

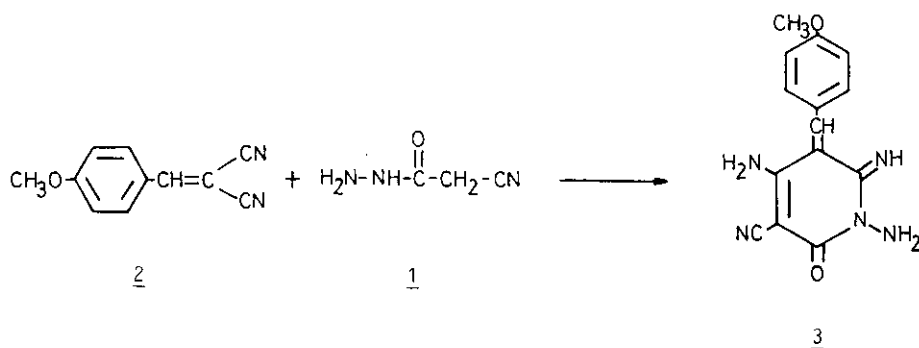
ON THE REACTION OF CYANOACETOHYDRAZIDE WITH α -SUBSTITUTED CINNAMONITRILES

Nazario Martín, Carlos Seoane, and José L. Soto*

Departamento de Química Orgánica, Facultad de Química,
Universidad Complutense, 28040- Madrid, Spain

Abstract - The condensation of cyanoacetohydrazide with benzylidenemalononitriles is reinvestigated and a structure of 1,6-diamino-3,5-dicyano-2-pyridone is confirmed on the basis of chemical and spectroscopic evidence.

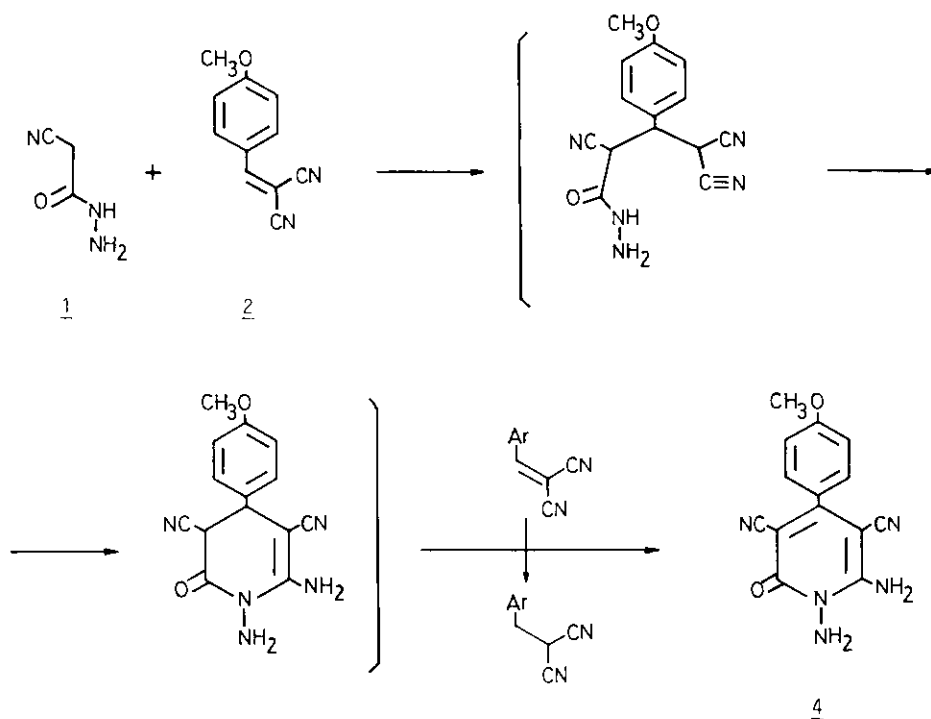
In a recent paper published in this journal¹, Zayed et al. have studied the reaction of cyanoacetohydrazide (1) with α -cyano-p-methoxycinnamionitrile (2) at room temperature using absolute ethanol as the solvent and triethylamine as the basic catalyst. The authors gave the structure 3 for the resulting stable compound (Scheme 1)(mp 212°C)². Although little detail is given, structure 3 was selected by the authors amongst other possibilities because only a cyano band was apparent in the infrared spectrum of the compound.



Scheme 1

This reaction was studied by us several years ago, together with a series of substituted α -cyanocinnamionitriles (benzylidenemalononitriles) in absolute ethanol-piperidine at room temperature, resulting in the formation of 1,6-diamino-3,5-

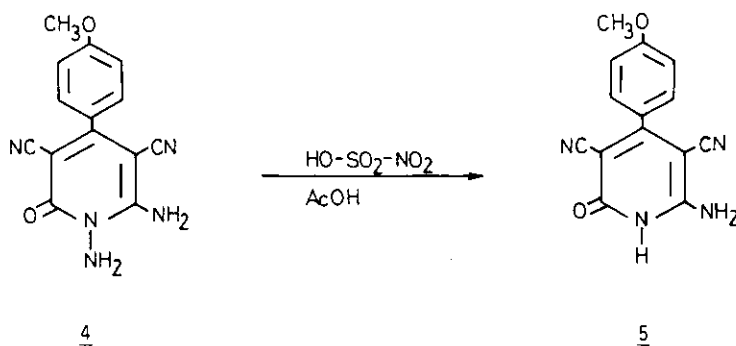
dicyano-4-(p-methoxyphenyl)-2-pyridone (4). The corresponding results were published in Synthesis in 1981³.



Scheme 2

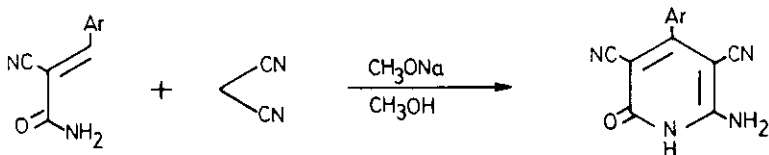
To check whether the different catalyst could cause such a different behaviour, we carried out the reaction according to Zayed's procedure, using triethylamine either at room or reflux temperature in absolute or 96% ethanol. From all reactions we obtained yellowish but colourless product after recrystallization from dioxane⁴, with microanalytical (C, 59.79; H, 3.90; N, 25.26) and mass spectral data (M^+ 281) in agreement with the molecular formula $C_{14}H_{11}N_5O_2$ of structure 4. The IR spectrum of the compound (potassium bromide pellet) shows a broad cyano stretching band at $2220-2200\text{ cm}^{-1}$, which is rather strong, as expected for conjugated nitriles⁵. The ^{13}C -NMR (in deuterodimethylsulfoxide at 20 MHz) spectrum shows clearly that the compound has two cyano groups, which appear as characteristic singlets at 116.8 and 115.9 ppm. Furthermore, all the carbon atoms of the ring appear at chemical shifts in agreement with structure 4. C_3 and C_5 give rise to two signals at 86.5 and 74.4 ppm and C_2 , C_4 and C_6 appear together with the

C_4' carbon of the benzene ring as four peaks at 160.9, 159.6, 159.4 and 156.8 ppm. The peaks due to C_1' , C_2' and C_3' are at 130.0, 126.6 and 114.1 ppm respectively and the methoxy group peak is at 55.5 ppm. The 1H -NMR spectrum (in deuterodimethylsulfoxide at 60 MHz) shows a sharp singlet at 3.8 ppm (3H, CH_3O) and two broad peaks at 5.1 ppm (2H) and 8.2 ppm (2H) due to the amino groups⁶, together with the p-disubstituted benzene system as four peaks centered at 7.1 ppm, integrating for four protons. All these facts are in agreement with the expected and reported³ characteristics of structure 4, and cannot be accounted for by structure 3. On the other hand, reaction of 4 with nitrosylsulfuric acid in acetic acid brings about its transformation into 6-amino-3,5-dicyano-4-(p-methoxyphenyl)-2-pyridone (5), (Scheme 3) a reaction which has been reported for several 1,6-diamino-4-aryl-3,5-dicyano-2-pyridones³ leading to a series of 6-amino-4-aryl-3,5-dicyano-2-pyridones, some of which were also prepared by a previously described



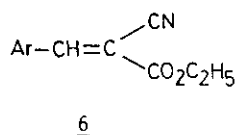
Scheme 3

alternative route⁷ (Scheme 4).



Scheme 4

As shown in Scheme 2, the formation of 4 in the reaction of 1 with 2 can be explained through the Michael addition of cyanoacetohydrazide (1) to α -cyanocinnamitrile (2), followed by nucleophilic attack on a cyano group to give the six-membered ring which, on aromatization, gives rise to the N-amino-2-pyridone (4). The α -cyanocinnamitrile (2) is the oxidant responsible for the dehydrogenation of the intermediate dihydropyridone to the aromatic system and benzylmalonitrile, the reduction product of 2, can be detected in the reaction mixture³. Similar aromatizations have also been previously reported by us⁸⁻¹¹. Finally, the reaction of ethyl α -cyanocinnamates (6) with cyanoacetohydrazide (1), also mentioned by Zayed et al.¹, which leads to the corresponding 1,6-diamino-2-pyridones, has also been previously reported by us¹².



ACKNOWLEDGEMENTS

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REFERENCES AND NOTES

1. E.M. Zayed, E.A.A. Hafez, S.A.S. Ghozlan and A.A.H. Ibrahim, Heterocycles, 1984, 22, 2553.
2. Concerning the melting point, see note 4.
3. J.L. Soto, C. Seoane, P. Zamorano and F.J. Cuadrado, Synthesis, 1981, 529.
4. The melting point of this compound, as well as other compounds of this series³, are not characteristic. They decompose over a range of temperatures; the crude, yellowish, compound obtained from ethanol decompose at about 210-225°C, according to the values reported by Zayed¹ and ourselves³. However, higher values should be given and a sample obtained after several recrystallizations from dioxane begins to decompose at a temperature, depending on the rate of heating, in the region of 270°C and decomposition is not complete at 300°C.
5. K. Nakanishi and P. Solomon, "Infrared Absorption Spectroscopy", Holden-Day, San Francisco, 1977. L.J. Bellamy, "The Infrared Spectra of Complex Molecules", Methuen & Co. London, 1958.

6. The signal at 5.10 ppm disappears on addition of TFA to the sample. Unequivocal assignment of this signal to the N-amino group was achieved when this group was removed in the nitrous deamination (see below).
7. A. Lorente and J.L. Soto, Afinidad, 1978, 35, 138. See also reference 3.
8. A.S. Alvarez-Insua, M. Lora-Tamayo and J.L. Soto, J. Heterocyclic Chem., 1970, 7, 1305.
9. L. Fuentes and J.L. Soto, An. Quim., 1977, 73, 1349.
10. L. Fuentes, A. Lorente and J.L. Soto, An. Quim., 1977, 73, 1359.
11. M.J. Rubio, C. Seoane and J.L. Soto, Heterocycles, 1983, 20, 783.
12. C. Seoane, J.L. Soto and P. Zamorano, Org. Prep. Proced. Int., 1984, 16, 393.

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