CHEMISTRY

L. S. SMIRNOVA, Kh. A. ABDUAZIMOV, Corresponding Member of the Academy of Sciences of the USSR S. Yu. YUNUSOV

1964

SovietRxiv

Abstract

Full Text

CHEMISTRY

L. S. SMIRNOVA, Kh. A. ABDUAZIMOV, Corresponding Member of the Academy of Sciences of the USSR S. Yu. YUNUSOV

ON THE ALKALOIDS OF *UNGERNIA SEVERTZOVII*

THE STRUCTURE OF UNSEVINE

Continuing the study of alkaloids of *U. Severtzovii* from various places of growth, we isolated and characterized 9 alkaloids from different organs of the plant.

From the leaves of *U. Severtzovii* collected in Karzhantau, in addition to the previously obtained lycorine, pancratine, and galanthamine ([1]), another 6 alkaloids were isolated, using the different solubilities of the alkaloids themselves in organic solvents, the preparation of their salts, and separation on a column packed with aluminum oxide. One of these alkaloids, with m.p. 213-214°, characterized in the form of the hydrobromide (m.p. 266-267°) and nitrate (m.p. 269-270°), did not give a depression of the melting point with hippeastrine, kindly provided to us by Dr. W. Döpke ([2]).

The second alkaloid, with m.p. 206-208° (with decomposition), proved identical with ungminorine, isolated from the leaves of *U. minor* ([3]). The third alkaloid, with m.p. 210-211°, is identical with tazettine, previously isolated from this same plant ([4]); the fourth—an optically inactive alkaloid with m.p. 186-187°—is isolated when the nonphenolic portion of the ether sum of alkaloids is treated with acetone. Elemental analysis of the base itself, its nitrate (m.p. 245-246°) and picrate (m.p. 241-243°), and determination of the equivalent weight by titration lead to the empirical formula $C_{17}H_{19}O_3N$. The nitrogen of the alkaloid is tertiary, since upon addition of methyl iodide to a solution of the alkaloid in methanol, the methiodide immediately precipitates. In the IR spectrum there is an absorption band at 1685 cm^{-1}, characteristic of a carbonyl group; analysis of functional groups revealed methoxyl and methylimide groups. The third oxygen atom is indifferent. The alkaloid is unsaturated and is hydrogenated with hydrogen over platinum. On the basis of the data presented, we propose the following expanded formula for this alkaloid

$$C_{14}H_{13}(=N-CH_3)(OCH_3)(>C=O)(-O-)(=).$$

In composition, expanded formula, and melting point, the alkaloid is similar to the known alkaloid narwedine ([5]), but differs from it by the absence of optical

activity and by the high melting point of the salts and derivatives. This suggested to us that the alkaloid might be the racemate of narwedine. To test this assumption, 0.3 g of the alkaloid was reduced with lithium aluminum hydride. After six hours of heating, the reaction mixture was treated with water and the ether layer was separated; after drying and concentrating it to a small volume, racemic galanthamine precipitated, with m.p. 228-230°, $[\alpha]_D \pm 0^\circ$, which does not give a depression of the melting point with levorotatory galanthamine isolated from *U. Victoris* ([6]).

After separation of the racemic galanthamine, the ether solution was evaporated to dryness and treated with acetone. From the portion dissolved in acetone, an alkaloid was obtained with m.p. 125-126°, $[\alpha]_D^{16} - 116.6^\circ$ (ethanol), which also does not give a depression of the melting point with levorotatory galanthamine.

Consequently, the alkaloid we isolated is racemic narwedine. It is possible that optically active narwedine racemizes in the pro-

···during the extraction process. To isolate optically active narwedine, special extractions were carried out.

I. Fresh leaves were moistened with ammonia and covered with chloroform. Three cold drainings were made, which were treated in the usual way ([1]). The narwedine obtained from the ether fraction has $[\alpha]_D + 310^\circ$ (chloroform).

II. Dry leaves were moistened with ammonia and covered with ether. The cold ether drainings were treated in the usual way. On concentration of the ether fraction, narwedine separated out, having $[\alpha]_D - 34.7^\circ$ (chloroform), and from the mother liquors of the same fraction (after isolation of galanthamine hydrobromide) dextrorotatory narwedine was isolated by chromatography on alumina.

Levorotatory narwedine has a melting point of 184-185°. Its iodomethylate (m.p. 201°) and picrate (m.p. 187-188°) were obtained. Until now levorotatory narwedine had been obtained only by oxidation of galanthamine; we have isolated it from the plant for the first time.

Continuing the study of *U. Severtzovii* from Brich-Mulla, from the roots of this plant, in addition to lycorine, tazettine, and ungeridine ([4]), we isolated an alkaloid with m.p. 173-174°—unsevine—previously isolated from the bulbs of the same plant ([3]). A thorough study of ungeridine showed that it is not an individual alkaloid, but a mixture of tazettine, ungerine, and hippeastrine. In terms of content, tazettine predominates in it.

Table 1

Place of collection	Date of collection	Part of plant	Sum of alkaloids, %	Alkaloids isolated	Content relative to dry plant, %
Karzhantau	10 IV 1961	Leaves	0.81	Lycorine	0.46
Karzhantau	10 IV 1961	Leaves	0.81	Pancratine	0.12
Karzhantau	10 IV 1961	Leaves	0.81	Galanthamine	0.01
Karzhantau	10 IV 1961	Leaves	0.81	*d, l*-Narwedine	0.003
Karzhantau	10 IV 1961	Leaves	0.81	Hippeastrine	0.0008
Karzhantau	10 IV 1961	Leaves	0.81	Ungminorine	0.0005
Karzhantau	10 IV 1961	Leaves	0.81	Tazettine	0.0001
Karzhantau	10 IV 1961	Leaves	0.81	*d*-Narwedine	0.002
Karzhantau	10 IV 1961	Leaves	0.81	*l*-Narwedine	0.01
Karzhantau	10 IV 1961	Bulbs	1.86	Lycorine	0.38
Karzhantau	10 IV 1961	Bulbs	1.86	Pancratine	0.64
Karzhantau	10 IV 1961	Bulbs	1.86	Galanthamine	0.033
Karzhantau	10 IV 1961	Bulbs	1.86	*d, l*-Narwedine	0.01
Karzhantau	10 IV 1961	Bulbs	1.86	Ungminorine	0.074
Karzhantau	23 III 1960	Roots	2.15	Lycorine	0.8
Karzhantau	23 III 1960	Roots	2.15	Pancratine	0.022
Karzhantau	23 III 1960	Roots	2.15	Ungminorine	0.48
Brich-Mulla	April 1960	Leaves	0.29	Lycorine	0.04
Brich-Mulla	April 1960	Leaves	0.29	Ungerine	0.043
Brich-Mulla	April 1960	Leaves	0.29	Tazettine	0.016
Brich-Mulla	April 1960	Leaves	0.29	Hippeastrine	0.0001

Place of collection	Date of collection	Part of plant	Sum of alkaloids, %	Alkaloids isolated	Content relative to dry plant, %
Brich-Mulla	10 VI 1961	Bulbs	0.9	Lycorine	0.15
Brich-Mulla	10 VI 1961	Bulbs	0.9	Ungerine	0.089
Brich-Mulla	10 VI 1961	Bulbs	0.9	Galanthamine	0.05
Brich-Mulla	10 VI 1961	Bulbs	0.9	Unsevine	0.025
Brich-Mulla	10 VI 1961	Bulbs	0.9	Tazettine	0.1
Brich-Mulla	10 VI 1961	Bulbs	0.9	Hippeastrine	0.0002
Brich-Mulla	April 1960	Roots	1.44	Lycorine	0.11
Brich-Mulla	April 1960	Roots	1.44	Tazettine	0.33
Brich-Mulla	April 1960	Roots	1.44	Unsevine	0.016
Brich-Mulla	April 1960	Roots	1.44	Hippeastrine	0.0001
Zarkent	10 III 1962	Bulbs	0.79	Ungminorine	0.25
Zarkent	10 III 1962	Bulbs	0.79	Lycorine	0.067
Zarkent	10 III 1962	Bulbs	0.79	Hippeastrine	0.02

Thus, the study of alkaloids of *U. Severtzovii* from various places of growth and of each organ separately showed that, depending on the place of growth, the alkaloids differ qualitatively and quantitatively (Table 1). Earlier ([7]) it was reported that a new alkaloid, unsevine, $C_{18}H_{21}NO_5$, had been isolated from bulbs of *U. Severtzovii* (from Brich-Mulla), and its expanded formula was given

$$C_{15}C_{12}\,(>N-CH_3)\,(CH_2O_2)(OCH_3)(-O-)(OH)(=).$$

To determine the nature of the oxygen bridge, we carried out reduction of unsevine with lithium aluminum hydride. The resulting dihydrounsevine (II), m.p. 154–155°, of composition $C_{18}H_{23}NO_5$, has two hydroxyls. A diol could be formed only if the ether bridge is part either of a hemiacetal group or of a δ-lactone ring. A simple ether linkage is, as a rule, not reduced by lithium alu-

Reaction scheme: structural formulas (II), (I), and (III) with arrows between them.

Figure 1: Reaction scheme: structural formulas (II), (I), and (III) with arrows between them.

minum hydride. A δ-lactone ring is absent in unsevine; consequently, there is possibly present a hemiacetal grouping

$$\begin{array}{c} OH \\ -O-CH- \end{array}$$

Alkaloids with a hemiacetal grouping give diols on reduction with lithium aluminum hydride, and upon catalytic hydrogenation both the double bond and the hemiacetal group are simultaneously reduced ([8]). This is exactly how unsevine behaves ([7]).

Dihydrounsevine proved to be identical with tetrahydroungerine, obtained by reduction of ungerine with lithium aluminum hydride ([10]).

Both diols give no depression of the melting point, and their IR spectra coincide completely. Tetrahydrounsevine also proved to be identical with hexahydroungerine, obtained by reduction of tetrahydroungerine with hydrogen over platinum. Consequently, unsevine differs from ungerine only in that, instead of the δ-lactone ring, it contains a hemiacetal group. To confirm this, oxidation of unsevine with chromic acid by two oxygen atoms was carried out. As a result of the reaction oxounsevine $C_{18}H_{19}NO_5$ (III), m.p. 132–133°, $[\alpha]_D + 101°$ (chloroform), was obtained; it gave no depression of the melting point with ungerine (III). The IR spectra of oxounsevine and ungerine are completely identical. Ungerine has structural formula II ([9], [10]), unsevine–formula I.

The conversion of unsevine into ungerine and into dihydrounsevine can be represented by the scheme:

Institute of the Chemistry of Plant Substances
Academy of Sciences of the Uzbek SSR

Received
16 VII 1963

CITED LITERATURE

[1] L. S. Smirnova, Kh. A. Abduazimov, S. Yu. Yunusov, Dokl. AN UzSSR, No. 7, 34 (1961).
[2] H. G. Boit, Ber., **89**, 1129 (1956).
[3] M. Normatov, Kh. A. Abduazimov, S. Yu. Yunusov, Dokl. AN UzSSR, No. 9, 25 (1961).
[4] S. Yu. Yunusov, Kh. A. Abduazimov, Dokl. AN UzSSR, No. 6, 44 (1953).

[5] H. G. Boit, W. Döpke, A. Beitner, Ber., **90**, 2197 (195).
[6] S. Yu. Yunusov, Kh. A. Abduazimov, ZhOKh, **27**, 3357 (1957).
[7] Kh. A. Abduazimov, L. S. Smirnova, S. Yu. Yunusov, Dokl. AN UzSSR, No. 7, 19 (1963).
[8] H. G. Boit, Ergebnisse der Alkaloid-Chemie bis, 1960, Berlin, 1961.
[9] N. F. Proskurnina, ZhOKh, **33**, 5, 1686 (1963).
[10] Kh. A. Abduazimov, S. Yu. Yunusov, DAN, **153**, No. 6 (1963).

Note: Figure translations are in progress. See original paper for figures.