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The Structure of Lucidusculine and the Absolute Configuration of Songorine

Lucidusculine, $C_{24}H_{35}O_4N$, m.p. 170~171°, was first isolated from the roots of *Aconitum luciduscululm* Nakai.[1a,b)] The structural studies of this alkaloid have been carried out by Suginome and his co-workers[1c~k)] and the presence of an allyl alcohol acetate group, $-CH(OCOCH_3)-\overset{|}{C}=CH_2$, and a secondary hydroxyl group in a six-membered ring has been suggested and the latter group was proved to be spacially close to the nitrogen function, which possesses the N-ethyl group, but the carbon-nitrogen framework of lucidusculine and the position of the last hydroxyl function have remained to be determined. The present authors wish to report the result of the crystallographic study of lucidusculine hydriodide, m.p. 249~250° (*Anal.* Calcd. for $C_{24}H_{35}O_4N \cdot HI$: C, 54.44; H, 6.85; N, 2.65. Found: C, 54.23; H, 6.77; N, 2.62), which was prepared from lucidusculine perchlorate, m.p. 254° (*Anal.* Calcd. for $C_{24}H_{35}O_4N \cdot HClO_4 \cdot H_2O$: C, 55.43; H, 7.35; N, 2.69. Found: C, 55.75; H, 7.24; N, 3.01) by exchanging the anion over the iodide form of Amberlite IRA 410 resin.

Crystals of the hydriodide from aqueous methanol were *ortho*-rhombic and belonged to the space group P $2_12_12_1$. Crystal density was measured to be 1.479 g./cm³ by flotation method, which corresponded to the calculated value of 1.496 g./cm³ with four molecules in the unit cell of dimensions a=16.02 Å, b=14.31 Å, c=10.25 Å. Three-dimensional data of *h0l*-*h3l* and *hk0*-*hk6* were collected from equi-inclination Weissenberg photographs taken with copper Kα radiation and intensities were estimated visually. The usual correction factors were then applied and 1803 independent structure amplitudes were derived. The co-ordinates of the iodine atoms were determined from the sections of the three-dimensional sharpened Patterson functions and the solution of the structure was achieved by Fourier and difference Fourier syntheses, followed by the least-squares refinement, which gave R=0.133 for the observed reflections. The absolute configuration of the molecule was determined by Bijvoet's anomalous dispersion method,[2)] using 40 pairs of reflections. A view of the stereoconfiguration of the molecule is shown in Fig. 1, and in this way, the structure of lucidusculine (I) was settled on firm basis as a diterpene alkaloid possessing the (−)-kaurene (II) carbon skeleton.

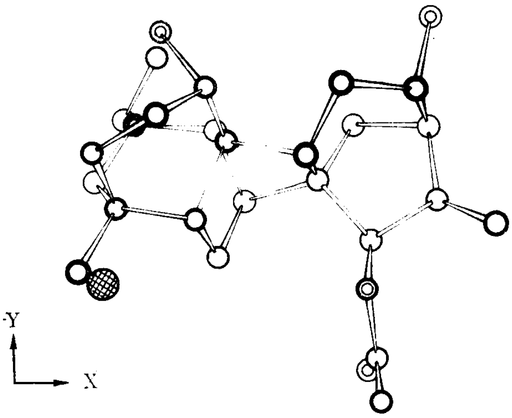

Fig. 1. A View of Lucidusculine Hydriodide along the c Axis

○ carbon ◎ nitrogen

◎ oxygen ▨ iodine

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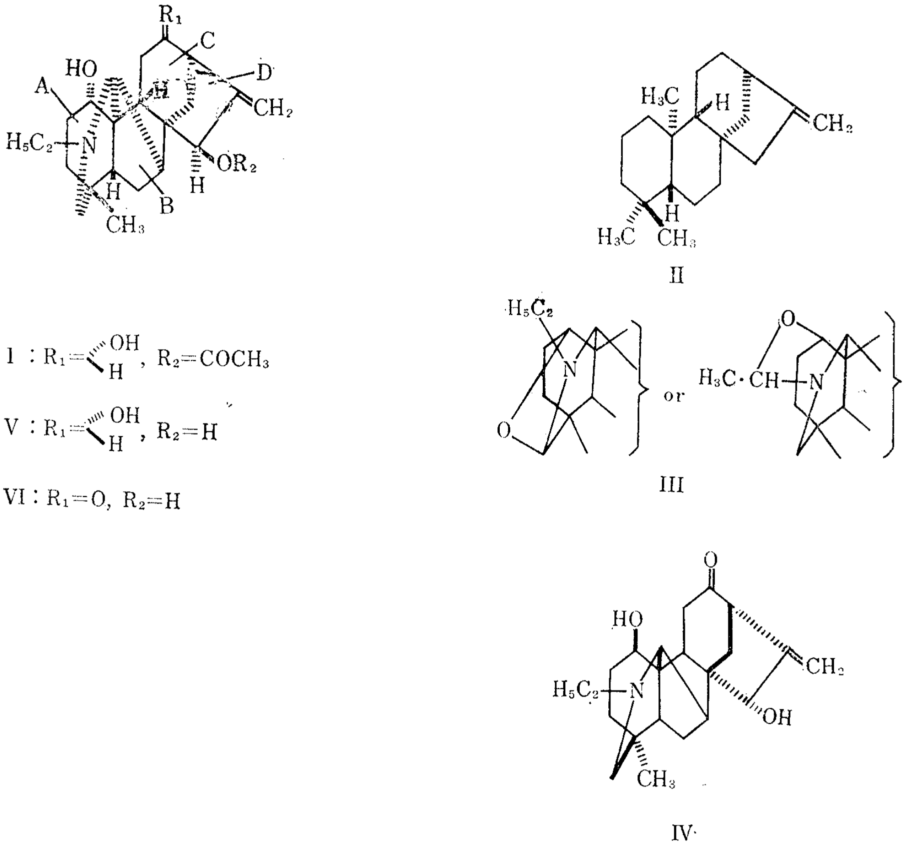

Chart 1.

In the crystalline state of lucidusculine hydriodide, the six-membered ring containing the nitrogen function is of a chair form, whereas both A and C rings have the boat conformation; and the hydroxyl group in the ring C is of an equatorial orientation. On the other hand, the hydroxyl group in the ring A is axially oriented from the boat ring and this fact, though at the particular case of crystals, is consistent with the ready formation of a carbinolamine ether (III)[1h] either by oxidation of I with N-bromosuccinimide or by the rearrangement of I N-oxide with potassium chromate.

Some time ago, the structure of an aconite alkaloid, songorine was intensively investigated by Canadian, Japanese and Russian groups[3] and finally Sugasawa has proposed the structural formula (IV) or its antipode for songorine. On the purpose of establishment of its absolute configuration, songorine was reduced with lithium aluminum hydride to furnish a crystalline product,[*1] m.p. 117~118.5°, $[\alpha]_D^{21}$ $-13°$ (methanol) (*Anal.* Calcd. for $C_{22}H_{33}O_3N \cdot H_2O$: C, 69.99; H, 9.35; N, 3.71. Found : C, 69.98; H, 9.20; N, 3.89). It was identified with luciculine (V), $C_{22}H_{33}O_3N \cdot H_2O$, m.p. 116~117°, $[\alpha]_D^{28}$ $-13°$ (methanol) (*Anal.* Found : C, 70.13; H, 9.42; N, 3.75), an alkamine of lucidusculine, by admixture and comparison of infrared absorption spectra, and therefore the structure of songorine was confirmed to be VI.

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[*1] Wiesner and his co-workers have reported[3a)] the isolation of napelline from "amorphous aconitine" and described that the reduction of songorine with lithium aluminum hydride gave napelline. Identity of luciculine with napelline is highly probable, but their direct comparison has not been carried out.

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