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ALKALOIDS OF THE CULTIVATED SPECIES Aconitum chasmanthum AND Delphinium elatum

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Representatives of the genera Aconitum and Delphinium belong to the most valuable alkaloid-bearing plants of the Ranunculaceae family [1]. The hypogeal organs (rhizomes with roots) of Aconitum chasmanthum Stapf and Delphinium elatum L. cultivated in the Polar-Alpine Botanical Garden (Kirovsk) have been analyzed for their alkaloid content. The first of them – a species of the Himalayan flora – was grown from seeds of culture origin obtained from Munich. The second is a Eurasian species that has become naturalized during cultivation for many years under the environmental and climatic conditions of the Khibiny mountains. In this introduction region, both plants have bound a second homeland, which has been shown above all in their resistance to unfavorable factors of the external environment of the subarctic and in their capacity for vegetative and seed reproduction.

Aconitum chasmanthum is a most valuable medicinal plant that is widely used in the scientific and folk medicines of a number of countries of South-East Asia [2]. Delphinium elatum is a source of raw material for obtaining drugs used in the treatment of diseases accompanied by a pathologically elevated muscular tonus. Insecticide [3].

Alkaloids were isolated from the air-dry comminuted raw material of Aconitum chasmanthum (200 g) that had first been treated with sodium carbonate solution by extraction with chloroform and the subsequent treatment of the concentrated chloroform solution with acid. The acid solution, after being made alkaline, yielded 2.6 g of total alkaloids (1.3% on the mass of dry raw material). By column chromatography on alumina with elution by hexane–ether a base (I) (157 mg) was obtained with mp 199-201°C (acetone), composition $C_{34}H_{47}NO_{11}$, M^+ 645, and base (II) (182 mg) and mp 115-117°C (acetone), composition $C_{23}H_{37}NO_5$, M^+ 407. Analysis of the ^1H and ^{13}C NMR spectra of these alkaloids ($CDCl_3$, Bruker WM, 400 and 100.61 MHz, respectively) showed that they were close to those published for aconitine and isotalatisidine [4]. A direct comparison with authentic specimens showed the identity of (I) with aconitine and of (II) with isotalatisidine [5] (mixed melting points, TLC, and IR spectra). This is the first time that either alkaloid has been isolated from this plant.

In a similar way to that described above, the air-dry rhizomes with roots of Delphinium elatum (966 g), gathered in the period of complete withering of the epigeal part of the plant, yielded 1.68 g of alkaloids from the acid solution and 22.43 g from the alkaline solution. The total amount of alkaloids was 2.5% of the mass of the dry raw material.

The chromatographic separation of the weakly basic fraction gave an amorphous base (III) (yield 0.5 g) the perchlorate of which had mp 215-219°C (from ethanol).

From the total basic alkaloids (22.43 g) was obtained a crystalline perchlorate with mp 215-219°C (ethanol) identical with the perchlorate of base (III). Its yield was 22 g.

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Base (III) had the composition $C_{38}H_{50}N_2O_{11}$ (HRMS) and, according to its IR spectrum, contained hydroxy (3470 cm^{-1}) and carbonyl (1730 cm^{-1}) groups and an aromatic ring (1500-1460 cm^{-1}). The PMR spectrum of (III) ($CDCl_3$, Tesla-567, 100 MHz, δ, ppm) contained signals at 1.00 (3H, t, J = 7 Hz, $N-CH_2-\underline{CH_3}$); 1.39 (3H, d, J = 7 Hz, methylsuccinimide fragment); 2.00 (3H, s, OAc); 3.28, 3.25, 3.17 (s, 3H each, 3 × OCH_3); 4.01 (s, 2H-18); 4.65 (t, J = 5 Hz, H-14β); 3.75 (2H, unresolved signal, H-6α and H-1β). Mass spectrum (m/z, %): M^+ 710 (4), $M^+ - 15$ (11), $M^+ - 31$ (100), 216 (35). The facts given correspond to the formula of nudicauline [6].

The absence of an authentic specimen of nudicauline and the complexity of its identification on the basis of the physicochemical constants given above and literature information [6] provided grounds for continuing work on its identification.

On saponifying (III) with methanolic caustic soda we obtained an amino alcohol with mp 168-171°C (acetone–ether) identical with a sample of delectinine [7] (mixed melting point, TLC, and PMR and mass spectra). The structure of the base isolated was also confirmed by the results of a comparison of its ^{13}C NMR spectrum with that published for nudicauline [6].

The rhizomes with roots of Delphinium elatum gathered in the incipient vegetation phase at the same growth site contained 2.24% of a mixture of bases, the main one again being nudicauline.

This substance has previously been isolated from the seeds of Delphinium elatum, but in very small amounts [8].

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