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FUNCTIONALIZED ISOPROPENYL ORGANOCOPPER REAGENTS III: CONJUGATE ADDITIONS OF 3,3-DIETHOXYISOPROPENYL CUPRATES TO ENONES.

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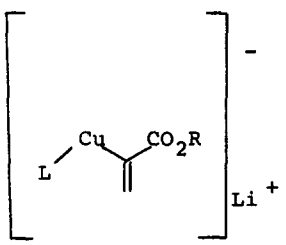
As part of our research program to develop new synthons for the introduction of acrylate units, we desired an appropriate organocopper reagent which would undergo 1,4 additions to α,β-unsaturated carbonyl compounds. Such a synthetic unit could then be introduced regiospecifically and hopefully stereospecifically with regard to substituents at the α and γ positions of an enone. From the accompanying paper,[1] it is evident that our objectives could not be met with an α-carbalkoxyvinyl cuprate such as 1. In this Communication, we wish to report on the preparation and conjugate addition reactions of two new cuprates (2,3) derived from the already known 2-lithio-3,3-diethoxypropene.[2] Synthetically, reagents 2 and 3 are ultimately equivalent to synthon 1 with the additional advantage of having the carbonyl moiety masked. In the latter context, reagents 2 and 3 are efficient synthons for transferring an acrolein unit.



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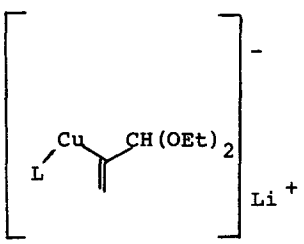
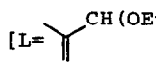
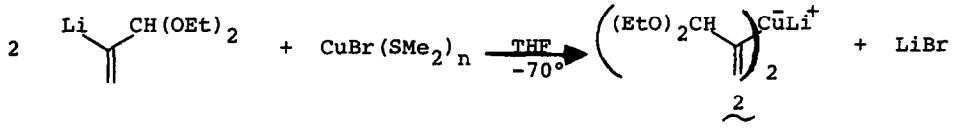


2 [L= 

]

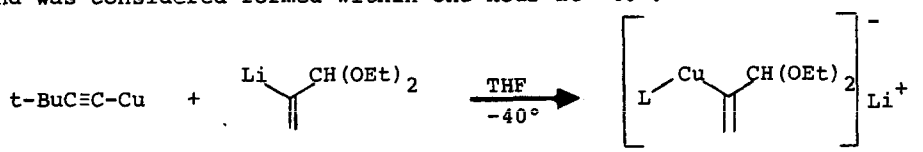
3 [L=t-Bu-C≡C-]

The homocuprate 2 was prepared in tetrahydrofuran by adding the preformed 2-lithio-3,3-diethoxypropene[2] to the dimethylsulfide complex of cuprous bromide[3] at low temperature (-60 to -70°C). Initially, the sulfide complex precipitated from solution upon cooling to -70°C; however, after addition of the isopropenyl lithium compound, a homogeneous, yellow solution resulted.



2

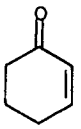
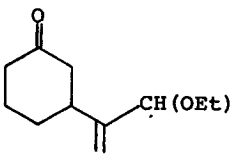
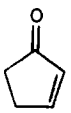
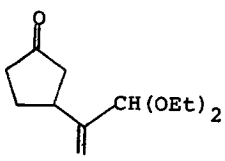
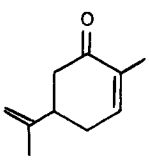
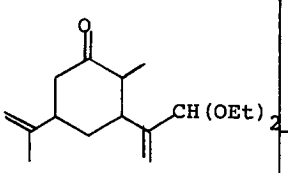
The mixed acetylenic isopropenyl cuprate 3 was prepared by initial generation of copper t-butylacetylide in THF at -40°C from cuprous iodide and lithium t-butylacetylide. This copper acetylide was completely in solution at -40°C but precipitated at temperatures approaching -70°C. A cold THF solution of 2-lithio-3,3-diethoxypropene was then added to the copper acetylide solution at -40°C. The resulting mixed cuprate 3 was completely in solution and was considered formed within one hour at -40°.



3 L=t-BuC≡C-

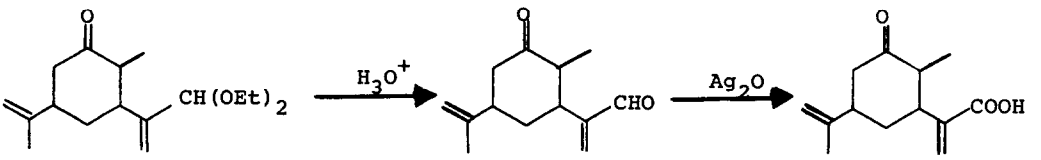
The reactions of cuprates 2 and 3 with several cyclic enones listed in Table I revealed some interesting differences. The homocuprate 2 reacted well with cyclohexenone, cyclopentenone and carvone, while the mixed cuprate 3 appeared less reactive towards cyclopentenone and unreactive towards carvone at -40°C. Neither reagent reacted with acetylcyclohexene at temperatures below -30°C. The reactions were maintained at the temperatures indicated in Table I for 2-3 hours after addition of the enone. The reactions were then quenched with a saturated ammonium chloride solution. A white precipitate resulted which was filtered and washed with ether. The filtrate and ether washes were extracted with 10% ammonium hydroxide to remove remaining copper species. The organic extracts were concentrated to a mixture of the 1,4-adduct, unreacted enone and some acrolein diethylacetal, which could be easily removed in vacuo.

Table I

Enone	Adduct[4]	Cuprate	Temp.	Yield
		2	-70°	80%
		3	-40°	96%
		2	-70°	65%
		3	-40°	15-20%
		2	-70°	65%
		3	-40%	0%

The failure of cuprate 3 to conjugately add to the more hindered carvone could only qualitatively be attributed to the increased stabilization by the acetylene ligand. The yields of the adducts have not been maximized, but these initial results suggest that the homocuprate 2 is more reactive towards 1,4-conjugate additions than the mixed cuprate 3.

The acrolein acetal adducts obtained could easily be transformed into the corresponding acrylic acid derivatives. Hydrolysis of the acetals with oxalic acid in acetone-water mixtures quantitatively yielded the acroleins. Subsequent oxidation of the aldehyde in aqueous dioxane and with silver oxide[5] completes the conversion to the acrylic acid derivative[4] which could not be obtained directly from copper reagent 1.



References

1. J. P. Marino and D. M. Floyd, Tetrahedron Lett., 0000 (1975).
2. J-C. Depezay and Y. L. Merrer, ibid., 2751 (1974).
3. H. O. House, C-Y. Chu, J. M. Wilkens and M. J. Umen, J. Org. Chem., 40, 1460 (1975).
4. All new compounds gave satisfactory elemental analyses, and exhibited spectral data consistent with the assigned structures.
5. J. A. Marshall and N. Cohen, J. Org. Chem., 30, 3475 (1965).