

CARBOXYVINYLATION; A ONE-STEP SYNTHESIS OF α,β -UNSATURATED ACIDS

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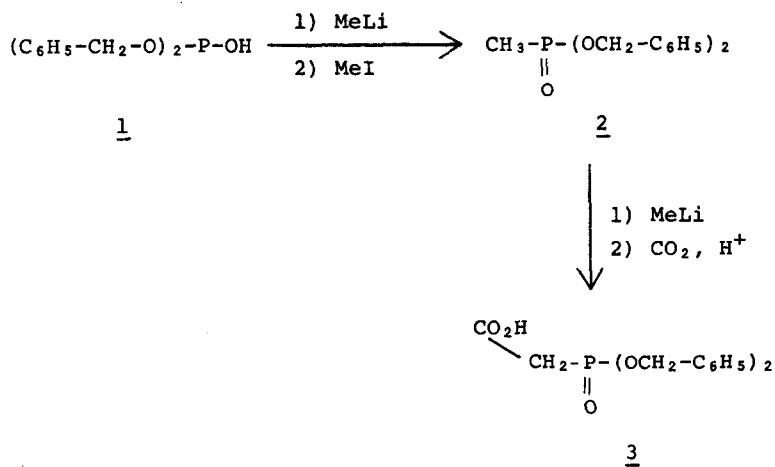
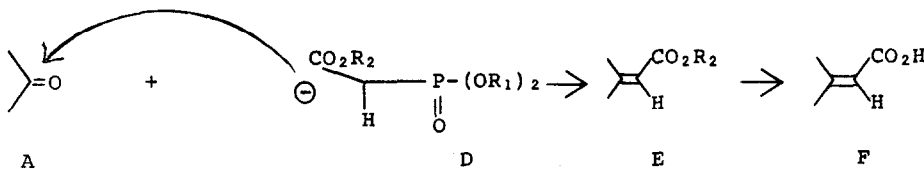
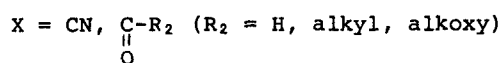
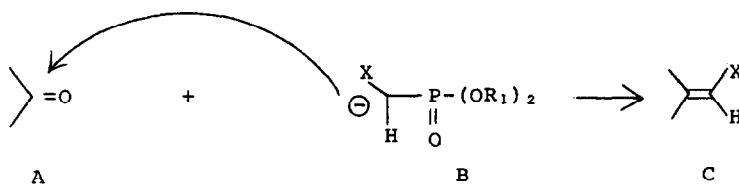
A frequently used two carbon homologation reaction is the Emmons reaction in which an aldehyde or ketone reacts with the anion derived from an α -phosphono reagent (A+C).¹ In many instances, the Emmons reaction is utilized to give an intermediate α,β -unsaturated ester, which can subsequently be hydrolyzed to give the α,β -unsaturated acid (C+F). A limitation of this procedure has been the homologation of carbonyl substrates which are acid or base sensitive and are not readily converted to their free acid under hydrolysis conditions. We report here a one-step carboxyvinilation of an aldehyde or ketone to give the derived α,β -unsaturated acid.

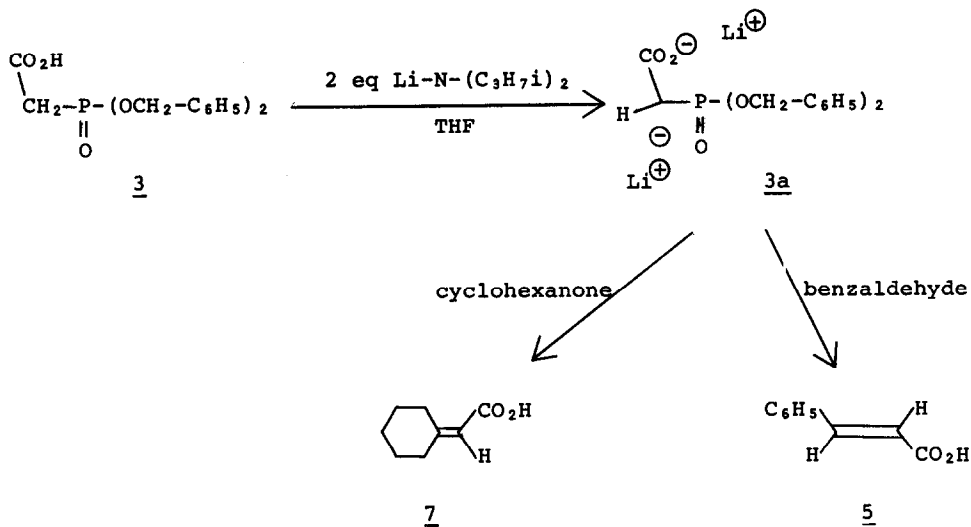
Treatment of dibenzylphosphite (1) with methyl lithium in tetrahydrofuran (THF) at -80° followed by addition of methyl iodide afforded (upon work-up) phosphonate 2 which was treated directly with methyl lithium in THF at -80° followed by the addition of carbon dioxide to give after work-up a 40% overall yield of the new reagent α -dibenzylphosphonoacetic acid (3); τ CDCl₃: [(CO₂H), -0.37 (singlet)], [(C₆H₅-CH₂O)₂, 2.67 (singlet)], [(C₆H₅-CH₂O)₂, 4.93 (doublet, J=9 Hz)], [(CH₂-P), 6.93 (doublet, J=22Hz)] isolated as an oil.^{2a,b,3}

$$\begin{array}{c} \text{O} \\ \parallel \\ \text{O} \end{array}$$

We theorized that 3 could be converted to its dianion, 3a, and that this reagent might react in the Emmons manner with aldehydes and ketones to give the corresponding α,β -unsaturated acids directly. In the hope of realizing this transformation, substrate 3 was treated with 2 equivalents of lithium diisopropylamide in THF at -80° followed by the addition of benzaldehyde, 4. The reaction was allowed to warm to room temperature and to stir for 12 hours. Work-up and preparative thick layer chromatography afforded a 70% yield of

trans-cinnamic acid, 5.^{4,5} The synthetic method was extended to ketones by the reaction of 3 with cyclohexanone, 6, in the same manner as described previously to give a 66% yield of 7.⁶





REFERENCES

1. W. S. Wadsworth and W. D. Emmons, *J. Amer. Chem. Soc.* **83**, 1733 (1961).
2. (a) Compound 3 gave a good high resolution mass spectrum.
(b) All attempts to crystallize 3 were unsuccessful.
3. The dibenzyl functionality was employed because it limits the water solubility of 3, and as a consequence, it can be easily extracted into organic solvents. In contrast, the corresponding dimethylphosphono derivative is completely soluble in water and cannot be extracted into organic solvent.
4. Silica gel plates and a 2:1 ether-petroleum ether solvent system were used for chromatography.
5. There was no evidence of the cis isomer.
6. Identical with a sample made by an alternate synthesis.

ACKNOWLEDGEMENT

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