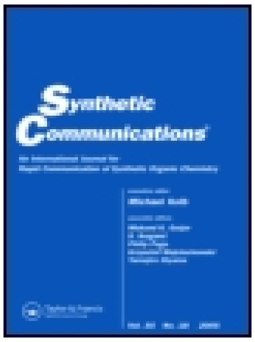

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The α'-Oxidation of α-Alkoxy Enones Using Manganese(III) Acetate in Combination with Carboxylic Acids

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THE α'-OXIDATION OF α-ALKOXY ENONES USING MANGANESE(III) ACETATE IN COMBINATION WITH CARBOXYLIC ACIDS

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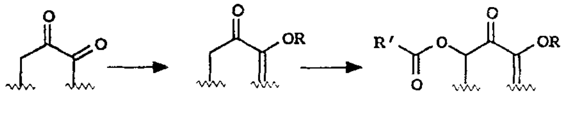
Abstract: The α'-oxidation of cyclic derivatives of α-alkoxy-α,β-unsaturated ketones using manganese(III)acetate in the presence of various carboxylic acids provided a convenient synthesis of 5-acyloxy-2-alkoxy-2-cyclopentenones and 6-acyloxy-2-alkoxy-2-cyclohexenones.

The oxidation of α,β-unsaturated ketones with manganese(III)acetate provided an efficient synthesis of α'-acyloxy-α,β-unsaturated ketones and the oxidation of α,β-unsaturated ketones using manganese(III)acetate in the presence of excess manganese(II)carboxylate or carboxylic acid provided a general synthesis of α'-acyloxy-α,β-unsaturated ketones[1].

In this study the latter oxidation process is extended to synthesize cyclic α-alkoxy-α,β-unsaturated ketones **2**,which exhibits the same regiochemical preference for the oxidation at the α'-position to afford the α'-acyloxy-α-alkoxy-α,β-unsaturated ketones **3** *in good yield(scheme).These* α'-acyloxy-α-alkoxy-α,β-unsaturated ketones **3** are useful intermediates in the synthesis of natural products[2].

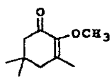
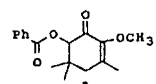
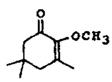
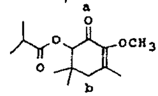
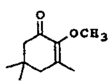
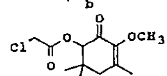
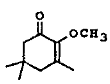
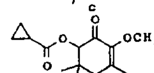
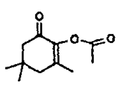
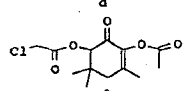
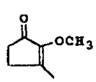
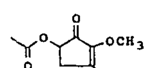
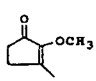
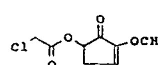
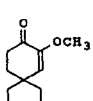
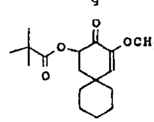
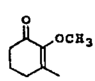
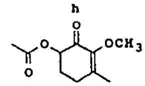
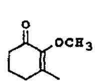
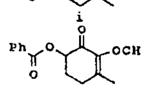
*author to whom correspondence should be addressed



1 2 3

Scheme

Table : The oxidation of α-alkoxy enones

Enone 2	Carboxylic Acid	Reaction Time (h)	Product 3	Yield (%)
	$PhCO_2H$	20	 a	73
	Me_2CHCO_2H	25	 b	83
	$ClCH_2CO_2H$	29	 c	88
	$(CH_2)_2CHCO_2H$	21	 d	90
	$ClCH_2CO_2H$	28	 e	66
	none	34	 f	60
	$ClCH_2CO_2H$	48	 g	47
	Me_3CCO_2H	36	 h	68
	none	35	 i	65
	$PhCO_2H$	48	 j	68

The general procedures for the synthesis of **3** are either not available or involve multiple steps.The conversion of cyclic α-diketones **1** to the α-alkoxy-α,β-unsaturated ketones **2**[3-12] and the oxidation of **2** using six equivalents of manganese(III)acetate in combination with twelve equivalents of a carboxylic acid led to the α-acyloxy-α,β-unsaturated ketones **3** in good yield (table).The anhydrous manganese(III)acetate, which is used for the oxidation was prepared from manganese(II)nitrate and acetic anhydride and dried over phosphorus(V)oxide prior to use.

The mechanism of this oxidations remain uncertain. The initial reaction takes place between the manganese(III) complex having both acetate and carboxylate ligands. The interaction of the α-β-unsaturated ketones with this complex,should result in acyl transfer via metal enolate formation (analogous to the enol lead triacetate intermediated proposed by Corey and Schaefer[13] for the acetoxylation reaction of ketones).

EXPERIMENTAL SECTION

All reagents were of commercial quality and reagent quality solvents were used without further purification. IR spectra were determined on a Phillips model PU9700. ^{1}H-NMR were determined on a Brucker AC 80 MHz FT spectrometer.

General procedure for the preparation of α'-acyloxy-α-alkoxy -α,β-unsaturated ketones:

A mixture of 4 equivalent of Mn(III)acetate and 12 equivalent of carboxylic acid in 160 ml of benzene was refluxed for 2 hours under a Dean-Stark trap. The mixture was cooled to 25^{0}C and 1 equivalent of enone was added. The mixture was refluxed until the dark brown color disappeared. The mixture was cooled to 25^{0}C diluted with 200 ml of ethyl acetate, washed successively with 1.0M of hydrochloric acid solution, aquecus saturated sodium bicarbonate

solution, saturated brine solution and dried over anhydrous magnesium sulphate.

6-Benzoyloxy-2-methoxy-3,5,5-trimethyl-cyclohex-2-en-1-one 3a: IR(neat):3010-2800,1780,1690 cm^{-1};^{1}H-NMR(CDCl$_3$) δ ppm: 1.05(s,3H,CH$_3$), 1.12(s,3H,CH$_3$), 1.90(s,3H,CH$_3$), 2.30(s,2H,CH$_2$), 3.70(s,3H,OCH$_3$), 5.50(s,1H,CH), 7.35-8.30(m,5H,C$_6$H$_5$). Anal. Calcd. for $C_{17}H_{20}O_4$(288.83): C,70.68 ; H,6.97. Found: C,70.76 ; H,7.21.

6-Isobutyroyloxy-2-methoxy-3,5,5-trimethyl-cyclohex-2-en-1-one 3b : IR(neat):3100-2810,1790,1680 cm^{-1}; ^1H-NMR($CDCl_3$) δ ppm: 0.95(s,3H,CH_3), 1.00(s,3H,CH_3), 0.90-1.40(m,6H,2CH_3), 1.42-2.30(m,6H,CH,CH_2,CH_3), 3.70(s,3H,OCH_3), 5.30(s,1H,CH). Anal. Calcd. for $C_{14}H_{22}O_4$(254.32):C,66.11 ; H,8.72. Found: C,66.45 ; H,8.52.

6-Chloroacetoxy-2-methoxy-3,5,5-trimethyl-cyclohex-2-en-1-one 3c : IR(neat):3040-2880,1779,1718 cm^{-1}; ^1H-NMR($CDCl_3$) δ ppm: 1.0(s,3H,CH_3), 1.10(s,3H,CH_3), 1.90(s,3H,CH_3), 2.30(s,2H,CH_2), 3.60(s,3H,OCH_3), 4.30(s,2H,CH_2Cl), 5.30(s,1H,CH). Anal. Calcd. for $C_{12}H_{17}O_4$Cl(260.71): C,55.27 ; H,6.57. Found: C,55.64 ; H,6.91.

6-Cyclopropanoyloxy-2-methoxy-3,5,5-trimethyl-cyclohex-2-en-1-one 3d: IR(neat):3110-2800,1760,1708 cm^{-1}; ^1H-NMR($CDCl_3$) δ ppm: 0.90-1.40(m,11H,2CH_3,2CH_2,1CH), 1.90(s,3H,CH_3), 2.30(s,2H,CH_2), 3.70(s,3H,OCH3), 5.20(s,1H,CH).Anal. Calcd. for $C_{14}H_{20}O_4$(252.3): C,66.64 ; H,7.99. Found: C,66.96 ; H,8.21.

2-Acetoxy-6-chloroacetoxy-3,5,5-trimethyl-cyclohex-2-en-1-one 3e: IR(neat):3110-3020,1773,1750,1711 cm^{-1}; ^1H-NMR($CDCl_3$) δ ppm: 1.10(s,3H,CH_3),1.20(s,3H,CH_3),1.70(s,3H,CH_3), 2.20(s,2H,CH_2), 2.30(s,3H,CH_3), 4.30(s,2H,CH_2Cl), 5.30(s,1H,CH).Anal. Calcd.for $C_{13}H_{17}O_5$Cl(288.72): C,54.07 ; H,5.93. Found: C,54.41 ; H,5.81.

5-Acetoxy-2-methoxy-3-methyl-cyclopent-2-en-1-one3f: IR(neat):2980-2880,1750,1720 cm^{-1}: ^1H-NMR($CDCl_3$) δ ppm; 1.97(s,3H,CH_3), 2.10(s,3H,CH_3), 2.20-2.35(m,2H,CH_2), 3.7(s,3H,OCH_3), 5.6(dd,J=5.6 and 12.7 Hz). Anal. Calcd. for $C_9H_{12}O_4$(184.19): C,59.12 ; H,4.92. Found: C,58.81 ; H,4.69.

5-Chloroacetoxy-2-methoxy-3-methyl-cyclopent-2-en-1-one 3g: IR(TF): 1730, 1680 cm^{-1}:^1H-NMR($CDCl_3$) δ ppm: 1.97(s,3H,CH_3), 2.20-2.35(m,2H,CH_2), 5.63(dd,J=5.6 and 12.7 Hz),4.21(s,2H,CH_2).Anal.Calcd. for $C_9H_{11}O_4$Cl(218.63): C,49.43 ; H,5.07. Found: C,49.14 ; H,5.23.

2-Methoxy-6-pivaloyloxy-spiro[4.4] undec-2-en-1-one 3h: IR(TF):1720,1680 cm^{-1}:^1H-NMR($CDCl_3$) δ ppm: 1.2(s,9H,C(CH_3)$_2$, 1.49-1.9(m,12H,CH_2), 3.7(s,3H,OCH_3), 5.5(s,1H,CH), 5.85(d,J=11.4Hz). Anal. Calcd. for $C_{17}H_{26}O_4$(294.38): C,69.35 ; H,8.90. Found: C,69.68 H,8.67. Mass spectrum (70eV) m/e (relative intensity) 294 (m+).

5-Acetoxy-2-methoxy-3-methyl-cyclohex-2-en-1-one 3l: IR(neat): 2980-2900,1740,1720cm^{-1}: ^{1}H-NMR($CDCl_3$) δppm: 1.80-2.40(m,4H,CH_2), 1.82(s,3H,CH_3),1.90(s,3H,CH_3),1.90(s,3H,CH_3), 3.80(s,3H,OCH_3), 5.60(m,1H,CH). Anal. Calcd. for $C_{10}H_{14}O_4$(198.21): C,60.59 ; H,7.11. Found: C,60.22 ; H,7.33.

6-Benzoyloxy-2-methoxy-3-methyl cyclohex-2-en-1-one 3j: IR(TF): 1726, 1683, 1683, 1633, 1601cm^{-1}:^{1}H-NMR δppm: 1.99(s,3H,Vinylic CH_3), 2.10-2.73(m,4H,CH_2),3.81(s,3H,OCH_3), 5.56(dd,J=5.6 and 12.7 Hz,1H,CH), 7.41-7.60(m,3H,Ar-H), 8.08-8.13(m,2H,Ar-H). Anal. Calcd. for $C_{15}H_{16}O_4$(260.28): C,69.21 ; H,6.19. Found: C,69,38 ; H,6.38.

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