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Four new alkaloids, dihydroleptopine 1, (±)-8-oxohypecorinine N-oxide 2, demethyltorulosine N-methochloride 3 and hypecoleptopine 4, have been isolated from the whole plants of *Hypecoum leptocarpum* Hook. *f*. et Thoms. (Fam. Fumariaceae) along with the known compound torulosine 5. Their structures are elucidated on the basis of spectral evidence.

There are about eighteen plants belonging to the genus *Hypecoum*, distributed in Mediterranean countries and Northwest Asia. Many of them were used in folk medicine. Various Alkaloids with different skeletons were isolated from the plants of *Hypecoum leptocarpum* Hook. *f*. et Thoms.6 In our continuing studies5, 6 on antitumor compounds from this plant, other four new compounds were isolated from the whole plants of *Hypecoum leptocarpum* Hook. *f*. et Thoms. On the basis of spectral evidence, the structures of the new alkaloids were elucidated as dihydroleptopine 1, (±)-8-oxohyperorinine N-oxide 2, demethyltorulosine N-methochloride 3 and hypecoleptopine 4, which possess a novel skeleton. The known alkaloid isolated is torulosine 5.

Dihydrolepomine 1 was isolated as white powder. In its 13C NMR (DEPT) spectrum, twenty signals were observed, of which the signal at δ 42.95 (q) corresponded N-methyl group, whereas the signals at δ 101.35 (t) and 101.60 (t) were due to two methyleneoxo groups. Three methylenes resonated at δ 40.87 (t, C-α), 24.21(t, C-4) and 49.38 (t, C-3). One 1,2,4,5-tetra- and one 1,2,3,4-tetrasubstituted phenyl rings were recognized on the basis of the following 1H NMR signals for four aromatic protons: δ 6.62 (s, 1H, 8-H), 6.64 (s, 1H, 5-H), 6.69 (d, 1H, J=8.0 Hz, 5'-H) and 6.43 (d, 1H, J=8.0 Hz, 6'-H).

According to the 13C NMR signal at δ 169.79 (s) and the IR absorptions at 1606 and 1378 cm⁻¹ for -COO⁻ as well as HMBC and HMQC experiments, the structure of 1 could be determined as shown in the Figure 1. (±)-8-Oxohyperorinine N-oxide 2 was obtained as yellow amorphous powder. Its HRFABMS suggested the molecular formula C₂₀H₁₆N₂O₈ ([M+H]+ at m/z 398.08718). The IR absorptions at 1653 and 1665 cm⁻¹ and the 13C NMR signals at δ 186.22 (s) and 169.76 (s) suggested a conjugated carbonyl and six-membered lactone4. The UV spectrum of 2 resembled to that of (±)-8-
oxohypecorinine. The $^1$H NMR signals for four aromatic protons at $\delta$ 7.09 and 6.94 (each s, 1H, 1- and 4-H), 7.04 and 7.50 (each d, $J$=8.0 Hz, 11- and 12-H) provided two tetrasubstituted phenyl rings. Two methylenedioxy groups were suggested by the $^1$H NMR signals at $\delta$ 6.16 and 6.20 (each s, 2H). The $^1$H NMR signal at $\delta$ 4.22 (t, 2H, $J$=6.4 Hz) for 6-H, the $^{13}$C NMR signal at $\delta$ 52.95 (t) for C-6 and the $^1$H NMR signal at $\delta$ 3.66 for N-methyl group indicated that 2 is a quaternary salt or N-oxide on the basis of the molecular formula and ion peak at $m/z$ 379 (M- H$_2$O)$_2^+$ in EIMS spectrum. 2 was found to be (±)-8-oxohypecorinine N-oxide.

Demethyltorulosine $N$-methochloride 3 was separated as yellow amorphous powder. The UV spectrum showed the same pattern as that of 2, indicating 3 to be secoberbin alkaloid. Furthermore, from the IR absorptions at 1650 and 1621 cm$^{-1}$ and $^{13}$C NMR signals at $\delta$ 189.44 and 167.10, a six-membered lactone and a conjugated carbonyl group could be concluded. Four protons on two tetra substituted phenyl rings appeared in $^1$H NMR spectrum at $\delta$ 6.93 (s, 1H, 1-H), 6.53 (s, 1H, 4-H), 7.18 and 7.53 (each d, 1H, $J$=8.5 Hz, 11- and 12-H). A methylenedioxy group was recognized from the $^1$H NMR at $\delta$ 6.04 (s, 2H). The $^1$H NMR signals at $\delta$ 3.96 and 3.62 (each s, 3H) could be assigned to two N-methyl groups, taking the chemical shifts of 6-H at $\delta$ 3.99 (t, 2H, $J$=7.0 Hz) and C-6 at $\delta$ 53.07 (t) into account. From the IR absorptions at 3422 cm$^{-1}$ (-OH), four $^{13}$C NMR signals at $\delta$ 148.70 (s), 152.70 (s, 2xC) and 156.09 (s) for four oxygenated aromatic C-atoms and the molecular formula (C$_{10}$H$_{18}$N$_4$O$_7$) provided by molecular ion peak at $m/z$ 384.10862 in the HRFABMS, two aromatic hydroxyl groups could be assumed. The methylenedioxy group could be located to C-2 and C-3 because of the base peak derived from the isoquinoline moiety at $m/z$ 206 in the EIMS spectrum. Thus, the hydroxyl groups could be assigned to C-9 and C-10. Consequently, the structure of 3 was elucidated as shown in Figure 1.

Hypecoleptopine 4 was obtained as white amorphous powder. The molecular ion peak at $m/z$ 445.1275 in its HREIMS suggested the molecular formula C$_{20}$H$_{19}$N$_3$O$_5$, which is in accordance with the observation of twenty-four signals in its $^{13}$C NMR spectrum. The $^1$H NMR (CDCl$_3$+CD$_3$OD) signals at $\delta$ 5.70, 5.60, 6.10 and 6.12 (each d, 1H, $J$=2 Hz) and their corresponding $^{13}$C NMR (CDCl$_3$+CD$_3$OD, DEPT) signals at $\delta$ 102.10 (t) and 104.10 in HMBC diagram suggested two methylenedioxy groups. An N-methyl group resonates at $\delta$ 1.95 (s, 3H) and 37.5 (q) in $^1$H NMR and $^{13}$C NMR spectrum, respectively. The moiety -CH$_2$CH$_2$- could be postulated from $^1$H NMR signals at $\delta$ 3.28, 2.81, 3.01 and 3.07 (each m, 1H) as well as $^{13}$C NMR signals at $\delta$ 31.00 (t, C-4') and 51.00 (t, C-3'). From the following $^1$H NMR signals five aromatic protons were recognized: $\delta$ 8.80 (s, 1H, 3-H), 7.10 (d, 1H, $J$=8 Hz, 7-H), 7.75 (d, 1H, $J$=8 Hz, 8-H), 6.60 (s, 1H, 6'-H) and 5.71 (s, 1H, 9'-H). According to HMQC and HMBC experiments two substructures 4a and 4b were concluded. The IR absorption at 3418 and 1664 cm$^{-1}$, $^1$H NMR (CDCl$_3$) signal at $\delta$ 7.19 (s, D$_2$O exchangeable) and the $^{13}$CNMR signals at $\delta$ 168.60 and 171.80 for quaternary C-atoms suggested the presence of an amide (-CONH-) group. Considering the molecular formula, besides the moieties 4a and 4b as well as the amide, the existence of >C=NH should be confirmed. Thus, four possibilities of ring A (A1-A4) could be deduced. A3 is obviously impossible because of the HMBC correlation $\delta$ 8.80 (s, 3-H) with $\delta$ 168.60 (s, C-1). A4 was excluded in view of the signal at $\delta$ 126.00 for C-11 instead at $\delta$ 140 for aromatic C-atom connected with nitrogen atom. In the UV spectrum, no bathochromic shift was observed when AICh was added to the methanolic solution, revealing that A2 is an amide, the existence of >C=NH should be confirmed.

The structure of 4 could be elucidated as indicated in Figure 1.

**Experimental Section**

**General.** Melting points were uncorrected. EIMS were recorded on a VG ZAB-HS instrument at 70 eV, and FABMS on a VG AutoSpec-300 instrument (positive mode). NMR spectra were recorded on a Bruker AM-400 and a Bruker AM 500 spectrometer (when not noted, 500 MHz for $^1$H, 125 MHz for $^{13}$C), using TMS as internal reference (chemical shifts in ppm), IR spectra on a Nicolet PROTEGE 460 spectrometer with KBr discs ($\nu_{max}$ in cm$^{-1}$); and UV spectra on a GBC Cintra 20 spectrometer in MeOH. Optical rotations were taken on a PE 341 Polarimeter. Column chromatography was performed on Si gel of 200-300 mesh. Cl$^-$ was identified with AgNO$_3$ (aq.) and KBr.

**Plant material & Extraction.**

**Isolation.** The purification of Fr B10 and FrB11 by polyacrylamide CC (30-60 mesh) eluted with CHCl$_3$:CH$_2$OH:CH$_3$COOEt (8:1:8) yielded 1. Compound 2 was obtained from Fr B12 repeatedly by CC with eluent CHCl$_3$:isopropanol:HCl (36%) (200:100:1) and CHCl$_3$:
CH$_3$OH\cdot$CH$_3$COOEt\cdot$H$_2$O (4:4:4:1). Compound 5 was isolated from FrB16 by CC with eluent: toluene:
CHCl$_3$:CH$_3$COOEt:CH$_3$OH (5:1:1). Compound 5 was isolated from FrB16 by CC with eluent:
CHCl$_3$:CH$_3$COOEt:CH$_3$OH (5:1:1). Compound 5 was isolated from FrB16 by CC with eluent:

**Dihydroxytopine 1.** White amorphous powder (MeOH), mp 185-89 °C; [α]$_D^{25}$ 0°(c 1.0, MeOH); UV: 296 nm; IR: 1600 (COO').

**Chromatographed with CHCl$_3$:CH$_3$COOEt:CH$_3$OH (5:1:1).** Compound 5 was isolated from FrB16 by CC with eluent:

**UV: 296 nm; IR: 1606 (COO'), 1585 and 1444 (aromatic C=O), 1378 (COO').** Compounds 5 and 12 were purified by CC (CH$_3$OH:CH$_3$CN:2:1) to give 4 FrA18 was chromatographed with CHCl$_3$:CH$_3$COOEt:CH$_3$OH (5:1:1) to afford 3.

**Yellow amorphous powder (MeOH), mp 100-105 °C; [α]$_D^{25}$ 0°(c 1.0, MeOH); UV (log ε): 371 (3.76), 310 (3.83), 250 (4.02); IR: 3422 (aromatic OH), 2955, 2924, 2854, 1650, 1621, 1500, 1488, 1461, 1380, 1284, 1035, 920; HRFABMS m/z: 384.10862 (M$^+$, Calc. for C$_2$H$_9$N$_2$O$_5$: 384.10833); EIMS m/z (rel. int.): 383 (40, [M-1]), 338 (12), 324 (5), 310 (42), 294 (16), 206 (100), 189 (70), 148 (50), 122 (34); 1H NMR (CD$_3$OD) δ 6.93 (s, 1H, 1-H), 6.04 (s, 2H, 2,3-OCH$_2$O-), 5.63 (s, 1H, 4-H), 4.31 (t, 2H, J=8.0 Hz, 5'-H), 7.50 (d, 1H, J=8.0 Hz, 12-H), 7.16 (d, 2H, J=8.0 Hz, 6-H), 1.29 (t, 3H, J=7.0 Hz, 6'-H). 13C NMR (DEPT, CD$_3$OD, 100 MHz) δ 167.10 (s, C-8), 138.21 (s, C-8a), 128.75 (s, C-12a), 128.63 (d), 127.90 (s), 127.07 (s), 119.84 (C-14), 118.44 (C-13), 115.87 (d, C-9), 118.37 (d, C-10), 124.30 (s, C-12), 129.81 (s, C-12a), 130.40 (s, C-4a), 132.44 (s, C-12a and C-14), 186.22 (C-13), 118.34 (C-14), 105.44 and 105.20 (each s, -OCH$_2$O-).

**Hypecoium Hypecoine 2.** Yellow amorphous powder (MeOH), mp 206.5-0.5 °C; [α]$_D^{25}$ 0°(c 0.12, CHCl$_3$); UV (log ε): 350 (3.44), 295 sh, 260 (4.56). λ$_{max}$ of MeOH-Cl$^+$: 350, 290 sh, 266. λ$_{max}$ of MeOH-Cl$^+$: 370, 260; IR: 3700 (free aromatic OH), 3418 and 1664 (-CONH-), 3283 (-C=NH), 1485, 1459, 1346, 1282, 1239, 1057, 1038, 920, 925 cm$^{-1}$ (-OCH$_2$O-); 1H NMR (CD$_3$OD): δ 7.10 (s, 1H, 1-H), 7.07 (s, 1H, 2-H), 7.06 (s, 1H, 3-H), 6.96 (d, 1H, J=8.0 Hz, 8-H), 8.08 (s, 1H, 12-H), 7.67 (d, 1H, J=9.0 Hz, 8-H), 5.17 (s, 1H, CONH), 7.16 (d, 1H, J=9.0 Hz, 8-H), 6.74 (d, 1H, J=9.0 Hz, 8-H), 6.64 (d, 1H, J=9.0 Hz, 8-H), 6.22 and 6.20 (each s, 1H, 5,6-OCH$_2$O-), 6.15 (s, 1H, C=NH), 5.88 (s, 1H, 9-H$^+$), 5.78 and 5.75 (each s, 1H, 9',8'-OCH$_2$O-), 2.82 (dd, 1H, J=15, 2 Hz, 4-H$^+$), 3.34 (dd, 1H, J=15, 5 Hz, 4'-H$^+$), 3.10 (dd, 1H, J=15, 5 Hz, 3'-H$^+$), 2.00 (s, 3H, N-Me), 13C NMR (DEPT, CD$_3$OD): δ 170.72 (s), 166.21 (s), 150.28 (s), 147.75 (s), 146.73 (s), 146.15 (s), 143.21 (s), 128.75 (s), 128.63 (d), 127.90 (s), 127.07 (s), 123.90 (s), 123.68 (s), 121.17 (s), 120.28 (d), 112.90 (d), 108.12 (d), 105.75 (d), 102.44 (t), 101.12 (t), 79.83 (s),
48.81 (t), 37.46 (q), 29.49 (t); $^{1}$H NMR (CDCl$_3$+CD$_3$OD): $\delta$ 8.80 (s, 1H, 3-H), 6.10 and 6.12 (each s, 1H, 5,6-OCH$_2$O-), 7.10 (d, 1H, J=8 Hz, 7-H), 7.75 (d, 1H, J=8 Hz, 8-H), 1.95 (s, 3H, N-Me), 3.01 and 3.07 (each m, 1H, 3'-H), 3.28 and 2.81 (each m, 1H, 4'-H), 6.60 (s, 1H, 6'-H), 5.70 and 5.60 (each s, 1H, 7', 8'-OCH$_2$O-), 5.71 (s, 1H, 9'-H); $^{13}$C NMR (CDCl$_3$+CD$_3$OD): $\delta$ 168.60 (C-1), 128.10 (C-2), 127.00 (C-3), 124.90 (C-4), 144.10 (C-5), 147.20 (C-6), 104.10 (5,6-OCH$_2$O-), 114.00 (C-7), 121.70 (C-8), 122.00 (C-9), 151.80 (C-10), 126.00 (C-11), 171.80 (C-12), 80.20 (C-1'), 37.50 (N-Me), 51.00 (C-3'), 31.00 (C-4'), 130.70 (C-5'), 109.10 (C-6'), 148.05 (C-7'), 147.90 (C-8'), 102.10 (7', 8'-OCH$_2$O-), 106.00 (C-9'), 129.50 (C-10').

Torulosine 5. Orange powder (MeOH), mp 190-92°C. Its UV, NMR and ELMS data are identical to those of authentic compound$^6$.

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