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Microwave Assisted Envirocat EPZ-10 Catalyzed Multi-component Synthesis of 1-Amidoalkyl-2-naphthols

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ABSTRACT

Microwave assisted catalytic efficiency of Envirocat EPZ-10 was explored in solvent free green synthesis of 1-amidoalkyl-2-naphthols by the reaction of aldehyde, 2-naphthol and acetamide. The products formed were characterized by spectroscopic methods such as NMR, IR and mass spectroscopy. The merits of developed synthetic method are use of Envirocat EPZ-10 as eco-friendly, reusable and heterogeneous catalysts, solvent-free reaction, shorter reaction time and easy isolation of product.

KEYWORDS

Envirocat EPZ-10, 1-Amidoalkyl-2-naphthols, Microwave synthesis, Reusability.

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INTRODUCTION

Catalysis assist is the major concerns and challenges of energy and sustainability through the development of greener synthetic routes for the production of industrially important organic compounds [1,2]. The green chemistry buoyed catalysts leads to efficient and benign synthetic protocols that avoid the use of volatile organic solvents, toxic reagents, harsh reaction conditions as well as challenging and time-consuming, wasteful separations [3-7]. Homogeneous catalytic systems result in better activity, higher selectivity and the possibility to tune the chemo-, regio- and enantioselectivity [8]. Though, widely employed for various organic transformations they are associated with a major drawback *viz.* difficulty in separation from the reaction mixture [9]. On the other hand, heterogeneous catalysis overcomes the drawbacks of homogeneous catalysis despite having low activity and selectivity [10]. Commercially available clay catalysts have attracted attention of researchers as they are known for their Lewis acid activity which makes them alternative catalysts [11]. Commercially available Envirocat EPZ-10 prepared by supporting $ZnCl_2$ on clay, is known to contain predominantly strong Lewis acid sites as well as weak Brønsted acid sites [12]. Hence, Envirocat EPZ-10 received considerable attention and used as catalyst in various organic transformations [13-16].

Heterocyclic compounds bearing 1,3-amino oxygenated functional groups such as 1-amidoalkyl-2-naphthols are popular due to their wide spectrum of pharmacological activities. Theses scaffold convert to 1-aminoalkyl-2-naphthol derivatives

by amide hydrolysis, which exhibits hypotensive and bradycardia activities [17,18]. 1-Amidoalkyl-2-naphthol core has been involved in an extensive collection of therapeutically significant drugs including nucleoside antibiotics and HIV protease inhibitors such as ritonavir and lipinavir [19-21]. The biologically potent promising medicinal activities exhibited by these motif's are cytotoxicity, antiviral, antibacterial [22], α1-adrenoceptors blocking [23], cardiovascular [24], *etc*. 1,3-Oxazines obtained from 1-amidoalkyl-2-naphthols also possesses pharmacological properties such as antibiotic [25], antitumor [26], antimalarial [27], antirheumatic [28] and anti-convulsant [29] activities. Owing to the significant biological properties, synthesis of 1-aminoalkyl-2-naphthols using green chemistry principles is a frontier area of research in organic synthesis. In this context, herein Envirocat EPZ-10 catalyzed microwave assisted multi-component synthesis of 1-amido-alkyl-2-naphthols under solvent-free conditions is reported.

EXPERIMENTAL

All reactions were carried out under air atmosphere in dried glassware. Infrared spectra were measured with a Perkin-Elmer one FTIR spectrophotometer. The samples were examined as KBr discs 5% w/w. ^{1}H NMR and ^{13}C NMR spectra were recorded on a Brucker AC (400 MHz for ^{1}H NMR and 100 MHz for ^{13}C NMR) spectrometer using $CDCl_3$ as solvent and tetramethylsilane (TMS) as an internal standard. Mass spectra were recorded on a Shimadzu QP2010 GCMS. The microwave used was of ONIDA company and domestic type. The melting points were determined in an open capillary and are uncorrected. All the chemical were obtained from local suppliers and used as received.

Sythesis: A mixture of aromatic aldehyde (1 mmol), 2-naphthol (1 mmol), amide/urea (1.1 mmol) and activated Envirocat EPZ-10 (50 mg) was irradiated in a microwave oven (240 W) at 120 ºC for appropriate time (5-10 min) and progress of reaction was monitored by TLC. After completion of reaction, reaction mixture was cooled to room temperature, solid residue was dissolved in ethyl acetate and mixture stirred for 5 min. The catalyst was recovered and the solvent was evaporated to afford solid and purified by column chromatography (*n*-hexane/ethyl acetate) using silica gel.

***N*-[(2-Hydroxynaphthalen-1-yl)phenylmethyl)]-acetamide (4a):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3351, 2969, 1640, 1598, 1507, 1344, 1146, 869, 744; ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.93 (s, 1H), 8.35 (s, 1H), 7.90 -7.88 (d, *J* = 7.2 Hz, 1H), 7.75-7.67 (m, 3H), 7.36-7.32 (t, 2H, *J* = 8.8), 7.25-7.11 (m, 6H), 1.99 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 169.6, 153.5, 142.8, 132.7, 129.4, 128.8, 128.1, 126.6, 126.4, 126.3, 122.7, 119.1, 118.9, 48.5, 23.1; EI-MS: *m/z* 292 (M+1).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-flurophenyl)-methyl)]acetamide (4b):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3421, 3315, 3071, 1640, 1597, 1578,1522, 1470, 1391, 1210, 1162, 1064, 946, 885, 787, 741, 712; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.86 (s, 1H), 8.29 (d, *J* = 8.1 Hz, 1H), 7.92 (br.d, 1H), 7.79 (d, *J* = 7.8 Hz, 1H), 7.69 (d, *J* = 8.8 Hz, 1H), 7.25 (m, 1H), 7.23 (t, *J* = 7.2 Hz, 1H), 7.18 (d, *J* = 8.7 Hz, 1H), 7.04-7.01 (m, 5H), 2.19 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 170.1, 160.6, 150.1, 144.2, 138.7, 135.8, 131.9, 127.8, 127.4, 127.1, 126.2, 124.9, 123.1, 120.6, 119.8, 118.2, 47.5, 22.3; EI-MS: *m/z* 309 (M$^+$).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-methylphenyl)-methyl)]acetamide (4c):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3415, 3308, 3068, 1631, 1601, 1570, 1519, 1469, 1390, 1209, 1158, 1063, 945, 884, 789, 744, 714; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.87 (s, 1H), 8.30 (d, *J* = 8.1 Hz, 1H), 7.84 (br.d, 1H), 7.77 (d, *J* = 7.9 Hz, 1H), 7.70 (d, *J* = 8.7 Hz, 1H), 7.28 (m, 1H), 7.20 (t, *J* = 7.2 Hz, 1H), 7.18 (d, *J* = 8.7 Hz, 1H), 7.05-7.02 (m, 5H), 2.21 (s, 3H), 1.94 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 169.4, 151.5, 142.4, 139.2, 134.1, 132.7, 128.4, 128.2, 127.9, 126.5, 125.2, 122.4, 121.7, 119.8, 118.9, 47.2, 22.6, 21.2; EI-MS: *m/z* 292 (M$^+$).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-nitrophenyl)-methyl)]acetamide (4d):** Pale yellow solid; IR (KBr, ν_{max}, cm^{-1}): 3389, 3299, 2594, 1645, 1602, 1518, 1438, 1064, 822, 729, 439; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.89 (s, 1H), 8.51 (d, *J* = 8.1 Hz, 1H), 8.02 (m, 2H), 7.81 (d, *J* = 7.2 Hz, 1H), 7.78 (t, *J* = 9.0 Hz, 2H), 7.54-7.51 (m, 2H), 7.33 (t, *J* = 7.2 Hz and 5.4 Hz, 1H), 7.24 (t, *J* = 7.2 Hz and 4.8 Hz, 1H), 7.19 (d, *J* = 8.4 Hz, 1H), 7.13 (d, *J* = 7.8 Hz, 1H), 2.12 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 169.4, 150.2, 146.3, 144.1, 129.7, 129.4, 129.1, 128.6, 128.1, 126.2, 123.3, 121.2, 119.8, 118.8, 117.4, 47.4, 21.9 ppm; EI-MS (*m/z*): 337 (M$^+$+1).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-chlorophenyl)-methyl)]acetamide (4e):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3392, 2959, 2689, 2604, 1630, 1561, 2520, 1488, 1432, 1365, 1333, 1271, 1234, 1168, 1083, 817, 742, 580, 490; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.94 (s, 1H), 8.47 (d, *J* = 8.7 Hz, 1H), 7.71 (m, 3H), 7.35 (t, *J* = 7.8 Hz and 5.4 Hz, 1H), 7.21 (m, 3H), 7.19 (d, *J* = 8.7 Hz, 2H), 7.11 (d, *J* = 8.7 Hz, 2H), 7.05 (d, *J* = 8.1 Hz, 2H), 1.97 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 169.2, 152.5, 143.8, 134.4, 130.9, 130.1, 129.4, 129.1, 128.4, 128.1, 126.1, 124.2, 120.5, 119.7, 47.1, 20.8; EI-MS (*m/z*) 326 (M$^+$+1).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-methoxyphenyl)-methyl)]acetamide (4f):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3390, 3060, 3002, 2955, 2832, 2780, 2704, 2611, 1620, 1588, 1510, 1421, 1370, 1329, 1260, 1168, 1080, 1054, 1034, 978, 878, 818, 807, 746; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.94 (s, 1H), 8.42 (d, 1H), 7.81-7.79 (m, 4H), 7.31-7.24 (m, 6H), 5.38 (s, 1H), 2.49 (s, 3H), 2.1 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 161.4, 154.4, 138.5, 134.5, 130.2, 128.5, 128.3, 126.1, 124.1, 123.4, 119.2, 114.8, 114.2, 55.7, 45.2; EI-MS: *m/z* 322 (M$^+$+1).

***N*-[(2-Hydroxynaphthalen-1-yl)-(2,4-chlorophenyl)-methyl)]acetamide (4g):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3394, 2960, 2689, 2606, 1629, 1562, 2518, 1489, 1430, 1361, 1329, 1269, 1238, 1165, 1081, 815, 741, 588, 492; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.92 (s, 1H), 8.46 (d, *J* = 8.7 Hz, 1H), 7.71 (m, 2H), 7.34 (t, *J* = 7.6 Hz and 4.2Hz, 1H), 7.21 (m, 3H), 7.19 (d, *J* = 8.7 Hz, 1H), 7.11 (d, *J* = 8.7 Hz, 2H), 7.05 (d, *J* = 8.1 Hz, 1H), 1.97 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 169.2, 152.4, 143.5, 134.2, 130.9, 130.1, 129.4, 129.1, 128.4, 128.1, 126.1, 124.2, 120.5, 119.7, 47.2, 21.2; EI-MS: *m/z* 360 (M$^+$+1).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-methylphenyl)-methyl)]urea (4h):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3285,

3165, 3068, 2921, 1630, 1592, 1394, 810, 789, 744; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.58 (s, 1H), 8.71 (s, 1H), 7.88-7.23 (m, 8H), 6.13 (br, 2H), 2.19 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 164.1, 152.2, 142.2, 137.5, 133.1, 132.7, 128.3, 127.9, 127.6, 126.5, 125.2, 122.4, 121.7, 119.8, 118.9, 51.2, 24.2 ppm; EI-MS: *m/z* 326 (M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(3-nitrophenyl)-methyl)]urea (4i):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3330, 3169, 3038, 2921, 1691, 1595, 1394, 807, 743; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.11 (s, 1H), 8.64 (s, 1H), 8.21-7.63 (m, 7H), 7.63-7.27 (m, 3H), 6.87 (s, 2H), 6.29 (s, 1H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 163.2, 154.2, 148.6, 143.5, 135.4, 135.1, 131.2, 127.8, 127.5, 127.2, 125.2, 124.7, 118.8, 50.8; EI-MS: *m/z* 337 (M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-nitrophenyl)-methyl)]urea (4j):** Pale yellow solid; IR (KBr, ν_{max}, cm^{-1}): 3330, 3169, 3038, 2921, 1691, 1595, 1394, 807, 743; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.10 (s, 1H), 8.34-7.93 (m, 9H), 7.45-7.22 (m, 2H), 6.78 (s, 2H), 6.31 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO-d_6): δ 164.2, 154.5, 147.9, 143.4, 135.4, 135.1, 131.2, 127.6, 127.3, 127.1, 125.4, 124.8, 118.7, 50.7; EI-MS: *m/z* 337 (M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-methoxy phenyl)-methyl)]urea (4k):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3485, 3365, 3270, 3057, 2922, 1638, 1585, 1392, 809, 790, 745; ^{1}H NMR (300 MHz, DMSO-d_6): δ 9.89 (s, 1H), 8.75 (s, 1H), 7.88-7.46 (m, 6H), 7.32-7.27 (m, 4H), 7.01 (s, 1H), 6.02 (br, 2H), 3.66 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 163.3, 153.2, 142.4, 135.7, 133.4, 129.3, 128.7, 128.3, 126.2, 123.2, 122.2, 118.5, 53.2; EI-MS: *m/z* 322 (M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(3-bromophenyl)-methyl)]benzamide (4l):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3396, 3202, 3064, 1629, 1580, 1435, 1345, 1270, 1190, 1047, 805, 731, 637, 521; ^{1}H NMR (300 MHz, DMSO-d_6): δ 10.22 (s, 1H), 9.03 (d, *J* = 8.7 Hz, 1H), 8.17 (d, *J* = 8.7 Hz, 1H), 8.12-7.79 (m, 4H), 7.58-7.49 (m, 5H), 7.32-7.36 (m, 4H), 7.21-7.16 (m, 2H) ppm; ^{13}C NMR (75 MHz, DMSO-d_6): δ 165.8, 153.4, 145.6, 134.7, 133.1, 131.8, 130.3, 129.7, 129.5, 129.3, 128.8, 128.5, 128.3, 127.6, 127.3, 127.1, 123.2, 122.1, 118.5, 117.6, 51.3; EI-MS (*m/z*): 432 (M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-nitrophenyl)-methyl)]benzamide (4m):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3411, 3215, 3044, 1650, 1540, 1446, 1352, 1057, 855, 749; ^{1}H NMR (300 MHz, DMSO-d_6): δ 10.08 (s, 1H), 8.91 (s, 1H), 8.21 (d, *J* = 8.7 Hz, 1H), 8.16 (d, *J* = 8.4 Hz, 2H), 7.94 (d, *J* = 7.5 Hz, 2H), 7.79 (d, *J* = 7.8 Hz, 1H), 7.71 (d, *J* = 9.0 Hz, 1H), 7.56-7.49 (m, 7H), 7.58-7.49 (m, 5H), 7.39 (t, *J* = 7.8 Hz and 7.2 Hz, 4H), 6.71 (m, 1H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 167.3, 153.2, 148.9, 134.1, 133.3, 130.3, 129.6, 129.3, 129.1, 127.8, 122.2, 122.1, 119.6, 117.7, 50.8; EI-MS: *m/z* 398 (M^++1).

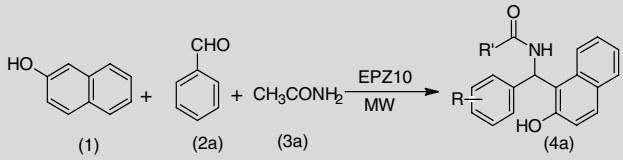
***N*-[(2-Hydroxynaphthalen-1-yl)-(4-chlorophenyl)-methyl)]benzamide (4n):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3419, 3277, 2053, 1628, 1529, 1445, 1270, 1051, 825, 730; ^{1}H NMR (300 MHz, DMSO-d_6): δ 10.09 (s, 1H), 8.89 (s, 1H), 8.23 (d, *J* = 8.1 Hz, 1H), 8.16 (d, *J* = 8.4 Hz, 2H), 7.84-7.75 (m, 4H), 7.61-7.27 (m, 10H), 6.24 (s, 1H) ppm; ^{13}C NMR (75 MHz, DMSO-d_6): 167.1, 154.3, 136.4, 132.5, 131.6, 129.5, 128.6, 128.1, 126.8, 123.2, 122.5, 119.4, 118.2, 49.6 ppm; EI-MS (*m/z*) 387 ((M^+).

***N*-[(2-Hydroxynaphthalen-1-yl)-(4-methylphenyl)-methyl)]benzamide (4n):** White solid; IR (KBr, ν_{max}, cm^{-1}): 3415, 3012, 2825, 1628, 1535, 1480, 1356, 819, 715; ^{1}H NMR (300 MHz, DMSO-d_6): δ 10.12 (s, 1H), 8.95 (s, 1H), 7.88-7.79 (m, 4H), 7.56-7.19 (m, 9H), 7.04 (d, *J* = 8.1 Hz, 2H), 6.08 (s, 1H), 2.21 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6): δ 167.6, 154.5, 143.8, 139.4, 134.8, 133.1, 129.5, 128.8, 128.2, 126.5, 125.2, 123.5, 122.7, 119.5, 118.1, 48.7, 20.1 ppm; EI-MS: *m/z* 367 (M^+).

RESULTS AND DISCUSSION

The optimization of amount of Envirocat EPZ-10 catalyst was carried out for model reaction of 2-naphthol (1 mmol), benzaldehyde (1 mmol) and acetamide (1.2 mmol) under solvent free conditions and microwave irradiation. The results of the study are summarized in Table-1. It is noteworthy that the reaction did not proceed in the absence of catalyst that signifies the decisive role of catalyst. Excellent yield of the desired product was observed when 50 mg of Envirocat EPZ-10 was employed. Low yields of the desired product were obtained for catalyst loading less than 50 mg while no significant increase in yields was observed when catalyst loading was employed beyond 50 mg. Thus, 50 mg of Envirocat EPZ-10 was chosen as the optimal quantity (Table-1, entry 6). The formation of desired product was confirmed by NMR, IR and mass spectroscopic techniques.

TABLE-1
OPTIMIZATION OF REACTION CONDITIONS FOR THE SYNTHESIS OF 1-AMIDOALKYL-2-NAPHTHOLS[a]



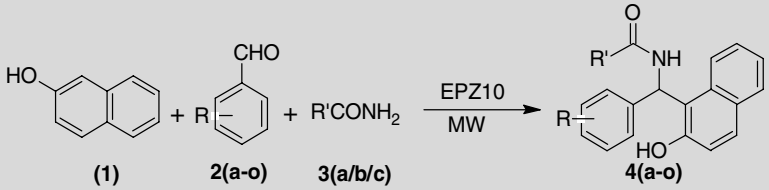
Catalyst (mg)	Reaction time (min)	Yield[b] (%)
0	25	No reaction
10	25	45
20	20	54
30	18	58
40	14	81
50	10	96
60	10	96
70	10	96
80	9	97
100	9	97

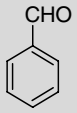
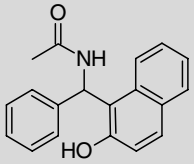
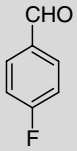
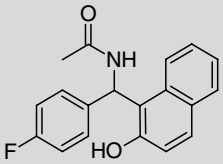
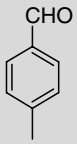
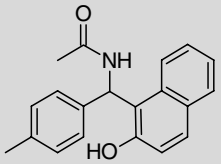
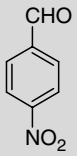
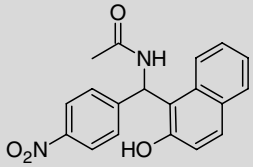
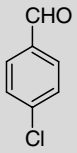
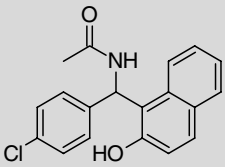
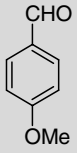
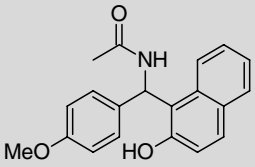
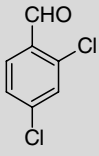
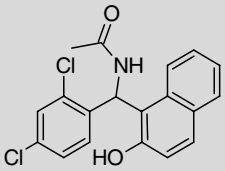
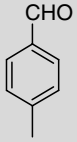
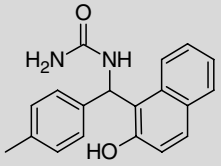
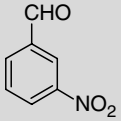
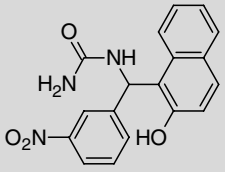
[a]Reaction conditions: 2-Naphthol (1 mmol), benzaldehyde (1 mmol), acetamide (1.2 mmol) and EP10 in MW at 120 °C, [b]Isolated yields.

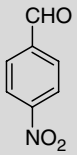
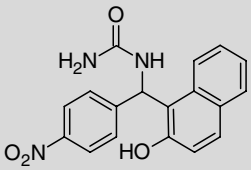
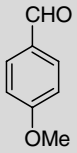
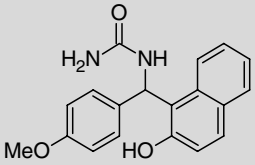
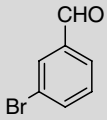
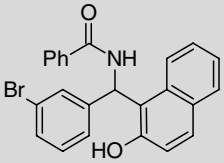
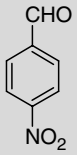
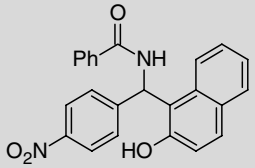
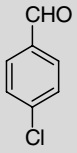
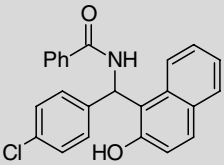
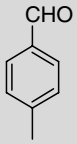
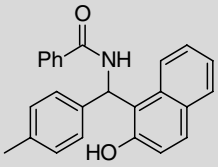
To prove the generality of method, the scope of this reaction for the synthesis of diversely substituted 1-amidoalkyl-2-naphthols was further explored. A variety of aromatic aldehydes with electron-donating as well as electron-withdrawing groups underwent smooth transformation to provide desired 1-amidoalkyl-2-naphthol derivatives in good to excellent yields (83-95%) in short reaction time (10-25 min) (Table-2). In all cases, 1-amidoalkyl-2-naphthols were the sole products and no byproduct was observed.

The plausible mechanism for the Envirocat EPZ-10 assisted synthesis of 1-amidoalkyl-2-naphthols is shown in **Scheme-I**. A condensation between 2-naphthol and corresponding aromatic

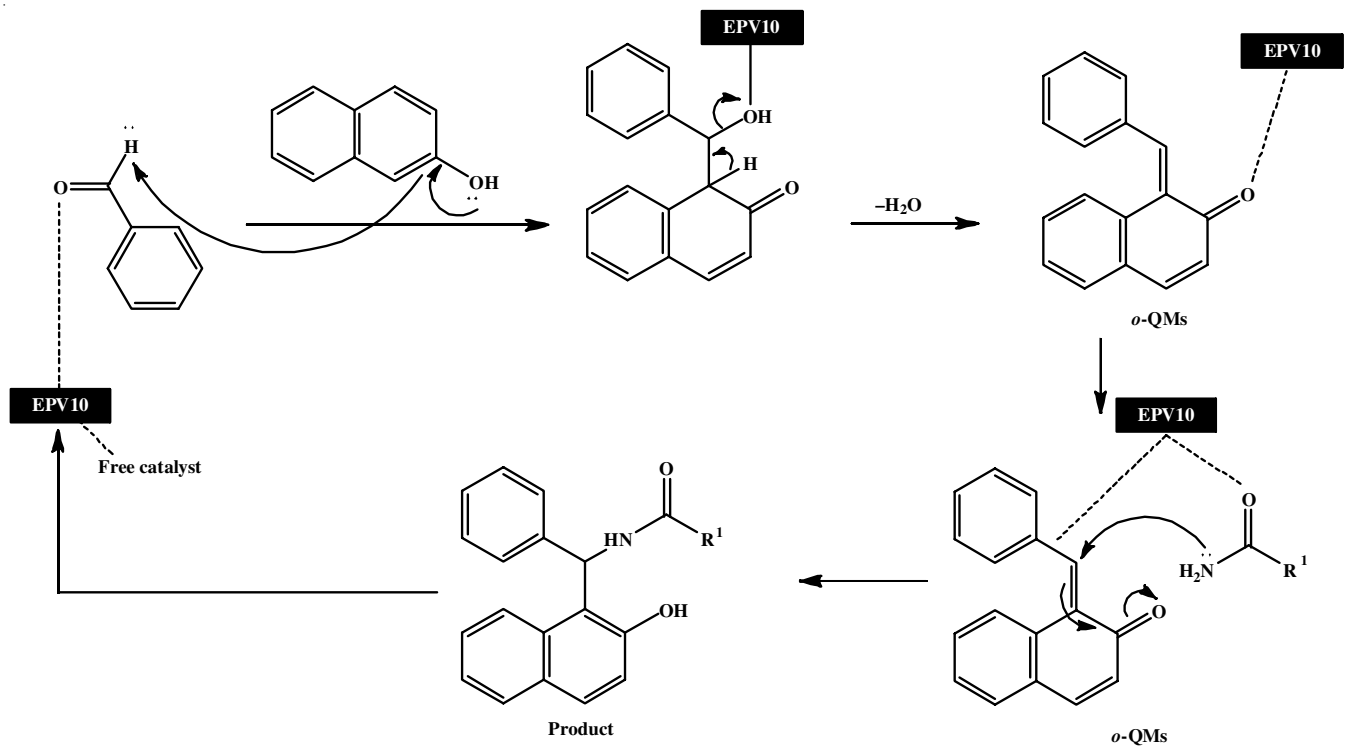
TABLE-2
SYNTHESIS OF THE LIBRARY OF 1-AMIDOALKYL-2-NAPHTHOLS[a]



Entry	RCHO (**2**)	$RCONH_2$ (**3**)	Product (**4**)	Time (min)/Yield (%)[b]	m.p.[d], obs. [lit] °C
a		CH_3CONH_2		10/(96-90)[c]	244-246 (241-243) [30]
b		CH_3CONH_2		9/93	230-232 (209-210) [30]
c		CH_3CONH_2		10/90	216-218 (222-223) [31]
d		CH_3CONH_2		9/95	246-248 (248-250) [32]
e		CH_3CONH_2		9/93	222-224 (224-227) [30]
f		CH_3CONH_2		15/85	186-188 (184-186) [30]
g		CH_3CONH_2		9/91	202-204 (198-199) [30]
h		NH_2CONH_2		19/90	218-220 (222-223) [32]
i		NH_2CONH_2		15/92	178-180 (179-180) [30]

j		NH_2CONH_2		12/93	201-203 (200-202) [33]
k		NH_2CONH_2		20/85	184-186 (182-184) [34]
l		$PhCONH_2$		18/80	224-226 (228-230) [31]
m		$PhCONH_2$		15/86	230-232 (228) [35]
n		$PhCONH_2$		16/84	174-176 (177-178) [31]
o		$PhCONH_2$		20/75	178-180 (175-177) [36]

[a]Reaction conditions: 2-Naphthol (1 mmol), aldehyde (1 mmol), urea/benzamide/acetamide (1.2 mmol) and EP10 (50 mg) were heated in MW at 120 °C, [b]Yields refer to the pure isolated products. [c]Yields after recovery of the catalyst 5 times, [d]Literature value in parenthesis.



Scheme-I: Plausible mechanism for the formation of 1-amidoalkyl-2-naphthols

TABLE-3
COMPARISON OF DIFFERENT METHODS FOR THE REACTION OF BENZALDEHYDE (**2a**), ACETAMIDE (**3a**) AND 2-NAPHTHOL (**1**) UNDER SOLVENT-FREE CONDITIONS

Catalyst	Catalyst loading	Temp. (°C)	Time (h)	Yield (%)	Ref.
$ZrOCl_2/8H_2O$/solvent-free	2 mol%	80	0.5	96	[38]
SiO_2–$HClO_4$/solvent-free	0.6 mol%	125	0.4	89	[39]
Sulfamic acid/solvent-free	50 mol%	30	0.15	80	[40]
$Fe(HSO_4)_3$/solvent-free	5 mol%	85	1.0	83	[46]
Silica sulphuri acid/solvent-free	0.02 g	RT	0.4	89	[42]
Mont. K10/solvent-free	0.1 g/mol	125	1.5	89	[43]
Iodine/solvent-free	5 mol%	RT	10	85	[44]
$K_5CoW_{12}O_40_3H_2O$/solvent-free	1 mol%	125	2	90	[45]
Dodecylphosphonic acid	0.1 mol%	90	0.2	90	[41]
Envirocat EPZ-10	50 mg	120	0.1	96	This work

aldehydes in the presence of Envirocat EPZ-10 catalyst generates *ortho*-quinonemethides (*o*-QMs) which subsequently undergo aza-Michael type conjugate addition at the β carbon of α,β-unsaturated carbonyl system by amino group in urea/benzamide /acetamide leading to the formation of desired 1-amidoalkyl-2-naphthols.

From the environmental and economical point of view, recyclability of the heterogeneous catalyst is also an important aspect. Hence, The recyclability study of Envirocat EPZ-10 was also focused for the model reaction. Gratifyingly, it was observed that the catalyst can be reused for six consecutive reactions after washing with $CHCl_3$ and drying in oven at 100 ºC (Fig. 1).

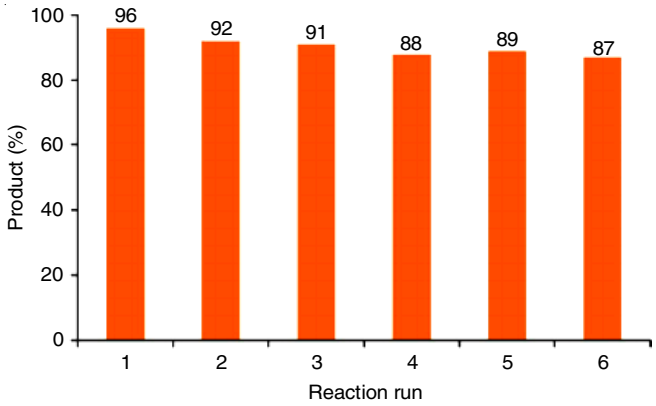


Fig. 1. Recyclability of Envirocat EPZ-10 for synthesis of *N*-((2-hydroxynaphthalen-1-yl)(4-phenyl)methyl)acetamide (**4a**)

To verify the significance of the developed method, the present method was compared with reported methods for the synthesis of *N*-[phenyl-(2-hydroxynapthalen-1-yl)methyl]-acetamide. Table-3 demonstrates that present method stands more efficient with respect to reaction temperature, catalyst load, reaction time and yield than previously reported methods.

Conclusion

Envirocat EPZ-10 catalyzed solvent-free method was developed for the synthesis of 1-amidoalkyl-2-naphthols (AANs) by the reaction of aldehyde, 2-naphthol and amide/ urea under microwave irradiation. The key advantages of the developed methods are use of Envirocat EPZ-10 as an eco-friendly, reusable and heterogeneous catalysts, solvent-free reaction conditions, shorter reaction times and easy isolation of product and use of microwaves as an efficient energy source.

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