Pergamon

Tetrahedron Letters, Vol. 35, No. 23, pp. 4023-4026, 1994
Elsevier Science Ltd
Printed in Great Britain
0040-4039/94 $7.00+0 00

0040-4039(94)E0690-Y

A NEW ROUTE TO HIGHLY SUBSTITUTED 1*H*-PYRROL-3(2*H*)-ONES

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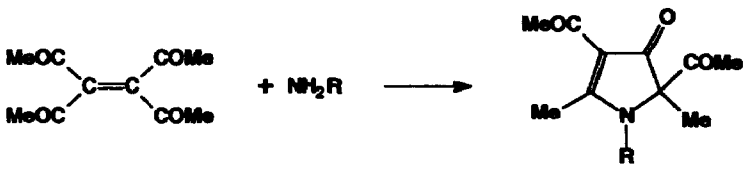
Abstract: Reaction of 3,4-diacetyl-3-hexen-2,5-dione , **1**, with alkyl or aryl primary amines, **2a-g**, led to highly substituted 1*H*-Pyrrol-3(2*H*)-ones, **3a-g**. The structure was established from a single crystal X-ray analysis of compound **3c**.

It has been shown that 3,4-diacetyl-3-hexen-2,5-dione , 1, is a molecule of particular interest for its capacity to react in different ways, according to the reagents and reaction conditions,usually leading to carbocyclic or heterocyclic compounds[1-5].

In our attempts to explore and exploit the synthetic potentiality of this molecule we have undertaken a study of the behaviour of **1** towards alkyl and aryl primary amines, **2a-g**. The two reagents, kept in anhydrous benzene under reflux for one hour, reacted to give in all cases one product, **3a-g**, in 90% yield (estimated on the reaction residue by NMR).



1 **2a-g** **3a-g**

R: a= C_6H_5 b= pClC_6H_4 c= pBrC_6H_4 d= pMeC_6H_4

e= p$MeOC_6H_4$ f= $C_6H_5CH_2$ g= $CH_3(CH_2)_2CH_2$

Analytic data showed that the products lost one molecule of water as compared with the reagents. In the IR spectra NH and OH absorption bands were absent while carbonylic bands were present. The ^1H NMR spectra showed, besides signals for amine groups, four singlets for four methyls (one of these at high field: 1,5-1,6 ppm); the ^{13}C NMR spectra had the peaks corresponding to three carbonyls, four methyls, a quaternary carbon (~80ppm) and two unsaturated carbons (~109 and ~181ppm). These data did not allow the assignment of the correct structure to the products[6]. The problem was solved through a single-crystal X-ray

diffraction study of compound **3c**. This product has the structure of 1-(p-bromophenyl)-2,4-diacetyl-2,3-dihydro-2,5-dimethyl-pyrrol-3-one[7]

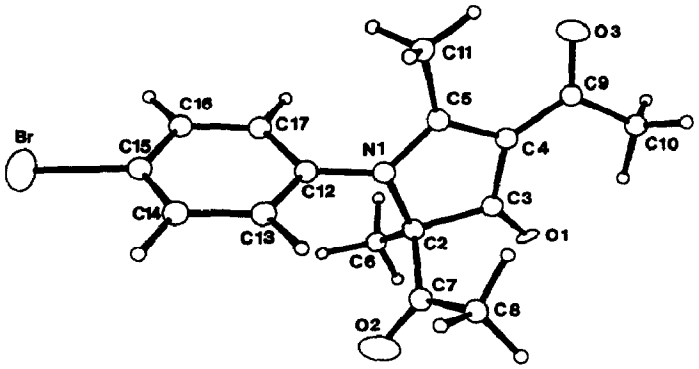
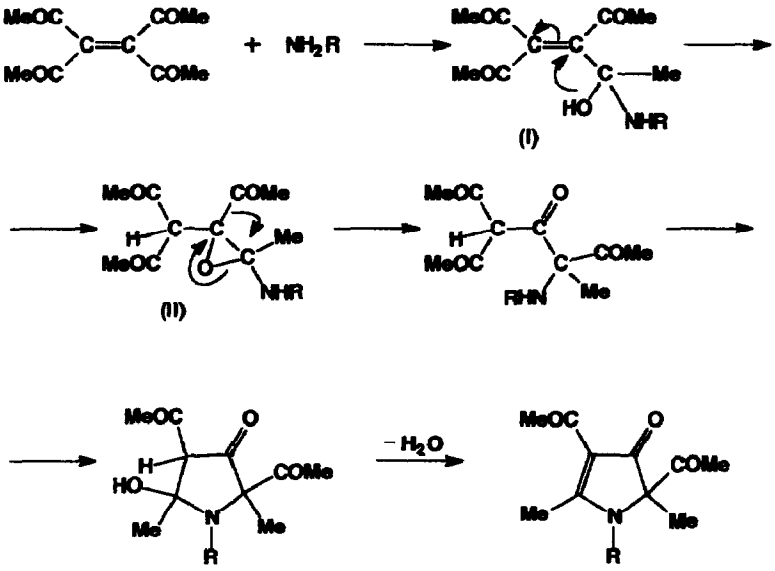


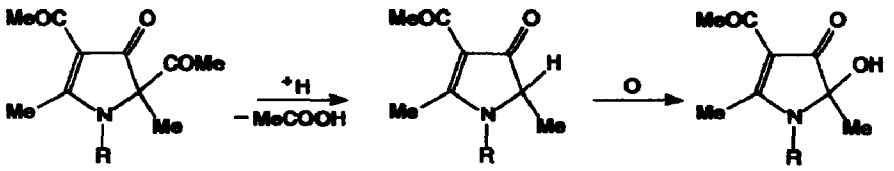
Figure. ORTEP drawing of compound **3c**.

This reaction is a new pathway for obtaining 1,2,2,4,5 polysubstituted pyrrol-3-ones bearing electron-withdrawing groups for which only a few syntheses are known[8-11]. It offers the advantages of ease of performance and high yield.

The reaction must involve a rearrangement of the skeleton of **1** with the migration of one acetyl group. A possible mechanism of reaction could pass from the amino-alcohol (I) and subsequent attack of the OH group on the electron-poor carbon of the double bond with formation of an epoxide (II). Opening of the latter with migration of the acetyl group, followed by cyclization and elimination of one molecule of water would lead to the product.



The compounds **3a-g** are not very stable but, slowly in the solid state and less slowly in solution (especially in presence of traces of ^{+}H or ^{-}OH ions), they transform to compounds **5a-g**[12]. The reaction could proceed to **4a-g**, by loss of one molecule of acetic acid, and subsequent oxidation by oxygen in the air.



3a-g **4a-g** **5a-g**

The oxidation probably proceeds as for other 1,2-disubstituted pyrrol-3-ones: the oxidation of these compounds is well known and a mechanism has been proposed[13].

Acknowledgement: Financial support from "Progetto Finalizzato Chimica Fine e Secondaria" del Consiglio Nazionale delle Ricerche (Rome) is gratefully acknowledged.

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6. Selected NMR data for compounds **3a-g**. **3a**: ^{1}H NMR δ: 1.59 (3H,Me,s); 2.28 (3H,Me,s); 2.48 (3H, Me,s); 2.50 (3H,Me,s); ^{13}C NMR δ: 16.45 (Me); 18.20 (Me); 25.36 (Me);30.03 (Me); 83.43 (C-2); 110.28(C-4); 181.90(C-5); 192.52 (CO); 193 71 (CO); 198.56 (CO). **3b**: ^{1}H NMR δ: 1.58 (3H,Me,s); 2.28 (3H,Me,s); 2.47 (3H,Me,s); 2.49 (3H,Me,s); ^{13}C NMR δ: 16.44 (Me); 18.59 (Me); 25.25 (Me); 29.89(Me); 83.33(C-2); 110.08 (C-4); 181.70 (C-5); 191.94 (CO); 193.58 (CO); 198.58 (CO). **3c**: ^{1}H NMR δ: 1.62(3H,Me,s); 2.28 (3H,Me,s); 2.46 (3H,Me,s); 2.49 (3H,Me,s); ^{13}C NMR δ: 16.37 (Me); 18.46(Me); 25.14(Me); 29.79(Me); 83.19(C-2);109.93(C-4); 181.53 (C-5); 191.77 (CO),193.41 (CO); 198.47 (CO). **3d**: ^{1}H NMR δ: 1.58 (3H,Me,s); 2.26 (3H,Me,s); 2.39 (3H,Me,s); 2.47 (3H,Me,s); 2.48 (3H,Me,s). **3e**: ^{1}H NMR δ: 1.58 (3H,Me,s); 2.26 (3H,Me,s); 2.46 (6H,2 Me,s). **3f**: ^{1}H NMR δ 1.56 (3H,Me,s); 2.23 (3H,Me,s); 2.45 (3H,Me,s); 2.66 (3H,Me,s); ^{13}C NMR δ: 15.25 (Me); 18.10 (Me); 24.40(Me); 29.65(Me); 82.89(C-2);109.51(C-4); 181.48(C-5);190.97 (CO); 193.22 (CO);199.04 (CO) **3g**: ^{1}H NMR δ: 1.50 (3H,Me,s); 2.21(3H,Me,s); 2.41(3H,Me,s); 2.71(3H,Me,s). NMR spectra were recorded for $CDCl_3$ solutions with a Bruker AC 200 (200 MHz) instrument.

7. X-ray data for compound **3c**: Bond lenghts(Angstrom) with e.s.d. 's in parentheses:

Br-C15	1.91(2)	C2-C6	1.66(3)	C9-C10	1.47(3)
N1-C2	1.51(3)	C2-C7	1.48(4)	C12-C13	1.38(3)
N1-C5	1.29(2)	C3-C4	1.39(3)	C12-C17	1.38(3)
N1-C12	1.44(2)	C4-C5	1.49(3)	C13-C14	1.38(3)
O1-C3	1.29(3)	C4-C9	1.43(3)	C14-C15	1.40(3)
O2-C7	1.36(3)	C5-C11	1.55(3)	C15-C16	1.30(3)
O3-C9	1.25(3)	C7-C8	1.56(4)	C16-C17	1.42(3)
C2-C3	1.65(3)				

Bond angles(deg.) with e.s.d. 's in parentheses:

Br-C15-C14	120(1)	O2-C7-C8	132(2)	C4-C5-C11	123(2)
Br-C15-C16	120(2)	O3-C9-C4	115(2)	C4-C9-C10	122(2)
N1-C2-C3	94(2)	O3-C9-C10	123(2)	C5-N1-C12	127(2)
N1-C2-C6	115(2)	C2-N1-C5	116(1)	C5-C4-C9	131(2)
N1-C2-C7	112(2)	C2-N1-C12	116(1)	C6-C2-C7	115(2)
N1-C5-C4	113(2)	C2-C3-C4	113(2)	C12-C13-C14	123(2)
N1-C5-C11	124(2)	C2-C7-C8	120(2)	C12-C17-C16	115(2)
N1-C12-C13	121(2)	C3-C2-C6	112(2)	C13-C12-C17	120(2)
N1-C12-C17	118(2)	C3-C2-C7	108(2)	C13-C14-C15	116(2)
O1-C3-C2	115(2)	C3-C4-C5	103(2)	C14-C15-C16	120(2)
O1-C3-C4	131(2)	C3-C4-C9	126(2)	C15-C16-C17	125(3)
O2-C7-C2	108(2)				

Complete tables of atomic coordinates, isotropic and anisotropic thermal parameters and calculated and observed structure factors have been deposited with the British Library Document Supply Centre as Supplementary Publication. Copies may be obtained through the Executive Secretary, International Union of Crystallography, 5 Abbey Square, Chester CH1 2HU, England.

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12. Analytic data are in accord with proposed structures. Selected NMR and IR data. **5a** : ^{1}H NMR δ: 1.37(3H,Me,s); 2.46(6H,2 Me,s). IR: 3230, 1650, 1620. **5b**: ^{1}H NMR δ: 1.35(3H,Me,s);2.40(3H, Me,s); 2.44 (3H,Me,s). IR: 3260, 1680, 1640. **5c**: ^{1}H NMR δ: 1.34 (3H,Me,s); 2.40 (3H,Me,s); 2.43 (3H,Me,s). IR: 3300, 1680,1630. **5d**: ^{1}H NMR δ: 1.36 (3H,Me,s); 2.42 (3H,Me,s); 2.46(3H,Me,s); 2.51 (3H,Me,s). IR: 3360,1670,1650. **5e**: ^{1}H NMR δ: 1.36 (3H,Me,s); 2.44 (3H,2 Me,s). IR: 3250, 1670,1630. **5f**: ^{1}H NMR δ: 1.41(3H,Me,s); 2.40(3H,Me,s); 2.54(3H,Me,s). IR: 3230,1690,1620. **5g**: ^{1}H NMR δ: 1.45(3H,Me,s); 2.33(3H,Me,s); 2.63(3H,Me,s). IR: 3140,1690,1590.
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(*Received in UK* 24 *February* 1994; *accepted* 8 *April* 1994)