ALKALOIDS OF *Fumaria parviflora*

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The total alkaloids of the plant *Fumaria parviflora* Lam., collected in Ashkhabad Province (Turkmen SSR), in the flowering and incipient fruit-bearing period have been studied. The methanolic extraction of 10.5 kg of the plant yielded 0.39% of total alkaloids, from which cheilanthifoline, scoulerine, parfumine, norjusiphine, isoboldine, coclaurine, dihydrosanguinarine, stylopine, sanguinarine, oxysanguinarine, adlumine, adlumidine, hydrastine, bicuculline, protopine, cryptopine, adlumidiceine, N-methyladlumine, a base with mp 281-282°C, and a new alkaloid — d-fumaricine — have been isolated from the plant for the first time.

By methanolic extraction of the plant *Fumaria parviflora* Lam. [1, 2] collected in the Ashkhabad Province in the period of flowering and incipient fruit bearing, we have obtained 0.39% of total alkaloids, which have been separated into phenolic and nonphenolic fractions. Separation of the combined phenolic alkaloids yielded cheilanthifoline, scoulerine, parfumine, isoboldine, norjusiphine, and coclaurine, while the nonphenolic fraction yielded dihydrosanguinarine, sanguinarine, stylopine, oxysanguinarine, adlumine, adlumidine, bicuculline, d-α-hydrastine, protopine, cryptopine, adlumidiceine, and base (I). From the quaternary alkaloid fraction N-methyladlumine and a base (II) were isolated. The alkaloids isolated were identified on the basis of their spectral characteristics and by direct comparison with authentic samples [1-5], and oxysanguinarine by comparison with a sample obtained by the oxidation of sanguinarine [6]. Base (I) is optical active, and the UV spectrum has two absorption maxima, at 237 and 288 nm (log ε 3.95, 3.74), while the IR spectrum has absorption bands at (cm^{-1}), 930, 1035 (methylenedioxy group), 1500, 1525, 1615 (aromatic ring), and 3100-3200 (hydroxy group). The mass spectrum shows the peak of the molecular ion with m/z 369, and also the peaks of ions with m/z 354 (100%), 338, 206 (42%), and 184.5 (M^{++}). The NMR spectrum shows signals in the form of three-proton singlets from an N-methyl group at 2.34 ppm and from two methoxy groups at 3.45 and 3.78 ppm, a one-proton singlet at 5.48 ppm, and one-proton doublets at 5.89 and 5.91 ppm (J = 2 Hz) (CH_2O_2). In the aromatic-proton region of the spectrum there are one-proton singlets at 6.37 and 6.57 ppm and a two-proton singlet at 6.70 ppm. The signals of methylene protons (6 H) appear in the form of a multiplet in the 2.35-3.70 ppm region.

The facts given permit the base to be assigned to the spirobenzylisoquinoline alkaloids with a hydroxy group in the five-membered ring [7]. The physicochemical properties and spectral characteristics of our base are identical with those of l-fumaricine, with the exception of the sign of rotation [7, 8]. In actual fact, when parfumine [9] was reduced with sodium tetrahydroborate, a product identical with (I) was obtained. Thus, base (I) is d-fumaricine, which has not previously been described in the literature.

EXPERIMENTAL

For chromatography we used type KSK silica gel and, for TLC, the following solvent systems: chloroform—ethanol (9:1) and (4:1), and benzene—ethanol (9:1), and (4:1). UV spectra were taken on a Hitachi spectrometer in ethanol, IR spectra on a UR-20 instrument (tablets with KBr), NMR spectra on a JNM-4H-100/100 MHz instrument with HMDS as internal standard (δ scale) in $CDCl_3$, and mass spectra on an MKh-1303 instrument.

Isolation and Separation of the Combined Alkaloids. Using a method described previously [4], 10.5 g of the air-dry plant *F. parviflora* was extracted with methanol. This gave 15.9 g

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of combined chloroform-extracted, 17.1 g of ether-extracted nonphenolic, 5.2 g of ether-extracted phenolic, and 1.3 g of chloroform-extracted phenolic alkaloids.

The combined ether-extracted phenolic material was chromatographed on a column of silica gel. The alkaloids were eluted with chloroform and with chloroform–ethanol systems in various ratios. The fractions eluted by chloroform yielded 0.05 g of cheilanthifoline and 0.11 g of scoulerine. From the fraction eluted by the (97:3) mixture 0.14 g of parfumine, and 0.13 g of norjusiphine were obtained, from the (9:1) fraction 0.01 g of isoboldine, and from the (4:1) fraction 0.02 g of coclaurine. The combined ether-extracted nonphenolic material was treated with methanol, which gave 3.5 g of protopine. The mother liquor (13.5 g) was chromatographed on a column of silica gel, the alkaloids being eluted with chloroform and with chloroform–ethanol. The fraction eluted by chloroform yielded 0.03 g of dihydrosanguinarine, 0.04 g of sanguinarine, 0.03 g of stylopine, and 0.1 g of oxysanguinarine. From the fraction eluted by the (98:2) mixture were obtained 0.4 g of adlumine and 0.6 g of adlumidine, and from the (96:4) fraction 0.8 g of d-α-hydrastine. The (9:1) fraction yielded 0.8 g of bicuculline, 0.1 g of fumaricine, 0.7 g of protopine, and 0.04 g of cryptopine, and the (4:1) fraction gave 0.3 g of adlumidiceine. A saturated solution of potassium iodide was added to the aqueous alkaline solution after the extraction of the alkaloids with ether and chloroform and acidification with sulfuric acid, and the iodides of the quaternary alkaloids were extracted with chloroform. The chloroform solution was filtered and dried, and the residue after the solvent had been distilled off was treated with methanol. This yielded 0.03 g of N-methyladlumine. The mother liquor was chromatographed on a column of silica gel with elution by chloroform and mixtures of chloroform and ethanol. The 9:1 mixture gave 0.008 g of base (II) (mp 281-282°C), and the 4:1 mixture 0.03 g of N-methyladlumine.

Base (II), mp 281-282°C (chloroform–methanol), mol. wt. 313 (mass-spectrometrically).

d-Fumaricine, mp 175-176°C (methanol), $[\alpha]_D$ +38° (c 0.4; chloroform).

Reduction of Parfumidine. At room temeprature, with stirring, 150 mg of $NaBH_4$ was added over 1 h to 30 mg of parfumidine in 10 ml of methanol. Then the solvent was distilled off, the residue was dissolved in 10% H_2SO_4, the solution was made alkaline with 25% NH_3, and the reaction product was extracted with ether. After the ether had been distilled off, a product was obtained which was identical with d-fumaricine (melting point, IR spectrum).

SUMMARY

Cheilanthifoline, scoulerine, norjusiphine, coclaurine, dihydrosanguinarine, oxysanguinarine, adluminidiceine, N-methyladlumine, and a base (II), and also d-fumaricine, not previously described in the literature, have been isolated for the first time from *Fumaria parviflora* Lam.

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