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Three-Component One-Pot Synthesis of New 2,5,6,7- and 2,5,8,10-Substituted Pyrimido[4,5-*b*]quinoline-4,6-diones and -2,4,6-Triones

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Abstract—A series of new pyrimido[4,5-*b*]quinoline derivatives was synthesized by three-component cyclocondensation of 2-R^1-6-aminopyrimidine-4-ones, 5,5-dimethylcyclohexane-1,3-dione (dimedone), and aromatic or heterocyclic aldehydes in a water medium in the presence of triethylbenzylammonium chloride. The replacement of the primary amino group in the position 6 of the key 6-aminopyrimidin-4-one with the secondary amino group led to the formation of 10-substituted analogs of pyrimido[4,5-*b*]quinolines which are of interest for biological screening.

Keywords: pyrimido[4,5-*b*]quinoline, three-component cyclocondensation, dimedone, triethylbenzylammonium chloride
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In recent years, pyrimidoquinolines are of great interest due to wide spectrum of biological activity of their derivatives. Some of them exhibit high antineoplastic [1, 2], antibacterial [3], antifungal [4], antimalarial activity [5].

Previously, we have reported the synthesis [6, 7] and biological properties [8] of pyrimido[4,5-*b*]quinolinediones containing various pharmacophore groups in the positions 9 and 10. Among them some derivatives with significant antitumor activity and inhibitory effect on the cancer DNA methylation have been identified. In this regard, an improvement of the methods of the synthesis and ring expansion of these compounds, as well as bioscreening and studying the structure–activity relationship is an urgent task of organic and medical chemistry.

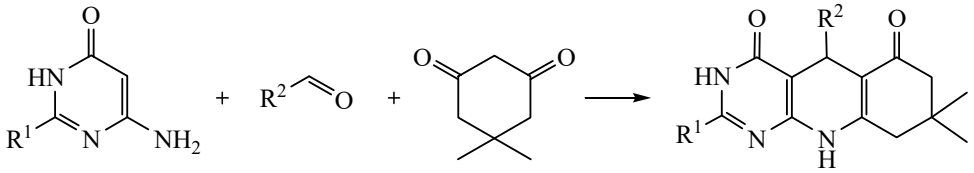
The two-component technique for annulation of 6-amino-substituted uracils with 2,3-dimethoxybenzaldehyde developed by us is simple and convenient for the synthesis of 9,10-substituted pyrimido[4,5-*b*]-quinolinediones [6–8], but limits the possibility of introducing new substituents both into the benzene and pyridine rings (into the position 5) of the fused system.

Here we report on the synthesis of new pyrimidoquinoline derivatives containing various pharmacophore fragments in the positions 2, 5, 8, and 10. The condensation reactions are widely used for building such structures, including microwave activation using 2-substituted 6-aminopyrimidin-4-ones, an aldehyde component and 1,3-dicarbonyl compounds as key compounds [9–13]. Aiming to the synthesis of the target compounds we performed the three-component single-stage cyclocondensation in an aqueous medium in the presence of triethylbenzylammonium chloride (TEBAC) as a catalyst [10] (Scheme 1).

The starting compounds were 6-amino-2-R^1-pyrimidin-4-ones **1a–1d**, aromatic or heterocyclic aldehydes **2a–2f**, and 5,5-dimethyl-1,3-cyclohexanedione **3**.

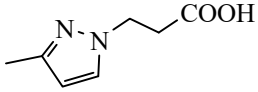
Variation of the substituents in the position 2 of the key compounds **1a–1d** would provide a possibility to evaluate changes in the biological properties of the synthesized pyrimido[4,5-*b*]quinolines **4a–4i**. The

Scheme 1.



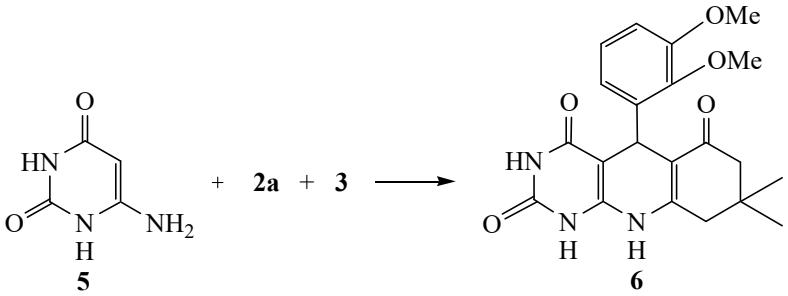
1a–1d **2a–2f** **3** **4a–4i**

1, $R^1 = NH_2$ (**a**), Me (**b**), SH (**c**), SCH_3 (**d**); **4**, $R^1 = NH_2$, R^2 = 2,3-$(OMe)_2$-C_6H_3 (**a**), 2-F-C_6H_4 (**b**), 4-F-C_6H_4 (**c**),



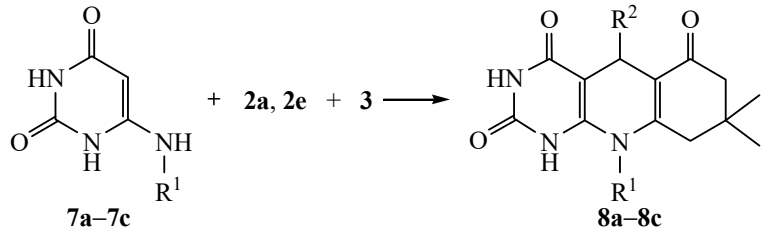
(**d**); R^1 = Me, R^2 = 2,3-$(OMe)_2$-C_6H_3 (**e**), 4-OH-C_6H_4 (**f**), 4-OMe-C_6H_4 (**g**); R^1 = SH, R^2 = 4-OH-C_6H_4 (**h**); $R^1 = SCH_3$, R^2 = 4-OH-C_6H_4 (**i**).

Scheme 2.



5 **6**

Scheme 3.



7a–7c **8a–8c**

7, R^1 = Me (**a**), $(CH_2)_3OH$ (**b**), Ph (**c**); **8**, R^1 = Me, R^2 = 2,3-$(OMe)_2$-C_6H_3 (**a**); $R^1 = (CH_2)_3OH$, R^2 = 4-OMe-C_6H_4 (**b**), 2,3-$(OMe)_2$-C_6H_3 (**c**).

reactions were carried out in water at a temperature of 80–90°C in the presence of a TEBAC catalyst. The reaction progress was monitored by TLC. In the case of compounds **4c**, **4d**, and **4i**, the absence of a catalyst does not have a significant effect on the yields of the target products.

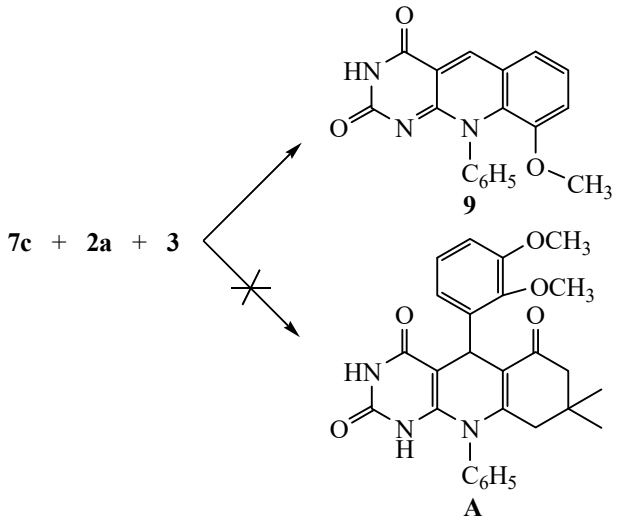
The substituted pyrimido[4,5-*b*]quinoline-4,6-diones **4a–4i** were isolated in a yield of 62–73% as pale yellow crystalline substances.

The use of 6-aminouracil **5** in the three-component cyclization instead of the starting 6-amino-2-substituted pyrimidines **1** under similar conditions led to the desired pyrimido[4,5-*b*]quinoline-2,4,6-trione **6** in 73% yield (Scheme 2).

Continuing the study, we performed some modification of the structure of compound **6** by introducing additional pharmacophore fragments, both aliphatic and aromatic, into the position 10 of the molecule. For this purpose the previously synthesized pyrimidin-4-ones **7a–7c** containing the secondary amino group at the position 6 were used as the key compounds instead of 6-aminopyrimidines **1a–1d** [6, 7].

Such studies would make it possible to obtain new 10-substituted analogs of pyrimido[4,5-*b*]quinolines and, thereby, to expand the range of the target pharmacologically active compounds. As expected, under analogous conditions the three-component cyclocondensation led to the formation of the target pyrimido-[4,5-*b*]quinolines **8a–8c** as stable pale yellow crystalline

Scheme 4.



substances (Scheme 3). The exception was the cyclocondensation of 6-phenylaminouracil **7c** with 2,3-dimethoxybenzaldehyde **2a** and dimedone that resulted in compound 9 instead of the expected tetrahydropyrimido[4,5-*b*]quinolinetrione **A** (Scheme 4).

The structure of compound **9** was solved from ^{1}H and ^{13}C NMR data. The upfield chemical shift of the C^{5}H proton (9.04 ppm), as well as the signal of the C^{6}H proton (7.81 ppm) along with the ^{13}C NMR data indicate the formation of compound **9**, which has been synthesized earlier by another method [7]. It is obvious that the cyclocondensation of aldehyde **2a** with 6-phenylaminouracil **7b** dominates over the intermediate Knoevenagel reaction between aldehyde **2a** and dimedone leading to the formation of compound **A**.

The structure of the synthesized compounds **4–8** was confirmed by the presence in the ^{1}H NMR spectra of characteristic singlets of the C^{5}H methine protons in the range of 4.76–5.11 ppm, as well as broadened singlets of NH-protons at 9.01–10.49 and 10.16–11.95 ppm.

In the IR spectra, the absorption due to NH and NH_2 stretching vibrations (3550–3160, 3470–3227, 3340–3160, 1668–1603 cm^{-1}) is characteristic. The presence of strong absorption bands in the range of 1633–1599 cm^{-1} is apparently due to the C=O group stretching vibrations.

In conclusion, a simple three-component one-pot procedure was developed for the synthesis of new 2,5,6,8,10-substituted pyrimido[4,5-*b*]quinoline derivatives by cyclocondensation of aromatic, heterocyclic aldehydes, 6-amino- or 6-substituted aminopyrimidine-4-one and 5,5-dimethylhexane-1,3-dione in an aqueous medium with or without triethylbenzylammonium chloride as a catalyst. The synthesized compounds are of practical interest for screening their biological properties and further chemical transformations.

EXPERIMENTAL

IR spectra were recorded on a Nicolet Avatar 330 FT-IR spectrometer in mineral oil. ^{1}H and ^{13}C NMR spectra of the solutions in DMSO-d_6–CCl_4 (1 : 3) were registered on a Varian Mercury-300 instrument at an operating frequency of 300 or 75 MHz, respectively, internal reference TMS. Melting points were determined on a Boetius 72/2064 apparatus. The reaction progress was monitored by TLC with the use of Silica gel 60F254 plates (Germany) eluting with chloroform–ethanol (2 : 1) or chloroform–ethanol (4 : 1) and detecting with UV light.

General procedure for the synthesis of substituted pyrimido[4,5-*b*]quinolines (4a–4i, 6, 8a–8c). A mixture of 1 mmol of the corresponding 6-aminopyrimidine, 1 mmol of aldehyde, 1 mmol of 5,5-dimethylcyclohexane-1,3-dione **3** and 0.075 g (0.33 mmol) of triethylbenzylammonium chloride in 10 mL of water was stirred at 80–90 °C for 12–20 h. After cooling to room temperature, the precipitate was filtered off, washed with alcohol and, if necessary, recrystallized from DMF or DMF–alcohol mixture.

Compounds **4c**, **4d**, and **4i** were obtained without the use of a catalyst, the reaction time was 22–24 h.

2-Amino-5-(2,3-dimethoxyphenyl)-8,8-dimethyl-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4a). Yield 67%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1603 w, 1624 m, 1653 m (C=O, NH, NH_2), 3161 w, 3327 m, 3455 s (NH, NH_2). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.87 s (3H, CH_3), 0.97 s (3H, CH_3), 1.90 d (1H, CH_2, *J* = 16.0), 2.08 d (1H, CH_2, *J* = 16.0), 2.33 d (1H, CH_2, *J* = 17.0), 2.38 d (1H, CH_2, *J* = 17.0), 3.71 s (3H, CH_3), 3.72 s (3H, OCH_3), 5.00 s (1H, CH), 6.20 br.s (2H, NH_2), 6.67–6.79 m ($3H_{Ar}$), 9.17 br.s (1H, NH), 10.16 br.s (1H, NH). Found, %: C 63.37; H 6.02; N 14.26. $C_{21}H_{24}N_4O_4$. Calculated, %: C 63.62; H 6.10; N 14.13.

2-Amino-8,8-dimethyl-5-(2-fluorophenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4b). Yield 67%, mp >300°C (DMF–ethanol, 1 : 1). IR spectrum, ν, cm^{-1}: 1614 s, 1641 w, 1667 s (C=O, NH, NH_2), 3175 m, 3272 s, 3451 s (NH, NH_2). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.94 s (3H, CH_3), 1.07 s (3H, CH_3), 1.93 d (1H, CH_2, *J* = 16.0), 2.08 d (1H, CH_2, *J* = 16.0), 2.35 s (2H, CH_2), 4.96 s (1H, CH), 6.01 br.s (2H, NH_2), 6.78–6.85 m ($1H_{Ar}$), 6.90–6.95 m ($1H_{Ar}$), 6.97–7.05 m ($1H_{Ar}$), 7.23–7.29 m ($1H_{Ar}$), 9.10 s (1H, NH), 10.25 br.s (1H, NH). Found, %: C 68.11; H 5.58; N 16.62. $C_{19}H_{19}FN_4O_2$. Calculated, %: C 68.24; H 5.73; N 16.75.

2-Amino-8,8-dimethyl-5-(4-fluorophenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4c). Yield 71%, mp >300°C (ethanol). IR spectrum, ν, cm^{-1}: 1600 w, 1618 m, 1664 s (C=O, NH, NH_2), 3181 m, 3237 s, 3302 w, 3465 s (NH, NH_2). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.88 s (3H, CH_3), 1.00 s (3H, CH_3), 1.98 d (1H, CH_2, *J* = 16.0), 2.16 d (1H, CH_2, *J* = 16.0), 2.39 d (1H, CH_2, *J* = 17.2), 2.43 d (1H, CH_2, *J* = 17.2), 4.80 s (1H, CH), 6.29 br.s (2H, NH_2), 6.92–7.00 m ($2H_{Ar}$), 7.13–7.21 m ($2H_{Ar}$), 9.29 br.s (1H, NH), 10.34 br.s (1H, NH). Found, %: C 64.11; H 5.16; N 15.62. $C_{19}H_{19}FN_4O_2$. Calculated, %: C 64.39; H 5.40; N 15.81.

2-Amino-8,8-dimethyl-5-(1-carboxyethyl-3-pyrazolo)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4d). Yield 62%, mp >300°C. IR spectrum, ν, cm^{-1}: 1593 s, 1622 m, 1663 s, 1697 m, 2500 br (C=O, COO^-, OH), 3176 m, 3234 m, 3442 s (NH, NH_2). ^1H NMR spectrum, δ, ppm (*J*, Hz): 1.03 s (3H, CH_3), 1.08 s (3H, CH_3), 2.11 s (2H, CH_2), 2.34 s (2H, CH_2), 2.69 t (2H, $COCH_2$, *J* = 6.8), 4.17 t (2H, NCH_2, *J* = 6.8), 4.76 s (1H, CH), 6.04 br.s (2H, NH_2), 6.99 s (1H, Pyr), 7.14 s (1H, Pyr), 9.01 s (1H, NH), 10.40 br.s (1H, NH), 12.02 br.s (1H, OH). Found, %: C 57.12; H 5.39; N 20.87. $C_{19}H_{22}N_6O_4$. Calculated, %: C 57.28; H 5.57; N 21.09.

2,8,8-Trimethyl-5-(2,3-dimethoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4e). Yield 66%, mp >300°C (DMF–ethanol). IR spectrum, ν, cm^{-1}: 1614 m, 1628 w, 1652 s (C=O, NH), 3311 s, 3470 m, 3537 s (NH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.88 s (3H, CH_3), 0.98 s (3H, CH_3), 1.94 d (1H, CH_2, *J* = 16.0), 2.10 d (1H, CH_2, *J* = 16.0), 2.10 s (3H, CH_3), 2.34 d (1H, CH_2, *J* = 16.9), 2.39 d (1H, CH_2, *J* = 16.9), 3.79 s (6H, $2OCH_3$), 5.11 s (1H, CH), 6.71–6.84 m ($3H_{Ar}$), 9.67 br.s (1H, NH), 11.82 br.s (1H, NH). Found, %: C 66.58; H 6.18; N 10.41. $C_{22}H_{25}N_3O_4$. Calculated, %: C 66.82; H 6.37; N 10.62.

5-(4-Hydroxyphenyl)-2,8,8-trimethyl-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4f). Yield 73%, mp >300°C. IR spectrum, ν, cm^{-1}: 1621 s, 1652 w, 1668 s (C=O, NH), 3366 s (NH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.91 s (3H, CH_3), 1.00 s (3H, CH_3), 2.00 d (1H, CH_2, *J* = 16.0), 2.16 d (1H, CH_2, *J* = 16.0), 2.19 s (3H, CH_3), 2.38 d (1H, CH_2, *J* = 17.2), 2.43 d (1H, CH_2, *J* = 17.2), 4.81 s (1H, CH), 6.52–6.57 m ($2H_{Ar}$), 6.93–6.98 m ($2H_{Ar}$), 9.00 s (1H, OH), 9.69 br.s (1H, NH), 11.94 br.s (1H, NH). Found, %: C 68.49; H 6.21; N 11.72. $C_{20}H_{21}N_3O_3$. Calculated, %: C 68.36; H 6.02; N 11.96.

2,8,8-Trimethyl-5-(4-methoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4g). Yield 64%, mp >300°C (DMF–ethanol). IR spectrum, ν, cm^{-1}: 1605 m, 1631 m, 1651 s (C=O, NH), 3141 w, 3197 w, 3256 s (NH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.91 s (3H, CH_3), 1.00 s (3H, CH_3), 2.00 d (1H, CH_2, *J* = 16.0), 2.17 d (1H, CH_2, *J* = 16.0), 2.20 s (3H, CH_3), 2.39 d (1H, CH_2, *J* = 17.2), 2.44 d (1H, CH_2, *J* = 17.2), 3.66 s (3H, OCH_3), 4.85 s (1H, CH), 6.70–6.75 m ($2H_{Ar}$), 7.06–7.11 m ($2H_{Ar}$), 9.73 br.s (1H, NH), 11.95 br.s (1H, NH). Found, %: C 68.77; H 6.17; N 11.17. $C_{21}H_{23}N_3O_3$. Calculated, %: C 69.02; H 6.34; N 11.49.

5-(4-Hydroxyphenyl)-8,8-dimethyl-2-mercapto-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4h). Yield 72%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1615 s, 1650 m, 1665 m (C=O, NH), 3102 w, 3185 s (NH, OH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.91 s (3H, CH_3), 1.05 s (3H, CH_3), 2.08 d (1H, CH_2, *J* = 16.0), 2.15 d (1H, CH_2, *J* = 16.0), 2.39 d (1H, CH_2, *J* = 17.2), 2.46 d (1H, CH_2, *J* = 17.2), 4.68 s (1H, CH), 6.52–6.58 m ($2H_{Ar}$), 6.88–6.99

m ($2H_{Ar}$); 8.25 br.s, 8.69 br.s, 11.22 br.s and 11.78 br.s (4H, OH, NH, NH, SH). Found, %: C 61.54; H 5.01; N 11.15; S 8.41. $C_{19}H_{19}N_3O_3S$. Calculated, %: C 61.77; H 5.18; N 11.37; S 8.68.

5-(4-Hydroxyphenyl)-8,8-dimethyl-2-(methylsulfanyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-4,6(1*H*,7*H*)-dione (4i). Yield 74%, mp >300°C (DMF–ethanol). IR spectrum, ν, cm^{-1}: 1599 m, 1647 s (C=O, NH), 3021 m, 3077 m, 3135 s, 3217 m, 3407 s, 3551 m (NH, OH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.91 s (3H, CH_3), 1.01 s (3H, CH_3), 2.01 d (1H, CH_2, *J* = 16.0), 2.16 d (1H, CH_2, *J* = 16.0), 2.42 d (1H, CH_2, *J* = 17.4), 2.45 d (1H, CH_2, *J* = 17.4), 2.49 s (3H, SCH_3), 4.78 s (1H, CH), 6.52–6.57 m ($2H_{Ar}$), 6.93–6.98 m ($2H_{Ar}$), 9.01 s (1H, OH), 9.66 br.s (1H, NH), 12.55 br.s (1H, NH). Found, %: C 62.37; H 5.28; N 10.71; S 8.09. $C_{20}H_{21}N_3O_3S$. Calculated, %: C 62.64; H 5.52; N 10.96; S 8.36.

8,8-Dimethyl-5-(2,3-dimethoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-2,4,6(1*H*,3*H*,7*H*)-trione (6). Yield 73%, mp >300°C. IR spectrum, ν, cm^{-1}: 1611 m, 1668 s, 1716 s (C=O, NH), 3110 w, 3168 w, 3340 s, 3446 m, 3511 m (NH, OH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.97 s (3H, CH_3), 1.07 s (3H, CH_3), 1.99 d (1H, CH_2, *J* = 15.9), 2.09 d (1H, CH_2, *J* = 15.9), 2.35 s (2H, CH_2), 3.78 s (3H, OCH_3), 3.80 s (3H, OCH_3), 4.94 s (1H, CH), 6.66 d. d ($1H_{Ar}$, *J* = 6.7, 3.0), 6.76–6.83 m ($2H_{Ar}$), 8.30 br.s (1H, NH), 9.83 br.s (1H, NH), 10.29 br.s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm: 26.9 (CH_3), 28.6 (CH_3), 29.9 (CH), 31.9 (C–C), 40.2, 50.3 (CH_2), 54.9 (OCH_3), 59.2 (OCH_3), 110.1 (CH), 121.7 (CH), 122.9 (CH), 138.8, 143.4, 146.9, 147.5, 151.8, 162.1. Found, %: C 63.27; H 5.62; N 10.29. $C_{21}H_{23}N_3O_5$. Calculated, %: C 63.46; H 5.83; N 10.57.

8,8,10-Trimethyl-5-(2,3-dimethoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-2,4,6-(1*H*,3*H*,7*H*)-trione (8a). Yield 64%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1634 s, 1648 s, 1733 s (C=O), 3125 m, 3203 m, 3461 w (NH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 1.03 s (3H, CH_3), 1.06 s (3H, CH_3), 2.05 s (2H, CH_2), 2.33 d (1H, CH_2, *J* = 16.8), 2.45 d (1H, CH_2, *J* = 16.8), 3.35 s (3H, NCH_3), 3.68 s (3H, OCH_3), 3.77 s (3H, OCH_3), 4.98 s (1H, CH), 6.65–6.70 m ($1H_{Ar}$), 6.77–6.86 m ($2H_{Ar}$), 10.48 br.s (1H, NH), 10.61 br.s (1H, NH). Found, %: C 64.44; H 5.87; N 10.47. $C_{22}H_{25}N_3O_5$. Calculated, %: C 64.21; H 6.12; N 10.21.

10-(3-Hydroxypropyl)-8,8-dimethyl-5-(4-methoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]quinoline-2,4,6(1*H*,3*H*,7*H*)-trione (8b). Yield 71%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1604 s, 1660 m, 1712 s (C=O, NH), 3175 w, 3365 w, 3395 w, 3445 (NH, OH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.98 s (3H, CH_3), 1.07 s (3H, CH_3), 1.62–1.80 m (2H, CH_2), 2.12 d (1H, CH_2, *J* = 16.0), 2.28 d (1H, CH_2, *J* 16.0), 2.41 d (1H, CH_2, *J* = 17.1), 2.67 d (1H, CH_2, *J* = 17.1), 3.51 br. t (2H, NCH_2, *J* = 5.4), 3.69 s (3H, OCH_3), 3.91–4.02 m (2H, OCH_2), 4.87 s (1H, CH), 5.12 m (1H, OH), 6.61–6.78 m ($2H_{Ar}$), 7.02–7.12 m ($2H_{Ar}$), 10.49 br.s (1H, NH), 10.65 br.s (1H, NH). Found, %: C 64.48; H 6.21; N 9.59. $C_{23}H_{27}N_3O_5$. Calculated, %: C 64.93; H 6.40; N 9.88.

10-(3-Hydroxypropyl)-8,8-dimethyl-5-(2,3-dimethoxyphenyl)-5,8,9,10-tetrahydropyrimido[4,5-*b*]-quinoline-2,4,6(1*H*,3*H*,7*H*)-trione (8c). Yield 68%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1625 s, 1654 s, 1716 s (C=O, NH), 3051 w, 3091 w, 3171 s, 3171 s, 3313 s, 3552 m (NH, OH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 0.96 s (3H, CH_3), 1.08 s (3H, CH_3), 1.80–2.00 m (2H, CH_2), 2.02 d (1H, CH_2, *J* = 16.0), 2.08 d (1H, CH_2, *J* = 16.0), 2.41 d (1H, CH_2, *J* = 17.0), 2.67 d (1H, CH_2, *J* = 17.0), 3.61 br. t (2H, NCH_2, *J* = 5.4), 3.74 s (3H, OCH_3), 3.78 s (3H, OCH_3), 3.80–4.02 m (2H, OCH_2), 5.01 s (1H, CH), 5.20 m (1H, OH), 6.64–6.69 m ($1H_{Ar}$), 6.77–6.81 m ($2H_{Ar}$), 10.49 br.s (1H, NH), 10.69 br.s (1H, NH). Found, %: C 63.09; H 6.24; N 8.95. $C_{24}H_{29}N_3O_6$. Calculated, %: C 63.28; H 6.41; N 9.22.

9-Methoxy-10-phenylpyrimido[4,5-*b*]quinoline-2,4(3*H*,10*H*)-dione (9). Yield 45%, mp >300°C (DMF). IR spectrum, ν, cm^{-1}: 1565 s, 1675 s, 1706 s (C=O, NH), 3052 s, 3167 s, 3345 m (NH). ^1H NMR spectrum, δ, ppm (*J*, Hz): 3.26 s (OCH_3), 7.28–7.32 m ($2H_{Ar}$), 7.38–7.52 m ($5H_{Ar}$), 7.81 br.d ($1H_{Ar}$, *J* = 7.4), 9.04 s (1H, =CH), 11.01 br.s (1H, NH). ^{13}C NMR spectrum, δ_C, ppm (*J*, Hz): 56.9 (CH_3), 115.4, 119.0 (CH), 122.7, 123.8 (CH), 125.0 (CH), 127.4 (2CH), 127.5 (CH), 127.9 (2CH), 131.3, 142.0, 142.8 (CH), 178.1, 156.1, 159.5, 161.7. Found, %: C 67.41; H 3.89; N 13.41. $C_{18}H_{13}N_3O_3$. Calculated, %: C 67.70; H 4.10; N 13.16.

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