

A SYNTHESIS OF ENOL LACTONES

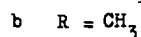
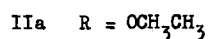
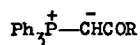
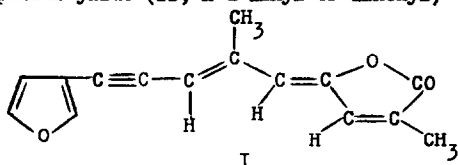
A.P. Gara, R.A. Massy-Westropp and G.D. Reynolds

Department of Organic Chemistry, University of Adelaide,
Adelaide, South Australia.

(Received in UK 25 August 1969; accepted for publication 16 September 1969)

This investigation began in an attempt to develop an efficient new synthetic method for the stereospecific synthesis of the γ -alkylidene double bond in the sesquiterpene, freelingyne, I (1). Although methods are available for the preparation of enol lactones they usually lack stereochemical control.

Enol lactones can be prepared by using the Wittig reaction between stable phosphorus ylids (II, R = alkyl or alkoxy) and cyclic five membered aliphatic anhydrides.



YLID	ANHYDRIDE	% YIELD [/]	<u>CIS</u>	<u>TRANS</u>
IIa	citraconic	58		1
IIa	maleic [*]	50		
IIa	dimethylmaleic	60		35
IIa	succinic	30		
IIa	<u>cis</u> -1,2,3-6-tetrahydrophthalic	94		
IIb	citraconic	24		22 [≠]
IIb	dimethylmaleic			80

[/] isolated

^{*} as furan adduct

[≠] mixture of both trans products

It is a general reaction with good yields (see Table for some examples) and offers considerable synthetic potential. Although most of the work has been carried out with carboethoxymethylene triphenylphosphorane (IIa) and acetylmethylene triphenylphosphorane (IIb), eight different phosphorus ylids have been used, all successfully.

Citraconic, dimethylmaleic, succinic and various substituted maleic and succinic anhydrides have all yielded the expected enol lactones. The reaction failed with maleic anhydride (probably because of addition to the double bond) but this problem was overcome by using the Diels-Alder adduct with furan. The product underwent a facile retro Diels-Alder reaction to give the desired enol lactone. These results should be contrasted with those observed for glutaric anhydride where the acylated phosphorane was obtained (2).

The reaction is not completely stereospecific although in most cases only the *cis* product could be isolated (3). However when both isomers were obtained, they were readily separable. Both electronic and steric factors must be considered in order to predict the products from unsymmetrical anhydrides (e.g. bromocitraconic and the cyclopentadiene adduct of citraconic anhydride). The configuration about the double bond was determined from chemical shift data or by unambiguous synthesis of the compound.

The reactions were carried out using equimolar quantities of reactants in refluxing chloroform or dimethoxyethane under nitrogen for 4-12 hr. Chromatography on silica gel gave the pure products.

The reaction described above gave enol lactones which have been successfully used for the synthesis of freelingyne (I, *trans, trans*-isomer) and analogues (4). The formation of enol lactones from phthalic anhydride has also been observed (5).

REFERENCES

1. R.A. Massy-Westropp, G.D. Reynolds and T.M. Spotswood, Tetrahedron Letters, 1939 (1966).
2. P.A. Chopard, R.J.G. Searle and F.H. Devitt, J.Org.Chem., 30, 1015 (1965).
3. The products are thermally stable considerably above the reaction temperatures employed.
4. R.A. Massy-Westropp and G.D. Reynolds, unpublished work.
5. P.A. Chopard, R.F. Hudson and R.J.G. Searle, Tetrahedron Letters, 2357 (1965).