Chromous Chloride Reduction VII. Stereochemistry and Structure of the Major Product Employed in the Confirmation of Endrin Residues

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In previous reports (1-5), reaction of endrin (I) and its degradation products with chromous chloride solution was utilized for the confirmation of their identity. Reaction of endrin with chromous chloride gave a major product in over 75% yield and was assigned structure (II) based on elemental analysis, infrared and N.M.R. spectroscopy. The stereochemistry on the chloromethylene moiety is postulated based on the work of Williamson et al (6). Recently, in using chromous acetate under similar conditions as described by Williamson et al, a minor product, isomeric to II in less than 10% yield was obtained. This product is assigned structure III based on high resolution N.M.R. analysis and decoupling experimental results which were obtained in co-operation with Drs. J.W. ApSimon and J. Buccini of Carleton University, Ottawa. Since N.M.R. analysis of related compounds is in progress, it appears desirable, if not necessary, to ascertain the stereochemistry of one of the isomers so that this stereochemistry of the isomer and other unknown related compounds can be assigned based on N.M.R. analysis. In addition, the results obtained will provide further substantiation on the findings of Williamson et al (6) on certain hexachlorobicyclic system and extend these observations to the hexachlorobicyclic system related to cyclodiene pesticides. This report describes the confirmation of the stereochemistry of pentachloroketone (II) by chemical means. This will substantiate results from high resolution N.M.R. and decoupling experiments to be reported elsewhere with Drs. J.W. ApSimon and J. Buccini.

Reagents

Pesticide grade solvents without further purification were used in this work.

Endrin was purified as described previously (5). Chromous acetate was obtained from Pfaltz and Bauer, Inc., U.S.A.

Instruments

A Tracor MicroTek Model 220 was used for monitoring the reactions. The column and conditons used were similar to those reported (7).

Infrared spectra were run on a Perkin-Elmer Model 457 instrument utilizing Nujol, Florolope and Micro KBr disc techniques.

Melting points were determined on a Mettler FPI automatic melting point apparatus.

Preparation of Pentachloro-Endrin (IV)

(Modification of Method Described in Ref. 8).

One gram of purified endrin was dissolved in 50 ml of pesticide grade dimethyl sulfoxide. After dissolution, 2.2 gm of sodium methoxide was added and the mixture refluxed until gas chromatographic analysis of the mixture showed little or no endrin peak, (approximately 52 hrs). The hot-dark mixture was poured into a 2 litre separatory funnel containing 1.5 litres of ice-cold water and extracted three times with methylene chloride. The combined methylene chloride extracts were washed with water, dried over anhydrous magnesium sulfate, and evaporated under vacuum to give a gummy appearing solid. Purification of the crude product by charcoal column under suction using benzene as eluant and subsequent evaporation of benzene gave 0.94 gm of a sticky-white solid. Recrystallization three times from acetone - hexane at 0°C afforded an analytically pure sample with m.p. 185°C having N.M.R. and IR characteristics identical to the literature values (8).

Acid - Catalyzed Isomerization of Pentachloro-Endrin (IV)

500 mg of IV was ground continuously in a pestle and mortar with 2 ml of 90% sulfuric acid for 10 min. The mixture was allowed to stand at room temperature, with occasional grinding, for 2 hrs at which time, the mixture was diluted with ice-cold water and extracted with chloroform. Concentration of the chloroform extract yielded white crystals. The mother liquor was concentrated to 1 ml and tituated with acetone to afford an additional crop of the same crystals (IR, GLC, TLC). The combined crystals, (320 mg) was recrystallized once from chloroform acetone to give large-stout crystals, m.p. 204°C (lit. (2) melting point 203° - 204°C). Its IR and N.M.R. spectrum were identical to the pentachloro ketone (II) obtained from chromous chloride (2) or chromous acetate (9) reaction on endrin. An admixture of this product with ketone II prepared previously (2) showed no depression in melting point.

Results and Discussion

The structure of endrin derivatives and the reaction pathway are shown in diagram 1. Since the identity of pentachloro-endrin (IV) was established (8) quite convincingly by the chemical shift of the chloromethylene proton and most important of all, by long range coupling constants data, the conversion of this compound (IV) to the ketone (II) by acid-catalyzed isomerization established the stereochemistry of the chloromethylene group in the ketone (II). Furthermore, based on the co-operative work with ApSimon and Buccini the presence of the long-range coupling of the chloromethylene protons Ha and Hb and the Hc (J_{HaHb} = 2cps, J_{HaHc} = 2cps, see structure II), according to the "W" or the "zigzag" rule (10), of the isomeric ketone (II) and the absence of such long-range coupling in ketone (III), together with the present chemical substantiation, it was proven unequivocally that the stereochemistry of the chloromethylene moiety of ketone II is as assigned previously (2).

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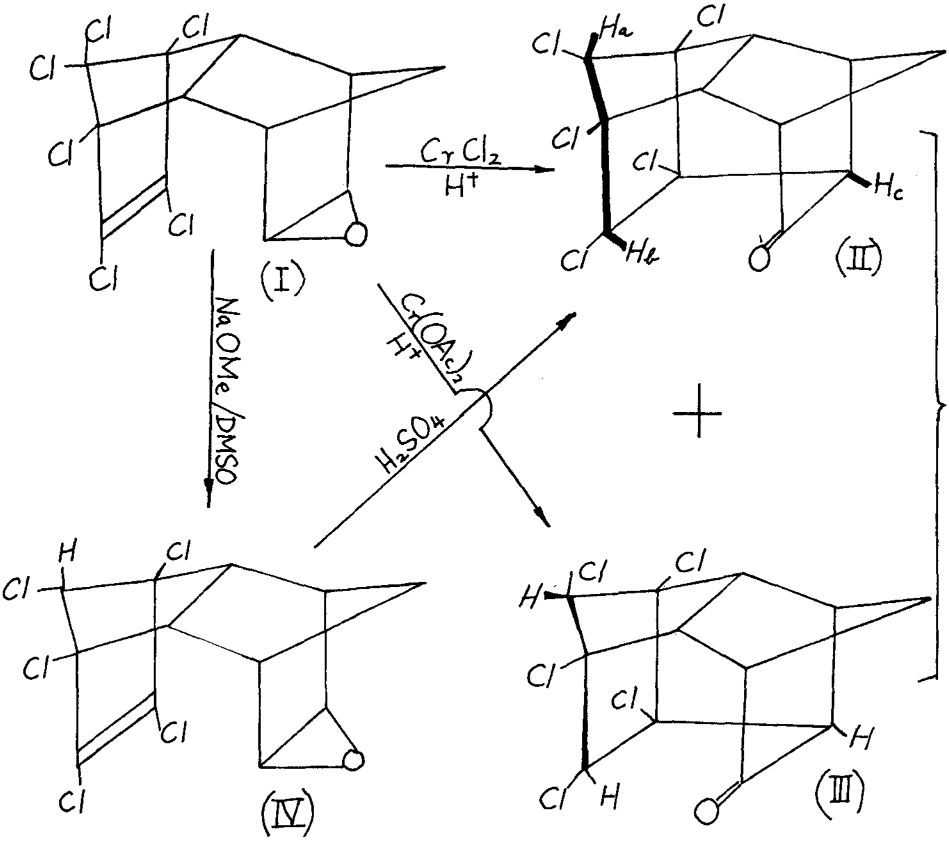
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