Supporting Information

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Bismuth-Catalyzed Direct Substitution of the Hydroxyl Group in Alcohols with Sulfonamides, Carbamates, and Carboxamides

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Experimental Section

General: Infrared (IR) spectra were recorded on a JASCO FT/IR 410 Fourier transform infrared spectrophotometer. NMR spectra were recorded on a JEOL JNM-LA500 spectrometer, operating at 500 MHz for 1H NMR and 125.65 MHz for 13C NMR. Chemical shifts in CDCl3 were reported downfield from TMS (= 0) or in the scale relative to CHCl3 (7.24 ppm) for 1H NMR. For 13C NMR, chemical shifts were reported in the scale relative to CHCl3 (77.0 ppm for 13C NMR) as an internal reference. ESI mass spectra were measured on Waters-ZQ4000. FAB and EI mass spectra were measured on a JEOL JMS-700 or JMS-BU20 GCmate. Column chromatography was performed with silica gel Merck 60 (230–400 mesh ASTM). Reactions were carried out in dry solvents under an argon atmosphere, unless otherwise stated. Anhydrous 1,4-dioxane was purchased from Kanto chemicals and used as received. Bi(OTf)3 was purchased from Aldrich Co., Ltd. and used as received. KPF6 was purchased from TCI and used as received.

General procedure

To a mixture of Bi(OTf)3 (3.92 mg, 0.006 mmol), KPF6 (1.11 mg, 0.006 mmol), and Drierite (45 mg) in a test tube was added 1,4-dioxane (1.0 mL). After being stirred for 10 min at room temperature, p-TsNH2 2a (77.0 mg, 0.45 mmol) and then alcohol 1a (63.1 mg, 0.3 mmol) were successively added. The reaction mixture was stirred at 23-26 °C for 10 min. The mixture was diluted with diethyl ether (5 mL) and silica gel (ca. 3 g) was added to the mixture. After filtration and washing with diethyl ether, solvent was removed under reduced pressure. The residue was purified by silica gel column chromatography (hexane/ethyl acetate = 8/1-6/1) to give 3aa (96%) as a colorless solid.

Spectra data:

Products 3aa (registry No. 121440-78-6), 3ac (registry No. 121846-94-4), 3ae (registry No. 691407-73-5), 3ah (registry No. 33413-50-9), 3aj (registry No. 879559-46-3), 3ba
(E)-N-(1,3-Diphenylallyl)-2-nitrobenzenesulfonamide (3ab):
colorless solid; IR (KBr) ν 746, 1170, 1367, 1448, 1545, 2924, 3286 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \(\delta\) 5.34 (ddd, \(J\) = 0.9, 6.4, 8.6 Hz, 1H), 5.91 (d, \(J\) = 8.6 Hz, 1H), 6.18 (dd, \(J\) = 6.4 Hz, 15.9 Hz, 1H), 6.42 (dd, \(J\) = 0.9 Hz, 15.9 Hz, 1H), 7.16–7.27 (m, 10H), 7.41 (ddd, \(J\) = 1.2, 7.9, 7.9 Hz, 1H), 7.51 (ddd, \(J\) = 1.2, 7.9, 7.9 Hz, 1H), 7.72 (dd, \(J\) = 1.2 Hz, 7.9 Hz, 1H), 7.83 (dd, \(J\) = 1.2 Hz, 7.9 Hz, 1H); \(^1\)C NMR (CDCl\(_3\)) ppm for CHCl\(_3\) in CDCl\(_3\) \(\delta\) 60.7, 125.0, 126.5, 127.1, 127.4, 128.1, 128.2, 128.6, 128.7, 131.1, 132.5, 132.9, 133.0, 134.7, 135.7, 138.7, 147.4; LRMS (ESI, methanol) \(m/z\) 417 [M+Na\(^+\)]; Anal. calcd. for C\(_{21}\)H\(_{18}\)N\(_2\)O\(_4\)S: C, 63.94; H, 4.85; N, 7.10%. Found: C, 64.10; H, 4.85; N, 6.82%.

(E)-N-(1,3-Diphenylallyl)-4-(trifluoromethyl)benzenesulfonamide (3ad):
colorless solid; IR (KBr) ν 713, 1062, 1138, 1157, 1320, 1415, 3267 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \(\delta\) 5.17 (d, \(J\) = 6.8 Hz, 1H), 5.21 (dd, \(J\) = 6.8, 6.8 Hz, 1H), 6.07 (dd, \(J\) = 6.8 Hz, 16.0 Hz, 1H), 6.38 (d, \(J\) = 16.0 Hz, 1H), 7.15–7.28 (m, 10H), 7.55 (d, \(J\) = 8.0 Hz, 2H), 7.82 (d, \(J\) = 8.0 Hz, 2H); \(^1\)C NMR (CDCl\(_3\)) ppm \(\delta\) 60.1, 123.1 (q, \(J_{C-F} = 273.0\) Hz), 125.8 (q, \(J_{C-F} = 3.7\) Hz), 126.4, 127.0, 127.5, 127.6, 128.0, 128.1, 128.5, 128.7, 132.5, 133.0, 134.7, 135.7, 147.4; LRMS (ESI, methanol) \(m/z\) 440 [M+Na\(^+\)]; HRMS (FAB) \(m/z\) 417.1012 [M+\(^{13}\)C\(^6\)] calcd. for C\(_{22}\)H\(_{18}\)F\(_3\)NO\(_2\)S = 417.1010.

(E)-Butyl 1,3-diphenylallylcarbamate (3ag):
colorless solid; IR (KBr) ν 713, 1062, 1138, 1157, 1320, 1415, 3267 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \(\delta\) 0.92 (t, \(J\) = 7.0 Hz, 3H), 1.30–1.42 (m, 2H), 1.56–1.63 (m, 2H), 4.07–4.11 (m, 2H), 5.11 (brs, 1H), 5.51 (brs, 1H), 6.32 (dd, \(J\) = 6.2 Hz, \(J\) = 15.9 Hz, 1H), 5.55 (d, \(J\) = 15.9 Hz, 1H), 7.21–7.37 (m, 10H); \(^1\)C NMR (CDCl\(_3\)) \(\delta\) 13.7, 19.0, 31.0, 56.6, 65.0, 126.5, 126.9, 127.6, 127.7, 128.5, 128.7, 129.3, 131.0, 136.4, 141.1, 155.9; LRMS (ESI, methanol) \(m/z\) 332 [M+Na\(^+\)]; Anal. calcd for C\(_{29}\)H\(_{33}\)NO\(_2\): C, 77.64; H, 7.49; N, 4.53%. Found: C, 77.65; H, 7.58; N, 4.55%.

(E)-3-(1,3-Diphenylallyloxazolidin-2-one (3ai):
colorless oil; IR (neat) ν 701, 747, 973, 1249, 1416, 1746, 3028 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \(\delta\) 3.28 (m, 1H), 3.61 (m, 1H), 4.30 (m, 1H), 4.37...
(m, 1H), 5.82 (d, J = 6.7 Hz, 1H), 6.45 (dd, J = 6.7 Hz, 15.9 Hz, 1H), 6.68 (d, J = 15.9 Hz, 1H), 7.26-7.44 (m, 10H); 13C NMR (CDCl₃)  δ 40.9, 58.3, 62.0, 124.7, 126.5, 127.7, 128.0, 128.6, 128.8, 133.8, 136.1, 137.9, 158.1; LRMS (ESI, methanol) m/z 302 [M+Na⁺].

(E)-N-(1,3-Diphenylallyl)pentanamide (3ak):  
colorless solid; IR (KBr) ν 696, 974, 1538, 1635, 2960, 3275 cm⁻¹; ¹H NMR (CDCl₃) δ 0.93 (t, J = 7.5 Hz, 3H), 1.35-1.41 (m, 2H), 1.57-1.69 (m, 2H), 2.24-2.29 (m, 2H), 5.78-5.85 (m, 2H), 6.34 (dd, J = 5.8 Hz, J = 16.2 Hz, 1H), 6.53 (d, J = 16.2 Hz, 1H), 7.22-7.40 (m, 10H); 13C NMR (CDCl₃) δ 13.7, 22.3, 27.7, 36.4, 54.5, 126.4, 127.1, 127.5, 127.6, 128.5, 128.6, 129.0, 131.2, 136.4, 141.0, 172.1; LRMS (ESI, methanol) m/z 316 [M+Na⁺]; HRMS (EI) m/z 293.1774 [M⁺] calcd. for C₂₀H₁₉NO = 293.1774.

(E)-N-(1,3-Diphenylallyl)cinnamamide (3al):  
colorless solid; IR (KBr) ν 696, 742, 1221, 1544, 1620, 1655, 3288 cm⁻¹; ¹H NMR (CDCl₃) δ 5.95-6.02 (m, 2H), 6.41 (dd, J = 4.8 Hz, 16.2 Hz, 1H), 6.46 (d, J = 15.6 Hz, 1H), 6.60 (d, J = 16.2 Hz, 1H), 7.28-7.32 (m, 3H), 7.34-7.41 (m, 9H), 7.50-7.51 (m, 2H), 7.69 (d, J = 15.6 Hz, 1H); ¹³C NMR (CDCl₃) δ 54.9, 120.5, 126.5, 127.2, 127.7, 127.75, 127.81, 128.5, 128.76, 128.77, 128.81, 129.7, 131.5, 134.7, 136.4, 140.8, 141.7, 165.0; LRMS (ESI, methanol) m/z 362 [M+Na⁺]; HRMS (EI) m/z 339.1622 [M⁺] calcd. for C₂₄H₂₁NO = 339.1618.

N-(Cyclohept-2-enyl)-N,4-dimethylbenzenesulfonamide (3de):  
colorless oil; IR (neat) ν 550, 584, 664, 945, 1159, 1337, 2926 cm⁻¹; ¹H NMR (CDCl₃) δ 1.28-1.31 (m, 1H), 1.54-1.60 (m, 3H), 1.69-1.72 (m, 1H), 1.84-1.87 (m, 1H), 2.06-2.08 (m, 1H), 2.15-2.20 (m, 1H), 2.42 (s, 3H), 2.74 (s, 3H), 4.63 (brs, 1H), 5.28 (brd, J = 12.0 Hz, 1H), 5.72 (m, 1H), 7.28 (d, J = 9.0 Hz, 2H), 7.68 (d, J = 9.0 Hz, 2H); ¹³C NMR (CDCl₃) δ 21.4, 26.2, 27.5, 28.2, 29.3, 32.3, 58.5, 127.1, 129.5, 132.3, 132.7, 136.8, 142.9; LRMS (ESI, methanol) m/z 302 [M+Na⁺]; HRMS (FAB) m/z 280.1370 [M+H⁺] calcd. for C₁₅H₂₂NO₂S= 280.1366.

N,4-Dimethyl-N-(2-phenylcyclohex-2-enyl)benzenesulfonamide (3ee):  
colorless solid; IR (KBr) ν 546, 665, 967, 1150, 1336, 2931 cm⁻¹; ¹H NMR (CDCl₃) δ 1.68-1.88 (m, 4H), 2.15-2.19 (m, 2H), 2.39 (s, 3H), 2.46 (s, 3H), 5.20-5.22 (m, 1H), 6.14-6.17 (m, 1H), 7.17 (d, J = 8.4 Hz, 2H), 7.21-7.29 (m, 5H), 7.52 (d, J = 8.4 Hz, 2H); ¹³C NMR (CDCl₃) δ 20.3, 21.4, 25.4, 27.6, 29.6, 54.1, 126.4, 126.8, 127.2, 128.0, 129.3, 132.5, 137.1, 137.4, 140.3, 142.8; LRMS
(ESI, methanol) m/z 364 [M+Na⁺]; HRMS (FAB) m/z 342.1524 [M+H⁺] calcd. for C₂₀H₂₄NO₂S= 342.1522.

(ESI, methanol) m/z 364 [M+Na⁺]; HRMS (FAB) m/z 342.1524 [M+H⁺] calcd. for C₂₀H₂₄NO₂S= 342.1522.

(E)-N-(4-(4-chlorophenyl)but-3-en-2-yl)-N,4-dimethylbenzenesulfonamide (3ge)
colorless solid; IR (KBr) v 548, 811, 953, 1146, 1334, 1490, 2981 cm⁻¹; ¹H NMR (CDCl₃) δ 1.19 (d, J = 7.4 Hz, 3H), 2.42 (s, 3H), 2.72 (s, 3H), 4.77-4.81 (m, 1H), 5.92 (dd, J = 5.2 Hz, 16.6 Hz, 1H), 6.33 (d, J = 16.6 Hz, 1H), 7.16 (d, J = 8.6 Hz, 2H), 7.25-7.30 (m, 4H), 7.72 (d, J = 8.6 Hz, 2H); ¹³C NMR (CDCl₃) δ 16.5, 21.4, 28.5, 53.6, 127.1, 127.5, 128.6, 129.1, 129.6, 130.2, 133.3, 134.8, 136.7, 143.1; LRMS (ESI, methanol) m/z 372 [M+Na⁺]; HRMS (FAB) m/z 350.0984 [M+H⁺] calcd. for C₁₈H₂₁NO₂ClS= 350.0976.

(E)-N-(4-(4-methoxyphenyl)but-3-en-2-yl)-N,4-dimethylbenzenesulfonamide (3he)
colorless oil; IR (neat) v 550, 816, 1152, 1248, 1336, 1512, 2934 cm⁻¹; ¹H NMR (CDCl₃) δ 1.18 (d, J = 6.8 Hz, 3H), 2.41 (s, 3H), 2.71 (s, 3H), 3.80 (s, 3H), 4.76-4.79 (m, 1H), 5.79 (dd, J = 5.7 Hz, 16.6 Hz, 1H), 6.29 (dd, J = 1.2 Hz, 16.6 Hz, 1H), 6.81-6.83 (m, 2H), 7.15-7.18 (m 2H), 7.28 (d, J = 8.2 Hz, 2H), 7.72 (d, J = 8.2 Hz, 2H); ¹³C NMR (CDCl₃) δ 16.7, 21.4, 28.4, 53.7, 55.2, 113.9, 126.1, 127.2, 127.5, 129.1, 129.6, 131.0, 137.0, 143.0, 159.3; LRMS (ESI, methanol) m/z 368 [M+Na⁺]; HRMS (FAB) m/z 346.1471 [M+H⁺] calcd. for C₁₉H₂₄NO₃S= 346.1471.

(E)-Butyl 4-(1-tosyl-1H-indol-3-yl)but-3-en-2-ylcarbamate (3ig)
colorless oil; IR (neat) v 572, 1174, 1371, 1714, 2960, 3322 cm⁻¹; ¹H NMR (CDCl₃) δ 0.91-0.95 (m, 3H), 1.34-1.42 (m, 5H), 1.58-1.64 (m, 2H), 2.33 (s, 3H), 4.05-4.11 (m, 2H), 4.46 (brs, 1H), 4.68 (brs, 1H), 6.22 (dd, J = 5.8 Hz, 16.2 Hz, 1H), 6.57 (d, J = 16.2 Hz, 1H), 7.21 (d, J = 8.2 Hz, 2H), 7.23-7.34 (m, 2H), 7.56 (s, 1H), 7.69 (d, J = 8.2 Hz, 2H), 7.75 (d, J = 8.2 Hz, 2H), 7.98 (d, J = 8.5 Hz, 1H); ¹³C NMR (CDCl₃) δ 13.7, 19.0, 21.1, 25.1, 31.0, 48.6, 64.7, 113.7, 119.9, 120.3, 123.4, 123.8, 124.9, 126.8, 128.9, 129.8, 132.7, 135.7, 135.4, 144.9, 156.0; LRMS (ESI, methanol) m/z 463 [M+Na⁺]; HRMS (FAB) m/z 441.1847 [M+H⁺] calcd. for C₂₄H₂₉N₂O₄S= 441.1843.

(E)-N,N-Dimethyl-N-{3-[4-(trifluoromethyl)phenyl]allyl}benzenesulfonamide (3le)
colorless solid; IR (KBr) v 553, 924, 1068, 1126, 1159, 1334, 2927 cm⁻¹; ¹H NMR (CDCl₃) δ 2.45 (s, 3H), 2.73 (s, 3H), 3.82 (d, J = 6.9 Hz, 2H), 6.18 (dt, J = 6.9, 16.0 Hz, 2H), 6.52 (d, J = 16.0 Hz, 1H), 7.34 (d, J = 8.0 Hz, 2H), 7.40 (d, J = 8.0 Hz, 2H), 7.56 (d,
\( J = 8.5 \, \text{Hz, 2H}\); \(^{13}\text{C}\) NMR (CDCl\(_3\)) \( \delta \) 21.4, 34.6, 52.3, 124.0 (q, 
\( J_{\text{C-F}} = 270 \, \text{Hz}\)), 125.5 (q, \( J_{\text{C-F}} = 3.1 \, \text{Hz}\)), 126.58, 126.62, 127.4, 129.6 (q, \( J_{\text{C-F}} = 32 \, \text{Hz}\)), 129.7, 132.34, 134.46, 139.61, 143.54; LRMS (ESI, methanol) \( m/z \) 392 [M+Na\(^+\)]; HRMS (FAB) \( m/z \) 370.1078 [M+H\(^+\)] calcd. for C\(_{18}\)H\(_{19}\)NO\(_2\)F\(_3\)S = 370.1083.

\((E)-N,4\text{-Dimethyl}-N-(\text{hex-2-enyl})\text{-benzenesulfonamide (3me):}\)
colorless oil; IR (neat) \( \nu \) 651, 728, 1163, 1339, 2929, 2959 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \( \delta \) 0.86 (t, \( J = 7.4 \, \text{Hz}\), 3H), 1.35 (tq, \( J = 7.4, 7.4 \, \text{Hz}\), 2H), 1.98 (dt, \( J = 7.4, 7.4 \, \text{Hz}\), 2H), 2.43 (s, 3H), 2.65 (s, 3H), 3.56 (d, \( J = 6.8 \, \text{Hz}\), 2H), 5.32 (dt, \( J = 6.8, 14.9 \, \text{Hz}\), 1H), 5.56 (dt, \( J = 7.4, 14.9 \, \text{Hz}\), 1H), 7.31 (brd, \( J = 8.3 \, \text{Hz}\), 2H), 7.67 (brd, \( J = 8.3 \, \text{Hz}\), 2H); \(^{13}\text{C}\) NMR (CDCl\(_3\)) \( \delta \) 13.5, 21.4, 22.1, 33.9, 34.1, 52.3, 124.0, 127.4, 129.5, 134.5, 135.3, 143.2; LRMS (ESI, methanol) \( m/z \) 290 [M+Na\(^+\)].

\((E)-N,4\text{-Dimethyl}-N-(\text{penta-2,4-dienyl})\text{-benzenesulfonamide (3ne):}\)
colorless oil; IR (neat) \( \nu \) 550, 740, 1009, 1162, 1339, 1599 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \( \delta \) 2.43 (s, 3H), 2.65 (s, 3H), 3.66 (d, \( J = 6.7 \, \text{Hz}\), 2H), 5.09 (brd, \( J = 10.4 \, \text{Hz}\), 1H), 5.18 (brd, \( J = 16.5 \, \text{Hz}\), 1H), 5.56 (dt, \( J = 6.7, 15.2 \, \text{Hz}\), 1H), 6.13 (dd, \( J = 10.4, 15.2 \, \text{Hz}\), 1H), 6.29 (dt, \( J = 10.4, 16.5 \, \text{Hz}\), 1H), 7.32 (brd, \( J = 8.0 \, \text{Hz}\), 2H), 7.67 (brd, \( J = 8.0 \, \text{Hz}\), 2H); \(^{13}\text{C}\) NMR (CDCl\(_3\)) \( \delta \) 13.5, 21.4, 34.1, 52.0, 118.0, 127.4, 127.6, 129.6, 134.8, 135.7, 143.3; LRMS (ESI, methanol) \( m/z \) 274 [M+Na\(^+\)]; HRMS (EI) \( m/z \) 251.0980 [M\(^+\)] calcd. for C\(_{13}\)H\(_{17}\)NO\(_2\)S = 251.0975.

\((E)-\text{Butyl 1,3-diphenylbut-2-enyl-carbamate (3og):}\)
colorless oil; IR (neat) \( \nu \) 698, 757, 1026, 1247, 1495, 1695, 2958, 3320 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \( \delta \) 0.92 (brs, 3H), 1.30-1.42 (m, 2H), 1.54-1.62 (m, 2H), 2.19 (s, 3H), 4.08 (t, \( J = 6.9 \, \text{Hz}\), 2H), 5.05 (brs, 1H), 5.71 (brs, 1H), 5.83 (d, \( J = 9.1 \, \text{Hz}\), 1H), 7.21-7.41 (m, 10H); \(^13\)C NMR (CDCl\(_3\)) \( \delta \) 13.72, 16.51, 19.03, 31.02, 53.15, 64.95, 125.88, 126.45, 127.34, 127.64, 128.24, 128.56, 128.70, 137.98, 141.98, 142.74, 156.05; LRMS (ESI, methanol) \( m/z \) 346 [M+Na\(^+\)]; HRMS (EI) \( m/z \) 323.1888 [M\(^+\)] calcd. for C\(_{21}\)H\(_{25}\)NO\(_2\) = 323.1880.

\(4\text{-Methyl-N-(1-phenyloct-2-ynyl)benzenesulfonamide (3qa):}\)
colorless solid; IR (KBr) \( \nu \) 578, 669, 1092, 1155, 1330, 1494, 2930, 3271 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\)) \( \delta \) 0.88 (t, \( J = 7.3 \, \text{Hz}\), 3H), 1.19-1.34 (m, 6H), 1.94-1.98 (m, 2H), 2.43 (s, 3H), 4.78 (d, \( J = 8.8 \, \text{Hz}\), 1H), 5.30 (d, \( J = 8.8 \, \text{Hz}\), 1H), 7.27-7.33 (m, 5H), 7.46-7.48 (m, 2H), 7.77 (d, \( J = 8.3 \, \text{Hz}\), 2H); \(^{13}\text{C}\) NMR (CDCl\(_3\)) \( \delta \) 13.9, 18.5, 21.5, 22.1, 27.9, 31.0, 49.4, 76.6, 87.5, 127.2, 127.5, 128.1, 128.5, 129.3, 137.6, 138.2, 143.2; LRMS (ESI, methanol) \( m/z \) 378 [M+Na\(^+\)]; HRMS (FAB) \( m/z \) 356.1682 [M+H\(^+\)] calcd.
for C$_{17}$H$_{16}$NO$_2$S = 358.0896.

**4-Methyl-N-(2-methyl-4-phenylbut-3-yn-2-yl)benzenesulfonamide (3ra):**
colorless solid; IR (KBr) ν 544, 670, 767, 988, 1091, 1148, 1326, 1423, 3273 cm$^{-1}$; $^1$H NMR (CDCl$_3$) δ 1.65 (s, 6H), 2.26 (s, 3H), 4.68 (s, 1H), 7.04–7.07 (m, 2H), 7.16 (brd, $J = 8.6$ Hz, 2H), 7.21–7.25 (m, 3H), 7.80 (d, $J = 8.0$ Hz, 2H); $^{13}$C NMR (CDCl$_3$) δ 21.3, 31.0, 50.5, 83.2, 90.5, 122.4, 127.6, 127.9, 128.1, 129.3, 131.5, 138.5, 143.0; LRMS(ESI, methanol) $m/z$ 336 [M+Na$^+$]; HRMS (EI) $m/z$ 298.0892 [M$^+$-CH$_3$] calcd. for C$_{17}$H$_{16}$NO$_2$S = 298.0896.

**Benzyl 2,4-diphenylbut-3-yn-2-ylcarbamate (3sf):**
colorless solid; IR (KBr) ν 696, 1052, 1084, 1261, 1533, 1702, 3298 cm$^{-1}$; $^1$H NMR (CDCl$_3$) δ 1.94 (s, 3H), 5.06 (s, 2H), 5.38 (s, 1H), 7.25–7.50 (m, 13H), 7.68 (d, $J = 7.6$ Hz, 2H); $^{13}$C NMR (CDCl$_3$) δ 32.0, 54.6, 66.6, 84.0, 90.9, 122.8, 125.3, 127.5, 127.9, 128.15, 128.17, 128.23, 128.3, 128.4, 131.8, 136.4, 136.5, 143.9; LRMS (ESI, methanol) $m/z$ 378 [M+Na$^+$]; HRMS (EI) $m/z$ 355.1572 [M$^+$] calcd. for C$_{24}$H$_{21}$NO$_2$ = 355.1567.