SYNTHESIS OF 6-PHENYLAMINOFURO[2,3-d]PYRIMIDINE-2,4(1H,3H)-DIONES FROM BARBITURYLBENZYLIDENES AND ISONITRILES †

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Abstract - Barbiturylbenzylidenes, prepared by Perkin condensation of aromatic aldehydes with 1,3-dimethylbarbituric acid, react with phenylisonitrile to yield four 5-aryl-6-phenylamino-1,3-dimethylfuro[2,3-d]pyrimidine-2,4(1H,3H)-diones.

The synthesis of fused pyrimidine systems is of importance as a source of new purine analogues of potential biological interest.[1] Among them, the *furo[2,3-d]pyrimidine system* has received little attention, with only few synthetic procedures reported in the literature.[1] Furo[2,3-d]pyrimidine derivatives act as sedatives, *antihistaminics, diuretics, muscle relaxants,* antiulcer agents, etc.[1] Our interest in the unknown system 6-phenylaminofuro[2,3-d]pyrimidine led us to develop an efficient two step procedure for the synthesis of the novel 5-aryl-6-phenylamino-1,3-dimethylfuro[2,3-d]pyrimidine-2,4(1H,3H)-diones (**7a-7d**) from 1,3-dimethylbarbituric acid (**2**). The strategy used took advantage of the known ability of benzylidene barbituric acids to undergo nucleophilic attack in a Michael fashion.[2,3] Thus, one equivalent of **2** reacts with another equivalent of benzaldehyde (**1a**), anisaldehyde (**1b**), p-nitrobenzaldehyde (**1c**), and piperonal (**1d**) in 1:1 ethanol-water solution under reflux for 5 minutes to give the corresponding 1,3-dimethyl-barbiturylbenzylidenes (**3a-3d**) in 90 to 98% yields.[2] Phenylisonitrile (**4**) was prepared by dehydration of formanilide with Ph_3P in ether.[4] The reaction of the benzylidenes (**3a-3d**) with an excess of the ethereal solution of **4** in refluxing toluene for 3 hours gave the expected fused pyridimines (Scheme 1).[5-8]

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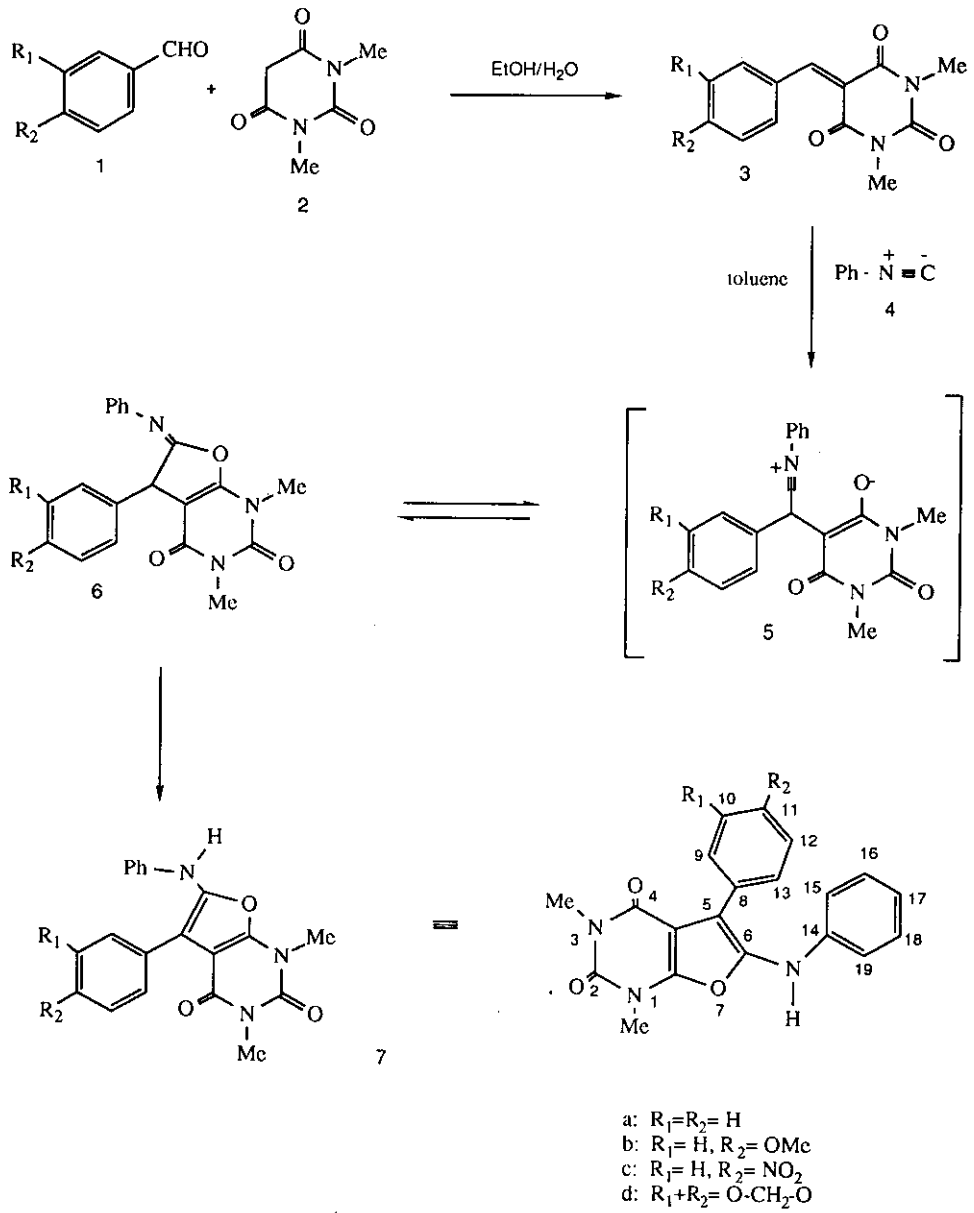
† This paper is dedicated to Professor William A. Ayer on the occasion of his 60th birthday.

Scheme 1:



a: $R_1=R_2=H$
b: $R_1=H$, $R_2=OMe$
c: $R_1=H$, $R_2=NO_2$
d: $R_1+R_2=O\text{-}CH_2\text{-}O$

The zwitterionic nature of the isonitrile (**4**) favors a Michael-type addition reaction to the benzylidenes (**3a-3d**) to give the intermediate (**5**). Cyclization of **5** affords the imine (**6**), which after tautomerization would yield the furo[2,3-d]pyrimidines (**7a-7d**). However, the possibility of having a concerted [4+2] cheletropic

cycloaddition to explain the formation of **6** is not ruled out. The reversibility of the reaction is supported by the observation that compounds (**7a-7d**) give off an isonitrile odor when heated above their melting points. This simple reaction sequence provides a facile route to the synthesis of fused furopyrimidines.

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5. Compound **7a**: yield 66%; mp 194-195°C (toluene); hreims (m/z) 347.1269 ($C_{20}H_{17}N_3O_3$); uv (MeOH) λ_{max} (nm) 237 (log ε 4.3), 280 (sh); ir (KBr) ν_{max} 3280, 1715, 1670 and 1655 cm^{-1} ; ^1H *nmr* (360 MHz, DMSO-d_6) δ 7.61 (2H, d, J=7 Hz, H9, H13); 7.33 (2H, t, J=7 Hz, H10, H12); 7.30 (1H, t, J=7 Hz, H11); 7.24 (2H, t, J=7 Hz, H16, H18); 6.93 (1H, t, J=7 Hz, H17); 6.75 (2H, d, J=7 Hz, H15, H19); 5.71 (1H, s, N-H); 3.53 (3H, s, N-Me); 3.40 (3H, s, N-Me); ^{13}C nmr (DMSO-d_6) δ 158.1 (C4); 152.8 (C7a); 150.5 (C2); 144.4 (C14); 141.4 (C6); 129.6 (C16, C18); 129.3 (C9, C13); 129.2 (C11); 129.1 (C8); 128.1 (C10, C12); 120.9 (C17); 117.2 (C5); 114.3 (C15, C19); 95.6 (C4a); 29.5 (N-Me) and 28.4 (N-Me).
6. Compound **7b**: yield 43%; mp 183-184°C (toluene); hreims (m/z) 377.1368 ($C_{21}H_{19}N_3O_4$); uv (MeOH) λ_{max} (nm) 240 (log ε 4.3), 282 (sh); ir (KBr) ν_{max} 3300, 1710, 1670 and 1655 cm^{-1} ; ^1H nmr (360 MHz, DMSO-d_6) δ 7.55 (2H, d, J=9 Hz, H9, H13); 7.25 (2H, dd, J=8, 9 Hz, H16, H18); 6.92 (1H, t, J=7 Hz, H17); 6.85 (2H, d, J=9 Hz, H10, H12); 6.74 (2H, d, J=7 Hz, H15, H19); 5.74 (1H, s, N-H); 3.77 (3H, s, O-Me); 3.51 (3H, s, N-Me); 3.39 (3H, s, N-Me); ^{13}C nmr (DMSO-d_6) δ 159.4 (C11); 158.2 (C4); 152.7 (C7a); 150.5 (C2); 144.6 (C14); 141.0 (C6); 130.6 (C9, C13); 129.6 (C16, C18); 121.4 (C8); 120.7 (C17); 117.0 (C5); 114.2 (C10, C12); 113.6 (C15, C19); 95.7 (C4a); 55.2 (O-Me); 29.5 (N-Me) and 28.3 (N-Me).

7. Compound **7c**: yield 67%; mp 197-198°C (toluene); hreims (m/z) 392.1120 ($C_{20}H_{16}N_4O_5$); uv (MeOH) λ_{max} (nm) 240 (sh), 265 (log ε 4.2) and 345 (br); ir (KBr) ν_{max} 3220, 1715, 1665 and 1660 cm^{-1}; ^1H nmr (360 MHz, DMSO-d_6) δ 8.13 (2H, d, J=9 Hz, H10, H12); 7.82 (2H, d, J=9 Hz, H9, H13); 7.26 (2H, t, J=8 Hz, H16, H18); 6.96 (1H, t, J=7.5 Hz, H17); 6.75 (2H, d, J=8 Hz, H15, H19); 5.86 (1H, s, N-H); 3.55 (3H, s, N-Me); 3.41 (3H, s, N-Me); ^{13}C nmr (DMSO-d_6) δ 158.0 (C4); 153.0 (C7a); 150.2 (C2); 146.9 (C14); 143.3 (C6); 142.7 (C11); 136.1 (C8); 130.1 (C9, C13); 129.7 (C16, C18); 123.3 (C10, C12); 121.5 (C17); 114.6 (C5); 114.5 (C15, C19); 95.1 (C4a); 29.6 (N-Me) and 28.4 (N-Me).
8. Compound **7d**: yield 59%; mp 216-217°C (95% ethanol); hreims (m/z) 391.1168 ($C_{21}H_{17}N_3O_5$); uv (MeOH) λ_{max} (nm) 242 (log ε 4.2), 283 (sh); ir (KBr) ν_{max} 3270, 1710, 1665 and 1660 cm^{-1}; ^1H nmr (360 MHz, DMSO-d_6) δ 8.40 (1H, s, NH); 7.15 (3H, br s, H9, H16, H18); 7.14 (1H, d, J=8 Hz, H13); 6.89 (1H, d, J=8 Hz, H12); 6.68 (2H, d, J=8 Hz, H15, H19); 6.75 (1H, t, J=7 Hz, H17); 5.99 (2H, s, O-CH_2-O); 3.38 (3H, s, N-Me); 3.23 (3H, s, N-Me); ^{13}C nmr (DMSO-d_6) δ 157.6 (C4); 152.8 (C7a); 149.9 (C2); 146.7 (C10); 146.6 (C11); 145.3 (C14); 141.5 (C6); 129.2 (C16, C18); 123.1 (C8); 123.0 (C13); 119.2 (C17); 115.2 (C5); 113.6 (C15, C19); 109.5 (C9); 107.8 (C12); 100.9 (OCH_2O); 94.4 (C4a); 29.2 (N-Me) and 27.9 (N-Me).

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