THE USE FOR 1,1,1-TRICHLOROPROPANONE IN THE ACYLATION OF ALCOHOLS

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The use of the title compound as an acylating agent of primary and secondary alcohols is described.

Keywords: 1,1,1-trichloropropanone, acylation of alcohols.

The exploitation of potential uses of trichloromethyl group containing substrates as benzoylating agents has long played an important role in our research toward the apllication of the classical and well known haloform reaction[1]. Thus mechanistic[2,3,4] and preparative[5,6] studies carried out on the reactions of 2,2,2-trichloro-l-arylethanones (**1**) with O, N and C nucleophiles turned out to be a useful high-yield alternative conversion method, when compared with conventional agents of which benzoyl chloride is one exemple.

Recently we reported the use of 1,1,1-trichloropropanone (**2**) in the acylation of a series of amines as a high-yield, clean and smooth method[7]. The advantages of the use of (**2**), when compared to the alternative methods of acetamide preparation using acetic acid or its derivatives is that a neutral species, chloroform, is the only by-product formed. Considering the lack of information in the literature on the use of (**2**) as a synthetic precursor we turned our attention to one of the most common reactions in organic chemistry, i.e., the acylation of alcohols. We now report the selective preparation of a number of acetates whose acylating agent is (**2**) in replacement of acetic acid or any derivative (equation). The kinetics of the alcoholysis of (**2**) in solvents of varying polarity is under investigation and will appear elsewhere.

$$CH_3\text{-}C(O)\text{-}CCl_3 + ROH \xrightarrow{Pr_3N} CH_3COOR + HCCl_3$$

In the Table are listed esters prepared by the reaction of (**2**) with various alcohols. Experimentally, in all cases the reaction was performed under reflux, using triethylamine as catalyst. Although the stoichiometry of the reaction is 1:1, a 10% excess of (**2**) was used in order to eliminate any residual alcohol. The reaction required more vigorous condition than those described for the reaction of (**2**) with amines, however the yields, ranging from 70 to 80%, were still high and the reaction proceeded in a clean and smooth way. Attempts to carry out the reaction in the absence of any catalyst failed. The experimental procedure (see Experimental Section) was common to all alcohols. The acylation reaction using compound (**2**) is so sensitive to the relative steric hindrance exhibited by the alcohols that no reaction was observed when t-butanol was used.

If the reaction of (**2**) with alcohols and amines proceeded well under relatively mild conditions the same is not true for the reaction of (**2**) with phenols. Attempts to prepare phenolic acetates, using either phenol or sodium phenoxide failed even under more severe conditions, even though several catalysts and solvents of varying polarity were tried. Typically sodium phenoxide (or phenol) was refluxed for several days along with tripropylamine and N,N-dimethylformamide as catalyst and solvent respectively, but the reagents were recovered unchanged.

Table - Acetylation of Alcohols with 1,1,1-Trichloropropanone (**2**).

Alcohol	% Yield[a]	b.p.	(b.p.lit.)
a) ethanol	80	76-7	77[b]
b) n-propanol	78	100-3	101[c]
c) isopropanol	73	90-2	90[d]
d) n-butanol	78	126-8	126[e]
e) 2-butanol	70	111-3	112[f]
f) n-hexanol	80	173-6	171-5[g]
g) cyclohexanol	75	170-3	172-3[h]
h) benzylic alc.	80	90-1/10mmHg	93/10mmHg[i]
i) ethylene glycol	80	191-3	190[j]

a- After distillation; b- Beilsteins Handbuch der Organischen Chemie, 1942, 2, 129; c- Idem, 1942, 2, 137; d- Idem, 1942, 2, 139; e- Idem, 1942, 2, 140; f- Idem, 1929, 2, 59; g- Idem, 1942, 2, 145; h- Idem, 1944, 6, 10; i- Idem, 1944, 6, 415; j- Idem, 1920, 2, 142.

In conclusion, we would like to add that compound (**2**) can selectively acylate primary and secondary aliphatic alcohols in the presence of a phenolic moiety, and under proper conditions[7] differentiate amines from alcohols. Indeed, while primary and secondary amines react with (**2**) at room temperature using hexane as solvent, the corresponding alcohols require a more polar medium and reflux conditions.

We would like to emphasize that the need of only catalytic amounts of tertiary amine is the most striking advantage of the present method over the conventional preparation using Ac_2O/pyridine, where equimolar amounts of pyridine (at least) are necessary. In the present method, since the by-product is chloroform, only trace amounts of catalyst are needed.

EXPERIMENTAL SECTION

Solvents were commercially available and were purified following common procedures described in the literature. The amines used as catalysts were purified by standard methods[8].

All the prepared esters were characterised by their IR (Perkin Elmer 781 model) and ^1H NMR spectra (Bruker AW 80, tetramethylsilane as internal standard). Gas chromatographic analyses were performed with a CG-37 machine, equipped with an OV-17% column.

1,1,1-trichloropropanone - This compound was prepared by chlorination of 1,1-dichloropropanone, following the literature[9]. The required dichloro-compound was obtained by chlorination of acetone as previously described[7].

Acetylation of Alcohols: a general procedure

The reaction mixture made up with 1,1,1-trichloropropanone (**2**) (5.3g, 33 mmol), the corresponding alcohol (30 mmol) and tripropylamine (1.0 ml), was refluxed until the disappearance of the alcohol (2-3 h), as shown by gas chromatography. The chloroform formed during the reaction was removed and the residue distilled. When the boiling points of reagents and products did not allow a simple distillation, an Ace Glass concentric tube fractionating unit with 40 theoretical plates was used.

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