

## Mass Spectrometry of Bisbenzylisoquinoline Alkaloids. Part III.<sup>1</sup> Alkaloids derived from Coclaurine Units joined Head-to-tail

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The mass spectra of isochondrodendrine, curine, and related alkaloids have been analysed, and fragmentation patterns consistent with deuteration experiments are suggested.

THE mass spectra of isochondrodendrine (type A) and curine-chondrocurine (type B) alkaloids have been reported by a number of authors,<sup>2-6</sup> but discussion of fragmentation has been essentially limited to the major

<sup>1</sup> Part II, J. Baldas, I. R. C. Bick, M. R. Falco, J. X. de Vries, and Q. N. Porter, preceding paper.

<sup>2</sup> D. C. DeJongh, S. R. Shrader, and M. P. Cava, *J. Amer. Chem. Soc.*, 1966, **88**, 1052.

<sup>3</sup> M. Tomita, T. Kikuchi, K. Fujitani, A. Kato, H. Furukawa, Y. Aoyagi, M. Kitano, and T. Ibuka, *Tetrahedron Letters*, 1966, 857.

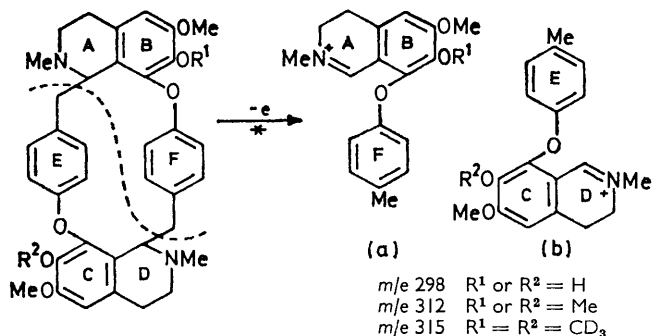
process which gives ions (a), (b), and (c). The unlabelled alkaloids give prominent  $M$  (23—75%) and  $M - H$  (11—33%) and weak  $M - Me^*$  (2—5%) ions; other fragmentation processes are conveniently discussed in groups.

<sup>4</sup> J. Baldas, Q. N. Porter, I. R. C. Bick, and M. J. Vernengo, *Tetrahedron Letters*, 1966, 2059.

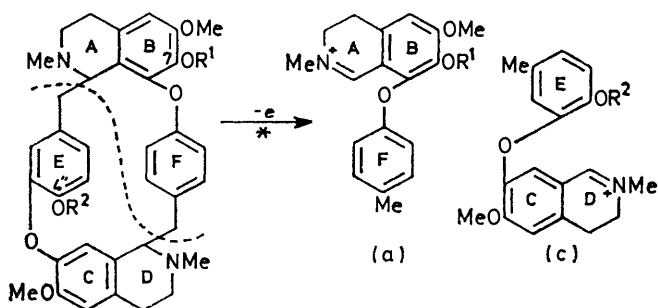
<sup>5</sup> G. W. A. Milne and J. R. Plimmer, *J. Chem. Soc. (C)*, 1966, 1966.

<sup>6</sup> A. K. Bhatnagar and S. P. Popli, *Experientia*, 1967, **23**, 242.

Ring A, B, and F and Ring C, D, and E Ions.—The major fragmentation process is double benzylic cleavage with hydrogen transfer to the charged ring A, B, and F (a)



- (1)  $R^1 = R^2 = H$  Isochondrodendrine  
 (2)  $R^1 = R^2 = Me$  Dimethylisochondrodendrine (cycleanine)  
 (3)  $R^1 = R^2 = CD_3$  [7,7'-dimethoxy- $^2H_6$ ]Dimethylisochondrodendrine  
 Alkaloids of type A

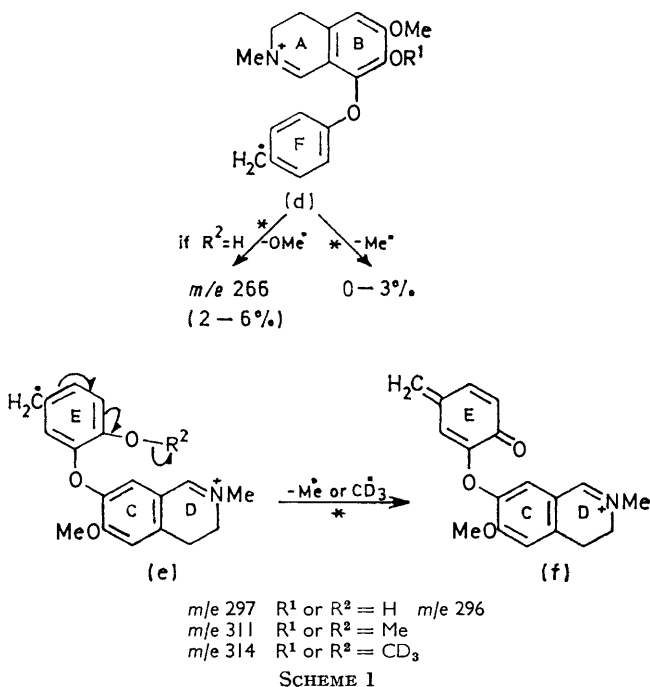


- (4)  $R^1 = R^2 = H$  Curine (R,R); chondrocurine (S,R)  
 (5)  $R^1 = R^2 = Me$  OO-Dimethylcurine (R,R); OO-dimethylchondrocurine (S,R)  
 (6)  $R^1 = R^2 = CD_3$  [7,4''-dimethoxy- $^2H_6$ ]Dimethylcurine (R,R); [7,4''-dimethoxy- $^2H_6$ ]dimethylchondrocurine (S,R)  
 (7)  $R^1 = H, R^2 = Me$  Hayatidine (S,R); O(4'')-methylcurine (S,S)  
 (8)  $R^1 = CD_3, R^2 = Me$  [7-methoxy- $^2H_3$ ]Dimethylchondrocurine (S,R); [7-methoxy- $^2H_3$ ]dimethylcurine (S,S)  
 (9)  $R^1 = Me, R^2 = H$  Chondrofoline ?  
 (10)  $R^1 = Me, R^2 = CD_3$  [4''-methoxy- $^2H_3$ ]Dimethylchondrofoline ?  
 Alkaloids of type B

or ring C, D, and E [(b) or (c)] fragments. When  $R^1 = R^2$ , alkaloids of type A and B [(1)—(6)] give one ion (100%) in which ion (a) = ion (b), or ions (a) and (c) are isomeric; however, when  $R^1 \neq R^2$  [type B, (7)—(10)], the expected two peaks for ions (a) and (c) are observed.

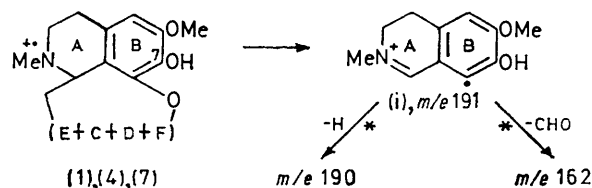
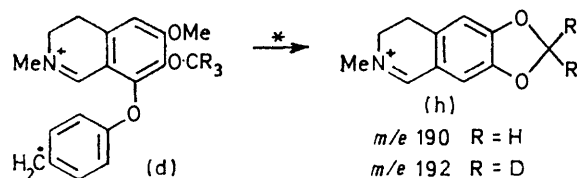
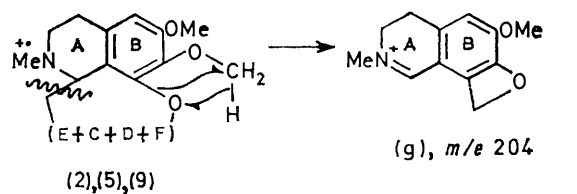
Ions due to double benzylic cleavage without hydrogen transfer [(d) and (e)] are weaker, and the only significant fragmentation of ion (d), by loss of  $OMe^{\cdot}$ , occurs when  $R^1 = H$  (Scheme 1). Loss of  $Me^{\cdot}$  from ion (d), whether  $R^1$  is H or Me, is very minor, and, when  $R^2 = H$ , the same applies to the case of ion (e), formed together with ion (d) from alkaloids (4) and (9) of type B. If  $R^2 = Me$ , a very marked loss of  $Me^{\cdot}$  occurs from ion (e) to give ion (f) ( $m/e$  296; 25—75%), whose structure is confirmed by the specific loss of  $CD_3^{\cdot}$  from ion (e)

( $m/e$  314) in the case of alkaloid (10). Thus an intense ion with  $m/e$  296 is characteristic of an alkaloid of



type B with a 4''-methoxy-group, and a 4''-hydroxy-group can be detected by measuring the spectrum before and after trideuteriomethylation.

Ions due to Rings A and B or Rings C and D.—A prominent ion at  $m/e$  204 is characteristic of alkaloids



with a ring B or C 7-methoxy-group [alkaloids (2), (5), and (9)]. Structure (g) is supported by a clear-cut shift to  $m/e$  206 for alkaloids (3), (6), and (8), which have

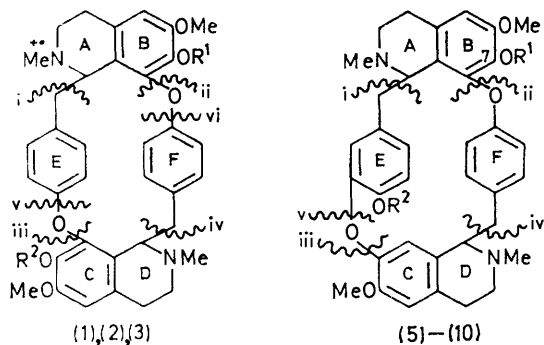
<sup>7</sup> J. Baldas, I. R. C. Bick, Q. N. Porter, and M. J. Vernengo, *Chem. Comm.*, 1971, 132.

a 7-trideuteriomethyl group. Thus an intense ion with  $m/e$  204 indicates a 7-methoxy-group, and a 7-hydroxy-group can be located by the appearance of an ion with  $m/e$  206 after trideuteriomethylation.

Metastable ions indicate that the ion with  $m/e$  190 from alkaloids (2), (5), and (9) originates from ion (d), and the shift to  $m/e$  192 for alkaloids (3), (6), and (8) is consistent with ion (h). Other prominent ions at  $m/e$  174, 159, 146, and 145 from these alkaloids are shifted to  $m/e$  175, 161, 147, and 146 in the deuteriated examples.

Alkaloids (1), (4), and (7), which have a ring B or C 7-hydroxy-group, give an ion (i) at  $m/e$  191.

*Ions due to Loss of Rings A and B or C and D, and of Rings E or F.*—A weak ion with  $M - 221$  for alkaloid

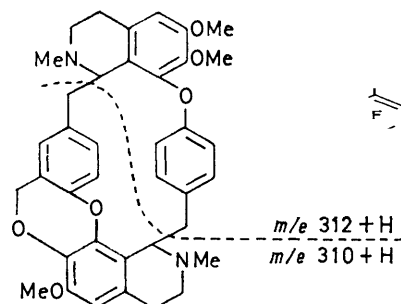


(2) shifted to  $M - 224$  for alkaloid (3), corresponds to cleavages iv and v, or i and vi with loss of the ring C and D or A and B fragments, respectively. Similarly cleavages iv and v for alkaloids (5), (6), and (8) give a weak ion with  $M - 191$ ; the corresponding loss of rings A and B is still weaker.

Alkaloids (1) and (2) give weak ions with  $M - 107$  and  $M - 121$  corresponding to cleavages i and iii or ii and iv, with loss of a ring E or F fragment together with a hydrogen atom or methyl group, respectively. Alkaloids (5)–(9) give weak ions with  $M - 121$  corresponding to cleavages ii and iv, with loss of ring F together with a methyl group (not from C-7). Alkaloids (5) and (7) also give weak ions at  $M - 137$ , shifted to  $M - 140$  in the case of alkaloids (6) and (8), from cleavages i and iii with loss of ring E and a hydrogen atom; this fragmentation was not observed with

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alkaloid (9). The weak  $\frac{1}{2}(M - 91)^{++}$  ions,<sup>3,4</sup> which are the only significant doubly charged ions in the spectra (*cf.* Parts I<sup>8</sup> and II<sup>1</sup>) are an interesting feature



(11) Insularine  
Alkaloid of type C

observed in all cases. The fragmentation of insularine (11) follows the same general pattern as for alkaloid (2).

#### EXPERIMENTAL

Mass spectra were recorded on an A.E.I. MS9 spectrometer operating at 70 eV and at a source temperature of 200–210°. The composition of the following peaks has been determined by high resolution measurement using heptacosafuorotributylamine as standard: (1)  $m/e$  169 (8%  $C_9H_8NO_2$ , 92%  $C_{10}H_{12}NO$ ), 176 (30%  $C_{10}H_{10}NO_2$ , 70%  $C_{11}H_{14}NO$ ), 191 (8%  $C_{10}H_9NO_3$ , 92%  $C_{11}H_{13}NO_2$ ), 382 ( $C_{17}H_{16}NO_3$ ), and 298 ( $C_{18}H_{20}NO_3$ ); (4)  $m/e$  162 ( $C_{10}H_{12}NO$ ), 176 (25%  $C_{10}H_{10}NO_2$ , 75%  $C_{11}H_{14}NO$ ), 191 ( $C_{11}H_{13}NO_2$ ), 266 ( $C_{17}H_{16}NO_2$ ), 282 ( $C_{17}H_{16}NO_3$ ), and 298 ( $C_{18}H_{20}NO_3$ ); (5)  $m/e$  159 ( $C_{11}H_{13}N$ ), 174 ( $C_{11}H_{12}NO$ ), 190 ( $C_{11}H_{12}NO_2$ ), 204 ( $C_{12}H_{14}NO_2$ ), 296 ( $C_{18}H_{18}NO_3$ ), and 431 ( $C_{27}H_{29}NO_4$ ).

The *O*-trideuteriated compounds (3), (6), (18), and (10) were prepared as described in Parts I<sup>8</sup> and II.<sup>1</sup>

Detailed mass spectral data are given in Supplementary Publication No. SUP 20264 (4 pp. 1 microfiche).\*

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\* J. Baldas, I. R. C. Bick, T. Ibuka, R. S. Kapil, and Q. N. Porter, *J.C.S. Perkin I*, 1972, 592.