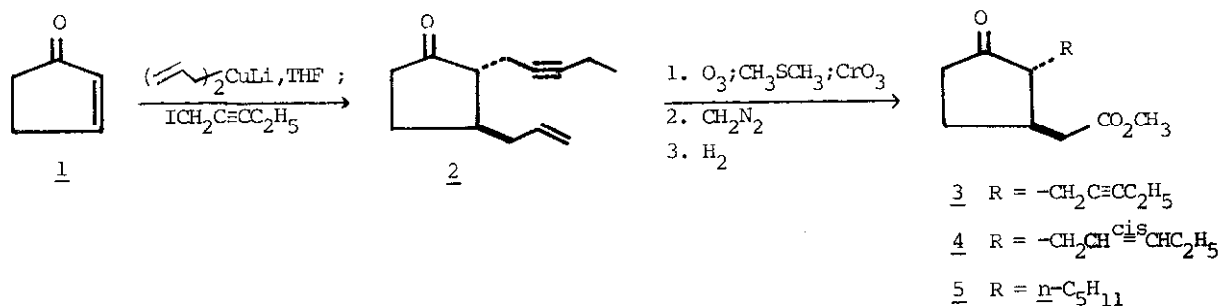


A SHORT, EFFICIENT SYNTHESIS OF METHYL DL-JASMONATE AND RELATED COMPOUNDS¹

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Methyl jasmonate (4) is found in *Jasminum grandiflorum* L. and is essential for the characteristic odor of Jasmine^{2,3}. Because of its importance, it has been the objective of several published chemical syntheses⁴, all of which, however, are long (7 steps or more) and proceed in low yield (30% or less). We now wish to report a short, high yield synthesis of methyl dl-jasmonate and some related compounds based on a conjugate addition-alkylation⁵ of cyclopentenone in which the allyl group is used as an acetic acid synthon. Malonic esters and other derivatives of acetic acid (ester) would appear to be unsuitable⁶ for use in this type of approach.



Addition of cyclopentenone (1) to a slight excess of lithium diallylcuprate⁷ in THF at -78° readily generated the copper-lithium enolate of 3-allylcyclopentanone⁸ which, after treatment with tetramethylethylenediamine (TMED)^{5b,d}, was smoothly alkylated with 1-iodo-2-pentyne⁹ in hexamethylphosphoramide (HMPA) to afford the disubstituted ketone (2) [I.R. : ν_{\max} (film) 3075, 1740, 1638, 915 cm^{-1} ; N.M.R. : δ (CDCl_3) 1.07 (t, $J = 7\text{ Hz}$, 3-H), 5.05 (m, 2-H), 5.7 ppm (broad m, 1-H)] in ca. 60% yield (although not optimized). Despite the well known tendency of cyclopentanone enolates to undergo rapid proton transfer reactions leading to equilibration^{5b} and thus to mixtures of products, using this reactive electrophile we found only relatively small amounts of polyalkylated material and no appreciable amount of any positional isomer or of the cis-isomer of the disubstituted cyclopentanone (2). In addition, no rearrangement^{5b} products were detected. These favourable features eliminated the need of having to effect a tedious separation of isomers, a problem inherent in many of the other syntheses⁴.

Selective ozonolysis¹⁰ of the ene-yne (2) in methanol-methylene chloride at -78° followed by oxidative work up (addition of dimethyl sulfide¹¹, solvent evaporation, and treatment with Jones reagent in acetone) readily gave dehydrojasmonic acid⁴, which was converted with diazomethane to pure methyl dehydrojasmonate (3)⁴, in an overall yield of greater than 80%. The acetylenic bond was completely stable under these conditions.

To complete the synthesis, methyl dehydrojasmonate (3) was hydrogenated in acetone using the Lindlar catalyst¹² to afford methyl dl-jasmonate (4)^{2,4}. Methyl dl-dihydrojasmonate (5)^{2,4} could also be obtained from (3) by catalytic hydrogenation in ethyl acetate using 5% palladium on carbon. Methyl dl-jasmonate (4) and methyl dl-dihydrojasmonate (5), both obtained in nearly quantitative yields from compound (3), displayed spectral and chromatographic properties in complete agreement (except for rotation) with those of authentic samples².

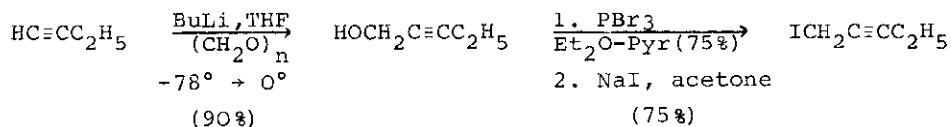
The short, efficient synthesis described above demonstrates the value of this approach to α -substituted- β -carboxyalkyl ketones from α,β -unsaturated ketones¹³.

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- Work up after 30 min afforded a 95% yield of 3-allylcyclopentanone. The reaction of a mixed cuprate, $(\text{O})(\text{C}_3\text{H}_5)\text{CuLi}$, with cyclopentenone in Et_2O -THF (but not in THF alone)^{5a,7} was also nearly quantitative. Coates and Sandefur^{5d} have shown, however, a deleterious effect of Et_2O in the alkylation reactions of copper-lithium enolates, thus making the diallylcuprate-THF system more attractive.
- 1-Iodo-2-pentyne was readily prepared by the following sequence :



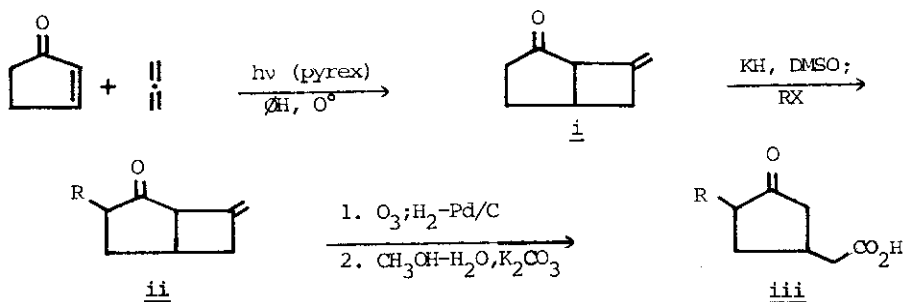
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13. We have also found, based on work by Eaton¹⁴, that the isomeric 2-alkyl-4-carboxymethylcyclopentanones (iii) can be synthesized by the method outlined below :



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