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Huperzine V, A New *Lycopodium* Alkaloid from *Huperzia serrata*

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Abstract: Huperzine V, a new *Lycopodium* alkaloid, was isolated from the whole plant of *Huperzia serrata*, and the absolute stereochemistry was determined by X-ray crystallographic analysis.

Keywords: Huperzine V, *Huperzia serrata*, *Lycopodium* alkaloids.

Lycopodium plants have long been studied and many alkaloids have been reported thus far. Most of the compounds reported have a common formula of $C_{16}N$[1] and some $C_{27}N_3$ type alkaloids were reported too[2]. By repeated chromatography over silica gel, we gained huperzine V (**1**, 11 mg from 10 kg dry whole plant), a $C_{27}N_3$ type *Lycopodium* alkaloid, from *Huperzia serrata.* In this paper, we report on the isolation and absolute stereochemistry of **1**.

Figure 1 Structure of **1**

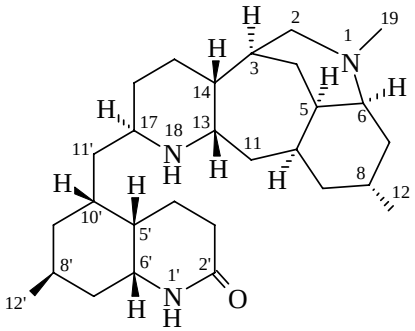

Figure 2 The ORTEP view of **1**·HCl

Huperzine V (**1**), obtained as white prisms, showed a positive effect on Dragendorff's reagent and has the molecular formula $C_{28}H_{47}N_3O$ deduced from the high-resolution mass spectrum (*m/z*, found 441.3698, calcd. 441.3719). The IR (KBr, cm^{-1}) spectrum showed absorption bands of NH (3412) and a lactam group (1637). The

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^{13}C NMR (**Table 1**) and DEPT spectra gave evidences for three methyls, twelve methylenes, twelve methines and one lactam group. The EIMS and NMR data were similar to those of lucidines A and B[2], suggesting **1** was a $C_{27}N_3$ type *Lycopodium* alkaloid. Since **1** was obtained as colorless prisms, huperzine V was subjected to X-ray crystallographic analysis[3], and the absolute stereochemistry was elucidated as **1** using the anomalous scattering of chlorine. The ORTEP drawing was shown in **Figure 2**. The complete assignments of C and H signals were finally determined by 2D-NMR spectrum (^{1}H-^{1}H COSY, HMQC, HMBC and NOESY).

Table 1 ^{1}H and ^{13}C assignments for compound **1**[a] (δ, ppm)

Site	δ_H (J in Hz)	δ_c	Site	δ_H (J in Hz)	δ_c
2	2.29 m, 2.78 d (11.3); 2H	66.8	16	1.43 m, 2.06 m; 2H	31.0
3	1.65 m, 1H	38.0	17	3.25 m	48.5
4	1.74 m, 1H	29.0	19	2.14 s, 3H	43.8
5	1.96 br.s, 1H	36.9	2'	- - -	174.5
6	1.93 m, 1H	64.2	3'	2.34 m, 2H	31.4
7	0.93 m, 2.06 m; 2H	39.4	4'	1.53 m, 1.78 m; 2H	15.5
8	1.68 m, 1H	23.6	5'	1.96 m, 1H	38.2
9	1.40 m, 1.73 m; 2H	45.6	6'	3.61 m, 1H	50.0
10	2.29 m, 1H	34.7	7'	1.65 m, 1.71 m; 2H	36.6
11	1.45 m, 2.64 m; 2H	33.9	8'	2.10 m, 1H	28.7
12	0.86 d (6.3), 3H	23.2	9'	1.29 m, 1.40 m; 2H	32.7
13	4.90 br.d (12.1), 1H	56.8	10'	2.10 m, 1H	29.8
14	2.10 [b]	45.0	11'	1.51 t (7.0), 2H	38.9
15	1.46 m, 1.96 m; 2H	24.4	12'	1.06 d (7.3), 3H	18.7

a. Solution in CD_3OD, δ values referenced to CH_3OH residue at δ_H 3.30 and δ_C 49.0, respectively.
b. Overlapping signal.

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References and Note

1. W. A. Ayer, *Nat. Prod. Rep*., **1991**, *8*, 455.
2. M. Tori, T. Shimoji, E. Shimura, S. Takaoka, S. Takaoka, K. Nakashima, M Sono, W. A. Ayer, *Phytochemistry*, **2000**, *53*, 503.
3. Crystallographic parameters have been deposited in the editorial office of CCL.

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