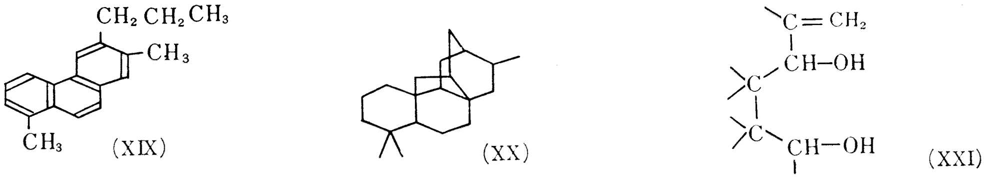
goup $\overset{|}{\underset{|}{N}}-\overset{|}{\underset{|}{C}}-OH$, whose hydroxyl group is spacially close to the angular methyl group and the alkaloid has also the allyl alcoholic group with one more hydroxyl group as illustrated in a partial structure (XXI), the structure of pseudokobusine is represented either by (Ia) or (Ib).



(XIX) (XX) (XXI)

Chart 4.

The author expresses his deep gratitude to Prof. Emeritus E. Ochiai and Prof. T. Okamoto for their helpful suggestions and he is also indebted to Mr. Y. Kawazoe for his nuclear magnetic resonance measurement and discussions. Thanks are due to Dr. K. Nukada, Goverment Chemical Industrial Research Institute, Tokyo and Mr. N. Hayakawa, Japan Institute for Atomic Energy for the use of nuclear magnetic resonance spectrometers and the members of the Analysis Center of this Faculty for elementary analyses and spectral measurements.

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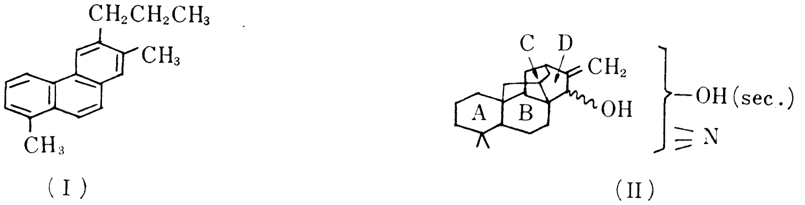
Structural Correlation of Kobusine to Pseudokobusine

In the previous paper[1] concerning the structural study of an aconite alkaloid, kobusine,*[1] $C_{20}H_{27}O_2N$, it was reported that all oxygen functions of kobusine are secondary hydroxyl groups which are located on six-membered rings and one of the two hydroxyl groups consists of an allyl alcoholic grouping of the type $H_2C=\overset{|}{C}-\overset{|}{\underset{|}{C}}-OH$. Selenium dehydrogenation reaction of kobusine was carried out[2] and 1,7-dimethyl-6-propylphenanthrene (I) was isolated from the neutral portion of the degradation mixture. On



(I) (II)

Chart 1.

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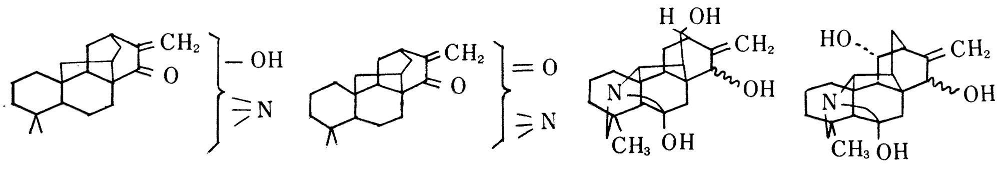
*[1] Kobusine is obtained from aconite roots in Hokkaido, which is assumed to be *Aconitum yesoensis* NAKAI.

[1] T. Okamoto: This Bulletin, **7**, 44 (1959).

[2] M. Natsume: *Ibid.*, **7**, 539 (1959).

these bases, a partial structure (II) has been considered for kobusine.

Oxidation of kobusine (II) with chromium trioxide-pyridine complex proceeds with the formation of two oxidation products, viz. kobusinone (III) and ketokobusinone (IV).[1] The ultraviolet absorption spectrum of the former product (III) exhibits the expected maxima at 225 mμ (ε 9000) and 330 mμ (ε 25), whereas the latter (IV) shows maxima at 218 mμ and 307 mμ with intensities of ε 7800 and ε 270 respectively. Thus the α,β-unsaturated ketone system of ketokobusinone (IV) was in the influence of the newly formed ketone group,[3] and therefore the location of the secondary hydroxyl group in question is limited to be at ring C in the partial structure (II) of kobusine.



(III) (IV) (Va) (Vb)

Chart 2.

In the preceding report,[4] one of the present authors has proposed the structure of pseudokobusine (either Va or Vb). One of three hydroxyl groups is located at ring C and this is evidenced by a series of chemical reactions. Consequently, the correlation of kobusine to pseudokobusine was planned so as to establish the structure of kobusine and it has been achieved as follows.

Pseudokobusine (V), m.p. 271~272°(decomp.) (*Anal.* Calcd. for $C_{20}H_{27}O_3N$: C, 72.92; H, 8.26; N, 4.25. Found : C, 73.11; H, 8.49; N, 4.21) was transformed to ketodihydropseudokobusinone (VI), m.p. 268~269°(decomp.) (*Anal.* Calcd. for $C_{20}H_{25}O_3N$: C, 73.36; H, 7.70; N, 4.28. Found : C, 73.60; H, 7.53; N, 4.42) via two steps and (VI) was treated with methane sulfonyl chloride in pyridine at room temperature to result a neutral compound (VII), m.p. 194~196° (from AcOEt) (*Anal.* Calcd. for $C_{21}H_{27}O_5NS$: C, 62.20; H, 6.71. Found : C, 61.98; H, 6.74) and a basic O-methane sulfonate (VIII), m.p. 209~210.5° (from AcOEt) (*Anal.* Calcd. for $C_{21}H_{27}O_5NS$: C, 62.20; H, 6.71; N, 3.46. Found : C, 62.09; H, 6.70; N, 3.24), the formation of two compounds of these kinds being analogous to the acetylation reaction and the cyanogen bromide degradation of ketodihydropseudokobusinone (VI).[4] Yields for (VII) and (VIII) are ca. 15% and ca. 20% respectively.

Hydrogenation of the O-methane sulfonate (VIII) over Raney-Ni at 30 kg./cm^2, 110~120° for 8 hr., followed by chromatography on alumina and recrystallization from acetone afforded a sulfur-free compound, m.p. 250~250.5°, IR $\nu_{\max}^{\text{KBr}}$ 1716 cm^{-1}, in 23% yield, whose analytical data fit to (IX) (*Anal.* Calcd. for $C_{20}H_{27}O_2N$: C, 76.64; H, 8.68; N, 4.47. Found: C, 76.68; H, 8.98; N, 4.38). The infrared absorption spectrum of the hydrogenolysis product (IX) suggested that one of two ketone groups was simultaneously reduced to hydroxyl and the structure of (IX) was expressed either by (IXa) or by (IXb). The derivative (IX) was oxidized to a diketone compound by means of chromium trioxide in pyridine, followed by mild alkaline treatment to stabilize the methyl group neighbored to

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[3] The similar kind of unusual phenomena in ultraviolet absorption spectra was observed in an aconite alkaloid, songorine and its derivatives. T. Sugasawa : *Ibid.*, **4**, 6 (1956); **9**, 889, 897 (1961). K. Wiesner, Z. Valenta, J.F. King, R.K. Maudgal, L.G. Humber, S. Itô : Chem. & Ind. (London), **1957**, 173. See also R.S. Cookson, N.S. Wariyar : J. Chem. Soc., **1956**, 2302; **1961**, 1224; S.F. Mason : Quart. Rev., **15**, 287 (1961); R.B. Woodward, E.G. Kovach : J. Am. Chem. Soc., **72**, 1009 (1950).

[4] M. Natsume : This Bulletin, **10**, 879 (1962).

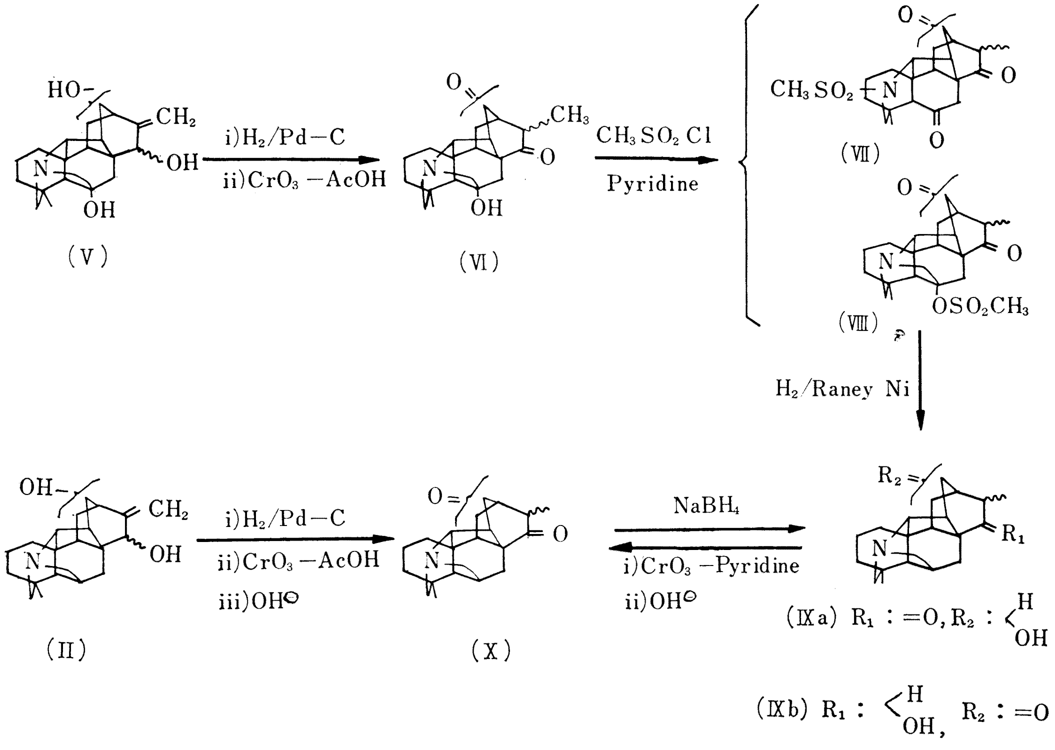
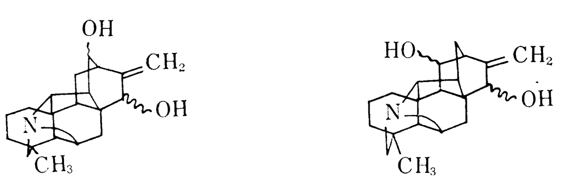


Chart 3.

one of the ketones. The diketone compound, m.p. 177~180° (from acetone-hexane) (*Anal.* Calcd. for $C_{20}H_{25}O_2N$: C, 77.13; H, 8.09. Found : C, 76.76; H, 8.25) thus obtained was proved to be identical with ketodihydrokobusinone (X), m.p. 177~179° (from acetone-hexane) (*Anal.* Calcd. for $C_{20}H_{25}O_2N$: C, 77.13; H, 8.09; N, 4.50. Found : C, 77.26; H, 8.21; N, 4.89) derived from kobusine (II), m.p. 263.5° (*Anal.* Calcd. for $C_{20}H_{27}O_2N$: C, 76.64; H, 8.68; N, 4.47. Found : C, 76.64; H, 8.54; N, 4.54) by mixed melting point determination and by comparison of infrared absorption spectra of both diketones.

Ketodihydrokobusinone (X) originated from kobusine was treated with sodium borohydride at room temperature for 19 hr. in methanol. The reduction product was purified by repeated chromatographies on alumina and a compound which melted at 250~250.5° (from acetone) was obtained. Its elemental analysis fit to $C_{20}H_{27}O_2N$ (*Anal.* Calcd. : C, 76.64; H, 8.68. Found : C, 76.35; H, 8.73) and identity of this sample with the monoketone compound (IX) of the pseudokobusine series was confirmed by both admixture and their superim posible infrared absorption spectra.



(IIa) (IIb)

Chart 4.

Thus, it could be rigorously established that kobusine and pseudokobusine possess the same fundamental carbon-nitrogen structure and two secondary hydroxyl groups of kobusine are located at the same positions as those of pseudokobusine. The structure of kobusine, therefore, is proved to be either (IIa) or (IIb).

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