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A New Photochemical Approach to Dimethylcyclopropanes. Synthesis of Epimaalienone and Conversion to α- and β-Cyperones

A.E. Greene, J-C. Muller and G. Ourisson

Laboratoire Associé au C.N.R.S., Institut de Chimie,
Université Louis Pasteur, Esplanade, 67-Strasbourg, France

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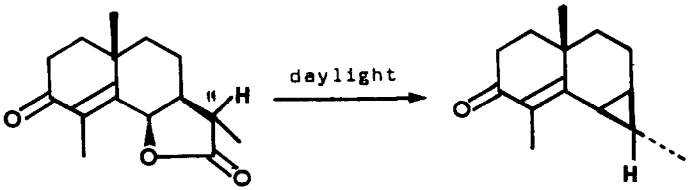
In a previous paper[1] a new photochemical decarboxylation reaction was described. Lactones 1 (C-11 epimers) were smoothly and stereospecifically converted in diffused daylight to ketone 2.



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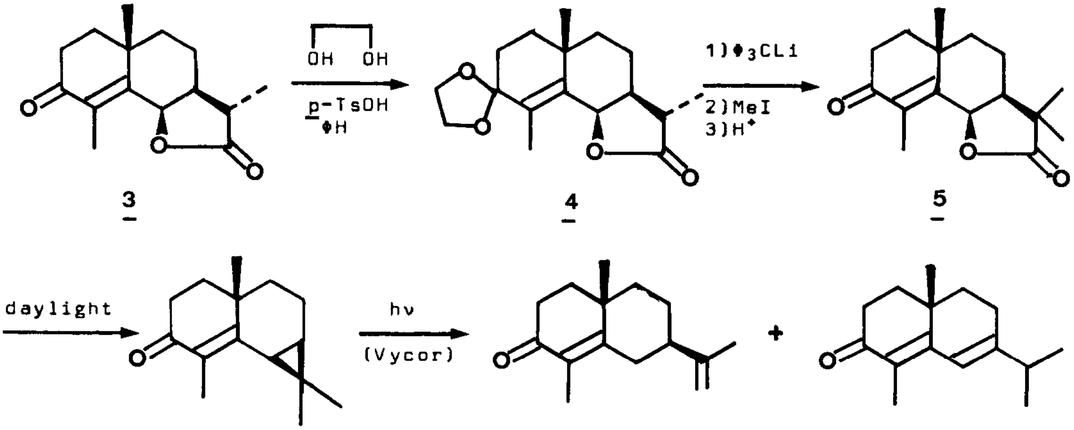
An extension of this reaction has led us to the synthesis of epimaalienone, 6. We now wish to report this synthesis and the photochemical conversion of 6 to α-cyperone and β-cyperone.



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Dihydro-6-episantonin[2], 3, was converted to its ethylene ketal 4 using ethylene glycol and *p*-toluenesulfonic acid in refluxing benzene, with azeotropic removal of water : NMR $\delta_{TMS}^{CDCl_3}$ 5.38 (d, J=5Hz, 1H), 4.05 (m, 4H), 1.77 (s, 3H), 1.33 (d, J=8Hz, 3H), and 1.12 ppm (s, 3H) ; $M^{+\cdot}$ 292 (calc 292). Successive treatment of 4 with excess triphenylmethyllithium in DME, methyl iodide, and aqueous acid afforded lactone 5, which was purified by filtration through silica gel and either sublimation (70° at 0.005 mm) or recrystallization from hexane—benzene (∿ 50 % yield from 3) : mp 125-126° , $[\alpha]_D$ -108° ($CHCl_3$) ; UV λ_{max}^{EtOH} 244 (ε = 15,400) and 327 nm (ε = 43) ; IR $\lambda_{max}^{CHCl_3}$ 5.66 and 6.00 μ ; NMR $\delta_{TMS}^{CDCl_3}$ 5.45 (d, J=5Hz, 1H), 1.90 (s, 3H), 1.35 (s, 3H), and 1.23 ppm (broad s, 6H), $M^{+\cdot}$ 262 (calc 262) ; *Anal.* Calc. for $C_{16}H_{22}O_3$: C 73.25, H 8.45 ; Found : C 73.03, H 8.65.

Lactone 5, neat, was exposed in a Pyrex vessel to weak daylight over a period of one week (exposure to direct sunlight resulted in a faster reaction, but in a lower yield of 6). Glc and tlc analyses indicated the formation of a single product, which was isolated by silica gel chromatography and identified as epimaalienone, 6 (85 % yield based on unrecovered 5) : bp ∿ 85° (0.04 mm) ; $[\alpha]_D$ -605° ($CHCl_3$) , UV λ_{max}^{EtOH} 279 nm (ε = 15,500) , IR λ_{max}^{film} 6.05 and 6.27 μ ; NMR $\delta_{TMS}^{CDCl_3}$ 1.79 (s, 3H), 1.24 (s, 3H), 1.10 (s, 3H), and 0.99 ppm (s, 3H) ; $M^{+\cdot}$ 218 (calc 218) ; *Anal.* Calc. for $C_{15}H_{22}O$: C 82.52, H 10.16 ; Found : C 82.57, H 10.14. The mechanism which we propose for this reaction has been discussed previously[1].

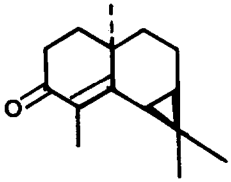
Vycor-filtered irradiation of ketone 6, performed in benzene or ether under nitrogen with a Philips HPK 125 W lamp, afforded two major products which were isolated by chromatography on alumina (benzene—hexane) and identified as α-cyperone, 7, and β-cyperone[3], 8, by spectroscopic and chromatographic comparisons with authentic samples. The results are summarized in Table I.

Table I

Irradiation of Epimaalienone, 6

Solvent[4]	time (hr)	Yield (%)[5,6]		
		6	7	8
benzene	5	5	47	32
ether	2	5	57	12

These results are consistent with those obtained from the irradiation of maalienone, 9, by Kropp and Krauss[7] in that only products derived from "external"cyclopropyl bond cleavage are observed. In contrast, ketone 10 is photochemically stable[8].



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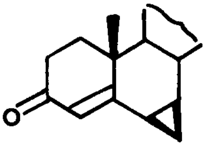

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References

1) G.W. PEROLD and G. OURISSON, Tetrahedron Letters, 3871 (1969). See also : R.S. GIVENS and W.F. OETTLE, J. Amer. Chem. Soc., 93, 3301 (1971), and references cited.

2) Obtained by epimerization (E. PIERS and K.F. CHENG, Canad. J. Chem., 46, 377 (1968)) of 1,2-dihydro-6α,11α-santonin, obtained by hydrogenation of α-santonin (J.J. SIMS, V.K. HONWAD and L.H. SELMAN, Tetrahedron Letters, 87 (1969)).

3) Obtained by H_2SO_4 treatment of α-cyperone (R. HOWE and F.J. McQUILLIN, J. Chem. Soc., 2423 (1955)).

4) Approximately 50 mg of 6 in 200 ml of solvent.

5) The yields are based on averaged glc compositions of the distilled reaction mixtures and are corrected for lost material. No other significant products were detected.

6) Control runs demonstrated that although α-cyperone and β-cyperone do not interconvert under the irradiation conditions, the amount of β-cyperone does diminish with time.

7) P.J. KROPP and H.J. KRAUSS, J. Org. Chem., 32, 4118 (1967).

8) J. PFISTER, H. WEHRLI, and K. SCHAFFNER, Helv. Chim. Acta, 50, 166 (1967).