

SHORT
COMMUNICATIONS

Three-Component Condensation of Ethyl 4,5-dioxo-2-phenyl-4,5-dihydro-1*H*-pyrrole-3-carboxylates with Malononitrile and 5,5-Dimethylcyclohexane-1,3-dione

M. V. Dmitriev^a, P. S. Silaichev^a, Z. G. Aliev^b, and A. N. Maslivets^a

^a Perm State University, ul. Bukireva 15, Perm, 614990 Russia
e-mail: koh2@psu.ru

^b Institute of Chemical Physics Problems, Russian Academy of Sciences,
Chernogolovka, Moscow oblast, Russia

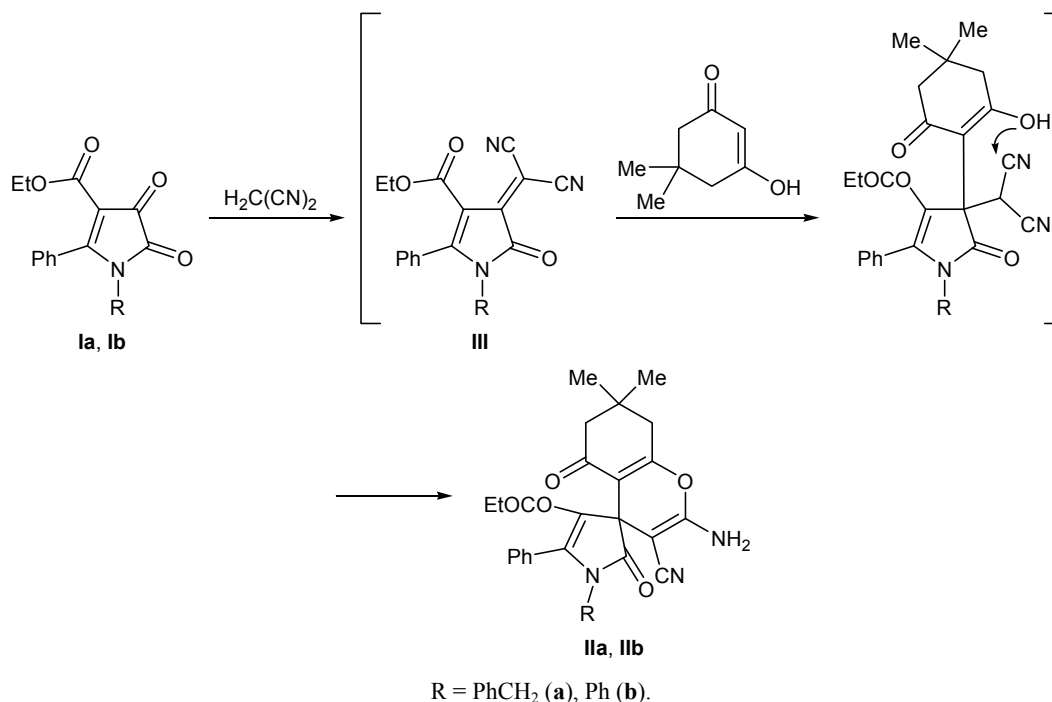
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We previously reported on three-component spiro heterocyclization of isatin with malononitrile and 5,5-dimethylcyclohexane-1,3-dione (dimedone), which led to the formation of 2'-aminospiro[indole-3,4'-pyran]-2(1*H*)-ones [1]. We now describe the three-component reaction of 1-substituted ethyl 4,5-dioxo-2-phenyl-4,5-dihydro-1*H*-pyrrole-3-carboxylates **Ia** and **Ib** with malononitrile and dimedone. The reaction was carried out by heating equimolar amounts of the reactants in boiling anhydrous benzene in the presence

of triethylamine (reaction time 1.5–2 h; TLC monitoring), and the products were the corresponding ethyl 2-amino-7,7-dimethyl-2',5'-dioxo-5'-phenyl-3-cyano-1',2',5,6,7,8-hexahydrospiro[chromene-4,3'-pyrrole]-4'-carboxylates **IIa** and **IIb** whose structure was confirmed by X-ray analysis.

Presumably, in the first step condensation of pyrrolediones **Ia** and **Ib** at the ketone carbonyl group with activated methylene group in malononitrile gives dicyanomethylidene derivatives **III**. Next follows



nucleophilic addition of the β -CH group in the enol tautomer of dimedone at the carbon atom in position 3 of the pyrrole ring, and subsequent addition of the enolic hydroxy group to the cyano carbon atom closes pyran ring, yielding final products **IIa** and **IIb**.

The described reaction is a rare example of spiro heterocyclization of monocyclic 1*H*-pyrrole-2,3-diones in three-component condensation with nucleophiles, leading to difficultly accessible spiro[chromene-4,3'-pyrrole] heterocyclic system.

Ethyl 2-amino-1'-benzyl-3-cyano-7,7-dimethyl-2',5-dioxo-5'-phenyl-1',2',5,6,7,8-hexahydrospiro[chromene-4,3'-pyrrole]-4'-carboxylate (IIa). Pyrroledione **Ia**, 1.0 mmol, was dissolved in 20 ml of anhydrous benzene, 1.0 mmol of malononitrile, 1.0 mmol of dimedone, and 1.0 mmol of triethylamine were added, the mixture was heated for 2 h under reflux and cooled, and the precipitate was filtered off and recrystallized from toluene. Yield 89%, mp 243–244°C. IR spectrum, ν , cm^{-1} : 3399, 3328, 3214 (NH_2), 2191 (CN), 1734 ($\text{C}^2=\text{O}$), 1674 ($\text{C}=\text{O}$, ester; $\text{C}^5=\text{O}$). ^1H NMR spectrum, δ , ppm: 0.84 t (3H, CH_2CH_3 , $J = 7.4$ Hz), 1.01 s (3H, Me), 1.08 s (3H, Me), 2.22 d and 2.35 d (1H each, 8-H, $J = 15.6$ Hz), 2.40 d and 2.69 d (1H each, 6-H, $J = 17.7$ Hz), 3.77 m (2H, OCH_2), 4.47 s (2H, CH_2Ph), 7.06–7.41 m (12H, H_{arom} , NH_2). ^{13}C NMR spectrum, δ_{C} , ppm: 13.41 (CH_3CH_2), 26.19 (Me), 28.15 (Me), 31.91 (C^7), 39.89 (C^8), 43.91 (C^4), 47.71 (CH_2Ph), 49.80 (C^6), 55.05 (C^3), 58.75 (OCH_2), 110.19 ($\text{C}^{4'}$), 111.32 (C^{4a}), 117.52 (CN), 126.47–136.51 (C_{arom}), 154.70 ($\text{C}^{5'}$), 159.77 (C^{8a}), 161.48 (C^2), 164.77

($\text{C}^{2'}$), 178.63 ($\text{C}=\text{O}$, ester), 195.30 (C^5). Found, %: C 71.02; H 5.47; N 8.08. $\text{C}_{31}\text{H}_{29}\text{N}_3\text{O}_5$. Calculated, %: C 71.11; H 5.58; N 8.03.

Ethyl 2-amino-3-cyano-7,7-dimethyl-2',5-dioxo-1',5'-diphenyl-1',2',5,6,7,8-hexahydrospiro[chromene-4,3'-pyrrole]-4'-carboxylate (IIb) was synthesized in a similar way. Yield 74%, mp 243–244°C (from ethyl acetate–acetone, 1:1). IR spectrum, ν , cm^{-1} : 3453, 3279, 3167 (NH_2), 2199 (CN), 1721 ($\text{C}^2=\text{O}$), 1690 ($\text{C}=\text{O}$, ester), 1663 ($\text{C}^5=\text{O}$). ^1H NMR spectrum, δ , ppm: 0.91 t (3H, CH_2CH_3 , $J = 7.2$ Hz), 1.02 s (3H, Me), 1.09 s (3H, Me), 2.23 d and 2.35 d (1H each, 8-H, $J = 16.4$ Hz), 2.41 d and 2.69 d (1H each, 6-H, $J = 17.3$ Hz), 3.83 m (2H, OCH_2), 7.02–7.32 m (10H, C_6H_5), 7.40 br.s (2H, NH_2). Found, %: C 70.73; H 5.43; N 8.13. $\text{C}_{30}\text{H}_{27}\text{N}_3\text{O}_5$. Calculated, %: C 70.71; H 5.34; N 8.25.

The IR spectra were recorded on an FSM-1201 spectrometer from samples dispersed in mineral oil. The ^1H and ^{13}C NMR spectra were measured on a Bruker AM-400 instrument at 400 and 100 MHz, respectively, using $\text{DMSO}-d_6$ as solvent and tetramethylsilane as internal reference.

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REFERENCE

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