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The Alkaloid Constituents of *Euchresta japonica* and the Stereochemical Assignment of Two Isomeric Sophoridine N-Oxides[1]

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Nine known lupin alkaloids, (+)-matrine, (+)-matrine N-oxide, (+)-sophoranol, (+)-sophoranol N-oxide, (−)-sophoridine (**1**), (−)-cytisine, (−)-N-methylcytisine, (−)-N-formylcytisine, (−)-baptifoline, and (−)-sophoridine N-oxide (**2a**), were isolated from the aerial parts of *Euchresta japonica* Benth., in addition to two alkaloids, (+)-5,17-dehydromatrine N-oxide and (−)-12-cytisineacetic acid, reported previously. **2a** was one of the two diastereoisomeric sophoridine N-oxides with different configurations of N-oxide nitrogen.

Seasonal variations of the alkaloid contents in the aerial and ground parts of *E. japonica* were also examined.

The N-oxidation of sophoridine with *m*-chloroperbenzoic acid gave two N-oxides in a ratio of *ca.* 1 : 5. The minor N-oxide was identical with **2a**. The major N-oxide (**2b**) was characterized as the other diastereomer of sophoridine N-oxide by MS spectroscopy and deoxygenation to sophoridine. The stereochemical assignments of the two isomers were carried out by analysis of their ^{1}H- and ^{13}C-NMR spectra.

Keywords——leguminosae; *Euchresta japonica*; lupin alkaloid; sophoridine; sophoridine N-oxide; seasonal variations of lupin alkaloids; N-oxidation of sophoridine; diastereoisomers of sophoridine N-oxide; alkaloid; ^{13}C-NMR

Euchresta japonica Benth. (leguminosae; Japanese name, Miyamatobera) is an evergreen and perennial shrub occurring in shady and humid places in the southern region of Japan. The roots have been used as a substitute for a Chinese drug, Shau-dou-gen (山豆根), and occasionally as an indigenous crude drug in folk remedies for neuralgic conditions and as a tonic. Previous studies on lupin alkaloids of the roots showed the presence of matrine, matrine N-oxide and cytisine.[3,4]

Recently, we reported the isolation of two alkaloids, (+)-5,17-dehydromatrine N-oxide[5] and (−)-12-cytisineacetic acid,[6] as new minor constituents in the aerial parts of *E. japonica*. Further examination of the lupin alkaloids resulted in the isolation of nine known alkaloids and one of the two diastereoisomeric N-oxides (**2a**) of (−)-sophoridine (**1**), which was different from the major product (**2b**) of N-oxidation of (−)-sophoridine. The above constituents were also detected chromatographically in the roots of this plant. The present paper describes the isolation of lupin alkaloids from *E. japonica*, together with variations of alkaloid contents at various stages of the plant growth, as well as the stereochemical assignment of two diastereoisomeric sophoridine N-oxides.

Variations of Alkaloid Constituents during the Plant Development.

The alkaloid fraction obtained from the aerial parts of *E. japonica*, collected in Kagoshima

1) A part of this work was presented at the 24th Meeting of the Japanese Society of Pharmacognosy at Tokyo, Sept. 30, 1977.
2) Location: *a) Ebara 2-4-41, Shinagawa-ku, Tokyo, 142, Japan*; *b) Yayoi-cho, 1-33, Chiba, 260, Japan.*
3) S. Shibata and Y. Nishikawa, *J. Pharm. Soc. Japan*, **81**, 1635 (1961).
4) B. Fujita, presented at the 50th Annual Meeting of the Pharmaceutical Society of Japan, 1930.
5) S. Ohmiya, H. Otomasu, J. Haginiwa, and I. Murakoshi, *Phytochemistry*, **17**, 2021 (1978).
6) S. Ohmiya, H. Otomasu, J. Haginiwa, and I. Murakoshi, *Phytochemistry*, **18**, 649 (1979).

Table I. Physical Constants and Chromatographic Properties of the Alkaloids isolated from *Euchresta japonica*

Alkaloids	mp(°C)	$[\alpha]_D^{\circ}$	*Rf* values on TLC				t_R (min) on HPLC		
			I	II	III	IV†	V	VI	VII†
(+)-Matrine	76	+40.3[a]	0.80	—	0.81	0.83	6.0	—	—
(+)-Matrine N-oxide	206	+46.5[a]	0.16	0.41	0.11	0.30	—	—	20.2
(+)-Sophoranol	171	+31.4[a]	0.67	—	0.69	0.56	7.7	—	—
(+)-Sophoranol N-oxide	261	+38.1[a]	0.07	0.21	0.11	0.16	—	—	35.8
(−)-Sophoridine (**1**)	109	−61.6[a]	0.55	—	0.16	0.76	—	30.2	—
(−)-Sophoridine N-oxide (**2a**)	—	−5.6[a]	0.12	0.30	0.11	0.22	—	—	26.8
(+)-5,17-Dehydromatrine N-oxide	—	+209.3[a]	0.12	0.35	0.11	0.26	—	—	23.0
(−)-Cytisine	155	−116.7[b]	0.30	—	0.16	—	47.0	—	—
(−)-N-Methylcytisine	137	−223.4[b]	0.71	—	0.60	0.64	10.2	—	—
(−)-N-Formylcytisine	172	−232.6[a]	0.42	—	0.57	0.27	36.0	—	—
(−)-12-Cytisineacetic acid methyl ester	109	−174.2[a]	0.86	—	0.87	—	6.0	—	—
(−)-Baptifoline	210	−137.2[a]	0.19	—	0.23	0.24	24.3	—	—

a) EtOH solution.
b) H_2O solution.
† Solvents I—VII and other solvents for TLC and HPLC are described in "Experimental" and in the following reference: S. Ohmiya *et al.*, *Phytochemistry*, **18**, 645 (1979).

prefecture in late July 1975 (flowering), was subjected to repeated chromatography on a silica gel or alumina column to yield (+)-matrine, (+)-matrine N-oxide, (+)-sophoranol, (+)-sophoranol N-oxide, (−)-sophoridine (**1**), (−)-baptifoline, (−)-cytisine, (−)-N-methylcytisine, (−)-N-formylcytisine, (+)-5,17-dehydromatrine N-oxide, (−)-12-cytisineacetic acid and one of the isomeric sophoridine N-oxides (**2a**). Table I shows the physical and chromatographic properties of the alkaloids isolated from the aerial parts of *E. japonica*.

The variations of each alkaloid content during the plant development of *E. japonica* were also examined, and the results obtained are shown in Fig. 1.

The Stereostructures of Sophoridine N-Oxides

Sophoridine N-oxide (**2a**, $C_{15}H_{24}N_2O_2$) was isolated as strongly hygroscopic colorless needles, $[\alpha]_D^{28}$ −5.6° (*c*=0.14, EtOH). Its infrared (IR) spectrum showed a lactam C=O absorption at 1625 cm^{-1}. The mass (MS) spectrum (70 eV) of **2a** showed a weak parent peak at *m/e* 264 (7%) and fragment ions at *m/e* 248 (67), 247 (98) and 246 (100) due to M^+-O, M^+-OH and M^+-H_2O, respectively, characteristic of aliphatic amine N-oxides.[5,7,8] **2a** was deoxygenated by treatment with H_2SO_3 or by catalytic hydrogenation (Pd-C in MeOH) to give (−)-sophoridine (**1**) as a major product.

The N-oxidation of **1** with *m*-chloroperbenzoic acid in CH_2Cl_2 afforded two N-oxides in a ratio of approximately 1:5. The minor product was identical with the naturally occurring sophoridine N-oxide (**2a**) (co-TLC, co-HPLC and MS). The major product (**2b**), colorless crystals, $[\alpha]_D^{25}$ −42.9° (*c*=0.17, EtOH) gave a MS fragmentation pattern similar to that of the natural product (**2a**) and was reduced to (−)-sophoridine by catalytic hydrogenation. It is, therefore, apparent that the natural (**2a**) and the synthetical N-oxide (**2b**) were diastereoisomers of sophoridine N-oxide ascribable to different configurations of the N-oxide nitrogen.

Concerning the structure of sophoridine, Sadykov *et al.*[9] established the formula **1a** by means of a detailed study of the proton magnetic resonance (^{1}H-NMR) spectrum. Therefore, taking account of the configuration of the N-oxide nitrogen, two possible structures for

7) N. Bild and M. Hesse, *Helv. Chim. Acta*, **50**, 1885 (1967).
8) J.K. Faulkner and K.J.A. Smith, *J. Pharm. Pharmacol.*, **26**, 473 (1974).
9) F.G. Kamaev, V.B. Leontiev, Kh. A. Aslanov, Yu. A. Ustynyuk, and A.S. Sadykov, *Khim. Prir. Soedin*, **1974**, 744.

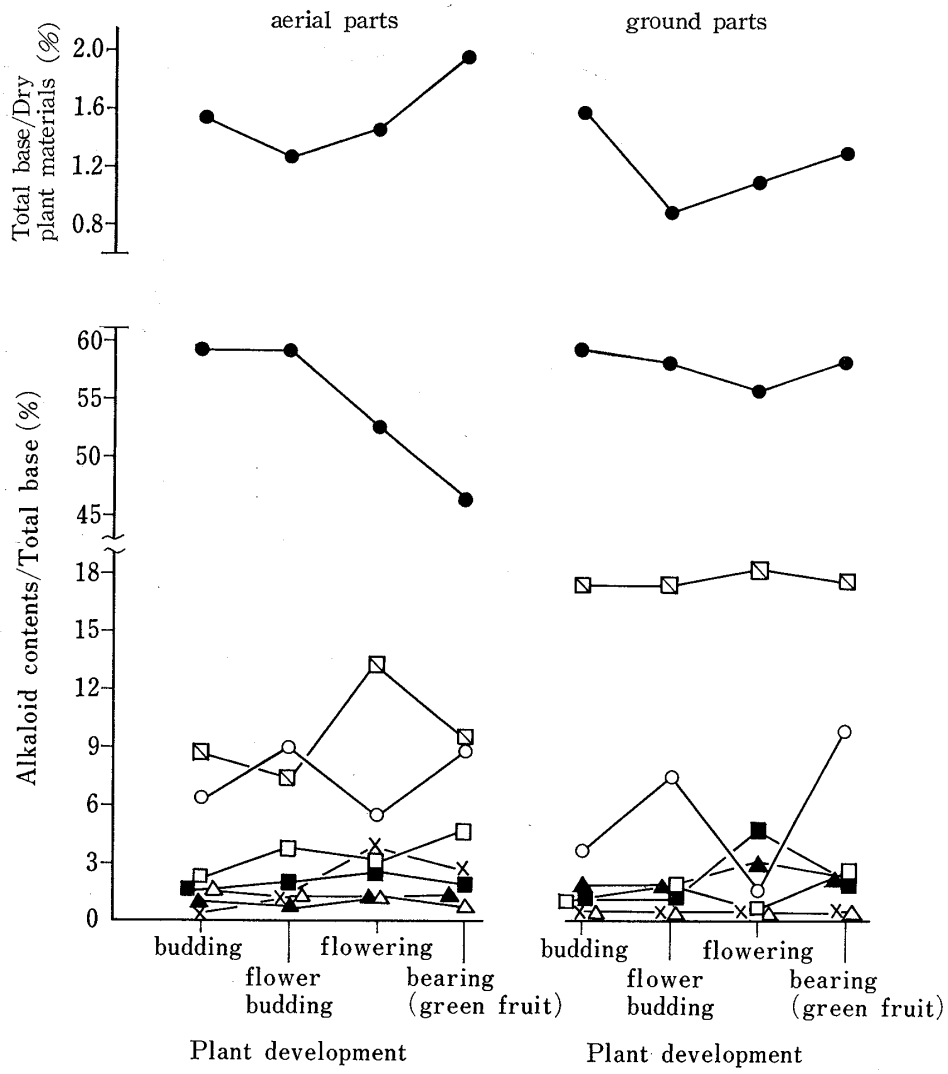


Fig. 1. Variations in Alkaloid Contents in the Aerial and Ground Parts during the Development of *Euchresta japonica*

Alkaloid contents were quantitatively estimated by high-speed liquid chromatography as described in "Experimental."
Symbols: —○— matrine, —●— matrine N-oxide, —□— sophoranol, —■— sophoranol N-oxide, —△— sophoridine, —▲— sophoridine N-oxide, —▨— cytisine, —×— N-methylcytisine.

sophoridine N-oxide are given by formulae **2a** and **2b**. The stereochemical features of the two sophoridine N-oxides **2a** and **2b** can be outlined as follows; 1) the ring junction of the quinolizidine moiety of **2a** is *trans* while that of **2b** is *cis*, 2) ring B in **2a** is boat form, 3) the amide group in **2a** is situated at the bisectional position between 17α- and 17β-H, whereas in **2b**, the dihedral angle between the amide group and 17α-H is small.[10] The stereochemical features of **2a** are very similar to those of sophoridine (**1**). As might be expected from the conformation, the chemical shifts of 17α-H and 17β-H in the ^{1}H–NMR spectrum ($CDCl_3$) of **1** were similar and their signals appeared as a 3H multiplet within the region of δ 3.2—3.6 containing the signal of 11-H.[11] The deshielding effect of the N^+-O^- bond on the ^{1}H-NMR

10) A. Ueno, K. Morinaga, S. Fukushima, Y. Iitaka, Y. Koiso, and S. Okuda, *Chem. Pharm. Bull.*, **23**, 2560 (1975); F. Bohlmann and D. Schumann, *Tetrahedron Lett.*, **1965**, 2435.
11) The signal assignment of the multiplet to 17α-H, 17β-H and 11-H was established by selective ^{1}H-decoupling ^{13}C-NMR measurement, which showed a correlation between the multiplet and the carbon signals at δ 47.5 (t) and 55.7 (d) of the 17-methylene and 11-methin carbons, respectively.

signal of the 17-methylene protons was not expected to be very great in **2a** or **2b**, because these hydrogens are distant from the N-oxide oxygen.[12] Therefore, the structural assignment of the two isomeric sophoridine N-oxides can be established by comparison of the signal patterns of the 17-methylene protons of the two N-oxides.

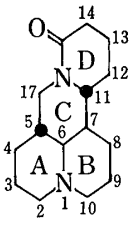
The ^{1}H-NMR spectrum ($CDCl_3$) of synthetic sophoridine N-oxide (**2b**) showed mutually coupled signals at δ 4.08 (1H, dd, J=13.5 and 7.5 Hz) and δ 3.14 (1H, dd, J=13.5 and 8 Hz) which could be assigned to the geminal protons of the 17-methylene group from the values of the chemical shifts and the coupling constants. On the other hand, the ^{1}H-NMR spectrum of the naturally occurring N-oxide (**2a**) showed no signal below δ 4.0, like that of sophoridine. These findings indicated that the structures of the natural sophoridine N-oxide and the major synthetic sophoridine N-oxide were **2a** and **2b**, respectively.

Analysis of the ^{13}C nuclear magnetic resonance (^{13}C-NMR) spectra of sophoridine and its two isomeric N-oxides provided further confirmation of the above structural assignments.

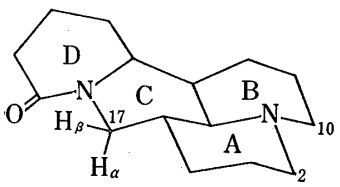
Table II. ^{13}C-NMR Data for Sophoridine (**1**) and Two Stereoisomers, naturally Occurring **2a** and Synthetic **2b**, of Sophoridine N-Oxide in $CDCl_3$[a,b]

Carbon No.	Compounds		
	1	**2a**	**2b**
2	55.8(t)	69.8(t)	71.0(t)
5	30.7(d)	29.2(d)	28.7(d)
6	63.3(d)	70.6(d)	72.6(d)
7	40.9(d)	40.3(d)	35.0(d)
10	50.2(t)	64.4(t)	58.2(t)
11	55.7(d)	55.3(d)	59.5(d)
17	47.5(t)	45.5(t)	46.7(t)

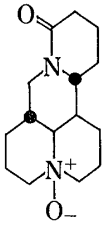
a) δ values in ppm from TMS as internal standard.
b) d=doublet, t=triplet.



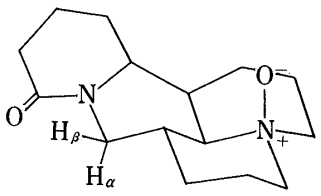
1



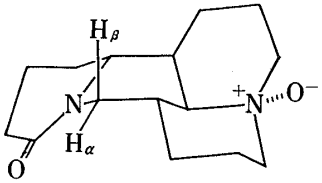
1a



2



2a



2b

Chart 1

12) K. Bachmann and W. von Phillipsborn, *Helv. Chim. Acta*, **55**, 637 (1972); G. Werner, M. Wieckmann, P. Scheiber, A. Gieren, T. Fisher, and W. Hoppe, *Liebigs Ann. Chem.*, **1976**, 617; J.D. Phillipson, S.S. Handa, and S.W. El-Dabbas, *Phytochemistry*, **15**, 1297 (1976).

The carbon shifts for C-2, 5, 6, 7, 10, 11 and 17 were assigned on the basis of data[13] previously reported for lupin and Nuphar alkaloids,[14] with the aid of the ^{1}H-off-resonance-decoupled spectra, and are listed in Table II.

The *cis* and *trans* ring fusion of quinolizidine can be distinguished by the signal positions of the two aminomethylene carbons. Namely, in *trans*-quinolizidine, the aminomethylene shifts are both at *ca.* δ 57, but in the *cis* form, one of the aminomethylene signals[13c] shows a remarkable high field shift. These observations parallel those for the *cis* and *trans* isomers of quinolizidine N-oxides, *e.g.*, nupharidine and 7-epinupharidine,[14] although their two aminomethylene carbons are somewhat deshielded by the positive nitrogen. In the ^{13}C-NMR spectrum of sophoridine, the chemical shift of C-10 on the B-ring showed a 5.6 ppm high field shift as compared with that of C-2 on the A-ring. This is considered to be due to the B-ring boat conformation.[15] The similar diamagnetic shift (5.4 ppm) of C-10 (δ 64.4) *vs.* C-2 (δ 69.8) was observed in the spectrum of the naturally occurring sophoridine N-oxide (**2a**), which suggested the *trans* configuration of the quinolizidine moiety in the molecule. On the other hand, the ^{13}C-NMR spectrum of synthetic sophoridine N-oxide (**2b**) showed a remarkable high field shift (12.8 ppm) of C-10 (δ 58.2) *vs.* C-2 (δ 71.0), suggesting the *cis* configuration of the quinolizidine moiety. Thus, it can be concluded that naturally occurring sophoridine N-oxide is represented as **2a** and the main product of synthetic sophoridine N-oxides as **2b**.

Compound (**2b**) has never been isolated from this plant source.

Experimental

Melting points were determined on a Kofler block and are uncorrected. The following equipment was used: IR spectra, Hitachi 215 grating infrared spectrometer; ^{1}H and ^{13}C-NMR spectra, JEOL-FX 100 spectrometer with tetramethylsilane (TMS) as an internal standard; optical rotation, Jasco DIP-181 polarimeter; mass spectra, JEOL JMS D-300 (high MS) and Hitachi RMS-4 (low MS) spectrometers.

TLC was performed on Si gel G (Merck) in solvents I, CH_2Cl_2–MeOH–28%NH_4OH (90: 9: 1); II, CH_2Cl_2–MeOH–28%NH_4OH (86: 12: 2); III, CH_2Cl_2–MeOH (80: 20), and on alumina in IV, C_6H_6–Me_2CO–MeOH (34: 3: 3). Analytical HPLC was carried out with solvents V, 15%MeOH·ether–2.5%NH_4OH (500: 10); VI, 15%MeOH·ether–2.5%NH_4OH (500: 12); VII, 25%MeOH·ether–H_2O–25%NH_4OH (500: 20: 15), at a flow rate of 1 ml/min, using a LiChrosorb SI-100 (10 μm, 0.3 × 50 cm) column and monitoring with an RI or UV detector. Preparative HPLC was performed with a LiChrosorb SI-100 (10 μm, 1 × 50 cm) column using solvent VI or VII and monitoring with an RI or UV detector. Column chromatography was carried on Si gel (Kiesel gel 60, 70—230 mesh, Merck) and alumina (active grade II—III, Merck). All known alkaloids except for (+)-sophoranol N-oxide were identified by comparison of IR and MS with those of authentic samples and by mixed mp and co-HPLC.

Isolation and Characterization of Alkaloids——*Euchresta japonica* was collected late in July 1975 (flowering) in Kagoshima prefecture, and divided into aerial (3 kg as dry material) and ground (6 kg as dry material) parts. The fresh plant materials were extracted five times with 75%MeOH at room temperature. The combined extracts from the aerial parts were concentrated to 5 l *in vacuo*, acidified with dil. HCl and filtered. The acid filtrate was extracted twice with ether, made strongly alkaline with K_2CO_3 until the upper layer was reversed by CH_2Cl_2 under ice-cooling, and then extracted with CH_2Cl_2 several times. The CH_2Cl_2 extracts were dried over anhyd. K_2CO_3 and evaporated to dryness to give 45 g (1.5%/dry material) of crude alkaloid fraction. From the ground parts, 66 g (1.1%/dry material) of crude alkaloid fraction was obtained by the same procedure. The above alkaloid fraction (9.5 g) from the aerial parts was applied to a silica gel column (3 × 95 cm) and eluted successively (monitoring by TLC) with the following solvents: 1, 1.5%MeOH·CH_2Cl_2–28%NH_4OH (1000: 1); 2, 3%MeOH·CH_2Cl_2–28%NH_4OH (1000: 2) (Fr 1); 3, 5%MeOH·CH_2Cl_2–28%NH_4OH (1000: 4) (divided into Frs 2 and 3 in order of elution); 4, 7%MeOH·CH_2Cl_2–28%NH_4OH (1000: 7) (divided into Frs 4 and 5 in order of elution); 5, 8%MeOH·CH_2Cl_2–28%NH_4OH (1000: 8) (divided into Frs 6, 7 and 8 in order of elution); 6, 10%MeOH·CH_2Cl_2–NH_4OH (1000: 10) (Fr 9); 7, 11%MeOH·CH_2Cl_2–28%NH_4OH (1000: 11) (Fr 10). Fr 1 was purified by Si gel column chromatography to give (−)-12-cytisineacetic

13) *a*) E. Wenkert, B. Chauncy, K.G. Dave, A.R. Jaffcoat, F.M. Schell, and H.P. Schenk, *J. Am. Chem. Soc.*, **95**, 8427 (1973); *b*) F. Bohlmann and R. Zeisberg, *Chem. Ber.*, **108**, 1043 (1975); *c*) D. Tourwé and G. van Binst, *Heterocycles*, **9**, 507 (1978).

14) R.T. LaLonde, T.N. Donvito, and A. I-M Tsai, *Canad. J. Chem.*, **53**, 1714 (1975).

15) J.D. Robert, F.J. Weigert, J.I. Kroschwitz, and H.J. Reich, *J. Am. Chem. Soc.*, **92**, 1338 (1970); J.A. Peters, J.M. van Der Toorn, and H. van Bekkum, *Tetrahedron*, **33**, 349 (1977).

acid methyl ester (45 mg), as reported previously.[6] Fr 2 (0.4 g) contained mainly (+)-matrine. Fr 3, which contained four alkaloids, was subjected to column chromatography on alumina, developing successively with C_6H_6, C_6H_6–MeOH (500: 1) and C_6H_6–MeOH (500: 2) to give (+)-matrine (75 mg), (−)-N-methylcytisine (0.3 g), (+)-sophoranol (0.25 g) and (−)-N-formylcytisine (35 mg). Fr 4 was rechromatographed on alumina using a C_6H_6–MeOH solvent system to yield (−)-sophoridine (0.10 g) and (−)-cytisine (1.26 g). The main alkaloid of Fr 5 was (−)-baptifoline (0.11 g). Fr 6 contained mainly (+)-matrine N-oxide (4.5 g). Fr 7 was subjected to prep. HPLC using solvent VII to yield (+)-matrine N-oxide (0.5 g) and (+)-5,17-dehydromatrine N-oxide (55 mg), as reported previously.[5] The main component of Fr. 8 was purified by prep. HPLC using solvent VII to give strongly hygroscopic crystals (104 mg) of (−)-sophoridine N-oxide (**2a**). Frs 9 and 10 were combined and subjected to prep. HPLC using solvent VII to give (+)-sophoranol N-oxide. (210 mg).

(−)-Sophoridine (1)——Colorless needles from *n*-hexane, mp 109°, $[\alpha]_D^{22}$ −61.6° (*c*=0.44, EtOH); IR ν_{max}^{KBr} cm^{-1}: 2800, 2750 (*trans* quinolizidine), 1620 (lactam C=O); MS (70 eV) *m/e* (%): 248 (M^+, 74%), 247 (100), 205 (35), 150 (56), 96 (78): ^{13}C-NMR ($CDCl_3$): δ 169.8 (s), 63.3 (d), 55.8 (t), 55.7 (d), 50.2 (t), 47.5 (t), 40.9 (d), 32.5 (t), 30.7 (d), 30.2 (t), 28.1 (t), 23.7 (t), 21.8 (t), 21.5 (t), 18.9 (t).

(−)-Sophoridine N-Oxide (2a)——Strongly hygroscopic needles from acetone, $[\alpha]_D^{28}$ −5.6° (*c*=0.14, EtOH); IR ν_{max}^{KBr} cm^{-1}: 1625 (lactam C=O); MS (70 eV) *m/e*: 264.1822 (M^+, Calcd for $C_{15}H_{24}N_2O_2$, 264.1837), 264 (M^+, 7%), 248 (M^+-O, 67), 247 (M^+-OH, 98), 246 (M^+-H_2O, 100), 245 (74), 150 (43), 148 (44), 134 (29), 96 (40); ^{13}C-NMR ($CDCl_3$): δ 169.6 (s), 70.6 (d), 69.8 (t), 64.4 (t), 55.3 (d), 45.5 (t), 40.3 (d), 32.4 (t), 29.2 (d), 28.0 (t), 27.9 (t), 20.4 (t), 19.3 (t), 18.4 (t), 17.9 (t).

(+)-Sophoranol N-Oxide——Colorless needles from acetone–MeOH, mp 259—261°, $[\alpha]_D^{28}$ +38.1° (*c*= 0.27, EtOH); IR ν_{max}^{KBr} cm^{-1}: 3120 (OH), 1630 (lactam C=O); MS (70 eV) *m/e* (%), 280.1752 (M^+, Calcd for $C_{15}H_{24}N_2O_3$, 280.1783), 280 (M^+, 1%), 264 (M^+-O, 32), 263 (M^+-OH, 22), 262 (M^+-H_2O, 51), 247 (57), 245 (55), 96 (53), 55 (88), and 41 (100); ^{1}H-NMR (5%CD_3OD–$CDCl_3$): δ 4.96 (1H, dt, J=10.5 and 6 Hz, 11-H), 4.28 (2H, s, 17-H_2); these data are consistent with those of synthetic sophoranol N-oxide prepared from (+)-sophoranol and *m*-chloroperbenzoic acid).

Estimation of Alkaloid Contents——The plant materials were collected in the middle of April, 1977 (budding), in late May, 1977 (flower budding), in early August, 1978 (flowering) and in late August, 1977 (green fruit bearing) in Kagoshima prefecture, and were divided into the aerial and the ground parts, which were distinguished by the presence or absence of chlorophyll.

The fresh materials were separately extracted five times with 75%MeOH at room temperature. The total base was extracted from each of the MeOH extracts by the procedure described above. The contents of individual alkaloids in the total base were estimated by HPLC using solvent VI for sophoridine (**1**), solvent V for the other tertiary and secondary alkaloids and solvent VII for N-oxides.

Deoxygenation of 2a——i) A solution of **2a** (10 mg) in MeOH was hydrogenated over 10%Pd-C at atmospheric pressure and at room temperature. The catalyst was filtered off, the filtrate was evaporated to dryness *in vacuo* and the residue was crystallized from *n*-hexane to give colorless needles (8 mg), mp 109°, $[\alpha]_D^{20}$ −61.2° (EtOH); this material was identical with (−)-sophoridine (IR, MS, co-TLC and co-HPLC).

ii) An aqueous solution of **2a** (10 mg) was saturated with SO_2 gas under ice-cooling and allowed to stand for 30 min. The reaction mixture was made strongly alkaline with K_2CO_3 under ice-cooling and extracted with CH_2Cl_2. The CH_2Cl_2 extracts were dried over K_2CO_3 and evaporated to dryness *in vacuo*. The residue was purified by prep. HPLC using solvent VI to give 5 mg of (−)-sophoridine.

N-Oxidation of (−)-Sophoridine (1)——A solution of **1** (24 mg) in CH_2Cl_2 was treated with *m*-chloroperbenzoic acid (85%, 21 mg) at room temp. with stirring. After further stirring for several min, the reaction mixture was washed with 5%Na_2CO_3 to remove the acid. The CH_2Cl_2 solution was dried over K_2CO_3 and concentrated to dryness *in vacuo*. The residue was subjected to prep. HPLC using solvent VII to give two N-oxides. The minor N-oxide (yield, 4 mg) was identical with the naturally occurring N-oxide (**2a**) (MS, co-TLC and co-HPLC). The major N-oxide (**2b**) (yield, 19 mg) was crystallized from acetone as strongly hygroscopic colorless crystals, $[\alpha]_D^{25}$ −42.9° (*c*=0.17, EtOH); IR ν_{max}^{KBr} cm^{-1}: 1620 (lactam C=O); MS (70 eV) *m/e*: 264 (M^+, 4), 248 (M^+-O, 38), 247 (M^+-OH, 62), 246 (M^+-H_2O, 100), 245 (87), 150 (30), 148 (44), 134 (35); ^{1}H-NMR ($CDCl_3$): δ 4.08 (1H, dd, J=13.5 and 7.5 Hz, 17α-H); ^{13}C-NMR ($CDCl_3$): δ 169.7 (s), 72.6 (d), 70.0 (t), 59.5 (d), 58.2 (t), 46.6 (t), 35.0 (d), 32.3 (t), 30.0 (t), 28.7 (d), 27.7 (t), 24.2 (t), 22.3 (t), 18.9 (t), 18.1 (t). The *Rf* values of **2a** and **2b** on TLC in solvent II were 0.30 and 0.25, respectively. The t_R values (min) of **2a** and **2b** on HPLC with solvent VII were 26.8 and 31, respectively. The reduction of **2b** by 10%Pd-C, as described above, gave sophoridine (co-TLC, co-HPLC and MS).

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