

Diastereoselective synthesis of 5-hydroxy-3-methylalkane-1,6-diones from ketones and acetylene in two atom-economic steps

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(3*R**,5*R**)-5-Hydroxy-3-methyl-1,5-di-*p*-tolylheptane-1,6-dione **2b**: yield 120 mg (71%), light yellow oil. ¹H NMR, δ : 7.81-7.79, 7.42-7.40, 7.24-7.22, 7.14-7.12 (m, 8H, Ph), 4.93 (s, 1H, OH), 3.14 (dd, ²*J* 16.6 Hz, ³*J* 6.3 Hz, 1H), 2.77 (dd, ²*J* 16.6 Hz, ³*J* 6.8 Hz, 1H) [C²H₂], 2.41, 2.31 (s, 6H, Me^{Ph}), 2.38-2.35 (m, 1H, C³H), 2.26-2.24 (m, 2H, C⁴H₂), 2.17 (s, 3H, C⁶Me), 1.07 (d, ³*J* 6.7 Hz, 3H, C³Me). ¹³C NMR, δ : 210.0 (C⁶), 200.1 (C¹), 143.7, 138.6, 137.3, 134.4, 129.1, 128.2, 125.8 (12C, Ph), 82.7 (C⁵), 46.7 (C²), 43.8 (C⁴), 25.6 (C³), 24.0 (C⁶Me), 21.8 (C³Me), 21.5, 20.8 (Me^{Ph}). IR (film, v/cm⁻¹): 3446, 3028, 2955, 2924, 2874, 2251, 1914, 1708, 1674, 1607, 1511, 1450, 1409, 1359, 1286, 1182, 1128, 1114, 1009, 940, 912, 812, 732, 581. Found (%): C 78.05; H 7.71. Calc. (%) for C₂₂H₂₆O₃ (%): C 78.07; H 7.74.

(3*R**,5*R**)-1,5-Di(biphenyl-4-yl)-5-hydroxy-3-methylheptane-1,6-dione **2c**: yield 173 mg (75%), white solid, mp 124-125 °C. ¹H NMR, δ : 7.99-7.97, 7.67-7.60, 7.57-7.53, 7.50-7.47, 7.44-7.40, 7.37-7.33 (m, 18H, Ph), 5.03 (s, 1H, OH), 3.21 (dd, ²*J* 16.7 Hz, ³*J* 6.5 Hz, 1H), 2.87 (dd, ²*J* 16.7 Hz, ³*J* 6.2 Hz, 1H) [C²H₂], 2.53-2.48 (m, 1H, C³H), 2.37-2.33 (m, 2H, C⁴H₂), 2.26 (s, 3H, C⁶Me), 1.16 (d, ³*J* 6.7 Hz, 3H, C³Me). ¹³C NMR, δ : 209.9 (C⁶), 200.1(C¹), 145.7, 140.4, 140.3, 139.7, 135.5, 128.9, 128.7, 128.2, 127.3, 127.2, 127.1, 127.1, 127.0, 126.4 (24C, Ph), 82.8 (C⁵), 46.8 (C²), 43.9 (C⁴), 25.6 (C³), 24.2 (C⁶Me), 22.1 (C³Me). IR (film, v/cm⁻¹): 3440, 3032, 2957, 2927, 2876, 2251, 1950, 1805, 1707, 1603, 1485, 1450, 1401, 1360, 1285, 1215, 1190, 1131, 1114, 1082, 1003, 910, 837, 762, 733, 698, 589. Found (%): C 63.35; H 5.34. Calc. for C₃₂H₃₀O₃ (%): C 83.09; H 6.54.

(3*R**,5*R**)-1,5-Bis(4-chlorophenyl)-5-hydroxy-3-methylheptane-1,6-dione **2d**: yield 157 mg (83%), yellow oil. ¹H NMR, δ : 7.84-7.82, 7.48-7.46, 7.43-7.41, 7.31-7.28 (m, 8H, Ph), 4.92 (s, 1H, OH), 3.10 (dd, ²*J* 16.1 Hz, ³*J* 6.7 Hz, 1H), 2.79 (dd, ²*J* 17.0 Hz, ³*J* 6.2 Hz, 1H) [C²H₂], 2.39-2.34 (m, 1H, C³H), 2.22-2.20 (m, 2H, C⁴H₂), 2.18 (s, 3H, C⁶Me), 1.07 (d, ³*J* 6.7 Hz, 3H, C³Me). ¹³C NMR, δ : 209.6 (C⁶), 199.3 (C¹), 140.2 (*i*-C), 139.8 (*i*'-C), 133.9 (*p*-C), 133.7 (*p*'-C), 129.6 (*o*'-C), 129.0 (*m*'-C), 128.6 (*m*-C), 127.6 (*o*-C), 82.7 (C⁵), 46.8 (C²), 43.9 (C⁴), 25.5 (C³), 24.2 (C⁶Me), 22.0 (C³Me). IR (film, v/cm⁻¹): 3439, 2956, 2928, 2873, 2252, 1907, 1787, 1708, 1679, 1591, 1490, 1455, 1399, 1361, 1315, 1212, 1091, 1005, 939, 910, 823, 732, 533. Found (%): C 63.35; H 5.34; Cl 18.64. Calc. for C₂₀H₂₀Cl₂O₃ (%): C 63.34; H 5.32; Cl 18.69.

(3*R**,5*S**)-5-Hydroxy-1,5-bis(3-methoxyphenyl)-3-methylheptane-1,6-dione **2e**: yield 89 mg (48%), yellow oil. ¹H NMR, δ : 7.51-7.49, 7.40-7.36, 7.32-7.31, 7.30-7.28, 7.16-7.13, 6.97-6.96, 6.92-6.89, 6.85-6.84, 6.83-6.82 (m, 8H, Ph), 4.94 (s, 1H, OH), 3.91, 3.84 (s, 6H, OMe), 3.18 (dd, ²*J* 16.7 Hz, ³*J* 6.2 Hz, 1H), 2.82 (dd, ³*J* 16.7 Hz, ³*J* 6.7 Hz, 1H) [C²H₂], 2.41-2.39 (m, 1H, C³H), 2.32-2.29 (m, 2H, C⁴H₂), 2.24 (s, 3H, C⁶Me), 1.11 (d, ³*J* 6.8 Hz, 3H, C³Me). ¹³C NMR, δ : 209.8 (C⁶), 200.3 (C¹), 143.7, 138.4, 137.3, 134.4, 129.1, 128.2, 125.8 (12C, Ph), 82.9 (C⁵), 47.0 (C²), 43.8 (C⁴), 25.7 (C³), 24.1 (C⁶Me), 22.0 (C³Me), 21.5, 20.8 (OMe). IR (film, v/cm⁻¹): 3049, 2954,

2923, 1934, 1848, 1709, 1676, 1594, 1486, 1458, 1432, 1360, 1280, 1263, 1216, 1177, 1125, 1047, 1019, 945, 877, 784, 705. Found (%): C 71.27; H 7.11. Calc. for C₂₂H₂₆O₅ (%): C 71.33; H 7.07.

(3*R**,5*R**)-5-Hydroxy-3-methyl-1,5-di(naphthalen-1-yl)heptane-1,6-dione **2f**: yield 183 mg (89%), yellow oil. ¹H NMR, δ: 8.61-8.59, 8.07-8.05, 7.99-7.97, 7.89-7.84, 7.78-7.76, 7.60-7.52, 7.49-7.45 (m, 14H, Naphth), 4.67 (s, 1H, OH), 3.33 (dd, ²J 16.5 Hz, ³J 5.3 Hz, 1H), 2.95 (dd, ²J 16.5 Hz, ³J 7.8 Hz, 1H) [C²H₂], 2.66 (dd, ²J 14.2 Hz, ³J 5.5 Hz, 1H), 2.38 (dd, ²J 14.2 Hz, ³J 5.2 Hz, 1H) [C⁴H₂], 2.51-2.46 (m, 1H, C³H), 1.98 (s, 3H, C⁶Me), 1.16 (d, ³J 6.7 Hz, 3H, C³Me). ¹³C NMR, δ: 210.8 (C⁶), 204.5 (C¹), 136.4, 135.9, 134.5, 133.9, 132.6, 131.1, 130.1, 129.6, 129.0, 128.4, 127.9, 127.6, 126.5, 126.4, 125.7, 125.6, 124.9, 124.8, 124.8, 124.3 (20C, naphthalene), 83.1 (C⁵), 50.7 (C²), 44.0 (C⁴), 25.5 (C³), 24.7 (C⁶Me), 22.4 (C³Me). IR (film, v/cm⁻¹): 3451, 3053, 2957, 2929, 2873, 2251, 1942, 1708, 1676, 1596, 1509, 1456, 1356, 1282, 1238, 1178, 1125, 1093, 910, 798, 780, 733, 649. Found (%): C 81.87; H 6.45. Calc. for C₂₈H₂₆O₃ (%): C 81.92; H 6.38.