UDC 547.944/945

A STUDY OF THE ALKALOIDS OF LEONTICE ALBERTII

D. Dzh. Kamalitdinov, S. Iskandarov, and S. Yu. Yunusov

Khimiya Prirodnykh Soedinenii, Vol. 5, No. 5, pp. 409–412, 1969

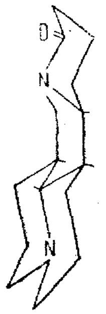
A comparative study of the alkaloids of L. Albertii Rgl. from various growth sites has shown that the quantitative composition of the combined alkaloids changes.

When the mixture of bases obtained from the epigeal part of L. Albertii (collected in the flowering stage in the Fergana region) was separated according to the solubility of their salts, N-methylcytisine and thaspine were isolated, the amount being far greater than in the combined alkaloids studied previously [1, 2].

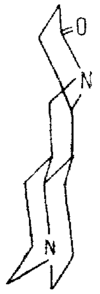
Chromatography of the mother liquor of the total alkaloids on silica gel gave four alkaloids of two types: anabasine, matrine, leontine, and leontalbinine. The individual fractions were separated according to their basicities, as a result of which a base similar to sophoridine (differing by the sign of the rotation) was obtained [3].

A comparison of the physicochemical properties of sophoridine and sophoridane with the properties of the base and its oxygen-free derivative showed that the alkaloid is the dextrorotatory enantiomer of sophoridine [4].

A. I. Begisheva, Kh. A. Aslanov, and A. S. Sadykov have proposed a new spatial structure (I) for sophoridine [5]. However, the experimental results obtained by N. G. Proskurnina and F. Rul'ko [6, 7] and by ourselves do not agree with formula I.



II



I

On dehydrogenation, sophoridine—like matrine and leontine, the C/D rings of which have a trans linkage—forms 5-hydroxy-6, 7-dehydromatrine. We have established that the lactam-containing part of the molecule does not take part in this reaction, since on dehydrogenation with the same conditions 17-oxo-sparteine is converted only into 17-oxo-5, 6-dehydrosparteine. On catalytic hydrogenation in glacial acetic acid at 60–80° C, sophoridine forms isosophoridine the A/B rings of which have a cis linkage. The IR spectrum of the desoxo compound exhibits a trans band, which shows the trans linkage of the C/D rings.

It has been found experimentally that in the isomerization of both matrine and allomatrine. which takes place only in acid medium, the dominating role is played by the basic property of the nitrogen atom, and $N_{(16)}$, which is incapable of forming a salt, does not take part in this reaction. To confirm, this, we attempted to hydrogenate 17-oxo-sparteine under the conditions for the isomerization of matrine and obtained the initial base in 100% yield.

A comparison of the rates of dehydrogenation of sophoridine, matrine, and leontine has shown that the spatial structure of sophoridine is close to that of leontine, i. e., the number of cis hydrogens at $C_{(5)}$—$C_{(7)}$ is smaller than in matrine. Consequently, sophoridine corresponds to the spatial structure II with trans A/B, B/C, A/C, and C/D ring linkages.

Structure II is also confirmed by the results of saponification and benzoylation, and the back-cyclization of the hydrochloride of N-benzoylsophoridinic acid into sophoridine.

If all the facts mentioned above and literature data on the mechanism of dehydrogenation, isomerization by the fusion of salts, and hydrogenation are taken into account, the proposed isomerization mechanisms [8] are not substantiated and have been treated incorrectly, since the nitrogen in the lactam grouping is unreactive, which was not taken into account in [8].

From the matrine mother liquor a new base with mp 70° C and the composition $C_{15}H_{24}N_2O_2$, which we have called albertidine, was isolated in the form of the perchlorate. It is an optically active ditertiary monoacid base forming a monoperchlorate with mp 254° C.

Its IR spectrum has the absorption bands of a trans-quinolizidine system (2700–2800 cm^{-1}) and of the carbonyl of a six-membered lactam (1640 cm^{-1}). The nature of the absorption in the "fingerprint" region is close to that of alkaloids of the matrine series.

The mass spectrum of albertidine has the peaks of ion similar to those from matrine, but some of them differ in intensity [9]. The maximum peaks in the spectra are those of the ion with m/e 96 and, especially, those formed in the further decomposition of this ion.

The intensity of the peaks of ions with m/e 205 (M – 43) and 150 (M – 98) are relatively low, which is probably due to the different A/C and B/C ring linkages.

Thus, albertidine is a new spatial isomer of matrine.

Experimental

The epigeal part of L. Albertii Rgl. (4.5 kg) was extracted with chloroform. Thaspine with mp 370° C (decomp.) (7 g) was isolated from the concentrated extract in the form of the sulfate. The acid mother liquor was made alkaline and extracted with ether (52.6 g) and chloroform (18 g), these amounts extracted being 1.75% of the weight of the dry plant.

Paper chromatography of the combined ethereal alkaloids: R_f 0.25, 0.52, 0.65, 0.82, and of the combined chloroform alkaloids: R_f 0.25 [M-1 paper; system 1: isobutanol–conc HCl–water (50 : 7.5 : 13.5); revealing agent: Dragendorff's reagent].

From the ethereal alkaloids a base with mp 134–135° C, R_f 0.23 (system 1) was isolated in the form of the perchlorate; it was identical with N-methyl-cytisine.

The mother liquor of the perchlorate in water was separated into a chloroform-soluble fraction (A) (R_f 0.51, 0.65, 0.82) and a chloroform-insoluble fraction (B) (R_f 0.24, 0.51, 0.65).

The chromatography of 10 g of B on silica gel with ether yielded a liquid base with bp 276° C (760 mm), $[\alpha]_D^{20}$ −52° (C 0.4; ethanol), composition $C_{10}H_{14}N_2$; perchlorate with mp 236–237° C; picrate with mp 202–203°C; R_f 0.32 [silica gel–gypsum (9 : 1); benzene–methanol (5 : 2) system]; mol. wt. 162 (mass spectrum); the base was identical with anabasine.

The methanolic fraction yielded a base with mp 102–103° C, $[\alpha]_D^{19}$ −77.5° (c 2.6; ethanol); perchlorate with mp 258° C. A mixture of the base with leontine gave no depression of the melting point.

The chromatography of 20 g of A on silica gel with chloroform yielded a base with mp 74–75° C, $[\alpha]_D^{22}$ +20° (c 0.39; ethanol); perchlorate with mp 213–214° C; hydrobromide with mp 274–275° C.

The IR spectrum coincided completely with that of matrine.

From the matrine mother liquors we obtained the base albertidine, $C_{15}H_{24}N_2O$, mp 70–71° C, $[\alpha]_D^{18}$ + 33.8° (c 0.52; ethanol), [sic] (system 1, M-1 paper). IR spectrum: 2800-2700, 1640 cm^{-1}. Mol. wt. 248 (mass spectrometrically).

Found, %: C 72.30, 72.45; H 9.65, 9.70; N 11.25, 11.15. Calculated, %: C 72.55; H 9.67; N 11.29.

5 g of A was separated into 13 fractions with respect to basicities.

The 4th to 6th fractions yielded a base with mp 108–109° C, $[\alpha]^{22}$ +59.3° (c 1.3; water) with the composition $C_{15}H_{24}N_2O$, giving a monomethiodide with mp 249–250° C (ethanol–acetone).

IR spectrum: 2800–2700, 1655 cm^{-1}.

Found, %: C 72.35, 72.40; H 9.62, 9.87; N 11.22, 11.38. Calculated, %: C 72.58; H 9.67; N 11.29.

Reduction of sophoridine with $LiAlH_4$. To 0.21 g of the base in 50 ml of absolute ether was added 0.2 g of $LiAlH_4$ in 50 ml of absolute ether, and the reaction mixture was heated for 5 hr. Then 10 ml of water was added, the ethereal layer was separated off, and the aqueous layer was extracted with ether. The combined ethereal extracts yielded an oily substance; the hydrochloride of the reaction product had mp 297–298° C (ethanol–acetone). The base isolated from the hydrochloride of the reduction product melted at 60–61° C, $[\alpha]_D^{21}$ +41° (c 0.219; ethanol); hydriodide with mp 162–164° C; methiodide with mp 168–270° C.

5-Hydroxy-6,7-dehydromatrine. To 0.6 g of the base in 30 ml of 5% CH_3COOH was added 4.8 g of cupric acetate. The mixture was heated in the water bath at 60–65° C for 1 hr. A dehydrobase with mp 184° C (from acetone), $[\alpha]_D^{20°}$ −416° (c 0.55; ethanol), was obtained.

Racemate of 5-hydroxy-6,7-dehydromatrine. To 0.049 g of 5-hydroxy-6,7-dehydromatrine in ethanol was added 0.049 g of the 5-hydroxy-6,7-dehydromatrine obtained by the dehydrogenation of matrine. The solvent was distilled off and the residue was recrystallized from acetone. The racemate melted at 162–163° C, $[\alpha]_D^{20°}$ ±0°, and the perchlorate had mp 196–198° C (ethanol).

Conclusions

1. Thaspine, N-methylcytisine, anabasine, matrine, leontine, leontalbinine, and the new alkaloids d-sophoridine and albertidine have been isolated from the epigeal part of L. Albertii Rgl.

2. A new spatial structure has been proposed for sophoridine.

REFERENCES

1. S. Yu. Yunusov and L. G. Sorokina, ZhOKh, 19, 1955, 1949.
2. S. Iskandarov, R. N. Nuriddinov, and S. Yu. Yunusov, KhPS [Chemistry of Natural Compounds] 3, 26, 1967.

3. A. P. Orechow, Ber. 66, 948, 1933.
4. D. Kamalitdinov, S. Iskandarov, and. S. Yu. Yunusov, KhPS [Chemistry of Natural Compounds], 3, 352, 1967.
5. A. I. Begisheva, Kh. A. Aslanov, and A. S. Sadykov, KhPS [Chemistry of Natural Compounds], 4, 371, 1968.
6. F. Rul'ko and N. F. Proskurnina, ZhOKh, 32, 1690, 1962.
7. F. Rul'ko, ZhOKh, 32, 1695, 1962.
8. Kh. A. Aslanov, A. S. Sadykov, V. B. Leont'ev, and A. I. Begisheva, KhPS [Chemistry of Natural Compounds], **5**, 93, 1969.
9. S. Iskandarov and S. Yu. Yunusov, KhPS [Chemistry of Natural Compounds], **4**, 106, 1968.

7 June 1968

Institute of the Chemistry of Plant Substances AS UzSSR