Isolation of bases. 1.3 kg air-dried leaves, collected in February (summer), 1973 (voucher specimen deposited in the herbarium of the Museo Nacional de Historia Natural, Santiago de Chile), finely ground, were extracted successively with petrol and MeOH. Removal of MeOH gave a residue which was suspended in 2N HCl, filtered and extracted with $CHCl_3$. The aq. soln was basified to pH 9 with NH_4OH and re-extracted with $CHCl_3$. The solid, yellowish-white residue (1.56 g) from the $CHCl_3$ extract of the basified solution showed three Dragendorff-positive spots on TLC (R_f 0.8, 0.3 and 0.2), the foremost of which was very much larger than the others. The product with R_f 0.8 was separated by crystallisation from Me_2CO and Me_2CO–MeOH (1:1). Column chromatography of the residual solutions on Al_2O_3 yielded further amounts of this first base, and allowed separation of the two minor components.

Skimmianine. R_f 0.8, mp 176–177°, UV, IR and PMR spectra as in ref. [13]. Picrate, mp 197° (MeOH).

Edulinine. 95 mg, R_f 0.3, mp 103–105° (EtOAc) (lit. 140–142° [14], 111–114° [15], 114–117° [15]), $[\alpha]_D^{20}$ −17° ($CHCl_3$; c = 1), UV, IR, PMR and MS as described in refs [14, 16].

Ribalinine. 15 mg, R_f 0.2, mp 235–236° (EtOH), UV spectrum as described in ref. [10]. MS ions at m/e 259.1215 (M^+, calc. for $C_{15}H_{17}NO_3$, 259.1208, base peak), 188.0711 (M^+-C_4H_7O, calc. for $C_{11}H_{10}NO_2$, 188.0711, 85%). The IR spectra of this substance and of an authentic sample of ribalinine were found to be identical.

Acknowledgements—We thank Dr. Gert Eckhardt for MS, Prof. O. O. Orazi for the IR comparison of ribalinine, and an anonymous referee for pointing out recent literature. This work was supported by DICYT.

REFERENCES

1. Skottsberg, C. (1921) *The Phanerograms of the Juan Fernández Islands.* Almquist and Wiksells, Uppsala.
2. Engler, A. (1931) *Die Natürlichen Pflanzenfamilien* 2nd ed., Vol. 19a. Engelmann, Leipzig.
3. Benages, I. A., de Juárez, M. E. A., Albónico, S. M., Urzúa, A. and Cassels, B. K. (1974) *Phytochemistry* **13**, 2891.
4. Deulofeu, V., Labriola, R. and de Langhe, J. (1942) *J. Am. Chem. Soc.* **64**, 2326.
5. Najjar, S., Cordell, G. A. and Farnsworth, N. R. (1975) *Phytochemistry* **14**, 2309.
6. Sun, G. C. (1975) *Dissertation Abstr.* **35B**, 5826.
7. Fish, F. and Waterman, P. G. (1973) *Taxon* **22**, 177.
8. Torres, R. and Cassels, B. K. (1975) *Anales Asoc. Quím. Arg.* **63**, 187.
9. Kuck, A. M., Albónico, S. M., Deulofeu, V. and Escalante, M. G. (1967) *Phytochemistry* **6**, 1541.
10. Corral, R. A., Orazi, O. O. and Benages, I. A. (1973) *Tetrahedron* **29**, 205.
11. Hostettmann, K., Pettei, M. J., Kubo, I. and Nakanishi, K. (1977) *Helv. Chim. Acta* **60**, 670.
12. Sharifi, I. A. and Stermitz, F. R. (1977) personal communication.
13. Mitscher, L. A., Bathala, M. S., Clark, G. W. and Beal, J. L. (1975) *Lloydia* **38**, 117.
14. Iriarte, J., Kincl, F. A., Rosenkranz, G. and Sondheimer, F. (1956) *J. Chem. Soc.* 4170.
15. Boyd, D. R. and Grundon, M. F. (1970) *J. Chem. Soc.* (*C*) 556.
16. Toube, T. P., Murphy, J. W. and Cross, A. D. (1967) *Tetrahedron* **23**, 2061.

Phytochemistry, 1978, Vol 17, pp 839–840 Pergamon Press. Printed in England.

ALKALOIDS AND A STEROL FROM *CHELIDONIUM JAPONICUM*

H. ITOKAWA, A. IKUTA, N. TSUTSUI and I. ISHIGURO
Tokyo College of Pharmacy, Hachioji, Tokyo, Japan

(*Received* 11 *July* 1977)

Key Word Index—*Chelidonium japonicum*; Papaveraceae; alkaloids; 6-hydroxymethyldihydrosanguinarine; bocconoline; norchelerythrine; norsanguinarine; α-spinasterol

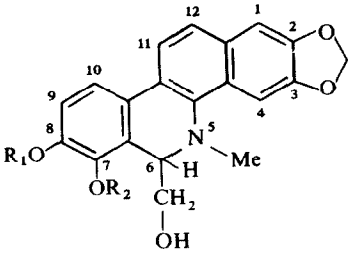
The presence of several alkaloids in root and aerial parts of *Chelidonium japonicum* Thunb have been reported by Slavik [1] on the basis of TLC and PC evidence. We now report isolation and identification on the alkaloids and sterols of this plant.

The basic $CHCl_3$ soluble fraction gave two compounds **1** and **2** after chromatographic separation. **1** and **2** showed identical UV spectra of characteristic benzo(*c*)-phenanthridine alkaloids. **1** contained two methylenedioxy groups at 6.25 and 6.50 (each *s*, 2H) by NMR and also a base peak at m/e 317 (M^+) in MS. **2** had one methylenedioxy group at 6.24 (*s*, 2H), two methoxyls at 4.23 and 4.4 (each *s*, 3H) by NMR, and a base peak at m/e 333 (M^+) by MS. From the available data **1** and **2** were identified as norsanguinarine and norchelerythrine respectively. The identities were confirmed by direct comparison with the authentic samples.

Elution with $CHCl_3$–EtOAc afforded **3** and crude **4** and **4** was rechromatographed on Al_2O_3 (grade IV) with benzene. **3** and **4** showed identical UV spectra and IR respectively. **3** had the following spectral properties: UV bands at 212, 228, 283, 320 and 350 (*sh*) and IR at 3440 (OH). NMR indicated the presence of two methoxyls at 3.92 and 3.96 (each *s*, 3H), one methylenedioxy group at 6.07 (*s*, 2H), N–Me at 2.76 (*s*, 3H), C_6–H at 4.72 (*q*, 1H), $C\underline{H}_2OH$ at 3.10 (*t*, 1H) and 3.53 (*q*, 1H).

The hydroxymethyl group was also suggested by m/e 348 (M^+-31) eliminated from the substituent at C_6. Slavik *et al.* [3] suggested that the loss of a substituent at C_6 in the MS was characteristic of 6-substituted dihydrobenzo-(*c*)-phenanthridine alkaloids. The above data suggested that this compound was identical with bocconoline isolated from *Bocconoria cordata* [2]. The identities were confirmed by direct comparison with the data of an

authentic sample. Compound **4** had UV_{max}^{MeOH} at 212, 235, 284, 322 and 350 (*sh*), IR at 3400 (OH); NMR data indicated the presence of N–Me at 2.71 (*s*, 3H) two methylenedioxy groups at 5.97 (*s*, 4H), C_6–H at 4.41 (*q*, 1H), and $C\underline{H}_2OH$ at 3.12 (*t*, 1H), 3.48 (*q*, 1H) and also a parent peak appeared at *m/e* 363 (M^+, 16%) and the fragment eliminated from C_6, as in **3**, appeared at 332 (M^+-31, 100%). From above spectral properties this compound was identified as **4**. This is a new natural product. Several related dihydrobenzophenanthridine alkaloids with acetonyl- and hydroxymethyl groups at C_6 have been reported previously [2, 4–6].



3, $R_1 = R_2 = Me$
4, $R_1 + R_2 = CH_2$

Compounds **5**–**7** were identified as sanguinarine, chelerythrine and protopine by direct comparison with authentic samples. Compound **8** from the quaternary base fraction was confirmed as the choline-HCl by direct comparison with an authentic sample.

In addition, in course of column chromatography, elution with $CHCl_3$ afforded compound **9**, which appeared as two peaks by GLC (OV-101). One peak showed *m/e* 412 (M^+) and the other *m/e* 414 (M^+). The former was confirmed as α-spinasterol by direct comparison of an authentic sample; the latter may be a dihydro derivative of α-spinasterol. In addition to the above compounds, KNO_3 (4.5 g) was obtained in separation procedure. The identification of all these alkaloids, except protopine and sanguinarine, are the first reports from this species.

EXPERIMENTAL

Mps are uncorr; IR spectra in KBr, NMR spectra with TMS as int. stand. All chromatographic separations were carried out with Si gel. The plant material *Chelidonium japonicum* Thunb. was collected 34 kg (fr. wt) in the province of Yamanashi and Kanagawa prefecture in April and May, 1974 (in flowering state).

Extraction and isolation. The fr. root (15 kg) exhaustively extracted with MeOH, hot MeOH and C_6H_6. The conc extract was separated into basic, neutral and acidic fractions and the basic $CHCl_3$ soluble fraction separated into constituents by a combination of column chromatography with C_6H_6, C_6H_6–EtOAc, $CHCl_3$ and $CHCl_3$–MeOH. Compound **1** (norsanguinarine, 42.6 mg) was obtained from C_6H_6 elution mp 278–280° (decomp.) ($CHCl_3$–EtOH), UV λ_{max}^{MeOH} (nm) 215, 245, 282, 296, 329, NMR (CF_3COOD, δ, ppm), 6.25 (*s*, 2H), 6.50 (*s*, 2H, —O>CH$_2$), 7.42 (*s*, 1H, C_1-H), 7.92 (*d*, 1H, *J* = 8 Hz, C_9-H), 7.94 (*s*, 1H, C_4-H), 8.15 (*d*, 1H, *J* = 10 Hz, C_{11}-H), 8.45 (*d*, 1H, *J* = 8 Hz, C_{10}-H), 8.47 (*d*, 1H, *J* = 10 Hz, C_{12}-H), 9.51 (*d*, 1H, *J* = 8 Hz). MS *m/e* 317 (M^+) 100% $C_{19}H_{11}NO_4$. Compound **2** (norchelerythrine, 3.4 mg) was obtained from C_6H_6 elution, mp 215–216° (EtOH) UV λ_{max}^{EtOH} (nm) 242, 255, 277 and 326 (*sh*), NMR (CF_3COOD, δ, ppm), 4.23 (*s*, 3H, OMe), 4.40 (*s*, 3H, OMe), 6.24 (*s*, 2H, —O>CH$_2$), 7.46 (*s*, 1H, C_1-H), 8.08 (*s*, 1H, C_4-H), 8.20 (*d*, 2H, *J* = 10 Hz, C_{10}, C_{11}-H), 8.56 (*d*, 1H, *J* = 10 Hz, C_9-H), 8.70 (*d*, 1H, *J* = 10 Hz, C_{12}-H), 9.86 (*d*, 1H, *J* = 9 Hz, C_6-H) MS *m/e* 333 (M^+, 100%) $C_{20}H_{15}NO_4$. Compound **3** (bocconoline 66.9 mg) was obtained by $CHCl_3$–EtOAc (47:3) elution. Mp 228–231° ($CHCl_3$–EtOH), M^+ *m/e* 379.132 ($C_{22}H_{21}NO_5$, found 379.141), UV λ_{max}^{MeOH} nm (log ε), 212 (4.22), 228 (4.33), 283 (4.45), 320 (3.96), 350 (3.46, *sh*), IR ν_{max}^{KBr} cm^{-1} 3440 (OH), 1600, 1460, 1410, 1265, 1238, 1182, 1023, NMR ($CDCl_3$, δ, ppm). 2.76 (*s*, 3H, N-Me), 3.10 (*t*, 1H), 3.53 (*q*, 1H), 4.72 (*q*, 1H), 3.92 (*s*, 3H, OMe), 3.96 (*s*, 3H, OMe), 6.07 (*s*, 2H, —O>CH$_2$), 7.00 (*d*, 1H, *J* = 9 Hz, C_9-H), 7.18 (*s*, 1H, C_1-H), 7.53 (*d*, 1H, *J* = 9 Hz, C_{12}-H), 7.58 (*d*, 1H, *J* = 9 Hz, C_{10}-H), 7.69 (*s*, 1H, C_4-H), 7.74 (*d*, 1H, *J* = 9 Hz, C_{11}-H), MS *m/e* 379 (M^+, 7%), 349 (M^+-30, 26%), 348 (M^+-31, 100%), 333 (13%), 174 (31.0%). Compound **4** (6-hydroxymethyldihydrosanguinarine, 25.1 mg) was obtained from $CHCl_3$–EtOAc (19·1) and on Al_2O_3(IV) from C_6H_6 by rechromatography. Mp 249–251.5° ($CHCl_3$–EtOH) M^+ *m/e* 363.110 ($C_{21}H_{17}NO_5$, found 363.110). UV λ_{max}^{MeOH} nm (log ε) 212 (4.24), 235 (4.39), 284 (4.42), 322 (4.02), 350 (3.54 *sh*), IR ν_{max}^{KBr} cm^{-1}, 3400 (OH) 1460, 1440, 1258, 1240, 1182, 1040 NMR ($CDCl_3$, δ, ppm), 2.71 (*s*, 3H, N-Me), 3.12 (*t*, 1H), 3.48 (*q*, 1H), 4.41 (*q*, 1H, C_6-H), 5.97 (*s*, 4H, —O>CH$_2$ × 2), 6.78 (*d*, 1H, *J* = 9 Hz, C_9-H), 7.01 (*s*, 1H, C_1-H), 7.24 (*d*, 1H, *J* = 8 Hz, C_{12}-H), 7.38 (*d*, 1H, *J* = 9 Hz, C_{10}-H), 7.53 (*s*, 1H, C_4-H), 7.58 (*d*, 1H, *J* = 8 Hz, C_{11}-H) MS *m/e* 363 (M^+, 16%), 333 (M^+-30, 43%), 332 (M^+-31, 100%), 317 (16%), 166 (17%). Compound **5** afforded as amorphous hydrochloride. (sanguinarine HCl) UV λ_{max}^{MeOH} 236, 283, 325 (*sh*) NMR, ($CDCl_3$, δ, ppm), 2.63 (*s*, 3H, N-Me), 6.20, 6.22 (each *s*, 2H, —O>CH$_2$). **6** (chelerythrine), UV λ_{max}^{MeOH} 229, 281, 316, NMR ($CDCl_3$, δ, ppm), 2.59 (*s*, 3H, N-Me), 3.93, 3.96 (each *s*, 3H, OMe × 2), 6.20 (*s*, 2H, —O>CH$_2$). Compound **7** was obtained by prep TLC. **7** (protopine) mp 207–208°, UV λ_{max}^{MeOH} 240, 289, MS *m/e* 353 (M^+), NMR ($CDCl_3$, δ, ppm), 2.07 (*s*, 3H, N-Me), 5.91, 5.94 (each *s*, 2H, —O>CH$_2$ × 2). **8** (choline-HCl) NMR (D_2O, δ, ppm), 3.20 (*s*, 9H), 3.52 (*m*, 2H), 4.08 (*m*, 2H). Compounds **9** (α-spinasterol and its dihydro compound) were obtained from $CHCl_3$ solution mp 170–171° (EtOH). GC–MS column 1.5% OV-101, column temp. 230°, t_R 5.1 min (1), 5.8 min (2). (1) *m/e* 412 (M^+), 369 (M^+-43), 351 (M^+-43-18), 273 (M^+-R), 246 (M^+-R-27), 231 (M^+-R-42), 229 (M^+-R-27-OH), 213 (M^+-R-42-18). (2) *m/e* 414 (M^+), 273 (M^+-R'), 246, 231, 229, 213. (1) and (2) ratio was 3·1.

Acknowledgements—We thank Prof. T. Furuya, Kitasato University for kind encouragement, Prof. H. Ishii, Chiba University, Prof. N. Ikegawa, Tokyo Institute of Technology for kind supply of samples. The authors are indebted to Mr. H. Motegi for his excellent technical assistance. Thanks are also due to the members of Central Analytical Laboratory of this University for NMR and MS measurements.

REFERENCES

1. Slavik, J. (1967) *Coll. Czech. Chem. Commun.* **32**, 4431.
2. Ishii, H., Hosoya, K. and Takao, N. (1971) *Tetrahedron Letters* 2429.
3. Slavik, J., Dolels, L., Hanus, V. and Cross, A. D. (1968) *Coll. Czech. Chem. Commun.* **33**, 1619.
4. MacLean, D. B., Gracey, D. E. F., Saunders, J. K., Rodorigo, R. and Mansk, R. H. F. (1951) *Can. J. Chem.* **47**, 1951.
5. Furuya, T., Ikuta, A. and Syōno, K. (1972) *Phytochemistry* **11**, 3041.
6. Tin-Wa, M., Fong, H. H. S., Abraham, D. J., Trojanek, J. and Farnsworth, N. R. (1972) *J. Pharm. Sci.* **61**, 1846.