ALKALOIDS OF *Dicentra*

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Methanolic extraction of *Dicentra spectabilis* L., collected in the flowering period in the botanical garden of Pyatigorsk Pharmaceutical Institute, has yielded 0.17% of combined alkaloids from the epigeal part and 0.25% from the roots. By the separation of these materials, dihydrosanguinarine, sanguinarine, scoulerine, cheilanthifoline, corydine, and protopine have been obtained. *Dicentra peregrina* Rudolph, collected in the flowering period on the island of Sakhalin, has yielded 1.8% of combined alkaloids from the epigeal part and 1.51% from the roots. From these combined materials have been isolated isocorydine, corydine, dicentrine, protopine, dihydrosanguinarine, sanguinarine, cheilanthifoline, bicuculline, lederine, scoulerine, isoboldine, predicentrine, reticuline, and allocryptopine.

Plants of the genus *Dicentra* Bernh., belonging to the family *Papaveraceae* [1], later included in the family *Fumariaceae* [2], are represented by nine species [3], of which *D. peregrina* is found on the territory of Soviet Union as an endemic plant of the Far East [4]. The alkaloid compositions of plants of this genus have been studied abroad, and from nine species about thirty bases have been isolated [1]. We have investigated the alkaloid compositions of two species of *Dicentra*, *D. spectrabilis* L. and *D. peregrina* Rudolph., this being the first time that the latter has been studied.

Methanolic extraction of the epigeal part of *D. spectabilis* collected in the flowering period in the Botanical Garden of the Pyatigorsk Pharmaceutical Institute yielded 0.17% of total alkaloids, which were separated into phenolic and nonphenolic fractions. From the nonphenolic ether-extracted alkaloids we have isolated protopine, sanguinarine, and dihydrosanguinarine, and from the phenolic fractions scoulerine and corydine.

The roots of *D. spectabilis* yielded 0.25% of total alkaloids, by separating of which we isolated protopine, sanguinarine, cheilanthifoline [5], scoulerine, and corydine.

Chloroform extraction of the epigeal part of *D. peregrina* collected in the flowering period on the island of Sakhalin gave 1.8% of total alkaloids which was separated into phenolic and nonphenolic fractions. From the nonphenolic fractions we have isolated isocorydine, dicentrine, protopine, dihydrosanguinarine, sanguinarine, chelerythrine, bicucculine, and lederine, and from the phenolic fractions scoulerine, isocorydine, isoboldine, predicentrine, and reticuline.

The roots of *D. peregrina* contained 1.51% of total alkaloids, from which we isolated isocorydine, dicentrine, protopine, allocryptopine, dihydrosanguinarine, sanguinarine, chelerythrine, bicucculine, scoulerine, corydine, isoboldine, and predicentrine. All the alkaloids isolated were identified by comparison with authentic samples [6], and dicentrine and predicentrine by comparing their properties and spectral characteristics with those given in the literature [7].

EXPERIMENTAL

UV spectra were taken on a Hitachi spectrophotometer in ethanol, mass spectra on a MKh-1303 instrument fitted with a system for the direct introduction of the substance into the ion source, and PMR spectra on a JEOL instrument with HMDS as standard (δ scale).

Isolation and Separation of the Total Alkaloids of *D. spectabilis*. The air-dry epigeal part of *D. spectabilis* (9 kg) was extracted with methanol six times. After the methanol had

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been distilled off, the residue was treated with 10% H_2SO_4. The acid solution was washed with ether and it was then made alkaline with 25% ammonia and extracted with ether and with chloroform. The total ether-extracted material was separated into phenolic (ether subfraction, 1.27 g, and chloroform subfraction, 0.25 g) and nonphenolic (8.20 g) fractions. The yield of chloroform-extracted material was 5.71 g. The nonphenolic ether-extracted alkaloids were treated with ethanol, which led to the precipitation of 5.1 g of protopine. The mother solution (3.1 g) was chromatographed on a column of silica gel (1:30). Elution was performed with benzene, benzene–ethanol, and ethanol. The benzene eluates yielded 0.038 g of dihydrosanguinarine. The fractions eluted with benzene–ethanol (99:1) gave 0.047 g of sanguinarine, and the (96:4) fractions yielded 0.66 g of protopine. The total phenolic alkaloids (1.7 g) were chromatographed on a column of silica gel (1:30). Fractions eluted by benzene–ethanol (99:1) gave 0.094 g of scoulerine, and the (97:3) fractions 0.987 g of corydine.

The chloroform-extracted alkaloids (5.71 g) were chromatographed on a column of silica gel. Fractions eluted by benzene–ethanol (99:1) yielded 0.021 g of scoularine, and the (96:4) fractions 1.47 g of protopine.

The air-dry roots of *D. spectabilis* (2 kg) were extracted by the method described above, giving 1.88 g of ether-extracted and 3.12 g of chloroform-extracted alkaloids. The ether-extracted material was separated into phenolic (0.79 g) and nonphenolic (1.09 g) fractions. When the nonphenolic ether-extracted alkaloids were treated with ethanol, 0.19 g of protopine was obtained. The mother liquor was chromatographed on a column of silica gel (1:30) and elution was performed in benzene and benzene–ethanol. The benzene fractions yielded 0.018 g of sanguinarine, and the fractions eluted by the (95:5) mixture gave 0.24 g of protopine. The phenolic fraction was chromatographed on a column of silica gel. From fractions eluted by benzene–ethanol (99:1) 0.028 g of cheilanthifoline and 0.026 g of scoulerine were eluted.

Isolation and Separation of the Total Alkaloids of *D. peregrina*. The air-dry epigeal part of *D. peregrina* (650 g) was wetted with 6% NH_4OH and extracted with chloroform eight times. The alkaloids were extracted from the dried chloroform solution with 10% H_2SO_4. The acid solution was made alkaline with 25% ammonia and extracted with ether and chloroform. This gave 9.92 g of ether-extracted and 1.79 g of chloroform-extracted alkaloids. The ether-extracted material was separated into nonphenolic (8.21 g) and phenolic (ether subfraction 1.28 g and chloroform subfraction 0.43 g) fractions. When the nonphenolic alkaloids were treated with methanol, 4.04 g of crystals was deposited, the fractional recrystallization of which from acetone yielded 2.5 g of isocorydine, 1.2 g of dicentrine, and 0.34 g of protopine. The material from the mother liquor (4.17 g) was chromatographed on a column of silica gel. Elution was carried out with chloroform and with chloroform–ethanol. The chloroform eluates yielded 0.022 g of dihydrosanguinarine, 0.035 g of sanguinarine, and 0.018 g of chelerythrine. From the fractions eluted by chloroform–ethanol (99:1) were obtained 0.037 g of D-bicucculine and 0.051 g of lederine, and from the (98:2) fractions 1.15 g of isocorydine, 0.64 g of dicentrine, and 0.45 g of corydine. The fractions eluted by the (96:4) mixture gave 0.35 g of protopine.

The ether-extracted material from the phenolic fraction (1.28 g) was chromatographed on a column of silica gel (1:35). Chloroform eluates yielded 0.019 g of *l*-scoulerine. Elution with chloroform–ethanol (98:2) gave 0.45 g of isocorydine and 0.28 g of corydine, and the (97:3) mixture gave 0,085 g of d-isoboldine. From the fractions eluted by the (96:4) mixture was obtained 0.056 g of predicentrine, and from the (95:5) mixture 0.41 of reticuline.

When the air-dry roots of *D. peregrina* (200 g) were extracted with chloroform by the method described above, an ether fraction of alkaloids (nonphenolic part 2.34 g, phenolic part 0.43 g) and 0.25 g of a chloroform fraction of chloroform alkaloids were obtained. Treatment of the nonphenolic alkaloids with ethanol yielded 0.89 g of a mixture of crystals consisting of isocorydine (0.34 g), dicentrine (0.41 g), protopine (0.11 g), and allocryptopine (0.03 g). The mother liquor (1.45 g) was chromatographed on a column of silica gel (1:30). Elution with chloroform and chloroform–ethanol yielded dihydrosanguinarine (8 mg), sanguinarine (16 mg), chelerythrine (9 mg), d-bicucculine (26 mg), isocorydine (181 mg), dicentrine (165 mg), corydine (95 mg), protopine (218 mg), and allocryptopine (185 mg). The phenolic fraction (0.43 g) was separated by chromatography on a column of silica gel into scoulerine (18 mg), isocorydine (110 mg), corydine (95 mg), isoboldine (21 mg), and predidentrine (16 mg).

By column chromatography, the chloroform fraction of alkaloids yielded 45 mg of isocorydine and 32 mg of allocryptopine.

Dicentrine. mp 158-159°C, $[\alpha]_D$ +57° (c 0.56; chloroform). UV spectrum: λ_{max} 220, 282, 303 nm (log ε 4.53, 4.20, 4.21). Mass spectrum: m/z 339 (M^+), 338 (100%), 324, 307, 296, 281, 265.

PMR spectrum (ppm): 2.45 (s, N–CH_3), 3.79 (s, 2OCH_3), 5.82 and 5.96 (d, J ∿ 2 Hz, CH_2O_2), 6.42, 6.70, 7.59 (s, 3 Ar–H), 2.25-3.25 (m, 7H).

Predicentrine. $[\alpha]_D$ +97° (c 0.28; ethanol). UV spectrum, λ_{max} 282, 303 nm (log ε 4.19, 4.20).

Mass spectrum: m/z 341 (M^+), 340 (100%), 326, 325, 310, 283, 266, 170.5 (M^{++}).

PMR spectrum, ppm,: 2.49 (s, N–CH_3), 3.48 (s, OCH_3), 3.79 (s, OCH_3), 3.82 (s, OCH_3), 6.52, 6.72, 7.86, (s, 3 Ar–H), 2.50-3.30 (m, 7H).

SUMMARY

Fifteen alkaloids have been obtained from two species of *Dicentra*. This is the first time that dihydrosanguinarine, scoulerine, isoboldine, predicentrine, reticuline, cheilanthifoline, and lederine have been isolated from plants of this genus.

LITERATURE CITED

1. F. Santavy, in: The Alkaloids, R. H. F. Manske and R. Rodrigo, eds., Academic Press, New York, Vol. XVII (1979), p. 385.
2. A. L. Takhtadzhyan, System and Phylogeny of Flowering Plants [in Russian], Moscow–Leningrad (1966), p. 106.
3. K. R. Stern, Brittonia, 13, 1 (1961).
4. Flora of the USSR [in Russian], Leningrad, Vol. VII (1937), p. 647.
5. R. H. F. Manske and W. R. Ashford, in: The Alkaloids, R. H. F. Manske and H. L. Holmes, eds., Academic Press, New York, Vol. IV (1954), p. 98.
6. S. U. Karimova, I. A. Israilov, M. S. Yunusov, and S. Yu. Yunusov, Khim. Prir. Soedin., 224 (1980).
7. I. A. Israilov, S. U. Karimova, M. S. Yunusov, and S. Yu. Yunusov, Khim. Prir. Soedin., 279 (1980).

ALKALOIDS OF *Papaver orientale*

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Continuing the separation of the total alkaloids of the plant *Papaver orientale* L., collected in the flowering phase in the region of Lake Sevan, orientalidine, mecambridine, isothebaine, and bracteoline have been isolated, together with new alkaloids — oreintine, O-methylisothebaine, and orientidine, the structures of which have been established.

Continuing a study of *Papaver orientale* L. from different growth sites [1-3], we have investigated the alkaloid composition of the epigeal part of the plant collected in the flowering phase in the region of Lake Sevan (Armenian SSR).

Methanolic extraction of the plant yielded 0.3% of total alkaloids, which were separated into nonphenolic and phenolic fractions. From the nonphenolic fraction we isolated orentalidine, isothebaine, mecambridine, and the new bases (I), (II), and (III), and from the phenolic

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