One-Pot Synthesis of 2,3-Disubstituted-2,3-dihydroquinazolin-4(*1H*)-ones Using [Hmim][NO_3]: An Eco-Friendly Protocol

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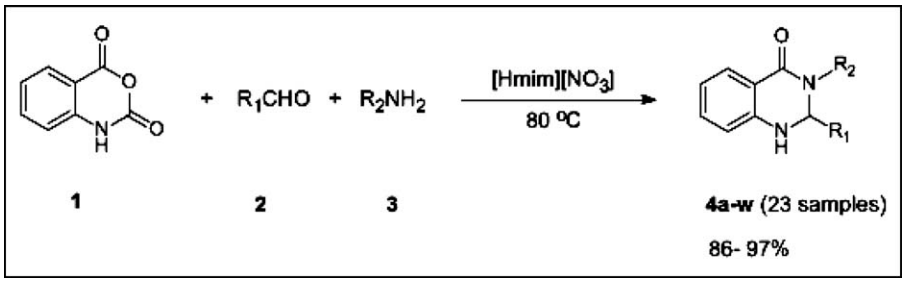

An efficient method for the synthesis of a series of 2,3-disubstituted-2,3-dihydroquinazolin-4(*1H*)-ones is described via one-pot condensation reaction of isatoic anhydride, aryl aldehydes, and primary amines using a Brønsted acidic ionic liquid, [Hmim][NO_3], as a catalyst and medium. The present protocol enjoys convenient reaction and simple work-up, greenness, short reaction times, and reusable catalyst as well as mild reaction conditions.

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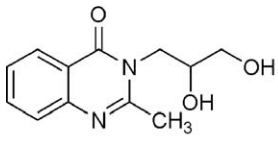
INTRODUCTION

The recent interest surrounding ionic liquids in regards to green chemistry and the associated development in their versatile applications has largely been a result of their unique physicochemical properties [1]. Significant research efforts ensued when ILs emerged as a possible ''green'' alternative to common organic solvents. In this decade, investigations have commenced to finding specialized technological applications for ILs such as catalysis and biocatalysis [2], energetic materials [3], polymer plasticizers [4], lubricants [5], cellulose dissolution [6], and active pharmaceutical ingredients (APIs) [7]. Recently, ILs continuing to shift from the research laboratory to industries [8].

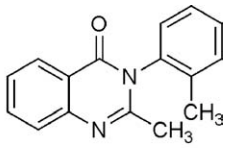
Quinazolinones are commonly used substructure within the pharmaceutical industry, as these fused heterocycles impart unique physical and biological compounds of interest. It occurs in different natural products and in a variety of synthetic compounds [9]. 2,3-Disubstuted-2,3-dihydroquinazoline-4(*1H*)-one alkaloids are a class of natural products which exhibit a variety of pharmaceutical activity [10] include anti-inflammatory, antibacterial, antimicrobial, antidepressant, and anticancer [11]. Known 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one drugs are diproqualone **I** which is used primarily for the treatment of inflammatory pain associated with osteoarthritis [12], and methaqualone **II** which has antimalarial effect and currently being used for the assessment of the abuse liability of sedative hypnotic drugs [13] (Scheme 1). Although there are several reports on the synthesis 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one derivatives, [14,15] yet the investigations for a convenient and green synthesis is on due to different drawbacks in the existing methods, e.g., harsh reaction conditions, using toxic solvents and metal-based catalysts, low yield, time consuming, and no easy available precursors. Chen *et al*. [16] has reported a new method for the preparation of 2,3-dihydroquinazoline-4(*1H*)-ones using classic ionic liquids such as [$C_n$mim][PF_6] or [$C_n$mim][BF_4] ($n = 2$ and 4). The main disadvantage of this method is instability of $[PF_6]^-$ and $[BF_4]^-$ anions toward hydrolysis in contact with moisture, forming HF and POF_3, which can dissolve glassware and damage steel autoclaves and reactors [17].

Our recent interest has been in the development of green synthetic methods on using ILs for the preparation of quinazolin-4(*3H*)-ones [18]. Herein, we report a highly efficient, one-pot, three-component, and eco-friendly protocol for the synthesis of 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one derivatives **4** by the condensation reaction of isatoic anhydride **1**, aryl aldehydes **2**, and primary amines **3** using 1-methylimidazolium nitrate, [Hmim][NO_3], as a catalyst and medium at thermal conditions (Scheme 2). To the best of our knowledge in the open literature, this

Scheme 1. Structure of 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one drugs, diproqualone (**I**) and methaqualone (**II**).



Diproqualone (I)



Methaqualone (II)

reaction involving a hydrophilic task-specific ionic liquid (TSIL) is unprecedented.

RESULTS AND DISCUSSION

The experimental procedure for this reaction is remarkably simple and requires no toxic organic solvents or inert atmosphere. The best results for this condensation reaction were obtained by taking a 1.1:1:1 mol ratio mixture of isatoic anhydride, aromatic aldehyde, and primary amine using 1 mmol [Hmim][NO_3] (Table 1) at thermal conditions (80°C) for 1–2 h. The reaction proceeded fast with high yield of the desired products using a Brønsted acidic ionic liquid (BAIL) with dual roles of catalyst and medium.

In an initial study, to examine the catalytic activity of different Brønsted acidic ionic liquids such as [Hmim][Cl], [Hmim][HSO_4], and [Hmim][NO_3] in this condensation reaction, 4-chlorobenzyladehede was first reacted with isatoic anhydride and ethylamine using each ionic liquids separately, at thermal conditions. These Brønsted acidic ionic liquids can be prepared simply by neutralization. In the course of this study, we found that [Hmim][NO_3] was the most effective catalyst in the term of yield of corresponding 2-ethyl-3-aryl-2,3-dihydroquinazoline-4(*1H*)-one (94%); whereas other ionic liquids formed the product with the yield of 63–86% (Table 2). In the absence of IL, the yield of product was found to be extremely low (Table 2, entry 4).

The generality of this process was demonstrated by the wide range of substituted and structurally diverse aryl aldehydes carrying either electron-withdrawing or electron-donating groups, which were used to synthesize the corresponding 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one derivatives in excellent yields (Table 3). On the other hand, aliphatic aldehydes as well as unsaturated ones, showed very poor yields. Another important aspect is that various functionalities such as methoxy, nitrile, halides, nitro, etc., were survived under the present reaction conditions (Table 3). The reaction conditions are mild enough not to damage to moieties such as methoxy which often undergoes cleavage in the strong acidic media (Table 3, entries 8, 9, 17, and 21). To evaluate the generality of this method, we also concentrated our study on the different primary amines (Table 3). The results illustrate the high ability of this method for synthesis of 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-ones with varied structures.

Chaiappe *et al*. reported [Hmim][NO_3] used as a promoter-solvent in the oxidative aromatic chlorination [19]. During our own investigation, no evidence was obtained to show the oxidation reaction for all of the 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-one products was occurred under this reaction conditions.

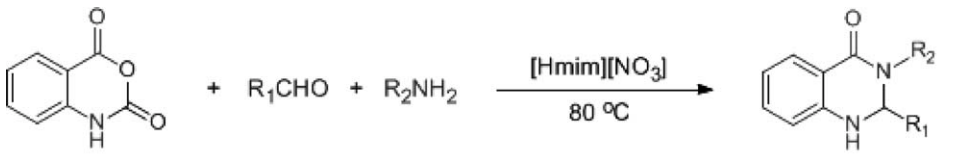
Because of the need to explore the role of water in this process, a study was performed which focused on the effect of water content of ionic liquid on its catalytic activity. The data listed in Table 4 were illustrated that catalytic activity of [Hmim][NO_3] heavily dependent of the amount of water content. That is, the ratio of water to ionic liquid must ranging between 0% and 15% (w/w) to obtain optimum yield (Table 4, entries 1 and 2). Furthermore, the ionic liquid [Hmim][NO_3] was miscible with water, whereas the products were immiscible with the ionic liquid; therefore, the water produced in the condensation reactions did not need to be removed.

The reusability of catalyst is important from an environmental point of view and economic consideration. Therefore, reusability of this ionic liquid was also examined using sequential reactions. The obtained results indicated that the catalyst could be recovered and reused successfully for four times without remarkable decrease in the product yield (82–94%).

CONCLUSIONS

In conclusion, [Hmim][NO_3] can be considered as a promising alternative medium and catalyst for the

Scheme 2. Synthesis of 2,3-disubstituted-2,3-dihydroquinazolin-4(*1H*)-ones using [Hmim][NO_3] as a catalyst and medium.

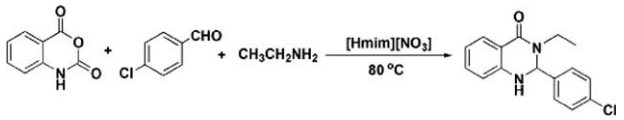


1 2 3 **4a-w** (23 samples)

86- 97%

Table 1

Reaction of isatoic anhydride, 4-chlorobenzaldehyde, and ethylamine using different amounts of [Hmim][NO_3].[a]



Entry	Ionic liquid (mmol)	Yield (%)[b]
1	0.8	75
2	0.9	86
3	1	94
4	1.1	94

[a] Reaction conditions: isatoic anhydride (1.1 mmol), ethylamine (1 mmol), 4-chlorobenzaldehyde (1 mmol), IL (1 mmol).
[b] Isolated yield.

synthesis of 2,3-disubstuted-2,3-dihydroquinazoline-4(*1H*)-ones, starting from isatoic anhydride, aryl aldehydes, and primary amines. This IL is non-volatile, air stable, easy to prepare and handle, and reusable. It also can act as an environmentally friendly catalytic system for this transformation showed that rate of reactions were enhanced and products were obtained in excellent yield. Moreover, this research not only affords the products in high yields but also avoids the problems associated with catalyst cost, non-green reaction conditions, safety, and pollution.

EXPERIMENTAL

Melting points were obtained by Stuart Scientific SMP2 apparatus and are uncorrected. Yields refer to isolated products and all products were characterized by their physical and spectral data. IR spectra were recorded on FTIR NICO let 400D. ^{1}H- and ^{13}C-NMR (500 and 125 MHz) spectra were recorded on a Bruker-Avance AQS 500 spectrometer in $CDCl_3$. Mass spectra were obtained on platform II spectrometer from Micro mass; EI mode at 70 eV. Elemental analysis was done on LECO, CHNS-932.

Synthesis of 1-methylimidazolium nitrate, [Hmim][NO_3]. A dilute nitric acid solution [5.059 g of nitric acid (65 wt %) in 20-mL water] was added to an aqueous solution of 1.05 equiv of *N*-methylimidazol (4.089 g, 49.79 mmol) at 0°C. The reaction mixture was allowed to warm to room temperature. Water was removed by sweeping compressed air above the solution at 80°C. Upon cooling the liquid down to room temperature, a white solid formed. This was powdered, washed with diethyl ether, and dried *in vacuo* at 40°C. IL was decolorized by refluxing the aqueous solution in the presence of charcoal for 24 h. Then, mixture was filtrate and water of filtrate was removed *in vacuo* for 12 h.

General procedure for the synthesis of 2,3-dihydroquinazolin-4(1H)-ones. Isatoic anhydride (1.1 mmol), aryl aldehyde (1 mmol), and primary amine (1 mmol) were successively added to [Hmim][NO_3] as a catalyst-medium (1 mmol) in a 25-mL flask. The mixture was heated under vigorously stirring at 80°C for appropriate times according to Table 3. The progresses of reactions were monitored by TLC (ethyl acetate: *n*-hexane, 1:3). After completion of reaction, 10-mL ethyl acetate (EtOAc) was added to the flask and completely was stirred. Then the solution was transferred to the funnel. The 2,3-disubstituted-2,3-dihydroquinazolin-4(*1H*)-one products were extracted by EtOAc, the organic layer was separated, and the solvent was evaporated under vacuum. The product was purified by recrystallization of residue from *n*-hexane.

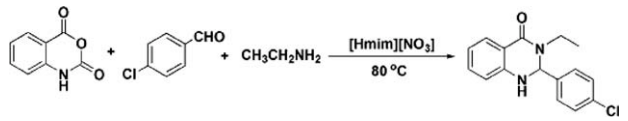
[Hmim][NO_3] recovery and reuse. The reusability of [Hmim][NO_3] was investigated in the multiple sequential reaction of isatoic anhydride, 4-chlorobenzaldehyde, and ethylamine. At the end of the reaction, IL was separated from the reaction mixture by extraction of the organics by ethyl acetate (2 × 10 mL). The aqueous phase containing IL was dried *in vacuo* for further use. Recycling was done until minimum yields up to 80% are obtained.

Spectral data. ***2-(4-Chlorophenyl)-3-ethyl-2,3-dihydroquinazolin-4(1H)-one (4a).*** (94%), mp 132–135°C; IR (KBr) υ_{max} = 3227, 3028, 2030, 1630, 1576, 1524, 1472, 1319, 1219, 1088, 1014, 844, 744 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H 1.60 (t, J = 7.2 Hz, 3H, CH_3), 2.93–2.97 (m, 1H, NCH_2CH$_3$), 3.93–3.97 (m, 1H, NCH_2CH$_3$), 4.55 (br, s, 1H, NH), 5.78 (s, 1H, CH), 6.56 (d, J = 7.9 Hz, 1H, ArH), 6.89 (td, J^1 = 7.6 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.26–7.30 (m, 1H, ArH), 7.34–7.38 (m, 4H, ArH), 7.99 (dd, J^1 = 7.8 Hz, J^2 = 1.5 Hz, 1H, ArH).

2-(2,4-Dichlorophenyl)-3-ethyl-2,3-dihydroquinazolin-4(1H)-one (4b). (97%), mp 158–161°C; IR (KBr): 3248, 2990, 1628, 1512, 1475, 1421, 1321, 1254, 1217, 1155, 1103, 1043, 847, 754, 698, 613, 527 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H 1.25 (t, J = 7.2 Hz, 3H, CH_3), 2.85–2.92 (m, 1H, NCH_2CH$_3$), 4.08–4.14 (m, 1H, NCH_2CH$_3$), 5.09 (br, s, 1H, NH), 6.10 (d, J = 2.4 Hz, 1H, CH), 6.53 (d, J = 8.0 Hz, 1H, ArH), 6.84 (t, J = 7.7 Hz, 1H, ArH), 7.16–7.18 (m, 1H, ArH), 7.21–7.25 (m, 2H, ArH), 7.43 (d, J = 2.0 Hz, 1H, ArH), 7.96 (dd, J^1 = 7.4 Hz, J^2 = 0.8 Hz, 1H, ArH); ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.6, 40.6, 67.9, 115.0, 116.4, 120.0, 128.0, 128.7, 128.8, 130.5, 133.0, 134.0, 135.7, 135.9, 144.6, 163.5 ppm; MS (EI, 70 eV): m/z = 321 (M^+, 5), 320 (M − 1, 3), 175 (86), 147 (76), 75 (100); Anal. Calcd. for $C_{16}H_{14}Cl_2N_2O$: C, 59.83; H, 4.39; N, 8.72; Found: C, 59.97; H, 4.34; N, 8.56.

Table 2

Reaction of isatoic anhydride, 4-chlorobenzaldehyde, and ethylamine using catalytic activity of different brønsted acidic ionic liquids.[a]

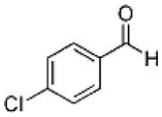
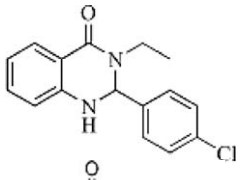
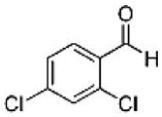
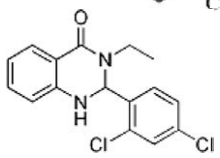
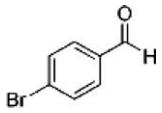
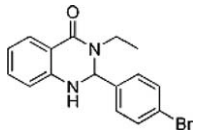
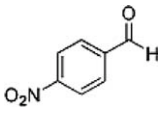
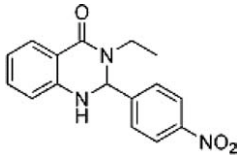
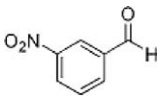
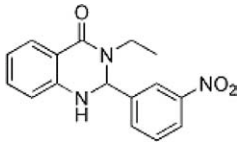
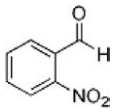
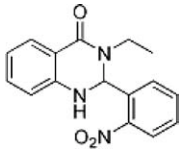
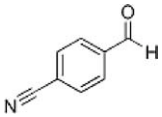
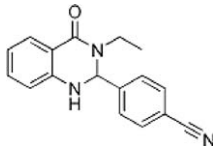
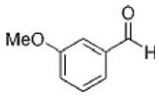
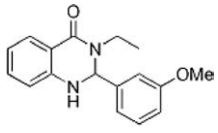
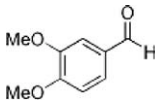
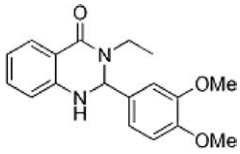
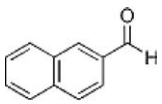
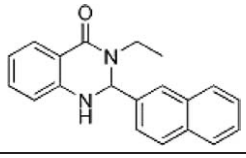


Entry	BAILs	Yield (%)[b]
1	[Hmim][NO_3]	94
2	[Hmim][HSO_4]	86
3	[Hmim][Cl]	63
4	–	Trace

[a] Reaction conditions: isatoic anhydride (1.1 mmol), ethylamine (1 mmol), 4-chlorobenzaldehyde (1 mmol), BAIL (1 mmol).
[b] Isolated yield.

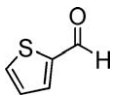
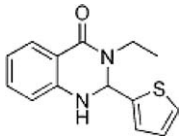
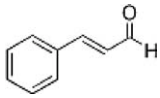
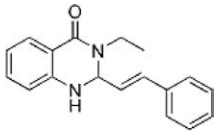
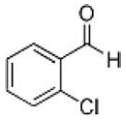
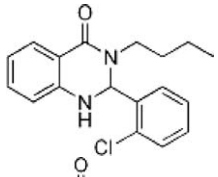
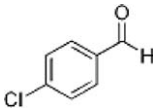
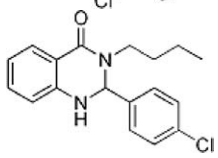
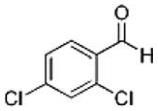
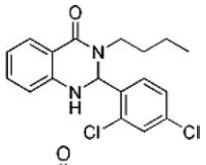
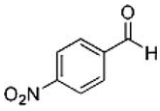
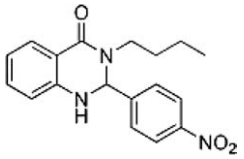
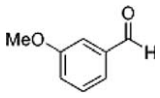
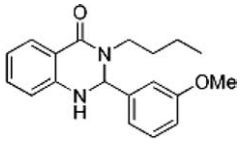
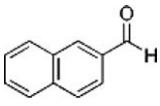
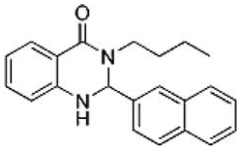
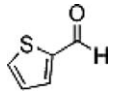
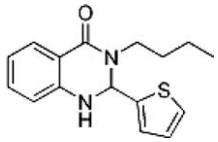
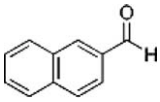
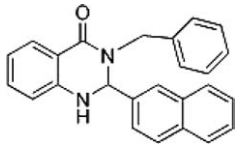
Table 3

Synthesis of 2,3-disubstituted-2,3-dihydroquinazolin-4(*1H*)-ones by condensation reaction of isatoic anhydride, aryl aldehydes, and primary amines using [Hmim][NO_3] as a catalyst-medium.[a]

Entry	Aldehyde	Amine	Product		Time (min)	Yield (%)[b]	Mp (°C)
1		$EtNH_2$		**4a**	60	94	132–135 [20]
2		$EtNH_2$		**4b**	60	97	158–161
3		$EtNH_2$		**4c**	80	96	129–131
4		$EtNH_2$		**4d**	90	93	160–161 [20]
5		$EtNH_2$		**4e**	90	95	176–178 [20]
6		$EtNH_2$		**4f**	120	91	155–158
7		$EtNH_2$		**4g**	100	92	170–172
8		$EtNH_2$		**4h**	90	90	112–116
9		$EtNH_2$		**4i**	60	94	146–149
10		$EtNH_2$		**4j**	90	87	140–143

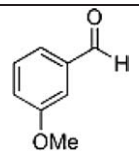
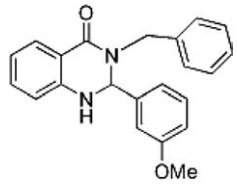
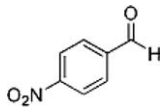
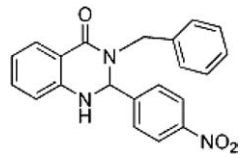
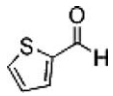
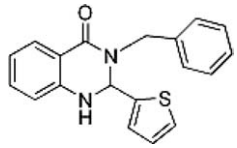
(*Continued*)

Table 3
(*Continued*)

Entry	Aldehyde	Amine	Product		Time (min)	Yield (%)[b]	Mp (°C)
11		$EtNH_2$		**4k**	60	91	126–128
12		$EtNH_2$		**4l**	60	95	132–134
13		*n*-$BuNH_2$		**4m**	60	93	146–149
14		*n*-$BuNH_2$		**4n**	60	97	150–151 [21]
15		*n*-$BuNH_2$		**4o**	60	90	135–138
16		*n*-$BuNH_2$		**4p**	60	94	137–139
17		*n*-$BuNH_2$		**4q**	60	90	102–105
18		*n*-$BuNH_2$		**4r**	60	87	144–146
19		*n*-$BuNH_2$		**4s**	60	90	99–101
20		$PhCH_2NH_2$		**4t**	60	85	157–159

(*Continued*)

Table 3
(*Continued*)

Entry	Aldehyde	Amine	Product		Time (min)	Yield (%)[b]	Mp (°C)
21		$PhCH_2NH_2$		**4u**	90	91	169–171
22		$PhCH_2NH_2$		**4v**	100	87	190–193
23		$PhCH_2NH_2$		**4w**	100	88	175–177

[a] Reaction conditions: isatoic anhydride (1.1 mmol), aldehyde (1 mmol), amine (1 mmol), [Hmim][NO_3] (1 mmol).
[b] Isolated yield.

2-(4-Bromophenyl)-3-ethyl-2,3-dihydroquinazolin-4(1H)-one (4c). (96%), mp 129–131°C; IR (KBr) υ_{max} = 3231, 3026, 2928, 1624, 1522, 1470, 1402, 1317, 1219, 1151, 1072, 1011, 843, 743, 698 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H 1.16 (t, J = 7.2 Hz, 3H, CH_3), 2.92–2.99 (m, 1H, NCH_2CH$_3$), 3.92–3.99 (m, 1H, NCH_2CH$_3$), 4.60 (br, s, 1H, NH), 5.76 (s, 1H, CH), 6.56 (d, J = 7.9 Hz, 1H, ArH), 6.89 (td, J^1 = 7.6 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.26–7.34 (m, 3H, ArH), 7.50–7.52 (m, 2H, ArH), 7.98 (dd, J^1 = 7.8 Hz, J^2 = 1.5 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.3, 40.0, 71.8, 114.8, 116.7, 120.0, 123.8, 128.7, 128.9, 132.6, 133.9, 139.5, 145.1, 163.2 ppm; MS (EI, 70 eV): m/z = 331 (M^+, 2), 301 (M − 1, 3), 169 (12), 61 (100); Anal. Calcd. for $C_{16}H_{15}BrN_2O$: C, 58.02; H, 4.56; N, 8.46; Found: C, 57.98; H, 4.61; N, 8.42.

3-Ethyl-2-(4-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4d). (93%), mp 160–161°C; IR (KBr) υ_{max} = 3240, 2350, 1626, 1580, 1526, 1470, 1348, 1259, 1111, 858, 748 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H 1.20 (t, J = 7.5 Hz, 3H, CH_3), 2.96–3.00 (m, 1H, NCH_2CH$_3$), 4.04–4.08 (m, 1H, NCH_2CH$_3$), 4.66 (br, s, 1H, NH), 5.88 (s, 1H, CH), 6.59 (d, J = 8.0 Hz, 1H, ArH), 6.92 (td, J^1 = 7.4 Hz, J^2 = 0.7 Hz, 1H, ArH), 7.30 (td, J^1 = 7.3 Hz, J^2 = 1.5 Hz,1H, ArH), 7.58 (d, J = 8.7 Hz, 2H, ArH), 8.00 (dd, J^1 = 3.9 Hz, J^2 = 1.2 Hz, 1H, ArH), 8.22 (d, J = 8.7 Hz, 2H, ArH) ppm.

3-Ethyl-2-(3-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4e). (95%), mp 176–178°C; IR (KBr) υ_{max} = 3275, 2972, 1625, 1580, 1525, 1475, 1424, 1350, 1300, 1281, 1219, 1103, 925, 758, 700 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ_H 1.07 (t, J = 7.1 Hz, 3H, CH_3), 2.78–2.85 (m, 1H, NCH_2CH$_3$), 3.92–3.99 (m, 1H, NCH_2CH$_3$), 5.74 (d, J = 2.7 Hz, 1H, NH), 6.33 (d, J = 1.8 Hz, 1H, CH), 6.47 (d, J = 8.0 Hz, 1H, ArH), 6.64 (td, J^1 = 7.5 Hz, J^2 = 0.7 Hz, 1H, ArH), 7.08 (td, J^1 = 7.7 Hz, J^2 = 1.5 Hz, 1H, ArH), 7.37 (t, J = 8.0 Hz, 1H, ArH), 7.57 (d, J = 7.7 Hz, 1H, ArH), 7.74 (d, J = 7.8 Hz, 1H, ArH), 8.01 (dt, J = 8.2, 1.2 Hz, 1H, ArH), 8.19 (d, J = 1.6 Hz, 1H, ArH) ppm.

3-Ethyl-2-(2-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4f). (91%), mp 155–158°C; IR (KBr) υ_{max} = 3308, 1626, 1506, 1422, 1348, 1171, 754, 704 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.24 (t, J = 7.2 Hz, 3H, CH_3), 2.76–2.83 (m, 1H, NCH_2CH$_3$), 4.12–4.19 (m, 1H, NCH_2CH$_3$), 5.42 (br, s, 1H, NH), 6.36 (s, 1H, CH), 6.52 (d, J = 7.9 Hz, 1H, ArH), 6.84 (td, J^1 = 7.6 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.22–7.26 (m, 1H, ArH), 7.47–7.53 (m, 2H, ArH), 7.57–7.60 (m, 1H, ArH), 7.98 (dd, J^1 = 7.8 Hz, J^2 = 1.4 Hz, 1H, ArH), 8.13 (dd, J^1 = 8.0 Hz, J^2 = 1.2 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.5, 41.0, 67.3, 115.1, 115.9, 119.7, 126.4, 128.4, 128.8, 130.2, 134.1, 134.8, 136.0, 144.3, 148.0, 163.7 ppm; MS (EI, 70 eV): m/z = 297 (M^+, 5), 250 (5), 175 (84), 147 (32), 91 (82), 77 (74), 76 (100).

2-(4-Cyanophenyl)-3-ethyl-2,3-dihydroquinazolin4(1H)-one (4g). (92%), mp 170–172°C; IR (KBr) υ_{max} = 3235, 3053, 2928, 2254, 1624, 1520, 1472, 1408, 1317, 1258, 1221, 1167, 1111, 1061, 1016, 922, 862, 824, 752, 721 cm^{-1}; ^{1}H-NMR

Table 4

Dependence of water on the activity of [Hmim][NO_3] in the reaction of isatoic anhydride, 4-chlorobenzaldehyde, and ethylamine.[a]

Entry	Water content % (w/w)	Yield (%)[b]
1	0	94
2	15	94
3	30	86
4	60	73

[a] Reaction conditions: isatoic anhydride (1.1 mmol), ethylamine (1 mmol), 4-chlorobenzaldehyde (1 mmol), IL (1 mmol).
[b] Isolated yield.

(500 MHz, $CDCl_3$): δ 1.19 (t, J = 7.2 Hz, 3H, CH_3), 2.91–2.98 (m, 1H, NCH_2CH$_3$), 3.99–4.06 (m, 1H, NCH_2CH$_3$), 4.76 (br, s, 1H, NH), 5.82 (s, 1H, CH), 6.58 (d, J = 8.1 Hz, 1H, ArH), 6.90 (td, J^1 = 7.8 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.27–7.30 (m, 1H, ArH), 7.51 (d, J = 8.3 Hz, 2H, ArH), 7.65 (d, J = 8.4 Hz, 2H, ArH), 7.97 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.4, 40.4, 71.5, 113.5, 115.1, 116.8, 118.6, 120.3, 127.5, 128.9, 133.2, 134.1, 144.6, 154.7, 163.0 ppm; MS (EI, 70 eV): m/z = 277 (M^+, 2), 175 (50), 147 (62), 102 (100).

3-Ethyl-2-(3-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one (4h). (90%), mp 11–116°C; IR (KBr) υ_{max} = 3296, 2965, 1632, 1508, 1414, 1306, 1252, 1178, 1028, 746 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.18 (t, J = 7.1 Hz, 3H, CH_3), 2.95–3.02 (m, 1H, NCH_2CH$_3$), 3.81 (s, 3H, OCH_3), 3.92–3.99 (m, 1H, NCH_2CH$_3$), 4.46 (br, s, 1H, NH), 5.78 (s, 1H, CH), 6.55 (d, J = 8.0 Hz, 1H, ArH), 6.88–7.02 (m, 4H, ArH), 7.28–7.32 (m, 2H, ArH), 8.00 (dd, J^1 = 7.8 Hz, J^2 = 1.4 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.3, 39.9, 55.7, 72.5, 112.7, 114.6, 115.1, 116.7, 119.4, 119.7, 128.9, 130.5, 133.7, 141.9, 154.5, 160.5, 163.3 ppm; MS (EI, 70 eV): m/z = 282 (M^+, 3), 253 (17), 175 (100), 147 (31), 119 (35), 92 (84).

2-(3,4-Dimethoxyphenyl)-3-ethyl-2,3-dihydroquinazolin-4(1H)-one (4i). (94%), mp 146–149°C; IR (KBr) υ_{max} = 3346, 2974, 2835, 1651, 1610, 1510, 1450, 1315, 1236, 1134, 1024, 889, 856, 806, 762, 696 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.11 (t, J = 7.1 Hz, 3H, CH_3), 2.93–3.00 (m, 1H, NCH_2CH$_3$), 3.81–3.90 (m, 1H, NCH_2CH$_3$), 3.82 (s, 3H, OCH_3), 3.88 (s, 3H, OCH_3), 4.68 (br, s, 1H, NH), 5.75 (s, 1H, CH), 6.57 (d, J = 8.0 Hz, 1H, ArH), 6.81–6.85 (m, 2H, ArH), 6.94 (dd, J^1 = 8.1 Hz, J^2 = 1.97 Hz, 1H, ArH), 7.00 (d, J = 1.97 Hz, 1H, ArH), 7.25 (td, J^1 = 7.7 Hz, J^2 = 1.5 Hz, 1H, ArH), 7.94 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.3, 39.6, 56.3, 56.3, 72.6, 110.0, 111.3, 114.5, 116.6, 119.5, 120.0, 128.8, 132.6, 133.7, 145.9, 149.8, 150.3, 163.6 ppm; MS (EI, 70 eV): m/z = 314 (M + 2, 8), 313 (M + 1, 43), 312 (M^+, 74), 311 (M − 1, 59), 283 (56), 175 (100), 147 (99); Anal. Calcd. for $C_{18}H_{20}N_2O_3$: C, 69.21; H, 6.45; N, 8.97; Found: C, 69.10; H, 6.45; N, 8.24.

3-Ethyl-2-(naphthalen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4j). (87%), mp 140–143°C; IR (KBr) υ_{max} = 3300, 2974, 2934, 1624, 1514, 1416, 1323, 1169, 1063, 953, 862, 750, 693 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.15 (t, J = 7.1 Hz, 3H, CH_3), 2.95–3.02 (m, 1H, NCH_2CH$_3$), 3.94–4.01 (m, 1H, NCH_2CH$_3$), 4.84 (br, s, 1H, NH), 5.95 (s, 1H, CH), 6.56 (d, J = 8.0 Hz, 1H, ArH), 6.85 (td, J^1 = 7.6 Hz, J^2 = 0.8 Hz, 1H, ArH), 7.25 (td, J^1 = 7.8 Hz, J^2 = 1.5 Hz, 1H, ArH), 7.52–7.56 (m, 2H, ArH), 7.59 (dd, J^1 = 8.6 Hz, J^2 = 1.8 Hz, 1H, ArH), 7.79 (s, 1H, ArH), 7.84–7.86 (m, 3H, ArH), 8.01 (dd, J^1 = 7.8 Hz, J^2 = 1.4 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.3, 40.0, 72.7, 114.7, 116.5, 119.6, 124.5, 126.4, 127.1, 127.2, 128.2, 128.6, 128.9, 129.6, 133.4, 133.8, 134.1, 137.6, 145.7, 163.5 ppm; MS (EI, 70 eV): m/z = 304 (M + 2, 3), 303 (M + 1, 14), 302 (M^+, 54), 301 (M − 1, 17), 273 (23), 175 (100), 147 (90); Anal. Calcd. for $C_{20}H_{18}N_2O$: C, 79.44; H, 6.00; N, 9.26; Found: C, 79.62; H, 6.17; N, 9.17.

3-Ethyl-2-(thiophen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4k). (91%), mp 126–128°C; IR (KBr) υ_{max} = 3277, 3084, 2976, 2936, 1620, 1508, 1373, 1321, 1252, 1209, 1151, 1057, 955, 851, 775, 698 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.22 (t, J = 7.2 Hz, 3H, CH_3), 3.04–3.11 (m, 1H, NCH_2CH$_3$) 4.00–4.07 (m, 1H, NCH_2CH$_3$), 4.79 (br, s, 1H, NH), 6.64 (d, J = 8.0 Hz, 1H, CH), 6.89–6.94 (m, 2H, ArH), 7.06 (dd, J^1 = 3.4 Hz, J^2 = 0.7 Hz, 1H, ArH), 7.22 (dd, J^1 = 5.0 Hz, J^2 = 1.1 Hz, 1H, ArH), 7.29–7.32 (m, 1H, ArH), 7.98 (dd, J^1 = 7.8 Hz, J^2 = 1.5 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.6, 40.1, 68.1, 115.2, 117.1, 120.2, 126.4, 126.8, 128.9, 133.8, 144.2, 145.2, 162.7 ppm; MS (EI, 70 eV): m/z = 260 (M + 2, 21), 259 (M + 1, 56), 258 (M^+, 87), 257 (M − 1, 77), 229 (77), 175 (99), 147 (95), 92 (100); Anal. Calcd. for $C_{14}H_{14}N_2OS$: C, 65.09; H, 5.46; N, 10.84; S, 12.41; Found: C, 65.10; H, 5.55; N, 10.84; S, 11.94.

3-Ethyl-2-styryl-2,3-dihydroquinazolin-4(1H)-one (4l). (95%), mp 132–134°C; IR (KBr) υ_{max} = 3306, 2936, 1622, 1510, 1475, 1427, 1369, 1290, 1207, 1153, 1090, 1028, 987, 878, 785, 750 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.29 (t, J = 7.1 Hz, 3H, CH_3), 3.13–3.21 (m, 1H, NCH_2CH$_3$), 4.01–4.08 (m, 1H, NCH_2CH$_3$), 4.44 (br, s, 1H, NH), 5.23 (d, J = 8.2 Hz, 1H, CH), 6.41–6.46 (m, 1H, ArH), 6.61–6.66 (m, 2H, ArH), 6.99 (td, J^1 = 7.5 Hz, J^2 = 0.7 Hz, 1H, ArH), 7.29–7.41 (m, 6H, ArH), 7.98 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.7, 39.7, 71.8, 114.9, 116.8, 119.8, 126.5, 127.2, 129.0, 129.1, 133.5, 133.7, 135.8, 145.5, 162.7 ppm; MS (EI, 70 eV): m/z = 280 (M + 2, 8), 279 (M + 1, 47), 278 (M^+, 79), 277 (M − 1, 70), 249 (69), 175 (100), 147 (95), 146 (76); Anal. Calcd. for $C_{18}H_{18}N_2O$: C, 77.67; H, 6.52; N, 10.06; Found: C, 77.15; H, 6.30; N, 9.93.

3-Ethyl-2-(2-chlorophenyl)-2,3-dihydroquinazolin-4(1H)-one (4m). (93%), mp 146–149°C; IR (KBr) υ_{max} = 3287, 2990, 2934, 1622, 1421, 1325, 1167, 1045, 1028, 878, 827, 756, 696 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 1.26 (t, J = 7.1 Hz, 3H, CH_3), 2.85–2.92 (m, 1H, NCH_2CH$_3$), 4.12–4.19 (m, 1H, NCH_2CH$_3$), 5.09 (br, s, 1H, NH), 6.15 (s, 1H, CH), 6.52 (d, J = 8.0 Hz, 1H, ArH), 6.83 (td, J^1 = 7.8 Hz, J^2 = 0.8 Hz, 1H, ArH), 7.18–7.30 (m, 4H, ArH), 7.42 (dd, J^1 = 7.9 Hz, J^2 = 1.0 Hz, 1H, ArH), 7.97 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 13.6, 40.6, 68.2, 114.9, 116.5, 119.7, 127.8, 127.9, 128.8, 130.5, 130.6, 132.3, 133.9, 137.2, 144.9, 163.6 ppm; MS (EI, 70 eV): m/z = 288 (M + 2, 8), 286 (M^+, 24), 257 (12), 175 (100), 147 (94); Anal. Calcd. for $C_{16}H_{15}ClN_2O$: C, 67.02; H, 5.27; N, 9.77; Found: C, 67.10; H, 5.44; N, 9.67.

3-Butyl-2-(4-chlorophenyl)-2,3-dihydroquinazolin-4(1H)-one (4n). (97%), mp 150–151°C; IR (KBr) υ_{max} = 3300, 2938, 1628, 1515, 1487, 1418, 1323, 1090, 1016, 852, 748 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.92 (t, J = 7.4 Hz, 3H, CH_3), 1.32–1.39 (m, 2H, CH_2), 1.55–1.63 (m, 2H, CH_2), 2.75–2.81 (m, 1H, NCH_2CH$_2$), 3.98–4.05 (m, 1H, NCH_2CH$_2$), 4.54 (br, s, 1H, NH), 5.75 (s, 1H, CH), 6.56 (d, J = 7.8 Hz, 1H, ArH), 6.89 (td, J^1 = 6.9 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.26–7.30 (m, 1H, ArH), 7.32–7.36 (m, 4H, ArH), 7.98 (dd, J^1 = 7.8 Hz, J^2 = 1.4 Hz, 1H, ArH).

3-Butyl-2-(2,4-dichlorophenyl)-2,3-dihydroquinazolin-4(1H)-one (4o). (90%), mp 135–138°C; IR (KBr) υ_{max} = 3265, 3030, 2949, 2868, 1628, 1524, 1470, 1383, 1323, 1240, 1198, 1171, 1153, 1099, 1042, 930, 839, 818, 741, 692, 615, 569, 532, 461 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.97 (t, J = 7.4 Hz, 3H, CH_3), 1.41–1.47 (m, 2H, CH_2), 1.63–1.69 (m, 2H, CH_2), 2.66–2.72 (m, 1H, NCH_2CH$_2$), 4.16–4.22 (m, 1H, NCH_2CH$_2$), 5.03 (br, s, 1H, NH), 6.05 (s, 1H, CH), 6.53 (d, J = 8.0 Hz, 1H, ArH), 6.86 (td, J^1 = 7.6 Hz, J^2 = 0.9 Hz, 1H,

ArH), 7.17–7.26 (m, 3H, ArH), 7.45 (d, J = 1.7 Hz, 1H, ArH), 7.97 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 14.2, 20.5, 30.5, 45.5, 68.2, 115.0, 116.5, 120.0, 128.0, 128.7, 128.9, 130.5, 133.0, 134.0, 135.7, 144.5, 163.8 ppm; MS (EI, 70 eV): m/z = 350 (M + 2, 5), 349 (M + 1, 2), 348 (M^+, 8), 291 (12), 203 (100), 147 (91); Anal. Calcd. for $C_{18}H_{18}Cl_2N_2O$: C, 61.90; H, 5.19; N, 8.02; Found: C, 61.93; H, 5.19; N, 8.19.

3-Butyl-2-(4-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4p). (94%), mp 137–139°C; IR (KBr) υ_{max} = 3300, 3078, 2938, 2872, 1632, 1525, 1485, 1408, 1350, 1319, 1234, 1153, 1070, 1016, 930, 874, 825, 743 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.91 (t, J = 7.4 Hz, 3H, CH_3), 1.34–1.40 (m, 2H, CH_2), 1.56–1.64 (m, 2H, CH_2), 2.76–2.82 (m, 1H, NCH_2CH$_2$), 4.08–4.13 (m, 1H, NCH_2CH$_2$), 5.16 (br, s, 1H, NH), 5.85 (s, 1H, CH), 6.61 (d, J = 8.0 Hz, 1H, ArH), 6.87 (td, J^1 =7.3 Hz, J^2 = 0.9 Hz, 1H, ArH), 7.27 (td, J^1 = 7.2 Hz, J^2 = 1.4 Hz, 1H, ArH), 7.54 (d, J = 8.7 Hz, 2H, ArH), 7.94 (dd, J^1 = 7.8 Hz, J^2 = 1.2 Hz, 1H, ArH), 8.17 (dd, J^1 = 6.9 Hz, J^2 = 1.8 Hz, 2H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 14.2, 20.5, 30.4, 45.5, 71.2, 115.3, 116.8, 120.2, 124.6, 127.6, 128.8, 134.2, 144.6, 147.6, 148.6, 163.3 ppm; MS (EI, 70 eV): m/z = 325 (M^+, 2), 203 (87), 147 (100), 119 (37); Anal. Calcd. for $C_{18}H_{19}N_3O_3$: C, 66.45; H, 5.89; N, 12.91; Found: C, 66.37; H, 5.95; N, 12.70.

3-Butyl-2-(3-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one (4q). (90%), mp 102–105°C; IR (KBr) υ_{max} = 3304, 2957, 2833, 1630, 1508, 1500, 1412, 1323, 1250, 1148, 941, 856, 791, 760 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.91 (t, J = 7.3 Hz, 3H, CH_3), 1.31–1.38 (m, 2H, CH_2), 1.55–1.63 (m, 2H, CH_2), 2.78–2.84 (m, 1H, NCH_2CH$_2$), 3.79 (s, 3H, OCH_3), 3.97–4.03 (m, 1H, NCH_2CH$_2$), 4.54 (br, s, 1H, NH), 5.74 (s, 1H, CH), 6.55 (d, J = 7.8 Hz, 1H, ArH), 6.87 (td, J^1 = 7.5 Hz, J^2 = 0.9 Hz, 1H, ArH), 6.89–6.92 (m, 1H, ArH), 6.94 (t, J = 2.3 Hz, 1H, ArH), 6.97 (d, J = 7.7 Hz, 1H, ArH), 7.24–7.30 (m, 2H, ArH), 7.99 (dd, J^1 = 7.8 Hz, J^2 = 1.5 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 14.2, 20.6, 30.2, 44.9, 55.7, 72.5, 112.6, 114.6, 115.0, 116.8, 119.2, 119.7, 128.9, 130.4, 133.7, 142.0, 145.4, 160.5, 163.4 ppm; MS (EI, 70 eV): m/z = 312 (M + 2, 3), 311 (M + 1, 12), 310 (M^+, 52), 309 (M − 1, 12), 253 (42), 203 (100), 147 (99); Anal. Calcd. for $C_{19}H_{22}N_2O_2$: C, 73.52; H, 7.14; N, 9.03; Found: C, 72.98; H, 7.01; N, 8.93.

3-Butyl-2-(naphthalen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4r). (87%), mp 144–146°C; IR (KBr) υ_{max} = 3300, 2953, 2870, 1624, 1510, 1440, 1383, 1304, 1232, 1171, 1076, 904, 827, 752, 696, 550, 780 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.90 (t, J = 7.4 Hz, 3H, CH_3), 1.32–1.37 (m, 2H, CH_2), 1.59–1.65 (m, 2H, CH_2), 2.81–2.87 (m, 1H, NCH_2CH$_2$), 4.05–4.11 (m, 1H, NCH_2CH$_2$), 4.60 (br, s, 1H, NH), 5.95 (s, 1H, CH), 6.54 (d, J = 8.0 Hz, 1H, ArH), 6.88 (t, J = 7.4 Hz, 1H, ArH), 7.26 (td, J^1 = 7.6 Hz, J^2 = 1.4 Hz, 1H, ArH), 7.53–7.57 (m, 3H, ArH), 7.78 (s, 1H, ArH), 7.85–7.87 (m, 3H, ArH), 8.03 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH); ^{13}C-NMR (125 MHz, $CDCl_3$): δ 14.2, 20.6, 30.2, 45.0, 72.7, 114.7, 119.8, 124.3, 126.2, 127.1, 128.2, 128.6, 128.9, 129.7, 133.4, 133.8, 134.0, 137.5, 145.3, 163.5; MS (EI, 70 eV): m/z = 330 (M^+, 3), 203 (20), 147 (23), 127 (100), 119 (48); Anal. Calcd. for $C_{22}H_{22}N_2O$: C, 79.97; H, 6.71; N, 8.48; Found: C, 79.49; H, 6.68; N, 8.43.

3-Butyl-2-(thiophen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4s). (90%), 99–101°C; IR (KBr) υ_{max} = 3292, 2949, 2868, 1632, 1502, 1412, 1315, 1242, 1153, 1113, 1030, 912, 860, 762, 704 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$): δ 0.95 (t, J = 7.5 Hz, 3H, CH_3), 1.36–1.43 (m, 2H, CH_2), 1.58–1.71 (m, 2H, CH_2), 2.91–2.96 (m, 1H, NCH_2CH$_2$), 4.06–4.12 (m, 1H, NCH_2CH$_2$), 4.66 (br, s, 1H, NH), 6.00 (s, 1H, CH), 6.64 (d, J = 8.0 Hz, 1H, ArH), 6.91–6.94 (m, 2H, ArH), 7.04 (d, J = 3.4 Hz, 1H, ArH), 7.22 (dd, J^1 = 5.0 Hz, J^2 = 1.0 Hz, 1H, ArH), 7.26–7.33 (m, 1H, ArH), 7.99 (dd, J^1 = 7.8 Hz, J^2 = 1.3 Hz, 1H, ArH) ppm; ^{13}C-NMR (125 MHz, $CDCl_3$): δ 14.2, 20.6, 30.4, 45.0, 68.3, 115.3, 117.3, 120.3, 126.3, 126.9, 128.9, 133.8, 144.2, 145.0, 162.9 ppm; MS (EI, 70 eV): m/z = 287 (M + 1, 5), 286 (M^+, 18), 285 (M − 1, 11), 229 (27), 203 (67), 147 (100), 146 (12); Anal. Calcd. for $C_{16}H_{18}N_2OS$: C, 67.10; H, 6.33; N, 9.78, S, 11.20; Found: C, 66.52; H, 6.26; N, 9.42, S, 10.76.

3-Benzyl-2-(naphthalen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4t). (85%), mp 157–159°C; IR (KBr) υ_{max} = 3296, 3028, 2927, 1629, 1487, 1425, 1354, 1313, 752, 692 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 3.75 (d, J = 15.3, 1H, CH), 4.64 (br, s, 1H, NH), 5.70 (d, J = 15.3, 1H, CH), 5.83 (s, 1H, CH), 6.50 (d, J = 7.8, 1H, ArH), 6.90 (td, J^1 = 7.5 Hz, J^2 = 0.94, 1H, ArH), 7.26–7.33 (m, 6H, ArH), 7.5 (dd, J^1 = 7.8 Hz, J^2 = 1.8, 1H, ArH), 7.53–7.55 (m, 2H, ArH), 7.7 (d, J = 1.2, 1H, ArH), 7.81–7.87 (m, 3H, ArH), 8.1 (dd, J^1 = 7.8 Hz, J^2 = 1.5, 2H, ArH) ppm; ^{13}C-NMR (500 MHz, $CDCl_3$) δ 47.4, 71.6, 114.8, 116, 119.7, 124.3, 126.4, 127.1, 127.2, 128.1, 128.5, 128.6, 129, 129.3, 129.7, 133.3, 134, 134.1, 137, 137.2, 145.5, 163.7 ppm; MS (EI) m/z = 364.16 (M^+), 273.12 (2.76), 237.17 (4.54), 91.13 (100), 65.14 (25.58).

3-Benzyl-2-(3-methoxyphenyl)-2,3-dihydroquinazolin-4(1H)-one (4u). (91%), mp 169–171°C; IR (KBr) υ_{max} = 3268, 2929, 2835, 1622, 1483,1402, 1352, 1253, 1174, 1029, 829, 758, 723, 694 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 3.73 (d, J = 15.3, 1H, CH), 3.82 (s, 3H, CH_3) 4.55 (br, s, 1H, NH), 5.57 (d, J = 15.3, 1H, CH), 5.63 (s, 1H, CH), 6.55 (d, J = 7.95, 1H, ArH), 6.8–6.9 (m, 3H, ArH), 7.23 (d, J = 2.8, 4H, ArH) 7.27–7.34 (m, 4H, ArH), 8.00 (dd, J^1 = 7.8 Hz, J^2 = 1.5, 1H, ArH); ^{13}C-NMR (500 MHz, $CDCl_3$) δ 47.2, 55.8, 71.3, 114.6, 114.7, 116.1, 119.6, 127.8, 128.4, 128.5, 128.9, 129.2, 131.8, 134, 137.3, 145.7, 160.7, 163.7 ppm; MS (EI) m/z = 344.41 (M^+), 253.18 (20.73), 237.17 (20.43), 91.00 (100), 65.00 (26.83).

3-Benzyl-2-(4-nitrophenyl)-2,3-dihydroquinazolin-4(1H)-one (4v). (87%), mp 190–193°C; IR (KBr) υ_{max} = 3294, 2941, 2810, 1631,1487, 1413, 1348, 763, 698 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 3.78 (d, J = 15.3, 1H, CH), 4.55 (br, s, 1H, NH), 5.68 (d, J = 15.3, 1H, CH), 5.71 (s, 1H, CH), 6.59 (d, J = 7.95, 1H, ArH), 6.95 (td, J^1 = 15.1 Hz, J^2 = 0.6, 1H, ArH), 7.27 (dd, J^1 = 7 Hz, J^2 = 1.6, 2H, ArH), 7.29–7.36 (m, 4H, ArH), 8 (dd, J^1 = 7.8 Hz, J^2 = 1.4, 1H, ArH), 8.18–8.19 (m, 2H, ArH) ppm; ^{13}C-NMR (500 MHz, $CDCl_3$) δ 47.8, 70.3, 115.2, 120.5, 124.6, 127.7, 128.2, 128.4, 129.2, 129.4, 134.4, 136.5, 144.5, 146.8, 163.3 ppm; MS (EI) m/z = 359.13 (M^+), 268.13 (2.52), 237.16 (6.28), 91.04 (100), 65.03 (29.44).

3-Benzyl-2-(thiophen-2-yl)-2,3-dihydroquinazolin-4(1H)-one (4w). (88%), mp 175–177°C; IR (KBr) υ_{max} = 3288, 2943, 2810, 1625, 1516, 1411, 1305, 786, 698 cm^{-1}; ^{1}H-NMR (500 MHz, $CDCl_3$) δ 3.78 (d, J = 15.4, 1H, CH), 5.44 (br, s, 1H, NH), 5.55 (d, J = 15.4, 1H, CH), 5.80 (s, 1H, CH), 6.60 (d, J = 8.0, 1H, ArH), 6.81–6.85 (m, 2H, ArH), 6.89 (d, J = 2.7, 1H, ArH), 7.13 (dd, J^1 = 5.0 Hz, J^2 = 1.0, 1H, ArH), 7.20–7.36 (m, 3H, ArH), 7.94 (dd, J^1 = 7.8 Hz, J^2 = 1.4, 1H, ArH) ppm; ^{13}C-NMR (500 MHz, $CDCl_3$) δ 47.2, 66.9, 115.3, 116.2,

119.6, 126.2, 126.5, 126.7, 127.9, 128.4, 128.9, 129.0, 134.0, 137.2, 143.7, 145.6, 163.1 ppm; MS (EI) m/z = 320.18 (2.84) (M^+), 69.16 (52.48), 61.07 (59.57), 57.19 (100).

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REFERENCES AND NOTES

[1] Wasserscheid, P.; Welton, T. Ionic Liquids in Synthesis, 2nd ed.; Weinhiem: Wiley-VCH Verlag GmbH & Co. KGaA, 2008; pp 57.

[2] (a) Cole, A. C.; Jenson, J. L.; Ntai, I.; Tran, K.-L. T.; Weaver, K. J.; Forbes, D. C.; Davis, J. H., Jr. J Am Chem Soc 2002, 124, 5962; (b) Davis, J. H., Jr. Chem Lett 2004, 33, 1072; (c) Pârvulescu, V. I.; Hardacre, C. Chem Rev 2007, 107, 2615; (d) van Rantwijk, F.; Sheldon, R. A. Chem Rev 2007, 107, 2757; (e) Gu, Y.; Li, G. Adv Synth Catal 2009, 351, 817.

[3] (a) Semiglak, M.; Reichert, M. W.; Holbery, J. D.; Wilkes, J. S.; Sun, L.; Thrashe, J. S.; Kirichenko, K.; Singh, S.; Katritsky, A. R.; Rogers, R. D. Chem Commun 2006, 2554; (b) Semiglak, M.; Melten, A.; Rogers, R. D. Acc Chem Res 2007, 40, 1182; (c) Soutullo, M. D.; O'Brien, R. A.; Gaines, K. E.; Davis, J. H., Jr. Chem Commun 2009, 2529.

[4] (a) Scott, M. P.; Brazel, C. S.; Benton, M. G.; Mays, J. W.; Holbrey, J. D.; Rogers R. D. Chem Commun 2002, 1370; (b) Rahman, M.; Brazel, C. S. Polym Degrad Stab 2006, 91, 3371; (c) Lunstroot, K.; Driesen, K.; Nockemann, P.; Viau, L.; Mutin, P. H.; Vioux, A.; Binnemans, K. Phys Chem Chem Phys 2010, 12, 1879.

[5] Zhou, F.; Liang, Y.; Liu, W. Chem Soc Rev 2009, 38, 2590.

[6] (a) Swatloski, R. P.; Spear, S. K.; Holbrey, J. D.; Rogers, R. D. J Am Chem Soc 2002, 124, 4974; (b) Sun, N.; Swatloski, R. P.; Maxim, M. L.; Rahman, M.; Harland, A. G.; Haque, A.; Spear, S. K.; Daly, D. T.; Rogers, R. D. J Mater Chem 2008, 18, 283; (c) Pinkert, A.; Marsh K. N.; Pang, S.; Staiger, M. P. Chem Rev 2009, 109, 6712.

[7] Hough, W. L.; Smiglak, M.; Rodriguez, H.; Swatloski, R. P.; Spear, S. K.; Daly, D. T.; Pernak, J.; Grisel, J. E.; Carliss, R. D.; Soutullo, M. D.; Davis, J. H., Jr.; Rogers, R. D. New J Chem 2007, 31, 1429.

[8] Rogers, R. D.; Seddon, K. R.; Volkov, S. Green Industrial Applications of Ionic liquids; Kluwer Academic Publishers: Dordrecht, 2009.

[9] (a) Biressi, M. G.; Cantarelli, G.; Carissimi, M.; Cattaneo A.; Ravenna, F. Farmaco Ed Sci 1969, 24, 199; (b) Hamel, E.; Lin, C. M.; Plowman, J.; Wang, H. D.; Lee, K. H.; Paull, K. D.; Biochem Pharmacol 1996, 51, 53; (c) Hour, M.-J.; Huang, L.-J.; Kuo, S.-C.; Xia, Y.; Bastow, K. F.; Nakanishi, Y.; Hamel E.; Lee, K. J Med Chem 2000, 43, 4479; (d) Gravier, D.; Dupin, J. P.; Casadebaig, F.; Hou, G.; Boisseau M.; Bernard, H. Pharmazie 1992, 47, 91; (e) Baker, B. R.; Schaub, R. E.; Joseph, J. P.; McEvoy F. J.; Williams, J. H. J Org Chem 1953, 18, 133; (f) Wolfe, J. F.; Rathman, T. L.; Sleevi, M. C.; Campbell, J. A.; Greenwood, T. D. J Med Chem 1990, 33, 161; (g) Alagarsamy, V.; Solomon, V. R. Dhanabal, K. Bioorg Med Chem 2007, 15, 235.

[10] (a) Michael, J. P. Nat Prod Rep 2004, 21, 650; (b) Johne, S. In Rodd's Chemistry of Carbon Compounds, Supplements to the 2nd ed.; Ansell, M. F., Ed.; Elsevier: Amsterdam, 1995; Vol. IV I/J, p 223.

[11] (a) Amin, A. H.; Mehta D. R. Nature 1959, 183, 1317; (b) Mehta, D. R.; Naravane, J. S.; Desai, R. M. J Org Chem 1963, 28, 445; (c) Wu, X.; Qin, G.; Cheung, K. K.; Cheng, K. F. Tetrahedron 1997, 53, 13323; (d) Ma, Z.-Z.; Hano, Y.; Nomura, T.; Chen, Y.-J. Heterocycles 1997, 46, 551; (e) Molina, P.; Tárraga, A.; Gonzalez-Tejero, A.; Rioja, I.; Ubeda, A.; Terencio, M. C.; Alcaraz, M. J. J Nat Prod 2001, 54, 1297.

[12] Audeval, B.; Bouchacourt, P.; Rondier, J. Gaz Med Fr 1988, 95, 70.

[13] Amin, A. H.; Mehta D. R.; Samarth, S. S. Prog Drug Res 1970, 14, 218.

[14] (a) Johne, S. Pharmazie 1981, 36, 583; (b) Mannschreck, A.; Koller, H.; Stühler, G.; Davies, M. A.; Traber, J. Eur J Med Chem Chim Ther 1984, 19, 381; (c) Sharma, S. D.; Kaur, V. Synthesis 1989, 9, 677; (d) Cizmarik, J.; Trupe, J. Pharmazi 1987, 42, 139; (e) Kung, P. P.; Casper, M. D.; Cook, K. L.; Willson-lin-gardo, L. J Med Chem 2000, 42, 4705; (f) Corbett, J. W.; Ko, S. S.; Rodgers, J. D.; Gearhart, L. A.; Magnus, N. A.; Bachheler, L. T.; Diamond, S.; Jeffey, S.; Trainor, G. L.; Anderson, P. S.; Erickson-Vitanen, K. J Med Chem 2000, 43, 2019; (g) Liu, J. F.; Lee, J.; Dalton, A. M.; Bi, G.; Yu, L.; Baldino, C. M.; McElory, E.; Brown, M. Tetrahedron Lett 2005, 46, 1241.

[15] (a) Moor, J. A.; Sutherland, G. L.; Sowerby, R.; Kelly, E. G.; Palermo, S.; Webster, W. J Org Chem 1969, 34, 887; (b) Su, W.; Yang, B. Aust J Chem 2002, 55, 695; (c) Shi, D.; Rong, L.; Wang, J.; Zhuang, Q.; Wang, X.; Hu, H. Tetrahedron Lett 2003, 44, 3199; (d) Sadanadam, Y. S.; Reddy, K. R. M.; Rao, A. B. Eur J Org Chem 1987, 22, 169; (e) Sharma, S. D.; Kaur, V. Synthesis 1989, 9, 677; (f) Shi, D.; Rong, L.; Wang, J.; Zhuang, Q.; Wang, X.; Hu, H. Tetrahedron Lett 2003, 44, 3199 (g) Liu, J.-F.; Ye, P.; Sprague, K.; Sargent, K.; Yohannes, D.; Baldino, C. M.; Wilson, C. J.; Ng, S.-C. Org Lett 2005, 7, 3363.

[16] Chen, J.; Su, W.; Wu, H.; Liub, M.; Jin, C. Green Chem 2007, 9, 972.

[17] Swatloski, R. P.; Holbrey, J. D.; Rogers, R. D. Green Chem 2003, 5, 361.

[18] Khosropour, A. R.; Mohammadpoor-Baltork, I.; Ghorbankhani, H. Tetrahedron Lett 2006, 47, 3561.

[19] Chaiappe, C.; Leandri, E.; Tebano, M. Green Chem 2006, 8, 742.

[20] Dabiri, M.; Salehi, P.; Otokesh, S.; Baghbanzadeh, M.; Kozehgary, G.; Mohammadi, A. A. Tetrahedron Lett 2005, 46, 6123.

[21] Chen, J.; Wu, D.; He, F.; Liu, M.; Wu, H.; Ding, J.; Su, W. Tetrahedron Lett 2008, 49, 3814.