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CHEMICAL ECOLOGY OF ARTHROPODS. IX.

STRUCTURE AND ABSOLUTE CONFIGURATION OF HIPPODAMINE AND CONVERGINE,TWO NOVEL ALKALOIDS FROM THE AMERICAN LADYBUG HIPPODAMIA CONVERGENS (Coleoptera - Coccinellidae).(1)

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In a previous communication (2) the isolation of two defensive alkaloids, hippodamine and convergine, from the american ladybug *Hippodamia convergens* was reported. A preliminary chemical study (2) led to the hypothesis that hippodamine could be represented by (I), with unknown stereochemistry at carbon atom 2. Convergine was supposed to be a 3_a or 6_a hydroxyhippodamine.

Due to the small quantities of material available, X-ray diffraction analysis seemed well suited to this structural study. The structure of convergine hydrochloride was established, using CuK_α-radiation, to be the N-oxide structure depicted in (II). The salt crystallizes in space-group $P2_1$, with a = 10.230, b = 8.046, c = 8.298 Å, β = 95.35° and two molecules in the unit cell. The refined atomic positions (R = 0.08) are given in table I.

As noted before (2), convergine is easily reduced into hippodamine. It follows that the structure of hippodamine is (I). The relationship between the two alkaloids is further demonstrated by the identity of convergine hydrochloride and hippodamine N-oxide hydrochloride (IR, MS and Rf), the latter being obtained on treatment of hippodamine first with monoperphtalic acid, then with hydrochloric acid.

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These results confirm the proposed formula (I) for hippodamine but demand a revision of the structure previously suggested for convergine.

The IR spectrum of convergine shows prominent bands at 1680 and 3200 cm^{-1} which were first attributed to a carbonyl group involved in a transannular interaction with a NH group (2). The disappearance of both bands on treatment of convergine with hydrochloric acid was interpreted in terms of an amino ketone - carbinolamine equilibrium (2).

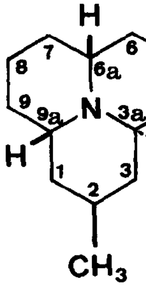
Since convergine has now been shown to be a N-oxide, these IR bands can only belong to its hydrated form (3). This can be converted to the N-oxide hydrochloride on acidic treament and concomitant disappearance of the IR bands at 3200 and 1680 cm^{-1} is then observed.

In contrast with coccinelline, another ladybug N-oxide alkaloid (4), convergine has so far only been obtained as an hydrate.

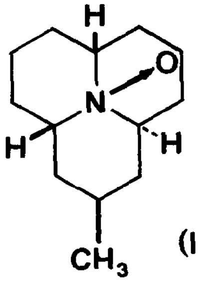
It has been confirmed that convergine hydrochloride dissolved in methanol (c = 0.67) is devoid of measurable optical rotation even at short wavelengths. This observation had previously led to the conclusion that hippodamine and convergine were racemic mixtures. This assumption was found incompatible with the X-ray results, which clearly indicated the presence of an asymmetric entity and established the absolute configuration of convergine as depicted in (II)(5). The optical activity of convergine hydrochloride were then measured in methanol again, acetonitrile, dichloromethane and chloroform and were found to be very small(6) and strongly dependent on the nature of the solvent. Observed values were :

- (α) in methanol (c = 2.06) at 579 nm = -0.8° ± 0.2° ; at 435 nm = -1° ± 0.2° ;
  at 365 nm = -1.2° ± 0.2°.
- (α) in acetonitrile (c = 0.44) at 579 nm = +2° ± 1° ; at 435 nm = +4° ± 1° ;
  at 365 nm = +8° ± 1°.
- (α) in dichloromethane (c = 0.41) at 579 nm = +4° ± 1° ; at 435 nm = +6° ± 1° ;
  at 365 nm = +10° ± 1°.
- (α) in chloroform (c = 0.39) at 579 nm = +3° ± 1° ; at 435 nm = +6° ± 1° ;
  at 365 nm = +10° ± 1° ; at 302 nm = +17° ± 1°.

In conclusion, the structure and absolute configuration of hippodamine and convergine, the defensive alkaloids of *Hippodamia convergens* (1), should be depicted by structures I and II respectively.



(I)



(II)

TABLE I : Atomic coordinates of the bonded atoms in convergine HCl.

ATOM	X	Y	Z
Cl	.7369	.5800	.3637
N	.2663	.6363	.7097
O	.2721	.7681	.8202
C1	.0196	.6482	.6937
C2	.0148	.4834	.7889
C3	.1426	.4710	.9036
C3a	.2629	.4765	.8075
C4	.3913	.4637	.9218
C5	.5138	.4666	.8265
C6	.5137	.6314	.7299
C6a	.3873	.6500	.6093
C7	.3795	.5192	.4765
C8	.2539	.5422	.3589
C9	.1340	.5299	.4592
C9a	.1383	.6578	.5934
C10	-.1077	.4834	.8863

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(5) The absolute configuration was determined according to the method of BIJVOET. cf. J. TROMMEL and J.M. BIJVOET, Acta Cryst., 7, 703, (1954).

(6) Cases are known of asymmetric compounds with immeasurably small optical activity. cf. K. MISLOW "Introduction to stereochemistry" p. 61 W.A. BENJAMIN N.Y. (1966).

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