SYNTHESIS OF α, α -DICHLORO- β -HYDROXYNITRILE MEDIATED BY TRI-n-BUTYLSTIBINE¹

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Abstract: α, α -Dichloro- β -hydroxynitriles were conveniently synthesized by the reaction of trichloroacetonitrile with aldehydes mediated by tri-n-butylstibine in excellent yields.

 α, α -Dichloro- β -hydroxynitrile is rather inaccessible.² Burton and coworkers reported³ that phosphonium ylide from trichloroacetonitrile and triphenylphosphine reacted with benzaldehyde to form 2-chloro-3-phenylacrylonitrile and triphenylphosphine oxide. We found that trichloroacetonitrile reacted with aldehydes mediated with tri-n-butylstibine to give α , α -dichloro- β -hydroxynitriles in excellent yields.

Thus, treatment of aldehydes with slight excess of trichloroacetonitrile and tri-n-butylstibine induced exothermal reactions. After being stirred at room temperature or heated at 60°C, the mixture was treated with ethanol and separated by alumina-silica gel (1:1) column to give α, α -dichloro- β -hydroxynitriles (Table). The reaction can be carried out without solvent or in the solvents such as tetrahydrofuran, carbon tetrachloride, benzene or hexane. Ketones and imines did not react under the similar conditions.

OH i)r.t.-60°C $RCH=0 + CCl_3CN + n-Bu_3Sb$ $RCHCCl_2CN + 1/2$ (Bu₃SbCl)₂O ii) H₂O

We postulate that the reaction is initiated by halophilic attack of tri-nbutylstibine to trichloro-acetonitrile resulting in an ion pair n-Bu₃SbCl⁺ and ~CCl₂CN. The ion-pair formation was supported by detection of dichloroacetonitrile from the reaction of tri-n-butylstibine with trichloroacetonitrile in protic solvent.⁴ In the presence of aldehyde, the nucleophilic attack of carbanion to carbonyl forms an intermediate ⁵, which on hydrolysis gave α, α -dichloro- β -hydroxynitrile and bis-(chloro-tri-n-butyl-antimony)-oxide. The latter was readily hydrolyzed and disproportionated⁶ on silica gel to dichloro. and dihydroxy-tri-n-butylstiborane.

Thus, the present reaction featured with simple procedure, high yield and high chemical selectivity might be useful for the synthesis of α, α -dichloro- β hydroxynitrile.

Entry	R	Condi T(°C)	tions t(hr)	Product*	Yield** (%)
1	n-C4H9-	r.t.	3.5	n-C4H9CH (OH) CCl2CN	87
2	n-C8H17-	60	1	$n-C_8H_{17}CH(OH)CCl_2CN$	94
3	CH3	60	1	CH3CH=CHCH(OH)CCl2CN	89
4	n-C7H15	60	0.5	n-C7H15CH=CHCH(OH)CCl2CN	95
5	K M	r.t.	0.5	CH (OH) CC12CN	89
6	C6H5-	r.t.	0.5	C6H5CH(OH)CCl2CN	95
7	р-СН30С6Н4-	60	1	$p-CH_3OC_6H_4CH(OH)CCl_2CN$	99
8	p-02NC6H4-	r.t.	0.5	$p-O_2NC_6H_4CH(OH)CCl_2CN$	97
9	с6н5 ∕	r.t.	0.5	C6H5CH=CHCH(OH)CCl2CN	70

Table. $\heartsuit, \heartsuit, \heartsuit, \heartsuit, \square$ -Dichloro- β -hydroxynitriles Resulted from Trichloroacetonitrile and Aldehydes Mediated by Tri-n-butylstibine

* The configuration of double bond does not changed after reaction (Entry 3,4 and 9). ** Isolated yield by column chromatography.

Acknowledgement: Thanks are due to the National Natural Science Foundation of China and Academia Sinica for financial supports.

References and Notes

- This paper is the 62nd report on the studies of the application of elementoorganic compounds of the 15th and 16th groups in organic synthesis. Report 61 see: Synth.Commun., in press.
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- 4. For the example of the halophilic reaction of triphenylphosphine, see: a) A. J.Speziale and R.C.Freeman, J.Am.Chem.Soc., 82, 903(1960); b) A.J.Speziale and L.J.Taylor, J.Org.Chem., 31, 2450(1966).
- 5. The ¹H NMR monitoring of the reaction disclose that, as the benzaldehyde disappeared, two sets of singlet appeared at 4.86ppm and 4.94ppm in the ratio of 2:1.At the same time, the aromatic protons changed to multiplets C1 n at about 7.32 ppm(\propto, α -dichloro- β -hydroxy- β -phenylpropionitrile showed two singlets at 4.90 and 7.38 ppm). This may account for the formation of a sixmembered ring intermediate.⁷
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(Received in Japan 22 March 1988; accepted 1 August 1988)