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LETTERS
TO THE EDITOR

Synthesis of 1-(3-Phenoxyphenyl)butane-1,3-dione from Ethyl Acetoacetate

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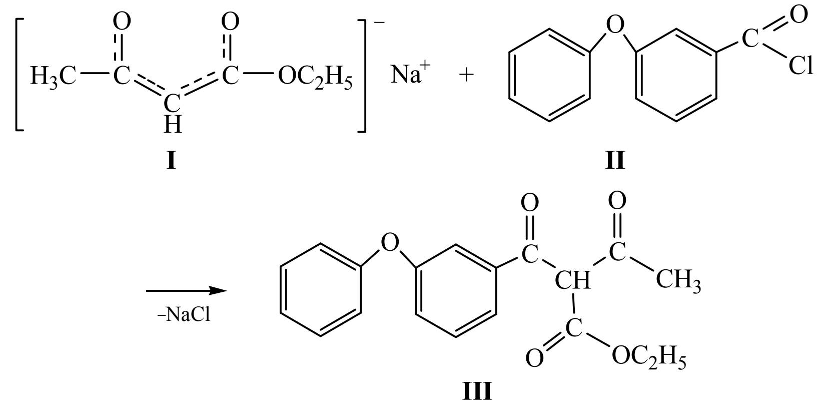
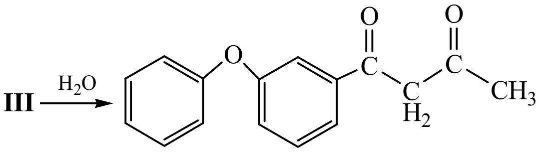
1,3-Diketones occupy an important place among various diphenyl oxide derivatives [1]. The presence of two reaction sites in the molecule makes them indispensable synthons for obtaining the new substances possessing a high biological activity. For example, 1,3-diketones can be used for the synthesis of 3-hydroxyketones, pyrazolo[5,1-*c*]-1,2,4-triazines [2], *N*-substituted aminopyridones [3], flavones, isoxazoles [4] and also as ligands in metal-polymer compounds [5], in polymer chemistry to improve dispersion of thermostabilizers in the compositions of halogenated polymers [6].

Currently, the synthesis of 1,3-dicarbonyl compounds containing diphenyloxide fragment is promising for obtaining new biologically active substances.



I **II** **III**

Acylation of sodium enolate of ethyl acetoacetate with 3-phenoxybenzoyl chloride was used for construction of the dicarbonyl system.



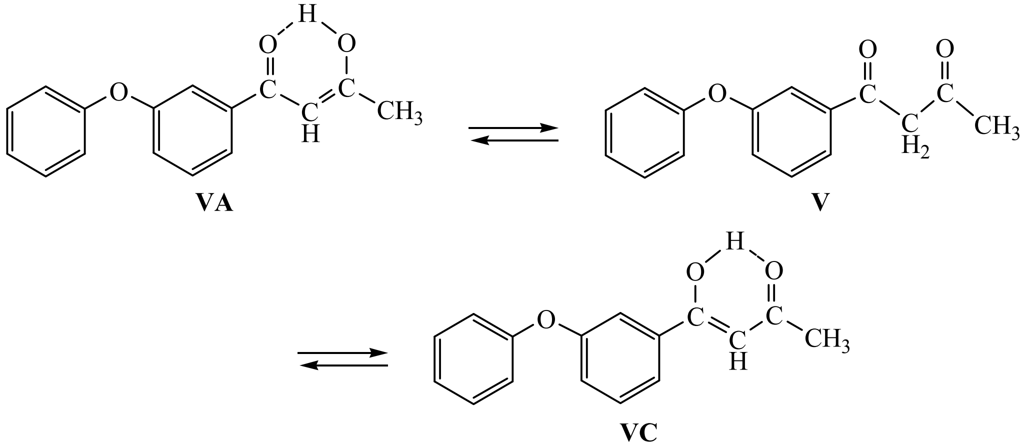
IV

Although the excess electron density is located predominantly at the oxygen atoms, which are more electronegative compared with the carbon atoms, the central carbon atom possesses the most nucleophilic reactivity. Therefore *C*-derivatives are formed. Subsequent ketone cleavage of the product of *C*-acylation results in the desired 1-(3-phenoxyphenyl)-butane-1,3-dione.

The reaction of sodium enolate of ethyl acetoacetate **I** with 3-phenoxybenzoyl chloride **II** was carried out at room temperature at vigorous stirring for 5 h. The hydrolysis of the resulting ethyl 3-oxo-2-(3-phenoxybenzoyl)butanoate **III** was performed at 100°C for 2 h.

The obtained dione **IV** is pale yellow finely dispersed crystalline solid melting at 125–130°C. The yield was 65%.

1-(3-Phenoxyphenyl)butane-1,3-dione **IV** exist as both diketone and keto-enol forms as show the spectral data which is due to intramolecular transfer of the proton with the simultaneous shift of the bonding electrons.



The presence of conjugated bonds and the formation of intramolecular hydrogen bond make the enol form more stable, therefore the enolization degree increases significantly.

The structure of the synthesized 1,3-diketone was confirmed by IR, ^{1}H NMR spectroscopy and gas chromatography-mass spectrometry.

The IR spectrum of the product obtained contains the absorption bands characteristic of the keto group (1714 cm^{-1}) and C=O involved into an intramolecular hydrogen bond (1612–1661 cm^{-1}) and the absorption band corresponding to the stretching vibrations of the OH groups (3058–3100 cm^{-1}). In the ^{1}H NMR spectrum of 1-(3-phenoxyphenyl)butane-1,3-dione there were signals of ketone and enol forms. The signals of protons of CH_3 and CH_2 groups of the keto form were registered at 0.8–2.25 and 4.3 ppm, respectively. A signal of vinyl CH group at 6.3 ppm indicates the presence of keto-enol tautomers. The protons of OH groups resonate in a very weak field (16 ppm). The high value of the chemical shift of the proton of the enol hydroxy group is caused by intramolecular hydrogen bond between this hydroxyl and a carbonyl group.

Ethyl 3-oxo-2-(3-phenoxybenzoyl)butanoate (III). To a mixture of 100 mL of absolute diethyl ether and 0.6 g (25 mmol) of sodium was added dropwise under cooling while stirring 3.5 g (27 mmol) of ethyl acetoacetate. Then the reaction mixture was incubated overnight. To the obtained sodium enolate of ethyl acetoacetate **I** was added with stirring a solution of 5.8 g (25 mmol) of 3-phenoxybenzoyl chloride in 50 mL of anhydrous ether. The mixture was stirred for 5 h, then poured into 150 mL of water, and the organic layer was separated. The aqueous layer was extracted with diethyl ether (2×50 mL). The organic layers were combined, washed until pH 7, dried over Na_2SO_4 and concentrated. Yield 7.3 g (90%), oily liquid, n_D^{20} 1.5785. IR spectrum, ν, cm^{-1}: 2962–3058 (C–H), 1750 (C=O, ether), 1680 (C=O, diketone), 1298 (C–C, CH_2), 1258 (C–O–C). ^{1}H NMR spectrum, δ, ppm: 0.8–1.32 m (3H, CH_3), 1.8–2.25 m (3H, CH_3), 4.2–4.25 m (2H, CH_2), 4.69 s (H, CH), 6.94–7.76 m (9H, $C_6H_5OC_6H_4$). Mass spectrum, m/z (I_{rel}, %): 326 (2) $[M]^+$, 197.2 (100), 140 (5).

1-(3-Phenoxyphenyl)butane-1,3-dione (IV). A mixture of 2-ethoxy-1-(3-phenoxyphenyl)butane-1,3-dione (**III**) and water was refluxed for 2 h. The precipitate formed was filtered off and washed with cyclohexane. The final product was recrystallized from methanol. Yield 4.2 g (65%), yellow crystals, mp 125–130°C. IR spectrum, ν, cm^{-1}: 2740–2890 (OH), 2900–3300 (C–H), 1780, 1696 (C=O), 1546 (C=C), 1294 (CH_3). ^{1}H NMR spectrum, δ, ppm: 0.8–2.25 m (3H, CH_3), 16.0 s (H, OH), 4.2–4.25 m (2H, CH_2), 6.03 s (H, =CH), 6.94–7.76 m (9H, $C_6H_5OC_6H_4$). Mass spectrum, m/z (I_{rel}, %): 254 (100) $[M]^+$, 255 (66) $[M + H]^+$, 253 (26), 197 (5), 161 (3).

The IR spectra were recorded on a Specord M 82 spectrometer. The ^{1}H NMR spectra were registered on a Varian Mercury 300 BB instrument in $CDCl_3$, internal reference hexamethyldisiloxane. Mass spectra were taken on a MAT-11 Variant (70 eV).

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