Thermal [3+2] Cycloaddition of Aromatic Azomethine Imines with Allenoates

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Abstract: The thermal [3+2] cycloadditions of two classes of aromatic azomethine imines with allenoates have been investigated. The reactions are operationally simple and proceed smoothly under mild reaction conditions to provide a variety of dinitrogen-fused heterocycles in moderate to excellent yields.

Key words: cycloaddition, azomethine imine, allenoate, quinoline, isoquinoline

Quinoline, isoquinoline and structurally related heterocycles occur widely in nature and some have a broad range of clinical applications, exhibiting a wide range of biological activities such as antitumor, anti-HIV, antibiotic, antifungal, antivirus, anti-inflammatory, anticoagulation, and bronchodilation, and can also act on the central nervous system.[1] For example, Ecteinascidin 743 (Yondelis, trabectedin; Figure 1) is a new antitumor agent of marine origin discovered in the Caribbean tunicate Ecteinascidia turbinate for the treatment of soft tissue sarcoma and ovarian cancer.[2] Phase II trials with Yondelis are also being carried out for breast cancer, lung cancer, prostate cancer, and for paediatric tumors. Higenamine[3] and RESPIR 4-95[4] (Figure 1) display anticoagulation and bronchodilation activities, respectively. Compounds **I** (Figure 1) are potent nonnucleoside, allosteric inhibitors of reverse transcriptase, and could interact with retroviral targets relevant to anti-HIV therapy.[5] The tetrahydroquinoline derivative **II** shows activity against antibacterial targets such as DNA gyrase.[6] Accordingly, the synthesis of quinoline and isoquinoline derivatives has attracted much attention.[7] However, although many synthetic methods have been developed,[7] new procedures for their synthesis would still be highly desirable.

Azomethine imines have emerged as a versatile 1,3-dipole for various thermal, metal-catalyzed, and organocatalytic 1,3-dipolar cycloaddition reactions and have been extensively applied in organic synthesis because of their easy accessibility, stability and the potential applications of the corresponding cycloadducts.[8,9] The range of azomethine imines available for the cycloaddition reactions has been expanded to include various imines such as 3-oxopyrazolidin-1-ium-2-ide derivatives and benzoyl(3,4-dihydroisoquinolin-2-ium-2-yl)amides, but research on aromatic azomethine imines is somewhat limited.[9z,10] Recently, we successfully developed [3+2], [3+3], [4+3], and [3+2+3] annulation reactions of azomethine imines with allenoates, affording facile access to dinitrogen-fused bicyclic or tricyclic heterocycles,[11] which are key units in or building blocks of many pharmaceuticals, agrochemicals, biologically active compounds, and other useful chemicals.[12] As part of our continuing efforts to develop the annulation reaction of azomethine imines,[11] we recently investigated the reactions of aromatic azomethine imines with allenoates. Herein, we present our results on the thermal [3+2] cycloaddition of aromatic azomethine imines with allenoates to furnish functionalized dinitrogen-fused tricyclic heterocycles.

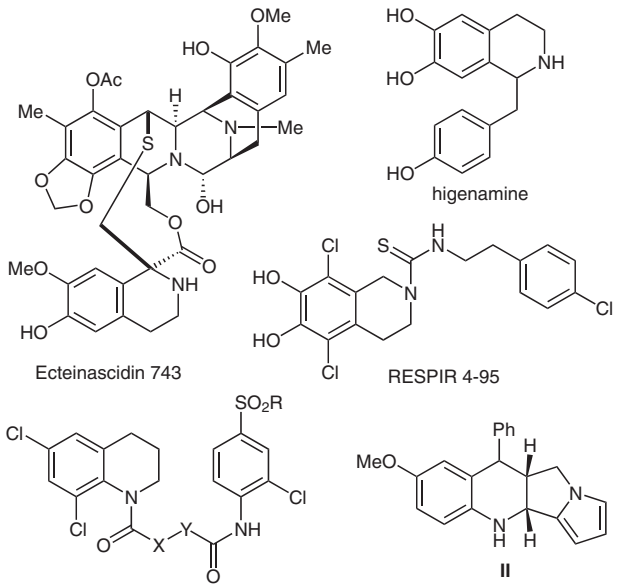

Figure 1 Pharmaceutically active quinoline and isoquinoline-related derivatives

The azomethine imines **1**, **8** and **13** were easily prepared according to reported procedures.[13] In initial attempts, azomethine imine **1** was treated with the allenoate **2a** in dichloromethane at room temperature for 96 hours (Scheme 1). The reaction worked sluggishly, and two new products were isolated in total 20% yield. When the reaction was carried out in toluene at room temperature for 96 hours, the same two products were obtained in poor yield (5%) due to the poor solubility of azomethine imine **1** in toluene. To increase the yield, the reaction was carried out in refluxing toluene. Under these conditions the azomethine imine was completely converted in 72 hours to give the product in 70% yield. However, several side-

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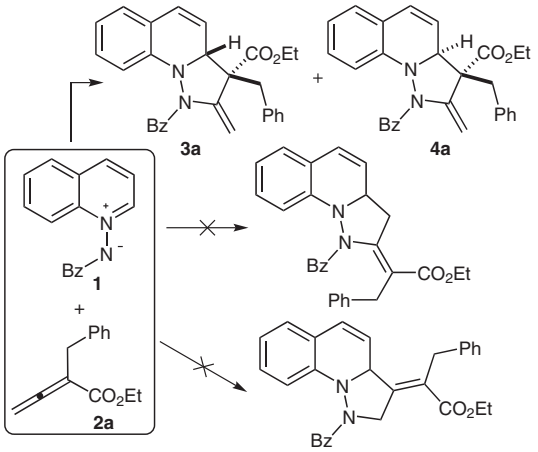
products were observed in small amounts. Decreasing the reaction temperature to 90 °C resulted in a clean reaction and improved yield (89%). The two products could be separated by silica gel chromatography, and were determined to be [3+2] cycloaddition products **3a** and **4a** (Scheme 1), on the basis of 2D NMR spectroscopic and X-ray crystallographic[14] analyses (Figure 2). In principle, since both active double bonds in allenoate could undergo the cycloaddition reaction with azomethine imine, three kinds of cycloadducts could be produced in the reaction, but the reaction was highly regioselective and produced the 2-*exo* methylene isomer as the sole regioisomer, which possessed two chiral carbons (Scheme 1). It is noteworthy that an interesting quaternary carbon center was incorporated into the molecular skeleton of the products **3a** and **4a**.



Scheme 1 The thermal cycloaddition of azomethine imine **1** with ethyl α-substituted allenoate **2a**

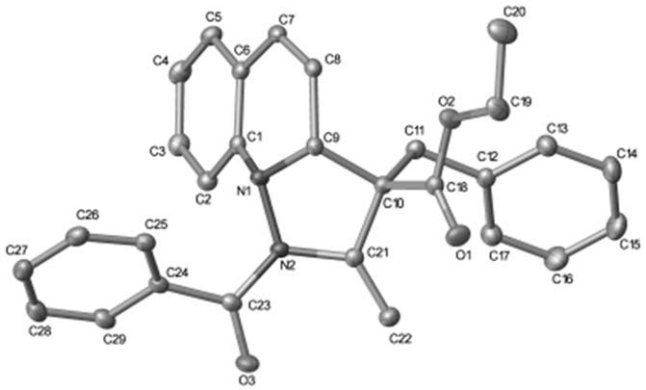
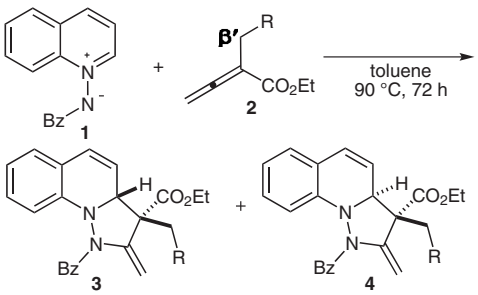


Figure 2 The X-ray crystal structure of **4a**

With the optimal reaction conditions in hand (toluene, 90 °C), azomethine imine **1** was treated with various substituted allenoates **2** in toluene for 72 hours, giving the functionalized dinitrogen-fused tricyclic heterocycles **3** and **4** in moderate to excellent yields, albeit with poor diastereoselectivity (Table 1, entries 1–13). Although poor

Table 1 Thermal Cycloaddition of Azomethine Imine **1** with α-Substituted Allenoates **2**[a]

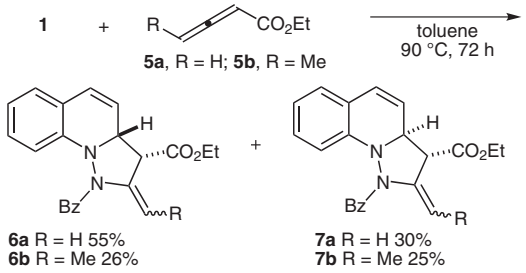


Entry	R	Product	Yield (%)[b]	Ratio **3**/**4**[c]
1	Ph (**2a**)	**3a** + **4a**	89	53:47
2	2-MeC_6H_4 (**2b**)	**3b** + **4b**	96	41:59
3	3-MeC_6H_4 (**2c**)	**3c** + **4c**	81	52:48
4	4-MeC_6H_4 (**2d**)	**3d** + **4d**	79	57:43
5	2-FC_6H_4 (**2e**)	**3e** + **4e**	94	49:51
6	3-FC_6H_4 (**2f**)	**3f** + **4f**	86	57:43
7	4-FC_6H_4 (**2g**)	**3g** + **4g**	82	52:48
8	2-ClC_6H_4 (**2h**)	**3h** + **4h**	91	40:60
9	3-ClC_6H_4 (**2i**)	**3i** + **4i**	68	40:60
10	4-ClC_6H_4 (**2j**)	**3j** + **4j**	65	60:40
11	2-BrC_6H_4 (**2k**)	**3k** + **4k**	73	45:55
12	3-BrC_6H_4 (**2l**)	**3l** + **4l**	70	53:47
13	CO_2Et (**2m**)	**3m** + **4m**	86	74:26[d]

[a] 1.2 equivalent of allenoate was used.
[b] Isolated yields.
[c] Based on isolated yield unless otherwise stated.
[d] Based on integration of signals in the ^1H NMR spectrum.

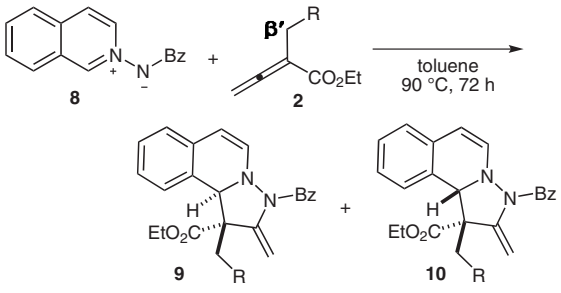
diastereoselectivities were obtained, both diastereomers could be separated, providing diverse heterocycles for medicinal chemistry. The allenoates with electron-withdrawing substituents in the aryl group worked as well as those allenoates with electron-donating substituents in the aryl group under otherwise identical conditions (entries 1–12), and the derivatives of ethyl 1-benzoyl-2-methylene-1,2,3,3a-tetrahydropyrazolo[1,5-*a*]quinoline-3-carboxylate could be obtained in 65–96% yield. The highest yield (96%) was achieved in the cycloaddition of β′-2-MeC_6H_4 substituted allenoate (entry 2). Although the R substituent in allenoate is some distance away from the active double bond, it seems that the position of R relative to the β′-position of allenoate has an influence on the yield. In general, in comparison with allenoates with *meta*- and *para*-substituents in the aryl group, allenoates with *ortho*-substituents in the aryl group underwent the reaction in higher yields (entries 2, 5, 8, and 11). The β′-ethoxycarbonyl allenoate was active and smoothly partic-

ipated in the cycloaddition to give the expected cycloadduct in 86% yield (entry 13), and ethyl buta-2,3-dienoate (**5a**) also worked efficiently to give the cycloadducts in 85% yield (Scheme 2). Unfortunately, the reaction with γ-substituted allenoate **5b** was more sluggish and afforded the cycloadduct in moderate yield (Scheme 2).



Scheme 2 Thermal cycloaddition of azomethine imine **1** with ethyl buta-2,3-dienoate (**5a**) and γ-substituted allenoate (**5b**)

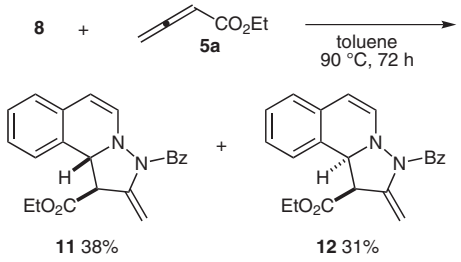
Table 2 Thermal Cycloaddition of Azomethine Imine **8** with α-Substituted Allenoates **2**[a]



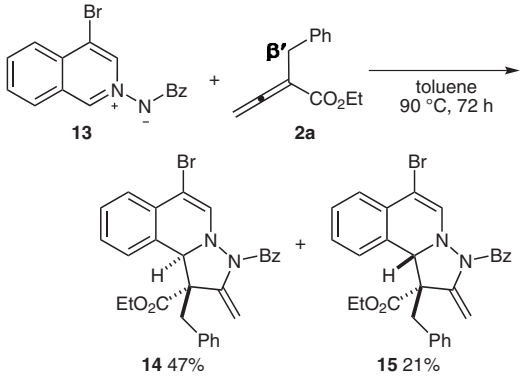
Entry	R	Product	Yield (%)[b]	Ratio **9**/**10**[c]
1	Ph (**2a**)	**9a** + **10a**	71	41:59
2	2-MeC_6H_4 (**2b**)	**9b** + **10b**	50	72:28[d]
3	3-MeC_6H_4 (**2c**)	**9c** + **10c**	75	40:60[d]
4	2-FC_6H_4 (**2e**)	**9e** + **10e**	98	52:48
5	3-FC_6H_4 (**2f**)	**9f** + **10f**	61	23:77
6	4-FC_6H_4 (**2g**)	**9g** + **10g**	71	32:68
7	2-ClC_6H_4 (**2h**)	**9h** + **10h**	72	51:49
8	3-ClC_6H_4 (**2i**)	**9i** + **10i**	66	35:65
9	3-BrC_6H_4 (**2l**)	**9l** + **10l**	76	41:59
10	CO_2Et (**2m**)	**9m** + **10m**	86	37:63

[a] 1.2 equivalent of allenoate was used.
[b] Isolated yield.
[c] Based on isolated yield unless otherwise stated.
[d] Based on integration of signals in the ^{1}H NMR spectrum.

Having investigated the reactions of aromatic azomethine imine **1**, based on the dihydroquinoline structure, with allenoates, we then explored the reaction of aromatic azomethine imine **8**, based on dihydroisoquinoline structure, with allenoates (Table 2). We were pleased to find that imine **8** was also active. A wide range of aryl groups with electron-donating or withdrawing substituents at the β′-position of the allenoate could be tolerated in the cycloaddition. The reactions were carried out in toluene at 90 °C for 72 hours to afford derivatives of ethyl 3-benzoyl-2-methylene-1,2,3,10b-tetrahydropyrazolo[5,1-*a*]isoquinoline-1-carboxylate in 50–98% yields with moderate diastereoselectivities (entries 1–10). Fortunately, most diastereomeric mixtures could be separated by using flash column chromatography. However, the diastereomeric mixtures obtained from the reaction of imine **8** with either allenoate **2b** or **2c** could not be separated by flash column chromatography, and the diastereomeric ratios were determined by NMR spectroscopic analysis. In contrast to reactions with azomethine imine **1**, the influence of the position of the R substituent relative to the β′-position of the allenoate on the yields were not clear (entries 2, 3 vs 4–8). Ethyl buta-2,3-dienoate (**5a**) also smoothly underwent the cycloaddition reactions, affording the corresponding cycloadduct in good yield (Scheme 3). Azomethine imine **13**, which is an analogue of **8**, underwent the reaction to produce the desired product in 68% yield with a diastereomeric ratio of around 2:1 (Scheme 4).



Scheme 3 Thermal cycloaddition of azomethine imine **8** with ethyl buta-2,3-dienoate (**5a**)



Scheme 4 Thermal cycloaddition of azomethine imine **13** with ethyl 2-benzylbuta-2,3-dienoate (**2a**)

In summary, thermal [3+2] cycloaddition reactions of aromatic azomethine imines with allenoates have been developed; the reactions were performed in toluene at 90 °C to give the functionalized dinitrogen-fused tricyclic heterocycles, which are pharmaceutically important compounds. The desired products were obtained in moderate to excellent yields. The reaction is operationally simple

and works efficiently, thus it is a potentially useful protocol for the synthesis of biologically active molecules.

Unless otherwise stated, all reagents were purchased from commercial suppliers and used without further purification. Organic solutions were concentrated under reduced pressure using a rotary evaporator or oil pump. Reactions were monitored by thin-layer chromatography (TLC) on silica gel precoated glass plates; chromatograms were visualized by fluorescence quenching under UV light at 254 nm. Flash column chromatography was performed with Qingdao Haiyang flash silica gel (200–300 mesh). Infrared spectra were recorded with a Bruker Optics TENSOR 27 instrument. ^{1}H and ^{13}C NMR spectra were recorded with a Bruker-300 spectrometer. Accurate mass measurements were performed with an Agilent instrument using the ESI-MS technique. X-ray crystallographic data were collected with a Bruker SMART CCD-based diffractometer equipped with a low-temperature apparatus operated at 100 K.

[3+2] Annulation of Azomethine Imines with Allenoates; General Procedure

A mixture of azomethine imine (0.125 mmol) and allenoate (0.15 mmol) in toluene (5 mL) was stirred at 90 °C for 72 h and then concentrated. The residue was purified by flash column chromatography (EtOAc–hexane) to afford the corresponding product. Some annulation products (**3m** and **4m** in Table 1; **9b** and **10b**, **9c** and **10c** in Table 2) were obtained as diastereomeric mixtures that could not be separated by flash silica gel column chromatography; in these cases the NMR spectra, the IR data, and HRMS data were collected for the diastereomeric mixture. Melting points are reported for crystalline solids but were not measured for amorphous solids.

Compound 3a

Yield: 26.7 mg (47%); white crystalline solid; mp 132.6–134.5 °C.

IR (film): 2979, 1722, 1666, 1599, 1484, 1454, 1339, 1292, 1261, 1222, 1187, 1095, 1079, 1043, 1009, 861, 773, 756, 738, 699, 653, 628 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.39–7.26 (m, 8 H), 7.20–7.18 (m, 2 H), 7.00–6.90 (m, 1 H), 6.78–6.70 (m, 1 H), 6.68–6.62 (m, 2 H), 6.32 (d, *J* = 9.8 Hz, 1 H), 6.06 (d, *J* = 1.4 Hz, 1 H), 5.42–5.40 (m, 1 H), 5.01 (d, *J* = 1.5 Hz, 1 H), 4.45–4.43 (m, 1 H), 3.88–3.83 (m, 1 H), 3.57–3.35 (m, 2 H), 3.24 (d, *J* = 14.3 Hz, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.3, 169.7, 143.8, 143.7, 135.8, 134.6, 130.8, 130.6, 129.5, 128.5, 127.7, 127.6, 127.40, 127.36, 126.8, 121.2, 120.9, 118.7, 111.8, 100.6, 64.6, 62.6, 61.3, 40.3, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{27}N_2O_3^+$: 451.2016; found: 451.2017.

Compound 3b

Yield: 22.83 mg (39%); white crystalline solid; mp 164.2–165.6 °C.

IR (film): 3122, 3031, 2963, 2934, 1720, 1673, 1645, 1599, 1578, 1485, 1456, 1447, 1403, 1368, 1335, 1294, 1263, 1233, 1217, 1191, 1179, 1159, 1109, 1088, 1074, 1018, 956, 931, 914, 883, 863, 835, 795, 779, 758, 726, 702, 661, 631, 601, 562, 531, 520, 462 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.55–7.43 (m, 1 H), 7.36–6.97 (m, 9 H), 6.79–6.77 (m, 1 H), 6.76–6.58 (m, 2 H), 6.33 (d, *J* = 10.0 Hz, 1 H), 6.05 (d, *J* = 1.4 Hz, 1 H), 5.56–5.53 (m, 1 H), 5.03 (d, *J* = 1.5 Hz, 1 H), 4.29–4.27 (m, 1 H), 3.91–3.86 (m, 1 H), 3.68 (d, *J* = 14.7 Hz, 1 H), 3.49–3.46 (m, 1 H), 3.22 (d, *J* = 14.7 Hz, 1 H), 2.39 (s, 3 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.6, 169.6, 144.1, 143.8, 137.4, 134.6, 134.3, 130.54, 130.51, 130.3, 129.6, 127.7, 127.6, 127.3, 127.2, 126.8, 126.4, 121.2, 120.9, 119.2, 111.8, 101.2, 65.2, 62.7, 61.3, 35.9, 20.5, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2184.

Compound 3c

Yield: 24.2 mg (42%); white solid.

IR (film): 3025, 2978, 2924, 1727, 1671, 1647, 1600, 1578, 1485, 1455, 1446, 1403, 1368, 1344, 1294, 1262, 1224, 1188, 1160, 1096, 1049, 1026, 1016, 862, 794, 785, 771, 751 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.37–7.26 (m, 3 H), 7.19–7.13 (m, 5 H), 7.12–6.93 (m, 2 H), 6.78–6.75 (m, 1 H), 6.74–6.57 (m, 2 H), 6.32 (d, *J* = 10.0 Hz, 1 H), 6.03 (d, *J* = 11.9 Hz, 1 H), 5.45–5.42 (m, 1 H), 5.03 (d, *J* = 1.5 Hz, 1 H), 4.45–4.43 (m, 1 H), 3.89–3.85 (m, 1 H), 3.56–3.35 (m, 2 H), 3.21 (d, *J* = 14.3 Hz, 1 H), 2.30 (s, 3 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.3, 169.7, 143.8, 138.2, 135.7, 134.7, 131.3, 130.5, 129.5, 128.4, 128.1, 127.8, 127.7, 127.6, 127.3, 126.7, 121.2, 120.8, 118.8, 111.8, 100.5, 64.5, 62.5, 61.3, 40.2, 21.3, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2174.

Compound 3d

Yield: 26 mg (45%); white crystalline solid; mp 163.4–165.4 °C.

IR (film): 3064, 3029, 2960, 2923, 1721, 1671, 1645, 1601, 1516, 1484, 1448, 1405, 1374, 1348, 1293, 1263, 1228, 1187, 1112, 1093, 1048, 1025, 1009, 874, 790, 772, 753, 694 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.39–7.15 (m, 7 H), 7.10 (d, *J* = 7.9 Hz, 2 H), 7.00 (m, 1 H), 6.78–6.76 (m, 1 H), 6.67–6.63 (m, 2 H), 6.31 (d, *J* = 10.0 Hz, 1 H), 6.13–5.95 (m, 1 H), 5.42–5.39 (m, 1 H), 5.01 (d, *J* = 4.2 Hz, 1 H), 4.46–4.45 (m, 1 H), 3.88–3.82 (m, 1 H), 3.59–3.34 (m, 2 H), 3.20 (d, *J* = 14.2 Hz, 1 H), 2.30 (s, 3 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.3, 169.7, 143.8, 143.8, 136.9, 134.7, 132.6, 130.62, 130.57, 129.5, 129.1, 127.7, 127.6, 127.4, 126.7, 121.2, 120.8, 118.8, 111.8, 100.4, 64.6, 62.6, 61.2, 39.9, 21.0, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2165.

Compound 3e

Yield: 27.3 mg (46%); white crystalline solid; mp 156.8–158.6 °C.

IR (film): 3070, 3029, 2980, 2936, 2902, 1726, 1674, 1644, 1601, 1484, 1453, 1401, 1351, 1315, 1291, 1263, 1227, 1186, 1176, 1168, 1152, 1110, 1092, 1046, 1020, 1006, 875, 793, 773, 753, 736, 697, 658, 527 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.48–7.46 (m, 1 H), 7.36–7.14 (m, 6 H), 7.14–6.94 (m, 3 H), 6.79–6.77 (m, 1 H), 6.68–6.62 (m, 2 H), 6.34 (d, *J* = 10.0 Hz, 1 H), 6.07 (d, *J* = 1.1 Hz, 1 H), 5.62–5.59 (m, 1 H), 5.09 (d, *J* = 1.5 Hz, 1 H), 4.35 (d, *J* = 4.9 Hz, 1 H), 3.90–3.85 (m, 1 H), 3.77 (d, *J* = 14.3 Hz, 1 H), 3.46–3.41 (m, 1 H), 3.03–3.01 (m, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.2, 169.7, 161.7 (d, *J* = 244.3 Hz), 143.8, 143.5, 134.6, 132.7 (d, *J* = 3.7 Hz), 130.6, 129.5, 129.2 (d, *J* = 8.3 Hz), 127.71, 127.66, 127.2, 126.8, 124.4 (d, *J* = 3.5 Hz), 122.7 (d, *J* = 14.5 Hz), 121.2, 120.9, 119.0, 115.1 (d, *J* = 23.0 Hz), 111.7, 100.3, 64.5, 62.5, 61.4, 31.7, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1929.

Compound 3f

Yield: 28.8 mg (49%); white solid.

IR (film): 3065, 2964, 2927, 1726, 1671, 1646, 1600, 1577, 1485, 1471, 1455, 1446, 1401, 1367, 1345, 1310, 1292, 1261, 1225, 1187, 1092, 1027, 928, 876, 795, 757, 732, 699, 664, 655, 633, 527, 488, 463 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.64–7.50 (m, 2 H), 7.35–7.14 (m, 6 H), 7.10–7.09 (m, 1 H), 7.05–6.94 (m, 1 H), 6.79–6.77 (m, 1 H), 6.68–6.62 (m, 2 H), 6.31 (d, *J* = 10.0 Hz, 1 H), 6.09 (d, *J* = 1.3 Hz, 1 H), 5.73–5.70 (m, 1 H), 5.12 (d, *J* = 1.5 Hz, 1 H), 4.39–4.38 (m, 1 H), 4.04 (d, *J* = 14.5 Hz, 1 H), 3.93–3.70 (m, 1 H), 3.51–3.48 (m, 1 H), 3.26 (d, *J* = 14.6 Hz, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.2, 169.5, 144.1, 143.8, 135.5, 134.5, 132.9, 132.1, 130.6, 129.5, 129.0, 127.8, 127.7, 127.5, 127.2, 126.8, 121.3, 120.9, 119.7, 111.7, 101.0, 65.1, 62.1, 61.4, 38.8, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1914.

Compound 3g
Yield: 25.3 mg (43%); white crystalline solid; mp 134.0–135.5 °C.

IR (film): 2963, 2925, 1727, 1669, 1601, 1578, 1510, 1485, 1455, 1446, 1403, 1368, 1346, 1261, 1222, 1188, 1160, 1103, 1050, 1017, 862, 839, 828, 794, 751 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.47–7.38 (m, 2 H), 7.38–7.28 (m, 3 H), 7.28–7.16 (m, 2 H), 7.08–6.92 (m, 3 H), 6.86–6.59 (m, 3 H), 6.33 (d, *J* = 10.0 Hz, 1 H), 6.04 (d, *J* = 1.4 Hz, 1 H), 5.40–5.38 (m, 1 H), 4.95 (d, *J* = 1.5 Hz, 1 H), 4.41–4.40 (m, 1 H), 3.88–3.85 (m, 1 H), 3.54–3.35 (m, 2 H), 3.21 (d, *J* = 14.3 Hz, 1 H), 0.59 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.1, 169.6, 162.2 (d, *J* = 246.3 Hz), 143.7, 143.6, 134.4, 132.3 (d, *J* = 7.9 Hz), 131.5 (d, *J* = 3.3 Hz), 130.8, 129.6, 127.8, 127.6, 126.8, 121.2, 121.0, 118.6, 115.3 (d, *J* = 21.0 Hz), 111.9, 101.0, 64.6, 63.1, 61.3, 39.7, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1915.

Compound 3h
Yield: 22.1 mg (36%); white crystalline solid; mp 185.7–187.1 °C.

IR (film): 3071, 3030, 2964, 2928, 2899, 1725, 1670, 1643, 1601, 1483, 1473, 1447, 1401, 1373, 1351, 1311, 1291, 1263, 1225, 1186, 1155, 1110, 1094, 1081, 1046, 1018, 877, 827, 793, 775, 757, 733, 695, 657, 631, 463 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.63–7.61 (m, 1 H), 7.48–7.38 (m, 1 H), 7.35–7.24 (m, 1 H), 7.24–7.14 (m, 6 H), 7.07–6.94 (m, 1 H), 6.86–6.56 (m, 3 H), 6.32 (d, *J* = 10.0 Hz, 1 H), 6.09 (d, *J* = 1.2 Hz, 1 H), 5.70–5.68 (m, 1 H), 5.13 (d, *J* = 1.5 Hz, 1 H), 4.34–4.32 (m, 1 H), 4.03 (d, *J* = 14.5 Hz, 1 H), 3.92–3.89 (m, 1 H), 3.50–3.47 (m, 1 H), 3.18 (d, *J* = 14.5 Hz, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.2, 169.6, 143.9, 143.8, 135.8, 134.5, 133.6, 132.2, 130.5, 129.5, 129.4, 128.8, 127.7, 127.5, 127.2, 127.1, 126.7, 121.2, 120.9, 119.4, 111.7, 100.9, 65.0, 62.0, 61.4, 35.9, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1621.

Compound 3i
Yield: 16.2 mg (27%); white solid.

IR (film): 3058, 3024, 2978, 2964, 2933, 2902, 1726, 1669, 1599, 1575, 1485, 1455, 1446, 1402, 1368, 1344, 1312, 1295, 1262, 1225, 1188, 1095, 1049, 1017, 883, 863, 786, 751, 725, 695, 671, 662, 650, 638, 629, 617, 605 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.48–7.40 (m, 2 H), 7.40–7.17 (m, 7 H), 7.08–6.95 (m, 1 H), 6.81–6.79 (m, 1 H), 6.70–6.66 (m, 2 H), 6.35 (d, *J* = 10.0 Hz, 1 H), 6.03 (d, *J* = 1.5 Hz, 1 H), 5.41–5.38 (m, 1 H), 4.96 (d, *J* = 1.6 Hz, 1 H), 4.42–4.40 (m, 1 H), 3.89–3.86 (m, 1 H), 3.57–3.34 (m, 2 H), 3.21 (d, *J* = 14.2 Hz, 1 H), 0.61 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.0, 169.6, 143.7, 143.5, 137.9, 134.4, 134.3, 130.85, 130.79, 129.7, 129.6, 128.9, 127.9, 127.8, 127.6, 126.8, 121.2, 121.0, 118.5, 111.9, 101.1, 64.4, 63.2, 61.4, 40.2, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1624.

Compound 3j
Yield: 23.5 mg (39%); white crystalline solid; mp 155.9–157.2 °C.

IR (film): 2980, 2347, 1726, 1670, 1600, 1578, 1486, 1455, 1446, 1403, 1368, 1344, 1294, 1261, 1224, 1183, 1094, 1046, 1016, 909, 866, 840, 753, 697, 650, 528, 464 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.49–7.39 (m, 2 H), 7.39–7.18 (m, 7 H), 7.09–6.96 (m, 1 H), 6.80–6.77 (m, 1 H), 6.76–6.63 (m, 2 H), 6.34 (d, *J* = 10.0 Hz, 1 H), 6.04 (d, *J* = 1.5 Hz, 1 H), 5.40–5.38 (m, 1 H), 4.95 (d, *J* = 1.5 Hz, 1 H), 4.39–4.38 (m, 1 H), 3.88–3.85 (m, 1 H), 3.52–3.42 (m, 1 H), 3.38 (d, *J* = 14.2 Hz, 1 H), 3.21 (d, *J* = 14.2 Hz, 1 H), 0.59 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.0, 169.7, 143.7, 143.5, 134.33, 134.29, 133.4, 132.2, 130.8, 129.6, 128.6, 127.85, 127.81, 127.6, 126.8, 121.2, 121.0, 118.5, 111.9, 101.2, 64.5, 63.2, 61.4, 39.9, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1605.

Compound 3k
Yield: 21.72 mg (33%); white crystalline solid; mp 192.4–193.9 °C.

IR (film): 3064, 2984, 2936, 2902, 1727, 1673, 1645, 1600, 1578, 1485, 1471, 1455, 1446, 1401, 1368, 1345, 1310, 1292, 1261, 1224, 1187, 1110, 1090, 1044, 1027, 1010, 929, 909, 866, 827, 756, 732, 698, 655, 634 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.64–7.50 (m, 2 H), 7.34–7.15 (m, 6 H), 7.10–7.05 (m, 1 H), 7.01–7.00 (m, 1 H), 6.79–6.70 (m, 1 H), 6.68–6.62 (m, 2 H), 6.31 (d, *J* = 10.0 Hz, 1 H), 6.09 (d, *J* = 1.3 Hz, 1 H), 5.73–5.70 (m, 1 H), 5.12 (d, *J* = 1.5 Hz, 1 H), 4.39–4.37 (m, 1 H), 4.04 (d, *J* = 14.5 Hz, 1 H), 3.93–3.89 (m, 1 H), 3.51–3.48 (m, 1 H), 3.26 (d, *J* = 14.6 Hz, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.2, 169.5, 144.1, 143.8, 135.5, 134.5, 132.8, 132.1, 130.6, 129.5, 129.0, 127.8, 127.7, 127.5, 127.2, 126.8, 121.3, 120.9, 119.6, 111.7, 100.9, 65.1, 62.0, 61.4, 38.8, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1125.

Compound 3l
Yield: 24.8 mg (37%); white solid.

IR (film): 2979, 1726, 1669, 1600, 1567, 1485, 1455, 1446, 1426, 1402, 1368, 1343, 1294, 1261, 1224, 1188, 1074, 1045, 1011, 863, 753, 698, 671 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.52 (t, *J* = 1.7 Hz, 1 H), 7.48–7.37 (m, 3 H), 7.37–7.29 (m, 2 H), 7.29–7.20 (m, 2 H), 7.16 (t, *J* = 7.8 Hz, 1 H), 7.07–6.97 (m, 1 H), 6.80–6.75 (m, 1 H), 6.77–6.61 (m, 2 H), 6.34 (d, *J* = 10.0 Hz, 1 H), 6.03 (d, *J* = 1.5 Hz, 1 H), 5.41–5.39 (m, 1 H), 4.96 (d, *J* = 1.6 Hz, 1 H), 4.41–4.40 (m, 1 H), 3.88–3.86 (m, 1 H), 3.54–3.42 (m, 1 H), 3.43–3.33 (m, 1 H), 3.20 (d, *J* = 14.2 Hz, 1 H), 0.60 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 172.0, 169.6, 143.7, 143.5, 138.2, 134.4, 133.7, 130.8, 130.5, 130.0, 129.6, 129.4, 127.88, 127.82, 127.6, 126.8, 122.4, 121.2, 121.0, 118.5, 111.9, 101.2, 64.5, 63.2, 61.4, 40.1, 12.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1121.

Compounds 3m and 4m
Yield: 47.9 mg (86%); white solid.

IR (film): 3058, 2982, 2936, 1732, 1669, 1600, 1578, 1485, 1455, 1403, 1371, 1347, 1293, 1265, 1191, 1098, 1045, 1025, 981, 931, 871, 755, 698, 665, 529, 463 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.84–7.68 (m, 4 H), 7.44–7.27 (m, 6 H), 7.13–6.97 (m, 2 H), 6.94–6.64 (m, 6 H), 6.39 (t, *J* = 9.6 Hz, 2 H), 6.03–5.75 (m, 4 H), 5.33 (d, *J* = 1.5 Hz, 1 H), 5.17 (d, *J* = 5.5 Hz, 1 H), 5.08–4.91 (m, 2 H), 4.37–3.98 (m, 6 H), 3.98–3.76 (m, 1 H), 3.46–3.43 (m, 1 H), 3.09–2.79 (m, 3 H), 2.51 (d, *J* = 17.9 Hz, 1 H), 1.37–1.14 (m, 9 H), 0.62 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.2, 170.7, 170.1, 169.8, 169.7, 169.2, 143.7, 143.5, 143.33, 143.27, 134.4, 133.9, 130.9, 130.8, 129.6, 129.4, 128.0, 127.8, 127.7, 127.6, 127.1, 126.9, 126.7, 122.1, 121.7, 121.4, 121.2, 120.9, 119.0, 112.3, 111.8, 101.2, 99.9, 64.5, 62.1, 61.8, 61.7, 61.3, 60.8, 60.5, 58.9, 40.1, 39.9, 14.0, 14.0, 13.8, 12.7.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{26}H_{27}N_2O_5^+$: 447.1914; found: 447.1915.

Compound 4a
Yield: 23.4 mg (42%); white crystalline solid; mp 152.3–153.6 °C.

IR (film): 2957, 2928, 2855, 2347, 1728, 1668, 1600, 1578, 1527, 1484, 1454, 1386, 1339, 1277, 1215, 1184, 1117, 1074, 820, 772, 751, 699, 660 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.79–7.67 (m, 2 H), 7.33–7.25 (m, 3 H), 7.21–7.04 (m, 4 H), 7.00–6.71 (m, 5 H), 6.54 (d, *J* = 10.0 Hz, 1 H), 6.04–5.94 (m, 1 H), 5.90–5.87 (m, 1 H), 4.78 (d, *J* = 5.2 Hz, 1 H), 4.35 (s, 1 H), 4.22–4.18 (m, 2 H), 3.43 (d, *J* = 13.9 Hz, 1 H), 2.72 (d, *J* = 13.9 Hz, 1 H), 1.27 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.9, 169.4, 143.6, 140.6, 136.0, 134.6, 130.74, 130.71, 129.6, 128.7, 128.0, 127.7, 127.4, 127.2, 126.6, 121.9, 121.8, 120.2, 111.8, 103.9, 65.0, 62.1, 61.6, 38.5, 13.9.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{27}N_2O_3^+$: 451.2016; found: 451.2008.

Compound 4b
Yield: 32.85 mg (57%); white crystalline solid; mp 147.3–148.2 °C.

IR (film): 3058, 2964, 1739, 1665, 1600, 1578, 1484, 1455, 1401, 1349, 1278, 1221, 1181, 1113, 1058, 1044, 912, 879, 796, 754, 696, 662 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.79–7.68 (m, 2 H), 7.42–7.26 (m, 3 H), 7.15–6.86 (m, 6 H), 6.86–6.73 (m, 2 H), 6.58 (d, *J* = 10.0 Hz, 1 H), 6.04–5.92 (m, 1 H), 5.85 (s, 1 H), 4.72–4.70 (m, 1 H), 4.44–4.13 (m, 3 H), 3.37 (d, *J* = 14.3 Hz, 1 H), 2.94 (d, *J* = 14.3 Hz, 1 H), 1.69 (s, 3 H), 1.29 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 169.5, 143.6, 140.2, 138.0, 134.7, 134.6, 130.8, 130.1, 129.8, 129.5, 128.7, 128.0, 127.8, 127.2, 126.7, 125.4, 121.94, 121.87, 120.4, 112.4, 103.8, 65.3, 62.0, 61.7, 34.5, 20.0, 14.0.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2166.

Compound 4c
Yield: 22.9 mg (39%); white crystalline solid; mp 141.1–142.3 °C.

IR (film): 3026, 2979, 2924, 1717, 1664, 1599, 1577, 1483, 1454, 1446, 1401, 1367, 1349, 1276, 1230, 1208, 1187, 1164, 1096, 1051, 1018, 796, 783, 771, 751, 696 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.73 (d, *J* = 6.9 Hz, 2 H), 7.32–7.25 (m, 3 H), 7.18–6.85 (m, 4 H), 6.80 (t, *J* = 7.4 Hz, 2 H), 6.68 (s, 2 H), 6.53 (d, *J* = 10.0 Hz, 1 H), 5.99 (s, 1 H), 5.90–5.87 (m, 1 H), 4.77 (d, *J* = 5.2 Hz, 1 H), 4.41 (s, 1 H), 4.35–4.09 (m, 2 H), 3.39 (d, *J* = 13.9 Hz, 1 H), 2.69 (d, *J* = 13.9 Hz, 1 H), 2.24 (s, 3 H), 1.27 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.1, 169.5, 143.7, 140.6, 136.9, 135.9, 134.6, 131.5, 130.8, 129.6, 128.7, 128.0, 127.8, 127.4, 127.2, 122.0, 121.8, 120.4, 111.9, 104.0, 65.0, 62.2, 61.6, 38.7, 21.3, 14.0.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2168.

Compound 4d
Yield: 20.1 mg (34%); white solid.

IR (film): 3054, 3023, 2981, 2924, 2414, 2379, 2358, 2344, 2324, 1727, 1667, 1600, 1578, 1515, 1484, 1455, 1447, 1402, 1368, 1349, 1276, 1230, 1209, 1186, 1165, 1113, 1096, 1072, 1050, 1017, 984, 972, 951, 939, 928, 907, 883, 861, 851, 838, 826, 817, 795, 771, 760, 727, 715, 695, 683 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.83–7.62 (m, 2 H), 7.44–7.22 (m, 3 H), 7.09–7.04 (m, 1 H), 7.03–6.86 (m, 3 H), 6.85–6.70 (m, 4 H), 6.53 (d, *J* = 10.1 Hz, 1 H), 5.98 (s, 1 H), 5.89–5.87 (m, 1 H), 4.76–4.75 (m, 1 H), 4.40 (d, *J* = 1.0 Hz, 1 H), 4.32–4.10 (m, 2 H), 3.39 (d, *J* = 13.9 Hz, 1 H), 2.68 (d, *J* = 13.9 Hz, 1 H), 2.27 (s, 3 H), 1.28 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.1, 169.5, 143.7, 140.6, 136.2, 134.6, 132.8, 130.8, 130.6, 129.6, 128.7, 128.2, 128.0, 127.8, 127.2, 122.0, 121.8, 120.4, 111.9, 104.0, 65.0, 62.2, 61.6, 38.3, 21.0, 14.0.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2163.

Compound 4e
Yield: 28 mg (48%); white crystalline solid; mp 143.9–145.6 °C.

IR (film): 2965, 2935, 1721, 1665, 1600, 1585, 1492, 1484, 1455, 1402, 1367, 1349, 1290, 1275, 1233, 1211, 1181, 1106, 1074, 1049, 1026, 930, 912, 884, 800, 755, 697, 662, 613, 526, 462 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.78–7.68 (m, 2 H), 7.41–7.26 (m, 3 H), 7.21–7.02 (m, 2 H), 7.00–6.84 (m, 4 H), 6.84–6.74 (m, 2 H), 6.59 (d, *J* = 10.0 Hz, 1 H), 5.97–5.93 (m, 2 H), 4.84–4.83 (m, 1 H), 4.37 (d, *J* = 1.1 Hz, 1 H), 4.28–4.15 (m, 2 H), 3.50–3.33 (m, 1 H), 2.90–2.73 (m, 1 H), 1.26 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.8, 169.6, 161.7 (d, *J* = 246.2 Hz), 143.6, 140.1, 134.7, 132.9 (d, *J* = 4.2 Hz), 130.8, 129.7, 129.0, 128.6 (d, *J* = 8.2 Hz), 128.0, 127.8, 127.2, 123.2, 123.0 (d, *J* = 3.7 Hz), 121.7 (d, *J* = 1.2 Hz), 120.1, 114.8 (d, *J* = 22.4 Hz), 112.0, 103.4, 100.0, 64.9, 61.8, 61.1, 31.3, 13.8.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1902.

Compound 4f
Yield: 21.9 mg (37%); white crystalline solid; mp 141.3–142.4 °C.

IR (film): 3058, 2964, 2929, 1720, 1666, 1600, 1577, 1484, 1472, 1455, 1446, 1401, 1349, 1264, 1210, 1050, 1022, 912, 880, 800, 752, 697, 663, 549, 458 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.80–7.66 (m, 2 H), 7.48–7.21 (m, 4 H), 7.21–6.96 (m, 4 H), 6.91–6.89 (m, 1 H), 6.85–6.71 (m, 2 H), 6.60 (d, *J* = 10.0 Hz, 1 H), 6.04–5.89 (m, 2 H), 4.82–4.80 (m, 1 H), 4.39 (d, *J* = 1.0 Hz, 1 H), 4.33–4.12 (m, 2 H), 3.60 (t, *J* = 14.3 Hz, 1 H), 3.10 (d, *J* = 14.2 Hz, 1 H), 1.25 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.0, 169.6, 143.5, 140.0, 135.9, 134.7, 132.6, 131.9, 130.8, 129.5, 129.0, 128.3, 128.0, 127.8, 127.3, 126.8, 126.5, 121.8, 121.7, 120.0, 112.7, 103.8, 65.1, 62.0, 61.3, 37.2, 13.9.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1926.

Compound 4g
Yield: 22.8 mg (39%); white crystalline solid; mp 169.7–170.7 °C.

IR (film): 2964, 2346, 1736, 1661, 1600, 1509, 1483, 1454, 1351, 1221, 1192, 1160, 1098, 1051, 1017, 928, 881, 862, 838, 804, 759, 695, 683, 672, 660, 640, 628 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.83–7.62 (m, 2 H), 7.44–7.20 (m, 3 H), 7.10–7.07 (m, 1 H), 6.97–6.70 (m, 7 H), 6.55 (d, *J* = 10.0 Hz, 1 H), 5.98 (d, *J* = 5.2 Hz, 1 H), 5.88–5.86 (m, 1 H), 4.79–4.78 (m, 1 H), 4.31 (d, *J* = 1.1 Hz, 1 H), 4.22–4.19 (m, 2 H), 3.41 (d, *J* = 14.0 Hz, 1 H), 2.68 (d, *J* = 14.0 Hz, 1 H), 1.27 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.9, 169.5, 161.8 (d, *J* = 245.5 Hz), 143.6, 140.6, 134.6, 132.4 (d, *J* = 8.0 Hz), 131.7 (d, *J* = 3.3 Hz), 130.8, 129.8, 128.9, 128.0, 127.8, 127.3, 121.9, 121.8, 120.0, 114.3 (d, *J* = 21.2 Hz), 111.8, 103.8, 65.1, 62.2, 61.8, 37.5, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1916.

Compound 4h
Yield: 33.05 mg (55%); white solid.

IR (film): 3059, 2982, 2936, 1720, 1666, 1600, 1577, 1484, 1455, 1446, 1402, 1367, 1349, 1272, 1231, 1210, 1189, 1167, 1112, 1058, 1025, 972, 930, 912, 882, 786, 753, 697, 661, 621 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.79–7.66 (m, 2 H), 7.44–7.17 (m, 4 H), 7.18–6.97 (m, 4 H), 6.98–6.85 (m, 1 H), 6.79 (t, *J* = 7.4 Hz, 2 H), 6.61 (d, *J* = 10.0 Hz, 1 H), 6.06–5.87 (m, 2 H), 4.82–4.80 (m, 1 H), 4.37 (d, *J* = 1.0 Hz, 1 H), 4.30–4.13 (m, 2 H), 3.54 (d, *J* = 14.1 Hz, 1 H), 3.05 (d, *J* = 14.1 Hz, 1 H), 1.25 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.9, 169.6, 143.5, 139.9, 135.8, 134.6, 134.0, 132.1, 130.7, 129.5, 129.1, 129.0, 128.1, 127.9, 127.7, 127.2, 125.8, 121.7, 121.6, 120.0, 112.4, 103.6, 65.1, 61.9, 61.2, 34.6, 13.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1630.

Compound 4i
Yield: 25 mg (41%); white solid.

IR (film): 3059, 3023, 2981, 2935, 2903, 1725, 1666, 1599, 1575, 1483, 1455, 1446, 1433, 1402, 1368, 1349, 1310, 1268, 1231, 1211, 1187, 1166, 1096, 1081, 1049, 1018, 882, 793, 752, 728, 695, 671, 661, 650, 639, 626, 616, 606 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.78–7.67 (m, 2 H), 7.42–7.22 (m, 3 H), 7.11–7.08 (m, 3 H), 6.95–6.87 (m, 2 H), 6.86–6.71 (m, 3 H), 6.54 (d, *J* = 10.0 Hz, 1 H), 6.04–5.96 (m, 1 H), 5.87–5.84 (m, 1 H), 4.81–4.80 (m, 1 H), 4.38 (d, *J* = 1.3 Hz, 1 H), 4.33–4.11 (m, 2 H), 3.38 (d, *J* = 14.0 Hz, 1 H), 2.70 (d, *J* = 14.0 Hz, 1 H), 1.29 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.8, 169.5, 143.6, 140.7, 138.2, 134.5, 133.3, 130.9, 129.8, 129.1, 129.0, 128.7, 128.0, 127.8, 127.3, 126.9, 121.9, 121.8, 121.0, 111.9, 103.7, 65.0, 62.1, 61.9, 38.1, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1634.

Compound 4j
Yield: 15.8 mg (26%); white crystalline solid; mp 177.8–179.0 °C.

IR (film): 2982, 2935, 2361, 2342, 1725, 1664, 1599, 1577, 1483, 1454, 1402, 1349, 1291, 1268, 1231, 1211, 1187, 1107, 1092, 1049, 1016, 928, 911, 881, 827, 785, 755, 697, 662, 521, 462 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.86–7.54 (m, 2 H), 7.49–7.19 (m, 3 H), 7.19–6.98 (m, 3 H), 6.90–6.87 (m, 1 H), 6.86–6.66 (m, 4 H), 6.54 (d, *J* = 10.0 Hz, 1 H), 6.07–5.93 (m, 1 H), 5.87–5.84 (m, 1 H), 4.81–4.80 (m, 1 H), 4.32 (d, *J* = 4.2 Hz, 1 H), 4.29–4.11 (m, 2 H), 3.40 (d, *J* = 14.0 Hz, 1 H), 2.68 (d, *J* = 14.0 Hz, 1 H), 1.28 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.8, 169.5, 143.6, 140.6, 134.6, 134.5, 132.6, 132.2, 130.9, 129.8, 129.0, 128.0, 127.8, 127.6, 127.3, 121.9, 120.0, 111.8, 103.8, 65.1, 62.2, 61.8, 37.7, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1622.

Compound 4k
Yield: 26.55 mg (40%); white crystalline solid; mp 136.3–138.2 °C.

IR (film): 2982, 1719, 1665, 1600, 1577, 1484, 1472, 1455, 1446, 1401, 1349, 1270, 1230, 1210, 1120, 1049, 1022, 912, 881, 784, 752, 697, 662 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.80–7.63 (m, 2 H), 7.44–7.21 (m, 3 H), 7.20–7.03 (m, 2 H), 6.98–6.72 (m, 4 H), 6.71–6.45 (m, 3 H), 5.98 (d, *J* = 4.0 Hz, 1 H), 5.87–5.84 (m, 1 H), 4.81–4.79 (m, 1 H), 4.36 (d, *J* = 1.3 Hz, 1 H), 4.34–4.13 (m, 2 H), 3.42 (d, *J* = 13.9 Hz, 1 H), 2.72 (d, *J* = 14.0 Hz, 1 H), 1.29 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.9, 169.5, 143.6, 140.7, 134.5, 130.8, 129.8, 129.0, 128.9, 128.8, 128.0, 127.8, 127.3, 126.64, 126.61, 121.91, 121.88, 120.0, 117.8, 117.5, 113.7, 113.4, 111.9, 103.7, 65.1, 62.2, 61.8, 38.2, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1123.

Compound 4l
Yield: 21.7 mg (33%); white crystalline solid; mp 153.1–154.0 °C.

IR (film): 3059, 2980, 2935, 1724, 1666, 1598, 1569, 1483, 1455, 1446, 1402, 1348, 1309, 1267, 1233, 1211, 1186, 1095, 1074, 1048, 1019, 972, 867, 788, 753, 697, 662, 612 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.83–7.64 (m, 2 H), 7.43–7.23 (m, 4 H), 7.17–6.96 (m, 3 H), 6.91–6.82 (m, 1 H), 6.80–6.77 (m, 3 H), 6.53 (d, *J* = 10.0 Hz, 1 H), 6.05–5.94 (m, 1 H), 5.86–5.84 (m, 1 H), 4.91–4.71 (m, 1 H), 4.40 (d, *J* = 1.3 Hz, 1 H), 4.35–4.09 (m, 2 H), 3.37 (d, *J* = 14.0 Hz, 1 H), 2.70 (d, *J* = 14.0 Hz, 1 H), 1.29 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.8, 169.5, 143.6, 140.7, 138.5, 134.5, 133.8, 130.9, 129.8, 129.6, 129.0, 128.0, 127.8, 127.3, 121.9, 121.8, 121.5, 120.0, 111.9, 103.7, 65.0, 62.1, 61.9, 38.1, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1099.

Compound 6a
Yield: 24.6 mg (55%); white solid.

IR (film): 3057, 2983, 2924, 1732, 1668, 1600, 1578, 1484, 1447, 1402, 1368, 1342, 1291, 1261, 1205, 1160, 1096, 1017, 900, 881, 862, 817, 793, 772, 759, 737, 716, 694, 683, 671 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.84–7.71 (m, 2 H), 7.48–7.27 (m, 3 H), 7.19–7.02 (m, 1 H), 7.00–6.70 (m, 3 H), 6.41 (d, *J* = 9.8 Hz, 1 H), 6.06–5.84 (m, 2 H), 5.19 (s, 1 H), 4.53–4.50 (m, 1 H), 4.40–4.12 (m, 2 H), 3.90–3.88 (m, 1 H), 1.32 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 169.2, 168.8, 143.1, 139.1, 134.3, 130.9, 129.6, 128.3, 127.8, 127.2, 126.9, 122.7, 122.5, 121.7, 114.2, 99.8, 61.6, 60.6, 54.1, 14.1.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{21}N_2O_3^+$: 361.1547; found: 361.1533.

Compound 6b
Yield: 12.1 mg (26%); white solid.

IR (film): 3058, 2963, 2925, 2859, 1732, 1651, 1600, 1577, 1485, 1453, 1404, 1378, 1337, 1308, 1259, 1211, 1156, 1115, 1044, 1015, 967, 891, 794, 760, 696, 663, 606 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.79–7.69 (m, 2 H), 7.45–7.28 (m, 3 H), 7.15 (td, *J* = 7.8, 1.7 Hz, 1 H), 7.02–6.93 (m, 1 H), 6.89–6.86 (m, 2 H), 6.42 (d, *J* = 9.9 Hz, 1 H), 6.15 (s, 1 H), 5.90–5.88 (m, 1 H), 4.41–4.38 (m, 1 H), 4.34–4.15 (m, 2 H), 3.82–3.80 (m, 1 H), 1.65–1.63 (m, 3 H), 1.31 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.2, 169.5, 142.8, 134.4, 133.9, 130.7, 129.8, 128.2, 127.7, 127.3, 126.6, 122.53, 122.49, 121.5, 115.9, 114.4, 63.2, 61.5, 54.3, 14.2, 14.0.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{23}H_{23}N_2O_3^+$: 375.1703; found: 375.1711.

Compound 7a
Yield: 13.3 mg (30%); white solid.

IR (film): 3059, 3027, 2962, 2933, 2902, 1727, 1665, 1600, 1578, 1485, 1455, 1447, 1403, 1370, 1346, 1292, 1261, 1223, 1176, 1158, 1102, 1071, 1020, 896, 872, 862, 802, 775, 752, 727, 697, 671, 652, 638, 628, 617, 606, 593 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.82–7.73 (m, 2 H), 7.44–7.26 (m, 3 H), 7.11–6.96 (m, 1 H), 6.83–6.78 (m, 1 H), 6.74–6.70 (m, 2 H), 6.43 (d, *J* = 10.0 Hz, 1 H), 6.09–5.98 (m, 1 H), 5.80–5.78 (m, 1 H), 5.09–4.94 (m, 1 H), 4.70–4.68 (m, 1 H), 3.89–3.84 (m, 2 H), 3.65–3.62 (m, 1 H), 0.76 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.0, 169.6, 143.4, 139.7, 134.4, 131.0, 129.6, 128.1, 127.9, 127.8, 126.8, 121.50, 121.47, 119.2, 112.6, 100.4, 61.1, 60.4, 57.2, 13.2.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{22}H_{21}N_2O_3^+$: 361.1547; found: 361.1530.

Compound 7b
Yield: 11.9 mg (25%); white solid.

IR (film): 2979, 1725, 1648, 1600, 1577, 1484, 1455, 1404, 1376, 1322, 1291, 1260, 1216, 1176, 1156, 1114, 1071, 1047, 1022, 966, 888, 829, 796, 754, 706, 652 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.73–7.70 (m, 2 H), 7.46–7.20 (m, 3 H), 7.11–7.06 (m, 1 H), 6.95–6.67 (m, 3 H), 6.52–6.50 (m, 1 H), 6.43 (d, *J* = 10.0 Hz, 1 H), 5.81–5.78 (m, 1 H), 4.59–4.56 (m, 1 H), 4.00–3.81 (m, 2 H), 3.65–3.59 (m, 1 H), 1.71–1.68 (m, 3 H), 0.80 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.2, 169.9, 143.6, 134.7, 133.8, 130.7, 129.7, 128.0, 127.9, 127.8, 126.8, 121.7, 121.5, 119.5, 113.9, 112.9, 61.0, 60.6, 54.5, 14.6, 13.4.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{23}H_{23}N_2O_3^+$: 375.1703; found: 375.1713.

Compound 9a
Yield: 16 mg (29%); white crystalline solid; mp 128.3–130.1 °C.

IR (film): 3029, 2964, 1725, 1661, 1631, 1494, 1454, 1409, 1368, 1340, 1262, 1237, 1200, 1084, 1042, 941, 872, 753, 700, 675, 655 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.71 (d, *J* = 6.4 Hz, 2 H), 7.51–7.30 (m, 3 H), 7.31–6.96 (m, 8 H), 6.93 (d, *J* = 7.4 Hz, 1 H), 6.10 (d, *J* = 7.7 Hz, 1 H), 5.96 (s, 1 H), 5.37 (d, *J* = 7.8 Hz, 1 H), 5.32 (s, 1 H), 4.47–4.21 (m, 2 H), 4.19 (s, 1 H), 3.16 (s, 2 H), 1.32 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.5, 167.7, 141.6, 137.2, 136.2, 134.9, 131.4, 131.3, 130.6, 129.0, 128.3, 128.00, 127.97, 127.4, 126.9, 126.8, 126.4, 125.2, 104.9, 102.0, 66.7, 64.5, 61.8, 38.0, 14.1.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{29}H_{27}N_2O_3^+$: 451.2016; found: 451.2017.

Compound 9b and 10b
Yield: 29 mg (50%); white crystalline solid; mp 152.1–153.7 °C.

IR (film): 3061, 3023, 2979, 1726, 1662, 1631, 1601, 1577, 1492, 1447, 1408, 1368, 1340, 1278, 1221, 1200, 1098, 1059, 1037, 940, 904, 872, 750, 699, 673, 567 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.75–7.65 (m, 2 H), 7.55–7.46 (m, 1 H), 7.46–7.27 (m, 5 H), 7.27–6.83 (m, 13 H), 6.13 (d, *J* = 7.8 Hz, 1 H), 5.98–5.97 (m, 1 H), 5.92 (d, *J* = 7.8 Hz, 1 H), 5.80 (d, *J* = 1.0 Hz, 1 H), 5.44 (d, *J* = 7.8 Hz, 1 H), 5.31 (d, *J* = 7.8 Hz, 1 H), 5.22 (s, 1 H), 4.82 (d, *J* = 10.4 Hz, 1 H), 4.61 (d, *J* = 1.3 Hz, 1 H), 4.40–4.19 (m, 2 H), 4.01 (d, *J* = 1.2 Hz, 1 H), 3.83–3.67 (m, 1 H), 3.58 (d, *J* = 14.7 Hz, 1 H), 3.34–3.33 (m, 1 H), 3.02 (d, *J* = 14.2 Hz, 1 H), 2.43 (s, 1 H), 2.14 (s, 3 H), 1.31 (t, *J* = 9.2, 5.1 Hz, 3 H), 0.92 (t, *J* = 7.1 Hz, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.8, 171.6, 167.62, 167.57, 142.2, 141.1, 138.6, 137.8, 137.4, 137.1, 135.0, 134.8, 134.4, 131.3, 130.8, 130.59, 130.56, 130.51, 130.47, 130.0, 129.3, 129.0, 128.8, 128.2, 128.00, 127.95, 127.9, 127.6, 127.1, 127.0, 126.8, 126.5, 126.3, 126.1, 125.3, 125.2, 124.9, 104.8, 104.6, 101.8, 101.6, 67.3, 67.2, 64.8, 64.6, 61.8, 61.4, 37.7, 33.7, 21.1, 20.8, 14.0, 13.4.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2175.

Compound 9c and 10c
Yield: 43.4 mg (75%); white solid.

IR (film): 2963, 2926, 1727, 1667, 1634, 1603, 1491, 1447, 1408, 1368, 1340, 1260, 1227, 1203, 1097, 1047, 1026, 939, 905, 862, 755, 700, 667, 635, 561 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.71 (dd, *J* = 7.9, 1.6 Hz, 1 H), 7.52–7.31 (m, 3 H), 7.31–6.97 (m, 13 H), 6.93 (d, *J* = 7.3 Hz, 1 H), 6.87 (dd, *J* = 5.6, 2.1 Hz, 1 H), 6.76 (s, 1 H), 6.11 (t, *J* = 4.7 Hz, 1 H), 5.98 (s, 1 H), 5.89 (d, *J* = 7.8 Hz, 1 H), 5.44–5.18 (m, 2 H), 5.00 (d, *J* = 1.4 Hz, 1 H), 4.86 (s, 1 H), 4.42–4.19 (m, 1 H), 3.90–3.60 (m, 2 H), 3.51 (d, *J* = 14.4 Hz, 1 H), 3.34 (d, *J* = 14.4 Hz, 1 H), 3.14 (s, 1 H), 2.30 (s, 3 H), 2.23 (s, 1 H), 1.34 (t, *J* = 7.1 Hz, 2 H), 0.94 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.8, 171.6, 167.7, 143.1, 141.8, 138.2, 137.2, 136.9, 136.7, 136.0, 135.5, 134.9, 132.0, 131.5, 130.7, 130.6, 130.2, 128.9, 128.7, 128.4, 128.2, 128.1, 128.04, 127.97, 127.8, 127.7, 127.4, 127.2, 127.1, 126.9, 126.8, 126.7, 126.3, 125.1, 124.9, 105.0, 104.2, 102.0, 101.1, 66.5, 65.6, 64.4, 63.3, 61.8, 61.3, 41.4, 38.3, 21.3, 14.0, 13.5.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{30}H_{29}N_2O_3^+$: 465.2173; found: 465.2167.

Compound 9e
Yield: 29.9 mg (51%); white crystalline solid; mp 140.3–141.6 °C.

IR (film): 3432, 2963, 1725, 1662, 1630, 1584, 1492, 1455, 1409, 1369, 1341, 1262, 1235, 1202, 1182, 1104, 1047, 942, 904, 861, 798, 758, 699, 674 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.72–7.69 (m, 2 H), 7.47–7.32 (m, 3 H), 7.33–7.06 (m, 5 H), 7.05–6.81 (m, 3 H), 6.14 (d, *J* = 7.8 Hz, 1 H), 5.88 (d, *J* = 1.3 Hz, 1 H), 5.48–5.28 (m, 2 H), 4.42–4.15 (m, 2 H), 4.04 (d, *J* = 1.3 Hz, 1 H), 3.45 (d, *J* = 14.1 Hz, 1 H), 2.91 (d, *J* = 14.1 Hz, 1 H), 1.31 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.6, 162.3 (d, *J* = 245.7 Hz), 141.5, 137.4, 135.0, 132.7 (d, *J* = 4.1 Hz), 131.5, 130.6, 129.0, 128.4 (d, *J* = 8.4 Hz), 128.2, 128.0, 127.5, 126.8 (d, *J* = 2.4 Hz), 125.3, 123.9, 123.7, 123.1 (d, *J* = 3.4 Hz), 114.7 (d, *J* = 22.6 Hz), 104.3, 100.4, 66.6, 64.0, 61.9, 30.3, 14.0.

HRMS (ESI): *m/z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1921.

Compound 9f
Yield: 8.4 mg (14%); white solid.

IR (film): 3066, 2981, 2935, 1726, 1662, 1630, 1616, 1588, 1524, 1489, 1448, 1409, 1368, 1340, 1254, 1201, 1144, 1122, 1099, 1080, 1047, 941, 904, 877, 753, 700, 674, 629 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.75–7.64 (m, 2 H), 7.47–7.31 (m, 3 H), 7.21–7.20 (m, 1 H), 7.09–7.07 (m, 3 H), 6.97–6.88 (m, 1 H), 6.87–6.69 (m, 3 H), 6.09 (d, *J* = 7.8 Hz, 1 H), 5.98 (d, *J* = 1.4 Hz, 1 H), 5.37 (d, *J* = 8.0 Hz, 2 H), 4.47–4.10 (m, 3 H), 3.16 (s, 2 H), 1.35 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.3, 167.9, 162.0 (d, *J* = 244.5 Hz), 141.7, 138.8 (d, *J* = 7.6 Hz), 137.0, 134.8, 131.3, 130.7, 129.1, 128.6 (d, *J* = 8.2 Hz), 128.2, 128.0, 127.8, 126.9 (d, *J* = 2.7 Hz), 126.83, 126.7, 125.3, 117.9 (d, *J* = 21.4 Hz), 113.3 (d, *J* = 20.9 Hz), 104.9, 101.6, 66.5, 64.4, 62.0, 37.8, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1931.

Compound 9g
Yield: 13.6 mg (23%); white solid.

IR (film): 3430, 2963, 1721, 1663, 1629, 1601, 1509, 1446, 1368, 1341, 1262, 1222, 1159, 1098, 1045, 798, 757, 699, 670 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.77–7.63 (m, 2 H), 7.50–7.30 (m, 3 H), 7.25–6.89 (m, 6 H), 6.87–6.73 (m, 2 H), 6.08 (d, *J* = 7.8 Hz, 1 H), 5.98 (d, *J* = 1.8 Hz, 1 H), 5.36 (d, *J* = 7.1 Hz, 2 H), 4.40–4.19 (m, 2 H), 4.15 (d, *J* = 9.7 Hz, 1 H), 3.13 (s, 2 H), 1.33 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.7, 161.7 (d, *J* = 244.9 Hz), 141.6, 137.1, 134.8, 132.8 (d, *J* = 7.9 Hz), 131.8 (d, *J* = 3.1 Hz), 131.4, 130.7, 129.0, 128.3, 128.0, 127.8, 126.8 (d, *J* = 5.7 Hz), 125.3, 114.3, 114.0, 104.8, 101.7, 66.6, 64.5, 61.9, 37.0, 14.1.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1920.

Compound 9h
Yield: 22.4 mg (37%); white solid.

IR (film): 3066, 2964, 1724, 1662, 1630, 1572, 1493, 1475, 1446, 1409, 1369, 1341, 1263, 1238, 1201, 1099, 1056, 1028, 941, 904, 860, 756, 698, 668, 623, 564 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.71–7.69 (m, 2 H), 7.40–7.35 (m, 4 H), 7.31–7.02 (m, 6 H), 6.96 (d, *J* = 7.3 Hz, 1 H), 6.15 (d, *J* = 7.8 Hz, 1 H), 5.88 (s, 1 H), 5.50–5.16 (m, 2 H), 4.47–4.15 (m, 2 H), 4.02 (s, 1 H), 3.56 (d, *J* = 14.0 Hz, 1 H), 3.08 (d, *J* = 14.0 Hz, 1 H), 1.29 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.5, 141.0, 137.6, 137.0, 135.0, 134.6, 132.5, 131.5, 130.6, 129.10, 129.04, 128.2, 128.0, 127.9, 127.6, 126.7, 126.6, 126.0, 125.3, 104.0, 100.8, 66.8, 64.5, 61.9, 34.0, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1614.

Compound 9i
Yield: 14.1 mg (23%); white solid.

IR (film): 3064, 2980, 1724, 1662, 1630, 1599, 1573, 1477, 1447, 1368, 1341, 1262, 1201, 1081, 1046, 940, 880, 771, 700, 671 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.77–7.63 (m, 2 H), 7.51–7.31 (m, 3 H), 7.21–7.20 (m, 1 H), 7.16–7.00 (m, 4 H), 7.00–6.88 (m, 3 H), 6.08 (d, *J* = 7.8 Hz, 1 H), 6.00 (d, *J* = 1.4 Hz, 1 H), 5.37 (s, 1 H), 5.35 (s, 1 H), 4.51–4.12 (m, 3 H), 3.14 (s, 2 H), 1.35 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.3, 167.7, 141.8, 138.3, 137.0, 134.8, 133.1, 131.33, 131.25, 130.7, 129.3, 129.1, 128.5, 128.3, 128.0, 127.8, 126.8, 126.7, 126.6, 125.3, 104.9, 101.6, 66.3, 64.4, 62.0, 37.9, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1604.

Compound 9l
Yield: 20.7 mg (31%); white solid.

IR (film): 3063, 2980, 1725, 1662, 1630, 1597, 1569, 1492, 1475, 1447, 1368, 1340, 1239, 1201, 1096, 1073, 1046, 941, 878, 769, 699, 664 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.73–7.66 (m, 2 H), 7.47–7.33 (m, 3 H), 7.28–7.17 (m, 2 H), 7.14–7.03 (m, 3 H), 7.03–6.89 (m, 3 H), 6.08 (d, *J* = 7.8 Hz, 1 H), 6.01 (d, *J* = 1.4 Hz, 1 H), 5.46–5.25 (m, 2 H), 4.46–4.15 (m, 3 H), 3.14 (s, 2 H), 1.35 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.3, 167.7, 141.8, 138.6, 137.0, 134.8, 134.1, 131.3, 130.7, 129.7, 129.5, 129.1, 128.8, 128.2, 128.0, 127.8, 126.8, 126.6, 125.3, 121.4, 104.9, 101.6, 66.3, 64.3, 62.0, 37.9, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1117.

Compound 9m
Yield: 18.2 mg (32%); white solid.

IR (film): 3064, 2982, 2936, 1732, 1667, 1631, 1601, 1579, 1492, 1447, 1408, 1370, 1344, 1261, 1226, 1182, 1093, 1059, 1028, 935, 907, 878, 755, 701, 649 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.69–7.50 (m, 2 H), 7.47–7.31 (m, 3 H), 7.30–7.23 (m, 1 H), 7.23–7.04 (m, 2 H), 6.90 (d, *J* = 7.4 Hz, 1 H), 6.04 (d, *J* = 7.8 Hz, 2 H), 5.50 (s, 1 H), 5.46 (d, *J* = 7.8 Hz, 1 H), 5.39 (d, *J* = 1.0 Hz, 1 H), 4.48–4.11 (m, 2 H), 3.75–3.41 (m, 2 H), 3.12–2.90 (m, 2 H), 1.35 (t, *J* = 7.1 Hz, 3 H), 0.98 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.2, 169.3, 167.7, 143.8, 137.7, 134.5, 130.9, 130.8, 130.2, 129.0, 128.3, 128.0, 126.4, 126.2, 124.8, 106.3, 100.0, 63.4, 61.9, 60.5, 60.3, 40.4, 14.0, 13.8.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{26}H_{27}N_2O_5^+$: 447.1914; found: 447.1916.

Compound 10a
Yield: 23.8 mg (42%); white crystalline solid; mp 173.5–174.8 °C.

IR (film): 3062, 3026, 2963, 1728, 1666, 1634, 1601, 1572, 1494, 1453, 1408, 1368, 1340, 1286, 1260, 1226, 1200, 1096, 1017, 939, 906, 862, 769, 700, 664, 635 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.47–7.38 (m, 2 H), 7.38–7.20 (m, 8 H), 7.20–7.11 (m, 3 H), 6.91–6.80 (m, 1 H), 6.12 (d, *J* = 1.4 Hz, 1 H), 5.89 (d, *J* = 7.8 Hz, 1 H), 5.27 (d, *J* = 7.8 Hz, 1 H), 4.97 (d, *J* = 1.4 Hz, 1 H), 4.84 (s, 1 H), 3.90–3.61 (m, 2 H), 3.53 (d, *J* = 14.3 Hz, 1 H), 3.36 (d, *J* = 14.4 Hz, 1 H), 0.93 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.8, 167.7, 142.9, 136.9, 135.6, 134.8, 130.9, 130.7, 130.3, 128.8, 128.5, 127.8, 127.6, 127.5, 127.4, 126.8, 126.3, 125.0, 104.3, 101.2, 65.5, 63.5, 61.4, 41.4, 13.4.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{27}N_2O_3^+$: 451.2016; found: 451.2025.

Compound 10e
Yield: 28 mg (47%); white crystalline solid; mp 176.0–177.9 °C.

IR (film): 3064, 2963, 1729, 1668, 1636, 1601, 1581, 1491, 1453, 1407, 1368, 1339, 1288, 1260, 1227, 1179, 1097, 1046, 1016, 938, 907, 871, 792, 759, 699, 663, 634 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.54–7.40 (m, 1 H), 7.33–7.31 (m, 2 H), 7.28–7.18 (m, 3 H), 7.18–7.00 (m, 6 H), 6.86–6.85 (m, 1 H), 6.10 (d, *J* = 1.3 Hz, 1 H), 5.85 (d, *J* = 7.8 Hz, 1 H), 5.27 (d, *J* = 7.8 Hz, 1 H), 5.07 (d, *J* = 1.5 Hz, 1 H), 4.81 (s, 1 H), 3.91–3.57 (m, 3 H), 3.17 (d, *J* = 15.8 Hz, 1 H), 0.92 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.7, 167.3, 161.6 (d, *J* = 243.9 Hz), 143.2, 136.4, 134.7, 132.3 (d, *J* = 3.6 Hz), 130.6, 130.3, 129.2 (d, *J* = 8.4 Hz), 128.7, 127.8, 127.4, 127.0, 126.9 (d, *J* = 5.9 Hz), 124.9, 124.5 (d, *J* = 3.5 Hz), 122.5, 122.3, 115.3 (d, *J* = 23.4 Hz), 104.4, 100.8, 65.9, 63.38, 63.35, 61.4, 33.29, 33.26, 13.4.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1931.

Compound 10f
Yield: 27.5 mg (47%); white crystalline solid; mp 155.1–156.7 °C.

IR (film): 3023, 2963, 2925, 1728, 1667, 1634, 1601, 1573, 1515, 1493, 1446, 1408, 1368, 1340, 1286, 1260, 1225, 1202, 1096, 1045, 1023, 939, 906, 863, 802, 769, 699, 665, 634 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.41–7.19 (m, 7 H), 7.20–7.05 (m, 5 H), 6.90–6.77 (m, 1 H), 6.11 (d, *J* = 1.3 Hz, 1 H), 5.88 (d, *J* = 7.8 Hz, 1 H), 5.26 (d, *J* = 7.8 Hz, 1 H), 4.96 (d, *J* = 1.4 Hz, 1 H), 4.84 (s, 1 H), 3.91–3.57 (m, 2 H), 3.49 (d, *J* = 14.4 Hz, 1 H), 3.31 (d, *J* = 14.4 Hz, 1 H), 0.92 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.8, 167.7, 142.9, 137.0, 136.9, 134.9, 132.4, 130.8, 130.7, 130.3, 129.2, 128.8, 127.8, 127.7, 127.6, 126.8, 126.3, 125.0, 104.3, 101.0, 65.5, 63.4, 61.4, 40.9, 20.9, 13.5.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1917.

Compound 10g
Yield: 27.9 mg (48%); white crystalline solid; mp 146.0–147.0 °C.

IR (film): 3064, 2961, 2929, 1727, 1665, 1635, 1602, 1573, 1510, 1493, 1446, 1408, 1368, 1340, 1286, 1223, 1160, 1098, 1046, 1016, 939, 906, 863, 837, 756, 699, 664, 633 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.45–7.24 (m, 7 H), 7.24–7.09 (m, 3 H), 7.07–6.94 (m, 2 H), 6.88 (d, *J* = 6.6 Hz, 1 H), 6.11 (d, *J* = 1.4 Hz, 1 H), 5.91 (d, *J* = 7.8 Hz, 1 H), 5.30 (d, *J* = 7.8 Hz, 1 H), 4.90 (d, *J* = 1.4 Hz, 1 H), 4.77 (s, 1 H), 3.88–3.57 (m, 2 H), 3.51 (d, *J* = 14.4 Hz, 1 H), 3.29 (d, *J* = 14.4 Hz, 1 H), 0.93 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.6, 167.8, 162.2 (d, *J* = 246.3 Hz), 142.6, 136.9, 134.7, 132.5 (d, *J* = 7.8 Hz), 131.3 (d, *J* = 3.2 Hz), 130.6, 130.5, 128.9, 127.9, 127.7, 127.4, 126.8, 126.3, 125.1, 115.3 (d, *J* = 21.1 Hz), 104.6, 101.7, 65.4, 64.2, 61.4, 40.6, 13.5.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}FN_2O_3^+$: 469.1922; found: 469.1914.

Compound 10h
Yield: 21.2 mg (35%); white crystalline solid; mp 104.1–106.0 °C.

IR (film): 3065, 2963, 2930, 1729, 1668, 1636, 1601, 1572, 1494, 1475, 1446, 1407, 1368, 1338, 1287, 1260, 1226, 1096, 1045, 1016, 936, 906, 865, 757, 699, 663, 635, 562, 462 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.62–7.60 (m, 1 H), 7.47–7.41 (m, 1 H), 7.40–7.21 (m, 6 H), 7.21–7.06 (m, 4 H), 6.85–6.83 (m, 1 H), 6.08 (d, *J* = 1.5 Hz, 1 H), 5.82 (d, *J* = 7.8 Hz, 1 H), 5.27 (d, *J* = 7.8 Hz, 1 H), 4.94 (d, *J* = 1.5 Hz, 2 H), 3.97 (d, *J* = 14.8 Hz, 1 H), 3.81–3.73 (m, 1 H), 3.68–3.59 (m, 1 H), 3.42 (d, *J* = 14.8 Hz, 1 H), 0.91 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.6, 167.1, 143.4, 136.5, 135.6, 134.7, 133.5, 131.8, 130.6, 130.4, 129.8, 128.74, 128.69, 127.9, 127.6, 127.5, 127.13, 127.09, 126.4, 124.9, 104.4, 100.9, 66.1, 64.1, 61.5, 37.8, 13.4.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1641.

Compound 10i
Yield: 26 mg (43%); white crystalline solid; mp 152.5–153.4 °C.

IR (film): 3064, 3024, 2981, 2931, 1728, 1667, 1634, 1598, 1572, 1493, 1476, 1446, 1408, 1368, 1339, 1286, 1226, 1202, 1120, 1096, 1047, 1027, 940, 907, 865, 769, 699, 666, 645 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.46–7.08 (m, 12 H), 6.92–6.85 (m, 1 H), 6.10 (d, *J* = 1.2 Hz, 1 H), 5.93 (d, *J* = 7.8 Hz, 1 H), 5.31 (d, *J* = 7.8 Hz, 1 H), 4.89 (d, *J* = 1.3 Hz, 1 H), 4.77 (s, 1 H), 3.86–3.61 (m, 2 H), 3.52 (d, *J* = 14.3 Hz, 1 H), 3.27 (d, *J* = 14.3 Hz, 1 H), 0.94 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.8, 142.5, 137.7, 136.9, 134.7, 134.3, 131.0, 130.6, 130.5, 129.7, 129.1, 129.0, 127.9, 127.7, 127.6, 127.3, 126.8, 126.4, 125.1, 104.6, 101.9, 65.3, 64.6, 61.5, 41.1, 13.5.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}ClN_2O_3^+$: 485.1626; found: 485.1613.

Compound 10l
Yield: 29.5 mg (45%); white crystalline solid; mp 162.0–164.0 °C.

IR (film): 2978, 1727, 1665, 1634, 1599, 1567, 1493, 1474, 1446, 1407, 1367, 1339, 1286, 1226, 1201, 1096, 1073, 1045, 939, 863, 783, 751, 698, 668 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.57 (s, 1 H), 7.44–7.26 (m, 7 H), 7.24–7.08 (m, 4 H), 6.91–6.84 (m, 1 H), 6.09 (d, *J* = 1.4 Hz, 1 H), 5.93 (d, *J* = 7.8 Hz, 1 H), 5.31 (d, *J* = 7.8 Hz, 1 H), 4.89 (d, *J* = 1.5 Hz, 1 H), 4.76 (s, 1 H), 3.90–3.60 (m, 2 H), 3.52 (d, *J* = 14.2 Hz, 1 H), 3.25 (d, *J* = 14.3 Hz, 1 H), 0.94 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.3, 167.8, 142.5, 138.0, 136.9, 134.7, 133.8, 130.58, 130.52, 130.46, 130.0, 129.6, 128.9, 127.9, 127.7, 127.3, 126.8, 126.4, 125.0, 122.5, 104.6, 101.9, 65.3, 64.6, 61.5, 41.1, 13.4.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1126.

Compound 10m
Yield: 30.2 mg (54%); white solid.

IR (film): 3063, 2982, 2937, 2905, 1732, 1666, 1633, 1602, 1579, 1492, 1447, 1409, 1370, 1343, 1261, 1189, 1097, 1071, 1026, 940, 910, 865, 773, 754, 701, 667, 646 cm^{-1}.

^1H NMR (75 MHz, $CDCl_3$): δ = 7.70–7.68 (m, 2 H), 7.46–7.30 (m, 3 H), 7.25–7.06 (m, 3 H), 6.90 (d, *J* = 7.3 Hz, 1 H), 6.14 (d, *J* = 1.6 Hz, 1 H), 5.95 (t, *J* = 8.1 Hz, 1 H), 5.28 (d, *J* = 7.9 Hz, 1 H), 5.28 (d, *J* = 7.9 Hz, 1 H), 5.21 (s, 1 H), 4.24–4.06 (m, 2 H), 3.84–3.62 (m, 2 H), 3.22–2.91 (m, 2 H), 1.26 (td, *J* = 7.1, 2.6 Hz, 3 H), 0.91 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.8, 169.9, 167.9, 142.5, 137.3, 135.1, 130.6, 130.4, 129.1, 128.1, 127.9, 127.1, 126.9, 126.3, 125.0, 104.3, 98.8, 65.2, 61.5, 61.1, 61.0, 39.0, 14.1, 13.4.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{26}H_{27}N_2O_5^+$: 447.1914; found: 447.1917.

Compound 11
Yield: 16.9 mg (38%); white solid.

IR (film): 2963, 1733, 1665, 1631, 1525, 1492, 1447, 1369, 1346, 1261, 1177, 1088, 1027, 930, 864, 798, 758, 700, 657 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.79–7.63 (m, 2 H), 7.50–7.31 (m, 3 H), 7.24–7.06 (m, 3 H), 6.96 (d, *J* = 7.5 Hz, 1 H), 6.00–5.95 (m, 1 H), 5.91 (d, *J* = 7.4 Hz, 1 H), 5.54 (d, *J* = 7.8 Hz, 1 H), 5.08–5.01 (m, 1 H), 4.95 (d, *J* = 10.5 Hz, 1 H), 4.42–4.12 (m, 3 H), 1.32 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 169.0, 167.8, 139.9, 137.4, 134.7, 130.7, 129.4, 129.0, 128.4, 127.9, 127.0, 126.9, 125.2, 107.2, 97.4, 62.5, 61.7, 54.4, 14.2.

HRMS (ESI): *m*/*z* $[M + H]^+$ calcd for $C_{22}H_{21}N_2O_3^+$: 361.1547; found: 361.1539.

Compound 12
Yield: 14.1 mg (31%); white solid.

IR (film): 3064, 2962, 2929, 2870, 1734, 1703, 1664, 1631, 1601, 1577, 1524, 1492, 1452, 1408, 1371, 1336, 1276, 1261, 1210, 1195, 1178, 1162, 1087, 1028, 968, 936, 899, 866, 797, 762, 700, 665, 644, 632 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.76–7.63 (m, 2 H), 7.46–7.32 (m, 3 H), 7.23–7.08 (m, 3 H), 6.90 (d, *J* = 6.8 Hz, 1 H), 6.13 (s, 1 H), 5.94 (d, *J* = 7.9 Hz, 1 H), 5.32 (d, *J* = 7.9 Hz, 1 H), 5.10 (d, *J* = 7.8 Hz, 1 H), 5.02–4.98 (m, 1 H), 4.03–3.88 (m, 1 H), 3.86–3.56 (m, 2 H), 0.82 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 170.3, 167.7, 139.1, 136.7, 134.8, 130.7, 130.4, 128.9, 128.3, 128.0, 127.7, 127.1, 126.4, 125.1, 105.0, 99.5, 62.0, 61.1, 57.7, 13.4.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{22}H_{21}N_2O_3^+$: 361.1547; found: 361.1542.

Compound 14
Yield: 31.3 mg (47%); white solid.

IR (film): 2979, 1729, 1671, 1523, 1486, 1449, 1381, 1355, 1278, 1225, 1086, 1018, 959, 802, 758, 702 cm^{-1}.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 7.50–7.07 (m, 14 H), 6.26 (s, 1 H), 6.08 (d, *J* = 1.6 Hz, 1 H), 5.00 (d, *J* = 1.6 Hz, 1 H), 4.85 (s, 1 H), 3.85 (dq, *J* = 10.8, 7.2 Hz, 1 H), 3.67 (dq, *J* = 10.8, 7.1 Hz, 1 H), 3.52 (d, *J* = 14.4 Hz, 1 H), 3.36 (d, *J* = 14.4 Hz, 1 H), 0.98 (t, *J* = 7.2 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.6, 142.8, 137.5, 135.3, 134.5, 130.9, 130.5, 129.6, 129.1, 128.6, 127.9, 127.7, 127.6, 127.53, 127.48, 126.5, 125.2, 101.3, 98.5, 65.5, 63.5, 61.7, 41.4, 13.6.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1113.

Compound 15
Yield: 13.6 mg (21%); white solid.

IR (film): 3063, 2965, 1706, 1603, 1522, 1451, 1367, 1323, 1277, 1261, 1198, 1165, 1108, 1086, 1024, 861, 799, 756, 711 cm^{-1}.

^{1}H NMR (300 MHz, DMSO-d_6): δ = 7.72–7.62 (m, 2 H), 7.50–7.24 (m, 5 H), 7.22–7.05 (m, 5 H), 7.02–6.90 (m, 2 H), 6.48 (s, 1 H), 5.90 (d, *J* = 1.4 Hz, 1 H), 5.35 (s, 1 H), 4.41 (d, *J* = 1.5 Hz, 1 H), 4.37–4.22 (m, 2 H), 3.16 (s, 2 H), 1.33 (t, *J* = 7.1 Hz, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 171.4, 167.8, 141.8, 137.7, 135.8, 134.5, 131.4, 130.9, 130.4, 129.3, 129.0, 128.2, 128.12, 128.09, 127.99, 127.5, 126.9, 126.6, 125.3, 102.4, 99.2, 66.6, 63.9, 62.0, 38.9, 14.0.

HRMS (ESI): *m*/*z* [M + H]$^+$ calcd for $C_{29}H_{26}BrN_2O_3^+$: 529.1121; found: 529.1099.

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