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Synthesis and characterization of novel Schiff bases containing pyrimidine unit

Jumbad H. Tomma, Mustafa S. Khazaal, Ammar H. Al-Dujaili *

Department of Chemistry, College of Education for Pure Science, Ibn Al-Haitham, University of Baghdad, Baghdad, Iraq

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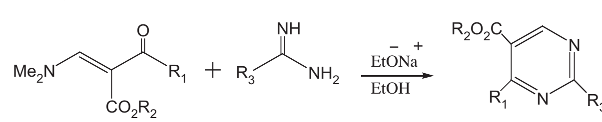
Abstract The work involves synthesis of novel Schiff base derivatives containing a pyrimidine unit starting with chalcones. 4-Aminoacetophenone was reacted with 4-nitrobenzaldehyde or 4-chlorobenzaldehyde in basic medium giving chalcones, $[I]_a$ and $[I]_b$, respectively, by Claisen-Schemidt reaction. The chalcones $[I]_a$ and $[I]_b$ were reacted with urea in HCl medium giving oxopyrimidines, $[II]_a$ and $[II]_b$. They were also reacted with thiourea in basic medium to give thioxopyrimidines, $[III]_a$ and $[III]_b$. The novel mono and bis Schiff bases, $[VIII]_{na}$, $[VIII]_{nb}$, $[IX]_{na}$, $[IX]_{nb}$, $[X]_{na}$, $[X]_{nb}$, $[XI]_{na}$, and $[XI]_{nb}$ were synthesized by the reaction of pyrimidine derivatives; oxopyrimdines, $[II]_a$ and $[II]_b$ and thioxopyrimidines, $[III]_a$ and $[III]_b$ with 4-(4′-*n*-alkoxybenzoloxy)benzaldehyde [VI] and polymethylene-α,ω-bis-4-oxybenzaldehydes $[VII]_m$, respectively, in dry benzene using drops of glacial acetic acid as a catalyst. The synthesized compounds were characterized by melting points, elemental analysis, FTIR, and ^{1}H NMR spectroscopy.

1. Introduction

Pyrimidines are one of the organic heterocyclic compounds containing a six member unsaturated ring structure composed of two nitrogen atoms at positions 1 and 3. Many workers are interested in synthesis of pyrimidine derivatives by using different methods, among these:

The condensation of the enaminone (1) with compound (2) in basic medium (Katritzky, 1997) gives the pyrimidine derivatives (3).



(1) (2) (3)

R_1=alkyl, aryl
R_2=Me, Et
R_3=NH_2, Me, Ph

In addition many chalcones (4) were reacted with urea and thiourea giving pyrimidine-2-one (5) and pyrimidine-2-thione

* Corresponding author. Tel.: +964 7901 333368.
E-mail address: ahdujaili@yahoo.com (A.H. Al-Dujaili).

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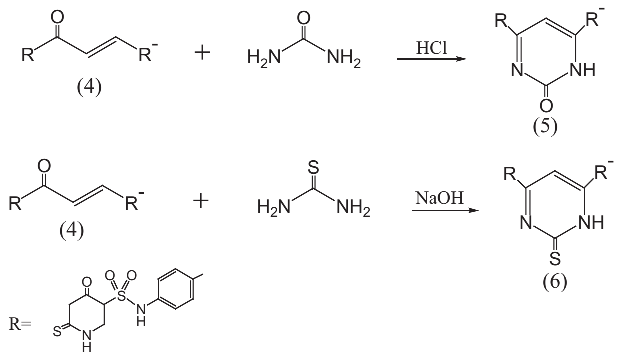
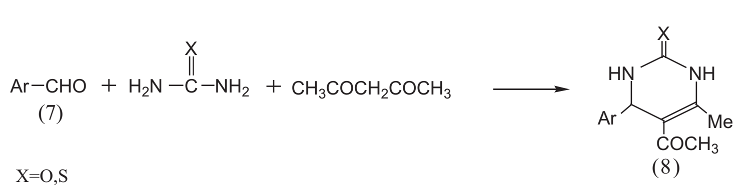
(6) derivatives (Fathalla et al., 2005) in acidic and basic media, respectively.



R⁻= p-nitrophenyl, p-chlorophenyl, 3-indolyl or p-N-dimethylaminophenyl

Also, the reaction of aromatic aldehyde (7) with urea or thiourea and acetyl acetone in ethanol acidified with few drops of acetic acid (El-Hamouly et al., 2006) resulted in pyrimidine derivatives (8).



X=O,S

Ar =Phenyl, 2-hydroxy-3-nitrophenyl, 3,4-dimethoxyphenyl or 3,4-trimethoxyphenyl

Recently, Schiff bases containing pyrimidine derivatives have been synthesized using the above methods with modified procedures (Parikh and Vyas, 2012a,b; Ray et al. 2012). Pyrimidine derivatives and heterocyclic annulated pyrimidines continue to attract great interest due to the wide variety of interesting biological activities observed in these compounds, such as anticancer, (Kandeel et al. 2013; Petrie et al. 1985) antiviral, (Nasr and Gineinah, 2002), antitumor, (Baraldi et al. 2002; Kandeel et al. 2012), anti-inflammatory, (Antre et al., 2011; Sondhi et al., 2001), and antimicrobial activities (Chowdhury et al. 1997; Parikh and Vyas, 2012c; Singh and Srivastava, 2013)

Schiff bases attract much interest both from a synthetic and biological point of view (Maddila et al. 2013; Vicini et al., 2003; Yerra et al., 2012). A through literature survey reveals that Schiff bases derived from various heterocyclic possess cytotoxic, (Parikh and Vyas, 2012d; Tarafder et al., 2002), anticonvulsant, (Hassanin and El-Edfawy 2012; Shiradkar and Nikalje, 2007), antiproliferative, (Sharma et al., 2013; Vicini et al., 2003), antimicrobial, (Gulcan et al. 2012; Kahveci et al., 2005), anticancer, (Betircan et al., 2006) and antifungal, (Choudhari et al. 2013; Singh and Dash, 1988) activities.

In the light of the above, we decided to synthesize novel Schiff-bases containing a pyrimidine unit.

2. Materials and methods

All chemicals were supplied from Aldrich–Sigma Chemicals Co., and used as received. FTIR spectra were recorded using potassium bromide disks on a 8400s Shimadzu spectrophotometer. The ^{1}H NMR spectra were recorded on Bruker AMX-300 spectrometer at 300 MHz, using deutrated DMSO as a solvent with TMS as an internal standard. Elemental analysis (C,H,N) was carried out using a Perkin-Elmer model 2400 instrument. Uncorrected melting points were determined by using a hot-stage Gallen Kamp melting point apparatus. All compounds were synthesized according to Scheme 1, and the following procedures:

2.1. General procedure for the synthesis of (chalcone): 4′-[3-(4″-substitutedphenyl)-2-propene-1-one] aniline $[I]_{a,b}$

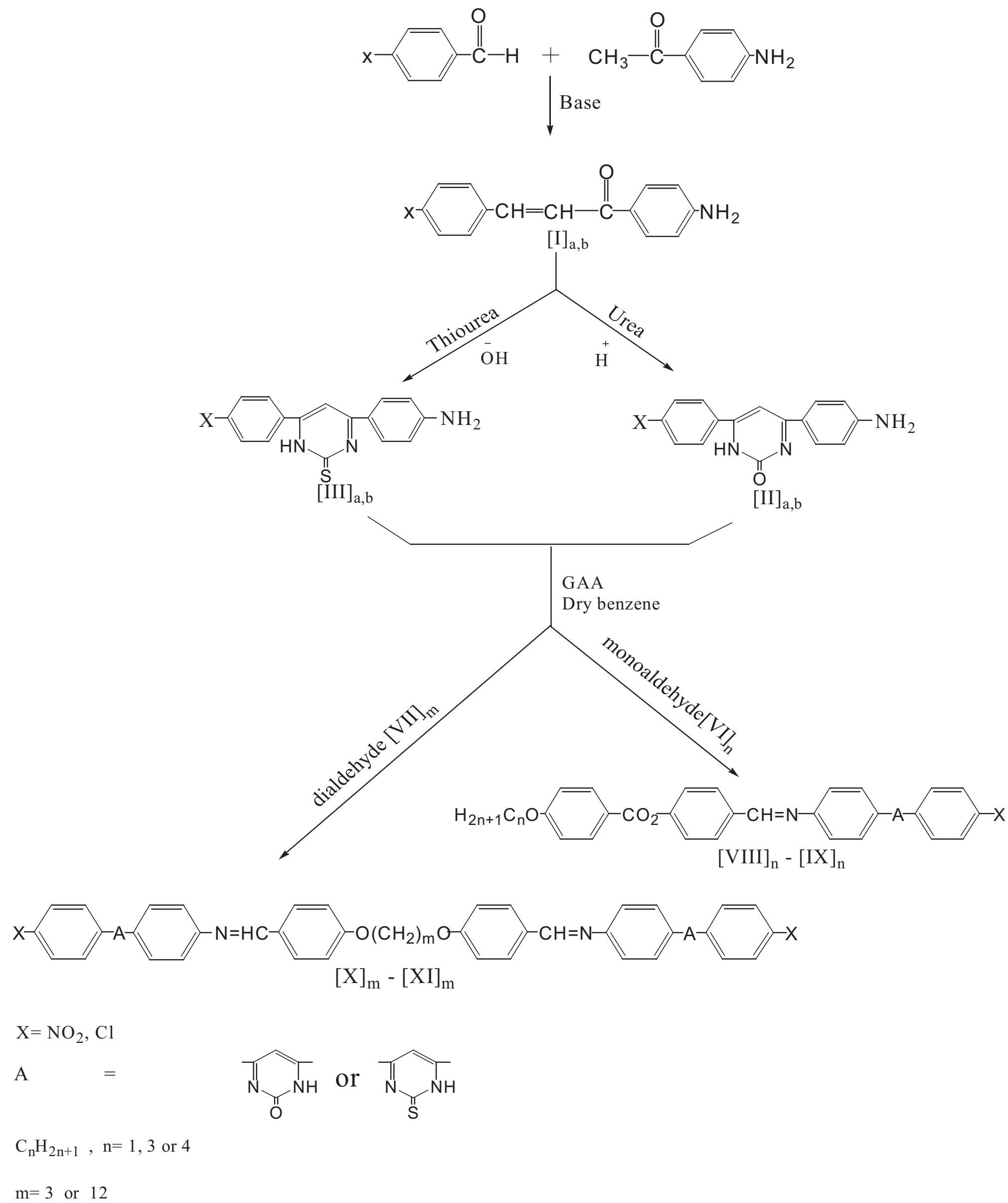
Equimolar quantities of 4-aminoacetophenone (1.35 g, 0.01 mol) and 4-chlorobenzaldehyde or 4-nitrobenzaldehyde (0.01 mol) were dissolved in minimum amount of alcohol. Sodium hydroxide solution (2 mL, 0.02 M) was added slowly and the mixture became cold. Then the mixture was poured slowly into 400 mL of ice water with constant stirring and kept in the refrigerator for 24 h (Kalirajan et al., 2009). The precipitate obtained was filtered, washed and recrystallized from chloroform.

2.1.1. Characterization of 4′-[3-(4″-nitrophenyl)-2-propene-1-one] aniline $[I]_a$

Orange solid, yield 90%; mp 210 °C. Anal. Calcd. for $C_{15}H_{12}N_2O_3$: C 67.16, H 4.48, N 10.45. Found: C 67.30, H 4.34, N 10.46. ^{1}H NMR spectrum, δ, ppm: 6.24 (s, 2H, NH_2), 6.5–6.8 (d, J = 20.71, 7.81 Hz, 2H, CHCH=), and 7.9–8.5 (d, J = 27.31, 8.91 Hz, 1H, =CHAr). IR (KBr) ν, cm^{-1}: 3273-3483 (NH_2 asy., sy.), 1654 (C=O), 1630 (=C–H), 1600 (C=Carom), 1504 (NO_2).

2.1.2. Characterization of 4′-[3-(4″-chlorophenyl)-2-propene-1-one] aniline $[I]_b$

Yellow solid, yield 75%; mp 164 °C. Anal. Calcd for $C_{15}H_{12}NOCl$: C 69.81, H 4.60, N 5.48; Found: C 69.90, H 4.66, N 5.44. IR (KBr) ν, cm^{-1}: 1070 (C–Cl).



Scheme 1

2.2. General procedure for the synthesis of 4′-[6-(4″-substitutedphenyl)-2-oxo-1,2-dihydropyrimidine-4-yl] aniline, $[II]_{a,b}$

A mixture of chalcone $[I]_a$ or $[I]_b$, (0.001 mol) and urea (0.06 g, 0.001 mol) in ethanol (20 mL) and conc. hydrochloric acid (5 mL) was refluxed for 6 h. The reaction mixture was then concentrated by reducing its volume to half (by solvent evaporation). Cooled and neutralized with ammonium hydroxide. The precipitated solid was filtered off, washed with water, dried and crystallized from ethanol.

2.2.1. Characterization of 4′-[6-(4″-nitrophenyl)-2-oxo-1,2-dihydropyrimidine-4-yl] aniline, $[II]_a$

Orange solid, yield 70%; mp 218 °C. Anal. Calcd for $C_{16}H_{12}N_4O_3$: C 62.34, H 3.90, N 18.18. Found: C 62.48, H 3.80, N 18.31. IR (KBr) ν, cm^{-1}: 3483, 3387, 3433 (NH_2 asy., sy. and NH), 3100 (C–Harom), 1639 (C═O amide), 1610 (C═N endocyclic), 1589(C═Carom), 1508(4-NO_2).

2.2.2. Characterization of 4′-[6-(4″-chlorophenyl)-2-oxo-1,2-dihydropyrimidine-4-yl] aniline, $[II]_b$

Yellow solid, yield 55%; mp 208 °C. Anal. Calcd for $C_{16}H_{12}N_3OCl$: C 64.54, H 4.03, N 14.16. Found: C 64.69, H 3.90, N 14.16. ^1H NMR spectrum, δ, ppm: 5.0 (s, 2H, NH_2), 7.5 (s, 1H, CH oxo-pyrimidine), 7.6 (s, 1H, NH oxo-pyrimidine) and 7.7–8.1 (d–d, J = 15.61, 8.40 Hz, 4H, ═CHAr). IR (KBr) ν, cm^{-1}: 1080(4-Cl).

2.3. General procedure for the synthesis of 4′-[6-(4″-substitutedphenyl)-2-thioxo-1, 2-dihydropyrimidine-4-yl] aniline $[III]_{a,b}$

A mixture of chalcone $[I]_a$ or $[I]_b$, (0.001 mol), thiourea (0.001 mol) and sodium hydroxide (0.1 g) in 80% EtOH

(25 mL) was refluxed for 6 h. The reaction mixture was concentrated under vacuum. Cooled and the solid was filtered off, washed with water, dried and then crystallized from ethanol.

2.3.1. Characterization of 4′-[6-(4″-nitrophenyl)-2-thioxo-1, 2-dihydropyrimidine-4-yl] aniline $[III]_a$

Pale brown solid, yield 60%; mp 276 °C. Anal. Calcd for $C_{16}H_{12}N_4O_2S$: C 59.26; H 3.70; N 17.28. Found: C 59.34; H 3.48; N 17.36. IR (KBr) ν, cm^{-1}: 3460, 3333, 3333 (NH_2 asy., sy and NH.), 3067 (C–Harom), 1628 (C=N endocyclic), 1597 (C=Carom), 1312 (C=S), 1512 (NO_2).

2.3.2. Characterization of 4′-[6-(4″-chlorophenyl)-2-thioxo-1, 2-dihydropyrimidine-4-yl] aniline $[III]_b$

Yellow solid, yield 50%; mp 200 °C. Anal. Calcd for $C_{16}H_{12}N_3ClS$: C 61.24, H 3.83, N 13.40. Found: C 61.32, H 3.65, N 13.46. ^1H NMR spectrum, (DMSO, 300 MHz,) δ: 6.05 (s, 1H) 6.18(s, 2H) 6.5–7.9 (m, 8H) and 7.3 (s, 1H). IR (KBr) ν, cm^{-1}: 1087(4-Cl).

2.4. Synthesis of n-alkoxybenzoic acid $[IV]_n$

This compound was prepared according to Tomma and Al-Dujaili, 2002.

2.5. Synthesis of n-alkoxybenzoyl Chloride $[V]_n$

General procedure for the preparation of carboxylic acid chlorides was described by Vogel (Vogel, 1974).

2.6. Synthesis of 4(4′-n-alkoxybenzoloxy)benzaldehyde [VI]

Acid chloride $[V]_n$ (10 mmol) was added to a stirred solution of 4-hydroxybenzaldehyde (10 mmol) and dry pyridine (1 mL) in dry DMF (10 mL) at (5-10 °C). Stirring was continued for 3 h at the same temperature. The resulting mixture was poured into 10% HCl (100 mL). The precipitate was filtered and washed with a solution of 10% $NaHCO_3$ and water for several times, (Al-Dujaili and Tomma, 2002) dried and recrystallized from ethanol.

2.7. Synthesis of polymethylene-α,ω-bis-4-oxybenzaldehydes $[VII]_m$

These compounds were prepared following the procedure described by Griffin and Havens (1981).

2.8. General procedure for synthesis of mono Schiff bases $[VIII]_{n,a,b}$–$[IX]_{n,a,b}$

A mixture of amino compounds $[II]_{a,b}$ or $[III]_{a,b}$ (0.01 mol), aldehyde $[VI]_n$ (0.012 mol), dry benzene (15 mL) and 2 drops of glacial acetic acid was refluxed for 3 h. The solvent was evaporated under vacuum and the residue crystallized from chloroform.

2.8.1. Characterization of 4-[4′-(4″-methoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-nitrophenyl)-2-oxo-1,2-di hydropyrimidine$[VIII]_{1a}$

Yellow solid, yield 75%; mp 220 °C. Anal. Calcd for $C_{31}H_{22}N_4O_6$: C 68.13, H 4.03, N 10.26. Found: C 68.24, H 3.95, N 10.34. ^1H NMR spectrum, δ, ppm: 3.9 (s, 3H, OCH3), 6.25 (s, 1H, CH=N), and 6.56-8.3 (m, 16H, Harom), 7.1 (s, 1H, H pyrimidine ring), 9.2 (s, 1H, NH). IR (KBr) ν, cm^{-1}: 3391 (NH), 3077 (C–Harom), 1724 (C=O ester), 1661 (C=O amide), 1634 (C=N exocyclic), 1609 (C=N endocyclic), 1601(C=Carom).

2.8.2. Characterization of 4-[4′-(4″-propoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-nitrophenyl)-2-oxo-1, 2-dihydropyrimidine $[VIII]_{3a}$

Yellow solid, yield 88%; mp 234 °C. Anal. Calcd for $C_{33}H_{26}N_4O_6$: C 68.99, H 4.53, N 9.76. Found: C 69.10, H 4.39, N 9.88. IR (KBr) ν, cm^{-1}: as indicated for $[VIII]_{1a}$.

2.8.3. Characterization of 4[4′-(4″-butoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-nitrophenyl)-2-oxo-1, 2-dihydropyrimidine$[VIII]_{4a}$

Orange solid, yield 75%; mp 198 °C. Anal. Calcd for $C_{34}H_{28}N_4O_6$: C 69.39, H 4.67, N 9.52. Found: C 69.29, H 4.87, N 9.55. ^1H NMR spectrum, δ, ppm: 4.05–4.1 (t, 2H, OCH2), 6.26 (s, 1H, CH=N), and, 6.61–8.29 (m, 16H, Harom), 7.7 (s, 1H, H pyrimidine ring), 9.86 (s, 1H, NH). IR (KBr) ν, cm^{-1}: as indicated for $[VIII]_{1a}$.

2.8.4. Characterization of 4-[4′-(4″-methoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-chlorophenyl)-2-oxo-1, 2-dihydropyrimidine$[VIII]_{1b}$

Yellow solid, yield 72%; mp 216 °C. Anal. Calcd for $C_{31}H_{22}N_3O_4Cl$: C 69.47, H 4.11, N 7.84. Found: C 69.50, H 3.93, N 7.93. IR (KBr) ν, cm^{-1}: 3360 (NH), 3070 (C–H arom), 1724 (C=O ester), 1655 (C=O amide), 1630 (C=N exocyclic), 1605 (C=N endocyclic), 1597 (C=C arom).

2.8.5. Characterization of 4-[4′-(4″-propoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-chlorophenyl)-2-oxo-1, 2-dihydropyrimidine$[VIII]_{3b}$

Pale yellow, yield 50%; mp 224 °C. Anal. Calcd for $C_{33}H_{26}N_3O_4Cl$: C 70.28, H 4.61, N 7.45. Found: C 70.42, H 4.47, N 7.50. IR (KBr) ν, cm^{-1}: as indicated for $[VIII]_{1b}$.

2.8.6. Characterization of 4-[4′-(4″-butoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-chlorophenyl)-2-oxo-1,2-dihydropyrimidine $[VIII]_{4b}$

Pale yellow, yield 89%, mp 224 °C. Anal. Calcd for $C_{34}H_{28}N_3O_4Cl$: C 70.65, H 4.85; N 7.41. Found: C 70.49, H 4.96, N 7.41. IR (KBr) ν, cm^{-1}: as indicated for $[VIII]_{1b}$.

2.8.7. Characterization of 4[4′-(4″-methoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-nitrophenyl)-2-thioxo-1, z2-dihydropyrimidine $[IX]_{1a}$

Orange solid, yield 49%; mp 230 °C. Anal. Calcd for $C_{31}H_{22}N_4O_5S$: C 66.19, H 3.91, N 9.69. Found: C 66.33, H 3.80, N 10.01. ^1H NMR spectrum, δ, ppm: 3.9 (s, 3H, OCH_3), 6.0 (s, 1H, CH=N), and, 6.65-8.4 (s, 16H, Harom), 7.01 (s, 1H, H pyrimidine ring), 9.15 (s, 1H, NH). IR (KBr) ν, cm^{-1}: 3418 (NH), 3070 (C–H arom), 1732 (C=O ester), 1635 (C=N exocyclic), 1605 (C=N endocyclic), 1585 (C=C arom), 1257 (C=S).

2.8.8. Characterization of 4[4′-(4″-propoxybenzoyloxy) benzylideneaminophenyl]-6–(4′-nitophenyl)-2-thioxo-1, 2-dihydropyrimidine [IX]$_{3a}$

Orange solid, yield 53%; mp >300 °C. Anal. Calcd for $C_{33}H_{26}N_4O_5S$: C 67.02, H 4.31, N 9.53. Found C 67.12, H 4.41, N 9.46. IR (KBr) ν, cm^{-1}: as indicated for [IX]$_{1a}$.

2.8.9. Characterization of 4[4′-(4″-butoxybenzoyloxy) benzylideneaminophenyl]-6-(4′-nitrophenyl)-2-thioxo-1, 2-dihydropyrimidine [IX]$_{4a}$

Orange solid, yield 80%; mp 240 °C. Anal. Calcd for $C_{34}H_{28}N_4O_5S$: C 67.55, H 4.79, N 9.31. Found C 67.47, H 4.79, N 9.31. IR (KBr) ν, cm^{-1}: as indicated for [IX]$_{1a}$.

2.8.10. Characterization of 4[4′-(4″-methoxybenzoyloxy) benzylideneaminophenyl]-6-(4-chlorophe-nyl)-2-thioxo-1, 2-dihydropyrimidine [IX]$_{1b}$

Yellow solid, yield 48%; mp 280 °C. Anal. Calcd for $C_{31}H_{22}N_3O_3SCl$: C 67.45, H 3.99, N 7.62. Found: C 67.52, H 3.84, N 7.70. IR (KBr) ν, cm^{-1}: 3413 (NH), 3058 (C–Har-om), 1724 (C=O ester), 1627 (C=N exocyclic), 1600 (C=N endocyclic), 1587 (C=C arom), 1257 (C=S).

2.8.11. Characterization of 4[4′-(4″-propoxybenzoyloxy)benzylideneaminophenyl]-6-(4-chlorophenyl)-2-thioxo-1,2-dihydropyrimidine [IX]$_{3b}$.

Pale yellow, yield 49%; mp >300 °C. Anal. Calcd for $C_{33}H_{26}N_3O_3SCl$: C 68.33, H 4.49, N 7.25. Found C 68.46, H 4.42, N 7.28. IR (KBr) ν, cm^{-1}: as indicated for [IX]$_{1b}$.

2.8.12. Characterization of 4[4′-(4″-butoxybenzoyloxy) benzylideneaminophenyl]-6-(4-chlorophenyl)-2-thioxo-1, 2-dihydropyrimidine [IX]$_{4b}$

Yellow solid, yield 70%; mp 158 °C. Anal. Calcd for $C_{34}H_{28}N_3O_3SCl$: C 68.74, H 4.72, N 7.08. Found: C 68.87, H 4.67, N 7.16. IR (KBr) ν, cm^{-1}: as indicated for [IX]$_{1b}$.

2.9. General procedure for the synthesis of bis Schiff bases [X]$_{n,a,b}$ - [XI]$_{n,a,b}$

These compounds [X]$_m$–[XI]$_m$ were obtained by using the same procedure given for the synthesis of Schiff bases [VIII]$_n$–[IX]$_n$ except the dialdehyde [VII]$_m$ was used instead of monoaldehyde [VI]$_n$.

2.9.1. Characterization of 1,3-Bis{4′-[6-(4″-nitrophenyl)-2-oxo-1,2-dihydropyrimidin-4-yl]anilinebenzylidine-4-oxy} propane, [X]$_{3a}$

Yellow solid, Yield 50%; mp 266 °C. Anal. Calcd for $C_{49}H_{36}N_8O_8$: C 68.06, H 4.17, N 12.96. Found: C 68.12, H 4.11, N 13.05. IR (KBr) ν, cm^{-1}: 3426 (NH), 3100(C–H arom), 1659 (C=O amide), 1627 (C=N exocyclic), 1605 (C=N endocyclic), 1593 (C=C arom).

2.9.2. Characterization of 1,3-Bis{4′-[6-(4″-nitrophenyl)-2-oxo-1,2-dihydropyrimidin-4-yl]anilinebenzylidine-4-oxy} dodecane [X]$_{12a}$

Yellow solid, yield 60%; mp 212 °C. Anal. Calcd for $C_{49}H_{36}N_8O_8$: C 70.30, H 5.45, N 11.31. Found: C 70.12, H 5.36, N 11.34. IR (KBr) ν, cm^{-1}: as indicated for [X]$_{3a}$.

2.9.3. Characterization of 1,3-Bis{4′-[6-(4″-chlorophenyl)-2-oxo-1,2-dihydro pyrimidin-4-yl]anilinebenzyli-dine-4-oxy} propane [X]$_{3b}$

Yellow solid, yield 82%, mp 238 °C. Anal. Calcd for $C_{49}H_{36}N_6O_4Cl_2$: C 69.75, H 4.27, N 9.96. Found: C 69.82, H 4.18, N 10.02. IR (KBr) ν, cm^{-1}: 3426 (NH), 3070 (C–Harom), 1650 (C=O amide), 1628 (C=N exocyclic), 1610(C=N endocyclic), 1601 (C=C arom).

2.9.4. Characterization of 1,12-Bis{4′-[6-(4″-chlorophenyl)-2-oxo-1,2-dihydro- pyrimidin -4-yl]anilinebenzylidine-4-oxy}dodecane [X]$_{12b}$.

Yellow solid, yield 56%; mp 222 °C. Anal. Calcd for $C_{58}H_{54}N_6O_4Cl_2$: C 71.83, H 5.27, N 8.67. Found: C 71.79, H 5.16, N 8.75. IR (KBr) ν, cm^{-1}: as indicated for [X]$_{3b}$

2.9.5. Characterization of 1,3-Bis{4′-[6-(4″-nitrophenyl)-2-thioxo-1,2-dihydro- pyrimidin-4-yl]anilinebenzylidine-4-oxy} propane [XI]$_{3a}$

Orange solid, Yield 63%; mp >300 °C. Anal. Calcd for $C_{49}H_{36}N_8O_6S_2$: C 65.63, H 4.02, N 12.50. Found: C 65.66, H 3.94, N 12.63. IR (KBr) ν, cm^{-1}: 3414 (NH), 3071 (C–Harom), 1630 (C=N exocyclic), 1600 (C=N endocyclic), 1597 (C=C arom) , 1246 (C=S).

2.9.6. Characterization of 1,12-Bis{4′-[6-(4″-nitrophenyl)-2-thioxo-1,2-dihydro- pyrimidin-4-yl]anilinebenzylidine-4-oxy} dodecane [XI]$_{12a}$

Orange solid, yield 50%; mp >300 °C. Anal. Calcd for $C_{58}H_{54}N_8O_6S_2$: C 68.10, H 5.28, N 10.96. Found: C 68.21; H 5.14; N 11.01. IR (KBr) ν, cm^{-1}: as indicated for [XI]$_{3a}$.

2.9.7. Characterization of 1,3-Bis{4′-[6-(4″-chlorophenyl)-2-thioxo-1,2-dihydro- pyrimidin-4-l]anilinebenzylidine-4-oxy}propane[XI]$_{3b}$

Yellow solid, yield 55%; mp >300 °C. Anal. Calcd for $C_{49}H_{36}N_6O_2S_2Cl_2$: C 67.20, H 4.11, N 9.60. Found: C 67.12, H 4.26, N 9.71. IR (KBr) ν, cm^{-1}: 3395 (NH), 3078 (C–H arom), 1627 (C=N exocyclic), 1601 (C=N endocyclic), 1597 (C=Carom), 1250(C=S).

2.9.8. Characterization of 1,12-Bis{4′-[6-(4″-chlorophenyl) -2-thioxo-1,2-dihydro- pyrimidin-4-yl]anilinebenzylidine -4-oxy}dodecane [XI]$_{12b}$

Pale brown solid, yield 53%; mp 222 °C. Anal. Calcd for $C_{58}H_{54}N_6O_2S_2Cl_2$: C 69.53, H 5.39, N 8.39. Found: C 69.64, H 5.31, N 8.43. ^{1}H NMR spectrum, δ, ppm: 3.9 (s, 3H, OCH3), 6.0 (s, 1H, CH=N), and, 6.65-8.4 (s, 16H, Harom), 7.01 (s, 1H, H pyrimidine ring), 9.2 (s, 1H, NH). IR (KBr) ν, cm^{-1}: as indicated for [XI]$_{3b}$.

3. Results and discussion

Chalcone was chosen as the starting material for the synthesis of oxopyrimidines and thioxopyrimidines derivatives by using appropriate reagents for that purpose. The chalcones [I]$_{a,b}$ are synthesized by Claisen-Schmidt condensation of 4-aminoacetophenone and 4-substitutedbenzaldehyde by base catalyzed reaction followed by dehydration to yield the desired chalcones.

The structural assignments of chalcones $[I]_{a,b}$ were based on melting points, elemental analysis and their spectral data of FTIR, and ^1H NMR spectroscopy. The FTIR spectrum of chalcone $[I]_b$, displays two bands in the region (3273–3483) cm^{-1} which could be attributed to asymmetric and symmetric stretching vibration of NH_2 group, a week band at 3105–3119 cm^{-1} due to stretching vibration of (=C–H) group. The tow bands at 1650 cm^{-1} and 1635 cm^{-1} were due to of C=O and C=C (CH=CH) stretching vibrations, respectively.

The ^1H NMR of chalcone $[I]_a$, shows the following features: two pairs of doublet of doublets in the region δ7.6-8.2 ppm which can be attributed to eight protons of the two 4-substitutedbenzene rings having different substituents at positions 1,4. A doublet peak observed at δ 6.6 ppm is due to the proton of COCH= moiety and a doublet peak observed at δ 8.3 ppm is due to the proton of =CHAr (Swamy and Agasimundin, 2008). The signal of the two protons of amine group appears as a singlet peak at δ 6.24 ppm.

3.1. Oxopyrimidines

Oxopyrimidine $[II]_{a,b}$ was synthesized from the reaction of chalcone $[I]_{a,b}$ with urea in acidic medium. The FTIR spectrum of oxopyrimidine [II]a, shows that the two absorption bands of the CH=CH and C=O groups in the chalcones [I]a,b, have disappeared and that new absorption bands for NH, C=O (amide) and C=N (endocyclic) at 3342-3387 cm-1, 1640 cm-1 and 1605 cm-1, respectively, have appeared. The characteristic bands of the synthesized compounds $[II]_{a,b}$ are assigned to various groups and are listed in experimental procedures.

^1H NMR spectrum of compound $[II]_a$, shows the following signals: eight aromatic protons appeared as two pairs of doublets at 6.7-7.5 and 7.9-8.0 ppm, a singlet signal at 7.6 ppm could be attributed to the one proton of NH (oxopyrimidine) and a singlet at δ 7.5 ppm due to the proton of CH (oxopyrimidine), and a singlet broad signal two protons of NH_2 group appeared at δ 5.0 ppm (Desai et al., 2008).

3.2. Thiopyrimidines

Thiopyrimidines $[III]_{a,b}$ were synthesized from the reaction of chalcones $[I]_{a,b}$ with thiourea in basic medium. The structures of the compounds $[III]_{a,b}$ were characterized by FTIR and ^1H NMR spectroscopy. The characteristic FTIR absorption bands of thiopyrimidines $[V]_{a,b}$, show that the two absorption bands of the CH=CH and C=O groups in the chalcones $[I]_{a,b}$, have disappeared and that new absorption bands for NH, C=N and C=S (endocyclic) groups around 3341 cm^{-1}, 1628 cm^{-1} and 1288 cm^{-1}, respectively, have appeared (Swamy and Agasimundin, 2008). In the ^1H NMR spectrum of thiopyrimidine [III]b, the signal of the eight aromatic protons appeared as many pairs of doublet at δ (6.5–7.9) ppm, the signal of the proton of NH (thioxopyrimidine) appeared as a singlet at δ 7.3 ppm, the signal of the proton of –CH (thioxopyrimidine) appeared as a singlet at δ 6.05 ppm, and a sharp singlet of the two protons of NH_2 group appeared at δ 6.18 ppm.

3.3. Mono-Schiff bases $[VIII]_n$ and $[IX]_n$

These new Schiff bases were synthesized by the refluxing of equimolar quantities of aromatic primary amine $[II]_{a,b}$ or $[III]_{a,b}$ and monoaldehyde $[VI]_n$ in dry benzene with some drops of glacial acetic acid. These Schiff bases were identified by their melting points, FTIR and ^1H NMR spectra. FTIR absorption spectrum $[VIII]_{4a}$, shows the disappearance of absorption bands due to NH_2 and C=O groups of the starting materials together with the appearance of a new absorption band in the region (1627–1637) cm^{-1} which is assigned to C=N stretching.

^1H NMR spectrum of compound $[VIII]_{1a}$, exhibited: a singlet signal at δ 9.2 ppm that could be attributed to the proton of NH of a pyrimidine unit, and a singlet signal at δ 7.1 ppm that could be assigned to the one proton of the pyrimidine ring, many signals in the region δ 6.65–8.3 ppm that could be attributed to the aromatic protons. The ^1H NMR spectrum also showed two sharp signals at 6.25 ppm and 3.9 ppm for one proton and three protons which could be attributed to the CH=N and OCH_3 groups, respectively.

^1H NMR spectrum of compound [IX]1a, showed a singlet signal at δ 8.8 ppm assigned to the proton of NH (pyrimidine moiety), many signals in the region δ 6.65–8.4 ppm that could be attributed to the sixteen aromatic protons, singlet signal at δ 7.01 ppm that could be assigned to the one proton of pyrimidine ring, a singlet signal at δ 6.0 ppm that could be attributed to azomethine proton, and a good sharp singlet of the protons of the terminal OCH_3 group appeared at δ 3.9 ppm.

3.4. Bis Schiff bases$[X]_m$–$[XI]_m$

These Schiff bases were synthesized by the refluxing of two moles of amino compounds $[II]_{a,b}$ or $[III]_a$ and one mole of dialdehyde $[VII]_m$ in dry benzene with some drops of glacial acetic acid. The structures of bis Schiff bases $[X]_m$–$[XI]_m$ were characterized by elemental analysis, melting point, and FTIR spectroscopy.

The FTIR absorption spectrum of compound $[XI]_{3a}$, showed that the absorption bands due to NH_2 and C=O groups of the starting materials have disappeared and that new absorption stretching band of C=N group in the region 1627–1630 cm^{-1} has appeared. The other data of functional groups which are characteristic of these compounds are given in the experimental procedures.

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