Regioselective synthesis of pyrazoles *via* the ring cleavage of 3-substituted *N*-alkylated 3-hydroxyisoindolin-1-ones

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N-Alkyl (Me, Et, ^{i}Pr, ^{t}Bu)-substituted phthalimides **5** were easily transformed to mono-, di-, or tri-substituted pyrazoles **6** *via* a one-pot addition–decyclisation–cyclocondensation process. The regiochemistry of the pyrazole ring was determined by X-ray crystallographic analysis and ^{1}H NOE experiments.

α-Acetylenic ketones have proven to be very suitable substrates for the synthesis of a wide range of heterocyclic systems.[1] However, the closest literature precedent to regioselective synthesis of pyrazoles using α-acetylenic ketones has been independently studied by the groups of Sabri,[2] Linderman,[3] and Giacomelli.[4] Regioselective syntheses of 2,3- or 1,3-substituted pyrazoles are of considerable interest to heterocyclic chemistry. In general, well-designed β-diketones (or diketo esters) as the precursors and a 1,3-dipolar cycloaddition process have been utilised to produce many pyrazole compounds.[5] However, unsymmetric 1,3-diketones (or diketo esters) give a mixture of two regioisomers in a ratio which depends on the nature of 1,3-diketones (or diketo esters).[5e] Thus, we designed a regioselective synthetic method for the preparation of mono-, di-, or tri-substituted pyrazoles according to methodology based on a hypothetic pathway shown in Scheme 1. Regioselective pyrazole formation involves nucleophilic addition of lithium acetylide onto the *N*-substituted phthalimides **1** to give the keto tautomers **3** of alkynyl-substituted hydroxyisoindolines **2**. Then, α-acetylenic ketones of type **3** may regioselectively react with a variety of hydrazines to produce 2,3-disubstituted pyrazoles **4**. Here, we describe a facile construction method of 2,3-disubstituted pyrazoles **6** employing a one-pot addition–decyclisation–cyclocondensation process.

Results and discussion

The requisite substrates **1** were prepared easily by the usual method from commercially available phthalic anhydride and phthalimide. Subsequently, we investigated a one-pot addition–decyclisation–cyclocondensation process as depicted in Scheme 1. The results are summarised in Table 1. The typical procedure is as follows: to a solution of lithium phenylacetylide (or *p*-tolylacetylide), which was prepared by treatment of *n*-BuLi with phenylacetylene (or *p*-tolylacetylene) in THF, was added a solution of **5a** in THF at 0 °C. After the starting material **5a** had disappeared, the reaction mixture was quenched by addition of H_2O and evaporated to give a residue that was dissolved in EtOH. A solution of hydrazine monohydrate in EtOH was then added and refluxed for 1 h to obtain the pyrazoles **6a-1** and **6a-2** in 74 and 70% yields, respectively. Similar reactions of **5b** and **5c** with lithium phenylacetylide, H_2O and hydrazine monohydrate under reflux conditions gave the pyrazoles **6b** and **6c** in very low yields, respectively. However, *N*-*tert*-butylphthalimide **5d** was easily converted to pyrazole **6d-1** under the mild reaction conditions in excellent yield. We then realized that the size of the *N*-substituted groups on **5** influences the ring cleavage of the C_3–N_2 bond of 3-alkynyl-3-hydroxyisoindoline, which affords the α-acetylenic ketone intermediate. In order to investigate the limitation and scope of a one-pot addition–decyclisation–cyclocondensation process, the reaction of **5d** with organometallic agents was carried out to produce the keto tautomer ynones of 3-hydroxyisoindolines *in situ*. Interestingly, **5d** was treated with lithium phenylacetylide, H_2O and methylhydrazine to give 2,3-disubstituted pyrazole **6d-2** as the sole product in high regioselectivity and yield. The reaction of **5d** with ethynylmagnesium bromide, H_2O and hydrazine monohydrate proceeded smoothly to give pyrazole **6d-3**. Compound **5d** was also treated with lithium (trimethylsilyl)acetylide under similar conditions to give the same desilylated pyrazole **6d-3** in good yield, which was identical to **6d-3** that was obtained by the reaction with ethynylmagnesium bromide. Similar treatment of **5d** with lithium *p*-tolylacetylide, H_2O and various substituted hydrazine derivatives afforded regioselectively the corresponding 2,3-disubstituted pyrazoles **6d-4**, **6d-5** and **6d-6** in good yields, respectively (Table 1).

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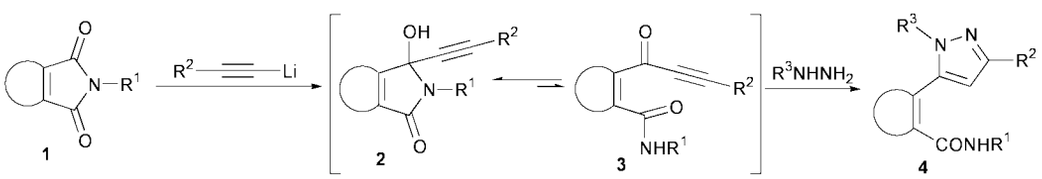
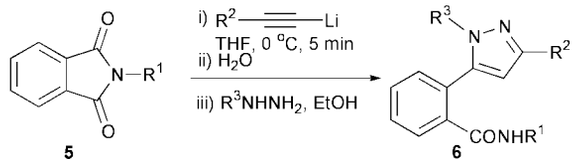


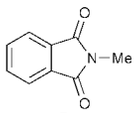
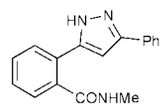
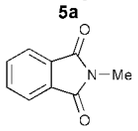
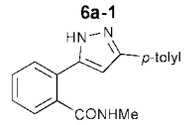
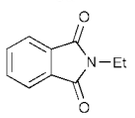
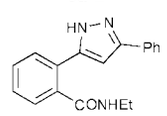
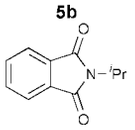
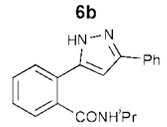
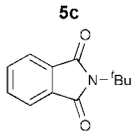
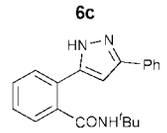
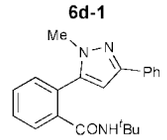
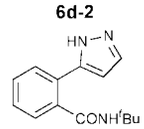
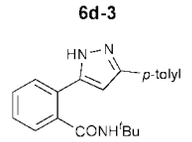
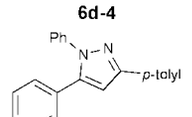
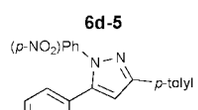
Scheme 1

DOI: 10.1039/b108485m

Table 1 Regioselective synthesis of pyrazoles **6** *via* ring cleavage of **5** by one-pot decyclization–cyclocondensation[a]



5 6

Substrates	Conditions[b]	Products[c]	Yield (%)[d]
 **5a**	R^2 = Ph R^3 = H, reflux 1 h	 **6a-1**	74
 **5a**	R^2 = p-tolyl R^3 = H, reflux 30 min	 **6a-2**	70
 **5b**	R^2 = Ph R^3 = H, reflux 3 h	 **6b**	6
 **5c**	R^2 = Ph R^3 = H, reflux 3 h	 **6c**	26
 **5d**	R^2 = Ph R^3 = H, rt 10 min	 **6d-1**	92
5d	R^2 = Ph R^3 = Me, rt 10 min	 **6d-2**	95
5d	R^2 = H R^3 = H, rt 5 min	 **6d-3**	72
5d	R^2 = TMS R^3 = H, rt 5 min	**6d-3**	96
5d	R^2 = p-tolyl R^3 = H, rt 15 min	 **6d-4**	95
5d	R^2 = p-tolyl R^3 = Ph, reflux 2 h	 **6d-5**	87
5d	R^2 = p-tolyl R^3 = (p-NO_2)Ph, reflux, 5 h	 **6d-6**	71

[a] 5.0 equiv. of hydrazine hydrate and 2.0 equiv. of methyl-, phenyl-, and *p*-nitrophenylhydrazines were used. [b] Reaction time with hydrazine derivatives. [c] The structure and position of substitution were determined by their characteristic data and NOE experiments. [d] Isolated yields.

In order to compare the reactivity with *N-tert*-butylphthalimide **5d**, the reactions of *N*-methyl-, ethyl- and isopropylphthalimides **5a–c** with lithium phenylacetylide, H_2O and phenyl- (or 4-nitrophenyl-) hydrazine were attempted under reflux conditions. However, these reactions resulted in 95, 97 and 97% recovery of the starting materials **5a–c**. In contrast, we could also isolate 3-hydroxyisoindoline **7** (R^1 = ^{t}Bu, R^2 = Ph) and α-acetylenic ketone **8** (R^1 = ^{t}Bu, R^2 = Ph) in 65 and 22% yields, respectively. When either **7** or **8** was treated with hydrazine monohydrate, the same pyrazole **6d-1** was produced in an excellent yield. Also, after treating the pure hydroxylactam **7** with bases such K_2CO_3, Et_3N and DMAP in THF, the reaction mixture was subjected to the usual method to give a 3 : 1 ratio of the ring–chain tautomers **7** and **8**. Thus, this characteristic reactivity of **5a–c** *vs.* that of **5d** may be explained in terms of a steric effect between the *N*-substituted groups and the 3-alkynyl groups of the *N*-alkylated 3-alkynyl-3-hydroxyisoindoline intermediates. In all of the pyrazole ring formations, cleavage of the ring at the C_3–N_2 bond of the 3-hydroxyisoindoline *N*-substituted with a *tert*-butyl group turned out to be preferable to that at the C_3–N_2 bond of 3-hydroxyisoindoline *N*-substituted with methyl, ethyl and isopropyl groups.

The structures of **6** were determined on the basis of their characteristic spectroscopic data. In particular, the structure of **6d-3** was determined by X-ray crystallographic analysis (Fig. 1).[6] ‡ The position of the N_2-4-nitrophenyl group of **6d-6** was

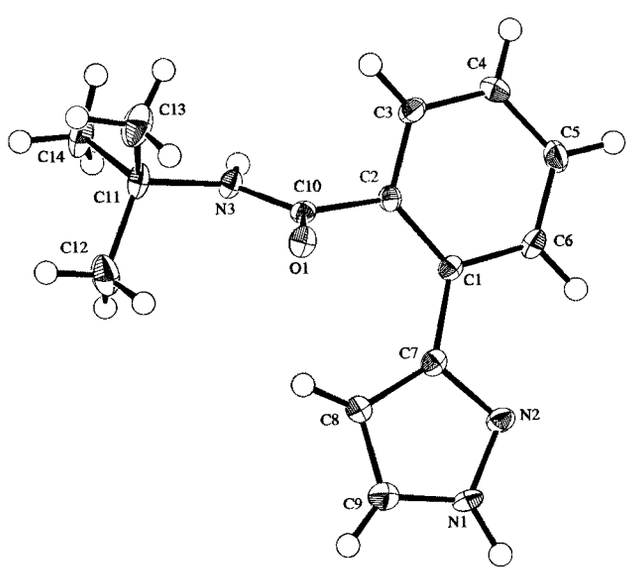
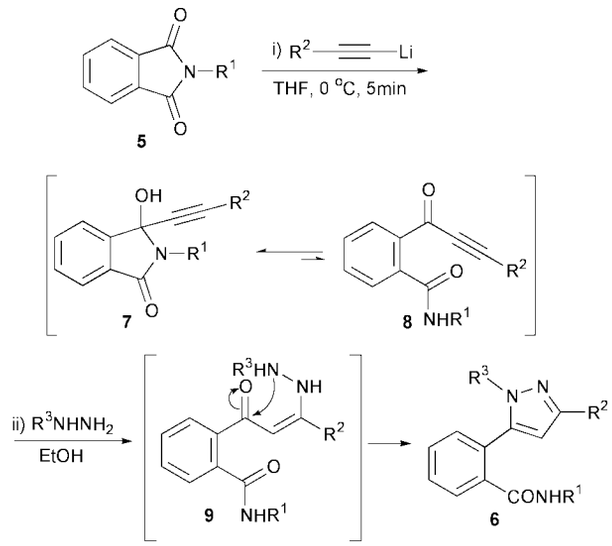


Fig. 1 X-Ray crystal structure of **6d-3**.

readily established by ^{1}H NOE experiments. Irradiation of the phenyl protons of the N_2-4-nitrophenyl group resulted in a 1.56% nuclear Overhauser enhancement of the phenyl proton of the C_3-2-*tert*-butylbenzamide of the pyrazole ring, but not in a ^{1}H NOE with the C_4-proton of the pyrazole ring. Moreover, irradiation of the phenyl protons of the C_5-*p*-tolyl group showed a 9.48% NOE with the C_4-proton of the pyrazole ring, but no ^{1}H NOE with the protons of the N_2-4-nitrophenyl group.

The regiochemical outcome may be rationalized according to Sabri's results[2] as shown in Scheme 2. Thus, the less sterically hindered unsubstituted nitrogen attacks the β-position of the ynone species **8**, generated *in situ*, to give a β-hydrazine-substituted alkenone **9**, in which the substituted nitrogen is brought into close proximity to the carbonyl carbon allowing rapid completion of the cyclization with expulsion of water to

‡ CCDC reference number 172539. See http://www.rsc.org/suppdata/p1/b1/b108485m/ for crystallographic files in .cif or other electronic format.



Scheme 2

give predominantly the 2,3-disubstituted pyrazoles. As a result, the regiochemical preference in this addition depends on steric, electronic and mechanistic factors.

In conclusion, we have found that an *N*-*tert*-butyl group is the best for producing the α-acetylenic ketone intermediate by ring cleavage at the C_3–N_2 bond of 3-hydroxyisoindoline to give the 2,3-disubstituted pyrazole. These species should be valuable for novel 5- or 6-membered heterocycles, such as isoxazole,[7] isothiazole[8] and quinoline[9] derivatives.

Experimental

General

Mps were measured on a Thomas-Hoover capillary apparatus and are uncorrected. Proton and carbon magnetic resonance spectra were measured downfield relative to tetramethylsilane in $CDCl_3$ unless otherwise noted (value in ppm); coupling constants *J* are reported in hertz; ^{1}H NMR, ^{13}C NMR and ^{1}H NOE experiments were conducted on Bruker AVANCE 300, 400 and FTNMR-DRX 500 spectrometers. Infrared spectral data were obtained on Hitachi 270–50 and EQUINOX55 spectrometers. Elemental analyses were performed with a Perkin Elmer 240C. X-Ray diffraction data were obtained with a Rigaku RAXIS-RAPID Imaging Plate diffractometer with graphite monochromated Mo-Kα radiation. Open column chromatography was carried out on silica gel 60 (70–230 mesh, Merck).

N-Methyl-2-(5-phenyl-2*H*-pyrazol-3-yl)benzamide (6a-1): typical procedure

To a solution of lithium phenylacetylide, which was prepared by treatment of *n*-BuLi (1.40 ml, 2.23 mmol, 1.6 M in hexane solution) with phenylacetylene (245.14 μl, 2.23 mmol) in THF (10 ml) was added a solution of **5a** (300 mg, 1.86 mmol) in THF (10 ml) at 0 °C. After 5 min, the reaction mixture was quenched by addition of H_2O (0.1 ml) and evaporated to give the residue, which was dissolved in EtOH (5 ml) and then a solution of hydrazine monohydrate (676.08 μl, 11.15 mmol, 80% in H_2O) in EtOH (5 ml) was added at room temperature. After being refluxed for 1 h, the reaction mixture was cooled to room temperature and evaporated under reduced pressure to give the residue, to which was added H_2O (10 ml) and which was then extracted with EtOAc. The combined organic layer was washed with brine, dried over anhydrous $MgSO_4$, filtered and evaporated to give the crude product. Purification by flash column chromatography on silica gel [EtOAc–hexane (2 : 1)] gave the pure **6a-1** (381 mg, 74%) as colorless prisms, mp 134–136 °C (CH_2Cl_2–hexane); IR (KBr) 3260, 3000 and 1650 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 2.82 (3H, d, *J* 4.8), 6.35 (1H, d, *J* 4.5), 6.71 (1H, s), 7.30–7.32 (2H, m), 7.33–7.42 (3H, m), 7.45 (1H, dd, *J* 1.1, 7.7), 7.59 (1H, dd, *J* 0.6, 7.2) and 7.74 (2H, dd, *J* 1.0, 7.2) (Found: C, 73.80; H, 5.52; N, 15.38. $C_{17}H_{15}N_3O$. requires C, 73.63; H, 5.45; N, 15.15%).

***N*-Methyl-2-(5-*p*-tolyl-2*H*-pyrazol-3-yl)benzamide (6a-2).** Compound **6a-2** was obtained under similar reaction conditions, starting from **5a** (300 mg, 1.86 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 1)] to give pure **6a-2** (379 mg, 70%) as colorless prisms, mp 152–154 °C (CH_2Cl_2–hexane); IR (KBr) 3250 and 1650 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 2.35 (3H, s), 2.79 (3H, d, *J* 4.9), 6.37 (1H, d, *J* 4.8), 6.66 (1H, s), 7.16 (2H, d, *J* 7.9), 7.28 (1H, dt, *J* 0.6, 7.4), 7.38 (1H, dt, *J* 1.1, 7.5), 7.42 (1H, d, *J* 10.6), 7.56 (1H, d, *J* 7.7) and 7.60 (2H, d, *J* 8.0); δ_C ($CDCl_3$, 125 MHz) 21.7, 27.3, 102.5, 125.9, 128.5, 128.6, 129.1, 129.2, 129.3, 129.9, 130.6, 135.6, 138.3, 146.2, 149.6 and 171.8 (Found: C, 74.38; H, 5.59; N, 14.38. $C_{18}H_{17}N_3O$ requires C, 74.20; H, 5.88; N, 14.42%).

***N*-Ethyl-2-(5-phenyl-2*H*-pyrazol-3-yl)benzamide (6b).** Compound **6b** was obtained under similar reaction conditions, starting from **5b** (207 mg, 1.18 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 1)] to give pure **6b** (21 mg, 6%) as colorless prisms, mp 148–149 °C (CH_2Cl_2–hexane); IR (KBr) 3250 and 1639 cm^{-1}; δ_H ($CDCl_3$, 300 MHz) 1.06 (3H, t, *J* 7.2), 3.35 (2H, q, *J* 7.2), 6.07 (1H, s), 6.75 (1H, s) and 7.30–7.78 (9H, m) (Found: C, 74.09; H, 5.92; N, 14.27. $C_{18}H_{17}N_3O$ requires C, 74.20; H, 5.88; N, 14.42%).

***N*-Isopropyl-2-(5-phenyl-2*H*-pyrazol-3-yl)benzamide (6c).** Compound **6c** was obtained under similar reaction conditions, starting from **5c** (198 mg, 1.05 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 1)] to give pure **6c** (85 mg, 26%) as colorless prisms, mp 197–198 °C (CH_2Cl_2–hexane); IR (KBr) 3306, 3063, 2975 and 1632 cm^{-1}; δ_H ($CDCl_3$, 400 MHz) 1.12 (6H, d, *J* 6.6), 4.19 (1H, m), 5.77 (1H, d, *J* 7.6), 6.78 (1H, s) and 7.31–7.80 (9H, m) (Found: C, 74.89; H, 6.40; N, 13.59. $C_{19}H_{19}N_3O$ requires C, 74.73; H, 6.27; N, 13.76%).

***N*-*tert*-Butyl-2-(5-phenyl-2*H*-pyrazol-3-yl)benzamide (6d-1).** Compound **6d-1** was obtained starting from **5d** (300 mg, 1.48 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane, (1 : 1)] to give pure **6d-1** (435 mg, 92%) as colorless prisms, mp 179–180 °C (CH_2Cl_2–hexane); IR (KBr) 3431, 3209, 3038, 2981 and 1636 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 1.34 (9H, s), 5.76 (1H, s), 6.78 (1H, s), 7.30–7.36 (2H, m), 7.39–7.45 (3H, m), 7.49 (1H, d, *J* 7.6), 7.62 (1H, d, *J* 7.6) and 7.80 (2H, d, *J* 7.3) (Found: C, 75.06; H, 6.70; N, 13.50. $C_{20}H_{21}N_3O$ requires C, 75.21; H, 6.63; N, 13.16%).

***N*-*tert*-Butyl-2-(2-methyl-5-phenyl-2*H*-pyrazol-3-yl)benzamide (6d-2).** Compound **6d-2** was obtained under similar reaction conditions, starting from **5d** (300 mg, 1.48 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 2)] to give pure **6d-2** (469 mg, 95%) as colorless prisms, mp 126–127 °C (CH_2Cl_2–hexane); IR (KBr) 3228, 3042, 2975, 1656 and 1545 cm^{-1}; δ_H ($CDCl_3$, 300 MHz) 1.31 (9H, s), 3.91 (3H, s), 5.78 (1H, br s), 6.20 (1H, s) and 7.32–7.77 (9H, m); δ_C ($CDCl_3$, 75 MHz) 28.5, 37.5, 51.5, 106.5, 125.6, 127.9, 128.2, 128.6, 128.7, 129.3, 129.4, 130.4, 130.9, 137.2, 144.5, 149.6 and 169.0 (Found: C, 75.58; H, 7.03; N, 12.48. $C_{21}H_{23}N_3O$ requires C, 75.65; H, 6.95; N, 12.60%).

***N*-*tert*-Butyl-2-(2*H*-pyrazol-3-yl)benzamide (6d-3).** Compound **6d-3** was obtained under similar reaction conditions, starting from **5d** (300 mg, 1.48 mmol). The crude product was

purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 1)] to give pure **6d-3** (346 mg, 96%) as colorless prisms, mp 189–190 °C (CH_2Cl_2–hexane); IR (KBr) 3146, 2964 and 1633 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 1.37 (9H, s), 5.70 (1H, br s), 6.53 (1H, d, *J* 1.7), 7.37–7.62 (5H, m) and 11.64 (1H, br s) (Found: C, 69.30; H, 7.18; N, 17.50. $C_{14}H_{17}N_3O$ requires C, 69.11; H, 7.04; N, 17.27%).

***N-tert*-Butyl-2-(5-*p*-tolyl-2*H*-pyrazol-3-yl)benzamide (6d-4).** Compound **6d-4** was obtained under similar reaction conditions, starting from **5d** (300 mg, 1.48 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 3)] to give pure **6d-4** (469 mg, 95%) as yellow prisms, mp 181–183 °C (CH_2Cl_2–hexane); IR (KBr) 3260, 3100, 3000 and 1655 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 1.33 (9H, s), 2.38 (3H, s), 5.77 (1H, br s), 6.75 (1H, s), 7.21 (2H, d, *J* 7.8), 7.35 (1H, t, *J* 7.5), 7.43 (1H, t, *J* 7.4), 7.50 (1H, dd, *J* 0.9 and 7.6), 7.61 (1H, d, *J* 7.6) and 7.68 (2H, d, *J* 7.9) (Found: C, 75.85; H, 7.08; N, 12.83. $C_{21}H_{23}N_3O$ requires C, 75.65; H, 6.95; N, 12.60%).

***N-tert*-Butyl-2-(2-phenyl-5-*p*-tolyl-2*H*-pyrazol-3-yl)benzamide (6d-5).** Compound **6d-5** was obtained under reflux conditions, starting from **5d** (300 mg, 1.48 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 2)] to give pure **6d-5** (527 mg, 87%) as yellow prisms, mp 67–68 °C (CH_2Cl_2–hexane); IR (KBr) 3420, 3320, 3060, 2980 and 1660 cm^{-1}; δ_H ($CDCl_3$, 400 MHz) 1.29 (9H, s), 2.36 (3H, s), 6.89 (1H, s), 7.14 (1H, d, *J* 7.6), 7.24 (2H, d, *J* 8.0), 7.29–7.49 (7H, m), 7.62 (1H, br s) and 7.74 (2H, d, *J* 8.0); δ_C ($CDCl_3$, 100 MHz) 21.3, 28.5, 51.5, 106.3, 123.8, 125.7, 127.0, 128.5, 128.8, 129.2, 129.4, 129.9, 130.0, 131.0, 137.5, 137.9, 139.5, 142.0, 152.0 and 166.6 (Found: C, 79.29; H, 6.48; N, 10.12. $C_{27}H_{27}N_3O$ requires C, 79.19; H, 6.65; N, 10.26%).

***N-tert*-Butyl-2-[2-(4-nitrophenyl)-5-*p*-tolyl-2*H*-pyrazol-3-yl]-benzamide (6d-6).** Compound **6d-6** was obtained under reflux conditions, starting from **5d** (300 mg, 1.48 mmol). The crude product was purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 2)] to give pure **6d-6** (477 mg, 71%) as yellow needles, mp 169–170 °C (CH_2Cl_2–hexane); IR (KBr) 3390, 3000, 2900, 1660 and 1600 cm^{-1}; δ_H ($CDCl_3$, 400 MHz) 1.17 (9H, s), 2.39 (3H, s), 5.41 (1H, br s), 6.80 (1H, s), 7.25 (2H, d, *J* 4.9), 7.33 (1H, dd, *J* 1.2, 5.0), 7.50 (4H, m), 7.66 (1H, dd, *J* 1.1, 5.3), 7.78 (2H, d, *J* 6.0) and 8.10 (2H, d, *J* 6.7); δ_C ($CDCl_3$, 100 MHz) 21.3, 28.6, 51.7, 107.7, 123.1, 124.5, 125.9, 128.2, 128.6,129.3, 129.5, 129.9, 130.4, 130.7, 137.7, 138.6, 142.9, 144.5, 145.5, 153.3 and 166.6 (Found: C, 71.48; H, 5.85; N, 12.42. $C_{27}H_{26}N_4O_3$ requires C, 71.35; H, 5.77; N, 12.33%).

Preparation of compounds 7 and 8

To a solution of *N-tert*-butylphthalimide **5d** (800 mg, 3.94 mmol) in THF (10 ml) was added a solution of lithium phenylacetylide which was prepared by treatment of phenylacetylene (519.4 μl, 4.73 mmol) with *n*-BuLi (2.96 ml, 4.73 mmol, 1.6 M in hexane solution) in THF (10 ml) at 0 °C under a N_2 atmosphere. After being stirred for 20 min, the reaction mixture was treated with H_2O (0.1 ml) and then extracted with EtOAc. The combined organic layer was washed with brine, dried over anhydrous $MgSO_4$ and filtered. The filtrate was evaporated *in vacuo* to afford the crude products **7** and **8**, which were purified by flash column chromatography on silica gel [EtOAc–hexane (1 : 3)] to give the pure products **7** (780 mg, 65%) and **8** (264 mg, 22%), respectively.

2-*N-tert*-Butyl-3-hydroxy-3-phenylethynylisoindolin-1-one (7). Colorless prisms, mp 148–150 °C (CH_2Cl_2–hexane); IR (KBr) 3300, 2240 and 1680 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 1.76 (9H, s), 3.78 (1H, s), 7.32 (3H, m), 7.42 (3H, m), 7.55 (1H, t like, *J* 7.4) and 7.66 (2H, dd, *J* 7.5, 7.6); δ_C ($CDCl_3$, 125 MHz) 28.74, 56.79, 84.11, 85.41, 86.80, 121.80, 122.96, 128.39, 129.07, 129.87, 130.50, 131.62, 132.64, 146.68 and 167.68 (Found: C, 78.48; H, 6.40; N, 4.37. $C_{20}H_{19}NO_2$ requires C, 78.66; H, 6.27; N, 4.59%).

***N-tert*-Butyl-2-(3-phenylpropynoyl)benzamide (8).** Colorless prisms, mp 168–170 °C (CH_2Cl_2–hexane); IR (KBr) 3350, 2255 and 1655 cm^{-1}; δ_H ($CDCl_3$, 500 MHz) 1.47 (9H, s), 5.60 (1H, br), 7.39–8.10 (8H, m) and 8.11 (1H, dd, *J* 1.0, 7.4); δ_C ($CDCl_3$, 125 MHz) 28.70, 52.13, 87.78, 93.68, 120.07, 128.26, 128.66, 129.34, 130.89, 131.12, 132.82, 133.18, 135.62, 138.88, 168.42 and 178.28 (Found: C, 78.80; H, 6.38; N, 4.42. $C_{20}H_{19}NO_2$ requires C, 78.66; H, 6.27; N, 4.59%).

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