.2

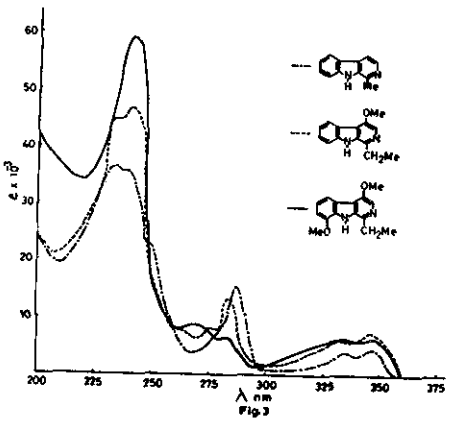
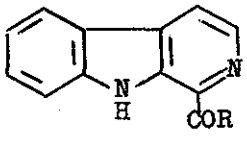


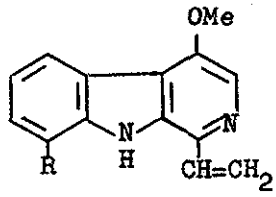
Fig.3

4-Methoxy-1-vinyl-β-carboline (Dehydrocrenatine) (VI) : The next fractions (51-60) eluted as a blue fluorescent solution and afforded colourless needles (35 mg) m.p. 145° (Lit.[5] m.p. 146-7°). The uv spectrum (Fig.2) which is closely similar to that of dehydrocrenatidine (V), together with its mass spectrum (M^+, m/e 224) led to the molecular formula $C_{14}H_{12}N_2O$ for the alkaloid. Its nmr spectrum (CD_3COCD_3) showed the following signals : δ 10.8 (1H, br, exchanged with D_2O, NH), 8.3 (1H, q, $J_{5,6}$ = 8 Hz, $J_{5,7}$ = 1.5 Hz, H-5), 8.15 (1H, S, H-3), 7.1 - 7.7 (3H, m, H-6, 7, 8), 5.5_A, 6.25_B, 7.1_X (ABX, J_{AX} = 11 Hz, J_{BX} = 17.5 Hz, J_{AB} = 1.5 Hz, $-CH=CH_2$), 4.1 (3H, S, 4-OMe). The above data is consistent with the structure (VI). A comparison with the alkaloid isolated from Picrasma javanica[5] could not be made due to non-availability of a sample.

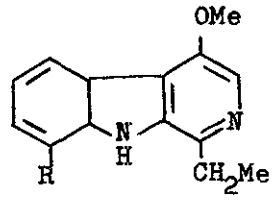
1-Carbamoyl-β-carboline (VII) : The fractions (62-66) showing a violet uv fluorescence crystallized as pale yellow needles (12 mg)



IV : R = OMe
VII : R = NH_2



V : R = OMe
VI : R = H



VIII : R = OMe
IX : R = H

m.p. 230°. The analytical and mass spectral (M^+, m/e 211) results agreed with the molecular formula $C_{12}H_9N_3O$ for the alkaloid. Its uv spectrum (Fig.1) exhibited λ_{max} (ethanol) 243, 253, 271, 291 and 361 nm (log ε, 4.31, 4.26, 4.29, 4.04 and 3.8) and ir ν_{max} 1700 cm^{-1}. In the nmr spectrum ($CDCl_3$), it showed the following signals : δ 10.27 (1H, br, exchanged with D_2O, NH), 8.4 (1H, d, $J_{3,4}$ = 5 Hz, H-3), 8.11 (1H, d, $J_{4,3}$ = 5 Hz, H-4), 8.14 (1H, q, $J_{5,6}$ = 8 Hz, $J_{5,7}$ = 1 Hz, H-5), 7.2 - 7.6 (3H, m, H-6, 7, 8), 5.7, 1.7 (1H each, br, exchanged with D_2O, NH_2). On the basis of this data the compound could be formulated as 1-carbamoyl-β-carboline (VII). Since sodium bicarbonate was used for basification during isolation of the crude alkaloid, it is unlikely that this compound would be an artefact arising from (IV)[12].

4,8-Dimethoxy-1-ethyl-β-carboline (Crenatidine) (VIII) :
Subsequent fractions (106-140) having a sky blue fluorescence gave colourless needles (100 mg) m.p.156°. Its uv spectrum (Fig.3) resembled that of harman and the mass spectrum (M^+, m/e 256) and analytical values agreed with the formula

$C_{15}H_{16}N_2O_2$ for the alkaloid. Its nmr spectrum indicated the structure (VIII) and the alkaloid was found to be identical in its m.m.p., tlc and ir spectra with an authentic sample of crenatidine[8].

1-Ethyl-4-methoxy-β-carboline (Crenatine) (IX) : The last fractions (150-172) gave a violet fluorescent solution and yielded colourless plates (40 mg) m.p. 175°. Its uv spectrum (Fig.3) showed λ_{max} (ethanol) 231, 240, 265, 275, 284, 331 and 345 nm and the mass spectrum (M^+, m/e 226) suggested the formula $C_{14}H_{14}N_2O$ for the alkaloid. The nmr values agreed with those described for crenatine (IX) and a comparison with an authentic sample[8] proved their identity.

Various β-carboline alkaloids have been isolated from plants belonging to about 17 families[6,13] and some have been encountered in the Simarubaceae. Alkaloids have not been reported from the genera Ailanthus except for a recent report of the isolation of canthin-6-one derivatives from A.altissima Swingle[14].

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