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DIANION OF 2-(METHYLTHIO)-4-PENTENOIC ACID: A USEFUL REAGENT FOR THE PREPARATION OF 5-METHYLENE-2(5*H*)-FURANONES

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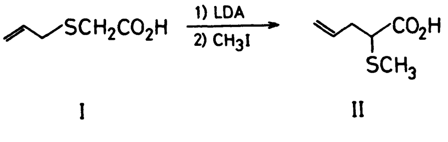
A general and mild approach to 5-methylene-2(5*H*)-furanones has been demonstrated, which involves (a) the alkylation of dianion of 2-(methylthio)-4-pentenoic acid, (b) the cyclization followed by dehydrosulfenylation, and (c) the facile dehydroiodination by Na_2CO_3.

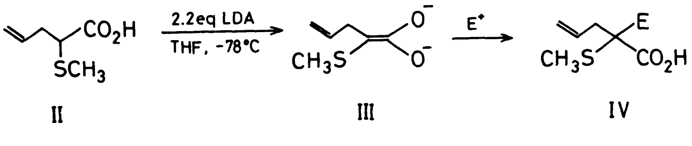
The constractions of methylene-lactones are of great importance in synthetic organic chemistry and have received considerable attention since the methylene-lactone unit has been found in many naturally occurring products and biologically active compounds.[1,2]

Until now, a wide variety of synthetic routes to α-methylene-lactones have been developed,[1] but the general procedures for the syntheses of γ-methylene-lactones and 5-methylene-2(5*H*)-furanones have received scant attention.[2] Recently, Katzenellenbogen[3] and Yamamoto[4] have found the efficient mercuric ion-catalyzed syntheses of γ-methylene-γ-butyrolactones from acetylenecarboxylic acids. We now report here a new and general method for preparing 5-methylene-2(5*H*)-furanones using the new dianion of 2-(methylthio)-4-pentenoic acid (II) as a framework of *exo*-methylene-lactone.

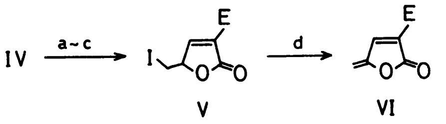
Treatment of (allylthio)acetic acid (I) with 2 equiv of lithium diisopropylamide (LDA) in THF at 0°C followed by the addition of CH_3I produced 2-(methylthio)-4-pentenoic acid (II) in 82% yield via [2,3]-sigmatropic rearrangement of the resulting dianion of I.[5]



Generation of dianion III was readily accomplished by reaction of acid II with 2.2 equiv of LDA in THF at -78°C for 30 min.[6] Subsequent addition of alkyl halides (1.1 equiv/THF) or aldehydes (1.1 equiv/THF-HMPA) followed by aqueous workup gave α-alkylated acids IV in good to high isolated yields (Table 1).



Iodolactonization of acids IV$^{2c)}$ and oxidation followed by dehydrosulfenylation$^{7)}$ produced 5-iodomethyl-2(5*H*)-furanones (V) in good overall yields from IV as shown in Table 1. Finally, treatment of V with 2.2 equiv of Na_2CO_3 in methanol at room temperature for 30 min smoothly gave the desired 5-methylene-2(5*H*)-furanones (VI) in nearly quantitative yields.



(a) $I_2/NaHCO_3$-KI-H_2O, r.t.
(b) MCPBA/CH_2Cl_2, -78°C
(c) $CaCO_3$/toluene, reflux
(d) Na_2CO_3/CH_3OH, r.t.

In these synthetic sequences, the dianion III is synthetically equivalent to α-anion VII of 5-methylene-2(5*H*)-furanone. This mild procedure would be highly potential in synthesis of the more functionalized molecules. Further synthetic applications of this dianion are in progress.

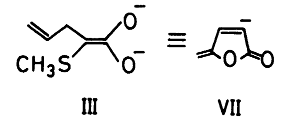
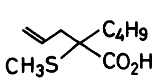
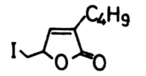
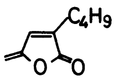
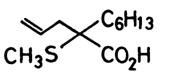
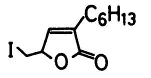
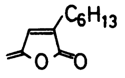
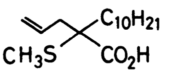
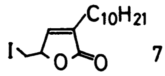
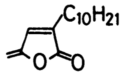
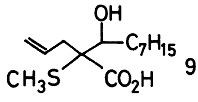
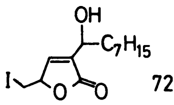
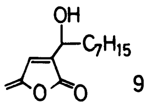
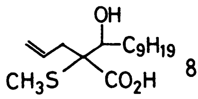
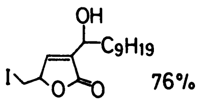
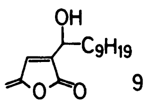


Table 1.

Electrophile	IV	Yield	V	Yield	VI	Yield
n-C_4H_9I		74%		75%		97%
n-$C_6H_{13}Br$		76%		83%		97%
n-$C_{10}H_{21}I$		85%		77%		97%
n-$C_7H_{15}CHO$		90%		72%		94%
n-$C_9H_{19}CHO$		89%		76%		98%

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References

1) For recent review, see: T. Shono and Y. Matsumura, J. Syn. Org. Chem. (Japan), 39, 358 (1981). 2) a) M. Yamamoto, J. Syn. Org. Chem. (Japan), 39, 25 (1981). b) Y. S. Rao, Chem. Rev., 76, 625 (1976). c) V. Jäger and H. J. Günter, Tetrahedron Lett., 1977, 2543. d) G. A. Kraus and H. Sugimoto, J. Chem. Soc., Chem. Commun., 1978, 30. e) R. M. Adlington and A. G. M. Barrett, J. Chem. Soc., Chem. Commun., 1979, 1122. f) H. Wyss, L. Révész, and R. Scheffold, Hel. Chim. Acta, 64, 2272 (1981). 3) a) R. A. Amos and J. A. Katzenellenbogen, J. Org. Chem., 43, 560 (1978). b) S. W. Rollinson, R. A. Amos, and J. A. Katzenellenbogen, J. Am. Chem. Soc., 103, 4114 (1981). 4) a) M. Yamamoto, J. Chem. Soc., Chem. Commun., 1978, 649. b) M. Tamamoto, J. Chem. Soc., Perkin I, 1981, 582. 5) K. Tanaka, M. Terauchi, and A. Kaji, Chem. Lett., 1981, 315. 6) B. M. Trost, M. J. Crimmin, and D. Butler, J. Org. Chem. 43, 4549 (1978). 7) For recent review, see: B. M. Trost, Acc. Chem. Res., 11, 453 (1978).

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