Isolation of a Substituted Benzyltoluene from Trifluoromethanesulphonic Acid Catalysed Acylation of Methylcyclohexene

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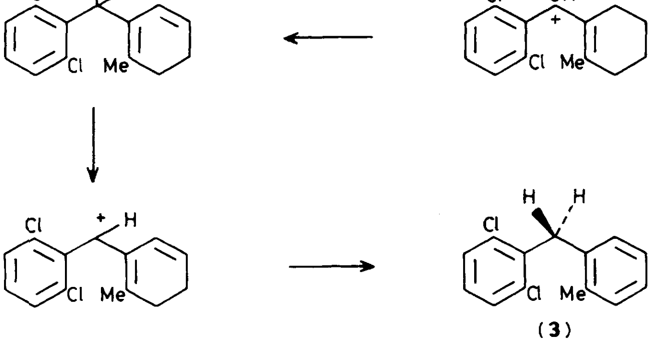
Reaction of 2,6-dichlorobenzoyl chloride with 1-methylcyclohexene in the presence of CF_3SO_3H affords 2-(2′,6′-dichlorobenzyl)toluene.

Acylation of alkenes, in the presence of Lewis or protonic acids, is a versatile method of preparing various derivatives resulting from mono-,[1] di-(pyrylium synthesis),[2] tri-,[3] and tetra-acylation.[4] There have been several reports of the acylation and benzoylation of cyclohexene and 1-methyl cyclohexene where acyl or benzoyl cyclohexene derivatives have been obtained, together with various ketonic products resulting from further cyclization.[1,5–7] In the presence of alkanes such as isopentane or cyclohexane, reduction of the carbenium intermediate might occur through intermolecular hydrogen transfer, and thus acylation results in the formation of acylcyclohexane or methylacylcyclohexane derivatives.[8] Intramolecular hydrogen shift accounted for the formation of 1-acetyl-4-phenylcyclohexane during the acetylation of cyclohexene in the presence of benzene as carbenium trap.[9] Similar hydrogen shifts were observed during acylation of cyclohexene with phenylacetyl chloride and resulted in the formation of various chloroketonic compounds or bicyclo derivatives.[6] On the other hand, intermolecular hydrogen transfer is known to occur between protonated carbonyl groups or acylium ions and isoalkanes leading to reduction of the carbonyl group and oxidation of the alkane.[10]



Scheme 1

We treated 2,6-dichlorobenzoyl chloride (**1**) (0.2 mol) with 1-methylcyclohexene (**2**) (0.1 mol) in the presence of CF_3SO_3H (0.03 mol) at reflux in 1,2-dichloroethane for 21 h. After hydrolysis, extraction with dichloromethane, treatment with aqueous sodium hydroxide, and further extraction with dichloromethane, bulb-to-bulb distillation afforded 2-(2′,6′-dichlorobenzyl)toluene† (**3**) (b.p. 140 °C/2 mbar)† which was recrystallized from EtOH (25% isolated yield) and an intractable residue which results from further alkylation and benzoylation of (**3**).

A possible reaction mechanism is shown in Scheme 1, which involves a double hydrogen shift. The driving force of the reaction is the aromatization of the cyclohexene moiety. Recently, trifluoromethanesulphonic acid was used in conjunction with triethylsilane to reduce substituted benzophenones to diphenylmethane derivatives, demonstrating the efficiency of this catalyst in the protonation steps.[11]

Oxidation of methylcyclohexene to toluene and reduction of benzoyl chloride to benzyl halide followed by conventional Friedel–Crafts alkylation, or oxidation of methylcyclohexene to toluene followed by acylation with dichlorobenzoyl chloride and further reduction of the resulting substituted benzophenone, are ruled out by the observed regioselectivity of the reaction, with no *para*-isomer being formed.

Our observation provides a new approach to regioselective preparation of diphenylmethane derivatives. However, the

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† (**3**) M.p.: 71—72 °C; ^1H n.m.r. ($CDCl_3$, 200 MHz) δ 2.41 (3H,s), 4.21 (2H,s), 6.53 (1H,d), 6.95—7.22 (4H,m), 7.32 (2H,d); Figure 1 shows the aromatic region of the ^1H n.m.r. spectra of 3.

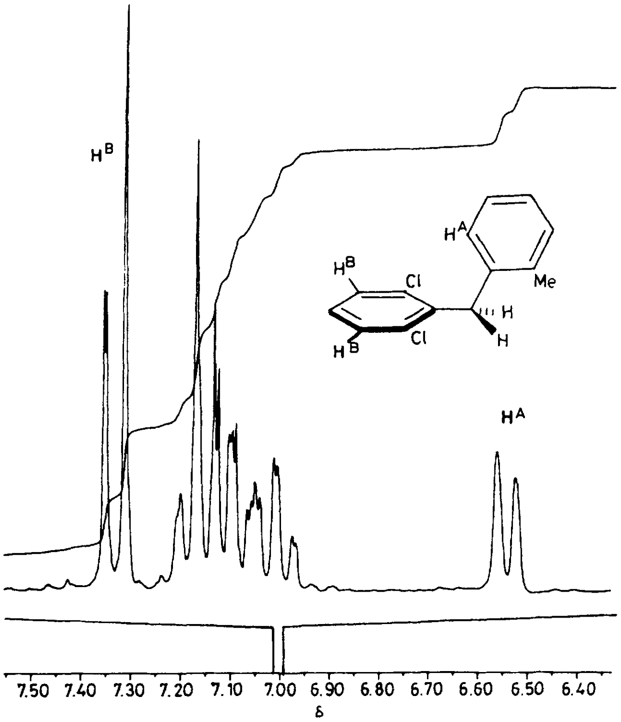

Figure 1. Aromatic region of the 200 MHz ^{1}H n.m.r. spectrum of (**3**).

scope of the reaction could be limited if the compounds obtained are able to react further to form higher alkylation and acylation products.

A 2D COSY long range analysis of the ^{1}H spectrum of (**3**) indicates that the high field aromatic proton which appears as a doublet (δ 6.53, J 7.3 Hz), is the hydrogen situated α to the methylene (H^A) since it is coupled to the protons at δ 6.95—7.22, to the methylene protons, and to the methyl protons. The observed high-field chemical shift of H^A is accounted for by the conformation depicted in Figure 1. The H^A proton is shielded by the dichlorobenzene framework. Furthermore, 2D analysis shows that the low field doublet arises from the 3,5-hydrogen (H^B) of the dichlorobenzyl system as the low field part of an AA'B system. This was confirmed using resolution enhanced sequences in the ^{13}C n.m.r. spectrum: ($CDCl_3$) δ 19.61, 33.88, 125.90, 126.05, 126.18, 128.07, 129.84, quaternary carbon, 135.82, 135.87, 136.32, 136.37; mass (70 eV), m/z (%) 252(55), 250(84), 237(14), 235(23), 217(34), 215(100), 201(10), 200(14), 199(25), 180(70), 179(51), 178(40), 165(46), 106(23), 105(21), 104(48), 91(43), 89(50), 88(20), 76(34).

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