Fluorescence Spectroscopic Detection of the Pyridinol form in Tautomeric 2(1*H*)-Pyridones

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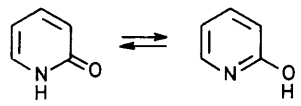
Fluorescence spectra can be used for the direct observation of the minor tautomer of 2(1*H*)-pyridones in which the tautomeric equilibrium is greatly in favour of the pyridone form.

2(1*H*)-Pyridone (**1**) is a fundamental compound in heteroaromatic tautomeric systems of interest in studies of biological systems.[1] However, the tautomeric equilibrium lies far to the pyridone form (**A**) in solution due to the greater stabilisation of this form by self-association and solvation.[2] This occurs in a variety of 2(1*H*)-pyridones and makes the study of the precise nature of the tautomerism difficult.

We have studied the fluorescence spectra of (**1**) and its derivatives (**2**)—(**8**), and report here what we believe is the first observation of fluorescence due to the pyridinol form (**1B**)—(**8B**) in solution of (**1**)—(**8**), in which the minor tautomers (**1B**)—(**8B**) are not observed in conventional u.v. spectral measurements.

Some fluorescence studies on (**1**) have already been reported, but little attention has been paid to the tautomeric properties and the excitation wavelength used has always been the absorption maximum (*ca.* 300 nm) of the pyridone form (**1A**).[3] The fluorescence intensities are largely dependent on the excitation wavelength. Therefore, it was expected that excitation near the absorption maximum of the pyridinol form would give different fluorescence spectra to those previously



(A) (B)

(1)

observed. The excitation wavelength of 270 nm was used in the present study, since 2-methoxypyridine and 2-hydroxypyridine show an absorbtion maximum at 270 nm in u.v. spectra.[4] The fluorescence spectrum of (**1**) thus observed is shown in Figure 1.

It can be seen from Figure 1 that fluorescence maxima were observed around 310 nm in addition to 370 nm in diluted cyclohexane and acetonitrile solution (4×10^{-5} mol dm^{-3}).

On the basis of reported spectra,[3] the observed fluorescence band at the longer wavelength is characteristic of that due to the pyridone form (**1A**). The band at the shorter wavelength was assigned as that due to the pyridinol form (**1B**) based on the fluorescence excitation and emission spectra of 2-methoxypyridine.

Table 1. Fluorescence and absorption characteristics of 2(1*H*)-pyridones and 2-methoxypyridines.[a]

Compound	2(1*H*)-Pyridones				1-Methyl-2(1*H*)-pyridones		2-Methoxypyridines	
	λ_{max} /nm	$\lambda_{em}(\lambda_{ex}$[b]) /nm	$\lambda_{em}(\lambda_{ex}$[b]) /nm	f_b/f_a[c]	λ_{max} /nm	λ_{em}[d] /nm	λ_{max} /nm	λ_{em}[d] /nm
(**1**) parent	299	367(300)[e]	303,366(268)[f]	0.50	309	384(375)[g]	273	303
(**2**) 3-Me	297	371(296)	308,372(269)	0.29	304	384	272	308
(**3**) 4-Me	294	367(294)	302,367(269)	0.26	304	384	270	302
(**4**) 5-Me	307	381(306)	309,379(278)	1.86	316	394	280	311
(**5**) 6-Me	302	369(302)	308,368(270)	1.37	310	388	274	306
(**6**) 5,6-$(Me)_2$	309	381(311)	313,381(278)	3.00	319	392	280	312
(**7**) 4,5,6-$(Me)_3$	304	379(307)	313,377(274)	1.71	314	416	277	310
(**8**) 4-Me,5,6-$[CH_2]_3$	310	387(311)	315,389(283)	0.38	325	393	284	316

[a] Measured in cyclohexane solution (4×10^{-5} mol dm^{-3}) at ambient temperature. [b] Excitation wavelengths. [c] Ratios of the intensities of the emission bands at the higher (f_a) and the lower wavelength (f_b) in the spectra excited at 270 nm. [d] Excited at the wavelength of the λ_{max}. [e] Determined from the fluorescence excitation spectra monitored at the higher emission wavelength. [f] Determined from the fluorescence excitation spectra monitored at the lower emission wavelength. [g] Measured in iso-octane; A. Fujimoto and K. Inuzuka, *Bull. Chem. Soc. Jpn.*, 1979, **52**, 1816.

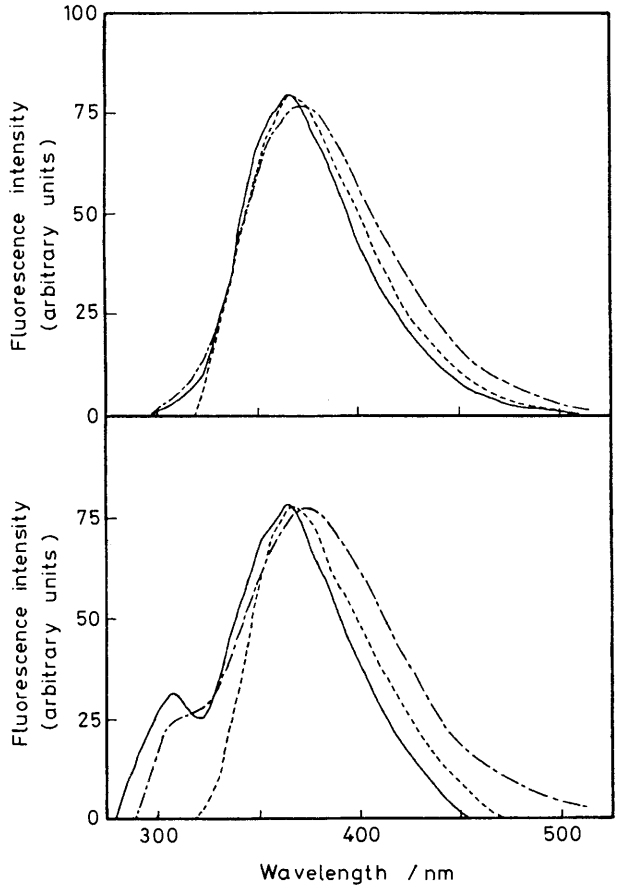


Figure 1. Fluorescence spectra of 2(1*H*)-pyridone (**1**) in cyclohexane (———), in acetonitrile (–·–·), and in ethanol (– – –) at ambient temperature. The excitation wavelength was 270 nm. The upper and lower spectra were observed in 4×10^{-4} and 4×10^{-5} mol dm^{-3} solutions, respectively.

The decrease in intensity of the band due to the pyridinol form (**1B**) in more concentrated solution (upper spectra) and absence of the same band in ethanol solution was indicative of the tautomeric features [*i.e.* stabilisation of the pyridone form (**1A**) either by self-association in non-polar solvent or by solvation in polar solvent].

The fluorescence spectra of some alkylated 2-pyridone derivatives (**2**)—(**8**) which exhibit only the absorptions due to the corresponding pyridone form (**2A**)—(**8A**) in the u.v. spectra were also measured under similar conditions, and the spectral features observed are summarised in Table 1, together with those of the absorption spectra.

The band assignments were made as above, and in all cases, the bands due to the pyridinol form were observed in highly diluted cyclohexane and acetonitrile solutions.

Although the relative fluorescence intensities (f_b/f_a) vary according to the substituents as shown in Table 1, a quantitative discussion of the substituent effect on the tautomeric properties of 2(1*H*)-pyridones using results from the fluorescence spectra can not be made at present. However, the direct observation of the pyridinol form reported herein will open a new strategy for the study of the tautomeric properties of 2(1*H*)-pyridones in solution.

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