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COMPREHENSIVE REVIEW ON 12-ARYL-8, 9, 10, 12-TETRAHYDROBENZO[A]XANTHENE-11-ONE DERIVATIVES AND ITS APPLICATIONS

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ABSTRACT:
In present review work, catalytic system was used as an efficient, low cost, non-toxic, availability and recyclable catalytic system for synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one derivatives *via* a one-pot three-component reaction of substituted aromatic aldehydes, 2-naphthol, and cyclic 1, 3-dicarbonyl compounds or dimedone. The method presented is a safe and eco-friendly approach for the multi-component synthesis of xanthene derivatives with many merits in comparison with other reported results including short reaction times, solvent-free conditions, excellent yields, high purity, cleaner reaction profiles, easy work up, mild reaction, economic, recyclable and environmentally benign catalyst, simple experimental procedures, no column chromatography for purification and reusability of catalyst make this method economically superior for large scale as a green protocols. The catalyst is readily recovered by simple filtration and evaporation can be recycled and reused several times with no significant loss of catalytic activity. Simple preparation of the catalyst are some advantages of the presented work. Its derivatives used as pH-sensitive fluorescent materials for visualization of biomolecules, as dyes, bactericidal, cytotoxic agents and in laser technology and having excellent biological properties such as antibacterial, anti-inflammatory activity, antiviral, antifungal so summarized consideration valuable role in industrial and pharmaceutical sectors.
The catalyst materials and products was investigated by using FT-IR, XRD, SEM, EDS, ^{1}H NMR, ^{13}C NMR and Mass as a modern advanced analytical spectral technique.

KEYWORDS: Multi-Component reactions (MCRs), Dimedone or Cyclic 1,3-dicarbonyl compounds-, β-Naphthol, Solid Acid Catalyst, Solvent-free conditions, environment friendly, Green Chemistry, Operational simplicity, One-Pot Synthesis.

INTRODUCTION:

The reaction in which at least three different reactants molecule combine to each other with the help of covalent bond to yields complex moieties which having synthetic and medicinal importance in chemistry such multicomponent reactions (MCRs) approach provide remarkable advantageous including reduce waste generation, facile automation, less steps in work up, etc. All other pathway useful in environmentally and ecofriendly point of view [i]. This route provides high atom economy and very high tendency of bond-forming-index (BFI) [ii]. Due to excellent features protocols was more attractive such as less hazardous synthesis, safe chemical design, benign solvents and auxiliaries, energy efficiency, renewable feedstocks, reduce use of derivatives, catalysis, design for degradation, real-time analysis, inherently safe chemistry all this green chemistry principle properly matched for multicomponent reactions (MCRs) protocols [iii]. Formation of multiple carbon-heteroatom bond, carbon-carbon bond, spontaneous domino or cascade reactions, cycloaddition and condensation in sequential manner so provide systematic and specific direction to synthetic organic chemistry [iv]. Numerous biologically potent heterocyclic compounds prepared which having great importance in the field of medicinal and pharmaceutical sectors [v].

Oxygen containing benzo xanthene heterocyclic derivatives having potent biological activities such as ant-malarial, anti-bacterial, anti-HIV, anti-fungal, algicidal, anti-cancer, anti-ulcer, anti-inflammatory, antioxidant and therapeutic effect on Alzheimer and diabetes disease and specific application in dyes, laser technology, photodynamic therapy, used as a antagonist for paralyzing action of Zoxazolamine and in fluorescent materials which are sensitive to pH for visualization of biomolecules [vi-vii], Present review focusing details about its synthesis by different reaction conditions including solvent-free condition, green solvents, microwave irradiation and ultrasonication pathways.

In solvent free condition provides sustainable and cleaner approaches to multicomponent reaction (MCRs) and protocols reduce to use of toxic hazardous substance or eliminate substance that are harmful to human life or environment and easily available renewable materials, non-toxic chemical substance utilized for organic synthesis so this methodology provides new opportunities to academician or researcher to develop numerous pathway for synthetic organic chemistry to develop drug molecules which having tremendous application in the field of medicine and pharmaceutical sector [viii-ix].

Solvent, solvent system's and solubilization concepts important in modern synthetic organic chemistry ideal solvent which satisfied maximum principles of green chemistry gives suitable direction for multicomponent reactions, solvent gives features recyclability, easily available, cost effective and showing effectiveness in reaction medium such effective ideal solvent including water, supercritical fluids, ionic liquids, non-toxic liquids polymers etc [x-xii].

Microwave irradiation was a promising green strategy which provides faster and more selective reaction due to homogenous heat distribution and heat can freely pass through the wall of reaction vessels, coupling directly with molecules and ions of reaction mixtures and protocols reduce time parameter for reaction with short duration completion of the reaction take place [xiii-xiv]. Ultrasonication irradiation provides the improvement of the multicomponent reaction progress due to cavitation effect and obtain higher yields. It is an environmental remediation and protection techniques in which less toxic substance, safe solvent, and reduction in energy use and reduce environmental pollution [xv-xvii]. All these ecofriendly and environmentally being protocols utilized for synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one derivatives, this oxygen containing heterocyclic compounds have great importance in medicinal and pharmaceutical chemistry, concern with

above methodologies various catalyst system used under different reaction condition pathway for synthesis benzo xanthene derivatives.

$NiFe_2O_4$@SiO_2@amino Glucose MNPs [xviii], NPs.SiO_2.H_2SO_4 [xix], TTAB [xx], Thiamine Hydrochloride (VB_1) [xxi], $ZrOCl_2$. $8H_2O$ [xxii], TiO_2-SiO_2 [xxiii], $SiCl_4$ [xxiv], Lactic Acid [xxv], $CeCl_3.H_2O$ [xxvi], DSIMHS [xxvii], [Fe_2O_3@HAP]-supported dual acidic nano catalyst [xxviii], PWA [xxix], I_2 [xxx], CA-SiO_2 [xxxi], Cu-SiO_2 [xxxii], GMA [xxxiii], BF_3. SiO_2 [xxxiv], TBAHS [xxxv], Lanthanum (III) chloride/chloroacetic acid [xxxvi], Ascorbic Acid [xxxvii], Tartaric Acid [xxxviii], Ionic Liqid-3/4 [xxxix], n-TSA [xl], CSA [xli], $Al_2(SO_4)_3.18H_2O$ [xlii], KF/CP NPs [xliii], Strontium triflate [xliv], HBF_4. SiO_2 [xlv], [bmim]BF_4/pTSA [xlvi], TCT [xlvii], $HClO_4$-SiO_2 [xlviii], SSA [xlix], Ce-MCM-41 [l], Fe_3O_4/CS NPS [li], Imidazole [lii], Nano ZnO, Co/Mn [liii], nPr_2NH_2][HSO_4] [liv], BNPs-TAPC [lv], GO / GO-SO_3H [lvi], NH_2SO_3H [lvii], HY Zeolite [lviii], IBX [lix], Manganese (IV) oxide [lx], AIL@MNP [lxi], TiO_2-$HClO_4$ [lxii], RiH [lxiii], [DDPA][HSO_4] [lxiv], SCMNPs@imine@SO_3H [lxv], Tannic Acid [lxvi], Sulfated Polyborate [lxvii], Piperidines/SDS [lxviii], $H_4SiW_{12}O_{40}$ [lxix], Tungstosilicic Acid [lxx], SBISAC [lxxi], $KHSO_4$ [lxxii], SSA [lxxiii], PDNES [lxxiv], ZrO_2-SO_3H NPs [lxxv], Trityl Chloride [lxxvi], TCCA [lxxvii], Ionic Liquid [Dsim]Cl, [Msim] PF_6, [Msim) BF_4 [lxxviii], Ammonium Oxalate [lxxix], Fe_3O_4 MNPs [lxxx], PVPP.OTf [lxxxi], Lawesson's Reagent [lxxxii], Cu(II)Fe_3O_4@APTMS-DFX [lxxxiii], GO-SB-PMo [lxxxiv], [TMXH]$FeCl_4$ [lxxxv], P_2O_5 [lxxxvi], $InCl_3$ [lxxxvii], pTSA [lxxxviii], NH_4Cl [lxxxix], Ionic liquid [xc], [NSPTEA][HSO_4] [xci], NH_2SO_3H [xcii], Ce (SO_4)$_2$.H_2O [xciii], Alum [xciv], ZnO NPs [xcv], Orange Peel [xcvi], Trichloroacetic Acid [xcvii], PEG-400 [xcviii], Zr (HSO_4)$_4$ [xcix], $CuSO_4$/SIO_2 [c], NSPVPC [ci], Cu(bpdo)$_2$.$2H_2O$]$^+$SBA-15 [cii], $CoFe_2O_4$@OCMC@Cu(BDC)Manganese(IV) Oxide [ciii], Fe_3O_4@SiO_2-$SnCl_4$ [civ], LAIL@MNP [cv], pTSA [cvi], DBSA [cvii], Sodium Acetate [cviii], ZnO Nanoparticle [cix], Acidic ionic liquid [cx], I_2/Acetic Acid [cxi], $Sc(OTf)_3$ [cxii], p-TSA [cxiii], Nano-SPA [cxiv], [bmim][PF_6] [cxv], $NaHSO_4.SiO_2$ [cxvi], TBAF [cxvii], Proline triflate [cxviii], $BF_3.OEt_2$ [cxix], $RnCl_3.nH_2O$ [cxx], Molecular Iodine [cxxi], H_2SO_4 [cxxii], BF_3. SiO_2 [cxxiii], $Fe_3O_4.SiO_2$ NPs [cxxiv], $Ni_{0.5}Co_{0.5}Fe_2O_4$ [cxxv], Fe_3O_4 MNPs [cxxvi], Indium sulfide (In_2S_3) nanoparticles [cxxvii], CuO@HNTs-SO_3H [cxxviii], Perchloric Polyborate [cxxix], γ-Fe_2O_3@PAMAM-SO_3H [cxxx], Baker's yeast [cxxxi], Glycine [cxxxii], Citric Acid [cxxxiii], SBISAC [cxxxiv], CDIPSPW [cxxxv], $NiFe_2O_4$@SiO_2@amino glucose magnetic nanoparticle [cxxxvi], TBAPIL@Si(CH_2)$_3$@nano-silica-based nano-catalyst [cxxxvii], [bmim]BF_4 [cxxxviii], HAp-encapsulated γ-Fe_2O_3-supported dual acidic [cxxxvix], Tartaric acid [cxl], Sulfonated carbon@titania composites [cxli], Fe_3O_4@MCM-41-SO_3H@[HMIm][HSO_4] [cxlii], BBSIC [cxliii], n-TSA [cxliv], Fe-Cu/ZSM-5 heterogeneous catalyst [cxlv], Co/Mn/nano ZnO [cxlvi], New basic ionic liquid from ethan-1,2-diyl bis (hydrogen sulfate) and DBU (1,8 diazobicyclo[5.4.0]undec-7-ene) [cxlvii], [(CH_3)$_4$N]$_2SiF_6$ [cxlviii], W/Cu@g-C_3N_4 [cxlix], 10-camphor sulfonic acid [cl], L-proline [cli], nano-AlPO4/Ti (IV) [clii], sulfated polyborate [cliii], Fe_3O_4@Agar-Ag as nanocatalyst [cliv], Fe_3O_4/SiO_2/PPA MNPs [clv], organic-inorganic Brønsted acidic ionic solids with phosphotungstate anion (BAIS-PW) [clvi], $CoFe_2O_4$ and $CoAl_{0.8}Fe_2O_4$ [clvii], Graphene Oxide (GO) containing 1-(2-aminoethyl) piperazine [clviii] .

All these reported pathways of catalyst to synthesized 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one derivatives under different condition including solvent free, reflux, microwave irradiation, ultrasonication approaches to obtain products. Among them some most of the protocols acceptable and obeys all green chemistry principles and follow environmentally and ecofriendly routes for synthesis of targeted molecules. Present review focus how methodologies development take place in synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one derivatives in details which helpful to new young researcher to search new innovative methodological route for one-pot multicomponent synthesis.

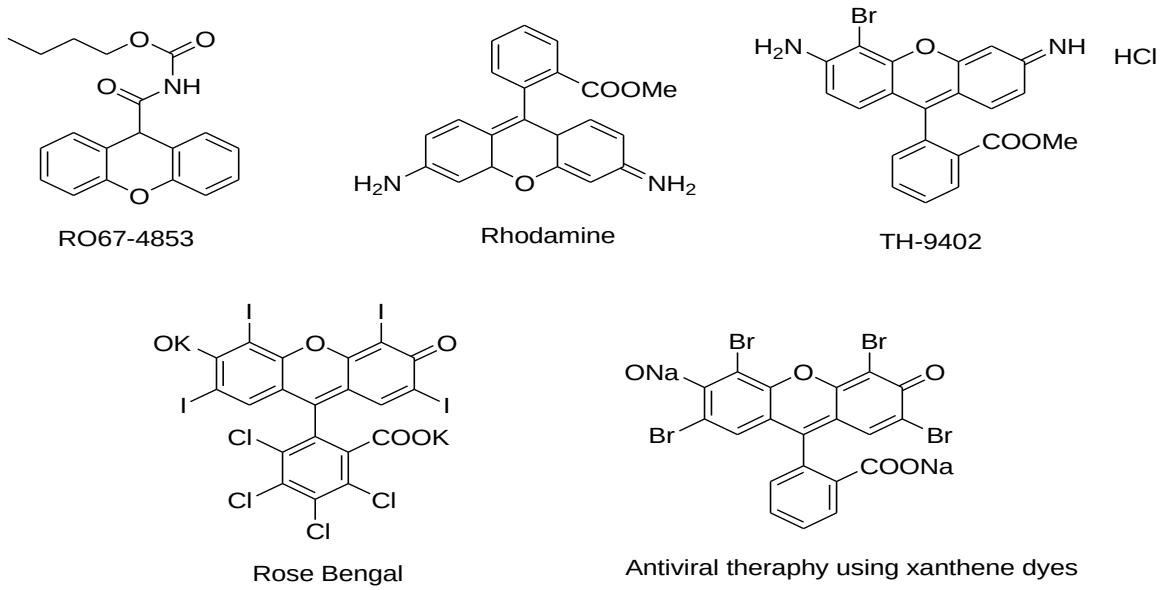


Figure I: Pharmacologically active xanthenes units

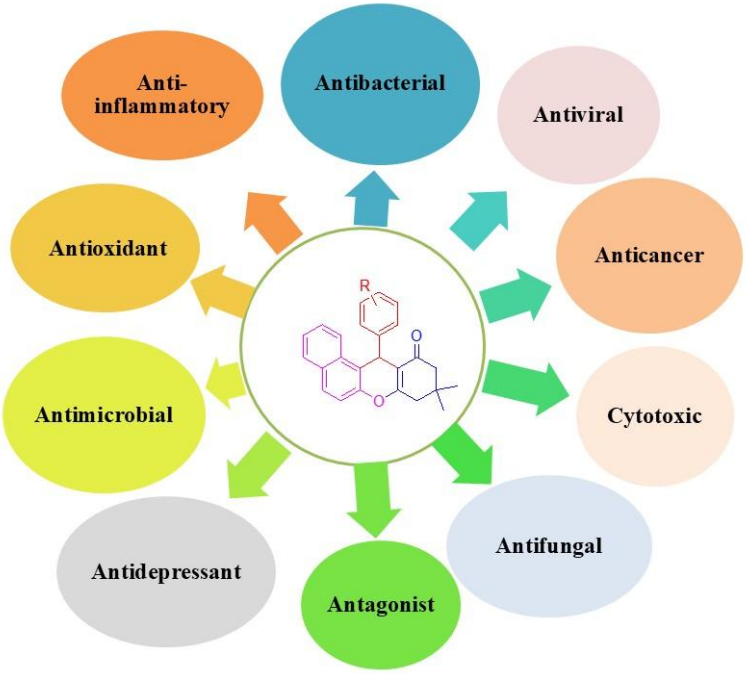


Figure II: Biological activity of xanthenes units

APPLICATIONS:

Due vast medicinal and synthetic demands these compounds used in active pharmaceutical ingredients (API) so great importance in industrial and pharmaceutical fields.

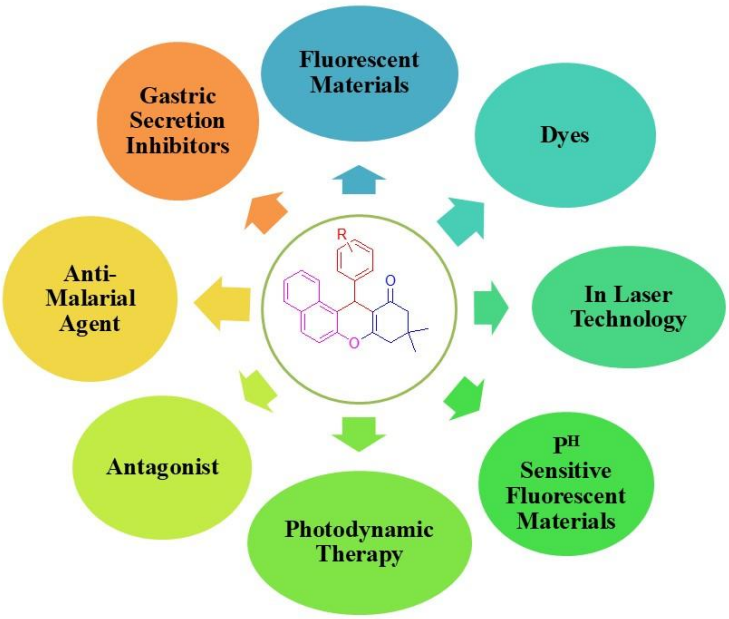


Figure III: Application of xanthene derivatives.

EXPERIMENTAL METHODS AS PER LITERATURE REPORTED METHODS:

Synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one Derivatives

A mixture of substituted aromatic aldehydes (1 mmol), 2-Naphathol (1 mmol), dimedone (1 mmol) and catalytic amounts of various homogenous or heterogenous or polymer supported or nanocatalyst or ionic liquids under specified condition such as monitored temperature, different solvent condition, solvent-free condition, microwave irradiation, ultrasonic irradiation, reflux condition resultant products formation monitored by thin layer chromatography (TLC) with the help of various solvent system n-hexane-Ethylacetate (varying proportion), petroleum ether-Ethylacetate (varying proportion) finally products recrystallized from ethanol as a solvent to obtained excellent yields targeted molecules.

Abbreviation:

FT-IR: Fourier transform Infrared Spectroscopy
TGA: Thermogravimetric Analysis
VSM: Vibrating Sample Magnetometer
XRD: Powder X-ray diffraction
DTGA: Differential Thermal Gravimetric Analysis
FESEM: Field Emission Scanning Electron Microscopy
ICP-OES: Inductively Coupled Plasma Optical Emission Spectroscopy
EDS: Energy Dispersive X-ray Spectroscopy
AFM: Atomic Force Microscopy
TEM: Transmission Electron Microscopy
UV-Vis: Ultra-Violet Visible Spectroscopy
HRMS: High Resolution Mass Spectroscopy
^{1}H NMR: Proton Nuclear Magnetic Spectroscopy
^{13}C NMR: Carbon Nuclear Magnetic Spectroscopy
Elemental Analysis
Raman Spectroscopy
Particle Size Distribution

Reaction Scheme-1:

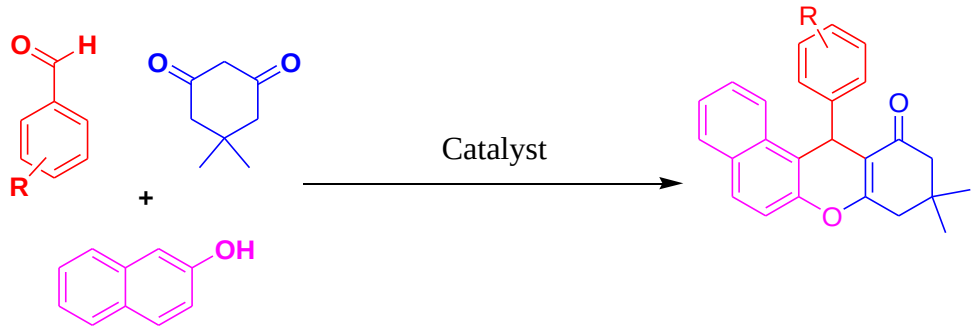


Table. 1 The comparison of various catalysts for synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]xanthene-11-one derivatives

Entry	Catalyst	Solvent	Catalyst loading (gm)	Temp (ºC)	Time (min)	Yield (%)
1	$NiFe_2O_4$@SiO_2@amino Glucose MNPs	SF	0.05 gm	r. t.	8-15	92-97
2	NPs.SiO_2.H_2SO_4	CH_2Cl_2	0.003 gm	r. t.	20	82-96
3	TTAB	H_2O	15 mol %	r. t.	2-8 h	74-91
4	Thiamine Hydrochloride (VB_1)	H_2O	10 mol %	r. t.	25-40	78-92
5	$ZrOCl_2$. $8H_2O$	EtOH	0.2 mmol	r. t.	0.5-5 h	75-97
6	TiO_2-SiO_2	PEG-400	5 mol %	r. t.	11-30	85-95
7	$SiCl_4$	CH_2Cl_2	2.5 mmol	r. t.	1-3.5 h	92-98
8	Lactic Acid	SF	50 mol %	50	5-30	81-95
9	$CeCl_3$.H_2O	MeOH	3 mol %	50	2-3.5 h	78-95
10	DSIMHS	SF	0.25 mmol	55	10-35	89-93
11	[Fe_2O_3@HAP]-supported dual acidic nanocatalyst	EtOH	0.015 gm	60	4-16	88-96
12	PWA	SF	15 mol %	60	40-95	81-92
13	I_2	SF	10 mol %	60	45-95	86-95
14	CA-SiO_2	SF	0.1 gm	60	30-55	75-90
15	Cu-SiO_2	SF	0.05 gm	60	20-35	80-90
16	GMA	SF	0.2 mmol	60	30-50	72-94
17	BF_3. SiO_2	SF	0.05 gm	60	15-25	75-96
18	TBAHS	H_2O	10 mol%	60	2h-5h	82-90
19	Lanthanum (III) chloride/chloroacetic acid	SF	10 mol %	70	10-11	90-97
20	Ascorbic Acid	SF	15 mol %	70	10-25	82-94
21	Tartaric Acid	SF	15 mol %	70	10-20	85-94
22	Ionic Liqid-3	SF	5 mol %	75	12-15	88-93
23	Ionic Liqid-4	SF	5 mol %	75	10-12	90-95
24	n-TSA	SF	15 mol %	70	30-270	70-96
25	CSA	SF	30 mol %	80	120	64-72
26	$Al_2(SO_4)_3$.$18H_2O$	SF	10 mol %	80	10-25	81-92

27	KF/CP NPs	SF	0.033 gm	80	60	88-92
28	Strontium triflate	SF	10 mol %	80	5-7 h	70-89
29	HBF_4. SiO_2	SF	0.2 mmol	80	60-90	84-95
30	[bmim]BF_4/pTSA	SF	0.5 ml 0.2 mmol	80	3 h	90
31	TCT	SF	5 mol %	80	30-70	84-93
32	$HClO_4$-SiO_2	SF	5 mol %	80	0.8-1.5 h	86-95
33	SSA	SF	0.1 mmol	80	20-65	72-85
34	Ce-MCM-41	Neat	1.7 mol %	80	30-90	85-96
35	Fe_3O_4/CS-Ag NPS	H_2O	15 mg	80	25-45	85-96
36	Imidazole	SF	10 mol %	80	10-20	80-95
37	Nano ZnO, Co/Mn	SF	0.025 gm	80	8-15	75-95
38	[nPr_2NH_2][HSO_4]	SF	50 mol %	80	10-20	65-82
39	BNPs-TAPC	SF	10 mg	80	8-15	93-99
40	GO	H_2O	0.03 gm	80	2-3 h	59-83
41	GO-SO_3H	H_2O	0.02 gm	80	2-3 h	83-94
42	NH_2SO_3H	Ionic liquid	0.2 mml	80	1-2 h	75-86
43	HY Zeolite	SF	20 mg	80	1-24 h	70-95
44	IBX	Ionic liquid	10 mol %	80	1 h	63-76
45	Manganese (IV) oxide	SF	10 mol %	90	15-30	76-91
46	AIL@MNP	SF	1.5 mmol %	90	30-65	80-91
47	TiO_2-$HClO_4$	SF	5 mg	90	18-31	87-93
48	RiH	SF	0.5 gm	90	30-75	94-98
49	[DDPA][HSO_4]	SF	0.3 mmol	90	30-60	85-93
50	SCMNPs@imine@SO_3H	SF	10 mg	90	12-25	91-97
51	Tannic Acid	SF	10 mol %	90	45-60	87-96
52	Sulfated Polyborate	SF	10 (wt %)	100	6-10	90-97
53	Piperidines SDS	SF	0.2 mmol 0.1 gm	100	1.5-24 h	77-92
54	Tungstosilicic Acid	SF	0.2 gm	100	15-40	83-91
55	[Pyridine-SO_3H]Cl	SF	7 mol %	100	9-15	85-96
56	SBISAC	SF	0.005 gm	100	7-27	83-96
57	$KHSO_4$	SF	10 mol %	100	15-60	45-95
58	SSA	SF	0.1 gm	80-100	30-45	75-95
59	PDNES	SF	5 mol %	110	30-120	70-96
60	ZrO_2-SO_3H NPs	SF	0.1 gm	110	13-20	89-96
61	Trityl Chloride	SF	7 mol %	110	40-70	82-94
62	TCCA	SF	5 mol %	110	25-40	74-90
63	Ionic Liquid, [Dsim]Cl	SF	10 mol %	110	6-15	83-95
64	Ionic Liquid, [Msim] PF_6	SF	10 mol %	110	8-12	83-95
65	Ionic Liquid, [Msim) BF_4	SF	10 mol %	110	7-13	85-97

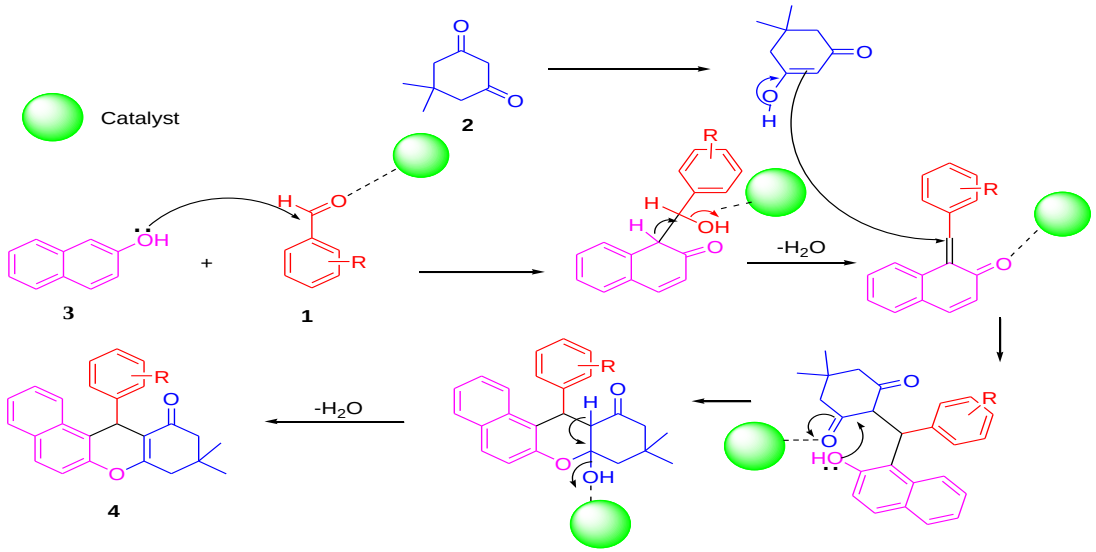
66	Ammonium Oxalate	SF	0.1 mmol	110	12-30	45-91
67	Fe_3O_4 MNPs	SF	5 mol %	110	1-2 h	80-95
68	PVPP.OTf	toluene	30 mg	110	5-6 h	80-95
69	Lawesson's Reagent	toluene	0.68g	Reflux	30-90	77-86
70	Cu(II)Fe_3O_4@APTMS-DF X	SF	0.02 gm	120	20-90	80-97
71	GO-SB-PMo	SF	5.1 mol %	120	1-30	75-95
72	[TMXH]$FeCl_4$	SF	0.20 mmol	120	10-20	81-98
73	P_2O_5	SF	20 mol %	120	5-30	85-95
74	$InCl_3$	SF	30 mol %	120	30-75	65-88
75	pTSA	SF	0.02 mmol	120	2-3 h	83-95
76	NH_4Cl	SF	10 mol %	120	10-40	70-94
77	Ionic liquid	SF	10 mol %	120	55-120	70-95
78	[NSPTEA][HSO_4]	SF	20 mol %	120	10-30	65-89
79	NH_2 SO_3 H	SF	20 mol %	120	1.5-2.16	79-84
80	$Ce(SO_4)_2.H_2O$	SF	0.10 gm	120	8-30	85-97
81	Alum	SF	10 mol %	120	25-55	85-95
82	ZnO NPs	SF	10 mol %	120	10-30	85-95
83	Orange Peel	SF	0.05 gm	120	30-90	80-95
84	Trichloroacetic Acid	SF	0.1 gm	120	10-30	66-98
85	PEG-400	SF	1 ml	120	5.5-7.5 h	79-90
86	$Zr(HSO_4)_4$	SF	15 mol %	125	25-60	15-90
87	$CuSO_4/SIO_2$	SF	5 mol %	125	75-110	76-91
88	NSPVPC	SF	20 mg	120-130	5-30	60-90
89	$Cu(bpdo)_2.2H_2O]^+$SBA-15	SF	0.03 gm	150	45-70	85-95
90	$CoFe_2O_4$@OCMC@Cu(BDC)Manganese (IV) Oxide	EtOH:H_2O (1:1)	0.002 gm	US	10-15	83-96
91	Fe_3O_4@SiO_2-$SnCl_4$, 50W	EtOH	20 mg	US	5-10	93-99
92	LAIL@MNP, sonication	SF	15 mg	US	20-60	65-96
93	pTSA	SF	-	US	0.5-3.0 h	85-97
94	DBSA	H_2O	0.1 mmol	US	60-240	63-93
95	Sodium Acetate, 450 W	SF	15 mol %	MW	5-8	85-95
96	ZnO Nanoparticle, 400 W solvent-free	SF	0.01gm	MW	15-18	86-93
97	Acidic ionic liquid, 240W	SF	5 mol %	MW	8-15	70-89
98	I_2/Acetic Acid	SF	20 mol %	Reflux	2.5-3.5 h	66-89
99	$Sc(OTf)_3$ /MW /300W	SF	10 mol %	MW	5-10 min	72-97
100	p-TSA	SF	2 mol %	120	35-45	80-92
101	Nano-SPA	SF	0.02 gm	MW	6	84-96
102	[bmim][PF_6]	SF	10 mol %	MW	12-17	82-92

103	$NaHSO_4.SiO_2$	CH_2Cl_2	-	Reflux	4-7 h	69-91
104	TBAF	H_2O	10 mol %	Reflux	2-3.5 h	75-99
105	Proline triflate	H_2O	0.1 mmol	Reflux	4-15 h	5-79
106	$BF_3.OEt_2$	SF	0.02 mmol	Reflux	45	75-82
107	$RnCl_3.nH_2O$	SF	5 mol %	Reflux	2-7	78-93
108	Molecular Iodine	Acetic Acid	20 mol %	MW	6-9	70-93
109	H_2SO_4	H_2O	0.1 mmol	Reflux	2.5-3.5 h	84-91
110	BF_3. SiO_2	EtOH	0.08 gm	Reflux	15	85-97
111	$Fe_3O_4.SiO_2$ NPs	H_2O : EtOH	5 mol %	Reflux	40-60	86-94
112	$Ni_{0.5}Co_{0.5}Fe_2O_4$	EtOH	20 mol %	Reflux	30	94-96
113	Boric Acid	EtOH	10 mol %	Reflux	2-4.5 h	77-90
114	Indium sulfide (In_2S_3) nanoparticles	SF	0.04 g	50°C	60	90-94
115	CuO@HNTs-SO_3H	SF	20 mg	120°C	18-25	87-96
116	Perchloric Polyborate	SF	75 mg	80°C	15-25	83-94

RESULT AND DISCUSSION:

Due to reduce waste, improve efficiency and enhance sustainability most of the present review protocols takes place in solvent-free conditions, according to solvent observation water, water: ethanol proportion and methanol used as a green solvent to carry out the transformation, few of the case in solvent optimization order used acetic acid, CH_2Cl_2, PEG-400, ionic liquid and toluene as solvent. Considering temperature optimization steps in this MCRs methodology some reaction optimized at room temperature, 50-150 °C temperature range, reflux condition, microwave irradiation condition and ultrasonication condition.

MECHANISM:



Plausible mechanism for the formation of tetrahydrobenzo[a]xanthene-11-ones in the presence of different solid acid catalyst

CONCLUSION:

Extremely facile and a nontoxic efficient protocol which including simple, rapid, clean, selective, features for one pot pseudo three component reaction between aldehyde, dimedone and 2-napthol under various green pathway such as green solvent medium, solvent free condition, microwave irradiation and ultrasonication condition for 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a]Xanthen-11-one this pathway offers mild reaction condition, short reaction time, avoid toxic organic solvents, operational simplicity for synthesis and excellent yields. Formed products purify by recrystallization method. Overall ecofriendly and environment friendly pathway utilized for catalyst and product synthesis except some methodology.

Current review focus details all points including solvent, catalyst, temperature parameter related to one-pot synthesis of 12-aryl-8, 9, 10, 12-tetrahydrobenzo[a] Xanthen-11-one so young researcher easy to further research which will be helpful to medicinal and pharmaceutical point of view.

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CONFLICT OF INTERESTS:

The authors declare no conflict of interests.

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