ALKALOIDS FROM PLANTS OF THE GENUS *Nitraria*

T. S. Tulyaganov,[1] N. M. Kozimova,[2] and F. Kh. Allaberdiev[3]

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The new alkaloid schobericine was isolated from the aerial part of N. schoberi. *The two new alkaloids komaroidine and acetylkomaroidine were isolated from the two* Nitraria *species* N. komarovii *and* N. schoberi. *Their structures were established using spectral data and chemical transformations. Their syntheses were carried out.*

Key words: *Nitraria, N. komarovii, N. sibirica, N. schoberi*, schobericine, komaroidine, acetylkomaroidine.

The genus *Nitraria* was first described by the physician Schober in 1735 from Lower Volga. In 1759, Linneaus used the binary name *Nitraria schoberi* for this plant [1, 2].

Plants of the genus *Nitraria* (Zygophyllaceae) are widely distributed around the world. Of the 11 species of this genus, 3 grow in deserts and salt marshes of Central Asia and Kazakhstan. These are *N. sibirica* Pall, *N. schoberi* L., and *N. komarovii* Iljin et Lava [2].

We continued this research by studying alkaloids of the aerial part of *N. schoberi* [3] collected near the village Derbent of Surkhandar'ya region of the Republic of Uzbekistan during flowering.

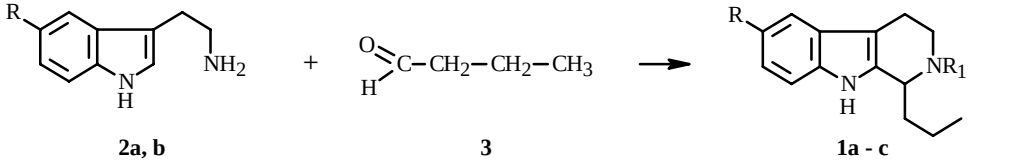
Column chromatography of the phenolic $CHCl_3$ part of the total bases isolated serotonin hydrochloride [4] and a new base with mp 193-195°C that we named schobericine (**1a**).

Schobicine has the formula $C_{14}H_{18}N_2O$. Its mass spectrum exhibited a peak for the molecular ion with $[M]^+$ 230. The UV spectrum had the following absorption maxima: 232, 278, 292 (log ε 4.35, 3.81, 3.80). These are typical of a nonconjugated indole chromophore [5]. The IR spectrum of **1a** contained the following absorption bands: 745 (*o*-disubstituted benzene); 1452, 1468, 1580, and 1620 (indole); 2845 and 2930 (saturated C–H); 3057 (Ar–H), and 3300-3400 (–NH and –OH).

The mass spectrum of **1a** exhibited a peak for the molecular ion $[M]^+$ 230 and was characterized by fragmentation indicating loss of a propyl group: $[M - 15]^+$, $[M - 29]^+$, and $[M - 43]^+$.

The PMR spectrum showed two 2H triplets at 2.65 and 3.08 ppm from neighboring methylenes and signals at 0.97 (3H, t), 1.63 (2H, m), 1.75 (2H, m), and 3.52 (1H, t). Aromatic protons (3H) appeared at 7.0-7.75 ppm.

Based on the physicochemical data, we assumed that schobericine was a tetrahydro-β-carboline alkaloid and had the most probable structure **1a**.



2a, b **3** **1a - c**

2a: R = OH
2b: R = H

1a: R = OH, R_1 = H
1b: R = H, R_1 = H
1c: R = H, R_1 = CH_3CO-

1) S. Yu. Yunusov Institute of the Chemistry of Plant Substances, Academy of Sciences of the Republic of Uzbekistan, Tashkent, fax (99871) 120 64 75, e-mail: tstulyaganov@rambler.ru; 2) Kokand State Pedagogical Institute, 3) Termez State University. Translated from Khimiya Prirodnykh Soedinenii, No. 2, pp. 164-166, March-April, 2006. Original article submitted October 31, 2005.

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A compound with this structure was synthesized by Pictet-Spengler condensation of serotonin (**2a**) with butyraldehyde [6].

The two new alkaloids komaroidine (**1b**) and acetylkomaroidine (**1c**) were isolated from the two *Nitraria* species *N. komarovii* and *N. schoberi*.

Komaroidine has the formula $C_{14}H_{18}N_2$, mp 206-208°C, $[\alpha]_D$ ±0. Its mass spectrum exhibited a peak for the molecular ion with *m*/*z* 214. The UV spectrum showed the following absorption maxima: 224, 280, 291 (sh) nm (log ε 4.51, 3.92, 3.87). These are typical of the chromophore of tetrahydro-β-carboline compounds [5].

The IR spectrum of **1b** contained absorption bands due to vibrations of *o*-disubstituted benzene (745 cm^{-1}), substituted indole (1441, 1465, 1578, 1620), saturated C–H (2840, 2930), and active H (3340).

The PMR spectrum had two 2H triplets at 2.68 and 3.10 ppm from neighboring methylenes and signals at 0.95 (3H, t), 1.63 (2H, m), 1.72 (2H, m), and 3.54 (1H, t). The aromatic protons (4H) resonated at 7.0-7.65 ppm as a complicated four-spin system.

The combined spectral data indicated that **1b** was a tetrahydro-β-carboline alkaloid. The mass spectrum also indicated the presence of a propyl group: $[M - 15]^+$, $[M - 29]^+$, $[M - 43]^+$.

Based on the physicochemical data and judging from that for komaroidine, the most probable structure was **1b**. A compound with this structure was synthesized by condensation of tryptamine (**2b**) with butyraldehyde by the literature method [6]. The resulting product had properties identical to those of the natural alkaloid komaroidine isolated by us.

Alkaloid **1c** had formula $C_{16}H_{20}N_2O$ and was optically inactive. Its mass spectrum contained a peak for the molecular ion with *m*/*z* 256. The UV spectrum exhibited the following absorption maxima: 220, 281, 292 (sh) nm (log ε 4.45, 3.88, 3.81). These were typical of a nonconjugated indole chromophore [5].

The IR spectrum of **1c** contained absorption bands due to vibrations of *o*-disubstituted benzene (748 cm^{-1}), substituted indole (1445, 1467, 1580, 1625), N–C=O (1645), saturated C–H (2850 and 2930), Ar–H (3055), and active H (3350).

The PMR spectrum showed two 2H triplets at 2.65 and 3.62 ppm from neighboring methylenes and signals at 0.98 (3H, t), 1.67 (2H, m), 1.76 (2H, m), 3.72 (1H, t), and 2.18 (3H, s). Aromatic protons (4H) appeared at 7.0-7.7 ppm as a complicated four-spin system.

The presence in the PMR spectrum of a 3H singlet at 2.18 ppm indicated the presence of an acetyl.

The combined spectral data showed that **1c** was a tetrahydro-β-carboline alkaloid.

Hydrolysis of **1c** in acidic medium produced the known alkaloid komaroidine (**1b**). Acetylation of komaroidine with acetic anhydride in pyridine produced the *N*-acetyl derivative of komaroidine, which was identical to **1c**.

Based on the spectral data and chemical transformations, the structure **1c** was established for the alkaloid, which we called acetylkomaroidine.

Thus, schobericine, komaroidine, and acetylkomaroidine were new alkaloids.

EXPERIMENTAL

The conditions for recording spectra, extraction, and separation of total bases from *N. schoberi* have been described in detail previously [7].

Separation of Total Akaloids from *N. schoberi*. The phenolic $CHCl_3$ part of the total bases (0.35 g) was separated by chromatography over a silica-gel column by elution with $CHCl_3$:C_2H_5OH mixtures (20:1, 15:1, 10:1, 4:1).

Fractions (5-6 mL) were collected. The known alkaloid serotonin hydrochloride was isolated from individual fractions (38-43).

Schobericine. Fractions 28-37 were combined and rechromatographed over a silica-gel column with elution by $CHCl_3$:CH_3OH (9:1). Fractions (3-4 mL) were collected. Fractions 16-24 were combined. Solvent was distilled off. The residual was crystallized from ethanol to afford schobericine (**1a**, 29 mg), mp 193-194°C.

The benzene part of the total bases (6.15 g) was separated by chromatography over a silica-gel column with elution by $CHCl_3$:CH_3OH (20:1, 15:1, 10:1, 6:1, 4:1). Fractions (10-15 mL) were collected.

Komaroidine (1b). Fractions 13-17 were combined and rechromatographed over a silica-gel column with elution by $CHCl_3$:CH_3OH (10:1). Fractions (7-8 mL) were collected. Fractions 16-23 were worked up by crystallization from ethanol:acetone to afford **1b** (43 mg), mp 207-208°C.

Acetylkomaroidine (1c). Fractions 8-15 were combined. Solvent was distilled off. The residual was crystallized from ethanol:acetone to afford **1c** (34 mg), mp 229-230°C.

Extraction and separation of the total bases from *N. komarovii* has been described in detail [8, 9].

The benzene part of the total bases was separated by chromatography over a silica-gel column with elution by $CHCl_3$:CH_3OH (20:1, 10:1, 4:1). Fractions (15-20 mL) were collected.

Komaroidine (1b). Fractions 14-16 were combined and separated by chromatography over a silica-gel column with elution by $CHCl_3$:CH_3OH (10:1). Fractions (8-10 mL) were collected. Fractions 17-23 were combined and worked up by crystallization from ethanol:acetone to afford **1b** (56 mg), mp 207-208°C.

Acetylkomaroidine (1c). Fractions 11-16 were combined and worked up by crystallization from ethanol:acetone to afford **1c** (51 mg), mp 229-230°C.

Hydrolysis of 1c. Komaroidine. Base **1c** (0.05 g) was dissolved in HCl (5 mL, 1 N) and heated at 90°C for 2 h. After the reaction was complete, the solution was cooled, made basic with KOH solution (10%), and extracted with $CHCl_3$. Solvent was distilled off. The residual was crystallized from acetone:ethanol to afford komaroidine (0.027 g), mp 207-208°C.

Acetylation of Komaroidine (Acetylkomaroidine). A mixture of **1b** (0.04 g), pyridine (1 mL), and acetic anhydride (1 mL) was left at room temperature for 5 d. After the reaction was complete, the excesses of anhdyride and pyridine were removed in vacuo. The dry residual was treated with water (2 mL) and made basic with conc. aqueous NH_3. The product was extracted with ether. The ether extract was dried over anhydrous Na_2SO_4. Solvent was distilled off. The residual was crystallized from acetone:ethanol to afford *N*-acetylkomaroidine (0.031 g), mp 229-230°C.

Synthesis of Komaroidine. A mixture of tryptamine hydrochloride (1 g, 0.005 mol) in water (15 mL), ethanol (25 mL), H_2SO_4 (3 mL, 2 N), and butyraldehyde (3 mL) was gradually heated to boiling on a sand bath and held at this temperature for 5 h. The alcohol was distilled off in vacuo. The solution was made basic with conc. aqueous NH_3. The product was extracted with $CHCl_3$. The $CHCl_3$ was distilled off. The solid was crystallized from acetone:alcohol to afford **1b** (0.91 g), mp 207-208°C.

Synthesis of Schobericine. Schobericine was synthesized by condensation of serotonin and butyraldehyde by the method described above for the synthesis of komaroidine to afford **1a** (0.87 g), mp 193-194°C.

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