Available online at www.derpharmachemica.com

Scholars Research Library

Der Pharma Chemica, 2015, 7(2):286-291
(http://derpharmachemica.com/archive.html)

ISSN 0975-413X
CODEN (USA): PCHHAX

Synthesis, characterization and antibacterial activity of some new chalcone derivatives

Birendra Kumar*[1], Binita Kumari[1], Neha Singh[1], B. Ram[2] and B. Balram[2]

[1]*Department of Chemistry, Gaya College, Gaya, (Bihar), India*
[2]*Green Evolution Laboratories, Wangapally Village, Nalgonda, Telangana State, India*

ABSTRACT

The growth of new compounds, chalcones has revealed that they acquire a wide variety of biological activities viz., antibacterial, anti-inflammatory, antitumor and antimalarial etc. Chalcones having an α, β unsaturated carbonyl group are versatile synthons for various chemical transformations. The chemistry of chalcones has taken an important place in organic chemistry; the research in this area is encouraged because of development of bacterial resistance to widely used antibiotics of this type. The present paper describes the synthesis and antibacterial activity of novel chalcone derivatives derived from 3-methoxy-4-hydroxy-acetopheneone.

Keywords: chalcones, apocynin, synthesis, antibacterial activity

---

INTRODUCTION

Chalcones having an α, β unsaturated carbonyl group are versatile synthons for various chemical transformations. Chalcones have been used as anticancer, anti-inflammatory and antioxidant agents [1], antimicrobial activity [2], **a**nti-infective and anti-inflammatory [3], antitumor agents [4], antimalarial and antitubercular activity [5], anti AIDS agents [6], cytotoxic agents with antimalarials [7]. Furthermore chalcones are known to exhibit as inhibitors of mycobacterial FAS-II and PknG [8], inhibitors of breast cancer resistance protein [9], inhibitors and promoters of tubulin polymerization [10], inhibitors of TNF-a and IL-6 with antimicrobial activity [11] and inhibitors of the voltage-gated potassium channel Kv1.3 [12]. Infectious diseases caused by bacteria have increased tremendously in recent years. Though many significant advances have been made in antibacterial therapy, the widespread use and misuse of antibiotics have caused the emergence of bacterial resistance to antibiotics [13-15]. A survey based on a structural activity relationship study revealed that certain small heterocyclic molecules act as highly functionalized scaffolds and are known pharmacophores of a number of biologically active and medicinally useful molecules [16,17]. Encouraged by the various biological activities associated with chalcones derivative, we report herein the synthesis, characterization and antibacterial activity of fifteen new chalcone derivatives derived from 3-methoxy-4-hydroxy-acetopheneone (apocynin) [18] bearing 3-chloro benzyl entity.

MATERIALS AND METHODS

The solvents were purified according to standard procedures prior to use, and all commercial chemicals were used as received. For thin-layer chromatography (TLC) analysis, Merck pre-coated Plates (silica gel 60 F254) were used and spots were visualized with UV light. Merck silica gel 60 (230-400 mesh) was used for flash column chromatography and the eluting solvents are indicated in the procedures. Melting point (mp) determinations were performed by using Mel-temp apparatus and are uncorrected. ^{1}H NMR spectra were recorded in Varian MR-400 MHz instrument. Chemical shifts are reported in δ parts per million (ppm) downfield from tetramethylsilane (TMS) with reference to

internal standard and the signals were reported as s (singlet), d (doublet), dd (doblet of doblet), t (triplet), q (quartet), m (multiplet) and coupling constants in Hz. The mass spectra were recorded on Agilent ion trap MS. Infrared (IR) spectra were recorded on a Perkin Elmer FT-IR spectrometer.

Experimental methods

Synthesis of 1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)ethanone (2)

To a stirred solution of potassium carbonate (1.4 mmol) in *N*,*N*-dimethylformamide (12 mL), a solution of compound 4-hydoxy-3-methoxyacetophenone (**1)** (2.5 mmol) in *N*,*N*-dimethylformamide (5 mL) was added dropwise at room temperature. The reaction mixture was stirred for 30 min and then 1-chloro-3-chloromethylbenzene (**2)** (2.5 mmol) was added. The reaction mixture was stirred at 78 °C for 3.5 h. The reaction was quenched with water and extracted with ethyl acetate. The organic layer was washed with water and saturated sodium chloride, dried over magnesium sulphate, filtered and the solvent was evaporated under vacuum which was used without further purification.

Yellow solid; Yield: 70%; m.p. 124-126 ^{o}C; IR (KBr): υ_{max} 3079. 2925, 1741, 1663, 1587, 1513, 1455, 1413, 1381, 1351, 1270, 1216, 1148, 1078, 1023, 975, 874, 806, 779, 682, 640 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 7.60 (s, 1H), 7.56 (d, 1H, *J* = 8.0Hz), 7.48 (s,1H), 7.38-7.28 (m, 3H), 6.90 (d, 1H, *J* = 8.0Hz), 5.20 (s, 2H), 3.98 (s, 3H), 1.6 (s, 3H). ESI- MS: m/z (rel.abund. %): 291.10 (M^{-}, 100).

General procedure for the preparation of chalcone derivatives 3(a-o)

To a solution of 10% sodium hydroxide in methanol (30 mL), compound **3** (0.55 mmol) and appropriate aromatic/heteroaromatic aldehydes (0.50 mmol) were added at 0−10 ^{o}C and stirred at room temperature for 2−3 h. The reaction mixture was diluted with water and extracted with ethyl acetate. The organic layer was washed with brine solution, dried over anhydrous sodium sulphate and filtered. Evaporation of the solvent under reduced pressure yielded the crude product which was purified by column chromatography (silica gel, 60-120 mesh) using hexane-ethyl acetate (2.5:1) as eluent.

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(2,4-dimethoxyphenyl)prop-2-en-1-one (3a)

Brown solid ; Yield: 69%; m.p. 04-106 ^{o}C; IR (KBr): υ_{max} 3075, 3004, 2940, 2839, 2601, 2064, 1972, 1739, 1674, 1649, 1591, 1567, 1507, 1469, 1420, 1379, 1317, 1260, 1199, 1166, 1145, 1114, 1082, 1058, 1025, 991, 945, 917, 877, 853, 813, 792, 775, 749, 698, 682, 646 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 8.10 (d, 1H, *J* = 19.4 Hz), 7.68-7.42 (m, 5 H) 7.32-7.24 (m, 3 H), 6.90 (d, 1H, *J* = 18.8 Hz), 6.55(d, 1H, *J* = 8.4 Hz), 6.42 (s, 1H), 5.20 (s, 2H), 3.98 (s, 3H), 3.96 (s, 6H); ESI-MS: m/z (rel.abund. %): 439.10 (M^{+}, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(2,5-dimethoxyphenyl)prop-2-en-1-one (3b)

Yellow solid ;Yield: 76%; m.p. 164-166 ^{o}C; IR (KBr): υ_{max} 3070, 2938, 2601, 2500, 2064, 1742, 1674, 1651, 1576, 1500, 1464, 1420, 1379, 1348, 1316, 1265, 1232, 1169, 1146, 1081, 1031, 993, 913, 876, 839, 801, 773, 746, 698, 654, 633 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 8.10 (d, 1H, *J* = 19.2 Hz), 7.70-7.50 (m, 3H), 7.45 (s, 1H), 7.38 (d, 3 H, *J* = 8.4 Hz), 7.18 (s, 1H), 6.98-6.82 (m, 3 H), 5.20 (s, 2H), 4.0 (s, 3H), 3.82 (s,3 H), 3.76 (s, 3H); ESI- MS: m/z (rel.abund. %): 439.10 (M^{+}, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(3,4,5-trimethoxyphenyl)prop-2-en-1-one (3c)

Orange solid ;Yield: 75%; mp:94-96^{0}C; IR (KBr): υ_{max} 3464, 3074, 2999, 2941, 2837, 1741, 1653, 1578, 1503, 1455, 1418, 1373, 1323, 1274, 1235, 1151, 1124, 1025, 976, 912, 873, 792, 741, 683, 627 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 7.78 (d, 1H, *J* = 18.0 Hz), 7.68-7.60 (m, 2H), 7.48-7.38 (m, 2H), 7.30-7.28 (m, 3H), 6.90 (d, 1H, *J* = 7.8 Hz), 6.80 (s, 2H), 5.20 (s, 2H), 4.0 (s, 3H), 3.92 (s, 3H), 3.86 (s, 3H); ESI-MS: m/z (rel.abund. %): 469.10 (M^{+}, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-ethoxy-3-methoxyphenyl)prop-2-en-1-one (3d)

Light yellow solid ;Yield: 74%; mp:114-116^{0}C; IR (KBr): υ_{max} 3066, 2976, 2953, 2881, 2841, 2591, 1651, 1574, 1511, 1464, 1421, 1384, 1335, 1258, 1232, 1196, 1141, 1031, 998, 913, 879, 841, 795, 774, 719, 701, 683, 648 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 7.76 (d, 1H, *J* = 19.6 Hz), 7.66-7.58 (m, 2H), 7.47 (s, 1H), 7.40 (s, 1H), 7.36 - 7.28 (m, 2H), 7.22 (d, 1H, *J* = 18.8 Hz), 7.15 (s, 1H), 6.94-6.80 (m, 2H), 5.40 (s, 2H), 4.2 (q, 2H, *J* = 5.8 Hz), 3.92 (s, 3H), 3.98 (s, 3H), 1.5 (t, 3H, *J* = 5.8Hz); ESI-MS: m/z (rel.abund. %): 453.10 (M^{+}, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(3-methoxy-4-propoxyphenyl)prop-2-en-1-one (3e)

Yellow solid ;Yield 69%; mp:124-126^{0}C; IR (neat): υ_{max} IR (KBr): υ_{max} 3063, 2938, 1741, 1651, 1574, 1511, 1462, 1420, 1380, 1336, 1258, 1231, 1198, 1141, 1027, 996, 977, 914, 879, 842, 797, 772, 701, 683, 648 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d$_6$): δ 7.73 (d, 1H, *J* = 20.4 Hz), 7.64-7.59 (m, 2H), 7.45 (d, 2H, *J* = 18.84 Hz), 7.33-7.29 (m,

3H), 7.26-7.15 (m, 2H), 6.92-6.87 (m, 2H), 5.21 (s, 2H), 4.2 (q, 2H, *J* = 9.2 Hz), 3.92 (s, 3H), 3.98 (s,3H), 2.0 (q, 2H, *J* = 9.64 Hz), 1.5 (t, 3H, *J* = 9.6 Hz); ESI-MS: m/z (rel.abund. %): 453.10 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-tert-butylphenyl)prop-2-en-1-one (3f)
Dark yellow solid ;Yield: 73%; mp:134-136^{0}C; IR (KBr): υ_{max} 3063, 2938, 1741, 1651, 1574, 1511, 1462, 1420, 1380, 1336, 1258, 1231, 1198, 1141, 1027, 996, 977, 914, 879, 842, 797, 772, 701, 683, 648 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 7.80 (d, 1H, *J* = 16.8 Hz), 7.65-7.56 (m, 3H), 7.50-7.42 (m, 2H), 7.34-7.28 (m, 3H), 6.92 (d, 1H, *J* = 16.8 Hz), 5.20 (s, 2H), 3.98 (s, 3H), 1.25 (s, 9H); ESI-MS: m/z (rel.abund. %): 435.10 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-(trifluoromethyl)phenyl)prop-2-en-1-one (3g)
Yellow solid ;Yield: 81%; mp:122-126^{0}C; IR (KBr): υ_{max} 2928, 1741, 1652, 1596, 1570, 1517, 1462, 1425, 1384, 1351, 1317, 1280, 1245, 1204, 1165, 1146, 1066, 1036, 993, 951, 914, 876, 821, 798, 782, 738, 703, 684, 652, 624 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 8.15-8.11 (m, 3H), 7.95 (d, 1H, *J* = 6.8 Hz), 7.83-7.80 (m, 3H),7.63 (d, 1H, *J* = 6.2 Hz), 7.58 (d, 1H, *J* = 6.4Hz), 7.43-7.40 (m, 3H), 7.23 (d, 1H, *J* = 7.4Hz), 5.23 (s, 2H), 3.98 (s, 3H); ESI-MS: m/z (rel.abund. %): 448.0 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-(trifluoromethoxy)phenyl)prop-2-en-1-one (3h)
Pale yellow solid ;Yield: 69%; mp:128-130^{0}C; IR (KBr): υ_{max} 2928, 1741, 1651, 1597, 1568, 1506, 1463, 1426, 1383, 1354, 1322, 1216, 1146, 1082, 1038, 996, 915, 877, 823, 798, 755, 703, 683, 649, 617cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 8.05-8.01 (m, 3H), 7.92 (d, 1H, *J* = 7.2 Hz), 7.75 (d, 1H, *J* = 7.8 Hz), 7.65 (d, 1H, *J* = 6.0 Hz), 7.55 (d, 1H, *J* = 6.0 Hz), 7.45-7.41 (m, 5H), 7.20 (d, 1H, *J* = 7.2Hz), 5.25 (s, 2H), 3.98 (s, 3H); ESI-MS: m/z (rel.abund. %): 462.9 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(3-(trifluoromethyl)phenyl)prop-2-en-1-one (3i)
Yellow solid ;Yield: 720%; mp:121-126^{0}C; IR (KBr): υ_{max} 2935, 1742, 1653, 1595, 1571, 1517, 1461, 1432, 1385, 1334, 1281, 1262, 1198, 1164, 1130, 1097, 1074, 1036, 998, 919, 895, 874, 826, 790, 740, 688, 654 cm^{-1}; ^{1} H NMR: (400MHz, DMSO-d_6): δ 8.32 (d, 1H, *J* = 6.2 Hz), 8.14 (d, 1H, *J* = 8.8 Hz), 8.22 (d, 1H, *J* = 6.4 Hz), 7.97 (d, 1H, *J* = 6.4 Hz), 7.98-7.95 (m, 2H), 7.70-7.68 (m, 1H), 7.64 (d, 1H, *J* = 6.0 Hz), 7.56 (d, 1H, *J* = 6.0 Hz), 7.48-7.46 (m, 3H), 7.20 (d, 2H, *J* = 7.2 Hz), 5.25 (s, 2H), 3.98 (s, 3H); ESI- MS: m/z (rel.abund. %): 447.9 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(2-(trifluoromethyl)phenyl)prop-2-en-1-one (3j)
Light orange solid ;Yield: 72%; mp:112-114^{0}C; IR (KBr): υ_{max} 2923, 1740, 1663, 1609, 1578, 1516, 1485, 1451, 1387, 1346, 1312, 1278, 1207, 1187, 1157, 1119, 1027, 969, 895, 873, 842, 813, 781, 761, 681, 641cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 8.15 (d, 1H, *J* = 16.4 Hz), 7.84 (d, 1H, *J* = 6.8 Hz), 7.78 (d, *J* = 6.8 Hz), 7.70-7.60 (m, 3H), 7.50-7.30 (m, 6H), 6.98 (d, 1H, *J* = 5.4 Hz), 5.25 (s, 2H), 3.98 (s, 3H); ESI-MS: m/z (rel.abund. %): 447.0 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-bromophenyl)prop-2-en-1-one (3k)
Light brown solid ;Yield: 78%; mp:140-144^{0}C; IR (KBr): υ_{max} 2937, 1740, 1659, 1582, 1512, 1485, 1419, 1378, 1322, 1257, 1198, 1150, 1100, 1074, 1026, 990, 919, 874, 798, 760, 699, 681, 656, 629 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 8.1 (d, 1H, *J* =10.6 Hz), 7.91 (d, 1H, *J* = 6.4 Hz), 7.84 (d, 2H, *J* = 7.4 Hz), 7.64-7.12 (m, 4H), 7.56 (m, 1H), 7.44 (m, 3H), 7.20 (d, 2H, *J* = 6.6 Hz), 5.20 (s, 2H), 4.0 (s, 3H); ESI-MS: m/z (rel.abund. %): 458.9 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(benzofuran-2-yl)prop-2-en-1-one (3l)
Yellow solid ; Yield: 70%; m.p. 134-136 ^{o}C; IR (KBr): υ_{max} 2942, 1741, 1652, 1593, 1569, 1543, 1514, 1450, 1423, 1383, 1349, 1311, 1271, 1234, 1147, 1124, 1026, 998, 967, 947, 908, 876, 842, 798, 777, 736, 707, 686, 644 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 7.72-7.64 (m, 3H), 7.68 (d, 1H, *J* =19.8 Hz), 7.52 (d, 1H, *J* =19.66 Hz), 7.46 (s, 1H), 7.42-7.38 (m, 4H), 7.26 (s, 2H), 7.02 (s, 1H), 6.95 (d, 1H, *J* = 10.2 Hz), 5.20 (s, 2H), 4.00 (s, 3H); ESI-MS: m/z (rel.abund. %): 449.8 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(pyridin-3-yl)prop-2-en-1-one (3m)
Off white solid; Yield: 76%; m.p. 124-126 ^{o}C; IR (KBr): υ_{max} 3463, 3024, 2970, 2853, 1741, 1660, 1579, 1510, 1470, 1418, 1372, 1310, 1260, 1231, 1166, 1142, 1013, 916, 872, 810, 785, 764, 696, 629 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 8.60 (s, 1H), 8.62 (s, 1H), 7.92 (d, 1H, *J* =10.8 Hz), 7.75 (d, 1H, *J* = 19.8 Hz), 7.67-7.58 (m, 3H), 7.45 (s, 1H), 7.38-7.28 (m, 4H), 6.95 (d, 1H, *J* =10.8 Hz), 5.20 (s, 2H), 4.00 (s, 3H); ESI-MS: m/z (rel.abund. %): 380.1 (M^+, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-fluorophenyl)prop-2-en-1-one (3n)
Yellow solid ;Yield: 81%; m.p. 104-106 ^{o}C; IR (KBr): υ_{max} 3075, 2992, 2831, 2607, 1740, 1649, 1593, 1568, 1508, 1462, 1424, 1378, 1325, 1282, 1263, 1233, 1145, 1094, 1034, 1003, 917, 874, 826, 801, 784, 735, 702, 682, 647cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 7.74 (d, 1H, *J* = 20.2 Hz), 7.64-7.59 (m, 4H), 7.45 (t, 2H, *J* =10.0 Hz), 7.31-7.26 (m, 3H), 7.10 (t, 2H, *J* = 11.6 Hz), 6.92 (d, 1H, *J* = 10.8 Hz), 5.20 (s, 2H), 4.00 (s, 3H); ESI-MS: m/z (rel.abund. %): 397.1 (M^{+}, 100).

(E)-1-(4-(3-chlorobenzyloxy)-3-methoxyphenyl)-3-(4-chlorophenyl)prop-2-en-1-one (3o)
Pale yellow solid ;Yield: 70%; m.p. 123-126 ^{o}C; IR (KBr): υ_{max} 3075, 3003, 2969, 2831, 2606, 1741, 1648, 1567, 1517, 1487, 1461, 1425, 1373, 1323, 1279, 1233, 1146, 1090, 1037, 998, 916, 873, 816, 797, 764, 703, 683, 640 cm^{-1}; ^{1}H NMR: (400MHz, DMSO-d_6): δ 7.72 (d, 1H, *J* = 20.4 Hz), 7.64-7.47 (m, 6H), 7.40 (d, 2H, *J* =10.2 Hz), 7.34-7.30 (m, 3H), 6.92 (d, 1H, *J* = 11.2 Hz), 5.20 (s, 2H), 4.00 (s, 3H); ESI- MS: m/z (rel.abund. %): 413.0 (M^{+}, 100).

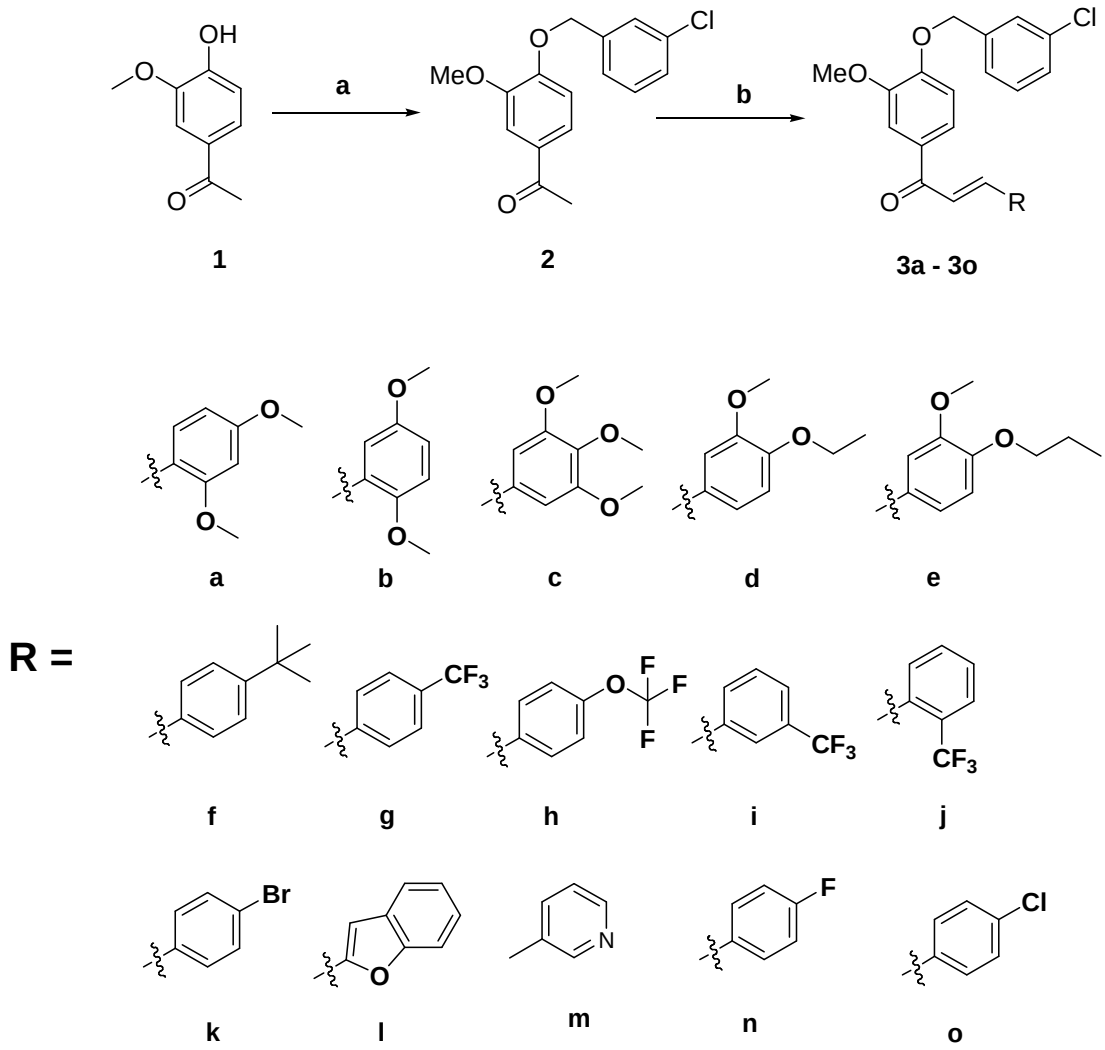
Biological assays
Antimicrobial test
The antibacterial activity of all the synthesized compounds (**3a-3o**) were screened against different Gram-positive (*Staphylococcus aureus and Streptococcus pyogenes)* and Gram-negative (*Escherichia coli* and *Pseudomonas aeruginosa*) organisms by measuring zone of inhibition. The antibacterial activity was performed by Agar diffusion method [19-20] at the concentration level of 50µg/ml. Ampicillin was used as standard drug at a concentration of 50µg/ml. Nutrient agar was used as culture media and DMSO was used as solvent control. The results of the antibacterial activity are shown in **Table 1**.

RESULTS AND DISCUSSION

The synthesis of fifteen new chalcone derivatives derivatives **3a-3o** is outlined in **Scheme 1**. Claisen schmidt condensation of apocynin with various benzaldehydes (**a –o**) was carried in presence of sodium hydroxide in methanol at room temperature for 2 h – 7 h to afford chalcone derivatives **3a-3o** in 78-98%. All the newly synthesized chalcone derivatives **3a-3o** was characterized by ^{1} H NMR, IR and Mass spectral data. In general the IR spectral data of all the chalcone derivatives **3a-3o** indicated the presence of distinctive functional groups such as –OH, –C=O, -CH=CH str in the range 3445-3290, 1700-1640 and 1644-1618, 1610-1590 cm^{-1}. The mass spectra of compounds showed (M+1) peaks, is in agreement with their molecular formula. As a representative example, the ^{1} H NMR spectrum of compound **2** indicated the following signals: the singlets at 5.20 ppm, 3.98 ppm and 2.58 ppm and at 1.60 ppm indicated the presence of a –O**CH$_2$**, -O**CH$_3$** and –**CH$_3$** respectively. All the other aromatic protons were observed at expected regions. The ^{1}H NMR data for the chalcone derivatives **3a – 3o** were also is in agreement with the assigned structures

Antimicrobial activities
Antibacterial evaluation data (Zone of inhibition) of the synthesized chalcone derivatives **3a–3o** is presented in **Table 1**. It is observed that most of the chalcone derivatives **3a-3o** showed antibacterial activity, exceptional being compound **3k** and **3o**. Compounds **3g, 3h, 3i, 3j, 3m, 3n** and **3l** exhibited excellent activity and compounds **3d, 3e, 3f** displayed good activity while the compounds **3a, 3b** showed moderate activity when tested against all the bacterial strains *Gram positive* and *Gram negative* bacteria. Furthermore it is observed that compound **3c** displayed equipotent activity, (zone of inhibition similar to the standard drug ampicillin) when tested against the bacterial strains. In general it is worth noting that compounds having fluorine moiety in the scaffold exhibited excellent activity while the compounds having alkoxy substituent showed good to moderate activity, therefore it can be concluded that a further structural activity studies is needed to achieve a promising ant-bacterial drug candidate.

Scheme 1:



Scheme 1. Synthesis of Chalcone derivatives 3a – 3o

Experimental Conditions: *a) 3-chloro-benzyl chloride, K_2CO_3, DMF, 70 ^oC, 1.0 h; b) Benzaldehydes (**a-o**), NaOH, methanol, 6 h.*

Table-1 Results of Antibacterial Activity of Compounds 3a-3o (Concentration Used 50 µg/mL of DMSO)

Table I-Antimicrobial activity of the synthesized compounds

Compd	Conc (µg/mL) in DMSO	Zone of inhibition in mm Antibacterial activity E.coli	P.aeruginosa	S.aureus	S.pyogenes
3a	50	11	10	10	11
3b	50	10	9	9	11
3c	50	16	15	14	16
3d	50	15	12	13	12
3e	50	15	13	11	14
3f	50	14	14	12	13
3g	50	18	16	16	17
3h	50	18	17	15	17
3i	50	17	17	16	18
3j	50	17	16	15	17
3k	50	--	--	--	--
3l	50	18	18	17	18
3m	50	18	17	16	17
3n	50	17	16	17	18
3o	50	--	--	--	--
SD *	50	16	15	14	16

SD: Standard drug: Ampicillin (50 µg/mL of DMSO);* "—" : in active

CONCLUSION

In conclusion, the newly synthesized compounds were characterized and tested for their prospective antibacterial activities at the concentrations 50 µg/mL with reference to the standard antibacterial drug Ampicillin. It is observed from the **Table 1** that the compounds **3g, 3h, 3i, 3j, 3m, 3n** and **3l** exhibited excellent activity and remaining all compounds displayed good activity or moderate activity. However, this is a very hopeful preliminary study and further evaluation is needed to use them for clinical use.

REFERENCES

[1] B.P. Bandgar, S. S. Gawande, R. G. Bodade, J. V. Totre, C. N. Khobragade, *Bioorg. Med. Chem.*, **2010**, 18, 1364–1370.
[2] Z. Nowakowska, *Eur.J. Med. Chem.*, **2007**, 42, 125 – 137.
[3] D. Kumar, N. M. Kumar, K. Akamatsu, E Kusaka, H. Harada, T Ito, *Bioorg.Med.Chem.Lett.*, **2010**, 20, 3916-3919.
[4] C. Julia, B.B. Jonathan, L.F. Bernard, W. G. Robert, A.M. Jorgen, P. Dharam, J.H. Andrew, *Bioorg. Med. Chem. Lett.*, **2008**, 18, 2055-2061.
[5] A.Namrata, S. Priyanka, S. Anindra, T. Sameer, S. Vandana, K.S. Diwakar, K. Kishore, B.N.S, Srivastava, T. Rama Pati, *Bioorg.Med.Chem.*, **2012**, 17, 5150-5163.
[6] X. Wu, P. Wilairat, M.L. Go, *Bioorg. Med. Chem. Lett.*, **2002**, 12, 2299-2302.
[7] J.H. Wu, X.H. Wang, Y.H. Yi, K.H. Lee, *Bioorg. Med. Chem.Lett.*, **2003**, 13, 1813-1815.
[8] J. Kapil, F.S. Veronika, Michael Wiese, *Bioorg. Med. Chem.*, **2012**, 20, 346-355.
[9] D. Christine, W. Malin, F. Maria, F. Annika, D. Kristian, A.A.W. Erik, G. Joachim, G. Morten, L. Kristina, *Bioorg. Med. Chem.*, **2011**, 19, 2659-2665.
[10] N.H. Nem, Y. Kim, Y.J. You, D.H. Hong, H.M. Kim, B.Z. Ahn, *Eur. J. Med.Chem.*, **2003**, 38, 179-187.
[11] B.P. Bandgar, S.A. Patil, B.L. Korbad, S.H. Nile, C.N. Khobragade, *Eur. J. Med. Chem*, **2010**, 45, 2629–2633.
[12] R.H. Hans, E.M. Guantai, C. Lategan, P.J. Smith, B. Wan, S.G. Franzblau, J. Gut, P.J. Rosenthal, K. Chibale, *Bioorg. Med. Chem. Lett.*, **2010**, 20, 942-944.
[13] D.T. Chu, J.J. Plattner, V. Katz, *J. Med. Chem*, **1996**, 39, 3853-3874.
[14] V. Beovic, *Int. J. Food Microbiol.*, **2006**, 112, 280-287.
[15] R. Finch, P.A. Hunter, *J. Antimicrob. Chemother.*, **2006**, 58, 13-22.
[16] R.B. Silverman, *Organic Chemistry of Drug Design and Drug Action*, Academic Press, San Diego, CA, USA, **1992**.
[17] L.A. Thompson, J.A. Ellman, *Chem. Rev.*, **1996**, 96**,** 555–600.
[18] Xiaoyu Lu, Wan Sainan, Jie, Jiang, *Eur.J.Med.Chem.*, **2011**, 45, 2691-2698.
[19] Subhakara Reddy Nallamilli, V. Ravi Kumar, V. Hima Bindu, B. Ram, A. Srinivas Rao, *Letters in Drug Design & Discovery*, **2011**, 8, 972-979.
[20] Daniela Batovska, Stoyan Parushev, Bistra Stamboliyska, Iva Tsvetkova, Mariana Ninova, Hristo Najdenski, *Eur.J.Med.Chem.*, **2009**, 44, 2211-2218.