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REACTIONS OF ALDEHYDES WITH LITHIUM DIMETHYLCOPPER[1]

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Various types of reductive processes have been observed with organocopper reagents, often as side reactions[3]. Of particular interest is the high yield of non-alkylated allene obtained by reaction of a substituted propargylic acetate with four equivalents of lithium dialkyl copper at low temperature[4]. During the exploration of possible mechanisms of such reductions, we observed that contrary to what is generally known with ketones, aldehydes react readily with organocuprates to give either primary or secondary alcohols.

1-Ethynylcyclohexanol acetate (1) (1 equiv.) was treated with lithium dimethylcopper (2 equiv.) in anhydrous ether-hexamethylphosphoric triamide (HMPT) (7:3) at -10° in the presence of p-methoxybenzaldehyde (2a) (2 equiv.) and trimethyl phosphite (0.1 equiv.)[5]. After preparative thin layer chromatography, in addition to unreacted starting material (38%) and cyclohexylidenebuta-2,3-diene (3)[6], there was isolated more than 25% of p-methoxybenzyl alcohol (4).

In contrast to this reduction process, reaction of p-methoxybenzaldehyde (2a) with lithium dimethylcopper (2 equiv.) in ether solution at -10° afforded quantitatively p-methoxy-α-methylbenzyl alcohol (5a), the 1,2-addition compound. Similarly, benzaldehyde (2b) and p-fluorobenzaldehyde (2c) gave α-methylbenzyl alcohol (5b) and p-fluoro-α-methylbenzyl alcohol (5c) respectively, in yields higher than 90%.

Reaction of lithium dimethyl copper with heptylaldehyde (6a) provided 2-octanol (6b) in isolated yield of more than 90% and only traces of the primary alcohol (6c), whereas under identical conditions (and 18 hr reaction time) acetophenone (7a) gave only 13% of α,α-dimethylbenzyl alcohol (6b).

Treatment of p-methoxybenzaldehyde (2a) with lithium dimethylcopper (1.4 equiv.) in ether-HMPT in presence of trimethyl phosphite, as mentioned above, afforded p-methoxybenzyl alcohol (4) in 16% yield, along with 73% of the 1,2-addition compound[3,7], namely p-methoxy-α-methylbenzyl alcohol (5a).

It thus appears that in contrast to ketones lithium dimethylcopper reacts readily with aldehydes to give secondary alcohols by a 1,2-addition reaction and sometimes primary alcohols by a reductive process. Similar observations made with other organocuprates will be reported in due time.

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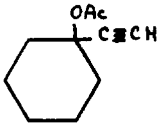
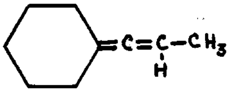


1

$p\text{-}R\text{-}C_6H_4\text{-}CHO$

2 a, R = OMe
b, R = H
c, R = F



3

$p\text{-}MeO\text{-}C_6H_4\text{-}CH_2OH$

4

$p\text{-}R\text{-}C_6H_4\text{-}CHOH\text{-}CH_3$

5 a, R = OMe
b, R = H
c, R = F

$CH_3\text{-}(CH_2)_5\text{-}R$

6 a, R = CHO
b, R = $CHOH\text{-}CH_3$
c, R = CH_2OH

$C_6H_5\text{-}R$

7 a, R = $CO\text{-}CH_3$
b, R = $CHOH\text{-}CH_3$

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