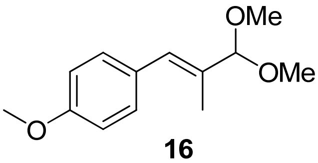
Acid promoted CIDT for the deracemization of dihydrocinnamic aldehydes with Betti's base

Goffredo Rosini,*[a] Claudio Paolucci,[a] Francesca Boschi,[a] Emanuela Marotta,[a] Paolo Righi[a] and Francesco Tozzi[a]

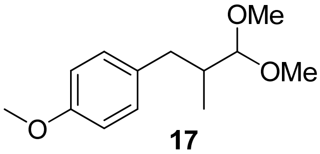
Electronic Supporting Information

For general experimental conditions see paper.



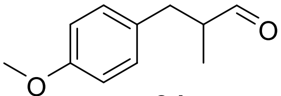
16

(*E*)-1-(3,3-dimethoxy-2-methylprop-1-enyl)-4-methoxybenzene, [(*E*)-16]: trimethyl orthoformate (42 mL, 0.384 mol) and *p*-toluensulfonic acid (0.954 g, 5.1 mmol) were added to a solution of (*E*)-3-(4-methoxyphenyl)-2-methylacrylaldehyde[1] (33.7 g, 0.191 mol) in dry methanol (620 mL) and under nitrogen. The reaction heated at solvent refluxing and followed by tlc (10% of Et_2O in pet. Ether). After 3 h the reaction was cooled at rt and quenched with a saturated aqueous solution of $NaHCO_3$. The solvents distilled under reduced pressure and the residue distilled at 100 °C/0.2 mm to give 24.5 g (57% yield) of acetal (*E*)-**16** as colorless oil. ^{1}H NMR (400 MHz, C_6D_6) δ: 7.23-7.19(*m*, 2H), 6.79-6.75(*m*, 2H), 6.71(*bs*, 1H), 4.56(*bs*, 1H), 3.33(*s*, 3H), 3.21(*s*, 6H), 1.95(*d*, *J* = 1.5Hz, 3H); ^{13}C NMR (100 MHz, C_6D_6) δ: 159.7, 134.0, 131.4, 130.8, 128.9, 114.7, 108.4, 55.4, m53.7, 14.2; IR (film): 2955.1, 2952.4, 2833.5, 1676.4, 1607.2, 1511.5, 1252.1, 1177.4, 1103.4, 1072.1, cm^{-1}.



17

1-(3,3-dimethoxy-2-methylpropyl)-4-methoxybenzene, (17): the acetal **7** (24 g, 108 mmol) dissolved in MeOH (500 mL) was hydrogenated in presence of 10% (w/w) Pd/Al_2O_3 (0.144 g) at rt and atmospheric pressure of hydrogen. After 2 h the catalyst was separated by filtration on celite and the solvent distilled under reduced pressure. The residue distilled at 82 °C/0.2mm to give 23.2 g (95.8% yield) of saturated acetal **17** as colorless oil; ^{1}H NMR (400 MHz, C_6D_6) δ: 7.05-7.01(*m*, 2H), 6.82-6.77(*m*, 2H), 3.98(*d*, *J* = 6.2 Hz, 1H), 3.36(*s*, 3H), 3.17(*s*, 6H), 2.95(*dd*, *J* = 13.5 and 4.6 Hz, 1H), 2.34(*dd*, *J* = 13.5 and 9.3 Hz, 1H), 2.12-2.01(*m*, 1H), 0.96(*d*, *J* = 6.8, 3h); ^{13}C NMR (100 MHz, C_6D_6) δ: 159.2, 133.6, 131.2, 114.8, 108.9, 55.4, 54.4, 54.3, 39.0, 38.4, 14.9; IR (film): 2934.5, 2832.6, 1611.9, 1512.8, 1463.6, 1248.0, 1178.8, 1106.2, 1072.0, 1047.4, cm^{-1}.



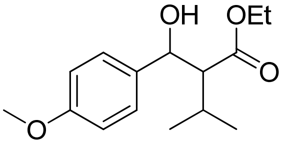
2d

3-(4-methoxyphenyl)-2-methylpropanal, (2d): to a solution of acetal **8** (23.2 g, 103.4 mmol) in THF (310 mL) 6N HCl (103 mL) was added and warmed at 40-50 °C. The reaction monitored by tlc (10% Et_2O in pet. Ether) and after 1 h the quenched with petroleum ether (400 mL) addition. The aqueous phase extracted with petroleum ether (2 x 150 mL) and the organic phases washed with water (3 x 50 mL), brine and dried on Na_2SO_4. The solvents distilled under reduced pressure and the residue

---

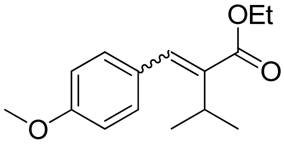
[1] Šunjic, V.; Majerić, M.; Hameršak, Z.; *Croatica Chem Acta* **1996**, 69, 643-660

distilled at 85-86 °C/0.3mm to give 14.5 g (80% yield) of aldehyde **2d** as colorless oil. ^{1}H and ^{13}C NMR are in agreement with those previously reported.[2]



***syn*- and *anti*-18**

Ethyl 2-(hydroxy(4-methoxyphenyl)methyl)-3-methylbutanoate, (*syn*- and *anti*-18): to a solution of di-isopropylamine (4.5 g, 40 mmol) in dry THF (33 mL) cooled to -20 °C BuLi (24.7 mL, 1.6 M in hexane, 39.6 mmol) was added dropwise over a period of 15 min then a solution of ethyl isovalerate (4.84 g, 36.4 mmol) in dry THF (22 mL) was added dropwise in 15 min at -20 °C. After 10 min 4-methoxybenzaldehyde (4.73 g, 34.7 mmol) in dry THF (22 mL) was added and stirred at -20 °C for 45 min. The reaction quenched by addition of saturated aqueous ammonium chloride (27 mL) then extracted with EtOAc (100 mL two times). The organic phase washed, in succession, with HCl (50 mL, 0.5 N), water (50 mL) and brine (50 mL). The organic solution dried on MgSO$_4$ and the solvent distilled under reduced pressure. The residue flash chromatographed (20% to 50% of Et$_2$O in pet. Ether) and then distilled at 128-130 °C/0.2 mm to give 8.52 g (92%) of *syn*- and *anti*-**18** in 7 to 1 ratio. A small amount of isomers were separated by flash chromatography: *syn*-**18**, ^{1}H NMR (400 MHz, CDCl$_3$) δ: 7.26(*m*, 1H), 7.24(*m*, 1H), 6.83(*m*, 1H), 6.81(*m*, 1H), 4.87(*d*, *J* = 8.8 Hz, 1H), 3.91(*dq*, *J* = 7.1 and 0.9 Hz, 2H), 3.77(*s*, 3H), 2.68(*d*, *J* = 8.8 and 4.6 Hz, 1H), 2.54(*bs*, 1H), 2.29(*m*, 1H), 1.04(*d*, *J* = 7.0 Hz, 3H), 1.03(*d*, *J* = 7.0 Hz, 3H), 1.00(*d*, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, CDCl$_3$) δ: 172.7, 159.1, 134.7, 127.8, 113.5, 72.6, 59.8, 58.6, 55.1, 26.7, 21.8, 18.1, 14.0; IR (film): 3476.1, 2962.4, 2935.5, 2875.5, 2836.8, 1727.0, 1612.3, 1513.8, 1249.4, 1177.2, 1031.7, 839.6 cm^{-1}; *anti*-**18**, ^{1}H NMR (400 MHz, CDCl$_3$) δ: 7.25(*m*, 1H), 7.23(*m*, 1H), 6.88(*m*, 1H), 6.86(*m*, 1H), 4.92(*m*, 1H), 4.13-4.01(*m*, 2H), 3.80(*s*, 3H), 3.23(*d*, *J* = 7.5 Hz, 1H), 2.52(*dd*, *J* = 7.5 and 6.2 Hz, 1H), 1.95(*m*, 1H), 1.14(*t*, *J* = 7.1 Hz, 3H), 1.04(*d*, *J* = 6.8 Hz, 3H), 0.93(*d*, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, CDCl$_3$) δ: 174.6, 158.9, 134.5, 127.1, 113.6, 72.3, 60.2, 59.2, 55.1, 27.7, 21.1, 19.5, 14.1; IR (film): 3490.8, 2962.9, 2935.6, 2874.8, 2836.6, 1728.9, 1612.5, 1513.5, 1248.6, 1176.9, 1033.5, 833.8 cm^{-1}.



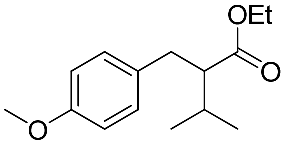
(*E*)- and (*Z*)-19

Ethyl 2-(4-methoxybenzylidene)-3-methylbutanoate, [(*E*)- and (*Z*)-19]: to a solution of **18** (8.2 g, 30.8 mmol) and 4-dimethylaminopyridine (0.210 g, 1.72 mmol) in THF (54 mL), Ac$_2$O (3.32 g mL, 32.5 mmol) was added dropwise at 0 °C. The reaction stirred for 1 h then potassium *tert*-butoxide (10.34 g, 92 mmol) in THF (76 mL) added dropwise in about 30 min at -2 and 0 °C. The cooled reaction stirred for 2 h and quenched by addition of *tert*-butyl methyl ether (130 mL) and ice-water (130 mL). The organic layer separated and the aqueous extracted with *tert*-buthylmethyl ether (130 mL), the combined organic phases washed with water (130 mL), brine (130 mL) and dried on MgSO$_4$. After filtration and solvent distillation, the residue flash chromatographed to give 6.57 g (86%) of (*E*)- and (*Z*)**-19** in 6 to 1 ratio as colorless oil, pe 105-108 °C/0.1 mm. A small amount of isomers were separated by flash chromatography: **(*E*)-19,** ^{1}H NMR (400 MHz, CDCl$_3$) δ: 7.49 (*s*, 1H), 7.28 (*m*, 1H), 7.26 (*m*, 1H), 6.92 (*m*, 1H), 6.89 (*m*, 1H), 4.25 (*q*, *J* = 7.1 Hz, 2H), 3.81 (*s*, 3H), 3.19 (*hept*, *J* = 6.9 Hz, 1), 1.34 (*t*, *J* = 7.1 Hz, 3H), 1.26 (*d*, *J* = 6.9 Hz,, 6H); ^{13}C NMR (100 MHz, CDCl$_3$) δ: 167.9, 159.3, 137.6, 137.2, 130.5, 128.3, 113.7, 60.1, 55.1, 27.4, 21.1, 14.2; IR (film) 2983.2,

---

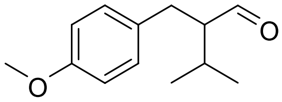
[2] Scrivanti, A.; Bertoldini, M.; Beghetto, V.; Matteoli, U. *Tetrahedron* 2008, **64**, 543-548

2959.7, 2923.0, 2887.9, 2972.3, 1707.2, 1606.2, 1510.3, 1251.0, 1169.7, 1138.6, 1037.4, 829.8, 733,7; (*Z*)**-19,** ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.19 (*m*, 1H), 7.17 (*m*, 1H), 6.83 (*m*, 1H), 6.81 (*m*, 1H), 6.46 (*bs*, 1H), 4.16 (*q*, *J* = 7.2 Hz, 2H), 3.79 (*s*, 3H), 3.19 (*dhept*, *J* = 6.9 and 1.3 Hz, 1), 1.17 (*d*, *J* = 6.9 Hz, 6H), 1.16 (*t*, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 170.7, 159.0, 139.7, 129.3, 128.4, 128.2, 113.5, 60.5, 55.2, 33.3, 21.4, 13.9; IR (film): 2957.8, 29.32.0, 2863,8, 2829.7, 1713.2, 1607.2, 1511.1, 1298.0, 1253.5, 1210.2, 1173.5, 1034.4, 825.6, cm^{-1}.



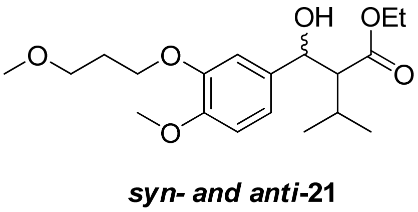
20

Ethyl 2-(4-methoxybenzyl)-3-methylbutanoate, (20): the unsaturated ester **19** (6.37 g, 25.67 mmol) dissolved in EtOH (167 mL) and in presence of 5% Pd on carbon (0.724 g) was hydrogenated at rt and atmospheric pressure of hydrogen. The reaction was complete in 30 min, then after filtration on celite and solvent evaporation under reduced pressure, the residue distilled at 109-111 °C/0.1mm to give 5.835 g (91%) of **20** of colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 7.08 (*m*, 1H), 7.06 (*m*, 1H), 6.80 (*m*, 1H), 6.78 (*m*, 1H), 4.00 (*m*, 2H), 3.77 (*s*, 3H), 2.79 (*d*, *J* = 7.8 Hz, 2H), 2.41 (*m*, 2H), 1.92 (*m*, 1H), 1.10 (*t*, *J* = 7.2 Hz, 3H), 1.02 (*d*, *J* = 6.8 Hz, 3H), 0.97 (*d*, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.9, 157.9, 132.0, 129.7, 113.7, 59.8, 55.2, 55.0, 35.0, 30.6, 20.4, 20.2, 14.2; IR (film): 2961.7, 2835.8, 1728.9, 1612.8, 1513.6, 1247.5, 1177.5, 1154.9, 1036.8, 821.4, cm^{-1}.



2e

2-(4-methoxybenzyl)-3-methylbutanale, (2e): in a dry three-necked flask, equipped with magnetic stirrer bar, was charged with the ester **20** (5.835 g, 23.31 mmol) in dry toluene (95 mL). The solution cooled to -70 °C and DIBAH (17 mL, 1.5 M in toluene, 25.4 mmol) added dropwise under nitrogen over a period of 90 min. The reaction stirred for 45 min until a complete consumption of the starting material (followed by tlc with 10% Et_2O in pet. ether). The reaction quenched at low temperature by MeOH (10 mL) addition then slowly poured into an ice-cold solution of HCl 1M (100 mL) and stirred for 30 min. Separate the aqueous layer and extracted with Et_2O (100 mL), the combined organic phases were washed with water (2 x 20 mL), brine (20 mL) and dried on Na_2SO_4. After solvent evaporation the residue purified by flash chromatography (10 to 30% of Et_2O in pet. Ether) and distilled at 85 °C/1 mm to give 4.09 (85% yield) of aldehyde **2e** as colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 9.68 (*d*, *J* = 2.7 Hz, 1H), 7.08 (*m*, 1H), 7.06 (*m*, 1H), 6.82 (*m*, 1H), 6.79 (*m*, 1H), 3.77 (*s*, 3H), 2.93 (*dd*, *J* = 14.3 and 9.2 Hz, 1H), 2.71 (*dd*, *J* = 14.3 and 5.1 Hz, 1), 2.46 (*m*, 1H), 2.05 (*m*, 1H), 1.04 (*d*, *J* = 4.5 Hz, 3H), 1.02 (*d*, *J* = 4.5 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 205.2, 158.0, 131.5, 129.8, 113.9, 59.9, 55.2, 31.2, 28.2, 19.9, 19.8; IR (film): 2960.8, 2873.6, 2835.7, 2717.6, 1724.0, 1612.1, 1513.2, 1465.2, 1247.9, 1178.4, 1036.2, 911.0, 733.2 cm^{-1}.



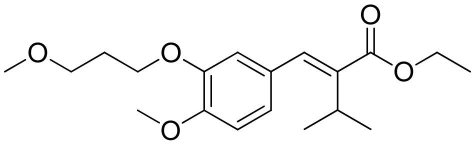
***syn-* and *anti*-21**

Ethyl 2-(4-methoxy-3-(3-methoxpropoxy)benzylidene)-3-methylbutanoate, [*syn*- and anti-21]: the reaction between 4-methoxy-3-(3-methoxypropoxy)benzaldehyde[3] (13.57 g, 60.5 mmol) and ethyl isovalerate (8.6 g, 66.1 mmol) was performed as upon described to prepare the esters **18**. The residue,

---

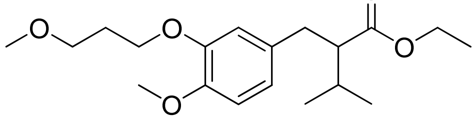
[3] R. R. Göschke, S. Stutz, W. Heinzelmann, J. Maibaum, *Helv. Chim. Acta* 2003, **86**, 2848-2870

as 6 to 1 mixture of *syn/anti* isomers, crystallized from 400 mL of *n*-hexane gave 16.724 g of pure *syn*-**21**. The products recovered from the crystallization, after purification by flash chromatography on silica gel (25% to 40% of EtOAc in petroleum ether), gave 3.846 g of a mixture of esters **21**.[4] Overall, 20.57 g (95.9% yield) of isomeric esters **21** were obtained. *syn*-**12**, white solid mp 73-75 °C; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 6.94 (*d*, J = 1.8 Hz, 1H), 6.88 (*dd*, J = 8.2 and 1.8 Hz, 1H), 6.80 (*d*, J = 8.2 Hz, 1H), 4.88 (*dd*, J = 8.6 and 2.9 Hz, 1H), 4.10 (*t*, J = 6.6 Hz, 2H), 3.95 (*dq*, J = 7.1 and 2.2 Hz, 2H), 3.83 (*s*, 3H), 3.56 (*t*, J = 6.2 Hz, 2H), 3.35 (*s*, 3H), 2.69 (*dd*, J = 8.5 and 4.6 Hz, 1H), 2.45 (*d*, J = 2.9 Hz, 1H), 2.36-2.23 (*m*, 1H), 2.13-2.05 (*m*, 2H), 1.07 (*t*, J = 7.1 Hz, 3H), 1.06 (*d*, J = 7.0 Hz, 3H), 1.00 (*t*, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 172.8, 148.9, 148.2, 135.2, 119.1, 111.6, 111.3, 72.9, 69.3, 66.0, 59.8, 58.6, 58.5, 55.9, 29.5, 26.9, 21.9, 18.1, 14.1; IR (KBr): 3498.3, 2963.7, 2882.0, 2836.4, 1717.6, 1594.2, 1518.7, 1446.1, 9724, 836.8, 821.2 cm^{-1}; *anti*-**21** colorless oil; ^{1}H NMR (400 MHz, $CDCl_3$) δ: 6.89 (*d*, J = 1.8 Hz, 1H), 6.85 (*dd*, J = 8.2 and 1.8 Hz, 1H), 6.82 (*d*, J = 8.2 Hz, 1H), 4.92-4.86 (*m*, 1H), 4.15-4.02 (*m*, 4H), 3.85 (*s*, 3H), 3.57 (*t*, J = 6.2 Hz, 2H), 3.36 (*s*, 3H), 3.28 (*bs*, 1H), 2.53 (*dd*, J = 7.3 and 6.3 Hz, 1H), 2.14-2.06 (*m*, 2H), 2.00-1.88 (*m*, 1H), 1.15 (*t*, J = 7.1 Hz, 3H), 1.04 (*d*, J = 6.8 Hz, 3H), 0.94 (*d*, J = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 174.8, 148.8, 148.4, 135.1, 118.4, 111.4, 110.9, 72.5, 69.3, 66.1, 60.3, 59.1, 58.6, 56.0, 29.5, 27.8, 21.1, 19.6, 14.2; IR (film): 3502.6, 2961.7, 2933.3, 2875.4, 2835.8, 1728.8, 1606.6, 1593.3, 1517.2, 1260.6, 1235.9, 1161.2, 1138.0, 1026.1, cm^{-1}.



(*E*)- *and* (*Z*)-22

Ethyl 2-(4-methoxy-3-(3methoxypropoxy)benzylidene)-3-methylbutanoate, [(*E*)- *and* (*Z*)-22]: a mixture 6 to 1 of isomeric esters *syn*- and *anti*-**21** (19.83 g, 55.9 mmol) was subjected to elimination as upon described to prepare the esters (*E*)- *and* (*Z*)-**19**. A crude unsaturated esters (*E*)- and (*Z*)-**22** (13 to 1 ratio) were purified by flash chromatography (with 20% to 35% ethyl ether in petroleum ether) to give 17.0 g (90% yield) as colorless oil. A small amount of isomeric esters were separated by flash chromatography: (*E*)-**22** isolated as colorless oil, ^{1}H NMR (400 MHz, $CDCl_3$) was identical to previously reported;[5] ^{13}C NMR (100 MHz, $CDCl_3$) δ: 168.0, 149.3, 148.1, 137.9, 137.4, 128.6, 121.9, 114.2, 111.3, 69.2, 66.0, 60.1, 58.6, 55.9, 29.5, 27.5, 21.2, 14.2; IR (film): 2959.3, 2932.1, 2874.0, 2836.3, 1707.6, 1515.0, 1266.2, 1243.1, 1138.7, 1039.1, 808.6, 770.5, cm^{-1}; (*Z*)-**22** isolated as colorless oil, ^{1}H NMR (400 MHz, $CDCl_3$) δ: 6.85-6.76 (*m*, 3H), 6.43 (*bs*, 1H), 4.16 (*q*, J = 7.1 Hz, 2H), 4.08 (*t*, J = 6.5 Hz, 2H), 3.85 (*s*, 3H), 3.56 (*t*, J = 6.2 Hz, 2H), 3.35 (*s*, 3H), 2.73 (*dhept*, J = 6.9 and 1.3 Hz, 1H), 2.09 (*m*, 2H), 1.171 (*d*, J = 6.9 Hz, 6H), 1.170 (*t*, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ: 170.7, 149.0,, 148.0, 140.0, 129.2, 128.1, 121.0, 113.0, 111.3, 69.3, 66.0, 60.5, 58.6, 55.9, 33.3, 29.6, 21.4, 14.0; IR (film): 2960.0, 2927.8, 2872.6, 1715.2, 1515.4, 1464.1, 1358.2, 1268.1, 1242.8, 1215.2, 1141.0, 1029.1, 891.4, 806.3, 770.7, cm^{-1}.



15

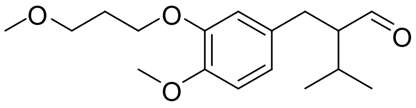
Ethyl 2-(4-methoxy-3-(3-methoxypropoxy)benzyl)-3-methylbutanoate, (15): the hydrogenation of a mixture of (*E,Z*)-**13** (16.7 g, 49.64 mmol) was performed as upon described to prepare the saturated ester **20**. The crude after solvent evaporation was distilled at 155 °C/0.2 mm to give 16.13 g (96%

---

[4] A small amount of pure *anti*-**12** was also obtained

[5] P. Herold, S. Stutz, PCT WO 02/02500 A1 for Speedel Pharma AG.

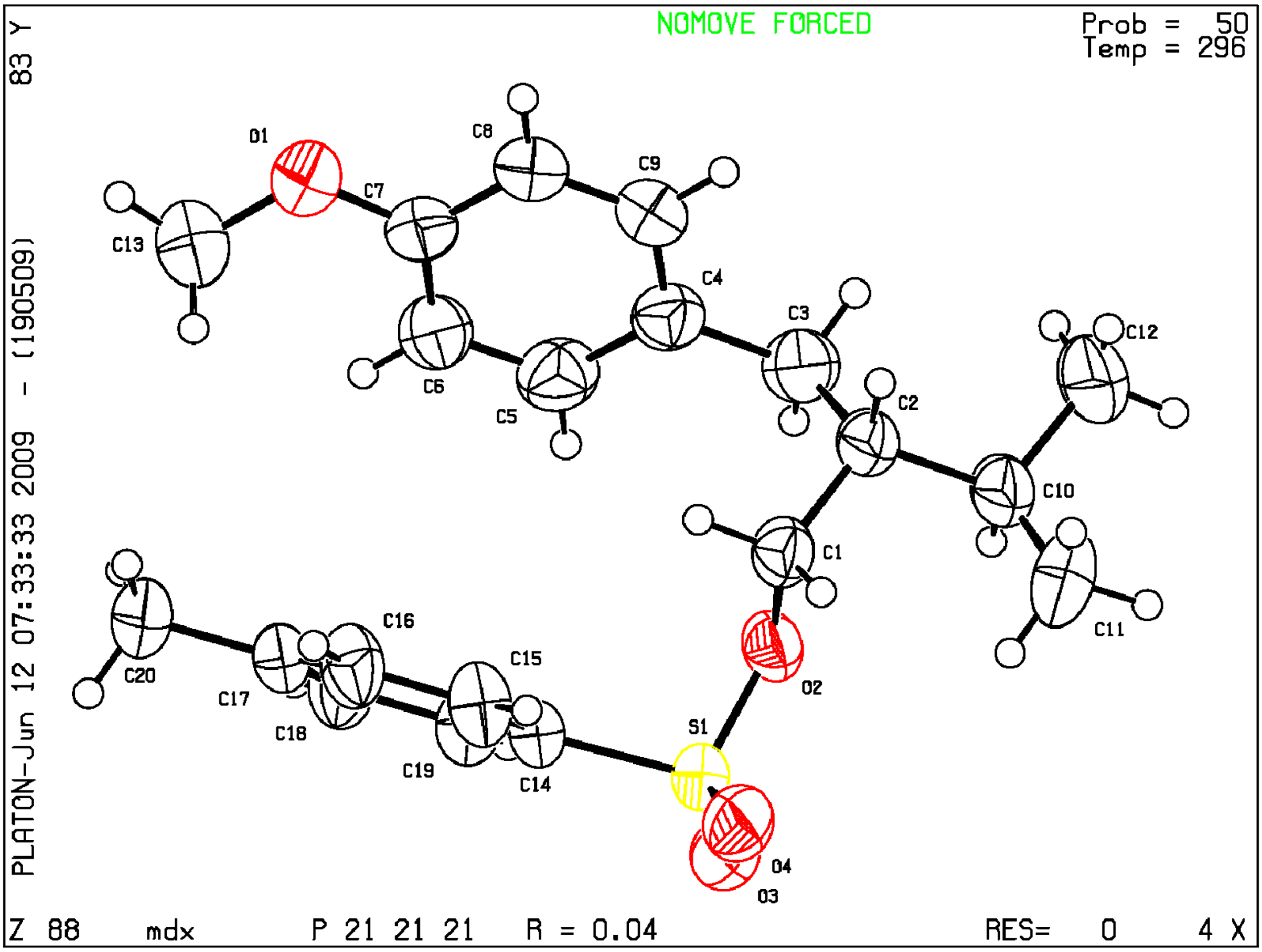
yield) of ester **15** as colorless oil; ^{1}H NMR (400 MHz, CDCl$_3$) δ: 7.76 (*d*, *J* = 8.2 Hz, 1H), 6.71 (*d*, *J* = 1.8 Hz, 1H), 6.69 (*dd*, *J* = 8.2 and 1.8 Hz, 1H), 4.08 (*t*, *J* = 6.5 Hz, 2H), 4.04-3.95 (*m*, 2H), 3.82 (*s*, 3H), 3.57 (*t*, *J* = 6.2 Hz, 2H), 3.35 (*s*, 3H), 2.78 (*d*, *J* = 7.9 Hz, 2H), 2.46-2.39 (*m*, 1H), 2.09 (*m*, 2H), 1.98-1.86 (*m*, 1H), 1.11 (*t*, *J* = 7.2 Hz, 3H), 1.02 (*d*, *J* = 6.7 Hz, 3H), 0.97 (*d*, *J* = 6.7 Hz, 3H); ^{13}C NMR (100 MHz, CDCl$_3$) δ: 174.9, 148.2, 147.8, 132.6, 121.0, 114.0, 111.7, 69.3, 66.0, 59.8, 58.6, 56.0, 54.8, 35.4, 30.6, 29.6, 20.4, 20.1, 14.2; IR (film): 2961.3, 2932.5, 2874.5, 2834.0, 1729.0, 1590.1, 1516.4, 1261.8, 1236.2, 1158.1, 1140.0, 1120.1, 1028.4, 804.5, cm^{-1}.



2f

2-(4-methoxy-3-(3-methoxypropoxy)benzyl)-3-methylbutanal (2f): the reduction of ester **15** (16.5 g, 45.8 mmol) was performed as upon described for ester **11**. After solvent evaporation the residue purified by flash chromatography (petr.ether/Et$_2$O 3:2) and after bulb to bulb distillation at 0.2 mm of pressure, 9.98 g, 74% yield, of aldehyde **2f** was obtained as colorless oil; ^{1}H NMR (400 MHz, CDCl$_3$) δ: 9.68 (*d*, *J* = 2.8 Hz, 1H), 6.77 (*d*, *J* = 8.1 Hz, 1H), 6.71 (*d*, *J* = 2.0 Hz, 1H), 6.69 (*dd*, *J* = 8.1 and 2.0 Hz, 1H), 4.09 (*t*, *J* = 6.5 Hz, 2H), 3.82 (*s*, 3H), 3.57 (*t*, *J* = 6.2 Hz, 2H), 3.36 (*s*, 3H), 2.92 (*dd*, *J* = 14.2 and 9.2 Hz, 1H), 2.70 (*dd*, *J* = 14.2 and 5.0 Hz, 1H), 2.50-2.44 (*m*, 1H), 2.14-1.99 (*m*, 3H), 1.04 (d, *J* = 4.4 Hz, 3H), 1.03 (d, *J* = 4.4 Hz, 3H); ^{13}C NMR (100 MHz, CDCl$_3$) δ: 205.2, 148.4, 147.9, 132.1, 121.0, 114.1, 111.9, 69.3, 66.0, 59.7, 58.6, 56.0, 31.7, 29.6, 28.3, 19.9, 19.8; IR(film): 2950.3, 2931.9, 2874.3, 2834.0, 2723.3, 1722.3, 1607.0, 1590.0, 1515.9, 1464.9, 1442.9, 1261.2, 1236.8, 1140.1, 1120.5, 1027.5 cm^{-1}.

Crystal Data for the tosylate of the alcohol derived from the enriched aldehyde 2e, as obtained after the CIDT procedure



Crystals were obtained from *n*-hexane (mp 71-73 °C).

Molecular formula: $C_{20}H_{26}O_4$ S, M_r = 362.47, Orthorhombic, space group $P2_12_12_1$ (No. 14), a = 9.3439(8), b = 13.2412(11), c = 15.8279(13), V = 1958.3(3) Å^3, T = 298(2) K, Z = 4, ρ_c = 1.229 g cm^{-3}, F(000) = 776, graphite-monochromated Mo$_{K\alpha}$ radiation (λ = 0.71073 Å), μ(Mo$_{K\alpha}$) = 0.186 mm^{-1}, colourless cube (0.3 × 0.3 × 0.3 mm^3), empirical absorption correction with SADABS (transmission factors: 0.9463 – 0.9464), 2400 frames, exposure time 10 s, $2.01 \leq \theta \leq 28.71$, $-12 \leq h \leq 12$, $-17 \leq k \leq 17$, $-20 \leq l \leq 20$, 22553 reflections collected, 4753 independent reflections (R_{int} = 0.0224), solution by direct methods (SHELXS97) and subsequent Fourier syntheses, full-matrix least-squares on F_o^2 (SHELX97), hydrogen atoms refined with a riding model, data / restraints / parameters = 4753/ 0 / 203, $S(F^2)$ = 1.095, $R(F)$ = 0.0406 and $wR(F^2)$ = 0.986 on all data, $R(F)$ = 0.0355 and $wR(F^2)$ = 0.932 for 4281 reflections with $F_0 > 4\sigma(F_0)$, weighting scheme $w = 1/[\sigma^2(F_o^2) + (0.0580P)^2 + 0.1234P]$ where $P = (F_o^2 + 2F_c^2)/3$, largest difference peak and hole 0.202 and –0.261 e Å^{-3}. Flack parameter[a]: 0.01(6) (R configuration at C2). Crystallographic data (excluding structure factors) for the structure reported in this paper have been deposited with the Cambridge Crystallographic Data Centre as supplementary publication no. CCDC-773610. Copies of the data can be obtained free of charge on application to CCDC, 12 Union Road, Cambridge CB21EZ, UK (fax: (+44) 1223-336-033; e-mail: deposit@ccdc.cam.ac.uk).

[a] Flack, H. D. Acta Cryst. **1983**, *A39*, 876-881