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STRUCTURE OF A NEW BETA-CARBOLINE ALKALOID FROM ELAEAGNUS COMMUTATA, (SILVERBERRY OR WOLF WILLOW)

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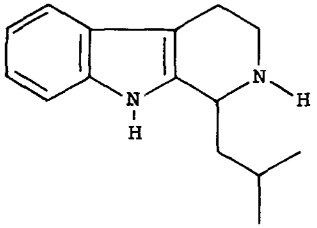
A new β-carboline alkaloid has been isolated from Elaeagnus commutata Bernh. (Fam. Elaeagnaceae), a shrub from 2 to 12 feet tall, which is widely distributed throughout western Canada (1). We propose that the alkaloid is 1-isobutyl-1,2,3,4-tetrahydro- β -carboline (I).

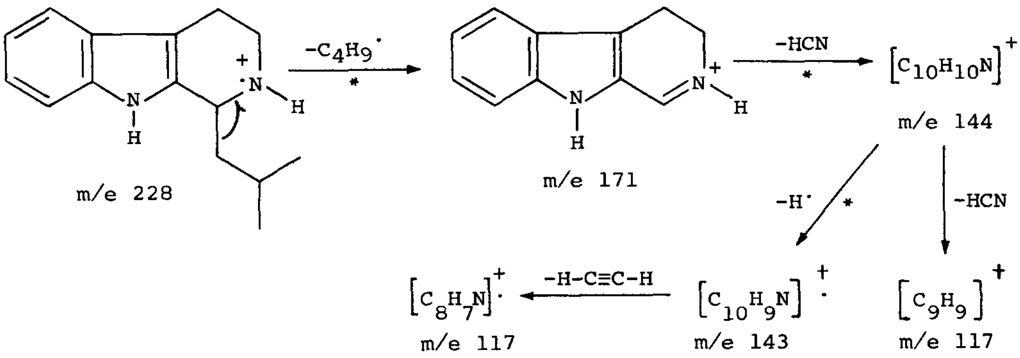


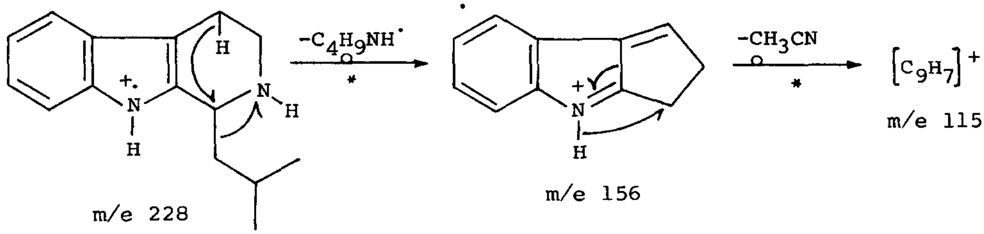
I

Dry, finely-powdered root bark of E. commutata was extracted with petroleum ether (b.p. 30-60°) and then with 95 percent ethanol. The concentrated alcoholic extract was dripped into 2 percent aqueous hydrochloric acid under vacuum at 40°. The resultant clear aqueous filtrate was extracted continuously with chloroform. Evaporation of the chloroform solution resulted in a dark brown viscous oil. Preparative thin layer chromatography of this oil on silica gel using hexane:chloroform:methanol (40:20:11), gave alkaloid I, (Rf; 0 37). A crystalline hydrochloride salt of I (m.p. 257-259°, methanol) was obtained by adding methanolic HCl to a methanol solution of I. This hydrochloride salt was optically inactive.

A characteristic indole absorption pattern was present in the u.v. spectrum of I.HCl: $\lambda_{max.}^{Ethanol}$; 223, 273, 279, and 289 mu. (2). There was no bathochromic shift upon the addition of either acid or base. The infrared spectrum of I.HCl in nujol gave an indole N-H peak at 3200 cm^{-1}. The n.m.r. spectrum of I.HCl (3) in deuterated dimethylsulfoxide showed a triplet centered at 8.98τ (J = 5 cps) which integrated for two methyl groups. Two multiplets at 6.75 and 7.00τ were indicative of the $-CH_2-CH_2-$ group in the piperidine portion of the molecule. A four proton multiplet centered at 2.75τ was due to aromatic protons of the phenyl ring. The methine and methylene protons of the isobutyl side chain gave a multiplet centered at 7.95τ and the C_1 proton showed a broad band at 5.38τ . A broad band at 0.30τ integrating for 2 protons, which exchanged with D_2O, was due to protons of the piperidine nitrogen. A singlet at -1.1τ indicated the proton from the indole nitrogen which was not readily exchanged with D_2O.

A high resolution mass spectrum of I.HCl (4) gave a molecular ion peak for the free base at m/e 228. Accurate mass determination gave the empiric formula $C_{15}H_{20}N_2$ (calculated 228.1627, found 228.1627). Cleavage of the isobutyl side chain as a radical resulted in the formation of the base peak at m/e 171. This fragmentation was followed by the loss of HCN, H· and H-C≡C-H to give peaks at m/e 144, 143 and 117 respectively. The peak at m/e 117 may also arise by a loss of HCN from m/e 144 since m/e 117 was approximately 66 percent $C_{10}H_9N$ and 33 percent C_9H_9 (from accurate mass determinations). It is suggested that I may also fragment after a rearrangement of the m/e 228 ion which involves migration of the isobutyl side chain to the piperidine nitrogen followed by loss of $C_4H_{10}N$ radical to give a peak at m/e 156. This fragmentation pattern was identical with that of various 1,2,3,4-tetrahydro- β -carbolines (5).





Tryptamine hydrochloride and isovaleraldehyde when heated under reflux in methanol gave 1-isobutyl-1,2,3,4-tetrahydro- β -carboline (HCl salt m.p. 258-260°) (6). This crystalline hydrochloride showed no melting point depression when mixed with the hydrochloride salt of the isolated alkaloid. The Rf values upon thin layer chromatography, retention times upon gas chromatography, n.m.r. spectra and infrared spectra were identical for the synthetic compound and the naturally occurring alkaloid.

Various aromatic and 1,2,3,4-tetrahydro- β -carbolines have been isolated from the Elaéagnaceae (7-9). However, this constitutes the first report of the occurrence of a 1,2,3,4-tetrahydro- β -carboline with an aliphatic side chain greater than one carbon atom. The isolation and characterization of alkaloid I suggests that further indole or β -

carboline alkaloids may be found which have their hypothetical biosynthesis from the condensation of a tryptophan (tryptamine) intermediate and C_5 terpenoid unit.

References

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4. We are indebted to Dr. A.M. Hogg and Mr. A. Budd, Department of Chemistry, The University of Alberta, for the high resolution mass spectral data.
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