

BENZO(c)THIOPHENE DERIVATIVES I
Alkali induced decomposition of
1,4-dicarbomethoxy-2,3-benzodithiane

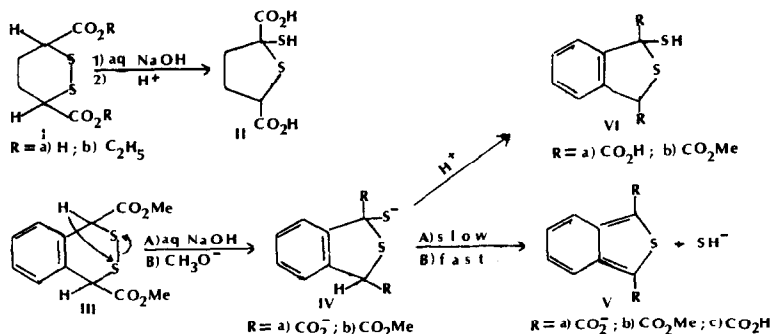
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Danehy *et al.* recently demonstrated that organic cyclic disulfides having an acidic carbon α to sulfur decompose in aqueous alkali to give cyclic hemidithioketals with a wide range of stability, by a possible mechanism involving the rapid conversion of the initially formed carbanions to thiolate anions (1a). In the case of 1,2-dithiane-3,6-dicarboxylic acid (Ia) and of its ethylester (Ib) or anhydride the reaction led to stable 2-mercaptothiolane-2,5-dicarboxylic acid (II) (1b).

We have now observed that the benzocondensed derivative of Ib (III) is actually transformed in alkaline medium into a thiolate anion (IV). However, this intermediate was found unstable when the ester groups were preserved during the reaction, a rapid decomposition taking place to benzo(c)thiophene derivatives (V). By contrast, relatively stable thiolate was formed when the reaction conditions also caused the ester to be hydrolysed.

S C H E M E I



meso or racemic -Dimethyl- α, α' -dibromo o. benzenediacetate (2) treated with K₂S₂ in 90% methanol at 0-5° under N afforded 60% racemic -1,4-dicarbomethoxy-2,3-benzodithiane (III), m. 144-146°. NMR (CDCl₃): 3,75 δ (s, 2COOCH₃), 4,50 δ (s, 2CH), 6,9-7,3 δ (m, 4 aromatic H). By allowing III to stand 2hrs in excess 0,1 N methanolic CH₃ONa at 40° 90% 1,3-dicarbomethoxy-benzo(c)thiophene (Vb), m. 160° was isolated. The analytical data of Vb were: $\lambda_{\text{max}}^{\text{MeOH}}$ 218(4,25), 247,5(4,48), 340(3,84) and 382m μ (4,06); NMR (CDCl₃): 4,0 δ (2COOCH₃), 7,2-7,4 and 8,3-8,5 δ (m, 4 aromatic H). By alkaline hydrolysis Vb gave 1,3-benzo(c)thiophene dicarboxylic acid (Vc), dec. 280-285°.

$\lambda_{\text{max}}^{\text{NaOH aq.}}$ 219(4,35), 235(5,96), 326(3,93) and 373m μ (4,01).

The unexpected formation of Vb was attributed to a loss of SH⁻ from a possible thiolate intermediate (IVb) in turn obtained from III by the mechanism reported for II^(1b) (see scheme I). To account for this hypothesis, experiments were performed aiming at identifying the thiolate (IV) and determining the ratio of H₂S evolved after acidification, to Vb formed.

By carrying out the reaction at 0° then quenching the mixture with conc.HCl after 15' we succeeded in isolating the mercapto derivative (VIb) as an oil which exhibited IR absorption at 2560 cm⁻¹ (SH) and NMR(CDCl₃) peaks at 3,45 δ (s,SH), 3,7-3,8 δ (m, 2COOCH₃), 5,35 δ (s,CH), 7,2-7,7 δ (m, 4 aromatic H). This product was contaminated by about 20% of the benzo(c)thiophene Vb as indicated by additional peaks in the region of COOCH₃ (4,0 δ) and of the aromatic protons (7,2-7,4 and 8,3-8,5 δ); the absence of NMR signals attributable to starting III also suggested a rapid interconversion of the corresponding carbanion to IVb.

In a parallel set of experiments the decomposition of III in methanolic CH₃ONa at 0° and 40° was followed by periodic UV analysis of Vb formed and titration of the H₂S evolved after acidification of the reaction mixture with conc.HCl. The conversion values III \rightarrow Vb after 2hrs were respectively 35% and 95% while the ratio of H₂S to Vb was nearly 1:1. These data, as far as the percentage of sulfur accounted for Vb and H₂S after 2hrs at 40° (>90% of the S content of III) strongly suggested that in the conversion III \rightarrow Vb the mechanism proposed might be the main one involved, if not the unique at all.

The formation of benzo(c)thiophene derivatives from III in aqueous 0,5 N NaOH at 40° is much slower than in methanolic CH₃ONa, 5% and 20% of Va being respectively detected by UV analysis after 2hrs and 24hrs. Conversely, the main reaction product isolated as viscous oil after acidification was identified as 1-mercapto 1,3-benzothiolane dicarboxylic acid (VIa) by converting it into the dimethyl ester VIb in refluxing CH₃OH and H₂SO₄. Attempts to obtain VIa in a pure state resulted in aromatization to the diacid Vc.

Two driving forces appear involved for the decomposition of III to benzo(c)thiophene derivatives (V) through thiolate anions (IV): a) the inductive effect on the acidic carbon of the oxygenated substituents; b) the gain in energy in going from III to the fully aromatic structure V. The much more rapid conversion in methanolic CH₃ONa than in aqueous NaOH can be consequently attributed to the more powerful inductive effect of the COOCH₃ groups in IVb in respect to that of the anions COO⁻ in IVa.

REFERENCES

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