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Reaction of 2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde with Naphthalen-1-amine, Quinolin-8-amine, and 1,3-Diketones

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Abstract—Condensation of 2′-hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde with naphthalen-1-amine and cyclohexane-1,3-dione, methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate, or dimedone gave the corresponding 7-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-7,8,9,10,11,12-hexahydro-12*H*-benzo[*c*]acridin-8-ones. The reaction of 2′-hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde with naphthalen-1-amine and indan-1,3-dione produced 7-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-8*H*-benzo[*h*]indeno[1,2-*b*]quinolin-8-one. 7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-7,8,9,10,11,12-hexahydrobenzo[*b*][1,10]phenanthrolin-8-ones were obtained by three-component condensation of 2′-hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde with quinolin-8-amine and cyclohexane-1,3-dione, methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate, or dimedone.

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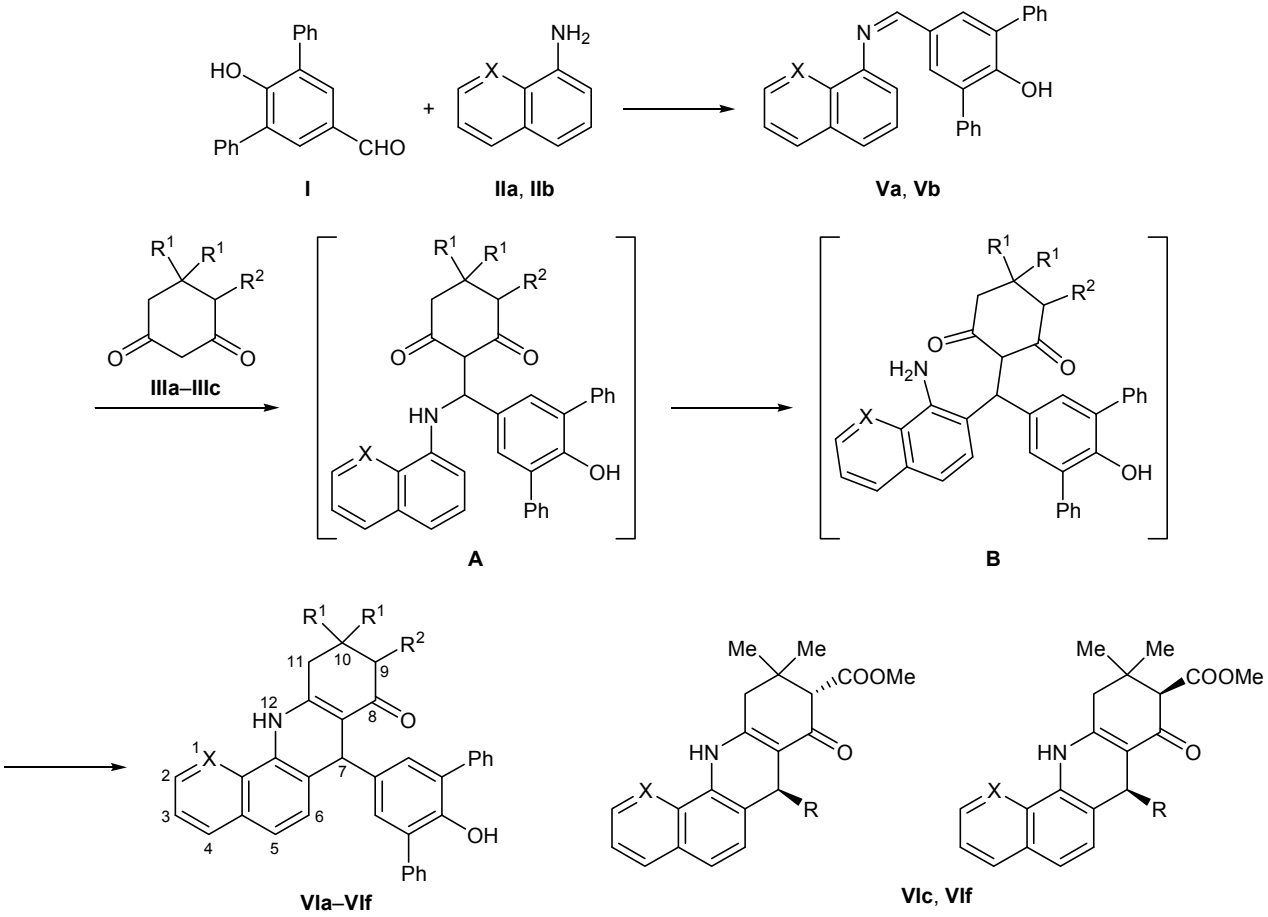
We previously studied three-component condensations of naphthalen-1-amine with 1,3-diketones and mono- and disubstituted benzaldehydes [1–3]. In the present work we selected as aldehyde component a trisubstituted benzaldehyde, 2′-hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde (**I**). Derivatives of aldehyde **I** are used as dyes, medical agents, insecticides, and stabilizers for polymeric materials [4–6]. Compound **I** was synthesized in quantitative yield according to the procedure described in [7]. We examined reactions of aldehyde **I** with naphthalen-1-amine (**IIa**) and quinolin-8-amine (**IIb**) and a series of 1,3-diketones: cyclohexane-1,3-dione (**IIIa**), 5,5-dimethylcyclohexan-1,3-dione (**IIIb**, dimedone), methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate (**IIIc**), and indan-1,3-dione (**IV**). The reactions were carried out by heating equimolar amounts of the reactants in boiling ethanol.

As we showed in [8], the direction of this reaction is determined by the order of mixing of the reactants. If an amine is mixed initially with diketone, the only product is the corresponding enamine which (after isolation as individual substance) does not react with aldehyde **I**. Mixing of amine **IIa** with aldehyde **I**, followed by addition of diketone **IIIa**–**IIIc**, leads to selective formation of benzo[*c*]acridin-8-ones **VIa**–**VIc**. In this case, the condensation involves intermediate formation of amino ketone **A** which undergoes rearrangement to intermediate **B** according to the scheme proposed in [9]; dehydration of **B** yields compounds **VIa**–**VIc** (Scheme 1). Likewise, the reaction of quinolin-8-amine (**IIb**) with aldehyde **I** and subsequent addition of diketone **IIIa**–**IIIc** selectively afforded 7,8,9,10,11,12-hexahydrobenzo[*b*][1,10]phenanthrolin-8-ones **VId**–**VIf**. Analogous compounds were obtained by condensation of Schiff base **V** (isolated from the reaction mixture) with diketones **IIIa**–**IIIc** on heating in a polar solvent under reflux.

The three-component condensation with an unsymmetrical β-diketone, methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate gave rise to mixtures of stereoisomeric products **VIc** and **VIf**. The reaction under relatively mild conditions (e.g., in boiling ethanol) was completely regioselective and highly stereoselective: the only products were the corresponding 9-methoxycarbonyl derivatives, and sterically and thermodynamically more favorable 7,9-*trans* isomer prevailed (the *trans*–*cis* isomer ratio was ~2:1).

The reaction of aldehyde **I** with amine **IIa** and indan-1,3-dione (**IV**) was carried out by heating equimolar amounts of the reactants in boiling butan-1-ol.

Scheme 1.



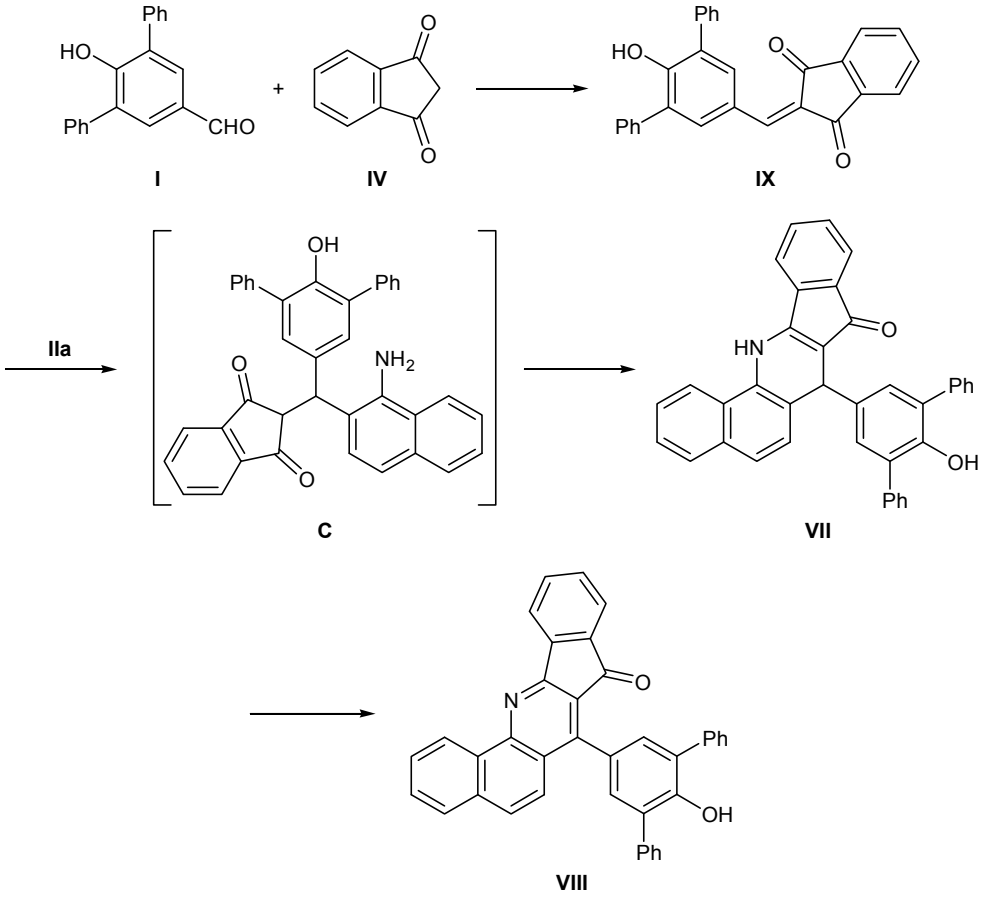
II, **V**, X = CH (**a**), N (**b**); **III**, $R^1 = R^2 = H$ (**a**), R^1 = Me, $R^2 = H$ (**b**), R^1 = Me, R^2 = MeOCO (**c**); **VI**, X = CH (**a**–**c**), N (**d**–**f**), $R^1 = R^2 = H$ (**a**, **d**), R^1 = Me, $R^2 = H$ (**b**, **e**), R^1 = Me, R^2 = MeOCO (**c**, **f**); **VIc**, **VIf**, R = 3,5-Ph_2-4-HOC_6H_2.

Taking into account our previous data [10], the reaction involves intermediate formation of amino ketone **C** which undergoes intramolecular cyclization to compound **VII** through elimination of water, and oxidation of **VII** with atmospheric oxygen yields final 7-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-8*H*-benzo[*h*]-indeno[1,2-*b*]quinolin-8-one (**VIII**) (Scheme 2). The use of butan-1-ol as solvent allowed us to avoid isolation and dehydrogenation of compound **VII**, as was reported previously for the condensation of amine **IIa** with substituted benzaldehydes and indan-1,3-dione (**IV**) in ethanol [11].

By special experiment we showed that the condensation of amine **IIa** with aldehyde **I** and diketone **IV** involves intermediate formation of 2-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-ylmethylidene)indan-1,3-dione (**IX**). Therefore, compound **VIII** can be formed by reaction of **IX** with amine **IIa**. In fact, the condensation of amine **IIa** with dione **IX** preliminarily synthesized from indandione **IV** and aldehyde **I** gave the same product **VIII**. However, we failed to obtain the corresponding condensation product from aldehyde **I**, indan-1,3-dione (**IV**), and quinolin-8-amine (**IIb**) under the same conditions as with amine **IIa**.

The structure of compounds **Va**, **Vb**, **VIa**–**VIf**, and **VII**–**IX** was confirmed by their elemental analyses and ^{1}H NMR and IR spectra. Compounds **VIa**–**VIf** characteristically showed in the IR spectra absorption bands due to stretching vibrations of the NH group (3266–3258 cm^{-1}, δNH 1609–1610 cm^{-1}) and conjugated ketone carbonyl group (1650–1630 cm^{-1}). The IR spectra of Schiff bases **Va** and **Vb** contained an absorption band at 1676 cm^{-1} due to stretching vibrations of the azomethine N=C bond. Stretching vibrations of aliphatic and aromatic C–H bonds in compounds **VIa**–**VIf** gave rise to absorption in the regions 2959–2933 and 3229–3024 cm^{-1}, respectively. Compound **IX** displayed in the IR spectrum a strong absorption band

Scheme 2.



at 1567 cm^{-1}, which was assigned to stretching vibrations of carbonyl groups conjugated with the aromatic ring. The corresponding absorption band in the spectrum of **VIII** had a medium intensity and was located at 1561 cm^{-1}. A medium-intensity band was present in the region 3537–3311 cm^{-1} in the IR spectra of **Va**, **Vb**, **VIa**–**VIf**, and **VII**–**IX**; this band belongs to stretching vibrations of the hydroxy group in the terphenyl substituent.

The ^{1}H NMR spectra of compounds **VIa**–**VIf** and **VII**–**IX** were very consistent with the assumed structures.

Compounds **VIa**–**VIc** were assigned the structure of benzoacridinone derivatives rather than benzophenanthridinones, whose formation from Schiff bases of the naphthalene series and 1,3-diketones was presumed in [12], on the basis of chemical shifts of protons on the C^1, C^{12}, and N atoms. The chemical shift of 1-H in acridinones **VIa**–**VIc** is equal to 8.05–8.10 ppm; the corresponding proton in compounds of the phenanthridine series resonates in a weaker field, at δ 8.80 ppm [13]. The position of the 1-H signal in the ^{1}H NMR spectra of **VIa**–**VIc** is determined by shielding effect exerted by the bulky aryl substituent. The signal from the CH proton (12-H) in the dihydropyridine fragment of compounds **VIa**–**VIf** also appears in a weaker field (δ 5.80–5.85 ppm) relative to the corresponding signals of cyclic compounds due to magnetically anisotropic effect of the neighboring aromatic ring having three substituents. The NH signal appeared in the spectra of heterocycles **VIa**–**VIf** as a singlet at δ 9.35–9.30 ppm, i.e., in the region typical of NH proton in acridinone derivatives [1].

The major stereoisomers of compounds **VIc** and **VIf** were assigned 7,9-*trans* configuration, taking into account downfield position of the 9-H signal in their ^{1}H NMR spectra (δ 3.50 ppm). This indicates that the 9-H proton is located in the area of deshielding by the aromatic ring. The corresponding signal of the minor 7,9-*cis* isomer is observed in a considerably stronger field (δ 3.04 ppm), for the 9-H proton appears above or below the aromatic ring plane (shielding area).

In the ^{1}H NMR spectrum of indandione **IX**, proton at the C=CH bond conjugated with two carbonyl

groups is characterized by the largest chemical shift (apart from the OH proton); it resonates as a singlet at δ 8.50 ppm, which is typical of structurally related compounds [14].

EXPERIMENTAL

The IR spectra were recorded in KBr on a Specord 75IR spectrometer. The ^{1}H NMR spectra were measured on Tesla BS-567A (100 MHz) and Bruker Avance-500 (500 MHz) instruments; the chemical shifts were determined relative to tetramethylsilane as internal reference.

2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-carbaldehyde (I) was synthesized according to the procedure described in [7]. A mixture of 12.5 g (0.051 mol) of 1,1′:3′,1″-terphenyl-2′-ol, 14.2 g (0.101 mol) of urotropin, and 50 ml of trifluoroacetic acid was stirred for 12 h at 85–95°C. The solvent was distilled off, 150 ml of 3 N hydrochloric acid was added to the residue, and the mixture was stirred for 3 h at 80°C. The precipitate was filtered off, washed with water, recrystallized from ethanol, and dried. Yield 13.2 g (95%), colorless crystals, mp 168–169°C. IR spectrum, ν, cm^{-1}: 3530, 3350, 3070, 2850, 1680, 1600, 1500, 1483, 1460, 1399, 1330, 1240, 1175, 1142, 1050, 905, 800, 760, 710, 630, 590. ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 7.46 d (4H, H_{arom}), 7.50–7.55 t (6H, H_{arom}), 7.60 d (4H, H_{arom}), 7.84 s (2H, H_{arom}), 9.94 s (1H, CHO). Found, %: C 83.17; H 5.17. $C_{19}H_{14}O_2$. Calculated, %: C 83.19; H 5.14.

5′-(Naphthalen-2-yliminomethyl)-1,1′:3′,1″-terphenyl-2′-ol (Va). A solution of 2.74 g (0.01 mol) of aldehyde **I** in 10 ml of butan-1-ol was added to a solution of 1.43 g (0.01 mol) of naphthalen-1-amine (**IIa**) in 20 ml of ethanol, and the mixture was heated for 15 min under reflux. The mixture was cooled, and the precipitate was filtered off and recrystallized from ethanol. Yield 2.95 g (85%), yellow crystals, mp 138–139°C. IR spectrum, ν, cm^{-1}: 3311, 3056, 2916, 2847, 1676, 1583, 1462, 1427, 1321, 1228, 1163, 1116, 1026, 892, 784, 748, 699, 578, 504. ^{1}H NMR spectrum, δ, ppm: 7.20–7.50 m (10H, H_{arom}), 7.59–7.90 m (10H, H_{arom}, OH), 8.50 s (1H, CH). Found, %: C 87.20; H 5.23; N 3.52. $C_{29}H_{21}NO$. Calculated, %: C 87.22; H 5.26; N 3.51.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-7,8,9,10,11,12-hexahydrobenzo[*c*]acridin-8-one (VIa). Aldehyde **I**, 2.74 g (0.01 mol), was added to a solution of 1.43 g (0.01 mol) of naphthalen-1-amine (**IIa**) in 50 ml of ethanol, the mixture was heated for 15 min under reflux, 1.12 g (0.01 mol) of cyclohexane-1,3-dione (**IIIa**) was added, and the mixture was heated for 5 h under reflux. After cooling, the precipitate was filtered off, washed with ethanol, and recrystallized from benzene. Yield 4.26 g (86%), yellow crystals, mp 317°C. IR spectrum, ν, cm^{-1}: 3550, 3264, 3093, 2954, 1650, 1609, 1552, 1518, 1481, 1420, 1395, 1341, 1277, 1234, 1185, 1157, 1106, 1049, 968, 818, 774, 762, 701, 637, 598. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.85–2.05 m (2H, CH_2), 2.20–2.35 m (2H, CH_2), 2.60–2.70 m (2H, CH_2), 5.25 s (1H, CH), 7.02 s (2H, H_{arom}), 7.20–7.45 m (14H, H_{arom}, OH), 7.65 d (1H, H_{arom}), 7.74 d (1H, H_{arom}), 8.05 d (1H, H_{arom}), 9.35 s (1H, NH). Found, %: C 85.21; H 5.48; N 2.82. $C_{35}H_{27}NO_2$. Calculated, %: C 85.17; H 5.51; N 2.86

Compounds **VIb** and **VIc** were synthesized in a similar way.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-10,10-dimethyl-7,8,9,10,11,12-hexahydrobenzo[*c*]acridin-8-one (VIb) was synthesized from aldehyde **I**, amine **IIa**, and 5,5-dimethylcyclohexane-1,3-dione (**IIIb**). Yield 4.00 g (76%), colorless crystals, mp 312°C. IR spectrum, ν, cm^{-1}: 3540, 3450, 3270, 2952, 1651, 1610, 1502, 1494, 1467, 1422, 1390, 1349, 1318, 1270, 1226, 1150, 1125, 1060, 1030, 960, 890, 800, 770, 748, 703, 698, 632, 597, 586. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.08 s and 1.10 s (3H each, CH_3), 2.10–2.13 m (2H, CH_2), 2.15–2.20 m (2H, CH_2), 5.45 s (1H, CH), 7.10 s (2H, H_{arom}), 7.20–7.49 m (14H, H_{arom}, OH), 7.70 d (1H, H_{arom}), 7.78 d (1H, H_{arom}), 8.10 d (1H, H_{arom}), 9.30 s (1H, NH). Found, %: C 85.18; H 5.96; N 2.71. $C_{37}H_{31}NO_2$. Calculated, %: C 85.19; H 5.99; N 2.69.

Methyl 7-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-10,10-dimethyl-8-oxo-7,8,9,10,11,12-hexahydrobenzo[*c*]acridine-9-carboxylate (VIc) was synthesized from aldehyde **I**, amine **IIa**, and methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate (**IIIc**). Yield 4.6 g (80%), grey crystals, mp 320°C. IR spectrum, ν, cm^{-1}: 3550, 3450, 3320, 3060, 2960, 1740, 1610, 1520, 1500, 1470, 1440, 1400, 1340, 1260, 1230, 1170, 1150, 1040, 900, 810, 780, 750, 710, 620. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.08 d (6H, CH_3), 1.10 d (6H, CH_3), 1.27 s (6H, CH_3), 2.10–2.13 m (4H, CH_2), 2.15–2.20 m (4H, CH_2), 5.45 s (1H, CH), 5.50 s (1H, CH), 7.13 s (4H, H_{arom}), 7.20–7.49 m (28H, H_{arom}, OH), 7.72 m (4H, H_{arom}), 8.10 m (2H, H_{arom}), 9.30 s (2H, NH). Found, %: C 80.9; H 5.86;

N 2.51. $C_{39}H_{33}NO_4$. Calculated, %: C 80.81; H 5.74; N 2.42.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5″-yl)-7,8,9,10,11,12-hexahydrobenzo[*b*][1,10]phenanthrolin-8-one (VId). Aldehyde **I**, 2.74 g (0.01 mol), was added to a solution of 1.43 g (0.01 mol) of quinolin-8-amine (**IIb**) in 50 ml of ethanol, the mixture was heated for 15 min under reflux, 1.12 g (0.01 mol) of cyclohexane-1,3-dione (**IIIa**) was added, and the mixture was heated for 5 h under reflux. After cooling, the precipitate was filtered off, washed with ethanol, and recrystallized from benzene. Yield 4.1 g (81%), light brown crystals, mp 304°C. IR spectrum, ν, cm^{-1}: 3552, 3260, 3090, 2964, 1650, 1609, 1562, 1520, 1491, 1420, 1395, 1341, 1278, 1234, 1186, 1157, 1106, 1059, 978, 818, 775, 762, 701, 637, 598. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.85–2.05 m (2H, CH_2), 2.20–2.40 m (2H, CH_2), 2.65–2.70 m (2H, CH_2), 5.25 s (1H, CH), 7.02 s (2H, H_{arom}), 7.20–7.45 m (13H, H_{arom}, OH), 7.65 d (1H, H_{arom}), 7.70 d (1H, H_{arom}), 8.00 d (1H, H_{arom}), 9.50 s (1H, NH). Found, %: C 82.50; H 5.42; N 5.59. $C_{34}H_{26}N_2O_2$. Calculated, %: C 82.57; H 5.30; N 5.66.

Compounds **VIe** and **VIf** were synthesized in a similar way.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-10,10-dimethyl-7,8,9,10,11,12-hexahydrobenzo[*b*][1,10]-phenanthrolin-8-one (VIe) was synthesized from aldehyde **I**, quinolin-8-amine (**IIb**), and 5,5-dimethylcyclohexane-1,3-dione (**IIIb**). Yield 4.50 g (70%), colorless crystals, mp 310°C. IR spectrum, ν, cm^{-1}: 3539, 3451, 3265, 2951, 1652, 169, 1513, 1491, 1477, 1432, 1391, 1349, 1318, 1270, 1227, 1150, 1125, 1050, 1029, 959, 891, 798, 770, 749, 703, 699, 632, 597, 586. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.08 s (3H, CH_3), 1.10 s (3H, CH_3), 2.10–2.13 m (2H, CH_2), 2.15–2.20 m (2H, CH_2), 5.5 s (1H, CH), 7.12 s (2H, H_{arom}), 7.20–7.50 m (13H, H_{arom}, OH), 7.75 d (1H, H_{arom}), 7.80 d (1H, H_{arom}), 8.10 d (1H, H_{arom}), 9.30 s (1H, NH). Found, %: C 82.68; H 5.76; N 5.41. $C_{36}H_{30}N_2O_2$. Calculated, %: C 82.73; H 5.79; N 5.36.

Methyl 7-(2′-hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-10,10-dimethyl-8-oxo-7,8,9,10,11,12-hexahydrobenzo[*b*][1,10]phenanthroline-9-carboxylate (VIf) was synthesized from aldehyde **I**, amine **IIb**, and methyl 2,2-dimethyl-4,6-dioxocyclohexane-1-carboxylate (**IIIc**). Yield 4.23 g (73%), grey crystals, mp 315°C. IR spectrum, ν, cm^{-1}: 3550, 3450, 3320, 3060, 2960, 1745, 1613, 1525, 1499, 1470, 1450, 1400, 1340, 1265, 1230, 1170, 1150, 1040, 905, 810, 780, 750, 715, 620. ^{1}H NMR spectrum (DMSO-d_6), δ, ppm: 1.08 d (6H, CH_3), 1.10 d (6H, CH_3), 1.27 s (6H, CH_3), 2.10–2.13 m (4H, CH_2), 2.15–2.20 m (4H, CH_2), 5.45 s (1H, CH), 5.50 s (1H, CH), 7.13 s (4H, H_{arom}), 7.20–7.49 m (26H, H_{arom}, OH), 7.72 m (4H, H_{arom}), 8.10 m (2H, H_{arom}), 9.30 s (2H, NH). Found, %: C 78.9; H 5.56; N 4.81. $C_{38}H_{32}N_2O_4$. Calculated, %: C 78.60; H 5.55; N 4.82.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-7,13-dihydro-8*H*-benzo[*h*]indeno[1,2-*b*]quinolin-8-one (VII). Aldehyde **I**, 2.74 g (0.01 mol), was added to a solution of 1.43 g (0.01 mol) of naphthalen-1-amine (**IIa**) in 50 ml of ethanol, the mixture was heated for 15 min under reflux, 1.46 g (0.01 mol) of cyclohexane-1,3-dione (**IIIa**) was added, and the mixture was heated for 1 h under reflux. Yield 4.68 g (89%), green–yellow crystals, mp 287°C. IR spectrum, ν, cm^{-1}: 3385, 3070, 2920, 1675, 1561, 1468, 1414, 1320, 1220, 1190, 1184, 1151, 1091, 991, 735, 699. ^{1}H NMR spectrum, δ, ppm: 7.40–7.70 m (16H, H_{arom}, OH), 7.75–7.95 m (4H, H_{arom}), 8.20 d (1H, H_{arom}), 8.50 s (2H, H_{arom}), 9.30 s (1H, NH). Found, %: C 86.52; H 4.76; N 2.63. $C_{38}H_{23}NO_2$. Calculated, %: C 86.50; H 4.78; N 2.65.

7-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-yl)-8*H*-benzo[*h*]indeno[1,2-*b*]quinolin-8-one (VIII). Solutions of 1.43 g (0.01 mol) of amine **IIa** in 10 ml of butan-1-ol and of 1.46 g (0.01 mol) of indan-1,3-dione (**IV**) in 10 ml of butan-1-ol were added to a solution of 2.74 g (0.01 mol) of terphenylcarbaldehyde **I** in 20 ml of butan-1-ol, and the mixture was heated for 4 h under reflux. The mixture was cooled, and the precipitate was filtered off and washed with three portions of hot acetone. Yield 4.5 g (85%), yellow crystals, mp 300°C. IR spectrum, ν, cm^{-1}: 3383, 3076, 2917, 1679, 1561, 1468, 1417, 1320, 1221, 1195, 1184, 1151, 1091, 991, 735, 699. ^{1}H NMR spectrum, δ, ppm: 7.40–7.70 m (15H, H_{arom}), 7.75–7.95 m (4H, H_{arom}), 8.20 d (1H, H_{arom}), 8.50 s (2H, H_{arom}), 9.48 br.s (1H, OH). Found, %: C 86.84; H 4.40; N 2.63. $C_{38}H_{23}NO_2$. Calculated, %: C 86.86; H 4.38; N 2.66.

2-(2′-Hydroxy-1,1′:3′,1″-terphenyl-5′-ylmethylidene)indan-1,3-dione (IX). A solution of 2.74 g (0.01 mol) of aldehyde **I** and 1.46 g (0.01 mol) of indandione **IV** in 30 ml of butan-1-ol was heated for 30 min under reflux. The precipitate was filtered off, washed with diethyl ether, and recrystallized from acetone. Yield 2.80 g (70%), yellow crystals, mp 246°C. IR spectrum, ν, cm^{-1}: 3460, 2923, 1681, 1567, 1468, 1418, 1326, 1282, 1219, 1193, 1153, 1086, 995, 960,

926, 880, 779, 733, 704, 691, 601, 526. ^{1}H NMR spectrum, δ, ppm: 7.35–7.45 m (3H, H_{arom}), 7.47–7.50 m (6H, H_{arom}) 7.60–7.68 m (2H, H_{arom}), 7.80–7.96 m (5H, H_{arom}), 8.50 s (1H, CH), 9.25 br.s (1H, OH). Found, %: C 83.60; H 4.49. $C_{28}H_{18}O_3$. Calculated, %: C 83.58; H 4.48.

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