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ORIGINAL PAPER

Synthesis of some novel phenylfuro[3,2-*d*]pyrimidine glycosides derivatives with expected antimicrobial activity

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Abstract
Reaction of ethyl 3-amino-5-phenylfuran-2-carboxylate **1** with benzoyl isothiocyanate gave 2,3-dihydro-6-phenyl-2-thioxofuro[3,2-*d*]pyrimidin-4-one. Compound **3** was reacted with benzyl chloride to afford 2-(benzylthio)-6-phenylfuro[3,2-*d*]pyrimidin-4-one **4** and also reacted with bromoglucopyranosyl to give *S*-glycoside **5**. The cyclization of ethyl 3-amino-5-phenylfuran-2-carboxylate **1** using thiourea, aniline, and carbon disulfide gave phenylfuro[3,2-*d*]pyrimidine derivatives. The pharmacological properties for the synthesized compounds were reported.

Keywords Synthesis · Benzoyl isothiocyanate · Phenylfuro[2,3-*d*]pyrimidine · Glycosides · Antimicrobial activities

Introduction

The fused pyrimidine derivatives are a class of compounds having many biological activities. This is related to the presence of the natural substrates of enzymes moiety and the purine bases of nucleic acids moiety. Synthesis of many furo[3,2-*d*]pyrimidines has been studied as potential inhibitors of folic acid cycle enzymes such as TS and DHFR by Gangjee et al. [1–5].

In the field of medical research, furo[3,2-*d*]pyrimidine derivatives have interesting antimicrobial [6], antifolate [7–9], antitumor [10–13], anticancer and antiviral activities [14, 15].

The synthesis of furo[3,2-*d*]pyrimidine derivatives was mentioned in the literature in few articles [16–26]. Therefore, we are aiming to report some new methodology for these pyrimidine derivatives (Fig. 1a, b, c).

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Results and discussion

Ethyl 3-amino-5-phenylfuran-2-carboxylate [27] **1** was reacted with benzoyl isothiocyanate at room temperature in the presence of dry acetone to yield compound **2**, in which it was cyclized by using sodium ethoxide to afford the 2,3-dihydro-6-phenyl-2-thioxofuro[3,2-*d*]pyrimidin-4(*1H*)-one **3**. Alkylation of **3** using benzyl chloride afforded 2-(benzylthio)-6-phenylfuro[3,2-*d*]pyrimidin-4-one **4**. Compound **3** was linked with 2,3,4,6-*O*-tetraacetyl-*α*-D-glucopyranosyl bromide [28, 29] to give compound **5**. The structure of compounds **2–4** was determined by spectral data. IR spectrum of **2** showed absorption bands at 1673 and 1709 cm^{-1} for two carbonyl groups. ^{1}HNMR spectrum of compound **2** showed (2NH) signal at 12.5 and 11.89 ppm (D_2O exchangeable). ^{1}HNMR of compound **3** showed signals at 11.32 and 13.21 ppm for (NH, SH) pyrimidine ring, respectively. Also, the IR spectrum showed bands at 3328 (NH), 2569 (SH), and 1682 (C=O) cm^{-1} and the absence of carbonyl of ester in Scheme 1.

^{1}HNMR of compound **4** showed a singlet peak at 4.43 ppm represented (CH_2) group and the absence of peak at 13.16 which represented (SH). IR spectrum of compound **5** showed absorption bands at 1752 cm^{-1} for carbonyl of acetyl group. ^{1}HNMR of compound **5** showed a doubled signal at 5.77 ppm due to a numeric proton of glucosyl group and a singlet signal at 2.02–2.08 ppm due to ($4CH_3$).

Fusion of ethyl 3-amino-5-phenylfuran-2-carboxylate **1** with thiourea afforded 6-phenylfuro [3, 2-*d*]

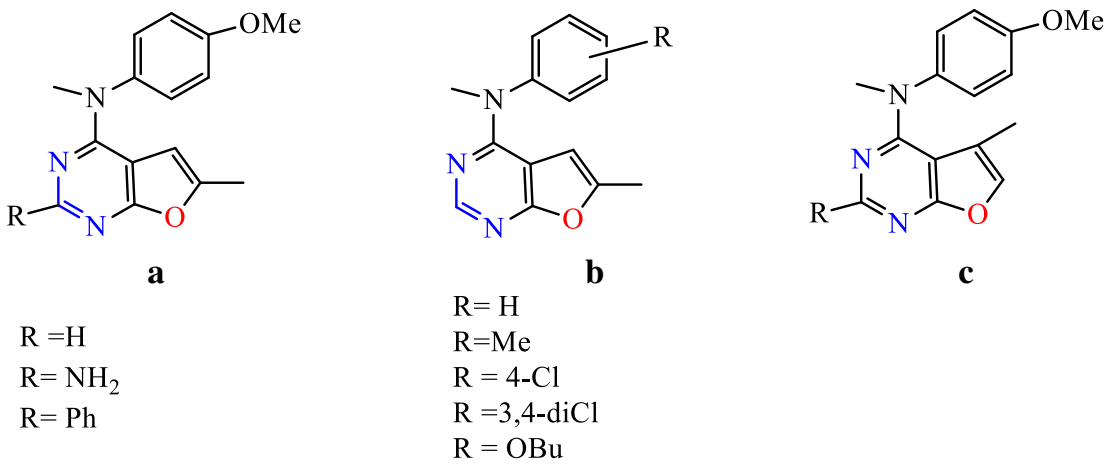
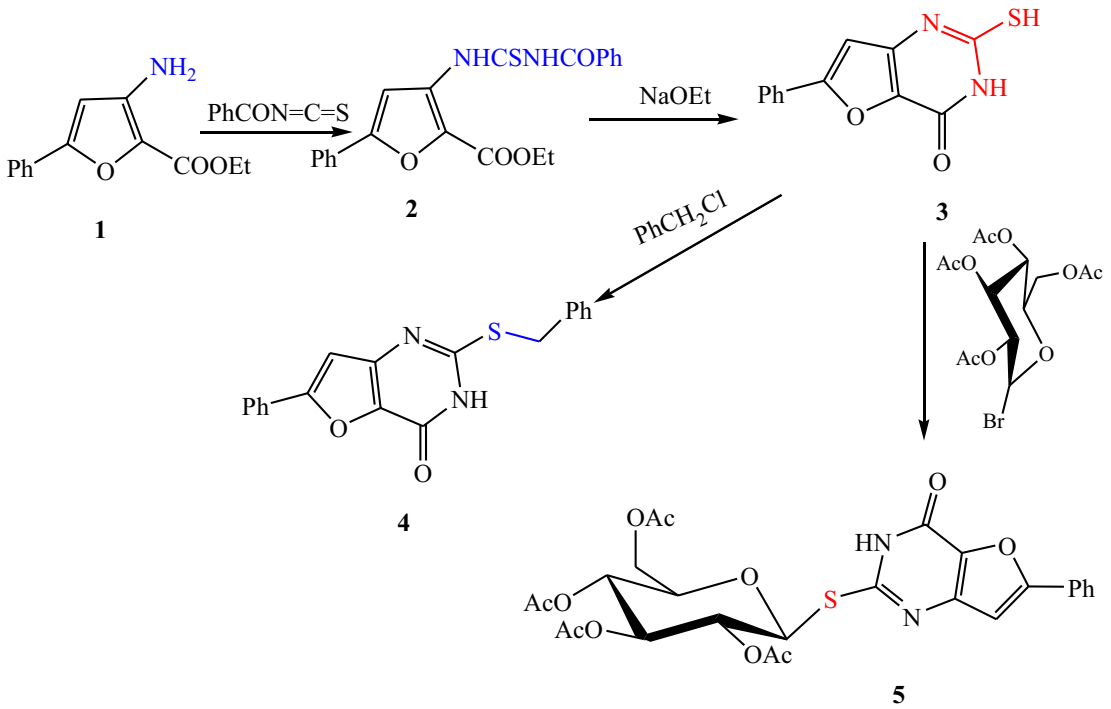


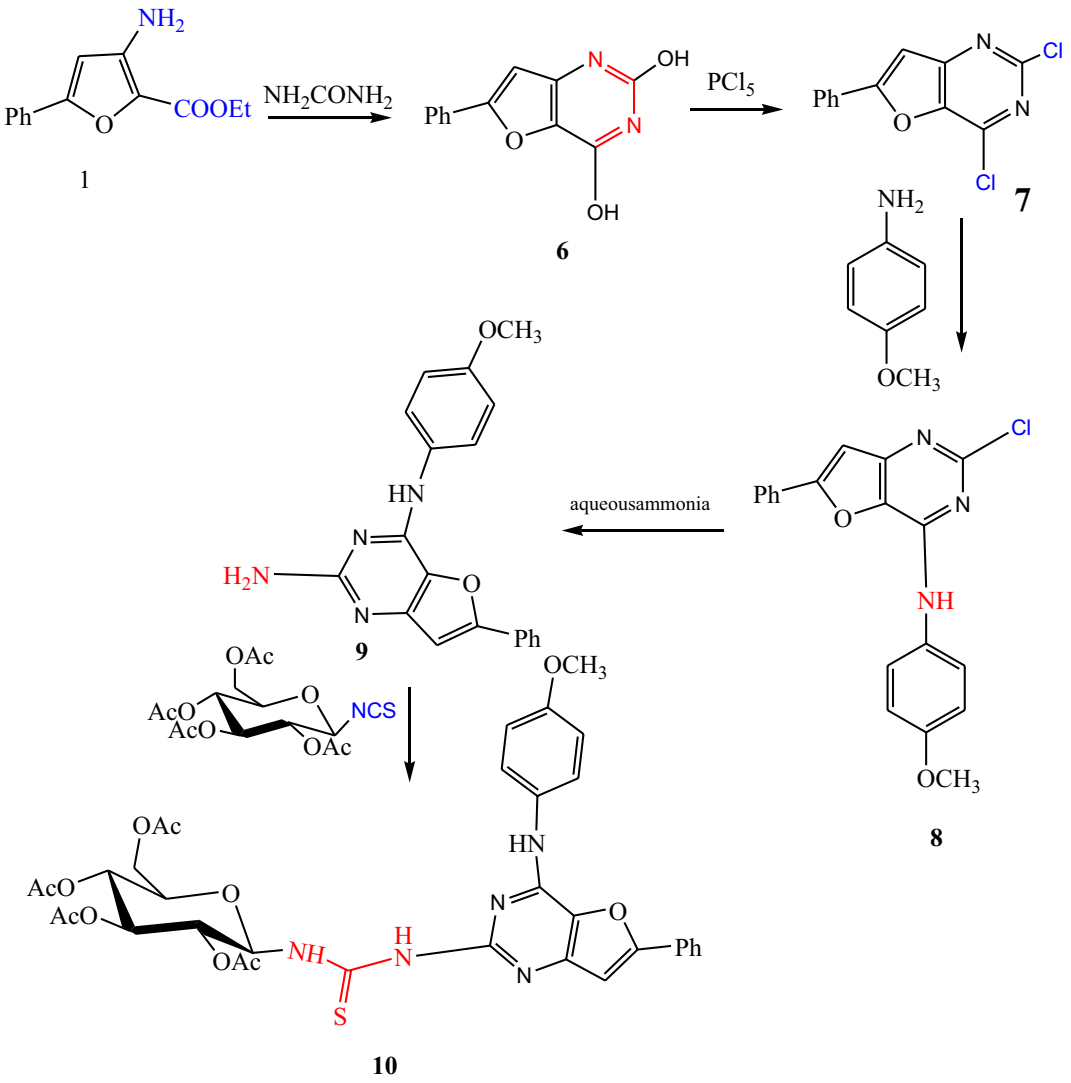
Fig. 1 Furo [2,3-*d*]pyrimidine derivatives used as anticancer agents



Scheme 1 Synthesis of the compounds **2–5**

pyrimidine-2,4-diol **6,** which was reacted with phosphorusoxychloride to give compound **7**. Compound **7** was reacted with *p*-methoxyaniline in tert-butanol to give 2-chloro-*N*-(4-methoxyphenyl)-6-phenylfuro [3,2-d]pyrimidin-4-amine **8** which was converted into compound **9** by using aqueous ammonia. The nucleophilic addition of compound **9** to 2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl isothiocyanate gave **10**. The reaction mixture in dioxan proceeded in the microwave oven [30]. The IR spectra of the glucopyranosyl thiourea **10** showed stretching band of C=S band at 1373 cm^{-1} and N–H bands at 3183–3026 cm^{-1} in Scheme 2. ^{1}HNMR of compound **8** showed a singlet signal at 3.79 ppm for (OCH_3) group and signal at 4.59 ppm for (NH) group. ^{1}HNMR spectrum of compound **9** showed a singlet signal at 7.64 ppm representing (NH_2) group.

Compound **1** was fused with aniline at 100 °C to form 3-amino-*N*, 5-diphenylfuran-2-carboxamide **11**. The ^{1}HNMR of **11** revealed a singlet signal at 9.23 for NH group. Treatment compound **11** with carbon disulfide gave compound **12** [31, 32]. The cyclization of compound **11** using sodium nitrite in the presence of acetic acid and or acetic anhydride gave compounds **13** and **14**, respectively



Scheme 2 Synthesis of compounds **6–10**

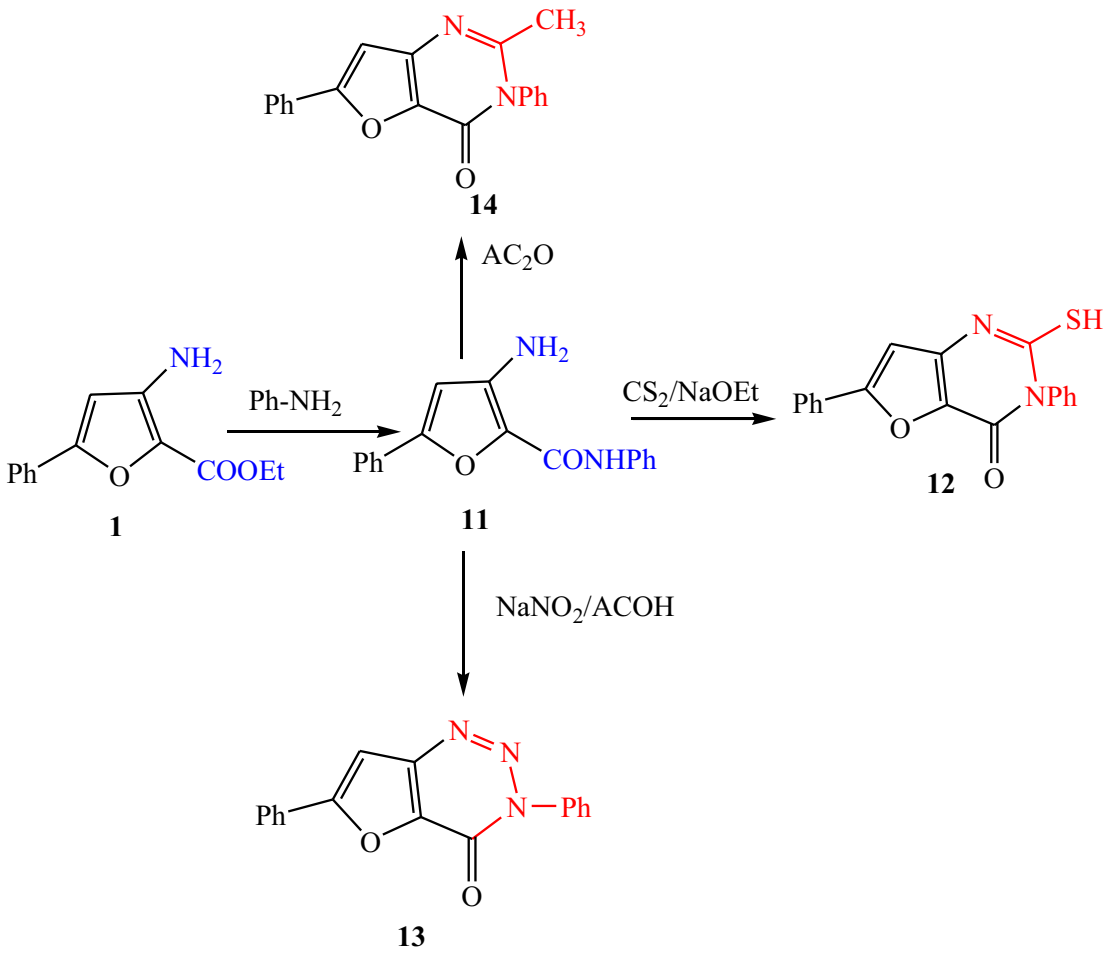
(Scheme 3). ^{1}HNMR of compound **12** showed the appearance of signal for (SH) group. ^{1}HNMR of compound **14** assigned a singlet signal at 1.92 ppm for CH_3 group and the absence of signal at 4.25 ppm for NH_2.

Antibacterial results

Compounds (**3, 5, 9, 10, 12**, and **14**) were evaluated for their antibacterial activity controlled by microdilution method [33]. The synthesized compounds were screened against *Bacillus subtilis* and *Staphylococcus aureus* as gram positive and *Escherichia coli* and *Pseudomonas aeruginosa* utilized as gram negative. The result is shown in Table 1. It is demonstrated from Table 1 compounds **3** and **10** highly significant activity more or equal MIC as compared to standard drug ciprofloxacin as control. DMSO was used as a solvent in an experiment because there was no effect in the experiment. The compound **3** was found potent activity against *E. coli* and *P. aeruginosa* at MIC 3.12 μg mL^{-1}. Furthermore, the compound **10** containing glucopyranosyl ring was found potent activity against *B. subtilis* with MIC 3.12 μg mL^{-1} while the standard ciprofloxacin indicated 6.25 μg mL^{-1}.

Antifungal results

The antifungal experimental demonstrated that synthesized compounds showed significant activity in comparison with griseofulvin as standard control against *Candida albicans* while compounds **3** and **5** showed high significant activity.



Scheme 3 Synthesis of compounds **11–14**

Table 1 Antibacterial activity data of the synthesized compounds

Antibacterial activity minimum inhibitory concentration (MIC) µg/mL				
Compounds	*E. coli*	*B. subtilis*	*P. aeruginosa*	*S. aureus*
3	3.12	6.25	3.12	6.25
5	6.25	25.00	12.50	12.50
9	12.50	50.00	25.00	25.00
10	6.25	3.12	6.25	6.25
12	6.25	6.25	3.12	6.25
14	12.50	12.50	25.00	12.50
Ciprofloxacin	12.50	6.25	6.25	6.25

Experimental

Melting points have been recorded by electrothermal 9 100 series digital melting point apparatus containing capillaries and are not corrected. IR spectrum was taken in the solid state as potassium bromide disks using a Perkin-Elmer model 1430 spectrometer. ^{1}HNMR spectra have been determined on a varian/gemini 400 MHz spectrometer in DMSO-d_6 used as a solvent and TMS used as an internal standard chemical shifts in ppm. Mass spectra were measured on an instrument vg-7035 at 70 or 15 eV. Elemental analyses were determined by a Leco CHNS-932 instrument.

Ethyl 3-[(benzoylcarbamothioyl)] amino-5-phenyl-furan-2-carboxylate (2) A solution of compound **1**(1 mol) in dry acetone (40 mL) was added to benzoyl isothiocyanate (1 mol). The reaction mixture was stirred at room temperature for 6 h. The solution was poured into ice-cold water. The formed solid product was dried and crystallized from ethanol to afford **2**. m.p. 209–211 °C, as pale yellow crystals. Yield: 68%. IR (KBr, cm^{-1}): 3358, 3302 (NH), 1709, 1673 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 1.26 (t, 3H, OCH_2CH_3), 4.23 (q, 2H, $O\underline{CH_2}CH_3$), 7.46–8.07 (m, 11H, furan-H + 2 phenyl-H), 11.89 (s, 1H, NH

D_2O exchangeable), 12.05 (s, 1H, NH, D_2O exchangeable). Anal. Calcd. for $C_{21}H_{18}N_2O_4S$, (394.44): C, 63.94; H, 4.60; N, 7.10; S, 8.13. Found: C, 63.96; H, 4.62; N, 7.08 S, 8.11.

2,3-Dihydro-6-phenyl-2-thioxofuro[3,2-*d*]pyrimidine-4-one (3) A mixture of compound **2** (1 mol) in ethanol was added to a solution of sodium ethoxide (1 mol). The reaction mixture was refluxed for 5 h, then cooled, poured into ice-cold water and neutralized with dil HCl. The formed solid product was dried and crystallized from ethanol to yield **3** as yellow crystals m.p. 321–323 °C. Yield 63%. IR (KBr, cm^{-1}): 3328 (NH), 2569 (SH) and 1682 (C=O) cm^{-1}. ^{1}HNMR (400 MHz, DMSO-d_6, ppm, δ): 6.74 (s, 1H, furan-H), 7.23–7.57 (m, 5H, phenyl-H), 11.76 (s, 1H, NH, D_2O exchangeable), 13.16 (s, 1H, SH, D_2O exchangeable). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ 115.2, 113.2, 129.3, 128.7, 127.3, 130.1, 147.2, 156.4, 168.7, 174.3. Anal. Calcd. for: $C_{12}H_8N_2O_2S$ (244.27): C, 59.00; H, 3.30; N, 11.47; S, 13.13. Found: C, 59.13; H, 3.33; N, 11.49; S, 13.11.

2-(Benzylthio)-6-phenylfuro[3,2-*d*]pyrimidin-4-one (4) A mixture of compound **3** (1 mol) in ethanol (20 mL) was added to benzyl chloride (1 mol) and sodium acetate in ethanol (20 mL). The reaction mixture was refluxed for 6 h, then cooled, dried and crystallized from ethanol to afford pale yellow crystals m.p. 309–311 °C, yields 57%. IR (KBr, cm^{-1}): 3423 (NH), 1669 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 4.43 (s, 2H, CH_2), 6.75–7.99 (m, 11H, furan-H + 2 phenyl-H), 11.34 (s, 1H, NH, D_2O exchangeable). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ 23.17, 34.75, 113.35, 115.73, 116.20, 118.89, 128.01, 129.14, 129.36, 140.27, 141.55, 147.22, 150.65, 153.20, 155.00, 163.24, 166.10, 173.13. Anal. Calcd. for: $C_{19}H_{14}N_2O_2S$ (334.39): C, 68.24; H, 4.22; N, 8.38; S, 9.59. Found: C, 68.26; H, 4.20; N, 8.40; S, 10.01.

2,3-Dihydro-6-phenyl-2(-2,3,4,6-tetra-*O*-acetyl-*ß*-D-glucopyranosyl-thioxofuro[3,2-*d*]pyrimidin-4(*1H*)-one (5) A mixture of **2** (1 mol) 2,3-dihydro-6-phenyl-2-thioxofuro[3,2-d]pyrimidine-4-one **3** in aqueous potassium hydroxide solution (5 mol, 2 mL) in absolute acetone (20 mL) was added to 2,3,4,6-*O*-acetyl-α-D-glucopyranosyl bromide (4.10 g, 0.01 mol) and stirred at room temperature for 7 h. The solvent was evaporated under reduced pressure. The formed solid product was washed with water to remove potassium bromide and crystallized from ethanol m.p. 215–217 °C. IR (KBr, cm^{-1}): 3293 (NH);1752; (C=O) 1213–1036 (C–O–C) cm^{-1}. ^{1}HNMR (400 MHz, DMSO-d_6, ppm, δ): 2.02–2.08 (4s, 12H, 4 CH_3CO), 3.69 (m, 2H, H-6,6$^-$), 4.11–4.27 (m, 2H, H-5, H 4), 5.07–5.13 (m, 2H, H-2, H-3), 5.77 (d, $J_{1,2} = 9.6$ Hz, 1H, H-1), 6.77 (s, 1H, furan-H), 7.27–7.36 (m, 5H, phenyl), 10.56 (s, 1H, NH, D_2O exchangeable).^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ 20.7, 22.01, 66.1, 73.2,74.2, 80.1, 115.7, 113.3, 129.01, 128.14, 127.3, 130.1, 147.3, 156.3, 168.7, 160.1. Anal. Calcd. for: ($C_{26}H_{26}N_2O_{11}S$; 574.56): C, 54.35; H, 4.56; N, 4.88; S, 5.58. Found: C, 54.39; H, 4.52; N, 4.91; S, 5.62.

6-Phenylfuro[3,2-*d*]pyrimidine-2,4-diol (6) Compound **1** (1 mol) was fused with urea (1 mol) at 200 °C. The mixture became a clear brown color. The reaction mixture was dissolved in 1 N sodium hydroxide and acidified with 1 N HCl. The product was crystallized from water m.p. 245–247 °C. Yield 69%. IR (KBr, cm^{-1}): 3431 (OH), 3070 (Ar C–H), 1630 (Ar C=C stretching). ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 11.32 (s, 1H, –OH, D_2O exchangeable), 9.12 (s, 1H, OH, D_2O exchangeable), 6.23 (s, 1H, furan-H), 7.04–7.23 (m, 5H, phenyl). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ C 128.92, 124.03, 128.11, 159.62, 151.67, 154.75. Anal. Calcd. for: ($C_{12}H_8N_2O_3$, 228.2): C, 63.16; H, 3.53; N, 12.28. Found: C, 63.14; H, 3.55; N, 12.285.

2,4-Dichloro-6-phenylfuro[3,2-*d*]pyrimidine (7) A mixture of compound **6** (1 mol) and phosphorus oxychloride was reacted under reflux for 13 h until a clear solution appeared. After completion of reaction by TLC test, the reaction mixture was evaporated under vacuum and then poured into ice water. The organic layer was extracted by chloroform, dried over sodium sulfate and then evaporated under vacuum. The solid product was crystallized from ethanol m.p. 278–280 °C. IR (KBr, cm^{-1}): 732 (C–Cl), 3063 (Ar C–H), 1660 (C=C). ^{1}HNMR (400 MHz, DMSO-d_6, ppm, δ): 7.21–7.42 (m, 5H, Ar–H), 6.39 (s, 1H, furan-H). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ C 126.92, 123.03, 126.11, 153.62, 161.67, 154.75. Anal. Calcd. for: ($C_{12}H_6Cl_2N_2O$, 265.09): C, 54.37; H, 2.28; Cl, 26.75; N, 10.57. Found: C, 54.39; H, 2.26 Cl, 26.77; N, 10.59.

2-Chloro-*N*-(4-methoxyphenyl)-6-phenylfuro[3,2-*d*]pyrimidin-4-amine (8) A mixture of **7** (1 mol) and *N,N*-di isopropylethylamine (1 mol) dissolved in tert-butanol (20 mL) was added to *p*-methoxyaniline; the reaction mixture was stirred at 80–90 °C for 12 h; the solvent was evaporated; and the residue was poured into water and extracted by ethyl acetate (40 mL), and dried over sodium sulfate. The organic layer was evaporated, and the residue was crystallized from ethyl acetate m.p. 310–312 °C. IR (KBr, cm^{-1}): 3076 (Ar–H), 760 (C–Cl), 1575 (C=C), 3321(N–H). ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 3.79 (s, 3H, OCH_3), 4.59 (bs, 1H, NH, D_2O exchangeable), 7.32 (dd, 2H, $J = 7.4$ H_Z, Ar–H), 6.98 (dd, 2H, $J = 7.4$ H_Z, Ar–H), 7.52–7.36 (m, 6H, phenyl, furan-H). Anal. Calcd. for: ($C_{19}H_{14}ClN_3O_2$,: 351.79): C, 64.87; H, 4.01; Cl, 10.08; N, 11.94. Found: C, 64.89; H, 3.98; Cl, 10.10; N, 11.92.

N^4-(4-Methoxyphenyl)-6-phenylfuro[3,2-*d*]pyrimidine-2,4-diamine (9) A mixture of compound **8** (1 mol) and 25% aqueous ammonia solution (7 mol) was refluxed at 80 °C for 8 h. The formed solid was filtered off, washed with water, dried and crystallized from ethanol to yield compound **9** m.p. 275–277 °C. IR (KBr, cm^{-1}): 3010 (Ar–H), C–H (2995), C=C (1565), N–H (3280 and 3386). ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 3.82 (s, 3H, OCH_3), 4.23 (bs, 1H, NH), 7.35 (dd, 2H, J = 7.3 H_Z, Ar–H), 6.96 (dd, 2H, J = 7.3 H_Z, Ar–H), 7.15 (s, 1H, furan-H), 7.64 (brs, 2H, NH_2, D_2O exchangeable), 7.23–7.53 (m, 5H, phenyl). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ 58, 118, 123, 126, 132, 140, 156, 158, 160. Anal. Calcd. for: ($C_{19}H_{16}N_4O_2$, 332.36): C, 68.66; H, 4.85; N, 16.86. Found: C, 68.68; H, 4.82; N, 16.84.

***N*-(2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosyl)-1-(4-(4-methoxyphenylamino)-6-phenylfuro[3,2-d]pyrimidin-2-yl)thiourea (10)** A mixture of (2 mol) of the corresponding substituted phenylfuro[3,2-*d*]pyrimidine derivatives (**9**) and (2 mol) of 2,3,4,6-tetra-*O*-acetyl-*β*-D-glucopyranosylisothiocyanate was allowed to irradiate for 7 min in a microwave oven at 750 Watts. Then, the reaction mixture became dark yellow. The reaction mixture was cooled at room temperature and crystallized from a mixture of toluene and ethanol (1:1 in volume) to give the product **10** m.p. 233–235 °C. IR (KBr, cm^{-1}): 3183–3026 (NH), 1748 (C=O) 1223–1035 (C–O–C), 1373 (C=S). ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 9.33 (brs, 1H, NH), 9.85 (brs, 1H, NH), 11.96 (brs, 1H, NH, D_2O exchangeable), 7.82–7.62 (m, 10H, C_6H_6, C_6H_4), 6.92 (s, 1H, furan-H), 5.93 (d, 1H, 1H′), 5.05–5.48 (m, 6H, $H_{2,3,4,5,6,6'}$), 2.35 (s, 3H, OCH_3), 2.01–1.98 (s, 12H, $4CH_3CO$). ^{13}C NMR (400 MHz, DMSO-d_6, ppm): δ 22.17, 56.9, 67.32, 106.73, 115.10, 117.88, 127.18, 129.95, 128.17, 130.87, 1154.06, 176.54, 180.48. Anal. Calcd. for: ($C_{34}H_{35}N_5O_{11}S$, 721.73): C, 56.58; H, 4.89; N, 9.70; S, 4.44. Found: C, 57.01; H, 4.93; N, 9.73; S, 4.47.

3-Amino-*N*,5-diphenylfuran-2-carboxamide (11) Compound **1** was fused (1 mol) with aniline (1 mol) at 100 °C for 3 h. The reaction mixture was cooled and dissolved in methanol, and the formed residue was filtered off, dried and crystallized from acetic acid to yield **11** as dark yellow crystals m.p. 245–247 °C. IR (KBr, cm^{-1}): 3467, 3409, 3307(s.1H, NH, D_2O exchangeable), 1679 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 6.52 (s, 2H, NH, D_2O exchangeable), 6.85 (s, 1H, furan), 7.06–7.36 (m, 10H, 2 phenyl-H), 9.23 (s, 1H, NH). ^{13}C NMR (400 MHz, DMSO-d_6) (δ; ppm): 106.76, 113.10, 114.88, 121.18, 121.95, 124.17, 128.87, 139.06, 146.54, 148.48, 151.78, 154.18, 164.13, 164.32, 166.49. Anal. Calcd. for: ($C_{17}H_{14}N_2O_2$, 278.31): C, 73.37; H, 5.07; N, 10.07. Found: C, 73.41; H, 5.13; N, 10.12.

2-Mercapto-3,6-diphenylfuro[3,2-*d*]pyrimidin-4(*3H*)-one (12) Compound **11** (1 mol) was added to CS_2 (1 mol), dissolved in sodium ethoxide solution (50 mL) and refluxed for 9 h. The reaction was cooled and poured into cold water, and dil HCl was added to neutralize at PH = 8.9. The formed residue was filtered off, dried and crystallized from ethanol to yield **12** as yellow crystals. IR (KBr, cm^{-1}): 1681 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 6.85 (s, 1H, furan), 7.21–7.42 (m, 10H, 2 phenyl-H), 12.63 (s, 1H, SH, D_2O exchangeable). Anal. Calcd. for: ($C_{18}H_{12}N_2O_2S$, 320.37): C, 67.48; H, 3.78; N, 8.74; S, 10.01. Found: C, 67.50; H, 3.42; N, 8.71; S, 10.12.

3,6-Diphenylfuro[3,2-*d*][1–3]triazin-4(*3H*)-one 13 $NaNO_2$ (1 mol) was dissolved in water (7 mL) at 0 °C and added dropwise was added with stirring to a solution of compound **11** (1 mol) dissolved in acetic acid (40 mL) in ice bath. The reaction mixture was stirred for 1 h. The formed residue was filtered off, dried and crystallized from acetic acid to afford **13** as yellow crystals. m.p. 340–342 °C, yield: 69%. IR (KBr, cm^{-1}): 1677 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 7.03 (s, 1H, furan-H), 7.45–8.12 (m, 10H, 2 phenyl). ^{13}C NMR (400 MH_Z, DMSO-d_6, ppm): δ 23.65, 113.42, 116.63, 121.60, 126.89, 129.49, 130.01, 138.11, 142.90, 146.55, 151.61, 154.12, 158.17, 164.20, 166.00, 169.04. Anal. Calcd. for: ($C_{17}H_{11}N_3O$, 289.29): C, 70.58; H, 3.83; N, 14.53. Found: C, 70.62; H, 3.87; N, 14.49.

2-Methyl-3,6-diphenylfuro[3,2-*d*]pyrimidin-4(*3H*)-one (14) A solution of **11** (1 mol) dissolved in acetic anhydride (30 mL) was refluxed for 8 h. The formed solid product was allowed to cool, filtered off and crystallized from ethanol to afford **14** as brown color crystals. m.p. 249–251 °C, yield: 87%. IR (KBr, cm^{-1}): 1680 (C=O) cm^{-1}. ^{1}H NMR (400 MHz, DMSO-d_6, ppm, δ): 3.06 (s, 3H, CH_3), 6.57 (s, IH, furan), 7.41–7.83 (m, 10H, 2 phenyl). ^{13}C NMR (400 MH_Z, DMSO-d_6, ppm): δ 22.76, 24.62, 113.15, 115.65, 121.90, 128.29, 129.85, 130.25, 137.39, 146.84, 147.27, 150.67, 151.25, 155.04, 158.24, 165.80, 167.17, 170.13. Anal. Calcd. for: ($C_{19}H_{14}N_2O_2$, 302.33): C, 75.48; H, 4.67; N, 9.27. Found: C, 75.43; H, 4.64; N, 9.03.

Experimental biological activity

Four bacterial strains, viz. *Escherichia coli* (MTCC 1302), *Bacillus subtilis* (MTCC-1133), *Pseudomonas aeruginosa* (MTCC 2295), and Staphylococcus *aureus* (MTCC-7443), were utilized within those examinations for the antimicrobial test. Ciprofloxacin was utilized as a standard drug for antibacterial activity, and minimum inhibitory concentration (MIC) of all compounds was estimated by the microdilution method using sequentially diluted compounds [33].

Table 2 Antifungal activity data of the synthesized compounds

Antifungal minimum inhibitory concentration (MIC) µg/mL		
Compounds	*A. niger*	*C. albicans*
3	6.25	3.12
5	6.25	6.25
9	6.25	3.12
10	25.00	12.50
12	12.50	6.25
14	12.50	12.50
Griseofulvin	50.00	25.00

MIC of the compounds was determined by used different concentrations. A series concentration of the compounds (100 µg/mL, 50 µg/mL, 25 µg/mL, 12.5 µg/mL, 6.25 µg/mL, 3.12 µg/mL, 1.56 µg/mL) was sequentially diluted in microtiter plate. Particularly, 0.1 mL of standardized inoculums (1–2 × 107 cfu/mL) was added in each test tube of microtiter plate [34]. The plates were hatched vigorously at 37 °C for 18–24 h. The highest dilution (the lowest concentration) of the compounds demonstrated no turbidity in the result when it might have been compared with the control might have been viewed as this MIC [35]. We used *Aspergillus Niger* (*A. Niger*) and *Candida albicans* (*C. albicans*) as antifungal activity of synthesized compounds. The synthesized compounds were investigated at various concentrations 100, 50, 25, 12.5, and 6.5 µg/mL, respectively. Griseofulvin is used as a standard control drug for antifungal activity as shown in Table 2.

Conclusion

We have reported the synthesis of novel phenylfuro[3,2-*d*] pyrimidine glycosides derivatives. Six of the newly synthesized compounds have been exhibited for their antimicrobial activities against two gram-positive, one gram-negative bacteria, as well as two fungal strains. Most of the tested compounds gave demonstrated activities toward the antibacterial strains and antifungal strains.

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