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AN UNUSUAL DICHLOROCYCLOPROPYL ARTEFACT IN ALKALOIDAL EXTRACTS OF *CROTALARIA GOREENSIS* GUILL. ET PERR.

By C. C. J. Culvenor, L. W. Smith and W. G. Woods.

Division of Organic Chemistry, CSIRO Chemical Research Laboratories,
Melbourne.

Present address (W.G.W.): U.S. Borax Research Corp., 412 Crescent Way,
Anaheim, California, U.S.A.

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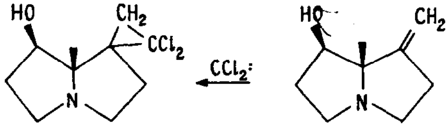
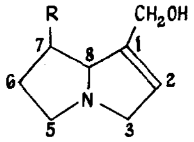
From alkaloid residues derived from *Crotalaria goreensis* Guill. et Perr. we have isolated a crystalline base, $C_9H_{13}ONCl_2$, the spectral properties of which are consistent only with the structure 7β-hydroxy-1-spiro (2'2'-dichlorocyclopropyl)-8β-pyrrolizidine (I) or its enantiomer. Since the major alkaloid of this species is 7β-hydroxy-1-methylene-8β-pyrrolizidine (II) (1) and the crude residues were kept for more than one year probably in the presence of a small quantity of chloroform (residual solvent), it seems highly probable that (I) is an artefact derived from (II).



(I) (II)



(III)

The latter is a fairly strong base and could conceivably react with chloroform to form dichlorocarbene which may then add to the double bond of the same or a different molecule. Quaternary artefacts formed from alkaloids

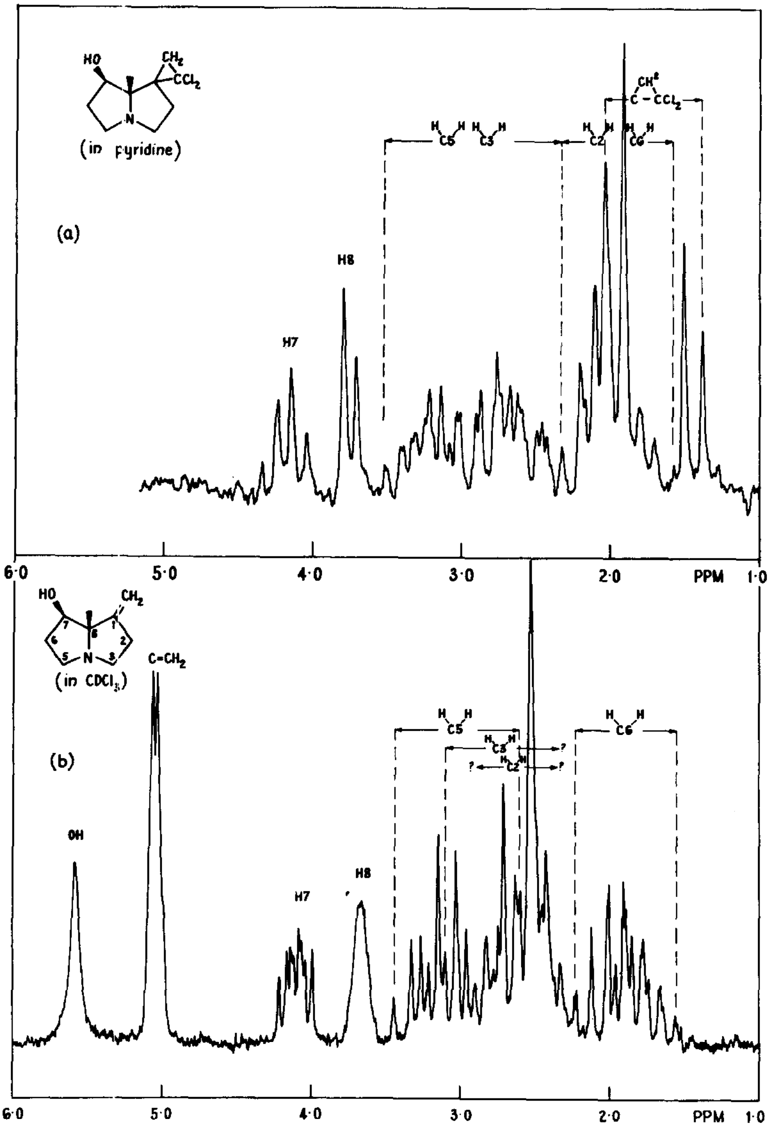

HO
CH2
CCl2
N
(in pyridine)
(a)
H7
H8
C5
C3
C2
C6
C - CCl2
6·0
5·0
4·0
3·0
2·0
PPM
1·0
HO
CH2
7
8
1
2
6
5
N
3
(in CDCl3)
C=CH2
(b)
OH
H7
H8
C5
C3
C2
C6
?
6·0
5·0
4·0
3·0
2·0
PPM
1·0

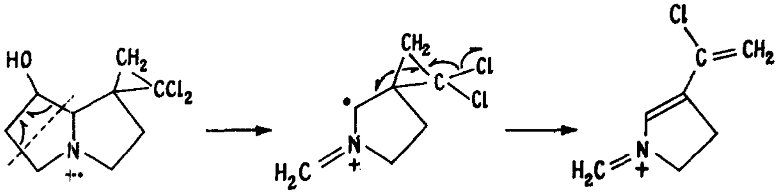
FIGURE 1.

with chloroform (2,3) or its bromochloromethane impurity (4,5) have been reported, but it is surprising in retrospect, that dichlorocyclopropyl derivatives of the above type have not previously been encountered.

The compound, m.p. 170°, is basic to litmus and does not contain ionic chlorine. It is transparent in the ultraviolet, and its infra-red spectrum shows broad hydroxyl absorption around 3000 cm^{-1} and no absorption in the 1600-1800 cm^{-1} region. The nuclear magnetic resonance spectrum (Fig 1a; measured at 60 Mc/s) shows a strong similarity in the downfield region to that of the alkaloid (II) (Fig. 1b) except that the signals due to the 1-methylene group are absent. Assignments for (II) are indicated on the spectrum. Signals due to protons on C2, C3, C5 and C6 cannot be fully assigned but are in accord with results of a recent study of the NMR spectra of retronecine (III, R = β-OH) heliotridine (III, R = α-OH) and related alkaloids (6). In these compounds, a large difference in shift between the protons on C5, and a correspondingly broad spread of signals as in Figs. 1a and 1b, is uniformly observed. The difference in shift between the protons on C6 is usually small, leading to averaging of vicinal coupling constants; it may on occasion, however, be comparatively large as is evident in Fig. 1b. The vicinal coupling constants of the C5, C6 and C7 protons may also exhibit an averaging due to rapid interconversion of conformations. In Fig. 1a, the multiplet, δ4.2, and the doublet, δ3.8 are fully interpretable as being due to the protons on C7 and C8 respectively (written as H7 and H8) in (I). The H8 multiplet of (II) is more complicated because of allylic couplings. Signals assigned to the C2, C3, C5 and C6 protons of (I) are of appropriate chemical shifts and multiplet complexity, and the indicated proton numbers are supported by an integrator trace. As expected the signals due to the C2 protons of (I) appear at higher field than the corresponding signals of (II). The unusual AB-type quartet at high field, due to two protons (δ, 1.46, 1.98;

J 7.3 c/s) not coupled to any others, cannot be reconciled with an ordinary pyrrolizidine alkaloid structure but agrees closely with expectation for the signals of the cyclopropyl ring in (I) (cf. the corresponding protons in 1-methyl-1-phenyl-2,2-dichlorocyclopropane; δ, 1.42, 1.71; J 7.1 c/s (7)).

The mass spectrum of the compound confirmed the empirical formula, $C_9H_{13}ONCl_2$, the parent mass being represented by three peaks m/e 221, 223, 225 in the 9 : 6 : 1 ratio required for two chlorine atoms. A similar trio of peaks at m/e 177, 179, 181 corresponds to loss of C_2H_4O, while the base peak at m/e 142 is accompanied by an isotope peak at m/e 144 of one-third intensity, corresponding to additional loss of one chlorine atom. This fragmentation is interpreted as follows:



The initial loss of the C6, C7 carbon atoms as an acetaldehyde molecule is a prominent feature of the mass spectra of pyrrolizidine derivatives substituted by hydroxyl on C7 (8) and the conjugated character of the m/e 142 ion is in accord with its high intensity. The mass spectrum thus provides confirmation of the structure (I).

Despite the probable origin of (I) from dichlorocarbene and (II), initial attempts to bring about such a reaction have not succeeded. Only intractable products were obtained from (II) and dichlorocarbene generated by the action of potassium t-butoxide on chloroform or ethyl trichloroacetate or by thermal decomposition of sodium trichloroacetate. Ylide formation with the tertiary nitrogen atom may compete with the desired reaction (9) or the hydroxyl group may also cause interference. Chloroform and (II), heated in a sealed tube at 150° for 42 hours, gave only a small amount of polymer in addition to unchanged (II). Further efforts to prepare (I) are in progress.

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