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Four-Component Synthesis of Disubstituted 1,3,4-Oxadiazole Derivatives from Cinnamaldehyde, an Aromatic Carboxylic Acid, a Secondary Amine, and *N*-Isocyaniminotriphenylphosphorane

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ABSTRACT: *The iminium intermediate generated by the reaction between a secondary amine and cinnamaldehyde was reacted with N-isocyaniminotriphenylphosphorane in the presence of benzoic acid derivatives to form the corresponding iminophosphorane intermediate, whose intramolecular aza-Wittig reaction led to disubstituted 1,3,4-oxadiazole derivatives. The syntheses were completed under neutral conditions at room temperature to give excellent yields.*
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INTRODUCTION

1,3,4-Oxadiadoles have attracted interest in medicinal chemistry as surrogates of carboxylic acid. They are an important class of heterocyclic compounds that have a wide range of pharmaceutical and biological activities such as antimicrobial, antifungal, antimalarial, analgesic, hypoglycemic, and antihypertensive anti-Inflammatory [1–5]. The multicomponent condensation reactions give advantages to other reactions. In recent years, several techniques have been reported for the preparation of $CNNPPh_3$ **4** [6,7]. There are various methods for the use of **4** in the synthesis of metal complexes. However, the application of **4** in the synthesis of organic compounds is uncommon. Today, most isocyanide-based multicomponent reactions (IMCRs) chemistry relates to the traditional reactions of Passerini and Ugi. Indeed, the wide number of various scaffolds now available mainly builds on these two IMCRs and their combination with other kinds of reactions [8–31]. In recent years, the intramolecular version of the aza-Wittig type reaction has attracted much attention because of its high potential for the synthesis of a wide variety of nitrogen hetrocycles [32]. Lately, we have established a one-pot technique to synthesize organophosphorus compounds [32–41]. Not many reliable simple examples have been reported for the single-step synthesis of 1,3,4-oxadiazoles, especially from easily available carboxylic acids and acid hydrazides [42]. In this paper, we report an efficient synthetic method for the preparation of disubstituted 1,3,4-oxadiazole derivatives using $CNNPPh_3$ **4** chemistry [27] (Scheme 1).

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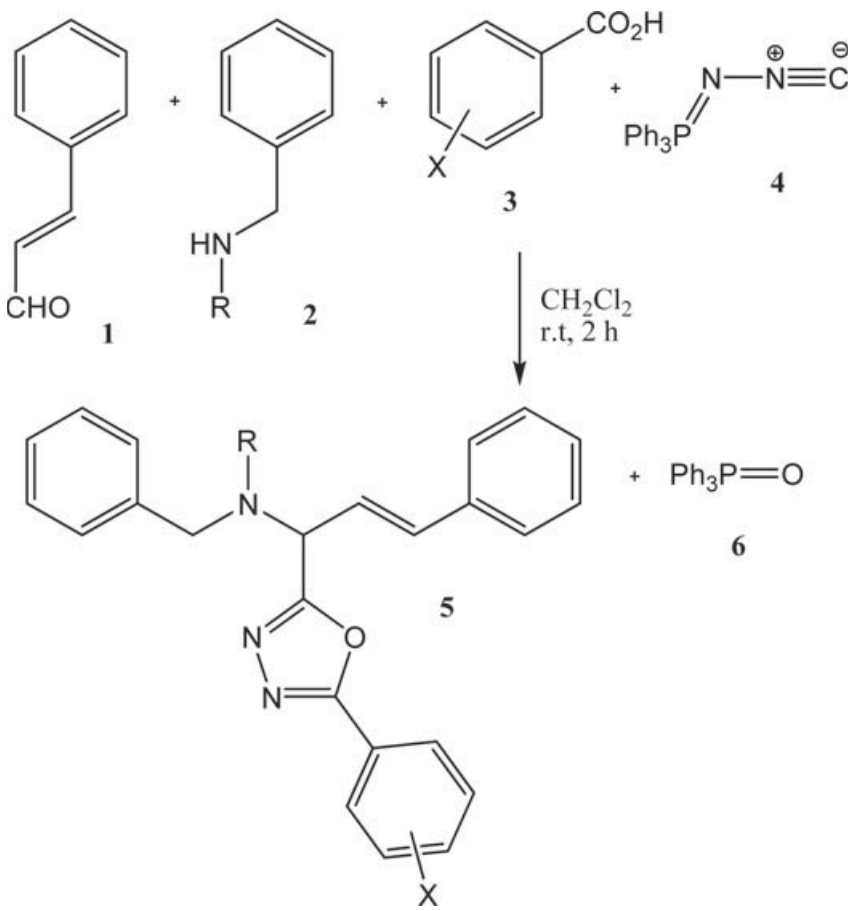


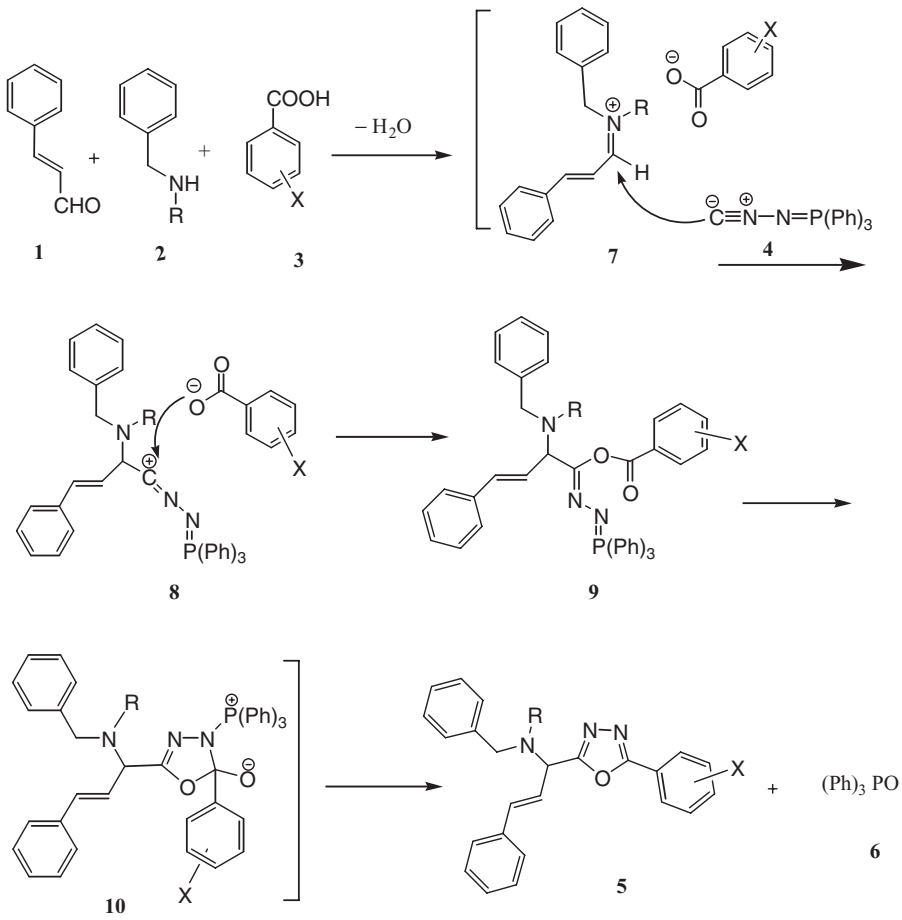
5a: R= Bn, X= 4-Br; **5b**: R= Et, X= 4-Br; **5c**: R= Me, X= 4-Br; **5d**: R= Bn, X= 3-Cl; **5e**: R= Et, X= 3-Cl; **5f**: R= Me, X= 3-Cl; **5g**: R= Bn, X= 4-Cl; **5h**: R= Et, X= 4-Cl; **5i**: R= Me, X= 4-Cl; **5j**: R= Bn, X= 4-F; **5k**: R= Et, X= 4-F; **5l**: R= Me, X= 4-F; **5m**: R= Et, X= 4-I; **5n**: R= Me, X= 4-I; **5o**: R= Bn, X= H.

SCHEME 1 Four-component synthesis of disubstituted 1,3,4-oxadiazole derivatives **5a–o**.

RESULTS AND DISCUSSION

As part of our ongoing program to develop highly efficient and powerful methods for the preparation of heterocyclic compounds [43], we wish to illustrate preparation of 1,3,4-oxadiazole derivatives using four-component and one-pot reactions of cinnamaldehyde, an aromatic carboxylic acid, a secondary amine, and *N*-isocyaniminotriphenylphosphorane (Scheme 1). The iminium intermediate formed by the reaction between a secondary amine **2** and cinnamaldehyde **1** is trapped by *N*-isocyniminotriphenylphosphorane **4** in the presence of benzoic acid derivatives **3** to lead to the formation of disubstituted 1,3,4-oxadiazole derivatives **5** and triphenylphosphine oxide **6** (Scheme 1). The reaction proceeds cleanly under mild conditions and without the formation of by-products to give excellent yields.

The structures of the products were deduced from their ^{1}H NMR, ^{13}C NMR, mass, and IR spectra. For example, the ^{1}H NMR spectrum of **5a** consisted of an AB-quartet for CH_2 of the benzyl group at $\delta = 3.72$ and 3.89 ppm ($^2J_{HH} = 12.5$ Hz), a doublet for CH ($\delta = 4.9$ ppm, $^3J_{HH} = 5$ Hz), and a multiplet at $\delta = 6.54$–7.96 ppm for H-aromatic and H-vinylic. The aryl groups demonstrated characteristic signals in the aromatic region of the spectrum. ^{13}C NMR spectrum of **5a** showed 18 separate resonances. Partial assignment of these resonances is given in the Experimental section. The ^{1}H and ^{13}C NMR spectra of compounds **5b–o** were similar to those of **5a**, except for the aromatic and aliphatic parts, which showed characteristic signals with proper chemical shifts. The mechanism postulated for this reaction is provided in Scheme 2. It is conceivable that the first event is the condensation reaction of the cinnamaldehyde **1**, secondary amine **2**, and



SCHEME 2 Proposed mechanism for the formation of disubstituted 1,3,4-oxadiazole derivatives **5a–o**.

benzoic acid derivative **3** that directs to an intermediate iminium ion **7**. The nucleophilic addition of the (*N*-isocyanimino)triphenylphosphorane **4** to the intermediate iminium ion **7** leads to a nitrilium intermediate **8**. This intermediate may be attacked by the conjugate base of the acid **3** to generate 1:1:1 adduct **9**. This adduct may undergo an intramolecular aza-Wittig reaction of an iminophosphorane moiety with the ester carbonyl group to provide the isolated disubstituted 1,3,4-oxadiazole **5** by the removal of triphenylphosphine oxide **6**.

CONCLUSIONS

The reported method offers a mild, simple way to prepare disubstituted 1,3,4-oxadiazole derivatives by a multicomponent reaction including an aza-Wittig closure. Because of the easy accessibility of the synthetic approach and the neutral conditions for the cyclization, this synthetic method has the potential to provide various disubstituted 1,3,4-oxadiazoles, which have a wide range of pharmaceutical and biological activities.

EXPERIMENTAL

Starting materials and solvents were obtained from Merck (Germany) and Fluka (Switzerland) and were used without further purification. The methods used to follow the reactions are TLC and NMR, which indicated that there is no side product. IR spectra were measured on a Jasco 6300 FTIR spectrometer. ^{1}H and ^{13}C NMR spectra were measured ($CDCl_3$) with a Bruker DRX-250 Avance spectrometer at 250.0 and 62.09 MHz, respectively. Elemental analyses were performed using a Heraeus CHN-O-Rapid analyzer. Mass spectra were recorded on a Finnigan-MAT 8430 mass spectrometer operating at an ionization potential of 20 eV. Flash chromatography columns were prepared with Merck silica gel powder.

General Procedure

To a magnetically stirred solution of secondary amine **2** (1.0 mmol), cinnamaldehyde **1** (1.0 mmol), and (*N*-isocyanimino)triphenylphosphorane **4** (1.0 mmol) in CH_2Cl_2 (5.0 mL), a solution of benzoic

acid derivative **3** (1.0 mmol) in CH_2Cl_2 (5.0 mL) was added dropwise at room temperature over 15 min. The mixture was stirred for 2 h. The solvent was removed under reduced pressure, and the viscous residue was purified by flash column chromatography (silica gel powder; petroleum ether–ethyl acetate (10:2)) to afford products **5a–o** as oils. The characterization data of the compounds are given below.

*Dibenzyl-{1-[5-(4-bromo-phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl-allyl} Amine (***5a***).* Yellow oil, yield: 83%. IR (neat, cm^{-1}): 3477, 3030, 2938, 1604, 1567, 1482, 1454, 1127, 835, 784. ^{1}H NMR: δ = 3.72, 3.89 (AB quartet, 4H, $^2J_{HH}$ = 12.5 Hz, $2CH_2$ of benzyl group); 4.9 (d, 1H,$^3J_{HH}$ = 5 Hz, CH); 6.54–7.96 (m, 21H, arom and vinylic).^{13}C NMR: δ = 54.64 ($2CH_2$ of the benzyl group); 57.46 (CH); 123.27, 135.41 (2CH vinylic); 122.81 (C_{Ar}—Br of C_6H_4Br); 136.04, 138.82 ($3C_{ipso(C=C)}$ of $3C_6H_5$); 122.81 (C_{Ar}—Br of C_6H_4Br); 126.49 ($C_{ipso(C=C)}$ of C_6H_4Br); 126.75, 127.31, 128.28, 128.39, 128.48, 128.70, 129.13, 132.45 (19CH arom); 164.41, 165.66 (2C of oxadiazole). Anal. calcd for $C_{31}H_{26}BrN_3O$ (536.46): C, 69.41; H, 4.89; N, 7.83; Found: C, 69.39; H, 4.90; N, 7.85. MS (EI): 536 (M^+, 2), 444 (7), 342 (60), 196 (100), 115 (20), 91 (90), 65 (10).

*Benzyl-{1-[5-(4-bromo phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-ethyl Amine (***5b***).* Yellow oil, yield: 84%. IR (neat, cm^{-1}): 3443, 3034, 2972, 1604, 1548, 1474, 1406, 1071, 835, 739. ^{1}H NMR: δ = 1.26 (t, 3H, CH_3 of Et); 2.48–2.92 (m, CH_2 of Et); 3.76, 3.46 (AB quartet, 2H, $^2J_{HH}$ = 12.5 Hz, CH_2 of the benzyl group); 4.92 (s, 1H, CH); 6.54–7.94 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 55.87 ($2CH_2$ of the benzyl group); 58.62 (CH); 122.92, 135.45 (2CH vinylic); 136.45, 138.31 ($2C_{ipso(C=C)}$ of $2C_6H_5$); 122.30 (C_{Ar}—Br of C_6H_4Br); 125.97 ($C_{ipso(C=C)}$ of C_6H_4Br), 126.35, 127.12, 128.29, 128.45, 128.53, 128.75, 129.42, 132.65 (14CH arom); 164.22, 165.34 (2C of oxadiazole). Anal. calcd for $C_{26}H_{24}BrN_3O$ (474.39): C, 65.83; H, 5.10; N, 8.86; Found: C, 65.85; H, 5.12; N, 8.83.

*Benzyl-{1-[5-(4-bromo phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-methyl Amine (***5c***).* Yellow oil, yield: 81%. IR (neat, cm^{-1}): 3058, 2859, 1604, 1407, 1482, 1011, 835, 739. ^{1}H NMR: δ = 2.36 (s, 3H, CH_3); 3.72 (s, 2H, CH_2 of the benzyl group); 4.78 (s, 1H, CH); 6.52–7.97 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 38.88 (CH_3); 58.62 (CH_2 of the benzyl group); 61.69 (CH); 123.54 (1CH vinylic); 122.76 (C_{Ar}—Br of C_6H_4Br); 135.39, 135.93, 138.27 ($2C_{ipso(C=C)}$ of $2C_6H_5$ and 1CH vinylic); 126.74 ($C_{ipso(C=C)}$ of C_6H_4Br); 126.74, 127.35, 128.43, 128.68, 128.75, 128.88, 129.10, 132.41 (14CH arom); 164.47, 165.61 (2C of oxadiazole). Anal. calcd for $C_{25}H_{22}BrN_3O$ (460.37): C, 65.22; H, 4.82; N, 9.13; Found: C, 65.20; H, 4.81; N, 9.13.

*Dibenzyl-{1-[5-(3-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl} Amine (***5d***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3477, 3065, 2972, 2936, 1554, 1495, 1266, 1073, 970, 748. ^{1}H NMR: δ = 3.73, 3.9 (AB quartet, 4 H, $^2J_{HH}$ = 15 Hz, $2CH_2$ of the benzyl group); 4.9 (d, 1H, $^3J_{HH}$ = 7.5 Hz, CH); 6.54–8.05 (m, 21H, arom and vinylic). ^{13}C NMR: δ = 54.66 (CH_2 of the benzyl group); 57.50 (CH); 123.23 ($C_{ipso(C=C)}$) of C_6H_4Cl); 127.31, 138.79 (2CH vinylic); 125.07, 125.51, 126.76, 128.29, 128.49, 128.71, 128.82, 130.48, 131.82 (19CH arom); 135.21, 135.45, 136.01 (3 $C_{ipso(C=C)}$) of $3C_6H_5$ and C_{Ar}-Cl of C_6H_4Cl); 164.05, 165.81 (2C of oxadiazole). Anal. calcd for $C_{31}H_{26}ClN_3O$ (492.01): C, 75.68; H, 5.33; N, 8.54; Found: C, 75.66; H, 5.35; N, 8.57. MS (EI): 491 (M^+, 2), 400 (9), 296 (22), 196 (91), 91 (100), 65 (10).

*Benzyl-{1-[5-(3-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-ethyl Amine (***5e***).* Yellow oil, yield: 85%. IR (neat, cm^{-1}): 3473, 3493, 2973, 1554, 1453, 1267, 1073, 970, 889. ^{1}H NMR: δ = 1.14 (t, 3H, CH_3 of Et); 2.59–2.85 (m, CH_2 of Et); 3.77, 3.87 (AB quartet, 2H, $^2J_{HH}$ = 12.5 Hz, CH_2 of the benzyl group); 4.92 (d, 1H, $^3J_{HH}$ = 5 Hz, CH); 6.47–8.03 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 13.06 (CH_3); 44.77 (CH_2 of ethyl); 54.62 (CH_2 of the benzyl group); 58.48 (CH aliphatic); 124.09 ($C_{ipso(C=C)}$) of C_6H_4Cl); 135.16 (C_{Ar}-Cl of C_6H_4Cl); 125.08, 134.76 (2CH vinylic); 125.16, 136.08, 139.26 ($2C_{ipso(C=C)}$) of $2C_6H_5$ and C_{Ar}-Cl of C_6H_4Cl); 125.25, 126.71, 126.95, 127.11, 128.20, 128.38, 128.60, 128.65, 130.43, 131.77 (14CH arom); 163.94, 166.09 (2C of oxadiazole). Anal. calcd for $C_{26}H_{24}ClN_3O$ (429.94): C, 72.63; H, 5.63; N, 9.77; Found: C, 72.61; H, 5.66; N, 9.79.

*Benzyl-{1-[5-(3-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-methyl Amine (***5f***).* Yellow oil; yield: 80%. IR (neat, cm^{-1}): 3054, 2829, 1546, 1455, 972, 911, 741. ^{1}H NMR: δ = 2.37 (s, 3 H, CH_3); 3.75 (s, 2H, CH_2 of the benzyl group); 4.80 (d, 1 H, $^3J_{HH}$ = 5 Hz, CH); 6.52–8.08 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 38.91 (CH_3), 58.65 (CH_2 of the benzyl group); 61.72 (CH); 123.55 ($C_{ipso(C=C)}$) of C_6H_4Cl); 127.33, 135.37 (2 CH vinylic); 135.19, 135.95, 138.28 ($2C_{ipso(C=C)}$) of $2C_6H_5$ and C_{Ar}-Cl of C_6H_4Cl); 125.12, 125.49, 126.75, 126.99, 128.32, 128.44, 128.68, 128.86, 130.43, 131.82 (14 CH arom); 164.04, 165.76 (2C of oxadiazole). Anal. calcd for

$C_{25}H_{22}ClN_3O$ (415.91): C, 72.19; H, 5.33; N, 10.10; Found: C, 72.17; H, 5.35; N, 10.13.

*Dibenzyl-{1-[5-(4-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl} Amine (***5g***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3479, 3033, 2950, 1560, 1450, 1265, 1075, 973, 891. ^1H NMR: $\delta = 3.72$, 3.89 (AB quartet, 4 H, $^2J_{HH} = 12.5$ Hz, $2CH_2$ of the benzyl group); 4.89 (d, 1 H, $^3J_{HH} = 5$ Hz, CH); 6.53–8.02 (m, 21H, arom and vinylic). ^{13}C NMR: $\delta =$ 54.66 (CH_2 of the benzyl group); 57.47 (CH); 122.23 ($C_{ipso(C=C)}$) of C_6H_4Cl); 123.35, 135.39 (2CH vinylic); 136.01 (C_{Ar}-Cl of C_6H_4Cl); 138.06, 138.73 ($3C_{ipso(C=C)}$) of $3C_6H_5$); 126.74, 127.31, 128.24, 128.46, 128.65, 128.72, 129.11, 129.48 (19CH arom); 164.30, 165.51 (2C of oxadiazole). Anal. calcd for $C_{31}H_{26}ClN_3O$ (492.01): C, 75.68; H, 5.33; N, 8.54; Found: C, 75.67; H, 5.35; N, 8.57.

*Benzyl-{1-[5-(4-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-ethyl Amine (***5h***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3455, 3035, 2927, 1609, 1482, 1445, 1093, 836. ^1H NMR: $\delta = 1.25$ (t, 3H, CH_3 of Et); 2.64–2.82 (m, CH_2 of Et); 3.71, 3.87 (AB quartet, 2H, $^2J_{HH} = 15$ Hz, CH_2 of the benzyl group); 4.92 (d, 1H, $^3J_{HH} = 5$ Hz, CH); 6.47–8.21 (m, 16H, arom and vinylic). ^{13}C NMR: $\delta = 13.45$ (CH_3); 44.91 (CH_2 of ethyl); 54.85 (CH_2 of the benzyl group); 58.79 (CH aliphatic); 122.35 ($C_{ipso(C=C)}$) of C_6H_4Cl); 123.45, 135.42 (2CH vinylic); 136.32 (C_{Ar}-Cl of C_6H_4Cl); 138.25, 138.86 ($2C_{ipso(C=C)}$) of $2C_6H_5$); 126.71, 127.33, 128.27, 128.43, 128.65, 128.72, 129.44, 129.56 (14CH arom); 164.30, 165.51 (2C of oxadiazole). Anal. calcd for $C_{26}H_{24}ClN_3O$ (429.94): C, 72.63; H, 5.63; N, 9.77; Found: C, 72.66; H, 5.65; N, 9.74.

*Benzyl-{1-[5-(4-chloro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-methyl Amine (***5i***).* Yellow oil, yield: 83%. IR (neat, cm^{-1}): 3031, 2853, 2803, 1608, 1549, 1484, 1095, 838, 742. ^1H NMR: $\delta = 2.36$ (s, 3H, CH_3); 3.72 (s, 2H, CH_2 of the benzyl group); 4.79 (d, 1H, $^3J_{HH} = 7.5$ Hz, CH); 6.51–8.05 (m, 16H, arom and vinylic). ^{13}C NMR: $\delta = 38.89$ (CH_3); 58.64 (CH_2 of the benzyl group); 61.70 (CH); 122.34 ($C_{ipso(C=C)}$) of C_6H_4Cl); 123.58, 135.33 (2CH vinylic); 138.06, 138.30 ($2C_{ipso(C=C)}$) of $2C_6H_5$); 135.96 (C_{Ar}-Cl of C_6H_4Cl); 126.74, 127.32, 127.71, 128.30, 128.43, 128.68, 128.87, 129.45 (14CH arom); 165.57, 167.07 (2C of oxadiazole). Anal. calcd for $C_{25}H_{22}ClN_3O$ (415.91): C, 72.19; H, 5.33; N, 10.10; Found: C, 72.16; H, 5.36; N, 10.08.

*Dibenzyl-{1-[5-(4-fluoro-phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl-allyl}-Amine (***5j***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3033, 2857, 1612, 1455, 1498, 1241, 1159, 845$^-$. ^1H NMR: $\delta = 3.72$, 3.90 (AB quartet, 2H, $^2J_{HH} = 12.5$ Hz, CH_2 of the benzyl group); 4.90 (d, 1H, $^3J_{HH} = 5$ Hz, CH); 6.54–8.11 (m, 21H, arom and vinylic),^{13}C NMR: $\delta = 54.62$ (CH_2 of the benzyl group); 57.43 (CH); 116.54 (d, $^2J_{CF} = 22.05$ Hz); 120.21 (d, $^4J_{CF} = 3.15$ Hz); 129.28 (d, $^3J_{CF} = 8.82$ Hz); 164.04 (d, $^1J_{CF} = 250.75$ Hz); 123.33, 135.36, 136.05, 138.81 (3 $C_{ipso(C=C)}$) of $3C_6H_5$ and 2CH vinylic); 126.74, 127.29, 128.25, 128.46, 128.66, 128.71 (15CH arom); 164.29, 165.45 (2C of oxadiazole). Anal. calcd for $C_{31}H_{26}FN_3O$ (475.21): C, 78.29; H, 5.51; N, 8.84; Found: C, 78.31; H, 5.53; N, 8.86. MS (EI): 476 (M^+, 5), 384 (3), 312 (10), 280 (97), 196 (100), 115 (19), 91 (80), 57 (44).

*Benzyl ethyl-{1-[5-(4-fluoro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl} Amine (***5k***).* Yellow oil, yield: 80%. IR (neat, cm^{-1}): 3032, 2854, 1613, 1498, 1453, 1260, 1159, 846, 741. ^1H NMR: $\delta = 1.17$ (t, 3H, CH_3 of Et); 2.56–2.88 (m, CH_2 of Et); 3.71, 3.88 (AB quartet, 2H, $^2J_{HH} = 15$ Hz, CH_2 of the benzyl group); 4.92 (d, 1H, $^3J_{HH} = 7.5$ Hz, CH); 6.47–8.04 (m, 16H, arom and vinylic). ^{13}C NMR: $\delta = 13.08$ (CH_3); 44.72 (CH_2 of Et); 54.60 (CH_2 of the benzyl group); 58.41 (CH); 116.38 (d, $^2J_{CF} = 22.05$ Hz); 120.25 (d, $^4J_{CF} = 3.78$ Hz); 129.26 (d, $^3J_{CF} = 8.82$ Hz); 164.02 (d, $^1J_{CF} = 252.8$ Hz); 124.25, 136.63, 136.12, 139.32 (2 $C_{ipso(C=C)}$) of $2C_6H_5$ and 2CH vinylic); 126.69, 127.08, 128.16, 128.36, 128.59, 128.64 (10CH arom); 164.25, 165.74 (2C of oxadiazole). Anal. calcd for $C_{26}H_{24}FN_3O$ (413.49): C, 75.52; H, 5.85; N, 10.16; Found: C, 75.50; H, 5.88; N, 10.13.

*Benzyl-{1-[5-(4-fluoro phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-methyl Amine (***5l***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3486, 3035, 2856, 1611, 1496, 1453, 1229, 845. ^1H NMR: $\delta = 2.36$ (s, 3H, CH_3); 3.72 (s, CH_2 of the benzyl group); 4.79 (d, 1H, $^3J_{HH} = 5$ Hz, CH); 6.51–8.09 (m, 16H, arom and vinylic). ^{13}C NMR: $\delta = 38.75$ (CH_3); 58.12 (CH_2 of the benzyl group); 61.86 (CH); 116.50 (d, $^2J_{CF} = 22.08$ Hz); 120.89 (d, $^4J_{CF} = 3.75$ Hz); 129.26 (d, $^3J_{CF} =$ 8.85 Hz); 164.10 (d, $^1J_{CF} = 251$ Hz); 124.23, 136.51, 136.45, 138.32 ($2C_{ipso(C=C)}$) of $2C_6H_5$ and 2CH vinylic); 126.73, 127.10, 128.21, 128.44, 128.67, 129.39 (10CH arom); 164.57, 165.74 (2C of oxadiazole). Anal. calcd for $C_{25}H_{22}FN_3O$ (399.46): C, 75.17; H, 5.55; N, 10.52; Found: C, 75.19; H, 5.56; N, 10.50.

*Benzyl ethyl-{1-[5-(4-iodo phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl} Amine (***5m***).* Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3461, 3032, 2972, 1600, 1561, 1478, 1278, 1006, 831. ^1H NMR: $\delta = 1.13$ (t, 3H, CH_3 of Et); 2.57–2.84 (m, CH_2 of Et); 3.70, 3.87

(AB quartet, 2H, $^2J_{HH}$ = 15 Hz, CH_2 of the benzyl group); 4.91 (d, 1H, $^3J_{HH}$ = 5 Hz, CH); 6.46–7.88 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 13.07(CH_3); 44.73 (CH_2 of Et); 54.60 (CH_2 of the benzyl group); 58.45 (CH); 98.59 (C_{Ar}-I of C_6H_4I); 123.33 ($C_{ipso(C=C)}$ of C_6H_4I), 126.69, 138.32 (2CH vinylic); 136.09, 139.27 ($2C_{ipso(C=C)}$ of $2C_6H_5$); 124.13, 127.09, 128.18, 128.35, 128.58, 128.64, 134.70 (14CH arom); 164.50, 165.94 (2C of oxadiazole). Anal. calcd for $C_{26}H_{24}IN_3O$ (521.39): C, 59.89; H, 4.64; N, 8.06; Found: C, 59.87; H, 4.63; N, 8.04.

*Benzyl-{1-[5-(4-iodo phenyl)-[1,3,4]oxadiazol-2-yl]-3-phenyl allyl}-methyl Amine (***5n***)*. Yellow oil, yield: 82%. IR (neat, cm^{-1}): 3452, 2926, 2854, 1656, 1562, 1509, 1458, 1071, 966. ^{1}H NMR: δ = 2.24 (s, 3H, CH_3); 3.75, 3.92 (AB quartet, 2H, $^2J_{HH}$ = 15 Hz, CH_2 of the benzyl group); 4.79 (d, 1 H, $^3J_{HH}$ = 7.5 Hz, CH); 6.52–7.78 (m, 16H, arom and vinylic). ^{13}C NMR: δ = 38.92 (CH_3); 58.63 (CH_2 of the benzyl group); 61.72 (CH); 98.73 (C_{Ar}-I of C_6H_4I); 123.28 ($C_{ipso(C=C)}$ of C_6H_4I), 126.75, 138.35 (2CH vinylic); 135.36, 135.94 (2 $C_{ipso(C=C)}$) of $2C_6H_5$); 123.54, 127.18, 127.35, 128.10, 128.37, 128.69, 128.88, 128.98 (14CH arom); 164.75, 165.62 (2C of oxadiazole). Anal. calcd for $C_{25}H_{22}IN_3O$ (507.37): C, 59.18; H, 4.37; N, 8.28; Found: C, 59.21; H, 4.35; N, 8.25.

*Dibenzyl-[3-phenyl-1-(5-phenyl-[1,3,4]oxadiazol-2-yl)-allyl] Amine (***5o***)*. Yellow oil, yield: 84%. IR (neat, cm^{-1}): 3027, 2939, 1558, 1494, 1452, 1072, 970, 742$^-$. ^{1}H NMR: δ = 3.72, 3.92 (AB quartet, 4H, $^2J_{HH}$ = 12.5 Hz, $2CH_2$ of the benzyl group); 4.92 (d, 1H, $^3J_{HH}$ = 5 Hz, CH); 6.56–8.12 (m, 22H, arom and vinylic).^{13}C NMR: δ = 54.59 (CH_2 of the benzyl group); 57.32 (CH); 123.53, 135.24 (2CH vinylic); 132.91, 136.11, 138.88 ($4C_{ipso(C=C)}$ of 4C6H5); 126.75, 126.99, 127.29, 128.23, 128.48, 128.66, 128.75, 129.12, 131.81 (20CH arom); 165.12, 165.38 (2C of oxadiazole). Anal. calcd for $C_{31}H_{27}N_3O$ (457.57): C, 81.37; H, 5.95; N, 9.18; Found: C, 81.36; H, 5.93; N, 9.20.

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