ALKALOIDS OF *THALICTRUM SIMPLEX*

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Hernandezine, berberine, and thalicsine have previously been isolated from the roots of *Th. simplex* L. [1, 2]. In order to separate the mixture of bases more completely, we extracted the roots gathered in May 1961 in the Susamyr valley (Kendyk Range, KirgSSR). 0.60% of combined tertiary bases and 0.32% of quaternary bases were isolated. When this mixture was separated according to solubility into ethereal and chloroformic fractions and into phenolic and nonphenolic fractions and also by chromatography on alumina 0.238% (of the weight of the dry root) of hernandezine, 0.006% of thalicsine, 0.008% of β-allocryptopine [3], 0.001% of thalicsimidine [3, 4] and thalictrisine [5], 0.002% of thalicmine, and 0.002% of thalicminine [5] were obtained. In addition, two new bases were isolated (0.002% of I and 0.001% of II), together with 0.25% of magnoflorine and 0.072% of berberine in the form of the iodides.

The base I forms yellowish crystals with mp 245–246° C (decomp.) and the base II yellow lustrous prismatic crystals with mp 182–183° C. Both alkaloids are optically inactive.

EXPERIMENTAL

Isolation of the alkaloids. One hundred kilograms of the raw material was extracted with chloroform in the usual way. When the extract was treated with 10% H_2SO_4, it deposited 100 g of hernandezine sulfate. The acid solution was made alkaline with 25% ammonia, and the free bases were extracted with ether and with chloroform. This gave 421 g of ethereal and 91 g of chloroformic fractions of the total alkaloids.

The base I. When the ethereal extract was concentrated, yellowish crystals deposited with mp 245–246° C (decomp.), $[\alpha]_D \pm 0°$ (c 1.0; 0.1 N HCl). Yield 2 g. IR spectrum, γ_{max}, cm^{-1}: 3600 (OH), 1720 (C=O), 1050, 960 (O_2CH_2). UV spectrum, λ_{max}, mμ: 239, 266, 315, 398 (log ε 4.34, 4.58, 4.06, 3.24).

Treatment of the ethereal fraction of the mixture of alkaloids. Hernandezine and thalicsine. The 421 g of combined alkaloids was dissolved in 500 ml of methanol, and 77 g of hernandezine was isolated. A hydrochloride was obtained from the mother liquor. Its base was identified as thalicsine (6.3 g). The mother liquor from the hydrochloride was converted into the base, dissolved in benzene, and passed through a column of alumina (activity grade II). The benzene eluate yielded 61 g of hernandezine. The remaining alkaloids were eluted from the column with chloroform, the solvent was evaporated off, and the residue was dissolved in 10% H_2SO_4; the solution was made alkaline with 25% ammonia and the alkaloids were extracted with ether. The ethereal extract was separated into a phenolic and a nonphenolic fraction.

β-Allocryptopine. The fraction of nonphenolic bases (277 g) was dissolved in 300 ml of methanol. On standing 8.0 g of prismatic crystals deposited with mp 169–170° C (acetone), giving no depression of the melting point with β-allocryptopine.

Thalicsimidine. From the methanolic mother liquor of the nonphenolic bases a hydrochloride was obtained the base from which (0.8 g) had mp 131–132° C (acetone), $[\alpha]_D$ +66.9° (c 1.42; ethanol), +20.2° (c 1.38; chloroform). UV spectrum, λ_{max}, mμ: 220, 280, 300, 314 (log ε 4.69, 4.39, 4.31, 4.20).

Found, %: C 69.10; H 7.32; N 3.67. Mol wt 375 (mass spectrometry). Calculated for $C_{22}H_{27}NO_5$, %: C 68.57; H 7.01; N 3.63. Mol wt 385.

Thalictrisine. The ethereal fraction of the phenolic bases was evaporated to dryness and the residue (10 g) was dissolved in methanol. On standing, prismatic crystals deposited with mp 261–263° C, $[\alpha]_D^{17} \pm 0°$ (c 0.95; chloroform) Yield 1 g. IR spectrum, ν_{max}, cm^{-1}: 3460 (OH), 1640 (C=O), 1040, 930 (O_2CH_2). UV spectrum, λ_{max} 288 mμ (log ε 3.95).

Found, %: C 67.40; H 6.43; N 3.60, 3.65; N—CH_3 3.7; OCH_3 8.7, 8.9. Mol wt 365 (mass spectrometry). Calculated for $C_{20}H_{21}NO_5$, %: C 67.60; H 5.91; N 3.94; N—CH_3 4.2; OCH_3 8.7.

Methylation of thalictrisine. β-Allocryptopine. Thalictrisine (0.1 g in 10 ml of methanol) was methylated with diazomethane. The crystals obtained were identical in respect of their UV, IR, and NMR spectra with β-allocryptopine.

Treatment of the chloroformic fraction of the mixture of bases. The base II. The chloroformic fraction of the mixture of alkaloids (91 g) was dissolved in 100 ml of ethanol, which led to the formation of lustrous yellow prismatic crystals having mp 182–183° C (acetone), $[\alpha]_D \pm 0°$ (c 1.74; chloroform). Yield 1 g. IR spectrum, ν_{max}, cm^{-1}: 3450 (OH), 1040, 940 (O_2CH_2).

Thalicminine. The ethanolic mother liquor of the chloroformic fraction of the total alkaloids was evaporated, the residue was dissolved in 250 ml of acetone, this solution was concentrated, and the resulting precipitate (17 g) was dissolved in chloroform and transferred to a column of alumina (activity grade II). On chloroform elution, fractions 5–6 deposited golden orange crystals with mp 263–265° C identified as thalicminine. Yield 2 g.

Thalicmine. The subsequent fractions of the chloroformic eluate yielded white crystals with mp 137–138° C identified by TLC and the melting point of a mixed sample as thalicmine. Yield 2 g.

Magnoflorine and berberine. After the removal of the tertiary bases, 1.8 kg of the raw material was extracted with methanol. The solvent was distilled off in vacuum, the residue was dissolved in water, and 10 g of potassium iodide was added. The grayish-white crystals of magnoflorine iodide (mp 249–251° C) that deposited were separated off. Yield 4.5 g. The mother liquor was evaporated and 1.3 g of berberine iodide was obtained.

CONCLUSIONS

Eleven alkaloids have been isolated from the roots of Thalictrum simplex L. Thalicmine, thalicminine, β-allocryptopine, and magnoflorine have been found in this species for the first time. Thalicmidine and thalictrisine are new alkaloids.

The main alkaloids of this species of plant are hernandezine in the tertiary fraction and magnoflorine in the quaternary fraction.

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