

A NEW SYNTHESIS OF 3(2H)-FURANONES FROM KETONES

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Ketones are allowed to react with the lithium salt of propynal diethyl acetal and the resulting adducts are treated with sulfuric acid-methanol (1:1) to give the title compounds.

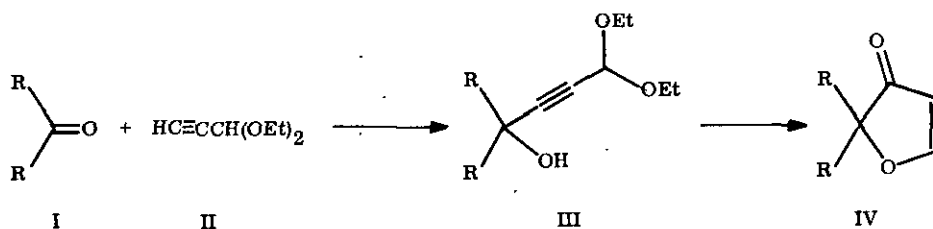
We wish to report a facile two-step procedure for the synthesis of 3(2H)-furanones^{1,2,3} based on the acid-catalyzed ring closure of propynal diethyl acetal adduct of ketones.

Ketone I was allowed to react with the carbanion of propynal diethyl acetal (II) to give the adduct III which was in turn dissolved in methanol and treated with sulfuric acid at 0°C. Both hydration of the triple bond and deacetalization took place spontaneously to yield 3(2H)-furanone IV having characteristic spectral properties (IR: two strong absorptions near 1700 and 1560 cm⁻¹, PMR: two doublets around δ 5.4 and 8.1). The results are given in the order of ketone, III (% yield), and IV (% yield): acetone, IIIa (64), IVa (98); cyclohexanone, IIIb (99), IVb (67, 59⁴); cyclododecanone, IIIc (79), IVc (70). Thus, the new method is applicable to both acyclic and cyclic ketones. The adduct of II and heptanal, however, gave a complex mixture of products under the above cyclization condition.

Formation of 3(2H)-furanone from III is remarkable in respect that the propargylic tertiary hydroxyl group in III stands against dehydration in contrast to the acid-catalyzed cyclopentenone synthesis from propargyl alcohol dianion adduct of ketones.⁵ Thus, the intermediate Va or Vb should be responsible for the III → IV transformation according to the Baldwin's rule⁶ (5-exo-trig, allowed).⁷

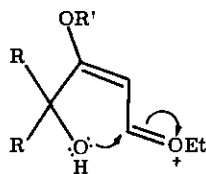
Following experimental procedure for IVc is typical: To a THF (10 ml) solution of II (0.96 g, 7.5 mmol) was added butyllithium hexane solution (1.85 M, 7.5 mmol) at -78°C. After 10 min cyclododecanone (0.91 g, 5.0 mmol) dissolved in THF (7 ml) was added in 15 min. Stirring at -78°C for 1 h and at r.t. for 30 min followed by work-up and column chromatography (silica gel, hexane-ether 5:1) gave IIIc (1.22 g, 79% yield).

The adduct IIIc (0.22 g, 0.71 mmol) was dissolved in methanol (1.0 ml) and cooled at 0°C. To this solution was added 98% sulfuric acid (1.0 ml) dropwise over 10 min. After the addition was completed, the reaction mixture was stirred for 30 min and worked up. Preparative TLC purification (silica gel, hexane-

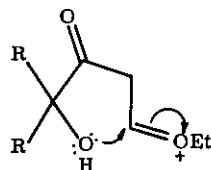


a: R = Me, b: R, R = -(CH₂)₅-, c: R, R = -(CH₂)₁₁-

ether 1:1, R_f 0.33-0.47) gave IVc (0.117 g, 70% yield), mp 81.0-81.5°C (hexane), IR (Nujol): 1709, 1684, 1567 cm^{-1} , PMR (CCl_4): δ 5.43 (d, $J = 2.7$ Hz), 8.04 (d, $J = 2.7$ Hz), MS: m/e 236 (M^+), Found: C, 75.92; H, 10.23%.



Va



Vb

$R' = \text{H or Me (or COCF}_3\text{)}$

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