Chemistry of Natural Compounds, Vol. 30, No. 6, 1994

ALKALOIDS OF *Nitraria komarovii*
XVII. PEGANINE N-OXIDE, N-ALLYLSCHOBERINE, AND DEHYDRONITRAMIDINE

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UDC 547.944/945

Three new alkaloids have been isolated from the epigeal part of Nitraria komarovii *— peganine N-oxide, N-allylschoberine, and dehydronitramidine. Their structures have been determined on the basis of chemical transformations and spectral results.*

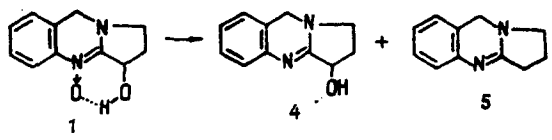
Continuing an investigation of the alkaloids of *Nitraria komarovii* Iljin et Lava [1], three bases (**1**, **2**, and **3**) have been isolated from the benzene fraction of the total bases.

Base (**1**), with the composition $C_{11}H_{12}N_2O_2$ was characterized by mp 207-108°C (alcohol—acetone) and $[\alpha]_D \pm 0$. Its PMR, mass, IR, and UV spectra showed that (**1**) belonged to the group of quinolizidine alkaloids.

The presence in the IR spectrum of (**1**) of characteristic bands of N-oxides, the presence in the mass spectrum of the peaks of the ions $(M - 16)^+$, $(M - 17)^+$, and $(M - 18)^+$, and its ready solubility in water permitted the assumption that base (**1**) was a N-oxide.

When (**1**) was reduced with zinc in hydrochloric acid, base (**4**), with mp 198-199°C, and a small amount of base (**5**), with mp 86-87°C, were obtained. Their melting points [2], R_f values, and IR and mass spectra agreed with those for *dl*-peganine and deoxypeganine, respectively.

In the PMR spectrum taken in $CDCl_3$, a downfield shift of the signals of the aromatic protons by approximately 0.15 ppm and also a downfield shift of the aliphatic protons, as compared with peganine, and the presence of a broadened signal at 6.15 ppm from the proton of a hydroxy group showed that the base was the N-oxide of peganine at N-1.



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Thus, the alkaloid isolated was peganine N-oxide and had structure (**1**). Peganine N-oxide has not been isolated previously, although there have been indirect indications of its presence [3].

Base (**2**) with mp 242-243°C, composition $C_{23}H_{25}N_3$, M^+ 343 and $[\alpha]_D \pm 0$. In the UV spectrum there were the following absorption maxima: λ_{max} (C_2H_5OH) 254, 307, 367 nm (log ε 4.12, 4.01, 3.32). On alkalinization, the bathochromic shifts characteristic for anhydronium bases (λ_{max} 282, 333, and 420 nm) were observed.

The PMR spectrum of this compound contained, in addition to a complex group of signals in the region of aliphatic and aromatic protons, the signals characteristic of an allyl group. Its spectral characteristics were close to those of schoberine and isoschoberine. Its mass spectrum differed by 40 mass units (allyl group). On the basis of the spectral results it was possible to assume that base (**2**) was an allyl derivative of schoberine or isoschoberine.

For a definitive answer to this question, we synthesized N_{16}-allylschoberine and N_{16}-allylisoschoberine by alkylating the corresponding bases with allyl bromide. A direct comparison showed the identity of base (**2**) and N-allylschoberine in all their parameters.

Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (3712) 89 14 75. Translated from Khimiya Prirodnykh Soedinenii, No. 6, pp. 780-783, November-December, 1994. Original article submitted March 29, 1993.

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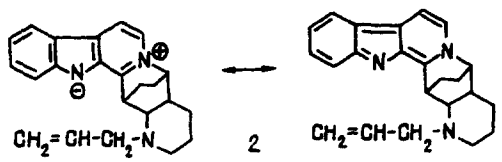

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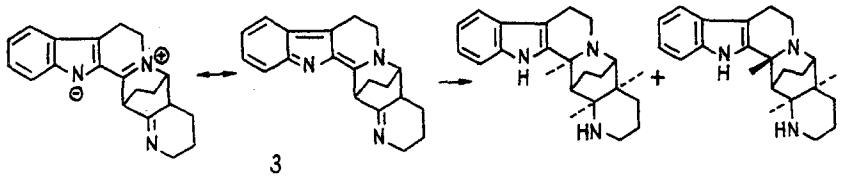
Thus the base was the allyl derivative of schoberine, with structure (2).

Base (3) with mp 268-269°C, composition $C_{20}H_{21}N_3$, $[\alpha]_D$ ±0. In the UV spectrum of (3) taken in alcohol there were three maxima, at 210, 250,and 365 nm (log ε 3.26, 3.81, 4.16), and in an alkaline medium bathochromic shifts were observed (λ_{max} 212, 257, and 388 nm), showing the anhydronium nature of the alkaloid.

The alkaloids schoberine and isoschoberine, with identical compositions, have been isolated previously from the plant under investigation. The UV spectrum of the alkaloid was close to that of nitramidine, but the molecule contained two fewer hydrogen atoms.

The PMR spectrum of (3) showed, in addition to a complex group of signals in the strong field, the following signals in the weak field (ppm): 7.28 (1H, m), 7.51 (2H, m), and 7.76 (1H, d).

When base (3) was reduced with sodium tetrahydroborate in methanol or by the Adams method, a mixture of two isomers in approximately equal amounts was obtained. These bases were isolated by column chromatography and were identified by direct comparison with authentic samples of nitrarine and isonitrarine.



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The alkaloid has been named dehydronitramidine. Chemical transformations and spectral characteristics have shown (3) as the most probable structure for it.

EXPERIMENTAL

UV spectra were taken in alcohol on a EPS-3T spectrophotometer (Hitachi), mass spectra on a MKh-1310 spectrometer, and IR spectra on a UR-20 instrument in tablets molded with KBr. PMR spectra were taken in CD_3OD on a Tesla 567A (100 MHz) instrument with HMDS as internal standard.

For TLC we used silica gel of types KSK and L 5/40. The following solvent systems were used for chromatography: 1) chloroform—methanol (1:1); 2) chloroform—ethanol (4:1); 3) chloroform—methanol (4:1); 4) chloroform—methanol—ammonia (8:2:0.1); 5) chloroform—ethanol—ammonia (8:2:0.1); 6) chloroform—ethanol—ammonia (5:3:0.1); 7) chloroform—ethanol—ammonia (6:4:0.1); 8) chloroform—acetone—ethanol—ammonia (5:4:1:0.1); 9) chloroform—methanol—ammonia (9:1:0.1); 10) chloroform—acetone—methanol—ammonia (5:3:2:0.1); 11) chloroform—acetone—ethanol—ammonia (5:2:3:0.1). Revealing agents: the Dragendorff reagent, and iodine vapor.

The extraction and separation of the total bases have been described in detail in [1, 4].

Peganine N-Oxide (1). Fractions 13-17 were combined and rechromatographed on a column of silica gel with elution by the solvent mixture chloroform—methanol (9:1). Fractions 7-13 yielded 65 mg of base (1) with mp 207-208°C (alcohol—acetone).

The mass spectrum of (1) contained the peaks of ions with m/z 204 (M^+, 3), 203 (4), 188 (8), 187 (12), 186 (10), 171 (9), 155 (26), 140 (100), 123 (24), 122 (14), 98 (64), 84 (65), 83 (77).

The following absorption maxima were observed in the UV spectrum of (1): λ_{max} (C_2H_5OH) 207, 220 (sh.), 225, 232 (sh.), 302 nm (lgε 4.16, 4.21, 4.27, 4.18, 4.06). The spectrum changed on alkalinization: λ_{max} (C_2H_5OH) 213, 220, 225 (sh.), 282 nm.

The following absorption bands (cm^{-1}) were present in the IR spectrum of (1): 770 (*o*-disubstituted benzene ring), 1230, 1270 (N → O), 1465, 1510, 1585, 1630 (C=C, C=N), 2840, 2860 and 2940 (CH_2 groups), 3150 (OH).

The following signals appeard in the PMR spectrum of (1) taken in $CDCl_3$: (δ, ppm): 2.25 and 2.66 (m, 2H, C-10), 3.68 (m, 2H, C-11), 4.75 (s, 2H, C-4), 5.38 (t, 1H, C-9), 6.15 (br.s, 1H, OH), 6.96 (m, 1H, C-5), 7.16 (m, 3H, C-6), -7 and -8).

Reduction of Peganine N-Oxide. Base (1) (42 mg) was reduced with granulated zinc in 10% hydrochloric acid for 7 h. The solution was decomposed with 10% caustic potash and extracted with chloroform. The chloroform was distilled off. The residue was separated chromatographically on a column of silica gel with elution by mixtures of chloroform and ethanol in various ratios (20:1, 10:1, 4:1). This gave 6 mg of base (5) with mp 86-87°C (petroleum ether) and 17 mg of base (4) with mp 198-199°C (alcohol—acetone). The PMR spectrum of base (4), taken in $CDCl_3$ showed the following signals: (δ, ppm): 2.05 and 2.43 (m, 2H, C-10), 3.25 (m, 2H, C-11), 4.52 (s, 2H, C-4), 4.72 (t, 1H, C-9), 6.80-7.15 (m, 4H, C-5, -6, -7, -8).

N-Allylschoberine (2). Fractions 32-38 from the benzene part of the total bases were rechromatographed on a column of silica gel, with elution by system (5). Fractions with a volume of 10-12 ml were collected. By crystallization from a mixture of alcohol and acetone, fractions 17-21 yielded 83 mg of base (2), with mp 242-243°C.

IR spectrum: 750, 840, 925, 1005, 1100, 1120, 1265, 1345, 1465, 1590, 1630, 1645, 2820, 2860, 2960, 3070, 3400 cm^{-1}. Mass spectrum: m/z: 343 (M^+, 20), 317 (67), 303 (48), 302 (37), 276 (24), 260 (26), 220 (68), 219 (100), 182 (57), 162 (51). The PMR spectrum contained the following signals: (δ, ppm): 1.2; 1.43; 2.0; 2.49; 3.06; 3.13; 3.24; 3.48; 4.51 (m, 2H, C-3), 4.92 (m, 2H, C-1), 5.42 (m, 1H, C-2), 7.16-8.52.

Alkylation of Schoberine with Allyl Bromide. N-Allylschoberine. With heating, 2 ml of freshly distilled allyl bromide was added to a solution of 137 mg of schoberine in 7 ml of alcohol. The mixture was boiled under reflux for 3 h. The course of the reaction was monitored chromatographically. At its end, the solvent was distilled off. The residue was purified by the usual method for alkaloids and was chromatographed on a column of silica gel with elution by system 5. This gave 0.087 g of base (2) with mp 242-243°C. M^+ 343.

N_{16}-Allylisoschoberine. A solution of 97 mg of isoschoberine in 7 ml of alcohol was treated with 2 ml of freshly distilled allyl bromide. The mixture was boiled under reflux for 3 h, and the product was worked up as described above for allylschoberine. This gave 65 mg of a base with mp 260-261°C (alcohol—acetone).

Dehydronitramidine (3). Fractions 39-43 were combined and chromatographed on a column of silica gel, with elution by chloroform—ethanol (4:1). Fractions with a volume of 15-20 ml were collected. By crystallization from acetone, fractions 13-19 yielded 158 mg of base (3) with mp 268-269°C. Its IR spectrum contained the following absorption bands: 770, 1110, 1335, 1460, 1510, 1530, 1585, 1630, 1650, 2860, 2940, 3070, 3400 cm^{-1}. The mass spectrum showed the peaks of ions with *m/z*: 303 (M^+, 57), 302 (27), 301 (25), 276 (17), 274 (10), 260 (21), 258 (8), 247 (7), 220 (68), 219 (100), 206 (26), 195 (20), 193 (16), 182 (55), 169 (27), 133 (21), 122 (29). In the PMR spectrum there were the following signals: (δ, ppm): 1.98; 2.25; 2.63; 3.22; 3.48; 4.27; 5.0; 7.28; 7.51; 7.76.

Reaction of Dehydronitramidine. a) In portions, 100 mg of sodium tetrahydroborate was added to a solution of 47 mg of base (3) in 5 ml of methanol, and then the mixture was stirred at room temperature for 2 h. The solvent was distilled off, and the residue was decomposed with water and extracted with chloroform. The chloroform was distilled off, and the residue was chromatographed on a column of silica gel, with elution by system 5. Fractions with a volume of 2-3 ml were collected, and 15 mg of a base with mp 255-256°c and 17 mg of a base with mp 208-209°C were obtained.

b) Base (3) (57 mg, dissolved in 10 ml of alcohol) was hydrogenated over Pt for 2 h. The catalyst was separated off, and the solvent was distilled off. The residue was separated chromatographically on a column of silica gel, with elution by system 5, giving 18 mg of a base with mp 208-209°C and 19 mg of a base with mp 255-256°C.

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