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A New Approach for the Synthesis of α-Methylene-γ-Butyrolactones from α-Bromomethyl Acrylic Acids (or Esters)

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This article may be used for research, teaching, and private study purposes. Any substantial or systematic reproduction, redistribution, reselling, loan, sub-licensing, systematic supply, or distribution in any form to anyone is expressly forbidden. Terms & Conditions of access and use can be found at http://www.tandfonline.com/page/terms-and-conditions A NEW APPROACH FOR THE SYNTHESIS OF α-METHYLENE-r-BUTYROLACTONES FROM α-BROMOMETHYLACRYLIC ACIDS (OR ESTERS) Jing-yao ZHOU Guo-di LU Shi-hui WU^{*} Department of Chemistry, Fudan University Shanghai 200433, P. R. CHINA

Abstract: This paper reports that a new approach for the synthesis of *d*-methylene-*t*-butyrolactones from the reaction of *d*-bromomethyl acrylic acid (or ester), powdered tin and carbonyl compounds in one pot with excellent to good yields.

The a-methylene-r-butyrolactone is a major class of in natural occurring sesquiterpene lactones skeleton exhibit remarkable physiological activities^[1]. which It is also one of the most important building blocks in synthetic organic chemistry of natural products. the Its biological activities and synthetic approach are reviewed in a series of articles [2]. Recently Stampf reported a direct method for the preparation of ∝-

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R=H, C₂H₅. R¹=H, R²: a=n-C₄H₉; b=n-C₆H₁₃; c=CH₃CH=CH; d=C₆H₅; e=C₆H₅CH=CH; f=4-NO₂C₆H₄; g=2-ClC₆H₄. R¹+R²: h= (CH₂)₅.

methylene- γ -lactone based on 2-carboethoxyallylation of aldehydes by means of tin(II) chloride and Amberlyst $15^{[3]}$.

we report an approach for the synthesis of Here a-methylene-r-butyrolactones based on 2-carboethoxyallylation of carbonyl compounds by means of organotin The reagent. a-methylene- r -butyrolactones canbe synthesized in one pot from *d*-bromomethylacrylic acid (or ester) in the medium of tetrahydrofuran and saturated aqueous solution of ammonium chloride. The results of reactions are summarized in following table.

In scheme, the reactions proceed smoothly above under normal condition without demand on absolute anhydrous and deoxygenation. The intermediate organotin reagents need not to be isolated. The products αmethylene-r-butyrolactones(3) can be obtained in one pot with excellent to good yields. Moreover, thereactions carry out without difficulty when the substrates containing reactive groups such as halogen, hydroxyl, methoxyl, or nitro group.

General procedure for the synthesis of α -methylene- γ -butyrolactions

A suspension of 8 mmol ethyl α -bromomethylacrylate(or α bromomethylacrylic acid), 8 mmol of aldehyde (or ketone), 8 mmol of actived tin, THF(20 mL), and saturated aqueous solution of ammonium chloride (10 mL) is stirred for 14 h at 60 °C. After evaporating of THF, 10 mL of brine is added. The reaction mixture is extracted with ether (2x25 mL), the combined extracts are dried over anhydrous sodium sulfate. The ether is removed and the mixture is treated with catalytic amount of p-toluenesulforic acid in 40 mL of dimethoxy-

	structure	yield (%)	
$product^*$	of product	$R=C_2H_5$	R=H
3a ^[4]	CH ₃ (CH ₂) ₃ -	81.2	68.2
3b[4]	сн ₃ (сн ₂) ₅ -	76.9	70.1
3c ^[5]	снзсн=сн-	76.1	65.2
3d[4]	O-LoLo	93.4	84.8
3e[6]	Ph-CH=CH	85.0	79.4
3f ^[7]	4-NO ₂ C ₆ H ₄	84.5	75.9
3g	2-C1C ₆ H ₄	80.9	73.1
3h[6]	V.L.	70.8	52.0

* For 3f the reaction is carried out in two steps that 4-nitrobenzaldehyde is introduced after metallic tin has disappeared. The solvent THF is replaced by dimethoxyethane and the reaction mixture is stirred for 14 h at 80 °C. ethane at room temperature for 2 h to converted 2 to 3. The products are purified by column chromatography on silica gel using petroleum ether/diethyl ether (1:1) as eluent.

All products are characterized by IR and 1 H NMR spectra, and the new compound 3g is also identified by mass spectra and elemental analysis.

 $3a: ymax(neat): 1760(s, C=0), 1660(w, C=C), 930(m, CH_2=C)cm^{-1}$. δ H(CCl₄, TMS): 0.89-1.33(m, 9H, C₄H₉), 2.49-3.34(m, 2H, CH₂), 4.20-4.50 (m,1H,O-CH), 5.33-5.40 (m,1H,C=CH),5.92-6.00 (m,1H,C=CH) ppm. 3b: ymax(neat): 1775(s,C=0), 1660(w,C=C), 930(m,CH₂=C)cm⁻¹. δ H(CCl₄,TMS):0.84-1.17(m,13H,C₆H₁₃),2.15-2.85(m,2H,CH₂), 3.95-4.33 (m,1H,O-CH), 5.33-5.50 (m,1H,C=CH), 5.83-6.11 (m,1H,C=CH) ppm. 3c: \forall max(neat): 1760(s,C=O), 1670(w,C=C), 920(m,CH₂=C)cm⁻¹. δ H(CCl₄,TMS): 1.67-1.77(d,3H,CH₃),2.33-3.33(m,2H,CH₂), 4.50-4.85 (m,1H,O-CH), 5.16-5.93 (m,3H,C=CH), 6.00-6.17 (m,1H,C=CH) ppm. 3d: \forall max(neat):1755(s,C=O),1660(w,C=C),930(m,CH₂=C)cm⁻¹. δ H(CCl₄,TMS): 2.46-3.45(m,2H,CH₂), 5.30-5.40(m,2H,O-CH, C=CH),6.00-6.13(t,1H,C=CH),7.08(s,5H,Ar-H) ppm. 3e: Jmax(neat):1755(s,C=O),1660(w,C=C),940(m,CH₂=C)cm⁻¹. δ H(CCl₄,TMS): 2.67-3.33(m,2H,CH₂),4.66-5.11(m,1H,O-CH), 5.33-6.67(m,4H,C=CH),7.00-7.31(m,5H,Ar-H) ppm.

3f: y max(neat): 1765(s,C=O), 1660(w,C=C), 1520(m,NO₂), 1340 (m,NO₂), 930(m,CH₂=C)cm⁻¹. δH(CCl₄,TMS): 2.33-3.50 (m,2H,CH₂), 5.50-5.67 (m,2H,O-CH,C=CH), 6.17-6.33(m,1H, C=CH), 7.17-7.42(m,2H,Ar-H), 8.00-8.21 (m,2H,Ar-H) ppm. 3g: m.p. 77-79 °C(uncorrected). y max(KBr): 1770(s,C=O), 1660(w,C=C), 930(m,CH₂=C) cm⁻¹. δH(CCl₄,TMS): 2.60-2.92 (m,1H,CH),3.40-3.76(m,1H,CH),5.60-5.92 (m,2H,OCH,C=CH), 6.28 (t,1H,C=CH), 7.20-7.51(m,4H,Ar-H) ppm. m/z(%): 208 (M⁺), 68 (base, C₄H₄O). Anal. Calcd. for C₁₁H₉ClO₂: C, 63.32; H, 4.35. Found: C, 63.21; H, 4.03. 3h: ymax(neat):1760(s,C=O),1670(w,C=C),930(m,CH₂=C)cm⁻¹. δ H(CCl₄,TMS): 1.33-1.85(m,10H,CH₂),2.50-2.66(m,2H,CH₂), 5.35-5.45(m,1H,C=CH),5.92-6.13(m,1H,C=CH) ppm.

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References and Notes

a) H.M.R. Hoffman and J. Rabe, Angew. Chem., Int.
 Ed. Eng., 1985, <u>24</u>, 94.

b) C. Beland; C.Roussakis; Y. Letourneux; N. E.
Alami and J. Villieras, Synth.Commun., 1985, 15, 1233.

 a) J.C. Sarma and R.P. Sarme, Hetercycles, 1986, <u>24</u>, 441.

- b) P.A. Grieco, Synthesis, 1975, 67.
- c) P.A. Gammil and T.A. Bryson, Synth. Commun., 1975, <u>5</u>, 254.
- P. Talaga; M. Schaeffer; C. Benezra and J.-L. Stampf, Synthesis, 1990, 530.
- J. Martin; P. C. Watts and F. Johnson, J. Org. Chem., 1974, <u>39</u>, 1676.
- Y. Okuda; S. Nakatsukasa; K. Oshima and H. Nozaki, Chemistry Letters, 1985, 481.
- P. Talaga; M.Schaeffer; C. Benezra and J-L. Stampf, Synthesis, 1990, <u>6</u>, 530.
- Y. Hirose; K. Ishikawa; N. Iida; N. Nakazawa; T. Toyama; H. Tachibana; Y. Enomoto; Y. Funakoshi and T. Fujita, Jpn Kokai Tokkyo Koho, 79 84,564; CA., 1979, 91, 174843.

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