

AZLACTONES IN HETEROCYCLIC SYNTHESIS: REACTION OF
 Δ^2 -OXAZOLIN-5-ONE WITH FURYLACROLEIN ANILS

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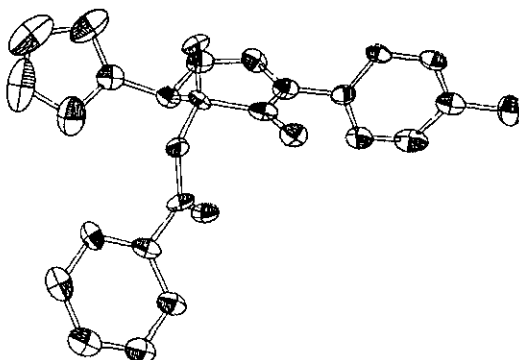
Abstract — Reaction of furylacrolein anils with mesoionic oxazolin-5-one gave α -pyridones and there was no evidence for the formation of β -lactams. The pyridone structures were fully supported by spectral data and the X-ray analysis of (4b).

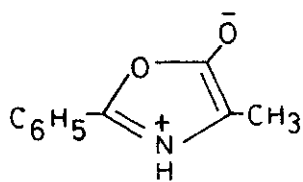
Az lactones have provided a useful way of synthesising novel heterocycles. In this connection mesoionic oxazolin-5-one (1) (Münchnone) has been thoroughly investigated. It reacts with a variety of multiple bonds which can act as typical dipolarophiles to give 1 : 1 cycloadducts which in turn may lose carbon dioxide to give stable heterocycles. Overall, in these reactions mesoionic compound (1) behaves as a typical 1,3-dipole¹⁻³. The azlactone (1) is also proposed to react in its valence tautomer ketene form with a number of typical ketenophiles like carbodiimides, enamines and unconjugated imines⁴. The proposed intermediacy of tautomeric ketene has recently been disputed⁵ and has become a point of considerable debate. Recently, Huisgen has reasserted his postulate regarding the intermediacy of a ketene in the formation of β -lactams⁶. We have investigated the reactions of azlactone (2) with various 1-aza-1,3-butadienes and here we wish to report the reaction of furylacrolein anils with (2). The azlactone (2) has also been added to the class of mesoionic oxazolones on the basis of its physical as well as chemical properties. It participates as a typical 1,3-dipole in its reactions with various alkenes and alkynes⁸⁻¹⁰.

The choice of studying (3) was made because of the interesting chemistry of the furan unit itself as well as when it is coupled with a diene system. Furan and vinylfuran compounds are well known to behave as dienophiles as well as possessing typical alkene character¹¹.

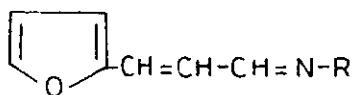
When azlactone (2) reacted with the imine in equimolar proportions in dry benzene at room temperature and the reaction mixture was stirred for 24 h, removal of solvent gave a residue which on repeated crystallisations from benzene-light petroleum ether gave a white crystalline material (4). The yields, mp and elemental data of these pyridones are given in Table 1 and spectral data in Table 2. The structural assignment (4a) was established by elemental as well as spectral data. IR (KBr) showed the presence of amido carbonyl groups at 1670 and 1665 cm^{-1} and there was no evidence for the formation of β -lactams. In this case no carbonyl group around 1745 cm^{-1} was present. Also spectral data clearly ruled out the possibility of furan ring involvement, i.e. the formation of product (5) or (6). ^1H NMR (360 MHz CDCl_3) δ : 1.40 (s, 3H, CH_3), 3.80 (s, 3H, OCH_3), 5.17 (dd, $J=3$ and 8.5 Hz, 1H, H_D), 5.41 (t, unresolved 1H, H_A), 6.15 (s, 1H, NH), 6.2 (d, $J=3$ Hz, 1H, furan H_3), 6.35 (dd, $J=3$ and 8.5 Hz, 1H, H_C), 6.41 (dd, $J=1$ and 3 Hz, 1H, furan H_2), 6.98 - 7.80 (unresolved, m, 10H, 9 aromatic and furan H_1). The azomethine proton which was present in imine (3a) at 8.2 (d, 1H) was not present, this conclusively proving that cyclo-addition has involved the azomethine function which ruled out structures (5) and (6). C.I.M.S. (m/z), M^+ 402 and other major fragments at 281, 228 and 198. The stereochemistry of the resulting pyridones (4) was unambiguously established based on the result obtained from the X-ray analysis of (4b)¹².

Molecular Structure of One of Enantiomers of the Pyridone (4b)

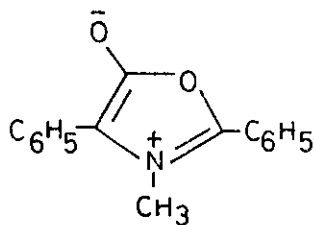




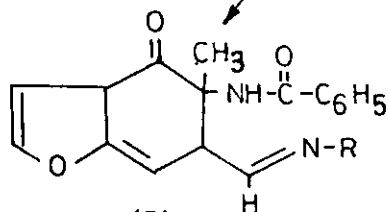
(2)



(3)

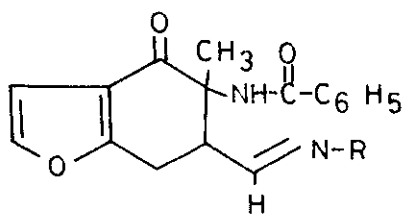


(1)

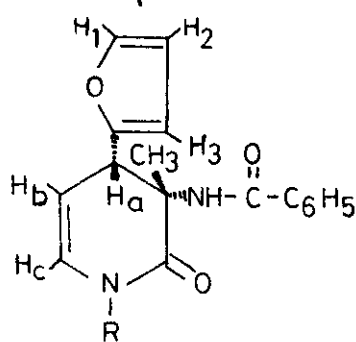


(5)

Aromatisation



(6)



(4)

a R = C₆H₄ (p-OCH₃)

b R = C₆H₄ (p-CH₃)

c R = C₆H₄ (p-Br)

d R = C₆H₄ (p-OC₂H₅)

e R = C₆H₅

Table 1. Characteristics of Pyridones

Compound No.	R	Melting Point (Furyl-acrolein Anil) °C	Yield Pyridone %	Melting Point (Pyridone) °C	Formula	Analysis (%)						
						Calculated				Found		
						C	H	N	Halogen	C	H	N
4a	C ₆ H ₄ (P-OCH ₃)	66	72	185	C ₂₄ H ₂₂ N ₂ O ₄	71.64	5.47	6.96	-	71.59	5.38	6.50
4b	C ₆ H ₄ (P-CH ₃)	75	72	221	C ₂₄ H ₂₂ N ₂ O ₃	74.61	5.69	7.25	-	74.38	5.60	7.10
4c	C ₆ H ₄ (P-Br)	84	62	205	C ₂₃ H ₁₉ N ₂ O ₃ Br	61.20	4.21	6.21	17.73	61.5	4.15	6.00
4d	C ₆ H ₄ (P-OC ₂ H ₅)	96	63	135	C ₂₅ H ₂₄ N ₂ O ₄	72.11	5.77	6.73	-	72.01	5.2	6.35
4e	C ₆ H ₅	65.5	55	125	C ₂₃ H ₂₀ N ₂ O ₃	67.74	5.38	7.53	-	67.32	5.30	7.38

Table 2. Spectral Data of Fyridones

Compound No.	Infrared(cm^{-1})	Nuclear Magnetic Resonance	Mass Spectra m/e (%)
4a	3345, 3020, 1645, 1665, 1660	1.40(s, 3H, -CH ₃), 3.80(s, 3H, -OCH ₃), 5.17(dd, 8.5Hz, 3H, 1H _b), 5.41(t, unresolved, 1H _a), 6.15(s, 1H, -NH), 6.20(d, ~3Hz, 1H, furan H ₃), 6.35(dd, 8.5Hz, 3H, 1H _c), 6.41(dd, ~3Hz, 1H, 1H, furan H ₂), 6.98-7.80(unresolved, m, 10H, 9 aromatic and furan H ₁).	402(0.02), 281(80), 280(100), 252(10), 228(40), 226(30), 125(50), 97(30).
4b	3365, 3020, 1645, 1665, 1660	1.42(s, 3H, -CH ₃), 2.37(s, 3H, -CH ₃), 5.36(dd, 8.5Hz, 3H, 1H _b), 5.43(t, unresolved, 1H _a), 6.16(s, 1H, -NH), 6.21(d, ~3Hz, 1H, furan H ₃), 6.33(dd, 8.5Hz, 3H, 1H _c), 6.40(dd, ~3Hz, 1H, 1H, furan H ₂), 7.16-7.8(unresolved, m, 10H, 9 aromatic and furan H ₁).	336(0.05), 265(80), 266(100), 237(45), 213(50), 112(15), 84(10).
4c	3345, 3020, 1645, 1660, 1670	1.41(s, 3H, -CH ₃), 5.14(dd, 8.5Hz, 3H, 1H _b), 5.39(t, unresolved, 1H _a), 6.14(s, 1H, -NH), 6.19(d, ~3Hz, 1H, furan H ₃), 6.34(dd, 8.5Hz, 3H, 1H _c), 6.42(dd, ~3Hz, 1H, 1H, furan H ₂), 7.02-7.78(unresolved, m, 10H, 9 aromatic and furan H ₁).	451(0.02), 449(0.02), 368(60), 367(100), 339(10), 315(25), 313(20), 212(50), 184(40).
4d	3340, 2950, 1645, 1660, 1670	1.10(t, 3H, -CH ₃), 1.45(s, 3H, -CH ₃), 3.57(q, 2H, -CH ₂), 5.14(dd, 8.5Hz, 3H, 1H _b), 5.40(t, unresolved, 1H _a), 6.15(s, 1H, -NH), 6.23(d, ~3Hz, 1H, furan H ₃), 6.34(dd, 8.5Hz, 3H, 1H _c), 6.39(dd, ~3Hz, 1H, 1H, furan H ₂), 6.82-7.75(unresolved, m, 9 aromatic and furan H ₁).	416(0.02), 295(80), 294(100), 266(10), 242(40), 240(30), 139(50), 111(20).
4e	3345, 3025, 1690,	1.40(s, 3H, -CH ₃), 5.21(dd, 8.5Hz, 3H, 1H _b), 5.33(t, unresolved, 1H _a), 6.06(s, 1H, -NH), 6.12(d, ~3Hz, 1H, furan H ₃), 6.24(dd, 8.5Hz, 3H, 1H _c), 6.36(dd, ~3Hz, 1H, furan H ₂), 6.80-7.50(unresolved, m, 11H, 10 aromatic and furan H ₁).	372(0.01), 251(80), 250(100), 223(10), 199(40), 197(30), 96(50), 68(30).

EXPERIMENTAL

The imines (3a-e) described in this study were prepared through known methods and melting point values agreed with those recorded in literature. All the imines used were always freshly crystallised again before and showed satisfactory IR, NMR and Mass spectra.

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12. Monoclinic, space group P21/c with a=11.239 (4), b=15.856 (6), c=11.265 (7) A;

Dcalc=1.29 g/cm for z=4. Final R value was 0.135 for 1523 effective reflections.

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