ALKALOIDS OF ANDRACHNE ROTUNDIFOLIA

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In the family Euphorbiaceae (spurges), numbering approximately 4500 species [1], more than 20 alkaloid-containing species have been found, mainly in recent years, from which 16 different bases have been isolated [2-5]; some of them are used in medicine [6].

We have begun an investigation of Andrachne rotundifolia C. A. Mey. (family Euphorbiaceae). The presence of alkaloids in Andrachne was established quantitatively by Massagetov in 1947 [7]. We collected the raw material for study in Central Asia near the town of Uch-Kurgan in the flowering phase (June 1964). The total alkaloids in the hypogeal part of this plant amounted to 0.2-0.3% and in the epigeal part 0.06-0.08% and included no phenolic bases. Paper chromatography showed that the total alkaloids both in the hypogeal and in the epigeal parts consisted of not less than six bases with R_f 0.41, 0.51, 0.63, 0.70, 0.78, and 0.84. In all the experiments, chromatography was carried out with Leningrad paper, type M with the solvent system 5% acetic acid-butan-1-ol (1:1); the spots were revealed with Dragendorff's reagent.

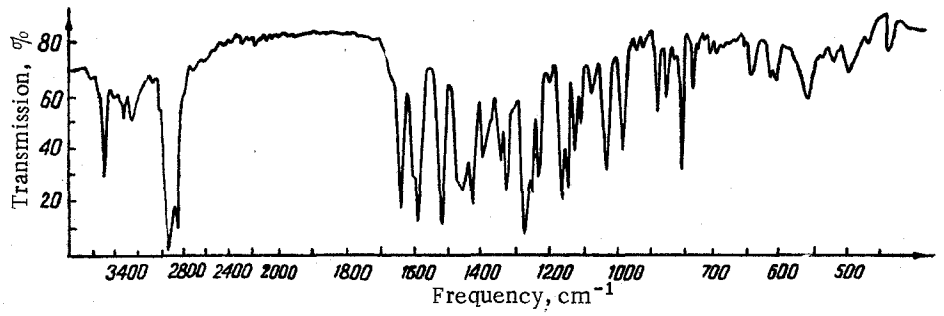

Fig. 1. IR spectrum of andrachinine.

The present paper gives the results of a chemical study of the ethereal fraction of the water-soluble components of the total material from the hypogeal part of Andrachne rotundifolia (roots and rhizomes). Three individual substances were isolated, one of which has been fairly well characterized and is, apparently, new. We have called it andrachnine.

Andrachnine is a light yellow crystalline substance with the composition $C_{11}H_{17}NO_2$, mp 89°-92° C (in vacuum 97°-99° C), optically inactive, R_f 0.65.

The IR spectrum (Fig. 1, taken on a UR-10 instrument in paraffin oil) shows absorption bands at 3456, 3300, and 3220 (-NH- and -OH groups) and 1585 and 1635 cm^{-1}, indicating the possibility that the alkaloid is aromatic in nature [8]. The UV spectrum (Fig. 2, taken on an SF-4 instrument in 95% ethanol) - λ_{max} 235-236, 335 mμ (log ε 3.92, 4.10, respectively) - is in favor of this.

The presence of an $-OCH_3$ group and two labile hydrogen atoms (-OH and -NH- groups) in the compound isolated has been established analytically. In correspondence with the information from the IR spectrum, the hydroxy group is alcoholic in nature. The presence of OH and NH groups is confirmed by the formation of the diacetyl derivative of andrachnine, which has absorption bands in the IR spectrum at 1740, 1607, 1630, and 1520 cm^{-1} and gives a single spot with R_f 0.88 on paper chromatography.

Base II is a light yellow very viscous liquid giving a perchlorate with mp 139°-140° C.

Base III is a white crystalline substance with mp 135°-136° C; IR spectrum: 3420, 3230, 1465 cm^{-1}, R_f 0.89.

Experimental

36.5 kg of the air-dry finely comminuted roots and rhizomes of Andrachne rotundifolia C. A. Mey. were made alkaline with 25% ammonia and exhaustively extracted with dichloroethane (1:10). The dichloroethane extracts were treated with 20% sulfuric acid. The sulfuric acid extracts were made alkaline with 25% ammonia to pH 8-9 and the alkaloids were extracted with chloroform. The chloroform extract was again treated with 20% sulfuric acid. The sulfuric acid extracts were purified with ether and activated carbon (type A) and were made alkaline with 25% ammonia.

The precipitate depositing after basification was separated off (fraction 1). Yield 46.78 g. The alkaloids were extracted from the aqueous alkaline solution after the separation of fraction 1 successively with ether (fraction 2, yield 9.62 g), benzene (fraction 3, yield 4.52 g), butan-1-ol (fraction 4, yield 3.62 g), and chloroform (fraction 5, yield 20.89 g). The total yield of alkaloids from 36.5 kg of the hypogeal parts of Andrachne rotundifolia was 85.43 g (0.23%).

The ethereal fraction 2, after the evaporation of the ether had the form of a clear amber-colored liquid of low mobility. From the results of paper chromatography, this fraction contained three alkaloids with R_f 0.63, 0.76, and 0.89.

Fraction 2 (9.62 g) was dissolved in acetone (50 ml), precipitated with n-hexane (0.8 *l*) and left in the cold. After 48 hr, a precipitate separated from the solution in the form of a resin (A) at whose surface yellowish acicular crystals formed. Very small white acicular crystals were present in suspension in the mother liquor (B). The mother liquor with the acicular crystals was decanted off and the yellow crystals of the base (andrachnine) were removed from the surface of the resin. After recrystallization from benzene, the base had R_f 0.65; mp 97°–99° C (in vacuum), optically inactive. IR spectrum: ν_{max} 3456, 3300, 3220, 1585, 1635 cm^{-1}. UV spectrum: λ_{max} 235–236, 335 mμ (log ε 3.92, 4.10).

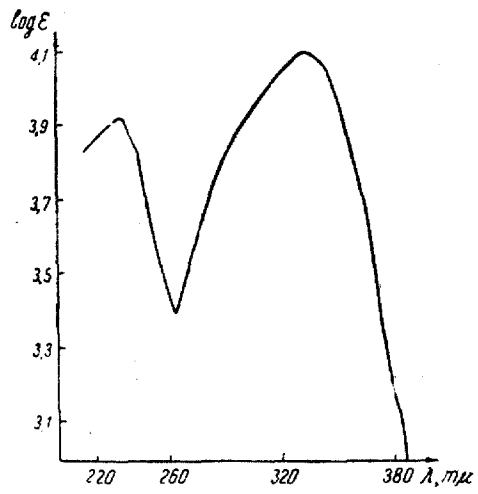

Fig. 2. UV spectrum of andrachnine.

Found, %: 67.86; 67.46; H 8.46; 8.73; N 7.51; 7.49; OCH_3 15.55; 15.35; H_{labile} 0.898; mol. wt. 193 (Rast); 213 (Beckmann). Calculated for $C_{11}H_{17}NO_2$, %: C 67.66; H 8.77; N 7.17; OCH_3 14.94; H_{labile} 1.03; mol. wt. 195.25.

Acetylation of andrachnine. A solution of 0.1 g of the base in 2 ml of pyridine was treated with 1 ml of acetic anhydride and left for a day. The solvent was eliminated under vacuum. The residue was dissolved in 5% sulphuric acid, and the solution was made alkaline with 25% ammonia and extracted with ether. This gave 0.06 g of the diacetyl derivative of andrachnine, which formed a yellow resin that could not be crystallized, R_f 0.88, IR spectrum: 1740, 1607, 1630, 1520 cm^{-1}.

Andrachnine forms very hygroscopic salts which makes it difficult to characterize them precisely.

Base II. The resinous residue after the separation of the andrachnine forms one spot on a paper chromatogram with R_f 0.74. The substance was not crystallized. The resin was dissolved in hydrochloric acid and a saturated solution of sodium perchlorate was added. The crystalline perchlorate formed rapidly resinified. The resinified part was eliminated on porous ceramic plates and the crystals of the perchlorate were washed with benzene and dried in a vacuum desiccator. The melting point of the perchlorate was 139–140° C; $[\alpha]_D$ 0.

Base III. The white needle-like crystals were filtered off from the mother liquor (B), forming the base (III) (0.01 g). The substance had mp 135–136° C, R_f 0.89, IR spectrum: ν_{max} 3420, 3230, 1465 cm^{-1}.

The spectroscopic investigations were carried out by M. E. Perel'son.

Summary

1. The content of total alkaloids in the hypogeal parts of Andrachne rotundifolia C. A. Mey. (family Euphorbicease) is 0.2–0.3% and in the epigeal parts 0.06–0.08%.

The total alkaloids in both the hypogeal and the epigeal parts of Andrachne rotundifolia consist of five or six nonphenolic bases.

2. Three individual substances have been isolated: andrachnine $C_{11}H_{17}NO_2$, which is a new alkaloid; base (II), giving a perchlorate with mp 139°–140° C; and base (III) with mp 135°–136° C.

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