Catalyst Free and High Selective Electrophilic
Mono-fluorination of Acetoacetamides: Facile and Efficient
Preparation of 2-Fluoro Acetoacetamides in PEG-400

Jingjing Bi, Zhiguo Zhang,* Qingfeng Liu, Guisheng Zhang*

College of Chemistry and Environmental Science, Key Laboratory of Green Chemical Media and Reactions, Ministry of Education; Henan Key Laboratory for Environmental Pollution Control, Henan Normal University, Xinxiang, Henan 453007, PR China
E-mail: zhazhiguoz030@yahoo.com.cn and zgs6668@yahoo.com

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I. General Remarks:

All reagents were purchased from commercial sources and used without further treatment, unless otherwise indicated. $^1$H NMR and $^{13}$C NMR spectra were recorded on a Bruker Avance/400 ($^1$H: 400 MHz, $^{13}$C: 100 MHz at 25 °C) and TMS as internal standard. Data are represented as follows: chemical shift, integration, multiplicity (br = broad, s = singlet, d = doublet, dd = double doublet, t = triplet, q = quartet, h = heptet, m = multiplet), coupling constants in Hertz (Hz). The mass spectra (EI) were measured on a Waters LC-MS system. Elemental analysis was performed on a Perkin-Elmer-2400 CHN elemental analyzer, the C, H and N analysis were repeated twice. Melting points were measured on a YuHua X-5 melting point measurement instrument from YuHua Instrument Co., Ltd. Microwave irradiation experiments were carried out using the XH-100 B optimizer microwave (an internal thermometer can be insert into the reaction system to control the temperature) from XiangHu from Xiang Hu Technology Co., Ltd, and the power range was up to 800 W. IR spectra were recorded on a Bio-Rad FTS-40 FT-IR spectrophotometer as KBr pellets. All reactions were monitored by TLC with GF254 silica gel coated plates. Flash column chromatography was carried out using 200-300 mesh silica gel at increased pressure.

II. Typical Procedure:

(I) For 2 (2j as an example):

The mixture of 3-oxo-N-$p$-tolylbutanamide 1j (191 mg, 1.0 mmol), selectfluor (390 mg, 1.1 mmol) was well stirred for 8 h in PEG-400 (3.0 mL) at 60 °C oil bath, then to the mixture was added water (10 mL), extracted with diethyl ether (15 mL×4). The solvent was removed under reduced pressure, and the residue was purified by a short flash silica gel column chromatography to give compound 2j (199 mg, 95%) (Eluent: petroleum ether/ethyl acetate = 5/1).
III. Analytical data of compounds 2

2-fluoro-3-oxo-N-(p-tolyl)butanamide (2j)
Light yellow solid; mp: 55-57 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.19 (s, 1H), 7.40 (d, \(J = 8\) Hz, 2H), 7.12 (d, \(J = 8\) Hz, 2H), 5.40 (d, \(J = 49.2\) Hz, 1H), 2.47-2.40 (m, 3H), 2.30 (s, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.58 (d, \(J = 19.2\) Hz), 161.21 (d, \(J = 19.2\) Hz), 135.15, 133.70, 129.62, 120.35, 92.94 (d, \(J = 200.8\) Hz), 26.62, 20.91; MS: calcd m/z 209.1, found 210.1 [(M+1)]\(^+\); IR (KBr, neat): \(\nu\) 3338, 1735, 1683, 1541, 1516, 1095, 811; Anal. Calcd for C\(_{11}\)H\(_{12}\)FNO\(_2\): C, 63.15; H, 5.78; N, 6.69. Found: C, 63.22; H, 5.70; N, 6.74.

2-fluoro-N-(4-methoxyphenyl)-3-oxobutanamide (2k)
Yellow solid; mp: 57-59 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.30 (s, 1H), 7.36 (d, \(J = 9.2\) Hz, 2H), 6.77 (d, \(J = 8.8\) Hz, 2H), 5.35 (d, \(J = 49.2\) Hz, 1H), 3.69 (s, 3H), 2.40-2.33 (m, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.68 (d, \(J = 20\) Hz), 161.25 (d, \(J = 19.6\) Hz), 157.05, 129.29, 122.16, 114.14, 92.92 (d, \(J = 200.5\) Hz), 55.37, 26.49; MS: calcd m/z 225.1, found 226.1 [(M+1)]\(^+\); IR (KBr, neat): \(\nu\) 3353, 1730, 1672, 1604, 1560, 1412, 824; Anal. Calcd for C\(_{11}\)H\(_{12}\)FNO\(_3\): C, 58.66; H, 5.37; N, 6.22. Found: C, 58.58; H, 5.42; N, 6.26.

2-fluoro-3-oxo-N-(o-tolyl)butanamide (2l)
Yellow viscous liquid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.10 (s, 1H), 7.60 (m, 2H), 7.06 (d, \(J = 8\) Hz, 1H), 7.11 (m, 2H), 7.06 (d, \(J = 8\) Hz, 1H), 5.35 (d, \(J = 49.2\) Hz, 1H), 2.39-2.31 (m, 3H), 2.15 (s, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.87 (d, \(J = 20.3\) Hz), 161.43 (d, \(J = 19.7\) Hz), 133.83, 130.52, 130.08, 126.56, 126.08, 123.22, 92.76 (d, \(J = 199.7\) Hz), 26.34, 17.25; MS: calcd m/z 210.1 [(M+1)]\(^+\); IR (KBr, neat): \(\nu\) 3324, 1739, 1685, 1538, 1459, 1360, 754; Anal. Calcd for C\(_{11}\)H\(_{12}\)FNO\(_2\): C, 63.15; H, 5.78; N, 6.69. Found: C, 63.28; H, 5.84; N, 6.77.

2-fluoro-N-(2-methoxyphenyl)-3-oxobutanamide (2m)
Yellow viscous liquid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.64 (s, 1H), 8.26 (d, \(J = 8\) Hz, 1H), 7.06 (t, \(J = 7.6\) Hz, 1H), 6.92 (t, \(J = 7.6\) Hz, 1H), 6.86 (d, \(J = 8\) Hz, 1H), 5.37 (d, \(J = 49.2\) Hz, 1H), 3.84 (s, 3H), 2.39-2.46 (m, 3H); \(^1^3\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.06 (d, \(J = 19.9\) Hz), 160.83 (d, \(J = 19.9\) Hz), 148.27, 125.96, 124.98, 120.89, 119.82, 110.15, 92.92 (d, \(J = 201.3\) Hz), 55.71, 26.45; MS: calcd m/z 225.1, found 226.1 [(M+1)]\(^+\); IR (KBr, neat): \(\nu\) 3410, 1740, 1695, 1549, 1463, 1255, 1118, 752; Anal. Calcd for C\(_{11}\)H\(_{12}\)FNO\(_3\): C, 58.66; H, 5.37; N, 6.22. Found: C, 58.74; H, 5.39; N, 6.30.
**N-(2,4-dimethylphenyl)-2-fluoro-3-oxobutanamide (2n)**
White solid; mp: 53-54 °C ; \(^1^H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.93 (s, 1H), 7.56 (d, \(J = 8.8\) Hz, 1H), 7.00 (d, \(J = 5.6\) Hz, 2H), 5.42 (d, \(J = 49.2\) Hz, 1H), 2.49-2.42 (m, 3H), 2.28 (s, 3H), 2.19 (s, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.67 (d, \(J = 20.2\) Hz), 161.40 (d, \(J = 19.6\) Hz), 136.08, 131.31, 129.94, 127.42, 123.27, 93.03 (d, \(J = 200.5\) Hz), 26.67, 20.92, 17.44; MS: calcld \(m/z\) 223.1, found 224.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3307, 1598, 1540, 1506, 1140, 1115, 875, 808; Anal. Caled for C\(_{12}\)H\(_{14}\)FNO\(_2\): C, 64.56; H, 6.32; N, 6.27. Found: C, 64.69; H, 6.38; N, 6.20.

**2-fluoro-3-oxo-N-phenylbutanamide (2o)**
Yellow viscous liquid; \(^1^H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.17 (s, 1H), 7.53 (d, \(J = 8\) Hz, 2H), 7.34 (t, \(J = 8\) Hz, 2H), 7.17 (t, \(J = 7.2\) Hz, 1H), 5.41 (d, \(J = 49.2\) Hz, 1H), 2.49-2.42 (m, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.38 (d, \(J = 19.7\) Hz), 161.28 (d, \(J = 16.0\) Hz), 136.27, 129.25, 125.54, 120.32, 92.94 (d, \(J = 201.2\) Hz), 26.71; MS: calcld \(m/z\) 195.1, found 196.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3330, 1738, 1684, 1601, 1541, 1446, 755, 692; Anal. Caled for C\(_{10}\)H\(_{10}\)FNO\(_2\): C, 61.53; H, 5.16; N, 7.18. Found: C, 61.43; H, 5.20; N, 7.15.

**N-(5-chloro-2-methoxyphenyl)-2-fluoro-3-oxobutanamide (2p)**
Yellow viscous liquid; \(^1^H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.63 (s, 1H), 8.31 (d, \(J = 2.4\) Hz, 1H), 7.01 (d, \(J = 8.8\) Hz, 2H), 6.76 (d, \(J = 8.8\) Hz, 1H), 5.39 (d, \(J = 49.2\) Hz, 1H), 3.85 (s, 3H), 2.48-2.40 (m, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 198.95 (d, \(J = 20.0\) Hz), 161.00 (d, \(J = 19.4\) Hz), 146.83, 126.80, 125.90, 124.50, 119.79, 110.99, 92.82 (d, \(J = 201.6\) Hz), 56.11, 26.50; MS: calcld \(m/z\) 259.0, found 260.0 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3408, 1740, 1698, 1596, 1533, 1485, 1254, 804, 645; Anal. Caled for C\(_{11}\)H\(_{11}\)ClFNO\(_3\): C, 50.88; H, 4.27; N, 5.39. Found: C, 50.97; H, 4.22; N, 5.40.

**N-(2-chlorophenyl)-2-fluoro-3-oxobutanamide (2q)**
Yellow viscous liquid; \(^1^H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.63 (s, 1H), 8.27 (d, \(J = 8.4\) Hz, 1H), 7.38 (d, \(J = 8.4\) Hz, 1H), 7.27 (t, \(J = 7.6\) Hz, 1H), 7.10 (t, \(J = 7.2\) Hz, 1H), 5.44 (d, \(J = 48.8\) Hz, 1H), 2.43-2.51 (m, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.10 (d, \(J = 20.1\) Hz), 161.14 (d, \(J = 19.6\) Hz), 133.01, 129.24, 127.73, 125.82, 123.65, 121.71, 92.70 (d, \(J = 201.1\) Hz), 26.50; MS: calcld \(m/z\) 229.0, found 230.0 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3401, 1699, 1596, 1548, 1444, 1361, 753; Anal. Caled for C\(_{10}\)H\(_{9}\)ClFNO\(_2\): C, 52.30; H, 3.95; N, 6.10. Found: C, 52.35; H, 4.00; N, 6.12.
**N-(4-chlorophenyl)-2-fluoro-3-oxobutanamide (2r)**

Yellow solid; mp: 56-57 °C; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.35 (s, 1H), 7.40 (d, $J = 8.8$ Hz, 2H), 7.18 (d, $J = 8.8$ Hz, 2H), 5.34 (d, $J = 49.2$ Hz, 1H), 2.39-2.32 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 199.56 (d, $J = 20$ Hz), 161.37 (d, $J = 19.8$ Hz), 134.83, 130.44, 129.08, 121.60, 92.79(d, $J = 200.8$ Hz), 26.55; MS: calcd m/z 229.0, found 230.0 [(M+1)$^+$]; IR (KBr, neat): v 3325, 1738, 1683, 1670, 1558, 1493, 820; Anal. Calcd for C$_{10}$H$_9$ClFNO$_2$: C, 52.30; H, 3.95; N, 6.10. Found: C, 52.33; H, 3.89; N, 6.15.

**N-(4-acetylphenyl)-2-fluoro-3-oxobutanamide (2s)**

White solid; mp: 106-108 °C; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.54 (s, 1H), 7.94-7.92 (dd, $J_1 = 8.8$ Hz, $J_2 = 2.4$ Hz, 2H), 7.68-7.66 (d, $J = 8.8$ Hz, 2H), 5.51-5.39 (d, $J = 48.8$ Hz, 1H), 2.57 (s, 3H), 2.49-2.43 (m, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 199.39 (d, $J = 20.0$ Hz), 197.18, 161.55 (d, $J = 19.7$ Hz), 140.64, 133.79, 129.80, 119.61, 92.81 (d, $J = 201.2$ Hz), 26.79, 26.58; IR (KBr, neat): v 3324, 1736, 1690, 1564, 1493, 824; Anal. Calcd for C$_{12}$H$_{12}$FNO$_3$: C, 60.76; H, 5.10; N, 5.90. Found: C, 60.75; H, 5.05; N, 5.88.

**Ethyl 4-(2-fluoro-3-oxobutanamido)benzoate (2t)**

Colourless liquid; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 8.62 (s, 1H), 8.03-8.01 (d, $J = 8.8$ Hz, 2H), 7.68-7.66 (d, $J = 8.8$ Hz, 2H), 5.54-5.42 (d, $J = 48.8$ Hz, 1H), 4.39-4.34 (q, $J = 7.2$ Hz, 2H), 2.50-2.45 (m, 3H), 1.41-1.38 (t, $J = 7.2$ Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 199.45 (d, $J = 19.5$ Hz), 166.01, 161.53 (d, $J = 19.7$ Hz), 140.39, 130.80, 126.99, 119.46, 92.82 (d, $J = 201.3$ Hz), 61.11, 26.73, 14.32; IR (KBr, neat): v 3326, 1748, 1693, 1530, 1526, 1428, 834; Anal. Calcd for C$_{13}$H$_{14}$FNO$_4$: C, 58.42; H, 5.28; N, 5.24. Found: C, 58.45; H, 5.36; N, 5.19.

**2-fluoro-3-oxo-N,N-diphenylbutanamide (2g)**

Yellow solid; mp: 97-98 °C; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 7.38-7.26 (m, 10H), 5.27 (d, $J = 49.6$ Hz, 1H), 2.30 (d, $J = 4.8$ Hz, 3H); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 203.22 (d, $J = 26.1$ Hz), 141.62, 141.02, 130.07, 129.25, 129.00, 128.85, 127.10, 89.91 (d, $J = 191.4$ Hz), 26.71; MS: calcd m/z 271.1, found 272.1 [(M+1)$^+$]; IR (KBr, neat): v 1693, 1492, 1354, 1094, 700; Anal. Calcd for C$_{16}$H$_{14}$FNO$_2$: C, 70.84; H, 5.20; N, 5.16. Found: C, 70.80; H, 5.26; N, 5.20.

**2-fluoro-N,N-dimethyl-3-oxobutanamide (2h)**

Light yellow liquid; $^1$H NMR (400 MHz, CDCl$_3$): $\delta$ 5.50 (d, $J = 49.6$ Hz, 1H), 3.04 (s, 3H), 2.92 (s, 3H), 2.24 (d, $J = 4$ Hz); $^{13}$C NMR (100 MHz, CDCl$_3$): $\delta$ 201.73 (d, $J = 24.1$ Hz), 163.49 (d, $J = 20.4$ Hz), 90.99 (d, $J = 192.9$ Hz), 36.75, 36.71, 35.70, 25.86; MS: calcd m/z 147.1, found...
N,N-diethyl-2-fluoro-3-oxobutanamide (2i)
Light yellow solid; mp: 92-94 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 5.32 (d, \(J = 50.0\) Hz, 1H), 3.35-3.17 (m, 4H), 2.17-2.16 (m, 3H), 1.06 (t, \(J = 6.8\) Hz, 3H), 0.98 (t, \(J = 6.8\) Hz, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 201.87 (t, \(J = 23.9\) Hz), 162.98 (t, \(J = 20.1\) Hz), 91.33 (d, \(J = 93.6\) Hz), 41.59, 40.52, 14.00, 12.30; MS: calcd m/z 175.1, found 176.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 2978, 2940, 1740, 1642, 1464, 1360, 1084; Anal. Calcd for C\(_8\)H\(_{14}\)FNO\(_2\): C, 54.84; H, 8.05; N, 7.99. Found: C, 54.80; H, 8.11; N, 8.02.

N-benzyl-2-fluoro-3-oxobutanamide (2u)
Colourless liquid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 7.35-7.24 (m, 5H), 6.87 (s, 1H), 5.31 (d, \(J = 49.2\) Hz, 1H), 4.51-4.40 (m, 2H), 2.45-2.37 (m, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 199.33 (d, \(J = 19.4\) Hz), 163.32 (d, \(J = 19.8\) Hz), 137.06, 128.85, 127.87, 127.79, 92.96 (d, \(J = 199.6\) Hz), 43.37, 26.62; MS: calcd m/z 209.1, found 210.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3338, 1736, 1684, 1539, 1455, 1360, 1093, 700; Anal. Calcd for C\(_{11}\)H\(_{12}\)FNO\(_2\): C, 63.15; H, 5.78; N, 6.69. Found: C, 63.20; H, 5.84; N, 6.72.

2-fluoro-4-methyl-3-oxo-N-phenylpentanamide (2v)
Light yellow liquid; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.20 (s, 1H), 7.53 (d, \(J = 7.6\) Hz, 1H), 7.16 (t, \(J = 7.6\) Hz, 1H), 5.53 (d, \(J = 49.2\) Hz, 1H), 3.26 (h, \(J = 6.8\) Hz, 1H), 1.20 (d, \(J = 7.2\) Hz, 3H), 1.13 (d, \(J = 6.4\) Hz, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 205.86 (d, \(J = 18.6\) Hz), 161.56 (d, \(J = 19.7\) Hz), 136.40, 129.22, 125.41, 120.27, 91.52 (d, \(J = 200.7\) Hz), 37.36, 18.42, 17.23; MS: calcd m/z 223.1, found 224.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3323, 2976, 1733, 1684, 1541, 1446, 755, 692; Anal. Calcd for C\(_{12}\)H\(_{14}\)FNO\(_2\): C, 64.56; H, 6.32; N, 6.27. Found: C, 64.62; H, 6.28; N, 6.24.

2-fluoro-3-oxo-3-phenyl-N-(p-tolyl)propanamide (2w)
Yellow solid; mp: 91-93 °C; \(^1\)H NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.30 (s, 1H), 8.14 (d, \(J = 7.6\) Hz, 2H), 7.59 (t, \(J = 7.6\) Hz, 1H), 7.46 (t, \(J = 8\) Hz, 2H), 7.16 (t, \(J = 8\) Hz, 2H), 6.25 (d, \(J = 48.8\) Hz, 1H), 2.33-2.29 (m, 3H); \(^{13}\)C NMR (100 MHz, CDCl\(_3\)): \(\delta\) 190.59 (d, \(J = 17.7\) Hz), 161.88 (d, \(J = 19.3\) Hz), 135.01, 134.65, 133.83, 133.62, 129.92, 129.56, 128.74, 120.27, 90.45 (d, \(J = 198.6\) Hz), 20.88; MS: calcd m/z 271.1, found 272.1 [(M+1)]\(^+\); IR (KBr, neat): \(v\) 3346, 1698, 1657, 1530, 1107, 731, 684; Anal. Calcd for C\(_{16}\)H\(_{14}\)FNO\(_2\): C, 70.84; H, 5.20; N, 5.16. Found: C, 70.82; H, 5.24; N, 5.11.
\[ \text{N,N'}-(1,4-\text{phenylene})\text{bis(2-fluoro-3-oxobutanamide)} \ (2x) \]
Light yellow solid; mp: 185-187 °C; \(^1H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 10.50 (s, 2H), 7.66 (d, \(J = 12.8\) Hz, 4H), 5.69 (d, \(J = 48.4\) Hz, 2H), 2.48-2.32 (m, 6H); \(^13C\) NMR (100 MHz, CDCl\(_3\)): \(\delta\) 200.43 (d, \(J = 20.9\) Hz), 162.15 (d, \(J = 21.0\) Hz), 134.12, 120.70, 92.92 (d, \(J = 193.6\) Hz), 26.45; MS: calcd \(m/z\) 312.1, found 313.1 [(M+1)+]; IR (KBr, neat): \(v\) 3323, 1732, 1683, 1568, 1515, 1407, 1095, 824; Anal. Calcd for C\(_{14}\)H\(_{14}\)F\(_2\)N\(_2\)O\(_4\): C, 53.85; H, 4.52; N, 8.97. Found: C, 53.93; H, 4.56; N, 9.01.

\[ \text{N-(4-chlorophenyl)-2-fluoro-2-methyl-3-oxobutanamide} \ (2y) \]
Light yellow solid; mp: 105-107 °C; \(^1H\) NMR (400 MHz, CDCl\(_3\)): \(\delta\) 8.36 (s, 1H), 7.53 (d, \(J = 8.8\) Hz, 2H), 7.30 (d, \(J = 8.8\) Hz, 2H), 2.36 (d, \(J = 3.2\) Hz, 3H), 1.81 (d, \(J = 22.8\) Hz, 3H); \(^13C\) NMR (100 MHz, CDCl\(_3\)): \(\delta\) 201.09 (d, \(J = 24.5\) Hz), 164.91 (d, \(J = 21.0\) Hz), 135.15, 130.29, 129.13, 121.47, 99.56 (d, \(J = 196.4\) Hz), 25.20, 20.84 (d, \(J = 22.7\) Hz); MS: calcd \(m/z\) 243.0, found 244.0 [(M+1)+]; IR (KBr, neat): \(v\) 3330, 1739, 1683, 1653, 1541, 1495, 1403, 833; Anal. Calcd for C\(_{11}\)H\(_{11}\)ClFNO\(_2\): C, 54.22; H, 4.55; N, 5.75. Found: C, 54.22; H, 4.49; N, 5.77.
IV. $^1$H NMR and $^{13}$C NMR spectra copies

Compound 2j
Compound 2k
Compound 2m
Compound 2n
Compound 2o
Compound 2p
Compound 2q
Compound 2r

Electronic Supplementary Material (ESI) for Green Chemistry
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Compound 2w
Compound 2x
Compound 2y