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STUDIES ON HETEROCYCLIC COMPOUNDS IV[1]. NOVEL DIAZOTIZATION PRODUCT OF ETHYL 5-AMINOFURAN-2-CARBOXYLATE

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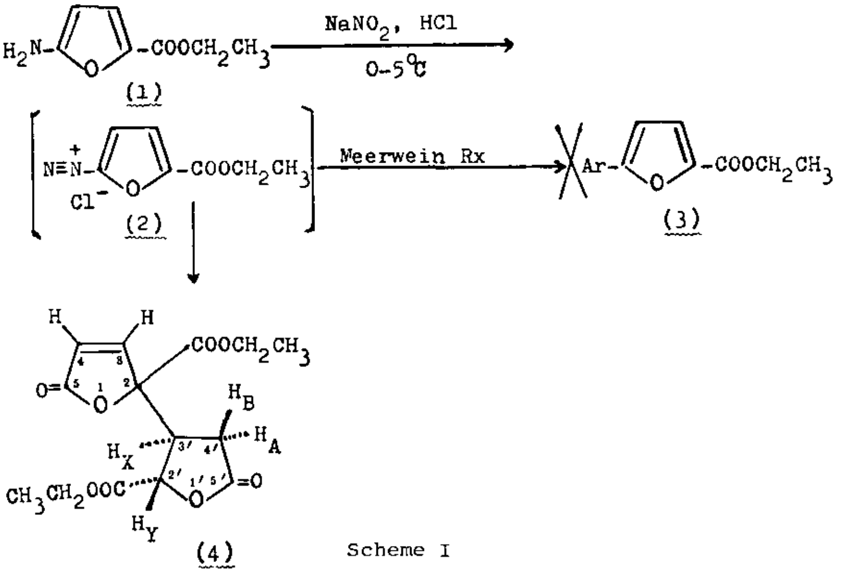
Abstract——Using ethyl 5-aminofuran-2-carboxylate as starting material for diazotization following standard method, instead of obtaining the usual diazonium salt, we isolated and characterized an unexpected dimeric product——diethyl 2'3'4'5'-tetrahydro-5,5'-dioxo [2,3'-bifuran] -2,2'(5H)-dicarboxylate.

It was found that no pure products after diazotization of α-aminofuran compounds have been isolated[2] and no further attempts on the synthesis of α-arylfuran derivatives via diazotization and Meerwein reaction have been found in literature. Therefore, we conducted the following experiments to study the interesting chemical behavior of those α-aminofuran derivatives.

As shown in Scheme I, Diazotization of ethyl 5-aminofuran-2-carboxylate (1) by using standard method reacting under $0\sim5^{\circ}C$, resulted a novel product (4), mp $94.5\sim95^{\circ}C$ (from EtOH-H_2O), instead of a diazonium salt. The yield of this unexpected product is 48%.



Scheme I

Based on mass spectrum (M^+ 312) and elemental analysis, the molecular formula of 4 was determined as $C_{14}H_{16}O_8$. The ir spectrum showed four carbonyl absorptions at 1732, 1742, 1770, 1790 cm^{-1}. The UV absorption at λ_{max}^{EtOH} 229 mμ was due to the enone chromophore. The 'H-nmr spectrum exhibited two ethoxyl groups at δ1.32 (t, J=8.0Hz, CH_3x2) and δ4.22 (q, J=8.0Hz, CH_2x2), a vinylene group at δ7.35 (d, J=5.5Hz, C_3-H) and δ6.24 (d, J=5.5 Hz, C_4-H) and an ABXY type signals at δ2.27 (dd, J_{BA}=18.4Hz, J_{BX}=5.5Hz, $C_{4'}$-H_B), δ2.74 (dd, J_{AB}=18.4Hz, J_{AX}=10.0Hz, $C_{4'}$-H_A), δ3.44 (m, J_{XA}=10.0Hz, J_{XB}=5.5Hz, J_{XY}=4.4Hz, $C_{3'}$-H_X) and δ4.85 (d, J_{XY}=4.4Hz, $C_{2'}$-H_Y). The assignment of $C_{3'}$-H_X was further confirmed by selective decoupling on ^{13}C-nmr spectrum. It was found that the signal at δ42.4 which could be accounted for by the $C_{3'}$ became singlet when the singal at δ3.44 was irradiated, whereas the signals of other carbons were not significantly affected. So, we are sure that the signal at δ3.44 is attributable to the $C_{3'}$-H_X. The downfield shift of this methine proton could be explained by the magnetic anisotropic effect of the two carbonyl groups at C_2 and $C_{2'}$.

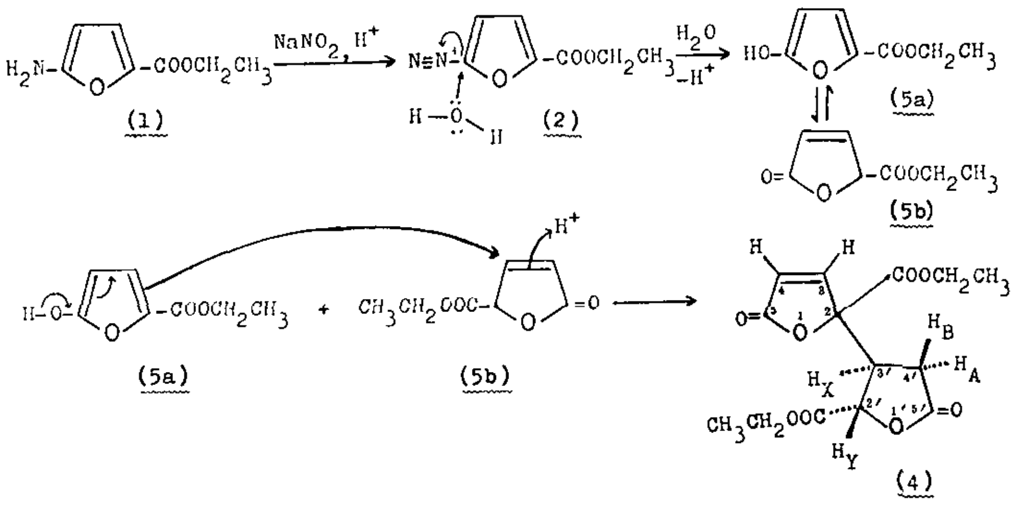
Table ^{13}C-NMR of 4

ppm	C-H coupling (in the case of off resonance)	Carbon
13.9	q.	$\underline{C}H_3$
14.0	q.	$\underline{C}H_3$
27.7	t.	C-4'
42.4	d.	C-3'
62.6	t-q.	$-O-\underline{C}H_2-CH_3$
63.7	t-q.	$-O-\underline{C}H_2-CH_3$
76.4	d.	C-2'
88.7	s.	C-2
124.2	d.	C-3
152.1	d.	C-4
165.8	s.	C=O
168.6	s.	C=O
170.1	s.	C=O
173.4	s.	C=O

JEOL FX100 TMS as an internal standard $CDCl_3$ as a solvent.

From the above data, we were convinced that compound 4 was proved to be diethyl 2'3'4'5'-tetrahydro-5,5'-dioxo [2,3'-bifuran]-2,2'(5H)-dicarboxylate. As to the stereochemistry of compound 4, the assignment were mainly based upon 'H-nmr spectrum. The coupling constants between $C_{4'}$-H and $C_{3'}$-H_X are 10.0Hz and 5.5Hz which suggest $C_{3'}$-H_X and $C_{2'}$-H_Y (J_{XY}=4.4Hz) are trans to each other. Therefore, the relative configuration was assigned as that shown in the structure of compound 4.

The mechanism of the formation of 4 could be explained as Scheme II, that is the diazonium slat (2) which formed after diazotization of 1 was then converted to hydroxyfuran compound (5a) which existed in tautomeric forms. Compound 4 was then formed from 5a and 5b via Michael addition.



Scheme II

Based on the mechanism suggested above, we understand that the diazonium salt (2) is rather unstable, therefore, we tried to synthesize 5-arylfuran derivatives by proceeding both diazotization and Meerwein reaction at the same time, that was to dissolve compound 1 into benzene (or anisole), and in the present of dil HCl and $CuCl_2$, $NaNO_2$ solution was added dropwise at different temperatures. However, the same dimeric compound 4 was obtained and the success of synthesis of α-arylfurans from α-aminofurans needs further efforts.

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