A FACILE INTRAMOLECULAR CYCLIZATION OF 4-DIAZOMETHYLCOUMARINS. A CONVENIENT ROUTE TO BENZOPYRANO[3,4-c]PYRAZOL-4(3H)-ONES

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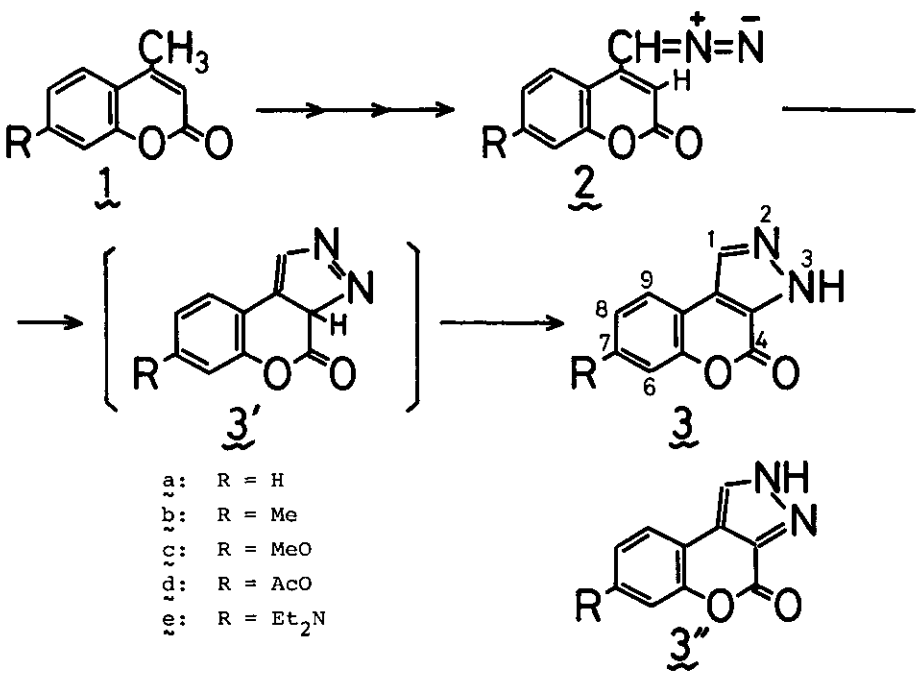
Abstract —— The 7-substituted 4-diazomethylcoumarins 2 as the stable aryldiazomethanes were rapidly transformed into their cyclized isomers, benzopyrano[3,4-c]pyrazol-4(3H)-ones 3 in high yields in refluxing toluene.

We have recently reported[1] the preparations of the 7-substituted 4-diazomethylcoumarins 2 as a new type of stable aryldiazomethanes which are potentially useful fluorogenic reagents for acids and alcohols.[1,2] In this communication we wish to report facile thermal cyclization of 2 leading to the formation of the benzopyrano[3,4-c]pyrazol-4(3H)-ones 3.



a: R = H
b: R = Me
c: R = MeO
d: R = AcO
e: R = Et_2N

Although 2 are extremely stable not always in solid state at room temperature in the open air but also in ordinary solvent ($CHCl_3$, THF, EtOH, benzene, etc) on reflux, sudden change of the diazo structures of 2 into 3 can be observed at the temperatures above ca. 100°C. Thus, when 1 mM of 2a-e[1] were allowed to be heated in 6 ml of refluxing toluene, yellow color of the solution disappeared and almost colorless crystals of pure 3a-e precipitated within a short period ($<$ 30 min), which were isolated nearly quantitatively ($>$ 85 %) simply by filtration of the reaction mixture on cool. Mass spectral and microanalyses data[3] showed that these new crystals are isomers of the starting 2a-e. ^{1}H-NMR spectra were consistent with the assignment of the benzopyranopyrazole structures of 3. In the NMR spectrum of 3a in DMSO-d_6, for instance, the characteristic diazomethyl proton (δ 5.90) and C^3 proton (δ 6.56) singlet signals of 2a disappeared and a new singlet signal attributable to C^1-H (δ 8.63) and a broad singlet NH signal (δ 14.56, exchangeable with D_2O) appeared instead in addition to aromatic proton signals [δ 7.28-7.40(3H, m, C^{6-8}-H), 7.94(1H, d, C^9-H)]. Furthermore, N-methyl derivative of 3a (needles from isoPrOH, mp 163-164°C) obtained by treatment with diazomethane was identical with the sample prepared by the different route as reported.[4] Some physical and spectral data of 3a-e are depicted in Table I. All the crystals of 3a-e do not melt below 270°C but tend to be sublimed at higher temperatures. 3c and 3e showed strong fluorescence (emission maximum in EtOH: 402 nm for 3c, 510 nm for 3e).

Table I. Benzopyrano[3,4-c]pyrazol-4(3H)-ones 3

Compound	Yield (%)	Appearance Recryst. Solvent	MS m/e [M^+]	IR ν_{max}^{KBr} cm^{-1} NH	IR CO	^{1}H-NMR δ (DMSO-d_6) C^1-H	NH
3a	85	needles (dioxane)	186	3282	1726	8.63	14.56
3b	91	leaves (dioxane)	200	3298	1727	8.56	14.50
3c	90	pale yellow needles (THF)	216	3284	1723	8.52	14.45
3d	95	pale yellow prisms (dioxane)	244	3278	1727 1757	8.71	14.52
3e	86	pale yellow prisms (CH_3CN)	257	3290	1724	8.46	14.24

Since the above transformations of 2 proceed rapidly at 100°C or above in dioxane, DMF, BuOH or pyridine as well as in toluene and also at 120-130°C without solvent, but proceed slowly at 90°C and never below 70°C regardless of the solvent used, the isomerization is supposed to be thermo-dependent 1,5-electrocyclic type of ring closure reaction which affords formal 1,3-dipolar cycloaddition product 3' followed by hydrogen migration leading to 3. As the final product we assigned the N^3-H structure 3 rather than the tautomeric N^2-H structure 3'' on the assumption that 3 is more stable. Possibilities of the other tautomeric structures can be eliminated from the NMR and IR spectral data. In spite of a number of intramolecular cyclization of diazoalkenes using tosylhydrazone precursors indirectly,[5] those of the isolated pure diazo compounds of heterocyclic system such as 2 are apparently unknown.

4-Diazomethylcoumarins 2 are reported[1] to be easily obtained by three steps from the corresponding 4-methylcoumarins 1, and the isomerizations of 2 are very facile to afford 3 in high yields. Therefore, the present set of tranformations starting from 1 through stable diazo intermediates 2 appears to provide a convenient route to benzopyrano[3,4-c]pyrazol-4(3H)-ones 3. Investigations on similar cyclizations of analogous stable aryldiazomethanes are in progress.

REFERENCES AND NOTES

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