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Synthesis and Antimicrobial Activity of Novel Azolylaminopyrimidinyl-chromen-2-ones

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Abstract: The goal of this endeavor is to create novel heterocyclic compounds with strong biological activity predictions. Target compounds are expected to exhibit diverse biological activities due to their assortment of heterocyclic rings, which include coumarin, pyrimidine, imidazole, and thiazole moieties. Through the reaction of a variety of coumarin chalcones 1a - g with benzoimidazo-2-yl guanidine 2a and / or benzothiazo-2-yl guanidine 2b in pyridine under reflux conditions, a novel series of pyrimidinyl chromenone derivatives 3 – 14 were produced in high yields.The products' NMR, IR, and elemental analytical data were used to determine their molecular structures. A few novel products' antimicrobial properties were assessed. Compounds 9, 12, and 13 demonstrated the strongest antimicrobial activity against Candida albicans, while compound 9 had the greatest effect against Escherichia coli. Compounds 10 and 14 also demonstrated strong activity against Stphylococcus aureus, and compounds 3, 6, and 9 were the most effective against Pseudomonas aeruginosa.

Keywords: Coumarins, guanidines, pyrimidines, chalcones, antimicrobial.

1. Introduction

Due to the diversity of biological actions, including antibacterial [1-3], anticoagulant [4-7], and anticancer [8-11] properties, coumarins have gained a lot of attention recently. The benefits of the planar aromatic rings bound to lactone, which provide an easily accessible group for H-bonding as well as the protein-ligand interaction that turns the heterocycle into a potent pharmacophore in medicinal chemistry [12]. Additionally, the fields of natural products and synthetic organic chemistry provided a significant increase in the use of coumarins and their derivatives [13].

Due to their nucleophilic and electrophilic behaviour, 3-acetylcoumarins are among the significant derivatives that are categorized as difunctional compounds. These chemical features have been utilized to synthesize a variety of heterocyclic systems with rings of different sizes. However, the six-membered pyrimidine ring which has two nitrogen atoms, gives its compounds great significance in the fields of medicinal chemistry [14] and natural products [15]. Additionally, the ring has high biological activities because it is a component of DNA and RNA. It has been shown that pyrimidines have a diversity in biological and pharmacological properties [16].

For example, the benzopyrimidines act as anticancer [17], antibacterial [18], anti-inflammatory [19], and antiviral reagents [20]. Several thienopyrimidines and fused thienopyrimidines derivatives have been reported to have antitumor [21], antidiabetic [22], antioxidant [23], anti-depressant [24], and adenosine receptor legendsactivities [25]. Here We have reported the synthesis of novel highly bioactive heterocyclic compounds that contain both pyrimidine and coumarin moieties, as a continuation of previous work [26–29].

2. Materials and methods

2.1. Materials

All reactions were monitored by thin-layer chromatography using 0.25 mm thick silica G/UV-254 precoated plates (Merck 60F254) and visualized using UV light (254/365 nm). Melting points uncorrected and determined with Kofler apparatus. Infrared spectra were recorded with a Fourier transform infrared ALPHBROKER-Platinum-ATR spectrometer (Bruker, Germany) and given in cm^{-1} using attenuated total reflectance (ATR). ^1H NMR spectra were recorded in DMSO-d_6 at 400 MHz Bruker Bio Spin AG spectrometer (Bruker, Switzerland). For ^1H NMR, the chemical shift (δ) is in parts per million (ppm) and tetramethylsilane is the internal standard (δ = 0). Elemental analysis was performed on a Perkin-Elmer CHN standard analyzer (Perkin Elmer, Waltham, MA).

2.2. Methods

2.2.1. All the chalcones **1(a-g)** are prepared according to the standered method [30].

2.2.2. Synthesis of pyrimidinyl chromenone derivatives (3-14):

General procedures:

In (20 mL) dry pyridine, (2mmol) of chalcones **1a-g** and (2mmol) of 1-(1H-benzo[d]imidazo (or thiazo)-2-yl) guanidine

2a,b were added and refluxed for 4-6 hours. The formed precipitates were collected on hot and filtered off, air dried and recrystallized from the suitable solvent to give the final products **3-14**.

2.2.2.1. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-phenyl-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (3):

Yield (0.39 g, 45 %), orange crystals, mp>300 ºC (DMF), IR 3160, 3190 cm^{-1} (2NH), 3042 cm^{-1} ($CH_{arom.}$), 1736 cm^{-1} (C=O), 1582 cm^{-1} (C=N), 1149 (C-O-C). ^1H NMR (DMSO-*d*6) 9.76 (1H, br, NH), 9.23 (1H, s, NH), 8.39 (1H, s, $H_{arom.}$), 8.26 (1H, s, $H_{arom.}$), 7.78 (1H, d, $H_{arom.}$), 7.61 (1H, d, $H_{arom.}$), 7.63-7.50 (4H, m, $H_{arom.}$), 7.45-7.38 (4H, m, $H_{arom.}$), 7.27 (1H,d, $H_{arom.}$), 7.17(1H, d, $H_{arom.}$), 6.85 (1H, d, $H_{arom.}$), 3.90 (2H, s , CH_2). Chemical Formula: $C_{26}H_{19}N_5O_2$, Molecular Weight: 433.46, Elemental Analysis: (Calcd.:C, 72.04; H, 4.42; N, 16.16), (found.: C, 72.28; H, 4.67; N, 16,29).

2.2.2.2. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-styryl-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (4):

Yield (0.47g, 51 %), pale yellow crystals, mp>300 ºC (DMF), IR 3170, 3138 cm^{-1} (2NH), 3020 cm^{-1} ($CH_{arom.}$), 1715 cm^{-1} (C=O), 1554 cm^{-1} (C=N), 1150 (C-O-C). ^1H NMR (DMSO-*d*6) 9.73 (1H, br, NH), 8.58 (1H, s, NH), 7.63 (2H, d, $H_{arom.}$), 7.61 (1H, d, $H_{arom.}$), 7.44-7.38 (5H, m, $H_{arom.}$), 7.31 (1H, d, $H_{arom.}$), 7.16 (1H, s, $H_{arom.}$), 7.00 (2H, d, $H_{arom.}$), 6.95-6.82 (3H, m, $H_{arom.}$), 6.80 (1H, d, $H_{arom.}$), 6.69 (1H, d, $H_{arom.}$), 3.81 (2H, s, CH_2). Chemical Formula: $C_{28}H_{21}N_5O_2$, Molecular Weight: 459.50, Elemental Analysis: (Calcd.:C, 73.19; H, 4.61; N, 15.24), (found.: C, 72.98; H, 4.47; N, 15.05).

2.2.2.3. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-(4-(dimethylamino)phenyl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (5):

Yield (0.46 g, 48 %), orange crystals, m.p >300 ºC (DMF), IR 3135, 3115 cm^{-1} (2NH), 3052 cm^{-1} ($CH_{arom.}$), 1720 cm^{-1} (C=O), 1548 cm^{-1} (C=N), 1103 (C-O-C). ^1H NMR (DMSO-*d*6), 9.68 (1H, br, NH), 8.31 (1H, s, NH), 7.52 (2H, d, $H_{arom.}$), 7.41 (2H, d, $H_{arom.}$), 7.24-7.21 (2H, m, $H_{arom.}$), 7.15 (1H, d, $H_{arom.}$), 7.10-7.04 (2H, m, $H_{arom.}$), 6.99-6-83 (3H, m, $H_{arom.}$), 6.78 (1H, d, $H_{arom.}$), 6.68 (1H, d, $H_{arom.}$), 3.80 (2H,s, CH_2), 2.98 (3H, s, CH_3), 2.55 (3H, s, CH_3). Chemical Formula: $C_{28}H_{24}N_6O_2$, Molecular Weight: 476.53, Elemental Analysis: (Calcd.:C, 70.57; H, 5.08; N, 17.64;), (found.: C, 70.71; H, 5.22 ; N, 17.43).

2.2.2.4. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-(4-chlorophenyl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (6):

Yield (0.45 g, 48 %), yellow crystals, mp >300 ºC (DMF), IR 3145, 3108 cm^{-1} (2NH), 3063 cm^{-1} ($CH_{arom.}$), 1730 cm^{-1} (C=O), 1562 cm^{-1} (C=N), 1091 (C-O-C). ^1H NMR (DMSO-*d*6) 9.84 (1H, br, NH), 8.28 (1H, s, NH), 7.7-7.63 (3H, m, $H_{arom.}$), 7.53-7.42 (5H, m, $H_{arom.}$), 7.16-7.09 (2H, m, $H_{arom.}$), 7.07 (1H, d, $H_{arom.}$), 6.98 (1H, d, $H_{arom.}$), 6.82 (1H, d, $H_{arom.}$), 6.68 (1H, d, $H_{arom.}$), 3.90 (2H, s, CH_2). Chemical Formula: $C_{26}H_{18}ClN_5O_2$, Molecular Weight: 467.91, Elemental Analysis: (Calcd.:C, 66.74; H, 3.88; N, 14.97), (found.: C, 66.55; H, 3.65; N, 15.05).

2.2.2.5. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-(benzo[d]-[1,3]dioxol-5-yl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (7):

Yield (0.54 g, 57 %, yellow crystals, mp >300 ºC (DMF), IR 3186, 3145 cm^{-1} (2NH), 3048 cm^{-1} ($CH_{arom.}$), 1716 cm^{-1} (C=O), 1561 cm^{-1} (C=N), 1167,1122,(C-O-C).^1H NMR (DMSO-*d*6) 9.87 (1H, br, NH), 9.16 (1H, s, NH), 8.19 (1H, s, $H_{arom.}$), 7.92-7.87 (1H, m, $H_{arom.}$), 7.87-7.85 (2H, m, $H_{arom.}$), 7.77 (1H, d, $H_{arom.}$), 7.15-7.13 (5H, m, $H_{arom.}$), 7.10 (1H, d, $H_{arom.}$), 7.00 (1H, d, $H_{arom.}$), 6.98 (1H, s, $H_{arom.}$), 6.82 (2H, s, CH_2), 3.89 (2H,s, CH_2).^{13}C NMR(DMSO-d_6)dept, d: 145.9, 134.2, 130.1, 129.8, 127.2, 125.5, 124.0, 122.8, 122.0, 119.4, 116.6, 115.9, 109.11, 107.51, 107.4, 106.37, 60.1 (opposite direction), 38.9 (opposite direction). Chemical Formula: $C_{27}H_{19}N_5O_4$, Molecular Weight: 477.47, Elemental Analysis: (Calcd.:C, 67.92; H, 4.01; N, 14.67), (found.: C, 67.38; H, 4.17; N, 14.81).

2.2.2.6. 3-(2-((1H-benz[d]imidazol-2-yl)amino)-6-(4-oxo-4H-chromen-3-yl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (8):

Yield (0.49 g, 49 %), dark orange crystals, mp >300 ºC (DMF), IR 3143, 3109 cm^{-1} (2NH), 3030 cm^{-1} ($CH_{arom.}$), 1735, 1715 cm^{-1} (C=O), 1564 cm^{-1} (C=N), 1150 (C-O-C).^1H NMR (DMSO-*d*6) 9.86 (1H, br, NH), 8.83(1H, s, NH), 8.59 (1H, s, $H_{arom.}$), 8.46 (1H, s, $H_{arom.}$), 7.88 (1H, d, $H_{arom.}$), 7.71 (1H, d, $H_{arom.}$), 7.69-7.50 (4H, m, $H_{arom.}$), 7.48-7.38 (4H, m, $H_{arom.}$), 7.35 (1H, d, $H_{arom.}$), 7.27 (1H, d, $H_{arom.}$), 6.95 (1H, d, $H_{arom.}$), 3.92 (2H, s , CH_2). Chemical Formula: $C_{29}H_{19}N_5O_4$, Molecular Weight: 501.49, Elemental Analysis: (Calcd.:C, 69.45; H, 3.82; N, 13.97), (found.: C, 69.27; H,3.95; N, 14.03).

2.2.2.7. 3-(2-(benzo[d]thiazol-2-ylamino)-6-phenyl-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (9):

Yield (0.41 g, 46 %), orange crystals, mp> 300 ºC(DMF), IR 3261 cm^{-1} (NH), 3053 cm^{-1} ($CH_{arom.}$), 1700 cm^{-1} (C=O), 1548 cm^{-1} (C=N), 1159 (C-O-C).^1H NMR (DMSO-*d*6) 9.88 (1H, br, NH), 7,97-7.73 (2H, t, $H_{arom.}$), 7.66-7.56 (2H, d, $H_{arom.}$), 7.52-7.4 (6H, m, $H_{arom.}$), 7.26-7.07 (1H, t, $H_{arom.}$), 7.05-6.99 (1H, d, $H_{arom.}$), 6.84 (1H, d, $H_{arom.}$), 6.82 (1H,t,$H_{arom.}$), 6.68 (1H, d, $H_{arom.}$), 3.93 (2H, s, CH_2). Chemical Formula: $C_{26}H_{18}N_4O_2S$, Molecular Weight: 450.51, Elemental Analysis: (Calcd.:C, 69.32; H, 4.03; N, 12.44), (found.: C, 69.11; H, 4.21; N, 12.63).

2.2.2.8. 3-(2-(benzo[d]thiazol-2-ylamino)-6-styryl-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (10):

Yield (0.55 g, 58 %), yellow crystals, mp> 300 ºC (DMF), IR 3151 cm^{-1} (NH), 3038 cm^{-1} ($CH_{arom.}$), 1733 cm^{-1} (C=O), 1548 cm^{-1} (C=N), 1148 cm^{-1} (C-O-C).^1H NMR (DMSO-*d*6) 9.68 (1H, br, NH), 8.02 (1H, d, $H_{arom.}$), 7.64-7.62 (1H, t, $H_{arom.}$), 7.52 (2H, d, $H_{arom.}$), 7.44-7.42 (1H, d, $H_{arom.}$), 7.4-7.33

(3H, m, $H_{arom.}$), 7.31-7.13 (3H, m, $H_{arom.}$), 7.09-7.01 (4H, m, $H_{arom.}$), 6.83 (1H, d, $H_{arom.}$), 6.7 (1H, t, $H_{arom.}$), 3.85 (2H, s, CH_2). ^{13}C NMR (DMSO-d_6) dept, d : 129.4, 129.3, 129.2, 129.1, 129.0, 128.9, 128.8, 128.7, 127.4, 127.3, 39.8 (opposite direction). Chemical Formula: $C_{28}H_{20}N_4O_2S$, Molecular Weight: 476.55, Elemental Analysis: (Calcd.:C, 70.57; H, 4.23; N, 11.76), (found.: C, 70.76; H, 4.05; N, 11.63).

2.2.2.9. 3-(2-(benzo[d]thiazol-2-ylamino)-6-(4-(dimethyl-amino)phenyl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one(11):

Yield (0.45 g, 46 %), pale orange crystals, mp >300 ºC (DMF), IR 3201 cm^{-1} (NH), 3012 cm^{-1} ($CH_{arom.}$), 1725 cm^{-1} (C=O), 1540 cm^{-1} (C=N), 1050 (C-O-C). ^{1}H NMR (DMSO-*d*6) 11.95 (1H, b, NH), 7.99-7.93 (2H, t, $H_{arom.}$), 7.83-7.64 (1H, d, $H_{arom.}$), 7.62-7.37 (2H, d, $H_{arom.}$), 7.35-7.22 (2H, t, $H_{arom.}$), 7.20-7.17 (2H, m, $H_{arom.}$), 7.0-6.98 (1H, t, $H_{arom.}$), 6.82-6.76 (2H, d, $H_{arom.}$), 6.74-6.69 (1H, d, $H_{arom.}$), 6.68-6.66 (1H, d,$H_{arom.}$) 3.92 (2H, s, CH_2), 3.0 (6H, s, 2CH_3). Chemical Formula: $C_{28}H_{23}N_5O_2S$, Molecular Weight: 493.58, Elemental Analysis: (Calcd.:C, 68.13; H, 4.70; N, 14.19;), (found.: C, 68.34; H, 4.55; N, 14.04).

2.2.2.10. 3-(2-(benzo[d]thiazol-2-ylamino)-6-(4-chloro-phenyl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (12):

Yield (0.51 g, 53 %, yellow crystals, mp> 320 ºC (DMF), IR 3162 cm^{-1} (NH), 3043 cm^{-1} ($CH_{arom.}$), 1733 cm^{-1} (C=O), 1559 cm^{-1} (C=N), 1093 (C-O-C). ^{1}H NMR (DMSO-*d*6) 9.88 (1H, b, NH), 7.97- 7.75 (2H, t, $H_{arom.}$), 7.73-7.66 (2H, d, $H_{arom.}$), 7.56-7.4 (5H, m, $H_{arom.}$), 7.26-7.07 (1H, t, $H_{arom.}$), 7.05-6.99 (1H, t, $H_{arom.}$), 6.84 (1H, d, $H_{arom.}$), 6.82 (1H, d, $H_{arom.}$), 6.68 (1H, t, $H_{arom.}$), 3.93 (2H, s, CH_2). Chemical Formula: $C_{26}H_{17}ClN_4O_2S$, Molecular Weight: 484.96, Elemental Analysis: (Calcd.:C, 64.39; H, 3.53; N, 11.55), (found.: C, 64.52; H, 3.75; N, 11.35).

2.2.2.11. 3-(6-(benzo[d][1,3]dioxol-5-yl)-2-(benzo[d]thiazol-2-ylamino)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (13):

Yield (0.51 g, 52 %), yellow crystals, mp> 300 ºC (DMF), IR 3160 cm^{-1} (NH), 3042 cm^{-1} ($CH_{arom.}$), 1736, 1700 cm^{-1} (C=O), 1553 cm^{-1} (C=N), 1162,1100 (C-O-C). ^{1}H NMR (DMSO-*d*6) 9.1 (1H, s, NH), 8.08 (1H, s, $H_{arom.}$), 7.97-7.95 (2H, t, $H_{arom.}$), 7.27-7.25 (3H, m, $H_{arom.}$), 7.24-7.09 (2H, m, $H_{arom.}$), 7.07-6.98 (2H, t, $H_{arom.}$), 6.96 (1H, t, $H_{arom.}$), 6.83 (1H, d, $H_{arom.}$), 6.17 (1H, t, $H_{arom.}$), 6.1 (2H, s, CH_2), 3.92 (2H, s, CH_2). Chemical Formula: $C_{27}H_{18}N_4O_4S$, Molecular Weight: 494.52, Elemental Analysis: (Calcd.: C, 65.58; H, 3.67; N, 11.33), (found.: C, 65.35; H, 3.79; N, 11.57).

2.2.2.12. 3-(2-(benzo[d]thiazol-2-ylamino)-6-(3-(4-methoxy-phenyl)-1-phenyl-1H-pyrazol-4-yl)-2,5-dihydropyrimidin-4-yl)-2H-chromen-2-one (14):

Yield (0.55 g, 44 %), yellow crystals, mp> 310 ºC (DMF), IR 3124 cm^{-1} (NH), 3040 cm^{-1} ($CH_{arom.}$), 1728 cm^{-1} (C=O), 1533 cm^{-1} (C=N), 1161, 1102 (C-O-C). ^{1}H NMR (DMSO-*d*6) 9.13 (1H, b, NH), 8.07-7.98 (4H, m, $H_{arom.}$), 7.72-7.40 (9H, m, $H_{arom.}$), 7.20-7.07 (5H, m, $H_{arom.}$), 6.83-6.71 (2H, d, $H_{arom.}$), 3.94 (2H, s, CH_2), 3.72 (3H, s, O–CH_3). Chemical Formula: $C_{36}H_{26}N_6O_3S$, Molecular Weight: 622.70, Elemental Analysis: (Calcd.:C, 69.44; H, 4.21; N, 13.50), (found.: C, 69.58; H, 4.05; N, 13.32).

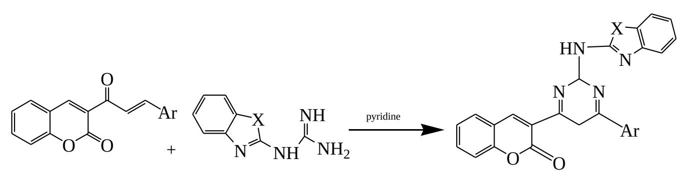
2.2.3. Antimicrobial activity of the synthesized products:

The antimicrobial activity of the recently synthesized products **3, 4, 5, 6, 9, 10, 12, 13** and **14** was assessed using the aseptic Muller Hinton agar medium and the agar well diffusion method. In this study; the microbial strains were Gram positive bacteria (*Staphylococcus aureus*), Gram Negative (*Escherichia coli* and *Pseudomonas aeruginosa*) and fungal strain (*Candida albicans*). After being suspended in 5 milliliters of 0.9% sterile saline, the microbial colonies were vortexed for 15 seconds to achieve 0.5 McFarland's standard opacity, which is equivalent to 1.5 x 10^8 colony-forming units (CFU)/ml. Sterile glass cork borers (6 mm in diameter) were used to create four wells on each MHA plate. A volume of 100 µl containing 10 mg of the investigated substance was added to each well. The negative control was ethyl alcohol. The medication solution was allowed to diffuse over the course of an hour on the plates. Following that, the plates were incubated for 24 hours at 37°C. Each product's inhibition zone against the tested microorganism was determined in millimeters. A compound's significant antimicrobial activity against a given bacteria is shown by an increase in its inhibition zone.

3. Results and Discussion:

3.1. Chemistry:

In this study aprocess known as Claisen-Schmidt condensation is used to prepare a variety of chalcones **1(a-g)** [**30**]. Moreover, under reflux circumstances, these compounds are excellent starting materials for reactions with different physiologically active substances like 1-(1H-benzo[d]imidazo-(thiazo)-2-yl) guanidine (**2a,b**) in pyridine to produce appro-priate novel pyrimidinyl chromenone derivatives **3–14**, Scheme 1, Table 1.



1a-g 2a,b 3-14

Scheme 1. Synthesis of compounds **3-14**.

The compounds' biological activity and use as building blocks for synthetic chemistry are greatly influenced by the presence of both coumarin and pyrimidine rings in the products. Based on the spectral and analytical data, the structure of compounds **3-14** was established. Their infrared spectra indicated a novel absorption band 3173–3111 cm^{-1} that can be attributed to NH groups in addition to the absence of absorption bands for NH and NH_2 groups. Additionally, their ^1H NMR spectra revealed an increase in aromatic protons and the appearance of a new signal due to the methylene group at 4.5-3.85 ppm, along with the elimination of the signal corresponding to the NH_2 group and the appearance of a new signal at δ 12.47-9.93 due to the presence of NH protons.

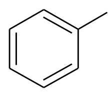
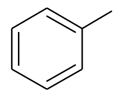
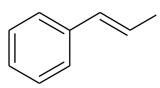
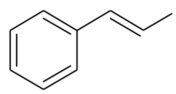
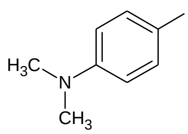
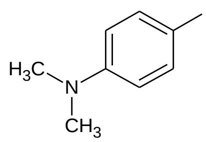
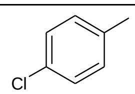
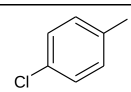
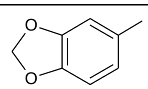
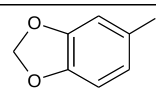
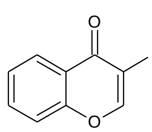
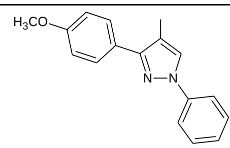
Comp.	Ar (X=NH)	Comp.	Ar (X=S)
3		**9**	
4		**10**	
5		**11**	
6		**12**	
7		**13**	
8		**14**	

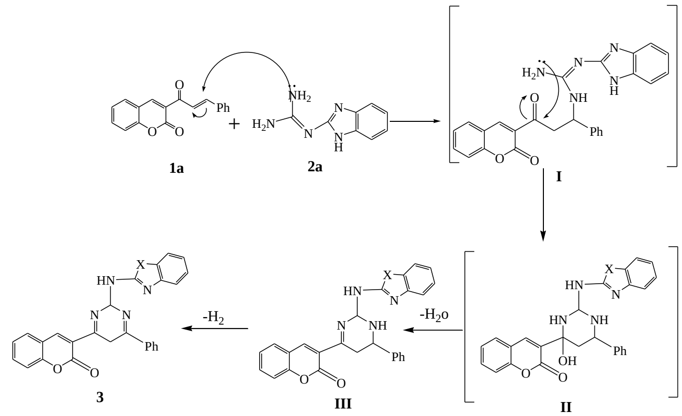
Table 1: Pyrimidinyl chromenone derivatives **3-14**

Scheme 2 shows the chemical process pathway for the synthesis of compounds **3–14**. It is evident that one of the amino groups in compound **2a** was first added nucleophilically to the chalcone **1a** to form **I**. This then smoothly went through intramolecular cycloaddition to form **II**, and the removal of the water molecule to form **III**, which was then oxidized by losing of H_2 molecule to produce the dihydropyrimidine product **3**. Released H_2 absorbed by chalcone **1a**, thus the yield was relatively low.

3.2. Biological activity (Antibacterial activity):

Antimicrobial activity of the synthesized products:

Four microbial strains were used to assess the antibacterial properties of the newly synthesized products **3, 4, 5, 6, 9, 10, 12, 13,** and **14**. The antibacterial activity of each drug was evaluated in solutions containing 50 mg/mL of the microorganisms, with the inhibition zone diameter (IZD) measured in millimeters. The results are shown in Table 2.



Scheme 2. Pathway for compound **3** synthesis.

Comp. / Bacterial species	Inhibition zone								
	3	4	5	6	9	10	12	13	14
Stephylococcus aureus	22	-ve	19	18	22	25	22	15	25
Escherichia coli	22	19	25	25	30	29	26	25	29
Pseudomonas aeruginosa	30	19	25	30	30	25	23	26	25
Candida albicans (yeast)	35	22	23	35	Complete In.Z	34	Complete In.Z	Complete In.Z	35

Table 2: Antibacterial activity for the new compounds

From the results recorded in table 2 we noticed that:

While compound **4** has no effect on Stephylococcus aureus, compounds **10** and **14** showed significant effect against the same bacteria.Compound **9** exhibits the highest activity in Escherichia coli, whereas compound **4** exhibits the lowest activity. Compounds **3, 6** and **9** have the highest activity against *Pseudomonas aeruginosa.* Compounds **9**, **12**, and **13** showed a complete inhibition zone in case of yeast, indicating their highest level of action.

4. Conclusion

When 1-(1H-benz[d]imidazo(or thiazo)-2-yl) guanidine (**2a,b**) interacted with the chalcones of 3-Acetylcoumarin 1(**a-g**), new, intriguing pyrimidinyl chromenone derivatives with strong predicted biological activity were produced.

CRediT authorship contribution statement:

Conceptualization, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; methodology, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; software, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; validation, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; formal analysis, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; investigation, M. T.

El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; resources, M. T. El-Wassimy, E. A. Ahmed, A. M. Ahmed and N. S. Hassan; data curation, N. S. Hassan; writing—original draft preparation, N. S. Hassan; writing—review and editing, M. T. El-Wassimy, E. A. Ahmed and A. M. Ahmed; supervision, M. T. El-Wassimy, E. A. Ahmed and A. M. Ahmed; project administration, E. A. Ahmed; Antimicrobial Activity, Eman F. Ahmed. All authors have read and agreed to the published version of the manuscript.

Data availability statement

The data used to support the findings of this study are available from the corresponding author upon request.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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