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RESEARCH ARTICLE

CLICK SYNTHESIS AND ANTI-BACTRIAL ACTIVIY OF NOVEL TRIS-CHALCONES

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ABSTRACT

Click synthesize of several novel *tris*-chalcone with 2,4,6-trichloro-1,3,5-triazine core from reaction of premade *tris*-aldhydes or *tris*-acetophenones with aromatic aldehydes or acetophenones under basic conditions in MeOH in the presence of NaOH are reported. All of the synthesized products were characterized by FT-IR, ^{1}H, $^{13}CNMR$ and elemental analysis. The antibacterial activities of *tris*-chalcones were estimated versus Staphylococcus aureus, Micrococcus luteus, Escherichia coli, Pseudomonas aeruginosa and Bacillus subtilis. Some compounds display promising activities.

INTRODUCTION

Click chemistry refers to a group of reactions that are simple to achieve, easy to purify, high yields, regiospecific, wide in scope, versatile, with safe byproducts that can be removed by nonchromatographic methods. In addition clarifies a set of powerful, highly reliable, and selective reactions for the rapid synthesis of valuable new compounds and combinatorial libraries via heteroatom linkags (Kolb *et al.,* 2001).Chalcones are a class of compounds with various substitution patterns on the two aromatic rings of 1,3-diphenyl-2-propen-1-one (Kachroo*et al.,* 2014).This structure constitutes an important group of natural products belonging to the flavonoid family, which have been reported to possess a high wide spectrum of biological activities (Trivedi *et al.,* 2008 and Ceylan *et al.,* 2013) including anti-mutagenic (Nowakowska*et al.,* 2007), anti-inflammatory (Nassar*et al.,* 2011),anti-fungal (Kumar*et al.,* 1993), anti-tumour (Syam*et al.,* 2012),antibacterial (Tran *et al.,* 2012),insect anti-feedant (Go *et al.,* 2005),anticancer (Jain*et al.,* 2014), anti-oxidant (Aichaoui *et al.,* 2009),and even recognized as inhibitor of hepatitis C virus (HCV) etc (Solankee*et al.,* 2015 and Mathewa *et al.,* 2014).Some of chalcones derivatives have been found to inhibit several important enzymes in cellular systems, such as xanthine oxidase (Khobragade*et al.,* 2008), and protein tyrosine kinase (Sogawa *et al.,* 1994. Nerya *et al.,* 2004). Biological activity of chalcone is due to presence of reactive α,β-unsaturated keto group. There are chalcones that reported as anti-hyperglycemic (Narender *et al.,* 2007), and antimalarial effect (Ugwu*et al.,* 2015).

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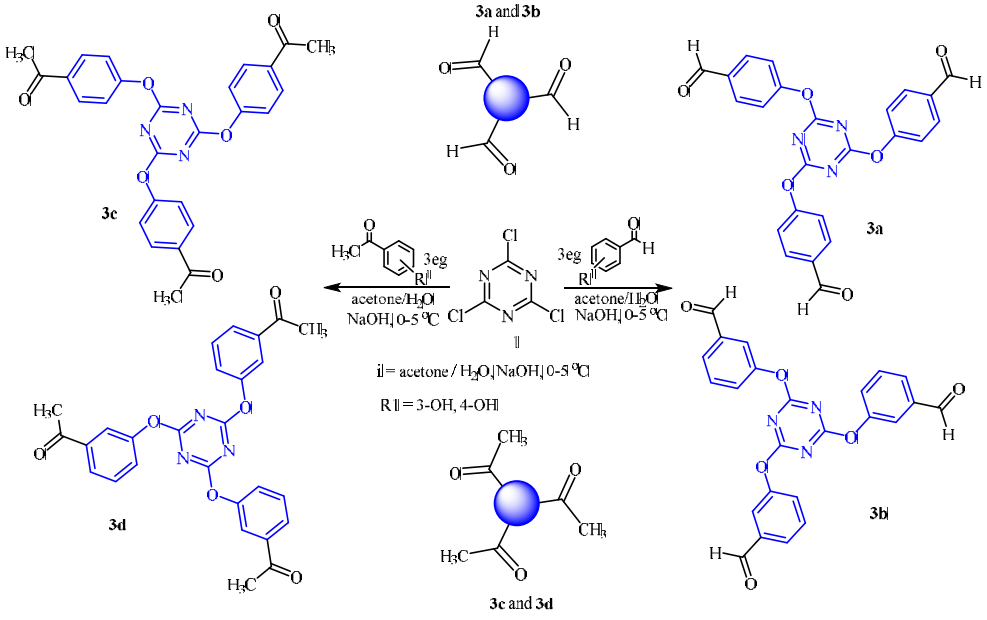
Chalcones are also key precursors in the synthesis of many biologically important heterocycles such as pyrazolines (Awasthi *et al.,* 2009),benzothiazepine (Prakash *et al.,* 2005), flavones (Bohn *et al.,* 1998),and 1,4-diketones (Raghavan*et al.,* 2002).The simple structure and effortless synthesis of chalcones clarify the substantial interest of chemist in this particular class of compounds. Various methods for the syntheses of chalcones have been discovered, including Suzuki coupling reaction (Sarda *et al.,* 2009 and Edrarir *et al.,* 2003),Claisen-Schmidt condensation (Kumar *et al.,* 2013 and Chen *et al.,* 2013),Friedel-Craft acylation (Jayapal *et al.,* 2010), Aldol condensation (Asiri *et al.,* 2014), and also green chemistry methods via microwave irradiation (Ameta *et al.,* 2011).Although, in recent years, a few *tris*-compounds have been prepared and used in the industrial, medical, as a versatile precursors for synthesis of other novel compound and even as active catalysts (Shaaban 2013, Chabre *et al.,* 2014, Danneberg *et al.,* 2015, Divia *et al.,* 2013 and Chouai *et al.,* 2009).However, as far we look in the literature there are only one synthetic related to synthesis of a *tris*-chalcones have been reports (Khan *et al.,* 2014). In continuation to our previous interest related to synthesis of photochromic1,3-diazabicyclo[3.1.0]hex-3-enes,photochromic with tripod coreand heterocyclic compounds (Mohammadi Zeydi *et al.,* 2016, Mahmoodi *et al.,* 2016, 2014, 2013, 2012, 2010, 2007, 2004 and Sharifzadeh*et al.,*2013). Here, several new *tris*-chalcones by using an efficient method including high yields, with inoffensive by-products that can be removed by nonchromatographic methods, readily available starting materials and reagents, reproducible, economic and time consuming, simple reaction conditions (insensitive to oxygen and water), use of solvent that easily removed, and simple product isolation, with stable product under physiological

conditions have been reported. It is notable that synthesis of *tris*-aldehyde **3a**, **3b** via different route previously was reported (Sarda *et al.,* 2009).

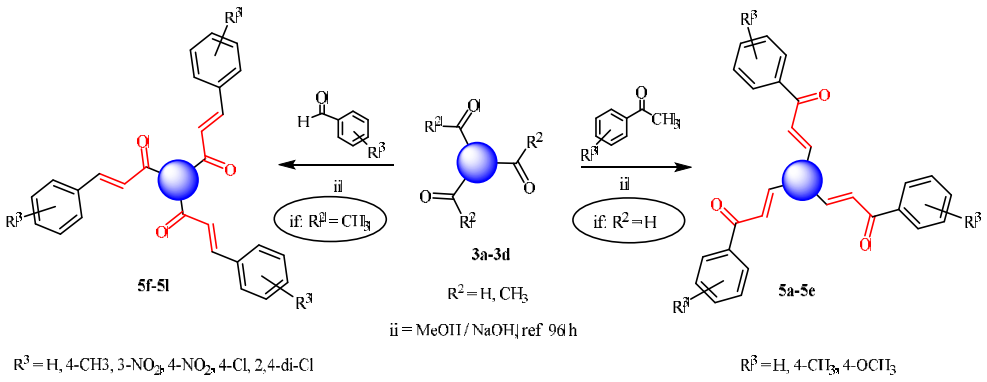
RESULTS AND DISCUSSION

The synthesized aldhyde-tripode-chalcones (ald-trip-chalc) or actophenone-tripode-chalcones (acto-trips-chalc) (**5a-l**) were performed according to scheme 1 and 2. In the initial step, tripod aldehydes (**3a-b**) and tripod acetophenone (**3c-d**) were synthesized by symmetrical style nucleophilic aromatic substitution (Ar-SN) of cyanuric chloride **1** with 3 or 4-hydroxybenzaldehyde or 3 or 4-hydroxyacetophenone (**2a-d**) in the presence of NaOH in acetone/water at 0-5 ºC. *Tris*-chalcones (**5a-l**) were synthesized by reacting of either ald-trips (**3a-b**) or acto-trips (**3c-d**) with appropriate substitute benzaldehydes or acetophenone in the presence of NaOH in MeOH.Try to do this reaction in EtOH and NaOH due to insolubility of starting materials the reaction was failed. Detailed studies of this process confirmed that the first aldol-type condensation reaction was completed within 30 min in MeOH used as solvent. In contrast, formation of the second and third chalcones was far more sluggish. For this reason the reaction was allowed to be completed in 4 days at the reflux condition.

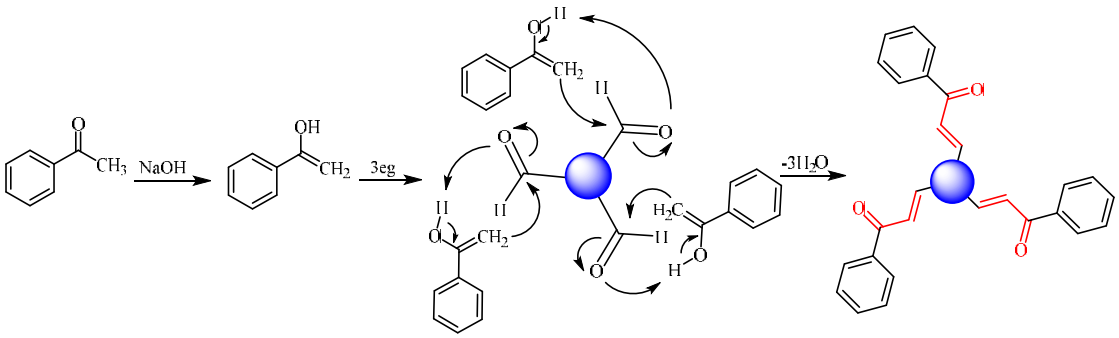
The products (**5a-l**) precipitated from the reaction mixture in a relatively pure state with no undesirable side reactions and were easily recrystallized in EtOH, with 86-99% yields.For all reactions, by addition of starting material, initially the color was pale yellow, but at the end of reaction the color was changed to the dark yellow it is a good indication of reaction performance. The purity of the compounds was determined by TLC and for two samples e.g. **3a** and **3b** the melting point was identified by reported one[43, 49]. Spectral data (IR, ^{1}H and ^{13}C NMR) of all the newly synthesized compounds were in full agreement with the proposed structures. The infrared spectra of tripod chalcones show usually a peak near 1650-1700 cm^{-1}, characteristic of an α,β-unsaturated carbonyl group. The α-H and β-H of chalcones resonate at δ 7.06-7.92 and 7.79-8.12 as two doublets (J = 15.6 Hz) in the ^{1}H NMR spectra. The proposed mechanism involved the formation of chalcone **5a** via a relevant tripod **3a** depict in scheme 3.The in vitro antibacterial activities of *tris*-chalcones **5a-5l**were assessed against three representative Gram-positive bacteria viz. Staphylococcus aureus (MTCC 96), Bacillus subtilis (MTCC 441), Micrococcus luteus (ATCC 9341), and two Gram-negative bacteria viz. Pseudomonas aeruginosa (MTCC 741) and Escherichia coli (E. coli) ATCC 25922. Penicillin was used as a positive control and DMSO as a negative control.



Scheme 1. Preparation of tripod 3a-d from cyanuricchloride



Scheme 1.Preparation of tripode-chalcones 5a-l



Scheme 1.Mechanism prepared of trischalcone 5a

Table 1.Antimicrobial activity of Compounds 5a-5l.

Entry	Compound	Antimicrobial activity (zone of inhibition in mm)				
		Gram-positive			Gram-negative	
		S. aureus	*B. subtilis*	*M. luteus*	*E. coli*	*P. aeruginosa*
1	5a	-	5	5	-	-
2	5b	5	9	8	-	-
3	5c	-	6	5	-	-
4	5d	7	11	12	-	-
5	5e	6	7	8	-	-
6	5f	-	7	7	6	-
7	5g	7	10	11	-	-
8	5h	-	7	5	-	-
9	5i	-	7	7	6	7
10	5j	-	7	8	-	-
11	5k	10	7	7	-	-
12	5l	-	8	7	-	-
13	DMSO	-	-	-	-	-
14	Penicillin	48	33	49	21	47

According to table 1 all *tris*-chalcones were inactive against Escherichia coli. Compounds **5b**, **5d**, **5e** and **5k** showed antibacterial activity against Staphylococcus aureus and compounds **5k** had good antibacterial activity. Compounds **5a-l** had good antibacterial activity against Bacillus subtilisand Micrococcus luteus, also compound **5d** and **5g** had remarkable activity against Micrococcus luteus. Compounds **5f** and **5i** showed good antibacterial activity against Escherichia coli.

Experimental Section

General procedure for the preparation of tripode derivatives (**3a-3d**).

Compounds 2a-d (3 mmol), NaOH (0.16 g, 4 mmol) and 20 mL distilled water were added to a suspension of cyanuric chloride (0.18 g, 1 mmol) in a dry acetone (25 mL) at 0-5 ºC. The mixture was stirred at this temperature for 4h, after completion of the reaction; the solid was removed by filtration and washed twice with distilled water. All the synthesized compounds were recrystallized from EtOAc (Scheme 1).

General procedure for the preparation of chalcone derivatives (**5a-l**)

Tripod derivatives 3a-d (1mmol) with substituted benzaldehydes or acetophenones (3mmol) and NaOH (0.16 g, 4 mmol) were dissolved in MeOH (10 mL). The reaction mixture was refluxed for four days, the progress of reaction was monitored by TLC (*n*-hexane: EtOAc 3:1). After completion of the reaction, the reaction mixture was poured into the crushed ice and neutralize with HCl.

Finally, the product was filtered, dried and purified by recrystallization from EtOH. In the similar procedure, other tripod chalcones (**5a-l**) were prepared by this method (Scheme 2). All of the synthesized tripod chalcones were characterized by IR, ^{1}H, ^{13}C NMR spectroscopy and elemental analysis.

*4,4',4''-((1,3,5-triazine-2,4,6-triyl)tris (oxy))tribenzaldehyde (**3a**)*

Yield 98%. White powder. M.p. 180-181 °C. IR: 3085, 1700, 1585, 1574, 1292. ^{1}HNMR: 7.34 (*d*, 2H, *J* = 8.4, ArH); 7.95 (*d*, 2H, *J* = 8.4, ArH); 10.02 (*s*, 1H, CHO).^{13}CNMR: 122.2, 131.3, 134.4, 155.6, 173.2, 190.6. – HRMS ((+)-ESI): *m/z* = 441.0965 (calcd. 441.0961 for $C_{24}H_{15}N_3O_6$): Anal. Calcd.for: C, 65.31; H, 3.43; N, 9.52. Found: C, 65.28; H, 3.45; N, 9.55.

*3,3',3''-((1,3,5-triazine-2,4,6-triyl)tris(oxy)) tribenzaldehyde (**3b**)*

Yield 96%.Cream powder. M.p. 232-234 °C. IR: 3090, 1698, 1580, 1571, 1210.^{1}HNMR: 7.34 (*d*, 1H *J* = 8.4, ArH); 7.48 (*d*, 1H, *J* = 8.0, ArH); 7.79 (*s*, 1H, ArH); 7.96 (*d*, 1H, *J* = 8.0, ArH); 10.13 (*s*, 1H, CHO). ^{13}CNMR: 122.1, 128.0, 128.1, 131.0, 138.2, 152.2, 173.3, 192.6. – HRMS ((+)-ESI): *m/z* = 441.0960 (calcd. 441.0961 for $C_{24}H_{15}N_3O_6$): Anal. Calcd. for: C, 65.31; H, 3.43; N, 9.52. Found: C, 65.33; H, 3.44; N, 9.50.

*1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy)) tris(benzene-1,4-diyl))tris(ethan-1-one) (**3c**)*

Yield 98%. White powder. M.p. 175-177 °C. IR: 3065, 1680, 1572, 1520, 1210. ^{1}HNMR: 2.62 (*s*, 3H, CH_3); 7.25 (*d*, 2H, *J* =

8.8, ArH); 8.01 (*d*, 2H, *J* = 8.8, ArH). ^{13}CNMR: 26.6, 121.6, 130.0, 135.1, 154.9, 173.3, 196.6. – HRMS ((+)-ESI): m/z = 483.1433 (calcd. 483.1430 for $C_{27}H_{21}N_3O_6$): Anal. Calcd. for: C, 67.08; H, 4.38; N, 8.69. Found: C, 67.05; H, 4.41; N, 8.66.

1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy)) tris(benzene-1,3-diyl))tris(ethan-1-one) ***(3d)***

Yield 97%. White powder. M.p. 186-187 °C. IR: 3010, 1684, 1595, 1575, 1197. ^{1}HNMR: 2.59 (*s*, 3H, CH_3); 7.34 (*d*, 1H, *J* = 8.4, ArH); 7.47 (*t*, 1H, *J* = 8.0, ArH); 7.71 (*s*, 1H, ArH); 7.82 (*d*, 1H, *J* = 7.6, ArH). ^{13}CNMR: 26.6, 121.2, 126.1, 126.2, 129.8, 138.5, 151.6, 173.5, 196.7. – HRMS ((+)-ESI): *m/z* = 483.1432 (calcd. 483.1430 for $C_{27}H_{21}N_3O_6$): Anal. Calcd. for: C, 67.08; H, 4.38; N, 8.69. Found: C, 67.05; H, 4.36; N, 8.64.

(2E,2'E,2''E)-3,3',3''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(1-phenylprop -2-en-1-one) ***(5a)***

Yield 86%. Yellow Crystal. M.p. 175-178 °C. IR: 3134, 1645, 1582, 1560, 1443, 1280.^{1}HNMR: 6.90 (*d*, 1H, *J* = 8.8, CH=CH-CO); 6.97 (*d*, 2H, *J* = 8.4, ArH); 7.31-7.35 (*m*, 2H, ArH); 7.71 (*d*, 1H, *J* = 8.8, ArH); 7.39 (*d*, 2H, *J* = 8.8, Ar-H); 8.02 (*d*, 2H, *J* = 8.4, Ar-H); 8.12 (*d*, 1H, *J* = 15.6, CH=CH-CO).^{13}CNMR: 115.7, 125.2, 128.6, 129.3, 129.7, 130.4, 131.3, 135.5, 135.5, 136.2, 162.6, 187.0. – HRMS ((+)-ESI): *m/z* = 747.2365 (calcd. 747.2369 for $C_{48}H_{33}N_3O_6$): Anal.Calcd. for: C, 77.10; H, 4.45; N, 5.62. Found: C, 77.14; H, 4.48; N, 5.60.

(2E,2'E,2''E)-3,3',3''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(1-(4-methoxyphenyl)prop-2-en-1-one) ***(5b)***

Yield 89%. Yellow Crystal. M.p. 179-181 °C. IR: 3150, 1640, 1600, 1576, 1540, 1222. ^{1}HNMR: 3.85 (*s*, 3H, OCH_3); 6.85 (*d*, 2H, *J* = 8.8, Ar-H); 7.09 (*d*, 2H, *J* = 8.8, Ar-H); 7.65 (*d*, 1H, *J* = 15.2, CH=CH-CO); 7.73-7.77 (*m*, 3H, CH=CH-CO, Ar-H); 8.15 (*d*, 2H, *J* = 8.8, Ar-H). ^{13}CNMR: 56.0, 114.4, 116.2, 118.9, 126.4, 131.1, 131.2, 131.3, 144.1, 160.3, 163.4, 187.7. – HRMS ((+)-ESI): *m/z* = 837.2682 (calcd. 837.2686 for $C_{51}H_{39}N_3O_9$): Anal. Calcd. for: C, 73.11; H, 4.69; N, 5.02. Found: C, 73.08; H, 4.65; N, 5.04.

*(2E,2'E,2''E)-3,3',3''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,3-diyl))tris(1-phenylprop-2-en-1-one)(****5c****)*

Yield 90%. Yellow Crystal. M.p. 159-160 °C. IR: 3015, 1642, 1598, 1570, 1482, 1265. ^{1}HNMR: 6.94 (*m*, 1H, CH=CH-CO); 7.17 (*s*, 1H, Ar-H); 7.26 (*d*, 1H, *J* = 7.6, Ar-H); 7.33 (*t*, 1H, *J* = 7.6, Ar-H); 7.48-7.58 (*m*, 3H, Ar-H); 7.63 (*t*, 1H, *J* = 7.2, Ar-H); 7.79 (*d*, 1H, *J* = 15.6, CH=CH-CO); 8.05 (*d*, 2H, *J* = 7.2, Ar-H). ^{13}CNMR:115.7, 118.2, 118.3, 120.3, 122.3, 128.9, 129.2, 130.3, 133.6, 136.4, 138.0, 138.0, 144.7, 158.0, 189.7. – HRMS ((+)-ESI): *m/z* = 747.2366 (calcd. 747.2369 for $C_{48}H_{33}N_3O_6$): Anal.Calcd.for: C, 77.10; H, 4.45; N, 5.62. Found: C, 77.06; H, 4.43; N, 5.64.

(2E,2'E,2''E)-3,3',3''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,3-diyl))tris(1-(p-tolyl)prop-2-en-1-one) ***(5d)***

Yield 92%. Yellow Crystal. M.p. 140-141°C. IR: 3120, 1644, 1599, 1582, 1538, 1261. ^{1}HNMR: 2.46 (*s*, 3H, CH_3); 7.23-7.28 (*m*, 2H, Ar-H, CH=CH-CO); 7.29-7.34 (*m*, 3H, Ar-H, CH=CH-CO); 7.54 (*d*, 1H, *J* = 7.2, Ar-H); 7.83 (*d*, 1H, *J* = 7.2, Ar-H); 7.92 (*d*, 2H, *J* = 8.4, Ar-H).^{13}CNMR:21.6, 115.6, 118.1, 120.3, 122.3, 129.1, 129.8, 130.3, 135.5, 136.4, 144.0, 144.3, 158.1, 189.1. – HRMS ((+)-ESI): *m/z* = 789.2842 (calcd. 789.2839 for $C_{51}H_{39}N_3O_6$): Anal. Calcd. for: C, 77.55; H, 4.98; N, 5.32. Found: C, 77.51; H, 4.96; N, 5.35.

(2E,2'E,2''E)-3,3',3''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,3-diyl))tris(1-(4-methoxyphenyl)prop-2-en-1-one) ***(5e)***

Yield 91%. Yellow Crystal. M.p. 166-168 °C. IR: 3115, 1643, 1600, 1568, 1549, 1257. ^{1}HNMR: 3.09 (*s*, 3H, OCH_3); 7.08 (*d*, 2H, *J* = 8.0, CH=CH-CO); 7.39 (*t*, 1H, *J* = 7.6, Ar-H); 7.48 (*s*, 1H, Ar-H); 7.53 (*d*, 2H, *J* = 8.4, Ar-H); 7.66 (*d*, 1H, *J* = 7.6, Ar-H); 7.72 (*d*, 1H, *J* = 15.6, CH=CH-CO); 7.89-7.98 (*m*, 3H, Ar-H). ^{13}CNMR:56.0, 114.4, 115.6, 118.0, 120.2, 122.3, 130.3, 130.9, 131.3, 136.5, 143.8, 135.5, 158.1, 163.6, 187.8. – HRMS ((+)-ESI): *m/z* = 837.2689 (calcd. 837.2686 for $C_{51}H_{39}N_3O_9$): Anal.Calcd.for: C, 73.11; H, 4.69; N, 5.02. Found: C, 73.14; H, 4.64; N, 5.06.

(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(3-phenylprop-2-en-1-one) ***(5f)***

Yield: 89%. Yellow Crystal. M.p. 132-135°C. IR: 3138, 1643, 1586, 1565, 1444, 1070. ^{1}HNMR: 6.90 (*d*, 1H, *J* = 8.8, CH=CH-CO); 6.97 (*d*, 2H, *J* = 8.4, Ar-H); 7.31-7.35 (*m*, 2H, Ar-H); 7.71 (*d*, 1H, *J* = 8.8, Ar-H); 7.39 (*d*, 2H, *J* = 8.8, Ar-H); 8.02 (*d*, 2H, *J* = 8.4, Ar-H); 8.12 (*d*, 1H, *J* = 15.6, CH=CH-CO). ^{13}CNMR:115.7, 125.2, 128.6, 129.3, 129.7, 130.3, 131.8, 135.5, 135.5, 136.2, 162.6, 187.0. – HRMS ((+)-ESI): *m/z* = 747.2366 (calcd. 747.2369 for $C_{48}H_{33}N_3O_6$): Anal.Calcd.for: C, 77.10; H, 4.45; N, 5.62. Found: C, 77.13; H, 4.47; N, 5.64.

(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy)tris(benzene-1,4-diyl))tris(3-(p-tolyl)prop-2-en-1-one) ***(5g)***

Yield 94%. Yellow Crystal. M.p. 193-194 °C. IR: 3111, 1643, 1600, 1570, 1510, 1220. ^{1}HNMR: 2.36 (s, 3H, CH_3); 6.91 (*d*, 2H, *J* = 8.8, Ar-H); 7.28 (*d*, 2H, *J* = 8.0, Ar-H); 7.67 (*d*,1H, *J* = 15.6, CH=CH-CO); 7.77 (*d*, 2H, *J* = 8.0, Ar-H); 7.87 (*d*, 1H, *J* = 15.6, CH=CH-CO); 8.08 (*d*, 2H, *J* = 8.8, Ar-H). ^{13}CNMR: 21.5, 115.8, 121.4, 129.2, 129.6, 129.9, 131.6, 132.6, 140.8, 143.2, 162.5, 187.5. – HRMS ((+)-ESI): *m/z* = 789.2836 (calcd. 789.2839 for $C_{51}H_{39}N_3O_6$): Anal.Calcd.for:C, 77.55; H, 4.98; N, 5.32. Found: C, 77.51; H, 4.96; N, 5.35.

(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(3-(3-nitrophenyl)prop-2-en-1-one) ***(5h)***

Yield 87%. Yellow Crystal. M.p. 232-234 °C. IR: 3127, 1643, 1602, 1584, 1540, 1520, 1340, 1223. ^{1}HNMR: 6.93 (*d*, 2H, *J* = 8.8, Ar-H); 7.72-7.81(*m*, 2H, Ar-H, CH=CH-CO); 8.13-8.17 (*m*, 3H, Ar-H, CH=CH-CO); 8.25 (*m*, 1H, Ar-H); 8.34 (*d*, 1H, *J* = 6.0, Ar-H); 8.76 (*s*, 1H, Ar-H). ^{13}CNMR: 115.8, 123.3, 124.8, 125.3, 129.3, 130.7, 131.9, 135.4, 137.3, 140.6, 148.8, 162.8, 187.4. – HRMS ((+)-ESI): *m/z* = 882.1925 (calcd. 882.1922 for $C_{48}H_{30}N_6O_{12}$): Anal. Calcd. for: C, 65.31; H, 3.43; N, 9.52. Found: C, 65.30; H, 3.46; N, 9.48.

(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(3-(4-nitrophenyl)prop-2-en-1-one) ***(5i)***

Yield 95%. Yellow Crystal. M.p.244-245 °C. IR: 3105, 1645, 1621, 1583, 1562, 1517, 1338, 1220. ^{1}HNMR: 6.93 (*d*, 2H, *J* = 8.8, Ar-H); 7.78 (*d*, 1H, *J* = 15.6, CH=CH-CO); 8.11-8.18 (*m*, 5H, Ar-H, CH=CH-CO); 8.29 (*d*, 2H, *J* = 8.8, Ar-H). ^{13}CNMR: 115.9, 124.3, 126.6, 129.2, 130.1, 131.9, 140.3, 141.8, 148.3, 162.9, 187.2. – HRMS ((+)-ESI): *m/z* = 882.1919 (calcd. 882.1922 for $C_{48}H_{30}N_6O_{12}$): Anal. Calcd. for: C, 65.31; H, 3.43; N, 9.52. Found: C, 65.34; H, 3.45; N, 9.48.

*(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(3-(4-chlorophenyl)prop-2-en-1-one)****(5j)***

Yield 90%. Yellow Crystal. M.p. 184-186 °C. IR: 3115, 1640, 1597, 1541, 1505, 1220. ^{1}HNMR: 6.91 (*d*, 2H, *J* = 8.8, Ar-H);7.52 (*d*, 2H, *J* = 8.4, Ar-H); 7.06 (*d*, 1H, *J* = 15.6, CH=CH-CO); 7.92 (*d*, 2H, *J* = 8.8, Ar-H); 7.95 (*d*, 1H, *J* = 16.0, CH=CH-CO); 8.10 (*d*, 2H, *J* = 8.8, Ar-H). ^{13}CNMR: 115.8, 123.3, 129.3, 129.5, 130.8, 131.7, 134.3, 135.2, 141.7, 162.7, 168.4. – HRMS ((+)-ESI): *m/z* = 849.1205 (calcd. 849.1200 for $C_{48}H_{30}Cl_3N_3O_6$): Anal. Calcd. for: C, 67.74; H, 3.55; N, 4.94. Found: C, 67.71; H, 3.57; N, 4.92.

(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy))tris(benzene-1,4-diyl))tris(3-(2,4-dichlorophenyl)prop-2-en-1-one) ***(5k)***

Yield 99%. Yellow Crystal. M.p. 158-159 °C. IR: 3100, 1640, 1595, 1580, 1483, 1222. ^{1}HNMR: 6.29 (*d*, 2H, *J* = 8.8, Ar-H); 7.55 (*m*, 1H, Ar-H); 7.74 (*s*, 1H, Ar-H); 7.92 (*d*, 1H, *J* = 15.6, CH=CH-CO); 8.02 (*d*, 1H, *J* = 15.6, CH=CH-CO); 8.11 (*d*, 2H, *J* = 8.8, Ar-H); 8.25 *(d*, 1H, *J* = 8.4, Ar-H).^{13}CNMR: 115.9, 125.8, 128.3, 129.2, 129.8, 130.1, 131.8, 132.0, 135.4, 135.7, 136.5, 162.9, 187.1. – HRMS ((+)-ESI): *m/z* = 953.0006 (calcd. 953.0002 for $C_{48}H_{27}Cl_6N_3O_6$): Anal. Calcd. for: C, 60.40; H, 2.85; N, 4.40. Found: C, 60.43; H, 2.83; N, 4.45.

*(2E,2'E,2''E)-1,1',1''-(((1,3,5-triazine-2,4,6-triyl)tris(oxy)tris(benzene-1,3-diyl))tris(3-(4-chlorophenyl)prop-2-en-1-one)****(5l)***

Yield 96%. Yellow Crystal. M.p. 152-153 °C. IR: 3050, 1641, 1601, 1538, 1583, 1269. ^{1}HNMR: 7.17 (*d*, 1H, *J* = 7.8, Ar-H); 7.39-7.45 (*m*, 4H, Ar-H); 7.55 (*d*,1H, *J* = 15.6, CH=CH-CO); 7.61 (*d*, 1H, *J* = 7.6, Ar-H); 7.65-7.69 (*m*, 3H, Ar-H); 7.86 (*d*, 1H, *J* = 16.0, CH=CH-CO). ^{13}CNMR: 115.1, 120.1, 120.7, 123.4, 129.2, 129.4, 130.3, 131.0, 134.1, 135.5, 139.3, 142.8, 158.0, 189.4. – HRMS ((+)-ESI): *m/z* = 849.1204 (calcd. 849.1200 for $C_{48}H_{30}N_3O_6Cl_3$): Anal.Calcd.for: C, 67.74; H, 3.55; N, 4.94. Found: C, 67.71; H, 3.57; N, 4.92.

Determination of antimicrobial activity

The antibacterial activity of compounds was measured biologically using the Agar well-diffusion method. Then Mueller–Hinton agar (Merck) plates were readied similar to manufacturers' instructions in order to compare the antibacterial activities of compounds. The sterile Mueller–Hinton agar plates were inoculated with the bacteria. 0.001 g of test samples was dissolved in 1 mL dimethyl sulfoxide to obtain a stock solution. 0.1 mL of each sample was dropped into each labeled well aseptically. The inculcated plates were then incubated for 24 h at 37 ºC. Penicillin was used as a positive control and DMSO as a negative control. After incubation time, antimicrobial activity was evaluated by measuring the zone of inhibition against the test organisms and compared with that of the standard. The results of our tests were presented as the inhibition zones, given in millimeters (mm). The experiment was carried out in repetitive and the average zone of inhibition was estimate.

Conclusions

In conclusion, we describe an efficient protocol for the synthesis of variety tripod chalcones in good yields from reaction of tripods 2a-d with aromatic aldehydes or acetophenons using NaOH in the MeOH. The synthesized compounds were characterized by TLC, melting point, IR, ^{1}H, ^{13}C NMR spectroscopy, HRMS and elemental analysis. Henceforth viewing these characteristic properties more intelligent compounds can be synthesized either as a photochromic compounds or subjected to pharmacological evaluation. The antibacterial activities of *tris*-chalcones were estimated versus Staphylococcus aureus, Micrococcus luteus, Escherichia coli, Pseudomonas aeruginosa and Bacillus subtilis.

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