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Antibacterial Screening of New Synthesis Schiff Base having Benzimidazole Moiety

MUAYED AHMED REDAYAN[1,*], MAHA SALIH HUSSEIN[2] and ASHRAF TARK LAFTA[2]

[1]Department of Chemistry, College of Education for Pure Sciences, Diyala University, Diyala, Iraq
[2]Department of Chemistry, College of Education, Samarra University, Salahaldin, Iraq

*Corresponding author: E-mail: mredayan@gmail.com; muayed1976@yahoo.com

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A new series of benzimidazole containing Schiff base moiety has been synthesized. The reaction was achieved through cyclocondensation reaction of the substituted 1,2-phenylenediamines and amino acids (glycine, alanine and tyrosine) to gave substituted benzimidazole derivatives **1(a-f)**. Condensation of these compounds with a variety of aromatic aldehyde yielded the new benzimidazole substituted Schiff base. The chemical structures of the synthesized compounds were confirmed by FT-IR, ^{1}H NMR and ^{13}C NMR. Selected compounds were tested *in vitro* for their antibacterial activity by disc diffusion method against two types of Gram-positive bacteria namely (*Staphylococcous aureus*, *Bacillus subtilis*) and Gram-negative bacteria namely (*Pseudomonas aeruginosa*, *Escherichia coli*). The results displayed that most of the prepared compounds have a good antibacterial activity in compared with the standard antibiotic ampicillin and ciprofloxacin.

Keywords: Benzimidazole, Schiff bases, Antibacterial activity, 1,2-Phenylenediamine.

INTRODUCTION

The derivatives of benzimidazole are a crucial class of the bioactive molecules in the field of pharmaceuticals and drugs [1]. The derivatives benzimidazole have occupied a prominent position in medicinal chemistry because of their significant properties as a treatment in clinical applications. Benzimidazole is a versatile pharmacophore producing a different range of biological activities [2], including analgesic [3] and anti-inflammatory [4-6]. Benzimidazole derivatives have found the application in different therapeutic areas including, antihypertensive [7], antiviral [8,9], antifungal [10-12], anticancer [13-15], antitubercular [16,17], antioxidant [18,19], antimicrobial [20-23], antibacterial [24-26]. Benzimidazole derivatives are highly active against several viruses such as HIV, herpes (HSV-1), RNA, influenza and human cytomegalovirus (HCMV) [27]. Some benzimidazole derivatives have been noted as thyroid receptor stimulants. Also widely used as drugs such as proton pump inhibitor omeprazole [25]. Schiff bases considered as important class of organic compounds, especially in the medicinal and pharmaceutical field. Thus, synthesis and development of novel Schiff base derivatives as potential chemotherapeutics still attract attention of organic and medicinal chemist [28]. Schiff bases derived mostly from different set of heterocyclic rings, were reported to possess a broad spectrum and wide range of biological activities including antibacterial [29] and antimicrobial [30].

EXPERIMENTAL

Melting points were taken in an electrically heated using Stuart SMP3 instrument and are uncorrected. FT-IR spectra were recorded on Shimadzu (FTIR-8400 S) Infrared spectrophotometer by KBr disc. The ^{1}H and ^{13}C NMR spectra were recorded on Bruker (400 MHz) instrument using tetramethylsilane (TMS) as an internal standard and DMSO-d_6 as solvent. The purity of the compounds was checked by TLC on silica gel plates using ultraviolet lamp.

General procedure for synthesis of compounds 1(a-f): A solution of 4-substituted 1,2-phenylenediamine (0.06 mol, 0.06 mol) and amino acids (glycine, alanine and tyrosine) (0.12 mol) in 6 N HCl (20 mL) was heated to reflux with stirring for 6 h. The progress of the reaction was monitored by TLC plate. On completion of the reaction, the reaction mixture was cooled to room temperature and the pH was maintained to 7.2 using 1 N NaOH solution in order to obtain buff coloured product, except for compounds (**d-f**) where addition of 1 N NaOH solution is not required. The product was recrystallized using ethanol as solvent [31].

(5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)methanamine (1a): Violet crystals, m.p.: 240-242 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3429, 3329), N-H benzimidazole (3228), aromatic C-H (3076), aliphatic C-H (2970, 2875), C=N (1618), aromatic C=C (1554, 1579), NO_2 (1510, 1323). ^{1}H NMR (400 MHz,

DMSO-d_6) δ: 3.66 (2H, s, CH_2), 5.75 (1H, s, N-H), 8.58 (2H, s, NH_2), 6.8-8.3 (3H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO) δ: 43.1 (CH_2), 135.8 (C=N of benzimidazole), 148.2, 124.3, 120.2, 115, 137.2, 150, yield 96 %.

1-(5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)ethan-1-amine (1b): Grey crystals, m.p.: 228-230 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3421, 3327), N-H benzimidazole (3226), aromatic C-H (3076), aliphatic C-H (2968, 2823), C=N (1641), aromatic C=C (1579, 1554), NO_2 (1515, 1334). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 1.3 (3H, d, CH_3), 3.9 (1H, q, C-H), 5.7 (1H, s, N-H benzimidazole), 8.14 (2H, s, NH_2), 6.54-8.01 (3H, m,Ar-H). ^{13}C NMR (400 MHz, DMSO) δ: 24.2 (CH_3), 52.3 (CH), 135.9 (C=N of benzimidazole), 150.1, 148.1, 137.1, 124.2, 119.9, 114.9, yield 97 %.

4-(2-Amino-2-(5-nitro-1*H*-benzo[*d*]imidazol-2-yl)-ethyl)phenol (1c): Black crystals, m.p.: 253-255 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3224), N-H benzimidazole (3331), aromatic C-H (3076, 3047), aliphatic C-H (2931, 2877), C=N (1641), aromatic C=C (1442-1579), O-H (3429), yield 95 %.

2-(Aminomethyl)-1*H*-benzo[*d*]imidazole-5-carboxylic acid (1d): Dark brown crystals, m.p.: 256-258 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3425, 3338), N-H benzimidazole (3244), aromatic C-H (3093), aliphatic C-H (2970, 2833), C=N (1624), C=O (1689), aromatic C=C (1589-1517), O-H (3425-2578). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 3.6 (2H, s, CH_2), 5.8 (1H, s, N-H benzimidazole), 11.99 (1H, s, O-H carboxylic), 8.9 (2H, s, NH_2), 6.8-7.9 (3H, m,Ar-H). ^{13}C NMR (400 MHz, DMSO-d_6) δ: 42.9 (CH_2), 166.5 (C=O), 129.7 (C=N of benzimidazole), 145.1, 125.6, 120, 118.6, 117.1, 115.9, yield 77 %.

2-(1-Aminoethyl)-1*H*-benzo[*d*]imidazole-5-carboxylic acid (1e): Black crystals, m.p.: 252-254 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3425, 3336), N-H benzimidazole (3234), aromatic C-H (3091), aliphatic C-H (2964, 2829), C=N (1624), C=O (1689), aromatic C=C (1450-1558), O-H (2576-3425). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 1.2 (3H, d, CH_3), 3.9 (1H, q, C-H), 5.8 (1H, s, N-H benzimidazole), 8.3 (2H, s, NH_2), 6.8-7.9 (3H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-TMS) δ: 48.2 (C-H), 17.9 (CH_3), 166.5 (C=O), 129.5 (C=N of benzimidazole), 145.1, 125.4, 118.9, 118.7, 117.4, 115.9, yield 77 %.

2-(1-Amino-2-(4-hydroxyphenyl)ethyl)-1*H*-benzo[*d*]-imidazole-5-carboxylic acid (1f): Red crystals, m.p.: 242-244 °C, IR (KBr, ν_{max}, cm^{-1}): NH_2 (3425, 3336), N-H benzimidazole (3238), aromatic C-H (3091), aliphatic C-H (2966, 2831), C=N (1624), C=O (1689), aromatic C=C (1450-1589), O-H (2540-3450). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 3.1 (2H, d, CH_2), 4.1 (1H, t, C-H), 4.3 (1H, s, O-H), 5.9 (1H, s, N-H benzimidazole), 6.2 (2H, s, NH_2), 11.99 (1H, s, O-H carboxylic) 6.8-8.5 (7H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-TMS) δ: 35.5 (CH_2), 53.08 (C-H), 170.1 (C=O), 134.8 (C=N of benzimidazole), 115.9, 117.2, 118.6, 125.6, 127.06, 128.4, 129.4, 129.6, 145.2, 166.4. ^{13}C-Dept 135 NMR (400 MHz, DMSO-d_6) δ:35.3 (CH_2), yield 89 %.

2.3 General procedure for the synthesis of compounds 2(a-r) [32]**:** Compounds **1(a-f)** (0.01 mol) were added to a solution of the different substituted benzaldehydes (*p*-bromobenzaldehyde, *p*-nitro benzaldehyde, *p*-hydroxybenzaldehyde) (0.012 mol) in dry ethanol 40 mL in round bottom flask. Two drops of glacial acetic acid were also added to the above mixture. The mixture was refluxed for 8-12 h and at the end of the reaction solvent was partially evaporated then poured in to water. The precipitate was collected by filtration, washed with ether, dried and compounds **2(a-r)** were synthesized by this method and recrystallized from the appropriate solvent like ethanol or ethanol-water.

4-((((5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)methyl)imino)-methyl)phenol (2a): Brown crystals, m.p.: > 350 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3115), aromatic C-H (3062), aliphatic C-H (2868, 2804), C=N (1610), NO_2 (1508,1350), aromatic C=C (1508-1444), O-H (3404), yield 88 %.

4-(((1-(5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)ethyl)imino)-methyl)phenol (2b): Brown crystals, m.p.: > 350 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3105), aromatic C-H (3043), aliphatic C-H (2862, 2802), C=N (1635), NO_2 (1506,1350), aromatic C=C (1437-1608), O-H (3365), yield 93 %.

4-(2-((4-Hydroxybenzylidene)amino)-2-(5-nitro-1*H*-benzo[*d*]imidazol-2-yl)ethyl)phenol (2c): Brown crystals, m.p.: 344-346 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3105), aromatic C-H (3043), aliphatic C-H (2918, 2862), C=N (1635), aromatic C=C (1585, 1467), NO_2 (1506, 1350), O-H (3365), yield 91 %.

2-(((4-Hydroxybenzylidene)amino)methyl)-1*H*-benzo-[*d*]imidazole-5-carboxylicacid (2d): Pink crystals, m.p.: 232-235 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3363), aromatic C-H (3058), aliphatic C-H (2884, 2812), C=N (1610), C=O (1689), aromatic C=C (1442, 1516), O-H of carboxylic, N-H benzimidazole and C-H alphatic (overlap) at (3500-2500), yield 87 %.

2-(1-((4-Hydroxybenzylidene)amino)ethyl)-1*H*-benzo-[*d*]imidazole-5-carboxylicacid (2e): Pink crystals, m.p.: 225-227 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3324), aromatic C-H (3088), aliphatic C-H (2883, 2809), C=N (1610), C=O (1695), aromatic C=C (1516, 1444), O-H of carboxylic, N-H benzimidazole and C-H alphatic (overlap) at 3550-2500 region, yield 91 %.

2-(1-((4-Hydroxybenzylidene)amino)-2-(4-hydroxy-phenyl)ethyl)-1*H*-benzo[*d*]imidazole-5-carboxylic acid (2f): Pink crystals, m.p.: 332-324 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3130), aromatic C-H (3023), aliphatic C-H (2966, 2881), C=N (1608), C=O (1695), aromatic C=C (1444, 1516), O-H of carboxylic, N-H benzimidazole and C-H alphatic (overlap) at 3550-2500 region, yield 86 %.

N-((5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)methyl)-1-(4-nitrophenyl)methanimine (2g): Yellow crystals, m.p.: 334-336 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3365), aromatic C-H (3105,3049), aliphatic C-H (2862, 2787), C=N (1635), aromatic C=C (1458-1606), NO_2 (1527, 1348). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 4.5 (2H, s, CH_2), 5.9 (1H, s, N-H benzimidazole), 8.8 (1H, s, C-H), 7.2-8.7 (7H, m,Ar-H).^{13}C NMR (400 MHz, DMSO-d_6) δ: 47.4 (CH_2), 152.8 (=C-H), 130.5 (C=N of benzimidazole), 148.4, 143.5, 141.9, 133.8, 128.2, 124.1, 118.6, 115, 112.3. ^{13}C-Dept 135 NMR (400 MHz, DMSO-d_6) δ: 47.3 (CH_2), yield 64 %.

N-(1-(5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)ethyl)-1-(4-nitrophenyl)methanimine (2h): Yellow crystals, m.p.: 335-336 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3365), aromatic

C-H (3107,3049), aliphatic C-H (2862, 2787), C=N (1635), aromatic C=C (1606-1450), NO_2 (1527, 1348), yield 76 %.

4-(2-(5-Nitro-1*H*-benzo[*d*]imidazol-2-yl)-2-((4-nitrobenzylidene)amino)ethyl)phenol(2i): Yellow crystals, m.p.: 334-336 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3105), aromatic C-H (3049), aliphatic C-H (2862, 2787), C=N (1635), aromatic C=C (1606-1458), NO_2(1527,1348), O-H (3365) yield 78 %.

2-(((4-Nitrobenzylidene)amino)methyl)-1*H*-benzo-[*d*]imidazole-5-carboxylic acid (2j): Brown crystals, m.p.: 310-312 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3367), aromatic C-H (3107), aliphatic C-H (2929, 2868), C=O (1697), C=N (1604), aromatic C=C (1456, 1417), NO_2 (1521,1348), O-H (2500-3600), yield 83 %.

2-(1-((4-Nitrobenzylidene)amino)ethyl)-1*H*-benzo-[*d*]imidazole-5-carboxylic acid (2k): Brown crystals, m.p.: 304-306 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3385), aromatic C-H (3107), aliphatic C-H (2981, 2856), C=O (1699), C=N (1604), aromatic C=C (1454, 1417), NO_2 (1521,1348), O-H (2500-3625). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 1.2 (3H, d, CH_3), 4.3 (1H, q, C-H), 5.03 (1H, s, N-H benzimidazole), 11.53 (1H, s, O-H carboxylic), 5.9 (1H, s, C-H), 6.8-8.6 (7H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-d_6) δ: 55.8 (C-H), 18.3 (CH_3), 149.8 (=C-H), 166.4 (C=O), 132.3 (C=N of benzimidazole), 148.7, 146.8, 132.3, 128.6, 127.3, 125.5, 124.2, 123.8, 118.7, 116.6, yield 81 %.

2-(2-(4-Hydroxyphenyl)-1-((4-nitrobenzylidene)-amino)ethyl)-1*H*-benzo[*d*]imidazole-5-carboxylic acid (2l): Red crystals, m.p.: 286-288 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3369), aromatic C-H (3034), aliphatic C-H (2920,2816), C=O (1707), C=N (1624), aromatic C=C (1446,1604), NO_2(1525,1352), O-H of carboxylic (2500-3350). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 3.1 (2H, d, CH_2), 4.07 (1H, t, C-H), 4.3 (1H, s, O-H), 5.9 (1H, s, N-H benzimidazole), 6.8 (1H, s, =C-H), 7.2-8.7 (11H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-d_6) δ: 35.8 (CH_2), 53.1 (C-H), 166.8 (C=O), 138.9 (C=N of benzimidazole), 114.5, 116.4, 119.9, 124.3, 126.02, 126.5, 132.01, 132.3, 134.4, 138.02, 140.4, 142.08, 149.4, 158.9, 161.5. ^{13}C-Dept 135 NMR (400 MHz, DMSO-d_6) δ: 35.74 (CH_2), yield 64 %.

1-(4-Bromophenyl)-N-((5-nitro-1*H*-benzo[*d*]imidazol-2-yl)methyl)methanimine (2m): Off white crystals, m.p.: 286-288 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3373), aromatic C-H (3097), aliphatic C-H (2927, 2850), C=N (1625), aromatic C=C (1593-1449), NO_2 (1519, 1338), C-Br (684), yield 75 %.

1-(4-Bromophenyl)-N-(1-(5-nitro-1*H*-benzo[*d*]-imidazol-2-yl)ethyl)methanimine (2n): Brown crystals, m.p.: 300-302 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3363), aromatic C-H (3093), aliphatic C-H (2927, 2850), C=N (1635), aromatic C=C (1593-1487), NO_2 (1517, 1338), C-Br (640). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 1.2 (3H, d, CH_3), 4.3 (1H, q, C-H), 5.7 (1H, s, N-H), 7.1 (1H, s, C-H), 7.2-8.6 (7H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-d_6) δ: 51.8 (C-H), 18.1 (CH_3), 158.2 (=C-H), 132.2 (C=N of benzimidazole), 144.8, 144.1, 143.2, 131.9, 131.7, 131.1, 129.2, 118.8, 114.7, 111.5, yield 54 %.

4-(2-((4-Bromobenzylidene)amino)-2-(5-nitro-1*H*-benzo[*d*]imidazol-2-yl)ethyl)phenol (2o): Brown crystals, m.p.: 304-306 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole and O-H (overlap) at (3200-3550), aromatic C-H (3086, 3032), aliphatic C-H (2921, 2840), C=N (1635), aromatic C=C (1458-1535), NO_2 (1535, 1346), C-Br (684), yield 89 %.

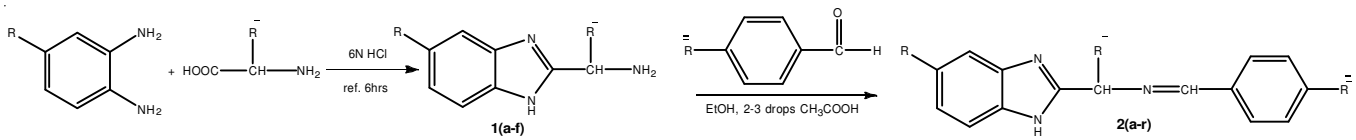
2-(((4-Bromobenzylidene)amino)methyl)-1*H*-benzo-[*d*]imidazole-5-carboxylic acid (2p): Offwhite crystals, m.p.: 288-290 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3350), aromatic C-H (3084, 3022), aliphatic C-H (2902, 2818), C=N (1624), C=O (1695), aromatic C=C (1485-1598), OH (2600-3355), C-Br (673). ^{1}H NMR (400 MHz, DMSO-d_6) δ: 4.3 (2H, s, CH_2), 5.7 (1H, s, N-H benzimidazole), 8.5 (1H, s, C-H), 6.7-8.5 (7H, m, Ar-H). ^{13}C NMR (400 MHz, DMSO-TMS) δ: 47.8 (CH_2), 150.07 (=C-H), 166.6 (C=O), 132.1 (C=N of benzimidazole), 132.5, 131.7, 129.8, 128.5, 127.7, 127, 126.5, 123.2, 115.6, 114.1. ^{13}C-Dept 135 NMR (400 MHz, DMSO-d_6) δ: 47.4 (CH_2), yield 51 %.

2-(1-((4-Bromobenzylidene)amino)ethyl)-1*H*-benzo-[*d*]imidazole-5-carboxylic acid (2q): Brown crystals, m.p.: 298-300 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3338), aromatic C-H (3092,3034), aliphatic C-H (2918, 2860), C=N (1626), C=O (1693), aromatic C=C (1461-1585), OH (2610-3340), C-Br (681), yield 66 %.

2-(1-((4-Bromobenzylidene)amino)-2-(4-hydroxyphenyl)ethyl)-1*H*-benzo[*d*]imidazole-5-carboxylic acid (2r): Brown crystals, m.p.: 288-290 °C, IR (KBr, ν_{max}, cm^{-1}): N-H benzimidazole (3363), aromatic C-H (3082), aliphatic C-H (2978, 2891), C=N (1618), C=O (1701), aromatic C=C (1456-1597), OH of carboxylic (2500-3400), C-Br (713), yield 93 %.

RESULTS AND DISCUSSION

The target compounds **2(a-r)** were synthesized by two steps procedure as depicted in **Scheme-I**. The synthesis of title compounds, started from reaction of substituted 1,2-phenylenediamine with three amino acids (glycine, alanine and tyrosine) in the presence of 6 N HCl yield the **1(a-f)** compounds. The starting products **1(a-f)** were taken for condensation reaction with different substituted benzaldehydes to give 1-(4-substituted phenyl)-*N*-((5-substituted-1*H*-benzo[*d*]imidazole-2-yl)-methyl)methanimine and 1-(4-substituted phenyl)-*N*-(1-(5-substituted-1*H*-benzo[*d*]imidazol-2-yl)ethyl)methanimine. The chemical structure of compounds **2(a-r)** were characterized by using IR, ^{1}H and ^{13}C NMR. The IR spectra for all target compounds showed absorption bands in the region of (2500-3625 cm^{-1}) for carboxylic O-H group and two peaks at (3327-3429) for NH_2 group, (3105-3385 cm^{-1}) for benzimidazole N-H group, (1689-1707 cm^{-1}) for C=O group, (1604-1641 cm^{-1}) for C=N group and two peaks at (1323-1535 cm^{-1}) corresponding for NO_2 group, (640-713 cm^{-1}) for C-Br. The ^{1}H NMR spectra for all target compounds exhibited the next chemical shifts at : δ 3.1-4.5 ppm (2H, s, CH_2), δ 1.2-1.3 ppm (3H, d, CH_3), δ 3.9-4.3 ppm (1H, q, C-H),δ 5-5.9 ppm (1H, s, N-H benzimidazole), δ 6.2-8.9 ppm (2H, s, NH_2),δ 5.9-8.8 ppm (1H, s, =C-H), δ 6.7-8.7 ppm (7H or 3H or 11H, m, Ar-H). The signals in ^{13}C NMR for all compounds were appeared at : δ 35.5-47.8 ppm attributed to the methylene group (-CH_2-), δ 48.2-55.8 ppm assigned to (-C-H) group, δ 17.9-24.2 ppm assigned to (CH_3) group, whereas signal at δ 166.4-170.1 ppm



Scheme-I: Synthesis of benzimidazole derivatives

accounted for (-C=O) group, δ 149.8-158.2 ppm assigned to (=C-H) group, also ^{13}C NMR spectra showed signal at about δ 130.5-138.9 ppm related to benzimidazole (-C=N) group, signals for benzene ring appeared at about δ 112.3-166.4 ppm (Ar-C). The purity of the prepared compounds was monitored by TLC plate. Physical properties of prepared compounds are shown in Table-1.

Antibacterial activity: The synthesized compounds were screened for their antibacterial activity *in vitro* against Gram-positive bacteria namely (*Staphylococcous aureus*, *Bacillus subtilis*) and Gram-negative bacteria (*Pseudomonas aeruginosa*, *Escherichia coli*) by disc diffusion method. The compounds were tested at concentration of (10 and 100 mg/mL). The zone of inhibition was measured in millimeters and was compared with reference standard antibiotic namely ampicillin and ciprofloxacin. The test compounds were dissol-ved in DMSO to obtain solution of different concentration. The results show in Table-2, which demonstrates that compounds containing carboxyl group at the 5-position of benzimidazole moiety namely **1e**, **2k**, **1f**, **2l** and **2p** showed a significant activities. Whereas the other compounds displayed middle activities when compared with the standard antibiotic ampicillin and ciprofloxacin.

Conclusion

The present work deals with synthesis a series of new benzimidazole substituted Schiff base and tested for their antibacterial activity. Some of the newly synthesized compounds exhibit importance antibacterial activity.

TABLE-1
ANALYTICAL DATA OF THE SYNTHESIZED COMPOUNDS

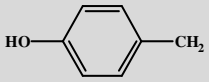
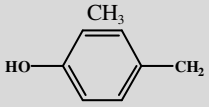
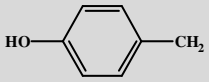
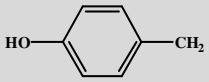
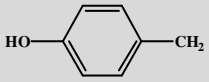
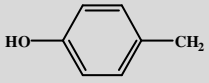
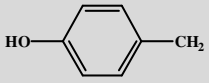
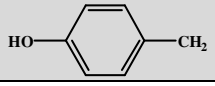
Compd. No.	R	R'	R"	m.p. (°C)	m.w. (g/mol)	m.f.	Colour	Yield (%)
1a	NO_2	H	–	240-242	192.18	$C_8H_8N_4O_2$	Black	96
1b	NO_2	CH_3	–	228-230	206.21	$C_9H_{10}N_4O_2$	Gray	97
1c	NO_2		–	253-255	298.30	$C_{15}H_{14}N_4O_3$	Black	95
1d	COOH	H	–	256-258	191.19	$C_9H_9N_3O_2$	Dark brow	77
1e	COOH	CH_3	–	252-254	205.22	$C_{10}H_{11}N_3O_2$	Black	70
1f	COOH		–	242-244	297.3	$C_{16}H_{15}N_3O_3$	Red	89
2a	NO_2	H	OH	> 350	296.29	$C_{15}H_{12}N_4O_3$	Brown	88
2b	NO_2	CH_3	OH	> 350	310.31	$C_{16}H_{14}N_4O_3$	Brown	93
2c	NO_2		OH	344-346	402.41	$C_{22}H_{18}N_4O_4$	Brown	91
2d	COOH	H	OH	232-235	295.30	$C_{16}H_{13}N_3O_3$	Pink	87
2e	COOH	CH_3	OH	225-227	309.33	$C_{17}H_{15}N_3O_3$	Pink	91
2f	COOH		OH	332-334	401.42	$C_{23}H_{19}N_3O_4$	Pink	86
2g	NO_2	H	NO_2	334-336	325.28	$C_{15}H_{11}N_5O_4$	Yellow	64
2h	NO_2	CH_3	NO_2	335-336	339.31	$C_{16}H_{13}N_5O_4$	Yellow	76
2i	NO_2		NO_2	334-336	431.41	$C_{22}H_{17}N_5O_5$	Yellow	78
2j	COOH	H	NO_2	310-312	324.30	$C_{16}H_{12}N_4O_4$	Brown	83
2k	COOH	CH_3	NO_2	304-306	338.32	$C_{17}H_{14}N_4O_4$	Brown	81
2l	COOH		NO_2	286-288	430.4	$C_{23}H_{18}N_4O_5$	Red	64
2m	NO_2	H	Br	286-288	359.18	$C_{15}H_{11}N_4O_2Br$	Off white	75
2n	NO_2	CH_3	Br	300-302	373.21	$C_{16}H_{13}N_4O_2Br$	Brown	54
2o	NO_2		Br	304-306	465.3	$C_{22}H_{17}N_4O_3Br$	Brown	89
2p	COOH	H	Br	288-290	358.20	$C_{16}H_{12}N_3O_2Br$	Off white	51
2q	COOH	CH_3	Br	298-300	372.22	$C_{17}H_{14}N_3O_2Br$	Brown	66
2r	COOH		Br	288-290	464.32	$C_{23}H_{18}N_3O_3Br$	Brown	93

TABLE-2
ANTIBACTERIAL ACTIVITY OF SYNTHESIZED COMPOUNDS

Compd. No.	Conc. (mg/mL)	Zone of inhibition (mm)			
		Gram-positive		Gram-negative	
		SA	BS	PA	EC
1b	10	13	10	12	15
	100	19	21	14	15
2n	10	13	14	-	-
	100	11	14	13	-
1e	10	13	23	30	27
	100	-	11	13	-
2k	10	15	19	11	22
	100	-	18	-	20
1d	10	14	27	19	21
	100	-	10	-	-
2l	10	12	11	11	11
	100	11	10	15	11
1f	10	15	23	20	27
	100	12	11	13	12
2p	10	13	16	14	17
	100	10	13	10	-
Ampicillin		22	23	-	10
Ciprofloxacin		19	23	29	-
DMSO solvent		0	0	0	0

SA = *S. aureus*, BS = *B. subtilis*; PA = *P. aeruginosa*; EC = *E. coli*

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