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Multi-Step Synthesis, Characterization and Bioevaluation of Novel 2-(3-Methoxy-9*H*-carbazol-9-yl)-*N*-phenyl Acetamide Analogues

VISWESWARA RAO CH. and LAKSHMAN SHAIK*

Department of Chemistry, GITAM School of Science, GITAM (Deemed to be University), Visakhapatnam-530045, India

*Corresponding author: E-mail: lshaik@gitam.edu

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In this work, the multi-step synthesis and characterization of novel 2-(3-methoxy-9*H*-carbazol-9-yl)-*N*-phenyl acetamide analogues is presented. These analogues were synthesized from 2-(3-methoxy-9*H*-carbzol-9-yl)acetyl chloride with substituted aromatic primary amines in the presence of organic base such as triethylamine and methylene dichloride under reflux conditions. The elemental analysis and structures of these novel compounds were elucidated by analyzing spectral data obtained through ^{1}H NMR, ^{13}C NMR and LCMS techniques. The bioevaluation of these newly synthesized compounds has been studied by evaluating their antibacterial and antifungal activities against various kinds of bacterial and fungal strains, respectively.

Keywords: Synthesis, 1,2-Dichloro benzene, 3-Methoxy-9*H*-carbazole, Substituted aniline.

INTRODUCTION

Carbazole derivatives are gaining a lot of attention as potential new medicines for a wide range of diseases [1,2]. A number of pharmacological activities have been demonstrated for carbazoles, including antibacterial, anti-inflammatory, anti-cancer, antihistaminic, antioxidant, hepatoprotective, anti-HIV, anti-protozoan, anti-tubercular and antiepileptic properties [3-6]. Carbazoles occur naturally in a wide range of compounds that exhibit a variety of useful biological properties, such as antimitotic and antioxidative properties [4-5].

There are a number of natural medicinal active substances that contain carbazole rings as part of their structure. As a result of recent developments, it has been possible to synthesize macrocyclic diamides with carbazole skeletons using this and oxy-linkage systems [7-15]. In recent years, several methods have been proposed for the synthesis of heterocyclic compounds that contain carbazoles [16-20]. Majority of the heterocyclic rings reported in the literature have been fused with carbazoles rings, such as indole carbazoles, pyrrole carbazoles and pyrido-carbazoles, as well as synthetic derivatives derived from these heterocyclic rings [21]. The synthesis of heterocyclic molecules substituted with carbazoles has been reported and the synthesis of such compounds is desirable [22,23]. In fact, oxygen-containing fused heterocyclic compounds, such as benzofurans analogues, are the most important type of heterocyclic compounds, as they possess numerous properties, such as antimicrobial, antifungal, anticonvulsant, anti-inflammatory properties and antitumor activities [24-26].

In this work, an attempt is made to synthesize and characterize novel 2-(3-methoxy-9*H*-carbazol-9-yl)-*N*-phenyl acetamide analogues from 2-(3-methoxy-9*H*-carbzol-9-yl)acetyl chloride with substituted aromatic primary amines in the presence of triethylamine and MDC under reflux conditions. All the synthesized compounds were also screened for antibacterial and antifungal activities.

EXPERIMENTAL

Chemicals, synthetic reagents and solvents used in this experiment were obtained from commercial sources and were used without further purification. In accordance with standard procedures, the reaction mixture was prepared using dry solvents and analyzed in a TLC method (*n*-hexane: ethyl acetate) on alumina-coated silica gel plates. The use of open capillary tubes has been established for the determination of compounds with the desired melting point without any corrections. The titled derivatives were characterized using a Bruker DRX-400 MHz and 100 MHz instrument with $CDCl_3$ as solvent. The ^{1}H & ^{13}C

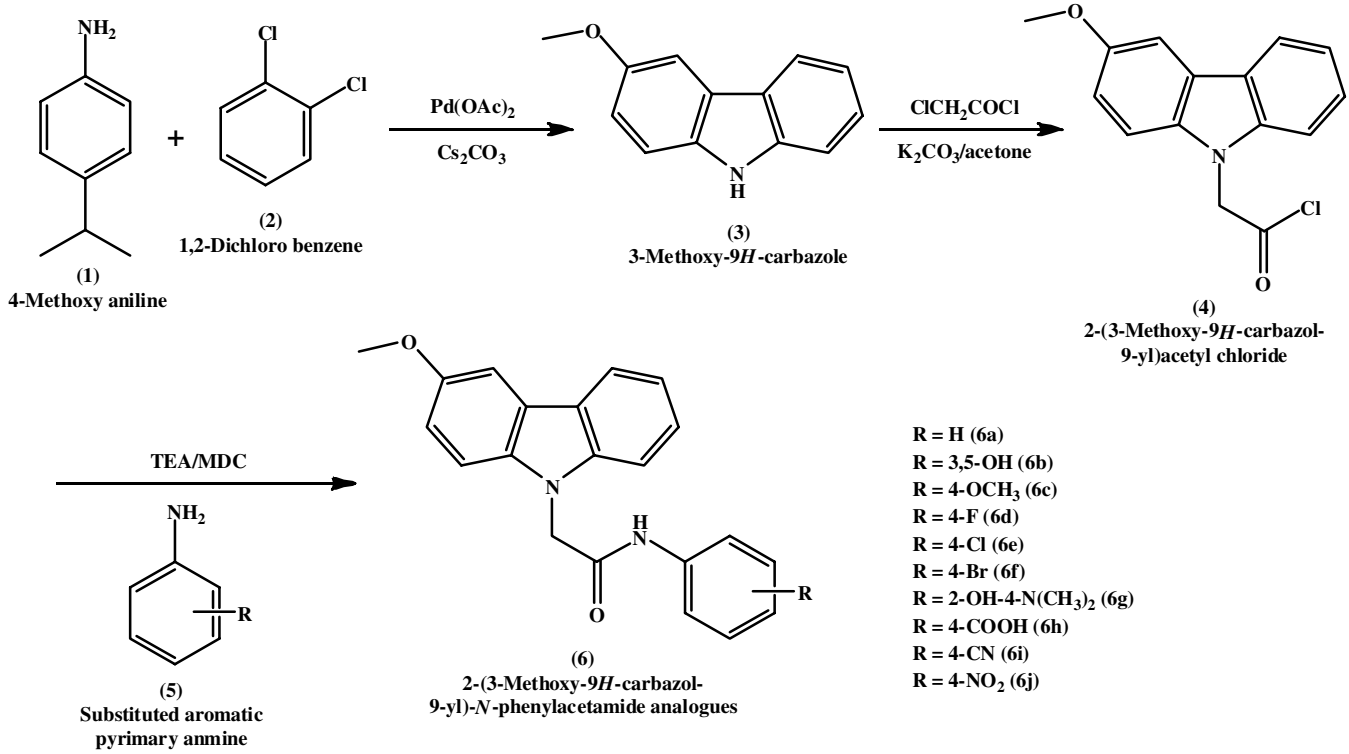
NMR spectrum were obtained using a Bruker DRX-400 MHz and 100 MHz instruments, respectively. The mass spectra was obtained using Shimadzu 2010A LCMS spectrometer.

Synthesis of 3-methoxy-9*H*-carbazole (3): In order to synthesize compound **3**, methoxyaniline (1 mmol), 1,2-dichlorobenzene (2 mmol) taken in a dry and cleaned four-necked RBF. The catalyst palladium acetate and cesium carbonate were added to RBF, which was connected to a magnetic stirrer and At 120 ºC, the reaction was performed for 12 h. Monitoring the reaction mixture using TLC (5:5 ethyl acetate:*n*-hexane). Once the reaction was completed, filtered the catalyst and then added ethyl acetate as solvent to the filtrate. After washing the mixture with a saturated $NaHCO_3$ solution, the organic layer of the mixture was separated and then distilled under vacuum. Using column chromatography, crude product was separated and recrystallized using ethanol. Yield: 74%; pale red solid, m.p.: 198-200 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.56 (1H, s, N-H, pyrole), 7.57 (1H, s, indole), 7.497 (1H, d, *J* = 8.0 Hz, Ar-H), 7.45-7.08 (5H, m, Ar-H), 3.12 (3H, s-OCH_3). ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 150.28, 132.08, 130.67, 127.20, 121.38, 120.46, 119.92, 112.09, 111.66, 110.24, 107.96, 98.55, 54.88; LCMS (*m/z*): 197.28 (M^+); Elemental analysis of calcd. (found) % of $C_{13}H_{11}NO$: C, 79.15 (79.10); H, 5.62 (5.61); N, 10.07 (10.19).

Synthesis of 2-(3-methoxy-9*H*-carbzol-9-yl)acetyl chloride (4): In order to synthesize compound **4**, acetone, K_2CO_3, 3-methoxy-9*H*-carbazole and chloroacetic chloride were mixed in a clean and dry four-necked 100 mL RBF fitted with a magnetic stirrer. The reaction was heated for 5 h at 50-55 ºC and the progress of the reaction was monitored using TLC (4:6 ethyl acetate:*n*-hexane). Upon completion of the reaction, the mixture was then added to cold water and ethyl acetate. Once the organic layer has been separated, it was washed twice with sodium bicarbonate solution and then separated again. The separated organic layer was then distilled under vacuum. Using columns chromatography, crude product was separated and recrystallized with ethanol. Yield: 75%; colourless solid, m.p.: 210-212 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 8.09 (1H, s, Ar-H), 7.813 (1H, s, Ar-H), 7.72-7.45 (4H, m, Ar-H), 6.92 (1H, d, *J* = 7.5 Hz, Ar-H), 3.58 (3H, s, -OCH_3), 2.89 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 168.78, 145.62, 136.85, 135.05, 129.86, 128.79, 128.29, 127.88, 125.39, 121.45, 54.39, 32.48; LCMS (*m/z*): 275.17 (M+2); Elemental analysis of calcd. (found) % of $C_{15}H_{12}NO_2Cl$: C, 65.80 (65.75); H, 4.42 (4.41); N, 5.10 (5.18).

Synthesis of title analogues (6a-j): Methylene dichloride and triethyl amine as solvents were mixed at room temperature in a clean, dry, four-necked RBF followed by the addition of 2-(3-methoxy-9*H*-carbzol-9-yl)acetyl chloride (1 mmol) and substituted aromatic primary amines (1.1 mmol). The reaction was carried out at 40 ºC for 5 h in order to achieve the desired product. The progress of the reaction mixture was monitored using TLC (4:6 ethylacetate:*n*-hexane). Upon completion of the reaction, cool water was introduced, followed by the addition of 10 mL of 5% HCl and 25 mL of ethyl acetate. After separating the organic layer, the brine solution was used to wash the organic layer. The organic layer was then separated and distilled under vacuum. Column chromatography was used to separate the desired product, which was then recrystallized in ethanol (**Scheme-I**).

2-(3-Methoxy-9*H*-carbazol-9-yl)-*N*-phenyl acetamide (6a): Yield: 85%; colourless solid; m.p.: 223-225 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.54 (1H, s, amide), 8.15 (1H, d, *J* = 7.0 Hz, Ar-H); 7.81 (1H, s, Ar-H), 7.72 (1H, d, *J* = 7.6 Hz,



Scheme-I: Synthesis of carbazole analogues (**6a-j**)

Ar-H), 7.68 (1H, d, *J* = 6.4 Hz, Ar-H), 7.57 (1H, d, *J* = 7.0 Hz, Ar-H), 7.53-7.17 (5H, m, Ar-H), 7.12 (1H, s, 1H, Ar-H), 6.88 (1H, d, *J* = 7.6 Hz, Ar-H), 3.598 (3H, s, -OCH_3), 2.15 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 166.72, 150.08, 137.86, 129.07, 128.96, 128.05, 127.44, 125.77, 124.09, 122.68, 120.92, 118.46, 112.53, 110.96, 108.45, 99.77, 53.17, 42.18; LC-MS: 331.24 (M+1); Elemental analysis of calcd. (found) % of $C_{21}H_{18}N_2O_2$: C, 76.34 (76.30); H, 5.49 (5.48); N, 8.48 (8.53).

***N*-(3,5-Dihydroxyphenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)acetamide (6b):** Yield: 94%; pale white; m.p.: 214-216 ºC; R_f: 0.65 (ethyl acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.47 (1H, s, amide), 8.54 (2H, s-$(OH)_2$), 7.23-6.84 (5H, m, Ar-H), 3.58 (3H, s, OCH_3), 2.17 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 168.77, 158.38, 151.47, 140.64, 127.83, 125.64, 123.86, 122.04, 121.22, 119.92, 113.48, 110.53, 108.76, 107.09, 100.06, 98.24, 96.46, 54.64, 42.37; LCMS (*m/z*): 361.28 (M-H); Elemental analysis of calcd. (found) % of $C_{21}H_{18}N_2O_4$: C, 69.59 (69.54); H, 5.01 (5.00); N, 7.72 (7.82).

2-(3-Methoxy-9*H*-carbzol-9-yl)-*N*-(4-methoxyphenyl)-acetamide (6c): Yield: 92%, colourless solid; R_f: 0.25 (ethyl acetate:*n*-hexane); m.p.: 206-208 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.568 (1H, s, amide), 8.11 (1H, d, *J* = 7.6 Hz, Ar-H), 7.80 (1H, s, Ar-H), 7.684 (1H, d, *J* = 8.4 Hz, H, Ar-H), 7.617 (1H, d, *J* = 8.0 Hz, Ar-H), 7.50-7.22 (4H, m, Ar-H), 6.82-6.66 (3H, m, Ar-H), 3.58 (3H, s, OCH_3), 2.31 (2H, s, CH_2); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 166.24, 157.68, 151.45, 131.09, 128.94, 125.64, 124.46, 123.35, 121.55, 120.67, 118.96, 115.76, 113.67, 110.94, 108.46, 106.76, 100.08, 54.86, 41.97; LCMS: 361.15 (M+H); Elemental analysis of calcd. (found) % of $C_{22}H_{20}N_2O_3$: C, 73.32 (73.26); H, 5.59 (5.58); N, 7.76 (7.84).

***N*-(4-Fluorophenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)-acetamide (6d):** Yield: 88%; colourless solid; m.p.: 254-256 ºC; R_f: 0.45 (ethyl acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.78 (1H, s, amide), 8.16 (1H, d, *J* = 7.2 Hz, Ar-H), 7.81 (1H, s, Ar-H), 3.62 (3H, s, -OCH_3), 2.28 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 169.48, 160.09, 151.34, 135.88, 129.94, 126.02, 124.77, 122.34, 121.64, 120.22, 118.46, 114.74, 111.88, 109.72, 107.64, 106.34, 100.66, 53.86, 42.64; LCMS: 348.22 (M^+); Elemental analysis of calcd. (found) % of $C_{21}H_{17}N_2O_2F$: C, 72.40 (72.34); H, 4.92 (4.91); N, 8.04 (8.12).

N-(4-Chlorophenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)acetamide (6e): Yield: 87%; colourless solid; m.p.: 260-262 ºC; R_f: 0.25 (ethyl acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.54 (1H, s, amide), 8.11 (1H, d, *J* = 7.2 Hz, Ar-H), 7.812 (1H, s, Ar-H), 7.784-7.435 (7H, m, Ar-H), 7.256 (2H, t, *J* = 7.2 Hz, Ar-H), 6.896 (1H, d, *J* = 7.6 Hz, Ar-H), 3.578 (3H, s, -OCH_3); 2.348 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 166.74, 150.56, 135.36, 131.36, 129.44, 128.01, 127.14, 126.64, 124.88, 121.99, 120.55, 119.33, 117.45, 112.72, 110.39, 108.45, 103.36, 53.45, 41.09. LCMS:366.41 (M+2); Elemental analysis of calcd. (found) % of $C_{21}H_{17}N_2O_2Cl$: C, 69.14 (69.63); H, 4.70 (4.69); N, 7.68 (7.72).

***N*-(4-Bromophenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)-acetamide (6f):** Yield: 87%, pale yellow solid; m.p.: 252-254 ºC; R_f: 0.45 (ethyla acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.57 (1H, s, amide), 8.07 (1H, d, *J* = 7.6 Hz, Ar-H), 7.825 (1H, s, Ar-H), 3.59 (3H, s, -OCH_3), 2.16 (2H, s, CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 166.72, 150.88, 135.75, 130.85, 128.94, 127.16, 126.54, 124.35, 121.41, 119.92, 117.35, 113.08, 110.44, 108.48, 103.66, 50.81, 40.22. LCMS: 410.22 (M+2); Elemental analysis of calcd. (found) % of $C_{21}H_{17}N_2O_2Br$: C, 61.63 (61.56); H, 4.19 (4.18); N, 6.84 (6.91).

***N*-(4-(Dimethylamino)-2-hydroxyphenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)acetamide (6g):** Yield: 94%, colourless solid; m.p.: 233-234 ºC; R_f: 0.50 (ethyl acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.428 (1H, s, amide), 8.34 (1H, s, Ar-H), 8.04 (1H, d, *J* = 7.0 Hz, Ar-H), 3.51 (3H, s, -OCH_3), 2.10 (2H, s, -CH_2-), 1.25 (s, 6H, $(CH_3)_2$);^{13}C NMR (100 MHz, $CDCl_3$) δ ppm:165.96, 150.17, 148.72, 145.54, 135.02, 128.87, 128.34, 125.66, 124.75, 122.71, 121.37, 120.45, 119.01, 117.49, 115.38, 112.11, 110.49, 108.88, 106.44, 52.89, 41.24, 39.03. LCMS: 390.93 (M^++H); Elemental analysis of calcd. (found) % of $C_{23}H_{23}N_3O_3$: C, 70.93 (70.91); H, 5.95 (5.94); N, 10.70 (10.86).

4-(2-(3-Methoxy-9*H*-carbazol-9-yl)-*N*-phenyl acetamide)-benzoic acid (6h): Yield: 85%, pale red; m.p.: 265-267 ºC; R_f: 0.60 (ethyl acetate:*n*-hexane). ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 11.17 (1H, s, acid), 10.01 (1H, s, amide), 8.13 (1H, d, *J* = 7.6 Hz, ArH), 3.65 (3H, s, OCH_3), 2.196 (2H, s, CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 167.45, 165.18, 150.07, 141.74, 135.74, 129.47, 128.83, 128.42, 127.04, 124.55, 122.96, 121.09, 119.77, 117.60, 113.74, 109.84, 103.78, 40.36, LCMS:374.62 (M+H); Elemental analysis of calcd. (found) % of $C_{22}H_{18}N_2O_4$: C, 70.57 (70.52); H, 4.85 (4.84); N, 7.48 (7.56).

***N*-(4-Cyanophenyl)-2-(3-methoxy-9*H*-carbazol-9-yl)-acetamide (6i):** Yield: 86%; pale red solid; m.p.: 237-239 ºC; R_f: 0.45 (ethyl acetate:*n*-hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.89 (1H, s, amide), 8.19 (1H, d, *J* = 7.4 Hz, Ar-H), 7.96 (1H, s, Ar-H), 3.60 (3H, s, -OCH_3) 2.25 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 169.45, 152.78, 140.86, 131.49, 128.77, 127.45, 125.62, 123.44, 121.76, 120.55, 118.89, 117.66, 114.78, 111.39, 109.09, 107.54, 99.14, 54.82, 40.74. LCMS: 354.39 (M+H); Elemental analysis of calcd. (found) % of $C_{22}H_{17}N_3O_2$: C, 74.35 (74.29); H, 4.82 (4.81); N, 11.82 (11.90).

2-(3-Methoxy-9*H*-carbazol-9-yl)-*N*-(4-nitrophenyl)-acetamide (6j): Yield: 84%; pale red solid; R_f: 0.55 (ethyl acetate:*n*-hexane); m.p.: 257-259 ºC: ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 9.94 (1H, s, amide), 8.21 (2H, d, *J* = 8.0 Hz, Ar-H), 8.01 (1H, d, *J* = 7.0 Hz, Ar-H), 7.81 (1H, s, Ar-H), 7.76 (2H, d, *J* = 7.2 Hz, Ar-H), 7.61 (2H, d, *J* = 8.4 Hz, Ar-H), 7.60 (1H, d, *J* = 7.0 Hz, Ar-H), 7.584 (1H, d, *J* = 7.2 Hz, Ar-H), 7.44 (2H, t, *J* = 7.0 Hz, Ar-H), 7.21 (2H, t, *J* = 6.8 Hz, Ar-H), 6.96 (1H, d, *J* = 8.0 Hz, Ar-H), 3.65 (3H, s, OCH_3), 2.42 (2H, s, -CH_2-); ^{13}C NMR (100 MHz, $CDCl_3$) δ ppm: 169.64, 152.76, 145.37, 140.09, 129.44, 128.37, 125.58, 123.12, 122.74, 121.08, 119.94, 117.86, 114.76, 110.39, 108.74, 107.65, 101.74, 54.81, 40.36. LCMS: 374.62 (M+H); Elemental analysis of calcd. (found) % of $C_{21}H_{17}N_3O_4$: C, 67.18 (67.13); H, 4.55 (4.54); N, 11.18 (11.25).

Antimicrobial activity: Agar well diffusion assays were used to analyze the antibacterial activity of test compounds

(**6a-j**) against Gram-positive bacteria, Gram-negative bacteria, as well as their antifungal activity against *Aspergillus niger* and *Candida albicans*. Each disc was incubated at 35 ºC for 24 h at 50, 100, 250 and 500 µg/mL for all bacteria.

RESULTS AND DISCUSSION

At room temperature, the initial yield of the reaction product was just 50%. When the temperature of the reaction mixture is increased to 55 ºC under reflux conditions, the reaction achieves completion within 5 h in the range of 84-94% yields. It is observed that titled analogues containing electron releasing groups (compounds **6b**, **6c** and **6g**) reacted more efficiently than those with withdrawing groups, moreover, the yield is also more in case of releasing groups than with those with withdrawing groups (compounds **6h**, **6i**, **6j**).

Antibacterial activity: The *in vitro* antibacterial activity of the synthesized compounds **6a-j** was compared with that of the standard antibiotic ciprofloxacin. The results in Table-1 indicated that most of the synthesized derivatives displayed potency against all strains of bacteria tested. Compounds **6d**, **6e** and **6f** showed excellent antibacterial activity against Gram-positive bacterial strains such as *E. coli* and *P. aeruginosa* as well as Gram-negative bacterial strains such as *B. subtilis* and *S. aureus*, respectively also since these compounds contain halogen atoms. As far as bacterial strains are concerned, derivatives **6a**, **6b**, **6c** and **6f** exhibit moderate to good activity. Due to the presence of highly electron withdrawing groups in compounds **6e** and **6j**, these compounds have shown low activity against bacterial strains.

Antifungal activity: Compounds **6d**, **6e** and **6f** showed significant activity against the fungal strain *Aspergillus niger* and *Candida albicans* whereas compounds **6h**, **6i** and **6j** have shown moderate activity. Only three compounds **6a**, **6b** and **6c** were poorly active at all concentrations (Table-2) for both fungi.

TABLE-1
ZONE OF INHIBITION OF CIPROFLOXACIN (10 µg/mL) AGAINST *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* AND *Bacillus subtilis*

Compd.	*Escherichia coli* was 25 mm				*Pseudomonas aeruginosa* was 25 mm			
	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL
6a	04	03	07	09	05	05	08	09
6b	05	05	07	12	03	05	06	10
6c	08	11	08	09	07	11	10	11
6d	12	11	13	17	12	13	14	18
6e	14	16	17	19	14	16	19	21
6f	11	15	18	19	12	15	17	21
6g	08	10	11	09	07	08	11	10
6h	03	04	04	07	02	03	04	05
6i	01	03	05	06	03	04	06	07
6j	01	02	02	03	02	04	05	07
Compd.	*Staphylococcus aureus* was 27 mm				*Bacillus subtilis* was 27 mm			
	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL
6a	04	05	06	09	05	08	08	10
6b	06	09	10	13	08	10	12	15
6c	08	10	14	15	05	07	10	13
6d	12	18	19	21	12	16	19	22
6e	13	17	19	20	13	14	18	22
6f	13	16	20	21	13	15	19	21
6g	05	11	13	14	08	10	12	12
6h	02	04	05	07	03	05	08	10
6i	03	04	05	07	05	08	09	11
6j	03	05	07	08	03	06	08	09

TABLE-2
ZONE OF INHIBITION OF KETOCONAZOLE (10 µg/mL) AGAINST *Aspergillus niger* AND *Candida albicans*

Compd.	*Aspergillus niger* was 22 mm				*Candida albicans* was 22 mm			
	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL	50 µg/mL	100 µg/mL	250 µg/mL	500 µg/mL
6a	02	03	05	06	02	05	06	08
6b	03	05	08	09	03	05	06	09
6c	02	05	07	08	04	06	07	09
6d	10	13	16	19	07	11	13	18
6e	09	13	15	18	08	12	14	17
6f	12	15	16	18	11	14	15	18
6g	04	08	09	11	05	08	09	11
6h	10	11	14	15	10	12	15	16
6i	08	09	11	12	09	10	12	13
6j	09	11	13	15	08	10	13	14

Conclusion

In conclusion, novel 2-(3-methoxy-9*H*-carbazol-9-yl)-*N*-phenyl acetamide analogues (**6a-j**) from 2-(3-methoxy-9*H*-carbazole-9-yl)acetyl chloride coupled with a substituted aromatic primary amine with maximum yield. Compounds bearing electron donating groups (**6b**, **6c** and **6g**) give more yield than the electron withdrawing groups (**6h**, **6i** and **6j**).The structures of synthesized compounds **6a-j** were well-characterized by ^{1}H NMR, ^{13}C NMR, LCMS spectra and elemental analysis. The compounds bearing halogen groups such as F, Cl and Br as substituent's (**6d**, **6e** and **6f**) exhibited excellent potent antimicrobial activity.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this article.

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