Reactivity of 2-Methylene-1,3-dicarbonyl Compounds. 1,3-Dipolar Cycloaddition Reaction with Nitrile Oxide

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Received May 13, 2002

The reaction of 2-methylene-1,3-dicarbonyl compounds **1** and nitrile oxides, which were prepared from hydroxymoyl chlorides **2** with triethylamine, gave 5,5-disubstituted 2-isoxazolines **3** regioselectively.

J. Heterocyclic Chem., **39**, 1013 (2002).

The formation of 2-isoxazolines by 1,3-dipolar cycloaddition of nitrile oxides to alkenes has been known for many years, and the scope and mechanism of the reaction have been studied in detail [1]. The utility of this heterocycle is derived from its ready conversion to useful synthetic intermediates, β-hydroxy ketones[2] and γ-amino alcohols [3]. In general, with monosubstituted olefins reaction gives exclusively or predominantly the 5-substituted isoxazoline, whatever the nature of the substituent on the dipolarophile. Reactions of nitrile oxide with both electron-rich and electron-deficient dipolarophiles are controlled mainly by the LUMO (dipole) – HOMO (dipolarophile) interaction, and union of the atoms with the larger coefficients leads to 5-substituted isoxazolines [4]. Houk *et al.* predicted that unsymmetrical electron-deficient 1,1-disubstituted ethylene will react with nitrile oxide to produce predominantly 4,4-disubstituted 2-isoxazolines [4b]. During the course of our studies on the reactivity of 2-methylene-1,3-dicarbonyl compounds **1** having two electron-withdrawing groups at the same olefinic carbon [5] we investigated the reaction with nitrile oxide. It is expected that the introduction of carbonyl group at the α-position of the α,β-unsaturated carbonyl compounds lower the LUMO energy level therefore its reaction with nitrile oxide is controlled by LUMO (dipolarophile) – HOMO (dipole) interaction. The coefficients of the terminal methylene carbons obtained from MNDO calculation of the most stable conformer of ethyl 2-benzoylacrylate **1d** are shown in Figure 1. Taking this into consideration with the coefficients of benzonitrile oxide reported by Houk *et al.* [4] the addition product could be 4,4-disubstituted 2-isoxazoline **4d-a** whether the reaction is controlled by LUMO (dipolarophile) (-0.6 eV) – HOMO (dipole) (-10 eV) or HOMO (dipolarophile) (-11 eV) – LUMO (dipole) (-1.0 eV) interactions.

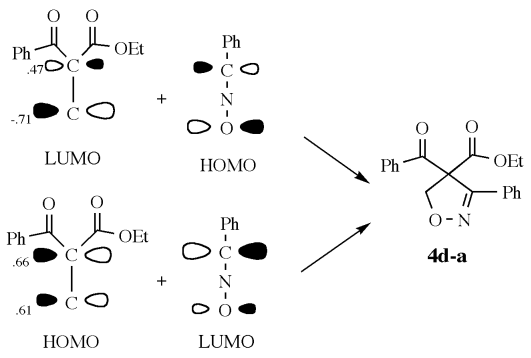
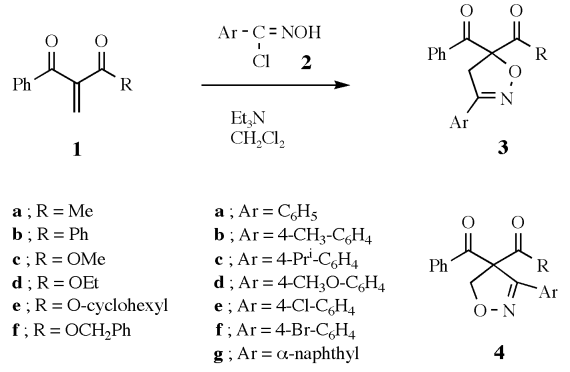


Figure 1

Triethylamine was added to a solution of enedione **1**, hydroxymoyl chloride **2**, which was prepared by Larsen's procedure [6], in CH_2Cl_2. The color of the reaction mixture turned pale yellow immediately. The solvent was evaporated off and the resulting residue was applied to preparative thin layer chromatography to give the product. Other cycloaddition products were not detected.

The C-4 methylene protons of the product each appeared as a doublet at *ca*. 3.7 ppm and *ca*. 4.5 ppm except for dibenzoyl **3b** series in the ^1H nmr spectra. From these results, it is not possible to distinguish whether the product is 5,5-disubstituted 2-isoxazoline **3** or 4,4-disubstituted 2-isoxazoline **4** clearly. The methylene carbons of the product show the signals at *ca*. 41~45 ppm in the ^{13}C nmr spectra. The ring methylene carbon of pyrazoline **5** resonance at 39.2 ppm [5d] whereas that of isoxazolizine **6** appear at 72.1 ppm [7], which suggest the product must be 5,5-disubstituted 2-isoxazoline **3**. This is further supported by observing the correlations in the HMBC (heteronuclear multiple bond correlation) spectrum of **3d-a** between signals of C-4 methylene protons and C-3, C-5, both carbonyl carbons and quarternary phenyl carbon attached to C-3.

Chart 1



The dipolar addition products were 5,5-disubstituted 2-isoxazolines **3** not 4,4-disubstituted 2-isoxazolines **4** predicted from frontier orbital. Huisgen *et al.* reported that

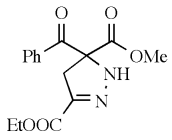
Table 1

4,5-Dihydroisoxazoles **3**

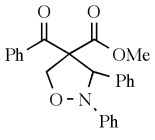
Entry	R^1	R^2	Yield(%)[a]
a-a	Me	H	66
a-b	Me	Me	76
a-c	Me	Pr^i	62
a-d	Me	OMe	72
a-f	Me	Br	67
a-g	Me	naphthyl	67
b-a	Ph	H	72
b-b	Ph	Me	82
b-c	Ph	Pr^i	70
b-d	Ph	OMe	70
b-e	Ph	Cl	70
b-f	Ph	Br	73
b-g	Ph	naphthyl	74
c-a	OMe	H	94
c-b	OMe	Me	84
c-c	OMe	Pr^i	71
c-e	OMe	Cl	82
c-f	OMe	Br	89
c-g	OMe	naphthyl	96
d-a	OEt	H	75
d-b	OEt	Me	84
d-c	OEt	Pr^i	72
d-d	OEt	OMe	72
d-e	OEt	Cl	85
d-f	OEt	Br	80
d-g	OEt	naphthyl	76
e-a	O-cyclohexyl	H	95
e-b	O-cyclohexyl	Me	99
e-c	O-cyclohexyl	Pr^i	98
e-d	O-cyclohexyl	OMe	77
e-e	O-cyclohexyl	Cl	88
e-f	O-cyclohexyl	Br	92
e-g	O-cyclohexyl	naphthyl	98
f-a	O-benzyl	H	70
f-b	O-benzyl	Me	88
f-c	O-benzyl	Pr^i	83
f-d	O-benzyl	OMe	71
f-e	O-benzyl	Cl	89
f-f	O-benzyl	Br	90
f-g	O-benzyl	naphthyl	82

[a] Isolated yields.

Chart 2



5



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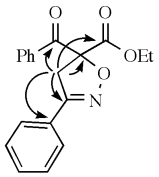

selected HMBC correlations of **3d-a**

nitrile oxides reacted with methyl acrylate to give 2-isoxazoline-5-carboxylic esters predominantly whereas almost equal ratio of 4- and 5-carboxylates were formed with methyl crotonate and methyl cinnamate [8]. This means that not only frontier orbital factor but also steric factor controls the reaction. In the reaction of 1,1-disubstituted ethylene such as 2-methylene-1,3-dicarbonyl compound with nitrile oxide, steric hindrance factor overcomes frontier orbital factor resulting in the formation of 5,5-disubstituted 2-isoxazoline.

EXPERIMENTAL

The nmr spectra were measured on a JEOL GX-270 spectrometer for samples in deuteriochloroform solution at 270 MHz for ^1H and 67.89 MHz for ^{13}C, and chemical shifts are expressed in δ-units using tetramethylsilane or chloroform as an internal reference. The ir spectra of solids (potassium bromide) and liquids (film) were recorded on a JASCO FT/IR-410 spectrometer. High-resolution mass spectra were obtained with a JEOL JMS-700 spectrometer. To dry the organic layers after extraction $MgSO_4$ was used. Preparative thin layer chromatography was performed with Silica gel 60 F_{254} 0.5 mm (Merck).

General Procedure for the Preparation of 4,5-Dihydroisoxazoles **3**.

To a stirred solution of 2-methylene-1,3-dicarbonyl compounds (**1**, 0.5 mmol) and hydroxymoyl chlorides (**2**, 0.5 mmol) in CH_2Cl_2 (3 ml), triethylamine (70 µl, 0.05 mmol) was added in one portion with stirring. The reaction mixture turned pale yellow immediately. After stirring was continued for additional 5 minutes, the reaction mixture was washed with water (3 ml x 5) and brine (2 ml). The organic layer was dried and evaporated. The resulting residue was subjected to preparative thin layer chromatography to give **3**. The yields of **3** are shown in table 1.

5-Acetyl-5-benzoyl-3-phenyl-4,5-dihydroisoxazole (**3a-a**).

This compound was obtained as viscous oil; ir ν CO 1717, 1688 cm^{-1}; ^1H nmr: δ 2.45 (s, 3H, CH_3), 3.82 (d, J = 17.8 Hz, 1H, C*H*H), 4.28 (d, J = 17.8 Hz, 1H, CH*H*), 7.42-7.73 (m, 8H, ArH), 8.01 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 25.5, 41.4, 97.3, 127.0, 127.8, 128.7, 128.8, 129.8, 130.9, 133.2, 134.0, 156.4, 192.3, 202.9; HR-MS m/z: Calcd. for $C_{18}H_{15}NO_3$: 293.1052. Found: 293.1060.

5-Acetyl-5-benzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole (**3a-b**).

This compound was obtained as viscous oil; ir ν CO 1719, 1687 cm^{-1}. ^1H nmr: δ 2.39 (s, 3H, CH_3), 2.44 (s, 3H, CH_3), 3.81 (d, J = 17.6 Hz, 1H, C*H*H), 4.26 (d, J = 17.6 Hz, 1H, CH*H*), 7.23 (d, J = 8.1 Hz, 2H, ArH), 7.47 (br t, J = 7.3 Hz, 2H, ArH), 7.59 (d, J = 8.1 Hz, 2H, ArH), 7.60 (br t, J = 7.3 Hz, 1H, ArH), 8.01 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 21.6, 25.5, 41.5, 97.1, 124.9, 126.9, 128.6, 129.5, 129.8, 133.2, 133.9, 141.3, 156.3, 192.5, 203.0; HR-MS m/z: Calcd. for $C_{19}H_{17}NO_3$: 307.1208. Found: 307.1225.

5-Acetyl-5-benzoyl-3-(4-isopropylphenyl)-4,5-dihydroisoxazole (**3a-c**).

This compound was obtained as viscous oil; ir ν CO 1719, 1690 cm^{-1}. ^1H nmr: δ 1.26 (d, J = 6.9 Hz, 6H, CH_3), 2.44 (s, 3H,

CH_3), 2.94 (heptet, J = 6.9 Hz, 1H, CH), 3.81 (d, J = 17.6 Hz, 1H, C*H*H), 4.26 (d, J = 17.6 Hz, 1H, CH*H*), 7.29 (d, J = 8.3 Hz, 2H, ArH), 7.47 (br t, J = 7.3Hz, 2H, ArH), 7.59 (br t, J = 7.3 Hz, 1H, ArH), 7.63 (d, J = 8.3 Hz, 2H, ArH), 8.00 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.8, 25.4, 34.2, 41.6, 97.1, 125.3, 126.9, 127.1, 128.6, 129.8, 133.2, 133.9, 152.1, 156.3, 192.5, 203.1; HR-MS m/z: Calcd. for $C_{21}H_{21}NO_3$: 335.1521. Found: 335.1509.

5-Acetyl-5-benzoyl-3-(4-methoxyphenyl)-4,5-dihydroisoxazole (**3a-d**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 111-112°, ir ν CO 1715, 1689 cm^{-1}; ^{1}H nmr: δ 2.44 (s, 3H, CH_3), 3.79 (d, J = 17.6 Hz, 1H, C*H*H), 3.85 (s, 3H, CH_3), 4.25 (d, J = 17.6 Hz, 1H, CH*H*), 6.93 (d, J = 9.0 Hz, 2H, ArH), 7.47 (br t, J = 9.0 Hz, 2H, ArH), 7.57 (br t, J = 7.3 Hz, 1H, ArH), 7.64 (d, J = 9.0 Hz, 2H, ArH), 8.01 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 25.5, 41.6, 55.4, 97.1, 114.2, 120.3, 128.59, 128.63, 129.8, 133.2, 133.9, 155.9, 161.5, 192.6, 203.2; HR-MS m/z: Calcd. for $C_{19}H_{17}NO_4$: 323.1158. Found: 323.1154.

5-Acetyl-5-benzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole (**3a-f**).

This compound was obtained as viscous oil; ir ν CO 1717, 1687 cm^{-1}. ^{1}H nmr: δ 2.44 (s, 3H, CH_3), 3.79 (d, J = 17.5 Hz, 1H, C*H*H), 4.25 (d, J = 17.5 Hz, 1H, CH*H*), 7.47-7.61 (m, 7H, ArH), 7.99 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 25.5, 41.1, 97.6, 125.3, 126.7, 128.4, 128.7, 129.8, 132.1, 133.1, 134.1, 155.6, 192.1, 202.5; HR-MS m/z: Calcd. for $C_{18}H_{14}BrNO_3$: 371.0157. Found: 371.0175.

5-Acetyl-5-benzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole (**3a-g**).

This compound was obtained as viscous oil; ir ν CO 1718, 1687 cm^{-1}. ^{1}H nmr: δ 2.50 (s, 3H, CH_3), 4.02 (d, J = 17.5 Hz, 1H, C*H*H), 4.50 (d, J = 17.5 Hz, 1H, CH*H*), 7.46-7.96 (m, 9H, ArH), 8.06 (br d, J = 7.1 Hz, 2H, ArH), 8.96 (br d, J = 8.9 Hz, 1H, ArH); ^{13}C nmr: δ 25.5, 44.1, 96.1, 124.7, 126.5, 126.7, 127.8, 128.2, 128.5, 128.6, 128.7, 129.8, 130.3, 131.2, 133.3, 133.9, 134.0, 157.0, 192.4, 203.0; HR-MS m/z: Calcd. for $C_{22}H_{17}NO_3$: 343.1208. Found: 343.1212.

5,5-Dibenzoyl-3-phenyl-4,5-dihydroisoxazole (**3b-a**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 105-106°, ir ν CO 1699, 1680 cm^{-1}; ^{1}H nmr: δ 4.32 (s, 2H, CH_2), 7.40-7.77 (m, 11H, ArH), 8.03 (br d, J = 7.2 Hz, 4H, ArH); ^{13}C nmr: δ 42.3, 96.7, 127.1, 127.9, 128.7, 128.8, 130.0, 130.8, 133.0, 133.9, 156.5, 192.7.

Anal. Calcd. for $C_{23}H_{17}NO_3$: C, 77.73; H, 4.82; N, 3.84. Found: C, 77.58; H, 4.78; N, 3.74.

5,5-Dibenzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole (**3b-b**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 125-127°, ir ν CO 1700, 1669 cm^{-1}; ^{1}H nmr: δ 2.39 (s, 3H, CH_3), 4.30 (s, 2H, CH_2), 7.43 (br t, J = 7.5 Hz, 4H, ArH), 7.56 (br t, J = 7.5 Hz, 2H, ArH), 7.63 (d, J = 8.2 Hz, 2H, ArH), 8.03 (br d, J = 7.5 Hz, 4H, ArH); ^{13}C nmr: δ 21.5, 42.3, 96.6, 125.2, 127.1, 128.7, 129.6, 130.1, 133.2, 134.0, 141.3, 156.6, 193.1.

Anal. Calcd. for $C_{24}H_{19}NO_3$: C, 78.03; H, 5.18; N, 3.79. Found: C, 78.23; H, 5.07; N, 3.66.

5,5-Dibenzoyl-3(4-isopropylphenyl)-4,5-dihydroisoxazole (**3b-c**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 102-103°, ir ν CO 1691, 1671 cm^{-1}; ^{1}H nmr: δ 1.26 (d, J = 6.9 Hz, 6H, CH_3), 2.96 (heptet, J = 6.9 Hz, 1H, CH), 4.30 (s, 2H, CH_2), 7.29 (d, J = 8.2 Hz, 2H, ArH), 7.43 (br t, J = 7.4 Hz, 4H, ArH), 7.56 (br t, J = 7.4 Hz, 2H, ArH), 7.67 (d, J = 8.2 Hz, 2H, ArH), 8.03 (br d, J = 7.4 Hz, 4H, ArH); ^{13}C nmr: δ 23.8, 34.2, 42.4, 96.6, 125.5, 126.9, 127.2, 128.6, 130.0, 133.1, 133.9, 152.1, 156.4, 192.9.

Anal. Calcd. for $C_{26}H_{23}NO_3$: C, 78.57; H, 5.83; N, 3.52. Found: C, 78.45; H, 5.77; N, 3.36.

5,5-Dibenzoyl-3-(4-methoxyphenyl)-4,5-dihydroisoxazole (**3b-d**).

This compound was obtained as viscous oil; ir ν CO 1696, 1679 cm^{-1}. ^{1}H nmr: δ 3.84 (s, 3H, CH_3), 4.29 (s, 2H, CH_2), 6.93 (d, J = 9.0 Hz, 2H, ArH), 7.43 (br t, J = 7.1 Hz, 4H, ArH), 7.56 (br t, J = 7.1 Hz, 2H, ArH), 7.67 (d, J = 9.0 Hz, 2H, ArH), 8.03 (br d, J = 7.1 Hz, 4H, ArH); ^{13}C nmr: δ 42.5, 55.4, 96.5, 114.2, 120.4, 128.6, 128.7, 130.0, 133.1, 133.8, 156.0, 161.5, 193.0; HR-MS m/z: Calcd. for $C_{24}H_{19}NO_4$: 385.1314. Found: 385.1344.

5,5-Dibenzoyl-3-(4-chlorophenyl)-4,5-dihydroisoxazole (**3b-e**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 152-153°, ir ν CO 1699, 1666 cm^{-1}; ^{1}H nmr: δ 4.28 (s, 2H, CH_2), 7.35-7.69 (m, 10H, ArH), 8.02 (br d, J = 7.2 Hz, 4H, ArH); ^{13}C nmr: δ 42.0, 97.0, 126.5, 128.3, 128.7, 129.1, 130.0, 133.0, 134.0, 136.9, 155.6, 192.5.

Anal. Calcd. for $C_{23}H_{16}ClNO_3$: C, 70.86; H, 4.14; N, 3.59. Found: C, 71.10; H, 4.06; N, 3.40.

5,5-Dibenzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole (**3b-f**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 161-162°, ir ν CO 1699, 1667 cm^{-1}; ^{1}H nmr: δ 4.28 (s, 2H, CH_2), 7.35-7.63 (m, 7H, ArH), 8.01 (br d, J = 7.4 Hz, 2H, ArH); ^{13}C nmr: δ 41.9, 97.0, 125.5, 126.9, 128.4, 128.7, 130.0, 132.0, 132.9, 134.0, 155.7, 192.4; HR-MS m/z: Calcd. for $C_{19}H_{16}BrNO_4$: 433.0314. Found: 433.0300.

5,5-Dibenzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole (**3b-g**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 154-155°, ir ν CO 1698, 1670 cm^{-1}; ^{1}H nmr: δ 4.52 (s, 2H, CH_2), 7.41-7.96 (m, 12H, ArH), 8.09 (br d, J = 7.1 Hz, 4H, ArH), 8.99 (br d, J = 8.2 Hz, 1H, ArH); ^{13}C nmr: δ 45.0, 95.6, 124.7, 124.9, 126.5, 126.9, 127.8, 128.5, 128.6, 128.7, 130.0, 130.4, 131.6, 133.1, 133.86, 133.93, 157.1, 192.8.

Anal. Calcd. for $C_{25}H_{19}NO_3$: C, 79.98; H, 4.72; N, 3.45. Found: C, 80.06; H, 4.69; N, 3.41.

5-Benzoyl-3-phenyl-4,5-dihydroisoxazole-5-carboxylic acid methyl ester. (**3c-a**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 134-135°, ir ν CO 1734, 1696 cm^{-1}; ^{1}H nmr: δ 3.74 (d, J = 17.6 Hz, 1H, C*H*H), 3.79 (3H, s, CH_3), 4.55 (d, J = 17.6 Hz, 1H, CH*H*), 7.35-7.72 (m, 8H, ArH), 8.12 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 42.4, 53.6, 92.0, 126.9, 127.9, 128.6, 128.7, 130.0, 130.7, 133.1, 134.0, 156.1, 169.5, 189.8.

Anal. Calcd. for $C_{18}H_{15}NO_4$: C, 69.89; H, 4.89; N, 4.53. Found: C, 69.96; H, 4.86; N, 4.53.

5-Benzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Methyl Ester (**3c-b**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 99°, ir ν CO 1754, 1691 cm^{-1}; ^1H nmr: δ 3.73 (d, J = 17.6 Hz, 1H, C*H*H), 4.39 (s, 3H, CH_3), 4.53 (d, J = 17.6 Hz, 1H, CH*H*), 7.20-7.60 (m, 7H, ArH), 8.12 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 21.5, 53.6, 77.2, 91.9, 125.2, 127.0 128.7, 129.5, 130.1, 133.3, 134.0, 141.2, 156.2, 169.2, 190.2.

Anal. Calcd. for $C_{19}H_{17}NO_4$: C, 70.58; H, 5.30; N, 4.33. Found: C, 70.55; H, 5.11; N, 4.22.

5-Benzoyl-3-(4-isopropylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Methyl Ester (**3c-c**).

This compound was obtained as colorless needles (hexane), mp 67°, ir ν CO 1728, 1697 cm^{-1}; ^1H nmr: δ 1.26 (d, J = 6.9 Hz, 6H, CH_3), 2.94 (heptet, J = 6.9 Hz, 1H, CH), 3.73 (d, J = 17.6 Hz, 1H, C*H*H), 3.78 (s, 3H, CH_3), 4.52 (d, J = 17.6 Hz, 1H, CH*H*), 7.25-7.65 (m, 7H, ArH), 8.12 (br d, J = 7.2 Hz, 2H, ArH); ^{13}C nmr: δ 23.8, 34.2, 42.6, 53.6, 91.9, 125.4, 126.8, 127.0, 128.6, 130.0, 133.2, 133.9, 152.0, 156.0, 169.5, 190.0.

Anal. Calcd. for $C_{21}H_{21}NO_4$: C, 71.78; H, 6.02; N, 3.99. Found: C, 71.72; H, 5.99; N, 3.97.

5-Benzoyl-3-(4-chlorophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Methyl Ester (**3c-d**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 121-122°, ir ν CO 1752, 1684 cm^{-1}; ^1H nmr: δ 3.70 (d, J = 17.6 Hz, 1H, C*H*H), 3.79 (s, 3H, CH_3), 4.53 (d, J = 17.6 Hz, 1H, CH*H*), 7.25-7.65 (m, 7H, ArH), 8.11 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 42.2, 53.7, 92.2, 126.4, 128.2, 128.6, 129.0, 130.0, 133.0, 134.1, 136.8, 155.2, 169.3, 189.6.

Anal. Calcd. for $C_{18}H_{14}ClNO_4$: C, 62.89; H, 4.10; N, 4.07. Found: C, 62.96; H, 4.01; N, 4.08.

5-Benzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Methyl Ester (**3c-f**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 130-131°, ir ν CO 1755, 1691 cm^{-1}; ^1H nmr: δ 3.70 (d, J = 17.6 Hz, 1H, C*H*H), 3.79 (s, 3H, CH_3), 4.53 (d, J = 17.6 Hz, 1H, CH*H*), 7.25-7.65 (m, 7H, ArH), 8.11 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 42.1, 53.7, 92.2, 125.2, 126.8, 128.3, 128.6, 130.0, 132.0, 133.0, 134.1, 155.3, 169.3, 189.5.

Anal. Calcd. for $C_{18}H_{14}BrNO_4$: C, 55.69; H, 3.63; N, 3.61. Found: C, 55.86; H, 3.51; N, 3.62.

5-Benzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole-5-carboxylic acid methyl ester (**3c-g**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 130-132°, ir ν CO 1761, 1696 cm^{-1}; ^1H nmr: δ 3.81 (s, 3H, CH_3), 3.92 (d, J = 17.5 Hz, 1H, C*H*H), 4.78 (d, J = 17.5 Hz, 1H, CH*H*), 7.46-7.95 (m, 9H, ArH), 8.17 (br d, J = 7.1 Hz, 2H, ArH), 8.96 (br d, J = 8.2 Hz, 1H, ArH); ^{13}C nmr: δ 45.1, 53.7, 90.8, 124.6, 124.8, 126.4, 126.9, 127.7, 128.3, 128.5, 128.6, 130.0, 130.4, 131.5, 133.8, 134.0, 156.7, 169.6, 189.8.

Anal. Calcd. for $C_{22}H_{17}NO_4$: C, 73.53; H, 4.77; N, 3.90. Found: C, 73.38; H, 4.63; N, 3.90.

5-Benzoyl-3-phenyl-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-a**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 98-99°, ir ν CO 1727, 1694 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 3.71 (d, J = 17.5 Hz, 1H, C*H*H), 4.25 (q, J = 7.1 Hz, 2H, OCH_2), 4.56 (d, J = 17.5 Hz, 1H, CH*H*), 7.39-7.73 (m, 8H, ArH), 8.13 (br d, J = 7.0 Hz, 2H, ArH); ^{13}C nmr: δ 13.8, 42.2, 62.8, 92.0, 127.0, 128.1, 128.6, 128.8, 130.1, 130.8, 133.3, 134.0, 156.1, 169.1, 190.0.

Anal. Calcd. for $C_{19}H_{17}NO_4$: C, 70.58; H, 5.30; N, 4.33. Found: C, 70.49; H, 5.30; N, 4.00.

5-Benzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-b**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 87°, ir ν CO 1756, 1695 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 2.38 (s, 3H, CH_3), 3.69 (d, J = 17.5 Hz, 1H, C*H*H), 4.24 (q, J = 7.1 Hz, 2H, OCH_2), 4.53 (d, J = 17.5 Hz, 1H, CH*H*), 7.20-7.61 (m, 7H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 13.8, 21.5, 42.3, 62.8, 91.8, 125.2, 127.0, 128.6, 129.5, 130.1, 133.4, 133.9, 141.2, 156.1, 169.2, 190.2.

Anal. Calcd. for $C_{20}H_{19}NO_4$: C, 71.20; H, 5.68; N, 4.15. Found: C, 71.08; H, 5.50; N, 4.03.

5-Benzoyl-3-(4-isopropylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-c**).

This compound was obtained as colorless needles (hexane), mp 77-80°, ir ν CO 1753, 1693 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 1.26 (d, J = 6.9 Hz, 6H, CH_3), 2.93 (heptet, J = 6.9 Hz, 1H, CH), 3.70 (d, J = 17.5 Hz, 1H, C*H*H), 4.24 (q, J = 7.1 Hz, 2H, OCH_2), 4.53 (d, J = 17.5 Hz, 1H, CH*H*), 7.25-7.65 (m, 7H, ArH), 8.12 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 13.9, 23.8, 34.2, 42.4, 62.8, 91.8, 125.5, 126.8, 127.0, 128.5, 130.0, 133.3, 133.8, 151.9, 155.9, 169.0, 190.0.

Anal. Calcd. for $C_{22}H_{23}NO_4$: C, 72.31; H, 6.34; N, 3.83. Found: C, 72.13; H, 6.27; N, 3.54.

5-Benzoyl-3-(4-methoxyphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-d**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 86-87°, ir ν CO 1755, 1695 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 3.68 (d, J = 17.5 Hz, 1H, C*H*H), 3.84 (s, 3H, CH_3), 4.24 (q, J = 7.1 Hz, 2H, OCH_2), 4.52 (d, J = 17.5 Hz, 1H, CH*H*), 6.92 (d, J = 8.8 Hz, 2H, ArH), 7.47 (br t, J = 7.3 Hz, 2H, ArH), 7.59 (br t, J = 7.3 Hz, 1H, ArH), 7.63 (d, J = 8.8 Hz, 2H, ArH), 8.12 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 13.8, 42.4, 55.4, 62.8, 91.8, 114.2, 120.5, 128.61, 128.64, 130.1, 133.4, 133.9, 155.7, 161.5, 169.2, 190.3; HR-MS m/z: Calcd. for $C_{20}H_{19}NO_4$: 353.1263. Found: 353.1273.

5-Benzoyl-3-(4-chlorophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-e**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 108-109°, ir ν CO 1755, 1693 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 3.67 (d, J = 17.5 Hz, 1H, C*H*H), 4.24 (q, J = 7.1 Hz, 2H, OCH_2), 4.54 (d, J = 17.5 Hz, 1H, CH*H*), 7.37-7.66 (m, 7H, ArH), 8.12 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 13.9, 42.0, 62.9, 92.1, 126.5, 128.6, 129.0, 130.0, 133.1, 134.0, 136.7, 155.1, 168.8, 189.6.

Anal. Calcd. for $C_{19}H_{16}ClNO_4$: C, 63.78; H, 4.51; N, 3.91. Found: C, 63.70; H, 4.31; N, 3.89.

5-Benzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-f**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 109-110°, ir ν CO 1752, 1692 cm^{-1}; ^1H nmr: δ 1.16 (t, J = 7.1 Hz, 3H, CH_3), 3.66 (d, J = 17.6 Hz, 1H, C*H*H), 4.24 (q, J = 7.1 Hz, 2H, OCH_2), 4.54 (d, J = 17.6 Hz, 1H, CH*H*), 7.45-7.61 (m, 7H, ArH), 8.12 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 13.9, 42.0, 62.9, 92.1, 125.1, 126.9, 128.4, 128.6, 130.0, 132.0, 133.1, 134.0, 153.2, 168.7, 189.6.

Anal. Calcd. for $C_{19}H_{16}BrNO_4$: C, 56.73; H, 4.01; N, 3.48. Found: C, 56.96; H, 3.84; N, 3.40.

5-Benzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3d-g**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 97-98°, ir ν CO 1750, 1695 cm^{-1}; ^1H nmr: δ 1.18 (t, J = 7.1 Hz, 3H, CH_3), 3.88 (d, J = 17.5 Hz, 1H, C*H*H), 4.27 (q, J = 7.1 Hz, 2H, OCH_2), 4.79 (d, J = 17.5 Hz, 1H, CH*H*), 7.46-7.95 (m, 9H, ArH), 8.18 (br d, J = 7.1 Hz, 2H, ArH), 8.96 (br d, J = 8.2 Hz, 1H, ArH); ^{13}C nmr: δ 14.0, 45.0, 62.9, 90.8, 124.6, 124.9, 126.4, 126.9, 127.7, 128.3, 128.5, 128.6, 130.0, 130.4, 131.5, 133.3, 133.8, 133.9, 156.7, 169.0, 189.8.

Anal Calcd. for $C_{23}H_{19}NO_4$: C, 73.98; H, 5.13; N, 3.75. Found: C, 73.92; H, 4.91; N, 3.53.

5-Benzoyl-3-phenyl-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-a**).

This compound was obtained as colorless needles (hexane), mp 101°, ir ν CO 1754, 1693 cm^{-1}; ^1H nmr: δ 1.20-1.73 (m, 10H, CH_2 x 5), 3.68 (d, J = 17.5 Hz, 1H, C*H*H), 4.58 (d, J = 17.5 Hz, 1H, CH*H*), 4.86 (m, 1H, OCH), 7.40-7.73 (m, 8H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.1, 23.3, 25.1, 30.8, 31.1, 42.1, 75.3, 91.9, 126.9, 128.1, 128.5, 128.7, 129.9, 130.6, 133.4, 133.8, 153.9, 168.4, 189.8.

Anal. Calcd. for $C_{23}H_{23}NO_4$: C, 73.19; H, 6.14; N, 3.71. Found: C, 73.14; H, 6.13; N, 3.60.

5-Benzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-b**).

This compound was obtained as colorless needles (hexane), mp 101-102°, ir ν CO 1751, 1687 cm^{-1}; ^1H nmr: δ 1.21-1.73 (m, 10H, CH_2 x 5), 2.38 (s, 3H, CH_3), 3.64 (d, J = 17.5 Hz, 1H, C*H*H), 4.55 (d, J = 17.5 Hz, 1H, CH*H*), 4.86 (m, 1H, OCH), 7.22 (d, J = 8.0 Hz, 2H, ArH), 7.47 (br t, J = 7.3 Hz, 2H, ArH), 7.58 (br t, J = 7.3 Hz, 1H, ArH), 7.59 (d, J = 8.0 Hz, 2H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 21.6, 23.2, 23.3, 25.1, 30.8, 31.1, 42.3, 75.2, 91.8, 125.2, 126.9, 128.5, 129.4, 129.9, 133.4, 133.7, 141.0, 155.9, 168.4, 189.9.

Anal Calcd. for $C_{24}H_{25}NO_4$: C, 73.64; H, 6.44; N, 3.58. Found: C, 73.55; H, 6.39; N, 3.60.

5-Benzoyl-3(4-isopropylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-c**).

This compound was obtained as colorless needles (hexane), mp 91°, ir ν CO 1755, 1690 cm^{-1}; ^1H nmr: δ 1.26 (d, J = 6.9 Hz, 6H, CH_3), 1.21-1.73 (m, 10H, CH_2 x 5), 2.94 (heptet, J = 6.9 Hz, 1H, CH), 3.65 (d, J = 17.5 Hz, 1H, C*H*H), 4.56 (d, J = 17.5 Hz, 1H, CH*H*), 4.86 (m, 1H, OCH), 7.27 (d, J = 8.3 Hz, 2H, ArH), 7.47 (br t, J = 7.3 Hz, 2H, ArH), 7.59 (br t, J = 7.3 Hz, 1H, ArH), 7.63 (d, J = 8.3 Hz, 2H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.2, 23.3, 23.8, 25.1, 30.8, 31.1, 34.2, 42.3, 75.2, 77.5, 91.7, 125.6, 126.8, 127.0, 128.5, 129.9, 133.4, 133.7, 151.8, 155.8, 168.4, 189.9.

Anal Calcd. for $C_{26}H_{29}NO_4$: C, 74.44; H, 6.97; N, 3.34. Found: C, 74.31; H, 6.82; N, 3.28.

5-Benzoyl-3-(4-methoxyphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-d**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 106-108°, ir ν CO 1750, 1693 cm^{-1}; ^1H nmr: δ 1.21-1.73 (m, 10H, CH_2 x 5), 3.63 (d, J = 17.4 Hz, 1H, C*H*H), 3.84 (s, 3H, CH_3), 4.54 (d, J = 17.4 Hz, 1H, CH*H*), 4.86 (m, 1H, OCH), 6.92 (d, J = 8.8 Hz, 2H, ArH), 7.47 (br t, J = 7.3 Hz, 2H, ArH), 7.59 (br t, J = 7.3 Hz, 1H, ArH), 7.64 (d, J = 8.8 Hz, 2H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.2, 23.3, 25.1, 30.8, 31.1, 42.4, 55.4, 75.2, 91.7, 114.1, 120.6, 128.46, 128.54, 129.9, 133.4, 133.7, 155.4, 161.3, 168.5, 190.0; HR-MS m/z: Calcd. for $C_{24}H_{25}NO_5$: 407.1733. Found: 407.1744.

5-Benzoyl-3-(4-chlorophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-e**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 106-108°, ir ν CO 1750, 1690 cm^{-1}; ^1H nmr: δ 1.19-1.73 (m, 10H, CH_2 x 5), 3.62 (d, J = 17.5 Hz, 1H, C*H*H), 4.55 (d, J = 17.5 Hz, 1H, CH*H*), 4.87 (m, 1H, OCH), 7.39 (d, J = 8.6 Hz, 2H, ArH), 7.47 (t, J = 7.3 Hz, 2H, ArH), 7.60 (br t, J = 7.3 Hz, 1H, ArH), 7.64 (d, J = 8.6 Hz, 2H, ArH), 8.13 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.1, 23.3, 25.1, 30.8, 31.1, 41.9, 75.4, 92.1, 126.6, 128.2, 128.5, 129.0, 129.9, 133.3, 133.9, 136.7, 155.0, 168.2, 189.5.

Anal. Calcd. for $C_{23}H_{22}ClNO_4$: C, 67.07; H, 5.38; N, 3.40. Found: C, 66.87; H, 5.28; N, 3.43.

5-Benzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-f**).

This compound was obtained as colorless needles (hexane), mp 117-118°, ir ν CO 1753, 1692 cm^{-1}; ^1H nmr: δ 1.19-1.73 (m, 10H, CH_2 x 5), 3.52 (d, J = 17.5 Hz, 1H, C*H*H), 4.55 (d, J = 17.5 Hz, 1H, CH*H*), 4.87 (m, 1H, OCH), 7.37-7.66 (m, 7H, ArH), 8.12 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.1, 23.3, 25.1, 30.8, 31.0, 41.9, 75.4, 92.1, 125.0, 127.0, 128.4, 128.5, 129.9, 132.0, 133.3, 133.9, 155.1, 168.2, 189.5.

Anal. Calcd. for $C_{23}H_{22}BrNO_4$: C, 60.54; H, 4.86; N, 3.07. Found: C, 60.78; H, 4.67; N, 3.13.

5-Benzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole-5-carboxylic Acid Cyclohexyl Ester (**3e-g**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 124-125°, ir ν CO 1743, 1690 cm^{-1}; ^1H nmr: δ 1.20-1.75 (m, 10H, CH_2 x 5), 3.83 (d, J = 17.4 Hz, 1H, C*H*H), 4.81 (d, J = 17.4 Hz, 1H, CH*H*), 4.90 (m, 1H, OCH), 7.46-7.95 (m, 9H, ArH), 8.19 (br d, J = 7.1 Hz, 2H, ArH), 8.95 (br d, J = 8.4 Hz, 1H, ArH); ^{13}C nmr: δ 23.2, 23.3, 25.1, 30.8, 31.1, 44.9, 75.3, 90.7, 124.6, 125.0, 126.4, 126.9, 127.6, 128.2, 128.47, 128.54, 129.9, 130.4, 131.1, 133.5, 133.8, 156.6, 168.5, 189.8.

Anal. Calcd. for $C_{27}H_{25}NO_4$: C, 75.86; H, 5.89; N, 3.28. Found: C, 75.63; H, 5.69; N, 3.29.

5-Benzoyl-3-phenyl-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-a**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 103-104°, ir ν CO 1748, 1685 cm^{-1}; ^1H nmr: δ 3.66

(d, J = 17.6 Hz, 1H, C*H*H), 4.57 (d, J = 17.6 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.1 Hz, 2H, OCH_2Ph), 7.12-7.71 (m, 13H, ArH), 8.05 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 42.1, 68.2, 91.9, 127.1, 128.0, 128.3, 128.53, 128.57, 128.62, 128.8, 130.0, 130.8, 133.2, 134.0, 134.3, 156.1, 168.9, 189.6.

Anal Calcd. for $C_{24}H_{19}NO_4$: C, 74.79; H, 4.97; N, 3.63. Found: C, 74.68; H, 4.89; N, 3.33.

5-Benzoyl-3-(4-methylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-b**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 115°, ir ν CO 1748, 1686 cm^{-1}; ^1H nmr: δ 2.38 (s, 3H, CH_3), 3.65 (d, J = 17.6 Hz, 1H, C*H*H), 4.54 (d, J = 17.6 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.1 Hz, 2H, OCH_2Ph), 7.10-7.60 (m, 12H, ArH), 8.05 (br d, J = 7.2 Hz, 2H, ArH); ^{13}C nmr: δ 21.5, 42.3, 68.1, 91.7, 125.2, 127.0, 128.3, 128.53, 128.54, 128.6, 129.5, 130.0, 133.9, 134.3, 141.2, 156.1, 169.0, 189.7.

Anal. Calcd. for $C_{25}H_{21}NO_4$: C, 75.17; H, 5.30; N, 3.51. Found: C, 74.99; H, 5.18; N, 3.41.

5-Benzoyl-3-(4-isopropylphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Ethyl Ester (**3f-c**).

This compound was obtained as colorless needles (hexane), mp 116-117°, ir ν CO 1757, 1696 cm^{-1}; ^1H nmr: δ 1.25 (d, J = 6.9 Hz, 6H, CH_3), 2.93 (heptet, J = 6.9 Hz, 1H, CH), 3.65 (d, J = 17.6 Hz, 1H, C*H*H), 4.54 (d, J = 17.6 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.1 Hz, 2H, OCH_2Ph), 7.12-7.63 (m, 12H, ArH), 8.05 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 23.7, 34.1, 42.3, 68.1, 91.7, 125.5, 126.9, 127.1, 128.3, 128.53, 128.54, 128.6, 130.0, 133.3, 133.9, 134.3, 152.0, 156.1, 169.0, 189.8.

Anal Calcd. for $C_{27}H_{25}NO_4$: C, 75.86; H, 5.89; N, 3.28. Found: C, 75.79; H, 5.87; N, 3.24.

5-Benzoyl-3-(4-methoxyphenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-d**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 119-120°, ir ν CO 1749, 1690 cm^{-1}; ^1H nmr: δ 3.64 (d, J = 17.6 Hz, 1H, C*H*H), 3.84 (s, 3H, CH_3), 4.53 (d, J = 17.6 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.3 Hz, 2H, OCH_2Ph), 6.92 (d, J = 8.9 Hz, 2H, ArH), 7.13-7.26 (m, 5H, ArH), 7.39 (br t, J = 7.3 Hz, 2H, ArH), 7.52 (br t, J = 7.3 Hz, 1H, ArH), 7.62 (d, J = 8.9 Hz, 2H, ArH), 8.05 (br d, J = 7.3 Hz, 2H, ArH); ^{13}C nmr: δ 42.4, 55.4, 68.1, 77.2, 91.7, 114.2, 120.5, 128.3, 128.5, 128.6, 128.7, 130.1, 133.3, 133.9, 134.4, 155.7, 161.6, 169.1, 189.8; HR-MS m/z: Calcd. for $C_{20}H_{19}NO_4$: 415.1420. Found: 415.1425.

5-Benzoyl-3-(4-chlorophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-e**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 117-118°, ir ν CO 1747, 1685 cm^{-1}; ^1H nmr: δ 3.62 (d, J = 17.5 Hz, 1H, C*H*H), 4.54 (d, J = 17.5 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.0 Hz, 2H, OCH_2Ph), 7.15-7.63 (m, 8H, ArH), 7.38, (d, J = 8.7 Hz, 2H, ArH), 7.61, (d, J = 8.7 Hz, 2H, ArH), 8.04 (br d, J = 7.1 Hz, 2H, ArH); ^{13}C nmr: δ 42.0, 68.3, 92.0, 126.4, 128.2, 128.46, 128.52, 128.6, 129.0, 129.9, 133.0, 133.9, 134.1, 136.7, 155.1, 168.6, 189.1.

Anal. Calcd. for $C_{24}H_{18}ClNO_4$: C, 68.66; H, 4.32; N, 3.34. Found: C, 68.66; H, 4.21; N, 3.23.

5-Benzoyl-3-(4-bromophenyl)-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-f**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 134-135°, ir ν CO 1743, 1685 cm^{-1}; ^1H nmr δ: 3.61 (d, J = 17.6 Hz, 1H, C*H*H), 4.54 (d, J = 17.6 Hz, 1H, CH*H*), 5.19 (ABq, J = 12.1 Hz, 2H, OCH_2Ph), 7.14-7.55 (m, 12H, ArH), 8.04 (br d, J = 7.4 Hz, 2H, ArH); ^{13}C nmr: δ 41.9, 68.3, 92.0, 125.1, 126.9, 128.2, 128.4, 128.46, 128.52, 128.6, 129.9, 132.0, 133.0, 133.9, 134.1, 155.2, 168.6, 189.1.

Anal. Calcd. for $C_{24}H_{18}BrNO_4$: C, 62.08; H, 3.91; N, 3.02. Found: C, 62.36; H, 3.76; N, 2.91.

5-Benzoyl-3-naphthalen-1-yl-4,5-dihydroisoxazole-5-carboxylic Acid Benzyl Ester (**3f-g**).

This compound was obtained as colorless needles (hexane-C_6H_6), mp 99-101°, ir ν CO 1754, 1685 cm^{-1}; ^1H nmr: δ 3.84 (d, J = 17.5 Hz, 1H, C*H*H), 4.79 (d, J = 17.5 Hz, 1H, CH*H*), 5.22 (s, 2H, OCH_2Ph), 7.17-7.94 (m, 14H, ArH), 8.11 (br d, J = 7.3 Hz, 2H, ArH), 8.92 (br d, J = 8.2 Hz, 1H, ArH); ^{13}C nmr: δ 45.0, 68.2, 90.7, 124.6, 124.8, 126.4, 126.8, 127.7, 128.2, 128.3, 128.46, 128.48, 128.6, 130.0, 130.4, 131.5, 133.2, 133.8, 133.9, 134.2, 156.3, 168.9, 189.4.

Anal Calcd. for $C_{28}H_{21}NO_4$: C, 77.23; H, 4.86; N, 3.22. Found: C, 77.15; H, 4.77; N, 3.14.

REFERENCES AND NOTES

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