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Anil Synthesis in the Design of Push−Pull Systems. Synthesis of 2- and 4-(4-Styrylphenyl)-substituted Diphenylpyrimidines

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Abstract—The potential of anil synthesis for the preparation of 2,4,6-triaryl-substituted pyrimidines with an extended chain of delocalized π-bonds was studied. The reaction of (*E*)-3-phenyl-1-(*p*-tolyl)prop-2-en-1-one or chalcone with benzamidine, 4-methylbenzamidine, or 4-isobutoxybenzamidine hydrochlorides in ethanol in the presence of KOH gave 2,4-diphenyl-6-(*p*-tolyl)pyrimidine, 4,6-diphenyl-2-(*p*-tolyl)pyrimidine, and 2-(4-isobutoxyphenyl)-4-phenyl-6-(*p*-tolyl)pyrimidine. The synthesized pyrimidines were reacted with (*E*)-*N*-(phenyl- or 2-chlorophenyl)-1-arylmethanimines in DMF in the presence of a KOH/LiH mixture to obtain (*E*)-4,6-diphenyl-2-(4-styrylphenyl)pyrimidines and (*E*)-2,6-diphenyl-4-(4-styrylphenyl)pyrimidines were obtained.

Keywords: 2,4-diphenyl-6-(*p*-tolyl)pyrimidine, 4,6-diphenyl-2-(*p*-tolyl)pyrimidine, 2-(4-isobutoxyphenyl)-4-phenyl-6-(*p*-tolyl)pyrimidine, (*E*)-3-phenyl-1-(*p*-tolyl)prop-2-en-1-one, chalcone, condensation, DMF/KOH/LiH, (*E*)-4,6-diphenyl-2-(4-styrylphenyl)pyrimidines, (*E*)-2,6-diphenyl-4-(4-styrylphenyl)pyrimidines

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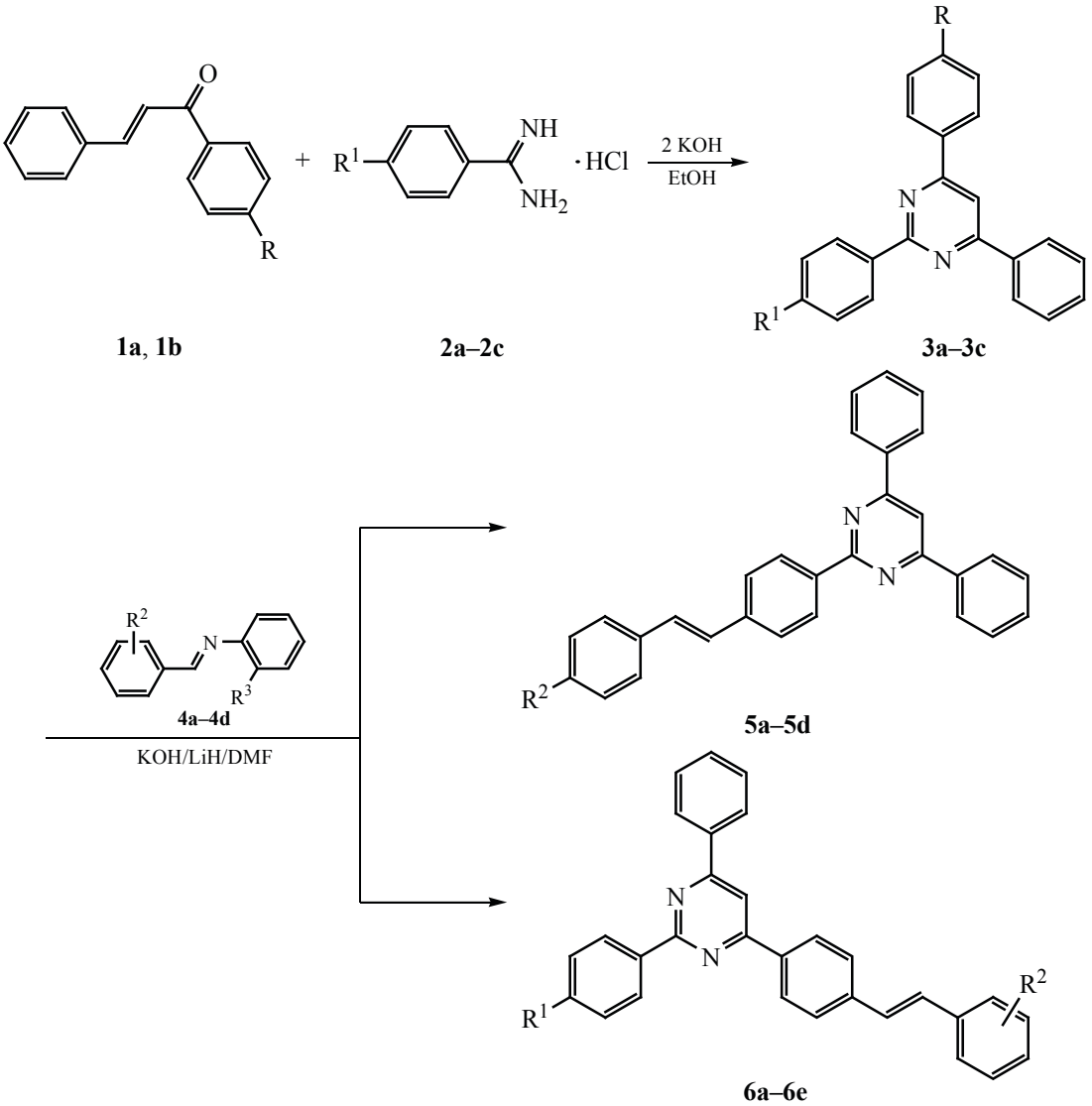
The growing interest in the synthesis of substituted pyrimidines with an extended chain of delocalized π-bonds is associated with the potential use of such compounds in the design of new organic optical materials (organic light-emitting diodes (OLED), field transistors (OFET), solar cells, luminescent sensors, etc.) [1] and preparations for biomedical applications [2]. The π-deficient aza-aromatic system of pyrimidine acts as the electron-acceptor part of the molecular system (π-acceptor), which, having bound to an electron-donor group (π-donor), forms, through delocalized π-bonds, an integral push–pull system. The latter exhibits optoelectronic properties due to charge transfer between the parts of the molecule.

Polyunsaturated conjugated chains can be introduced into the pyrimidine core can formally be carried out in two ways: by constructing the ring from simple precursors bearing the required functional groups and by chemically modifying of the available functional groups. It should be noted that the reported uses of the former approach to the target pyrimidines via acyclic precursors are limited to the synthesis of 4(6)-(2-arylethenyl)pyrimidines from substituted cinnamaldehydes by the Biginelli reaction [3]. The alternative synthetic approach to π-conjugated pyrimidine derivatives involves condensation of methylpyrimidines with arene(hetarene)carbaldehydes [4] and cross-coupling reactions on the basis of transition metals [5] or the so-called anil synthesis [6, 7].

The anil synthesis is known to involve the reaction of *para*-tolyl-substituted heterocycles, in particular, pyrimidines with Schiff bases from aromatic and heterocycle aldehydes and aniline or 2- or 4-chloroanilines in anhydrous DMF in the presence of strong bases: alkali metals and their hydroxides, alkoxides, and amides, preferentially potassium hydroxide or *tert*-butoxide [6]. However, it is slightly surprising that this method of synthesis of pyrimidines with extended π-conjugated chains, even though it allows one to vary synthons, uses accessible reagents, and simple in experimental implementation has not gained wide acceptance. Note that π-conjugated pyrimidines synthesized in this way over the past years contained one phenyl or one methyl substituent in the pyrimidine ring or phenyl and alkyl or alkoxyl together [7], whereas derivatives with two phenyl substituents in the pyrimidine ring have never been approached by this method. In this connection, we

Scheme 1.



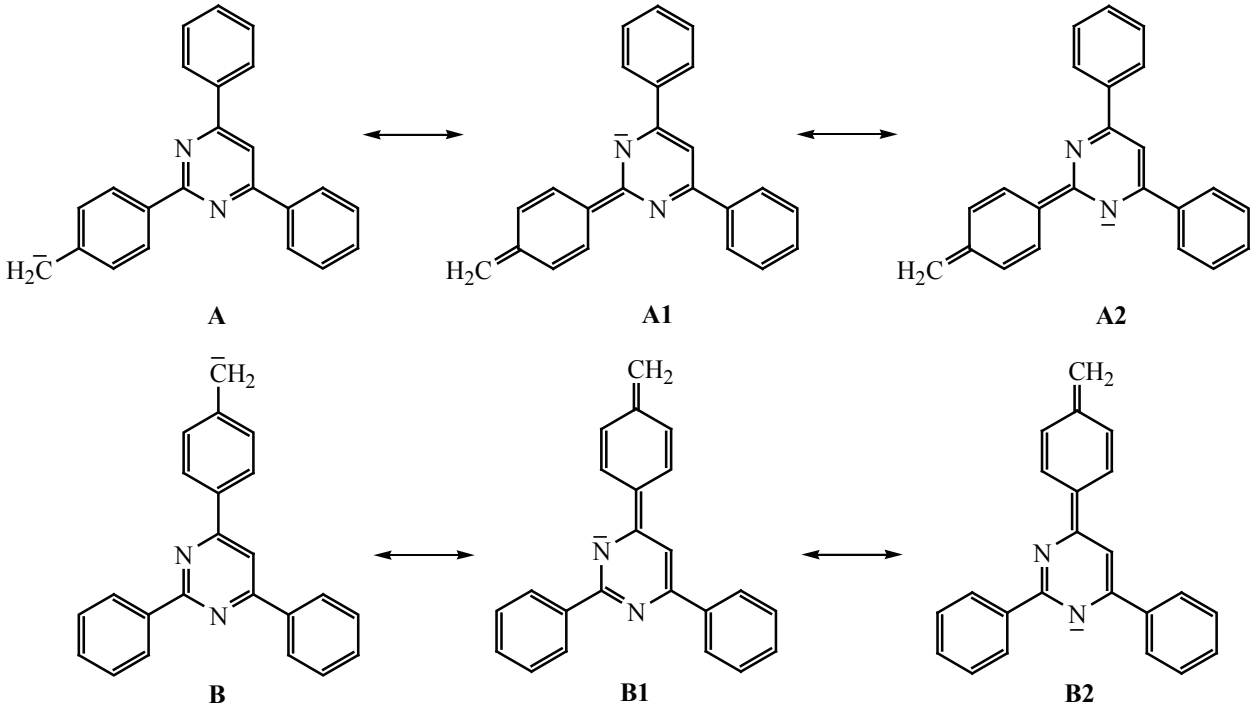
1a, **1b**, R = H (**a**), Me (**b**). **2a–2c**, R^1 = H (**a**), Me (**b**), *i*-BuO (**c**). **3a–3c**, R, R^1 = H, Me (**a**), Me, H (**b**), Me, *i*-BuO (**c**). **4a–4d**, R^2, R^3 = H, H (**a**), 4-MeO, Cl (**b**), 4-*i*-Pr, Cl (**c**), 3,4(CH_2O_2), Cl (**d**). **5a–5d**, R^2 = H (**a**), MeO (**b**), *i*-Pr (**c**), 3,4-(CH_2O_2) (**d**). **6a–6e**, R^1, R^2 = H, H (**a**), H, 4-MeO (**b**), H, 3,4-(CH_2O_2) (**c**), H, *i*-Pr (**d**), *i*-BuO, H (**e**).

decided to explore the potential of the anil synthesis as a convenient and efficient method of synthesis of the target π-conjugated pyrimidines from isomeric 2,4,6-triaryl-substituted pyrimidines. The synthesis was performed as shown in Scheme 1.

The reaction of (*E*)-3-phenyl-1-arylprop-2-en-1-ones **1a** and **1b** with benzamidine (**2a**), 4-methylbenzamidine (**2b**), and 4-isobutoxybenzamidine hydrochlorides (**2c**) in ethanol in the presence of KOH involved cyclocondensation and concurrent dehydrogenation–aromatization to give 2,4,6-trisubstituted pyrimidines **3a–3c**. The latter were use the starting compounds in the anil synthesis. 4-Isobutoxybenzamidine hydrochloride (**4a**) was prepared similarly to benzamidine [8].

We studied the anil synthesis with pyrimidines **3a–3c** and Schiff bases from aniline or 2- or 4-chloroanilines and aromatic aldehydes and modified the experimental procedure, which allowed use to optimize and simplify the process not sacrificing the yield of the target products. We found that the reported methods of synthesis, isolation, and purification of Schiff bases from aniline or 2- or 4-chloroanilines and aromatic aldehydes, except that for (*E*)-*N*,1-diphenylmethanimine (**4a**) [9], are not quite satisfactory [10].

Scheme 2.



We synthesized Schiff bases **4a–4d** from aromatic aldehydes and 2-chloroaniline by heating the reagents in the absence of solvents. The products were further reacted without isolation and purification. Of the bases mentioned in the original protocol we chose KOH, but, for the sake of convenience and simplicity, instead of the recommended 7–10 molar excess of anhydrous KOH, we used a mixture of 5 mol of anhydrous KOH and 5 mol of LiH in DMF.

It was found that 4,6-diphenyl-2-(*p*-tolyl)pyrimidine (**3a**), 2,4-diphenyl-6-(*p*-tolyl)pyrimidine (**3b**), and 4,6-diphenyl-2-(4-isobutoxyphenyl)pyrimidine (**3c**) smoothly react with (*E*)-*N*-(2-chlorophenyl)-1-(aryl)methanimines **4a–4d** in a KOH/LiH mixture in DMF at 95–105°C to form target trisubstituted pyrimidines **5a–5d** and **6a–6e**.

To explain the reactivity of isomeric pyrimidines **3a–3c** in the anil synthesis in the presence of alkalis, we considered, as a working hypothesis, the possible boundary mesomeric structures formed by deprotonation of the methyl group of the 2-(*p*-tolyl) substituent in the pyrimidine ring. The negative charge in the two canonical forms of the resulting carbanion **A** is effectively delocalized by the nitrogen atoms through a chain including five conjugated double bonds (boundary formulas **A1** and **A2**). At the same time, in carbanion **B**, formed due to deprotonation of the 4-(*p*-tolyl) substituent in the pyrimidine ring is stabilized in a similar way in one canonical formula (boundary formula **B1**) and through a chain including four conjugated double bonds in the another (boundary formula **B2**) (Scheme 2).

The mesomeric forms, where the negative charge delocalized over phenyl carbons and the C^5 atom of the pyrimidine ring, but these forms are less favored by energy and contribute much less of the mesomeric stabilization of the carbanions.

The reaction presumably involves the initial formation of such carbanions, where the energetically most efficient stabilization of the negative change through the most extended π-conjugated chain takes place, and just such cations further react with electrophilic imines.

Conclusive evidence for the structure of the synthesized compounds was obtained by IR and ^1H and ^{13}C NMR spectroscopy. Analysis of the ^{13}C NMR spectra gave a lot of useful information.

For example, starting pyrimidine **3a** and its derivative **5a** with the 2-(*p*-tolyl) substituent on has a symmetry plane, which passes through the methyl group and pyrimidine C^5 atom (compound **3a**) or through the methyl and 2-(4-styrylphenyl) groups (compound **5a**); as a result, the C^{13} NMR spectra of compounds **3a** and **5a** contain as little as 11 and 17 signals, respectively. At the same time, in the C^{13} NMR spectra of their isomeric pyrimidines **3b** and **6b**, which have no symmetry elements, we observe 17 and 22 signals, respectively.

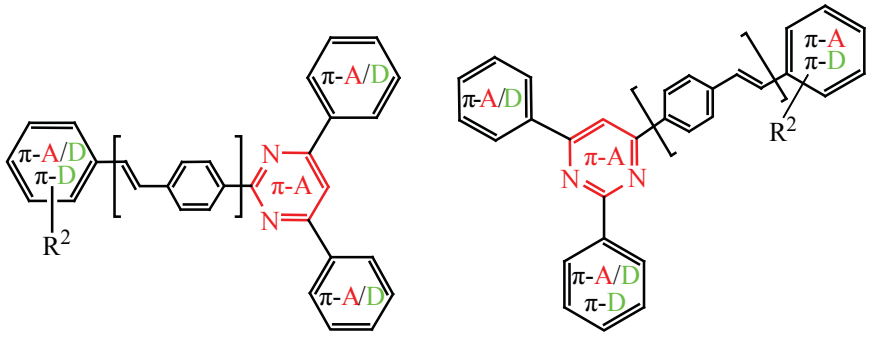


Fig. 1. Electron cloud distribution in synthesized systems **5** and **6**.

The structures of the synthesized series of isomeric pyrimidines **5a–5d** and **6a–6e** comprise the main elements of V-shaped push–pull systems, where the π-acceptor (π-A) and π-donor parts of the molecule (π-D) are conjugated by the type π-A/D–π-A–π-A/D [11] (Fig. 1).

The central positions in both compound **5** and **6** is occupied by the π-deficient pyrimidine ring (π-A), which is directly linked with the unsubstituted phenyl group with the stabilizing ±*M* effect (π-A/D), phenyl group with the ±*M* effect (R^1 = H, π-A/D) or +*M* effect (R^1 = isobutyl, π-D), and phenyl group π-conjugated through the 4-ethenyl spacer with the phenyl group, whose substituents determine the electronic characteristics of the entire 4-(4-styrylphenyl) substituent in the pyrimidine ring.

Some representatives of both series of pyrimidines exhibit well-defined fluorescence, which is undoubtedly associated with the high mobility of the electron cloud and provides evidence of the push–pull nature of the synthesized conjugated systems.

EXPERIMENTAL

The IR spectra were measured on a Nicolet Avatar 330 FTIR spectrophotometer in mineral oil. The ^{1}H NMR spectra were obtained on a Varian Mercury-300 spectrometer at 300 MHz and a Bruker Avance Neo 400 spectrometer at 400 MHz, internal reference TMS. The elemental analyses were obtained on a EuroVector EA 3000 elemental analyzer. Thin layer chromatography was performed on Silufol UV-254 in 1 : 8 ethyl acetate–hexane (**3a–3c**, **5a–5c**, **6a**, **6c–6e**) and 1 : 4 ethyl acetate–hexane (**6b**), spot visualization under UV light.

4-Isobutoxybenzamidine (2c). Dry gaseous HCl stream was bubbled through a solution of 1.75 g (0.01 mol) of 4-isobutoxybenzonitrile [12] and 0.6 g (0.013 mol) of absolute ethanol in 5 mL of dry ether with cooling on an ice bath until the reaction mixture had gained 0.5 g, after which it was allowed to stand overnight at room temperature. The ether was evaporated at reduced pressure, and the residue was cooled on ice bath and poured with 20 mL of absolute alcohol saturated with gaseous ammonia. After 2 days, ethanol was evaporated, the residue was treated with dry ether, and the precipitate was filtered off. Yield 1.9 g (83.1%), mp 238–240°C. IR spectrum, ν, cm^{-1}: 3360, 3120, 2740 (NH_3^+, NH_2^+), 1669 (NH_2), 1608 (C=C–C=N). The product was further reacted without purification.

Pyrimidines 3a–3c (*general procedure*). A mixture of 0.01 mol of amidine hydrochloride **2a–2c**, 0.01 mol of (*E*)-1-aryl-3-phenylprop-2-en-1-one **3a–3c**, and 1.12 g (0.02 mol) of KOH in 30 mL of absolute ethanol was left to stand overnight at room temperature and then refluxed for 3 h, and the solvent was evaporated. The residue was poured with 50 mL of water, left to stand for 3 h in the cold, and the precipitate was filtered off.

4,6-Diphenyl-2-(*p*-tolyl)pyrimidine (3a) was prepared from 4-methylbenzamidine hydrochloride [13] and (*E*)-*N*,1-diphenylmethanimine (**4a**). Yield 65.0%, mp 188–190°C, R_f 0.62. IR spectrum, ν, cm^{-1}: 1605, 1595 (C=C–C=N). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm: 2.47 s (3H, CH_3), 7.27–7.32 m (2H, $H^{3',5'}$, C_6H_4), 7.48–7.58 m (6H, $2H^{3',4',5'}$, C_6H_5), 8.24 s (1H, $H^5_{pyrimidine}$), 8.34–8.42 m (4H, $2H^{2',6'}$, C_6H_5), 8.54–8.59 m (2H, $H^{2',6'}$, C_6H_4). ^{13}C NMR spectrum, δ, ppm: 21.0 (CH_3), 109.5, 126.9, 127.8, 128.1, 128.4, 130.0, 134.9, 136.8, 139.6, 163.4, 163.7. Found, %: C 85.54; H 5.77; N 8.45. $C_{23}H_{18}N_2$. Calculated, %: C 85.68; H 5.63; N 8.69.

2,4-Diphenyl-6-(*p*-tolyl)pyrimidine (3b) was prepared from benzamidine hydrochloride and (*E*)-3-phenyl-1-(*p*-tolyl)prop-2-en-1-one [14]. Yield 72.3%, mp 150–152°C (150–152°C [15]). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm: 2.48 s (3H, CH_3), 7.32–7.36 m (2H, $H^{3',5'}$, C_6H_4), 7.44–7.58 m (6H, $2H^{3',4',5'}$, C_6H_5), 8.23 s (1H, $H^5_{pyrimidine}$), 8.27–8.31 m (4H, $2H^{2',6'}$,

C_6H_4), 8.36–8.41 m (2H, $H^{2',6'}$, C_6H_5), 8.65–8.70 m (2H, $H^{2',6'}$, C_6H_5). ^{13}C NMR spectrum, δ, ppm: 20.9 (CH_3), 109.4, 126.80, 126.84, 127.7, 127.8, 128.1, 128.9, 129.8, 130.0, 134.0, 136.8, 137.6, 140.1, 163.2, 163.7, 163.8.

2-(4-Isobutoxyphenyl)-4-phenyl-6-(*p*-tolyl)pyrimidine (3c). Yield 76.7%, mp 120–122°C, R_f 0.80. IR spectrum, ν, cm^{-1}: 1607, 1585 (C=C–C=N). ^1H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 1.09 d (6H, Me_2, *J* 6.7), 2.07–2.20 m (1H, CH), 2.47 s (3H, CH_3), 3.83 d (2H, CH_2, *J* 6.5), 6.95–7.00 m (2H, $H^{3',5'}$, C_6H_4O-i-Bu), 7.31–7.35 m (2H, $H^{3',5'}$, C_6H_4Me), 7.47–7.57 m (3H, $H^{3',4,5'}$, C_6H_5), 8.14 s (1H, $H^5_{pyrimidine}$), 8.24–8.28 m (2H, $H^{2',6'}$, C_6H_4Me), 8.33–8.38 m (2H, $H^{2',6'}$, C_6H_5), 8.56–8.61 m (2H, $H^{2',6'}$, C_6H_4O-*i*-Bu). ^{13}C NMR spectrum, δ, ppm: 18.8 (Me_2), 20.9 (CH_3), 27.7 (CH), 73.5 (CH_2), 108.6, 113.5 (2CH), 126.7 (2CH), 126.8 (2CH), 128.1 (2CH), 128.8 (2CH), 129.3 (2CH), 129.9, 130.1, 134.1, 137.0, 139.9, 160.7, 163.1, 163.5, 163.6. Found, %: C 82.43; H 6.52; N 7.27. $C_{27}H_{26}N_2O$. Calculated, %: C 82.20; H 6.64; N 7.10.

Pyrimidines 5a–5d and 6a–6e (*general procedure*). A mixture of 0.0055 mol of aromatic aldehyde and 0.0055 mol of 2-chloroaniline was heated for 4 h at 140–150°C in a 20-mLround-bottomed flask. After cooling, 1.61 g (0.005 mol) of pyrimidine **3a**, **3b**, or **3c**, 1.4 g (0.025 mol) of single melted KOH, 0.20 g (0.025 mol) of LiH, and 10 mL of dry DMF was added, and the resulting mixture was heated for 3 h at 90–100°C. Already after 5 min, the yellowish color of the solution changes to dark crimson. The mixture was then cooled to room temperature, poured onto 50 g of ice, and left in the cold. The product was filtered off through a paper filter and recrystallized from 80% AcOH.

(*E*)-4,6-Diphenyl-2-(4-styrylphenyl)pyrimidine (5a) was prepared from pyrimidine **3a** and (*E*)-*N*,1-diphenylmethanimine (**4a**). Yield 64.3%, mp 202–204°C, R_f 0.64. IR spectrum, ν, cm^{-1}: 1585, 1574 (C=C–C=N). ^1H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm: 7.21–7.27 m (1H, H^4, C_6H_5CH=CH), 7.25 s (2H, $C_6H_5C\underline{H}$=C$\underline{H}$), 7.32–7.38 m (2H, $H^{3,5}$, C_6H_5CH=CH), 7.50–7.60 m (8H, $H^{3,4,5}$, $2C_6H_5$ and $H^{2,6}$, $C_6H_5C\underline{H}$=C$\underline{H}$), 7.66–7.71 m (2H, $H^{3,5}$, C_6H_4), 8.27 s (1H, $H^5_{pyrimidine}$), 8.38–8.43 m (4H, $H^{2,6}$, $2C_6H_5$), 8.66–8.71 m (2H, $H^{2,6}$, C_6H_4). ^{13}C NMR spectrum, δ, ppm: 109.7, 125.9, 126.1, 126.9, 127.1, 127.8, 128.0, 128.1, 128.2, 129.2, 130.1, 136.6, 136.7, 136.8, 138.9, 163.1, 163.8. Found, %: C 88.15; H 5.32; N 6.64. $C_{30}H_{22}N_2$. Calculated, %: C 87.77; H 5.40; N 6.82.

(*E*)-4,6-Diphenyl-2-[4-(4-methoxystyryl)phenyl]-pyrimidine (5b) was prepared from pyrimidine **3a** s (*E*)-*N*-(2-chlorophenyl)-1-(4-methoxyphenyl)methanimine (**4b**). Yield 77.6%, mp 234–236°C, R_f 0.24. IR spectrum, ν, cm^{-1}: (C=C–C=N). ^1H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 3.83 s (3H, OCH_3), 6.86–6.91 m (2H, $H^{3,5}$, $C_6\underline{H}_4$MeO), 7.08 d (1H, C$\underline{H}$=CH, *J* 16.3), 7.20 d (1H, CH=C$\underline{H}$, *J* 16.3), 7.48–7.60 m (8H, $H^{2,6}$, $C_6\underline{H}_4$MeO, $H^{3,4,5}$, $2C_6H_5$), 7.62–7.66 m (2H, $H^{3,5}$, C_6H_4), 8.26 s (1H, $H^5_{pyrimidine}$), 8.38–8.42 m (4H, $H^{2,6}$, $2C_6H_5$), 8.63–8.67 m (2H, $H^{2,6}$, C_6H_4). ^{13}C NMR spectrum, δ, ppm: 54.5 (OCH_3), 109.6 ($C^5H_{pyrimidine}$), 113.6 (2CH, $C^{3,5}$, $C_6\underline{H}_4$MeO), 125.5 (CH), 125.6 (2CH), 126.9 (4CH), 127.4 (2CH), 128.1 (2CH), 128.2 (4CH), 128.8 (CH), 129.3, 130.1 (2CH), 136.2, 136.8, 139.3, 158.9, 163.1, 163.8. Found, %: C 84.35; H 5.63; N 6.44. $C_{31}H_{24}N_2O$. Calculated, %: C 84.52; H 5.49; N 6.36.

(*E*)-4,6-Diphenyl-2-[4-(4-isopropylstyryl)phenyl]-pyrimidine (5c) was prepared from pyrimidine **3a** with (*E*)-*N*-(2-chlorophenyl)-1-(4-isopropylphenyl)methanimine (**4e**). Yield 72.2%, mp 172–174°C, R_f 0.52. IR spectrum, ν, cm^{-1}: 1583, 1574 (C=C–C=N). ^1H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 1.29 d (6H, Me_2), 2.92 septet (1H, C$\underline{H}Me_2$, *J* 6.9), 7.18 d (1H, C$\underline{H}$=CH, *J* 16.3), 7.18–7.22 m (2H, $H^{3,5}$, $C_6\underline{H}_4C_3H_7$), 7.23 d (1H, CH=C$\underline{H}$, J 16.3), 7.46–7.51 m (2H, $H^{2,6}$, $C_6\underline{H}_4C_3H_7$), 7.52–7.60 m ($8H_{arom}$), 7.64–7.68 m (2H, $H^{3,5}$, C_6H_4), 8.26 s (1H, $H^5_{pyrimidine}$), 8.38–8.43 m (4H, $H^{2,6}$, $2C_6H_5$), 8.64–8.68 m (2H, $H^{2,6}$, C_6H_4). ^{13}C NMR spectrum, δ, ppm: 23.5 (Me_2), 33.2 (CH), 109.6, 125.8, 126.0, 126.2, 126.8, 126.9 (4CH), 128.1, 128.2 (4CH), 129.1, 130.1, 134.2, 136.5, 136.8, 139.1, 147.6, 163.1, 163.8. Found, %: C 87.73; H 6.17; N 6.37. $C_{33}H_{28}N_2$. Calculated, %: C 87.57; H 6.24; N 6.19.

(*E*)-2-{4-[2-(Benzo[*d*][1,3]dioxol-5-yl)vinyl]phenyl}-4,6-diphenylpyrimidine (5d) was prepared from pyrimidine **3a** and (*E*)-1-benzo[*d*][1,3]dioxol-5-yl-*N*-(2-chlorophenyl)methanimine (**4d**). Yield 73.1%, mp 183–185°C, R_f 0.28. IR spectrum, ν, cm^{-1}: 1586, 1573 (C=C–C=N). ^1H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 6.01 s (2H, CH_2), 6.80 d (1H, H^7, C_6H_3, *J* 8.0), 7.01 d.d (1H, H^7, C_6H_3, *J* 8.0, 1.7), 7.08 d (1H, C$\underline{H}$=CH, *J* 16.3), 7.18 d (1H, CH=C$\underline{H}$, *J* 16.3), 7.18 d (1H, H^4, C_6H_3, *J* 1.7), 7.50–7.60 m (6H, $H^{3,4,5}$, $2C_6H_5$), 7.62–7.66 m (2H, $H^{3,5}$, C_6H_4), 8.27 s (1H, $H^5_{pyrimidine}$), 8.38–8.43 m (4H, $H^{2,6}$, $2C_6H_5$), 8.63–8.67 (2H, $H^{2,6}$, C_6H_4). ^{13}C NMR spectrum, δ, ppm: 100.5 (CH_2), 105.1 (CH), 107.7 (CH), 109.6 (CH), 121.3 (CH), 125.7 (2CH), 126.0(CH), 126.9(4CH), 128.1(2CH), 128.2(4CH), 128.9 (CH), 130.1 (2CH), 131.1, 136.3, 136.8, 139.1, 146.9, 147.6, 163.1, 163.8. Found, %: C 81.78; H 4.75; N 6.31. $C_{31}H_{22}N_2O_2$. Calculated, %: C 81.92; H 4.88; N 6.16

(*E*)-2,4-Diphenyl-6-(4-styrylphenyl)pyrimidine (6a) was prepared from pyrimidine **3b** and (*E*)-*N*,1-diphenylmethanimine (**4a**). Yield 63.8%, mp 186–188°C, R_f 0.59. IR spectrum, ν, cm^{-1}: 1600, 1589 (C=C–C=N).

^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 7.24 d (1H) and 7.29 d (1H, CH=CH, *J* 16.0), 7.22–7.27 m ($1H_{arom}$), 7.32–7.39 m ($2H_{arom}$), 7.48–7.60 m ($8H_{arom}$), 7.70–7.75 m ($2H_{arom}$), 8.30 s (1H, $H^5_{pyrimidine}$), 8.39–8.44 m ($4H_{arom}$), 8.66–8.71 m ($2H_{arom}$). ^{13}C NMR spectrum, δ, ppm: 109.6, 126.2, 126.3, 126.9, 127.2, 127.3, 127.4, 127.7, 127.8, 128.06, 128.14, 129.6, 129.9, 130.1, 135.7, 136.5, 136.8, 137.6, 139.2, 163.28, 163.32, 163.8. Found, %: C 87.62; H 5.27; N 6.93. $C_{30}H_{22}N_2$. Calculated, %: C 87.77; H 5.40; N 6.82.

(*E*)-2,6-Diphenyl-4-[4-(4-methoxystyryl)phenyl]-pyrimidine (6b) was prepared from pyrimidine **3b** and (*E*)-*N*-(2-chlorophenyl)-1-(4-methoxyphenyl)methanimine (**4b**). Yield 78.5%, mp 162–164°C, R_f 0.42. IR spectrum, ν, cm^{-1}: 1601, 1590 (C=C–C=N). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 3.83 s (3H, CH_3), 6.87–.92 m (2H, $H^{3',5'}$, C_6H_4MeO), 7.08 d (2H, C<u>H</u>=CH, *J* 16.3), 7.24 d (2H, CH=C<u>H</u>, *J* 16.3), 7.45–7.60 m ($8H_{arom}$), 7.66–7.71 m ($2H_{arom}$), 8.30 s (1H, $H^5_{pyrimidine}$), 8.38–8.43 m ($4H_{arom}$), 8.66–8.71 m ($2H_{arom}$). ^{13}C NMR spectrum, δ, ppm: 54.5 (OCH_3), 109.5 (CH), 113.6 (2CH), 125.1 (CH), 126.0 (2CH), 126.9 (2CH), 127.1 (2CH), 127.4 (2CH), 127.7 (2CH), 127.8 (2CH), 128.1 (2CH), 129.1, 129.3 (CH), 129.8 (CH), 130.0 (CH), 135.1, 136.8, 137.6, 139.7, 159.0, 163.2, 163.4, 163.7. Found, %: C 84.67; H 5.33; N 6.52. $C_{31}H_{24}N_2O$. Calculated, %: C 84.52; H 5.49; N 6.36.

(*E*)-2,6-Diphenyl-4-[4-(4-isopropylstyryl)phenyl]-pyrimidine (6c) was prepared from pyrimidine **3b** and (*E*)-*N*-(2-chlorophenyl)-1-(4-isopropylphenyl)methanimine (**4c**). Yield 73.0%, mp 150–152°C, R_f 0.67. IR spectrum, ν, cm^{-1}: 1588 (C=C–C=N). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 1.28 d (6H, CH_3, *J* 6.9), 2.91 septet (1H, CH, *J* 6.9), 7.17 d (1H, C<u>H</u>=CH, *J* 16.4), 7.18–7.23 m ($2H_{arom}$), 7.26 d (1H, CH=C<u>H</u>, *J* 16.4), 7.46–7.59 m ($8H_{arom}$), 7.69–7.73 m ($2H_{arom}$), 8.31 s (1H, $H^5_{pyrimidine}$), 8.40–8.44 m ($4H_{arom}$), 8.67–8.71 m ($2H_{arom}$). ^{13}C NMR spectrum, δ, ppm: 23.6 (Me_2), 33.3 (CH), 109.6 (CH), 126.2 (2CH), 126.30 (2CH), 126.32 (2CH), 126.5 (CH), 127.0 (2CH), 127.3 (2CH), 127.8 (2CH), 127.9 (2CH), 128.3 (2CH), 129.6 (CH), 130.0 (CH), 130.2 (CH), 134.2, 135.5, 136.9, 137.7, 139.5, 147.9, 163.3, 163.4, 163.8. Found, %: C 87.40; H 6.35; N 6.07. $C_{33}H_{28}N_2$. Calculated, %: C 87.57; H 6.24; N 6.19.

(*E*)-4-{4-[2-(Benzo[*d*][1,3]dioxol-5-yl)vinyl]phenyl}-2,6-diphenylpyrimidine (6d) was prepared from pyrimidine **3b** and (*E*)-1-benzo[*d*][1,3]dioxol-5-yl-*N*-(2-chlorophenyl)methanimine (**4d**). Yield 60.4%, mp 173–174°C, R_f 0.45. IR spectrum, ν, cm^{-1}: 1589 (C=C–C=N). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 6.06 s (2H, CH_2), 6.95 d (1H, $H^{7'}$, C_6H_3, *J* 8.0), 7.12 d.d (1H, $H^{6'}$, C_6H_3, *J* 8.0, 1.5), 7.25 d (1H, C<u>H</u>=CH, *J* 16.5), 7.35 d (1H, $H^{4'}$, C_6H_3, *J* 1.5), 7.38 d (1H, CH=C<u>H</u>, *J* 16.5), 7.58–7.65 m ($6H_{arom}$), 7.77–7.81 m ($2H_{arom}$), 8.49–8.54 m ($4H_{arom}$), 8.55 s (1H, $H^5_{pyrimidine}$), 8.64–8.69 m ($2H_{arom}$). ^{13}C NMR spectrum, δ, ppm: 101.1 (CH_2), 105.4 (CH), 108.4 (CH), 110.1 (CH), 122.1 (CH), 125.9 (CH), 126.6 (2CH), 127.3 (2CH), 127.7 (2CH), 128.0 (2CH), 128.6 (2CH), 128.9 (2CH), 129.9 (CH), 130.8 (CH), 131.1 (CH), 131.4, 135.1, 136.6, 137.5, 140.2, 147.3, 147.9, 163.3, 163.7, 164.1. Found, %: C 82.15; H 4.65; N 5.98. $C_{31}H_{22}N_2O_2$. Calculated, %: C 81.92; H 4.88; N 6.16

(*E*)-2-(4-Isobutoxyphenyl)-4-(4-styrylphenyl)-6-phenylpyrimidine (6e) was prepared from pyrimidine **3c** and (*E*)-*N*,1-diphenylmethanimine (**4a**). Yield 64.7%, mp 162–164°C, R_f 0.61. IR spectrum, ν, cm^{-1}: 1607 (C=C–C=N). ^{1}H NMR spectrum (DMSO-d_6–CCl_4, 1 : 3), δ, ppm (*J*, Hz): 1.09 d (6H, $2CH_3$, *J* 6.7), 2.14 m (1H, CH), 3.84 d (2H, CH_2, *J* 6.4), 6.96–7.01 m (2H, C_6H_4O-*i*-Bu), 7.20–7.28 m ($3H_{arom}$), 7.32–7.38 m ($2H_{arom}$), 7.50–7.60 m ($5H_{arom}$), 7.69–7.74 m ($2H_{arom}$), 8.21 s (1H, $H^5_{pyrimidine}$), 8.35–8.42 m ($4H_{arom}$), 8.57–8.62 m ($2H_{arom}$). ^{13}C NMR spectrum, δ, ppm: 18.9 (Me_2), 27.7 (CH), 73.6 (OCH_2), 108.8, 113.6 (2CH), 126.2 (2CH), 126.4 (2CH), 126.9 (2CH), 127.2 (2CH), 127.3, 127.5, 128.1 (2CH), 128.2 (2CH), 128.3, 129.4 (2CH), 129.6, 130.1, 135.9, 136.6, 137.0, 139.2, 160.8, 163.2, 163.3, 163.7. Found, %: C 84.80; H 6.06; N 5.64. $C_{34}H_{30}N_2O$. Calculated, %: C 84.61; H 6.27; N 5.80.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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