

Synthesis of Functionally-substituted Dienediamines and some Chemical Transformations

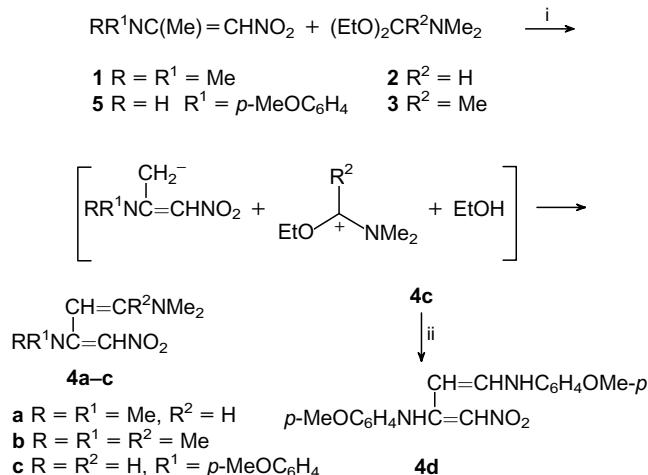
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New syntheses of dienediamines and the products of their chemical transformations (derivatives of 4-pyridone imine, biphenyl and 2-pyridone), based on the reactions of amide acetals with enamines followed by transamination, are reported.

In the course of our investigation into the influence of the “enamine component’s” structure upon the direction of the Nenitescu reaction^{1–4} we set ourselves the aim of studying the possibility of synthesising hitherto unknown dienediamines. These are interesting starting compounds either for this reaction or for use in other areas of organic synthesis. Firstly, 1-nitro-2-dimethylaminoprop-1-ene **1**⁵ was selected as the starting compound. The peculiarities of the structure of **1** enabled its use for our purposes. The presence of such a strong electron-withdrawing substituent as the nitro group leads to a significant “acidification” of the β-methyl group’s protons and causes their abstraction by basic agents. Thus, heating of **1** with DMF diethyl acetal **2** or dimethylacetamide (DMA) diethyl acetal **3** in the absence of solvent smoothly yields 1-nitro-2,4-bis(dimethylamino)butadiene **4a**, 91%, m.p. 150–152 °C (PrⁱOH), MS *m/z* 185 (M^+); ¹H NMR ($CDCl_3$) δ: 3.02 (6H, br.s, NMe₂), 3.14 (6H, s, NMe₂), 4.64 (1H, d, *J* 13.1 Hz, 3-CH), 6.62 (1H, s, 1-CH), 7.30 (1H, d, *J* 13.1 Hz, 4-CH) and -pentadiene **4b**, yield 60%, m.p. 110–112 °C (AcOEt).[†]

As tertiary enamines (and also dienediamines) are only suitable for the synthesis of 5-hydroxybenzofurans² the reaction of **2** with 1-nitro-2-(*p*-methoxyphenyl)aminoprop-1-ene **5**³ has been studied (this compound can be used for indole synthesis),² and the dienediamine **4c**, yield 65%, m.p. 190–192 °C (MeOH) is obtained as a result. It has been shown that the transamination of the 8-dimethylamino group in **4c** proceeds successfully on treatment with *p*-anisidine in DMF in the presence of *p*-toluenesulfonic acid (*p*-TsOH), and diene **4d** is obtained as a result, yield 68%, m.p. 178–180 °C (PrⁱOH).



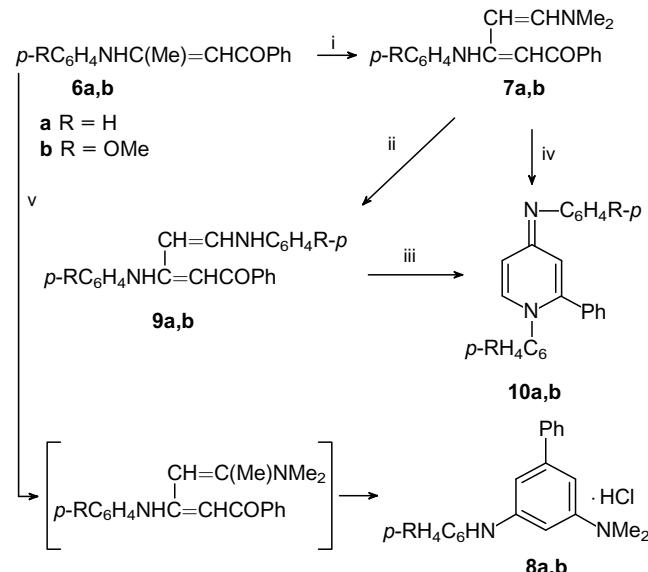
Scheme 1 Reagents and conditions: i, mixture of **1** or **5** with **2** or mixture of **1** with **3**, reflux for 30–40 min; ii, **4c**, *p*-anisidine and *p*-TsOH in DMF are mixed for 4 days at 20 °C, water added to mixture.

Analogously to nitroenamines **1** and **5**, enaminoketones **6a,b**⁴ condense with **2** to afford dienes **7a,b**, yield 85%, m.p.

[†] All new compounds gave the expected IR, ¹H NMR and mass spectra and satisfactory elemental analyses.

156–157 °C (PrⁱOH) and **7b**, yield 85%, m.p. 168–169 °C (PrⁱOH). The presence of a carbonyl function in **6a,b** presents, however, a number of complications. So, in the reaction of **6a,b** with DMA acetal **3** closing of the benzene ring occurs with the formation of the otherwise inaccessible diaminodiphenyl derivatives (isolated as hydrochlorides): **8a**, yield 55%, m.p. 192–193 °C (PrⁱOH), MS *m/z* 288 (M^+), ¹H NMR ([²H₆]DMSO) δ: 2.93 (6H, s, NMe₂), 6.73–6.65 (3H, m, 2,4,6-CH), 6.79–7.55 (10H, m, arom.), 8.09 (1H, br.s, NH) and **8b**, yield 57%, m.p. 212–214 °C (MeOH). Reactions of **7a,b** with arylamines also proceed extremely rarely – in these cases intermediates **9a,b** form imino derivatives of 4-pyridone **10a,b** which exist as two isomers (1:1)[‡] with respect to their C=N bonds: **10a**, yield 68%, m.p. 168–170 °C (heptane), MS *m/z* 322 (M^+), ¹H NMR ([²H₆]DMSO) δ: 5.95 and 6.17 (in 1H, d, *J*_{3,5} 3 Hz, 3-CH), 6.22 and 6.02 (in 1H, dd, *J*_{5,3} 3 Hz, *J*_{5,6} 8 Hz, 5-CH), 7.45 and 7.38 (in 1H, d, *J*_{6,5} 8 Hz, 6-CH), 6.77–7.32 (15H, m, arom.) and **10b**, yield 53%, m.p. 148–150 °C (PrⁱOH). Intermediates **9a,b** have been isolated by transamination under milder conditions: **9a**, yield 53%, m.p. 145–147 °C (toluene); **9b**, yield 63%, m.p. 142–144 °C (PrⁱOH).

Finally, β,β-disubstituted enamine **12**⁶ can also be used as



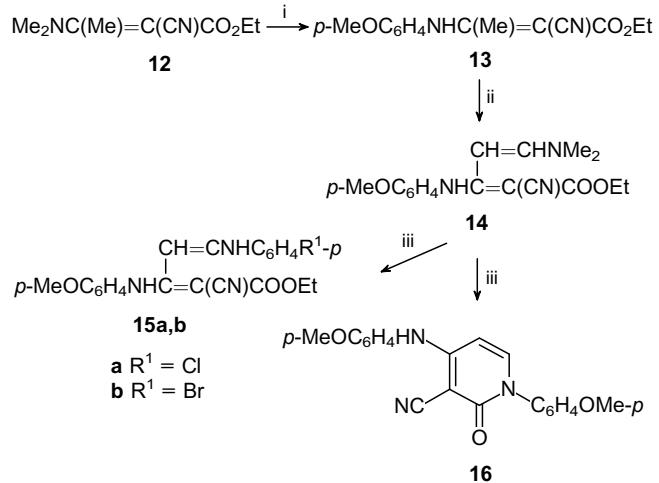
Scheme 2 Reagents and conditions: i, mixture of **2** and **6a,b**, reflux for 5 h in DMF; ii, mixture of **7a,b** and the corresponding *p*-R₆H₄NH₂ in AcOH are mixed for 1.5 h at 45–50 °C; iii, **9a,b** in AcOH, reflux for 1.5 h; iv, mixture of **7a,b** and the corresponding *p*-R₆H₄NH₂ in toluene, reflux for 25 h; v, mixture of **6a,b** and **3**, reflux for 25 h.

starting material. The transamination of **12** smoothly affords enamine **13**, yield 58%, m.p. 96–98 °C (PrⁱOH), which interacts with **2** to give dienediamine **14**, yield 78%, m.p. 165–167 °C (toluene). Transamination of the latter also leads to unexpected results: using *p*-chloro- or *p*-bromoaniline the

[‡] Only one set of signals is observed in the NMR spectra of **10a,b** in CF₃COOH.

dienediamines **15a,b** are obtained: **15a**, yield 89%, m.p. 165–167 °C (Pr^iOH –dioxane); **15b**, yield 61%, m.p. 169–171 °C (Pr^iOH –dioxane). On using the more basic *p*-anisidine, 1-(*p*-methoxyphenyl)-3-cyano-4-(*p*-methoxyphenylamino)-2-pyridone **16** is isolated, yield 71%, m.p. 256–257 °C (MeOH–DMF), MS m/z 347 (M^+), ^1H NMR ($[^2\text{H}_6]\text{DMSO}$) δ : 3.77 (3H, s, OMe) and 3.79 (3H, s, OMe), 6.97–7.29 (8H, m, two C_6H_4), 5.76 (1H, d, J 8 Hz, 5-CH), 7.56 (1H, d, J 8 Hz, 6-CH), 9.37 (1H, br.s, NH).

Thus, as a result of the current investigation a number of



Scheme 3 *Reagents and conditions:* i, mixture of **12** and *p*-anisidine, reflux in AcOH for 4–5 h; ii, **13** and **2**, reflux for 10 h in toluene; iii, mixture of **14** and substituted aniline, reflux for 5 min in AcOH.

new functionally-substituted dienediamines[§] have been obtained and some factors have been determined which limit

[§] The results of an investigation into the interaction of dienediamine derivatives with quinone derivatives will be published in the following publication.

the possibility of their formation when using the methods described in the present work. At the same time, based on this study, it has proved possible to synthesise previously inaccessible derivatives of 4-pyridone imine, biphenyl and 2-pyridone.

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