The First Highly Enantioselective Homogeneously Catalyzed Asymmetric Reductive Amination: Synthesis of *N*-Benzylamino Acids

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Supporting Information

S1: The members of the selected ligand library and enantioselectivities obtained in the reductive amination of phenylpyruvic acid with benzylamin in presence of ligand and $[\text{Rh}(\text{COD})_2]\text{BF}_4$:

Ligands	% ee
1 (1R,2R)-1,2-Bis[(2-methoxyphenyl)phenylphosphino]ethane	0
2 (2R,3R)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene	73
3 (2S,3S)-2,3-Bis(diphenylphosphino)butane	82
4 (3R,4R)-1-Benzyl-3,4-bis(diphenylphosphino)pyrrolidine	83
5 (R)-[3,4-Dimethylphosphaferrocen-1-yl)methyl]dicyclohexylphosphine	0
6 1,2-Bis((2R,5R)-2,5-dimethylphospholan-1-yl)benzene	27
7 1,2-Bis((2R,5R)-2,5-diethylphospholan-1-yl)benzene	40
8 1,2-Bis((2R,5R)-2,5-di(benzyloxymethyl)phospholan-1-yl)benzene	15
9 1,2-Bis((2R,5R)-2,5-dimethylphospholan-1-yl)ethane	30
10 1,2-Bis((2R,5R)-2,5-diethylphospholan-1-yl)ethane	53
11 (1R,2R)-1,2-Bis-(methylphenylphosphino)benzene	10
12 1,2-Bis[(4R,5S,6S,7R)-4,7-dimethyl-5,6-dimethoxy-1,3,2-dioxaphosphhepan-2-yl]ethane	0
13 (2R)-1,2-Bis(diphenylphosphino)propane	53
14 (2R,4R)-2,4-Bis(diphenylphosphino)pentane	36
15 (S)-1-[2'-(Diphenylphosphino)phenyl]diphenylphosphinoethane	46
16 Methyl 2,3-bis-O-benzyl-4,6-desoxy-4,6-bis-(diphenylphosphino)- α -D-galactopyranoside	0
17 (R)-1-[(1S)-2-(Dicyclohexylphosphino)ferrocenyl]ethylidiphenylphosphine	40
18 (R)-1-[(1S)-2-(Dicyclohexylphosphino)ferrocenyl]ethyldicyclohexylphosphine	25
19 (R)-1-[(1S)-2-(Diphenylphosphino)-ferrocenyl]ethyl-di-tert-butylphosphine	0
20 (R)-1-[(1S)-2-(Diphenylphosphino)ferrocenyl]ethyldicyclohexylphosphine	0
21 (R)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl	27
22 (R)-7-Carboxybutyl-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl	0
23 (R)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl	17
24 (R)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl	0
25 (R)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl	0
26 (2R,3R,5R,6R)-5,6-dimethyl-2,3-bis(diphenylphosphinomethyl)-1,4-dioxane	0
27 (2R,3R,5R,6R)-2,3-Dimethoxy-2,3-dimethyl-5,6-bis(diphenylphosphinomethyl)-1,4-dioxane	37
28 (2R,3R,5R,6R)-2,3-Diethoxy-2,3-dimethyl-5,6-bis(diphenylphosphinomethyl)-1,4-dioxane	20
29 (2S,3S,5R,6R)-2,3-Diethoxy-2,3-dimethyl-5,6-bis(diphenylphosphinomethyl)-1,4-dioxane	0
30 (2S,3S,5R,6R)-2,3-Diethoxy-2,3-dimethyl-5,6-bis[di(3,5-difluoromethylphenyl)phosphinomethyl]-1,4-dioxane	0
31 (1S,2S)-trans-1,2-Bis-(diphenylphosphinomethyl)cyclohexane	20
32 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane	9
33 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2-methyl-2-oxymethyl-1,3-dioxolane	0
34 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2-methyl-2-benzoyloxymethyl-1,3-dioxolane	0
35 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2-(2-oxyphenyl)-1,3-dioxolane	0
36 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2-phenyl-2-oxymethyl-1,3-dioxolane	0
37 (4S,5S)-1,4-Bis[bis(3,5-dimethyl-4-methoxyphenyl)phosphinomethyl]-2,2-dimethyl-1,3-dioxolane	0

38	(1R,2R,3S,4S)-1,2-Bis(diphenylphosphinomethyl)-3,4-diphenylcylobutane	0
39	(1R,2R,3S,4S)-1,2-Bis[di(3,5-dimethylphenyl)phosphinomethyl]-3,4-diphenylcylobutane	0
40	(1R,2R,3S,4S)-1,2-Bis[di(3,5-bis-trifluoromethylphenyl)phosphinomethyl]-3,4-diphenylcylobutane	0
41	(2S,4S)-4-Diphenylphosphino-2-(diphenylphosphinomethyl)pyrrolidine	0
42	(2S,4S)-N-tert-Butoxycarbonyl-4-(diphenylphosphino)-2-(diphenylphosphinomethyl)-pyrrolidine	24
43	(2R,4R)-N-Anilidoxy-4-(diphenylphosphino)-2-(diphenylphosphinomethyl)pyrrolidine	17
44	(2S,3S)-1,4-Bis(diphenylphosphino)-2,3-dioxybutane	0
45	(2R,5R)-2,5-Bis(diphenylphosphino)-1,6-di(benzyloxy)hexane	0
46	(1S)-3-diphenylphosphino-1-(diphenylphosphinomethyl)propylamine	0
47	(1R,2R)-(trans)-1,2-Bis-(diphenylphosphinoxy)cyclohexane	17
48	(1R,2R)-(trans)-1,2-Bis-[di-(2-methylphenyl)phosphinoxy]cyclohexane	0
49	(1R,2R)-(trans)-1,2-Bis-[di-(4-trifluoromethylphenyl)phosphinoxy]cyclohexane	0
50	(1R,2R)-(trans)-1,2-Bis-[di-(3,5-dichlorophenyl)phosphinoxy]cyclohexane	0
51	(1R,2R)-(trans)-1,2-Bis-[di-(3,5-bis-trifluoromethylphenyl)phosphinoxy]cyclohexane	0
52	(1R,2R)-(trans)-1,2-Bis-[di-(3,5-difluorophenyl)phosphinoxy]cyclohexane	0
53	Methyl 2,6-(O)-dibenzoyl-3,4-(O)-bis-[bis-(3,5-dimethylphenyl)phosphino]-β-D-glucopyranoside	0
54	Phenyl 4,6-O-benzylidene-2,3-(O)-bis[[bis-(3,5-dimethylphenyl)phosphino]-β-D-glucopyranoside	5
55	Phenyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-β-D-glucopyranoside	39
56	Phenyl-4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-β-D-glucopyranoside	0
57	Methyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-β-D-glucopyranoside	0
58	Methyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-α-D-glucopyranoside	0
59	Phenyl-4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-α-D-glucopyranosid	0
60	Methyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-β-D-galctopyranoside	0
61	Methyl-4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-β-D-galactopyranoside	0
62	Methyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-α-D-galactopyranoside	0
63	Methyl 4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-α-D-galactopyranoside	0
64	Phenyl 4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-α-D-galactopyranoside	0
65	Phenyl 4,6-O-(p-anisyliden)-2,3-bis-O-(diphenylphosphino)-α-D-galactopyranoside	0
66	(3R,4R)-3,4-Bis(diphenylphosphinoxy)-1-benzylpyrrolidine	0
67	(3R,4R)-3,4-Bis(phenylphosphinoxy)-2,5-dioxo-1-benzylpyrrolidine	0
68	(R)-2-(N-Benzyl-N-diphenylphosphino)amino-1-(diphenylphosphinoxy)butane	0
69	(R)-2-(N-Isopropyl-N-diphenylphosphino)amino-1-(diphenylphosphinoxy)propane	0
70	(2R)-1-[(diphenylphosphino)(cyclopentyl)amino]-methyl-2-diphenylphosphinoxy-3-(1-naphthalenyloxy)propane	11
71	(S)-1-(Diphenylphosphino)-2-(diphenylphosphinoxymethyl)pyrrolidine	0
72	(S)-1-(Dicyclohexylphosphino)-2-(dicyclohexylphosphinoxymethyl)pyrrolidone-5	0
73	(S)-1-(Dicyclohexylphosphino)-2-(dicyclohexylphosphinoxymethyl)pyrrolidine	0
74	(S)-2-(N-Methyl-N-dicyclohexylphosphino)amino-1-(dicyclohexylphosphinoxy)propane	0
75	(1S,3R,4R)-2-Diphenylphosphino-3-diphenylphosphinoxymethyl-2-azabicyclo[2.2.1]heptane	0
76	(R)-2,2'-Bis(diphenylphosphinomethyl)-1,1'-binaphtyl	0
77	(R)-2,2'-Bis(diphenylphosphinoxy)-1,1'-binaphtyl	0
78	(S)-2-[2-(Diphenylphosphino)-phenyl]-4-isopropyl-1,3-oxazoline	0
79	(S)-2-[2-(Diphenylphosphino)-phenyl]-4-isopropyl-4-methyl-1,3-oxazoline	0
80	(S)-2-[2-(Diphenylphosphino)phenyl]-4-tert-butyl-1,3-oxazoline	0
81	(R)-2-[2-(Diphenylphosphino)-phenyl]-4-phenyl-1,3-oxazoline	0
82	(R)-1-(2-Diphenylphosphino-1-naphthyl)-isoquinoline	0
83	(R,R)-2,2"-Bis[(S)-1-(diethylphosphino)ethyl]-1,1"-biferrocene	0
84	(3R,4S)-3-Diisopropylphosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	27
85	(3R,4S)-3-Di(2-tolyl)phosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	3
86	(3R,4S)-3-Dicyclohexylphosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	29
87	(3R,4S)-3-Diphenylphosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	6
88	(3R,4S)-3-Di(2-tolyl)phosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	0
89	(3R,4S)-3-Di(3,5-dimethylphenyl)phosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-	18

	yl}tetrahydrofurane	
90	(3R,4S)-3-Diisopropylphosphinoxy-4-{4-[di(4-fluorophenyl)phosphino]-2,5-dimethylthien-3-yl}tetrahydrofurane	23
91	(3R,4S)-3-Diisopropylphosphinoxy-4-{4-[di(3,5-dimethylphenyl)phosphino]-2,5-dimethylthien-3-yl}tetrahydrofurane	16
92	(3R,4S)-3-Diisopropylphosphinoxy-4-{4-[di(3,5-bis-trifluoromethylphenyl)phosphino]-2,5-dimethylthien-3-yl}tetrahydrofurane	26
93	(3R,4S)-3-Di(3,5-dimethylphenyl)phosphinoxy-4-[4-(di-o-tolylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	22
94	(3R,4S)-3-Diphenylphosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	12
95	(3R,4S)-3-Di(o-tolyl)phosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	22
96	(3R,4S)-3-Di(3,5-dimethylphenyl)phosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	20

S2: The members of the selected ligand library and enantioselectivities obtained in the reductive amination of pyruvic acid with benzylamin in presence of ligand and $[\text{Rh}(\text{COD})_2]\text{BF}_4$:

Ligands	% ee
1 (1R,2R)-1,2-Bis[(2-methoxyphenyl)phenylphosphino]ethane	25
2 (2R,3R)-2,3-Bis(diphenylphosphino)-bicyclo[2.2.1]hept-5-ene	33
3 (2S,3S)-2,3-Bis(diphenylphosphino)butane	57
4 (3R,4R)-1-Benzyl-3,4-bis(diphenylphosphino)pyrrolidine	62
6 1,2-Bis((2R,5R)-2,5-dimethylphospholan-1-yl)benzene	16
7 1,2-Bis((2R,5R)-2,5-diethylphospholan-1-yl)benzene	21
9 1,2-Bis((2R,5R)-2,5-dimethylphospholan-1-yl)ethane	19
10 1,2-Bis((2R,5R)-2,5-diethylphospholan-1-yl)ethane	19
11 (1R,2R)-1,2-Bis-(methylphenylphosphino)benzene	5
13 (2R)-1,2- Bis(diphenylphosphino)propane	47
14 (2R,4R)-2,4-Bis(diphenylphosphino)pentane	23
15 (S)-1-[2'-(Diphenylphosphino)phenyl]diphenylphosphinoethane	9
17 (R)-1-[(1S)-2-(Dicyclohexylphosphino)ferrocenyl]ethylidiphenylphosphine	33
18 (R)-1-[(1S)-2-(Dicyclohexylphosphino)ferrocenyl]ethylidicyclohexylphosphine	20
19 (R)-1-[(1S)-2-(Diphenylphosphino)-ferrocenyl]ethyliditert-butylphosphine	33
20 (R)-1-[(1S)-2-(Diphenylphosphino)ferrocenyl]ethylidicyclohexylphosphine	51
21 (R)-2,2'-Bis(diphenylphosphino)-1,1'-binaphthyl	29
22 (R)-7-Carboxybutyl-2,2'-bis(diphenylphosphino)-1,1'-binaphthyl	4
23 (R)-2,2'-Bis(di-p-tolylphosphino)-1,1'-binaphthyl	1
24 (R)-2,2'-Bis(diphenylphosphino)-6,6'-dimethoxy-1,1'-biphenyl	0
25 (R)-2,2'-Bis(di-p-tolylphosphino)-6,6'-dimethoxy-1,1'-biphenyl	0
31 (1S,2S)-trans-1,2-Bis-(diphenylphosphinomethyl)cyclohexane	12
32 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2,2-dimethyl-1,3-dioxolane	15
33 (4S,5S)-4,5-Bis(diphenylphosphinomethyl)-2-methyl-2-oxymethyl-1,3-dioxolane	2
37 (4S,5S)-1,4-Bis[bis(3,5-dimethyl-4-methoxyphenyl)phosphinomethyl]-2,2-dimethyl-1,3-dioxolane	2
41 (2S,4S)-4-Diphenylphosphino-2-(diphenylphosphinomethyl)pyrrolidine	13
42 (2S,4S)-N-tert-Butoxycarbonyl-4-(diphenylphosphino)-2-(diphenylphosphinomethyl)-pyrrolidine	17
47 (1R,2R)-(trans)-1,2-Bis-(diphenylphosphino)oxy)cyclohexane	0
53 Methyl 2,6-(O)-dibenzoyl-3,4-(O)-bis-[bis-(3,5-dimethylphenyl)phosphino]-β-D-glucopyranoside	0
54 Phenyl 4,6-O-benzylidene-2,3-(O)-bis[bis-(3,5-dimethylphenyl)phosphino]-β-D-glucopyranoside	5
55 Phenyl 4,6-O-benzylidene-2,3-bis(O-diphenylphosphino)-β-D-glucopyranoside	39
66 (3R,4R)-3,4-Bis(diphenylphosphino)oxy)-1-benzylpyrrolidine	0
67 (3R,4R)-3,4-Bis(phenylphosphino)oxy)-2,5-dioxo-1-benzylpyrrolidine	0
68 (R)-2-(N-Benzyl-N-diphenylphosphino)amino-1-(diphenylphosphino)oxy)butane	0
69 (R)-2-(N-Isopropyl-N-diphenylphosphino)amino-1-(diphenylphosphino)oxy)propane	0
70 (2R)-1-[(diphenylphosphino)(cyclopentyl)amino]-methyl-2-diphenylphosphinoxy-3-(1-naphthalenyloxy)propane	0
71 (S)-1-(Diphenylphosphino)-2-(diphenylphosphinoxymethyl)pyrrolidine	0
84 (3R,4S)-3-Diisopropylphosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	0
85 (3R,4S)-3-Di(2-tolyl)phosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	7
86 (3R,4S)-3-Dicyclohexylphosphinoxy-4-[4-(diphenylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	18
87 (3R,4S)-3-Diphenylphosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	0
88 (3R,4S)-3-Di(2-tolyl)phosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	7
89 (3R,4S)-3-Di(3,5-dimethylphenyl)phosphinoxy-4-[4-(di(4-fluorophenyl)phosphino)-2,5-dimethylthien-3-yl]-tetrahydrofuran	2
90 (3R,4S)-3-Diisopropylphosphinoxy-4-[4-[di(4-fluorophenyl)phosphino]-2,5-dimethylthien-3-yl]-tetrahydrofuran	14
91 (3R,4S)-3-Diisopropylphosphinoxy-4-[4-[di(3,5-dimethylphenyl)phosphino]-2,5-dimethylthien-3-yl]-tetrahydrofuran	18
92 (3R,4S)-3-Diisopropylphosphinoxy-4-[4-[di(3,5-bis-trifluoromethylphenyl)phosphino]-2,5-dimethylthien-3-yl]-tetrahydrofuran	9

	yl}tetrahydrofurane	
93	(3R,4S)-3-Di(3,5-dimethylphenyl)phosphinoxy-4-[4-(di-o-tolylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	0
94	(3R,4S)-3-Diphenylphosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	9
95	(3R,4S)-3-Di(o-tolyl)lphosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	0
96	(3R,4S)-3-Di(3,5-dimethylphenyl)lphosphinoxy-4-[4-(dicyclohexylphosphino)-2,5-dimethylthien-3-yl]-tetrahydrofurane	0

S3: Analytical data of chiral amino acids obtained:

(S)-N-Benzyl phenylalanine (2a): ^1H NMR ($\text{D}_2\text{O}/5\%\text{H}_2\text{SO}_4$) δ 3.03 (dd, $J = 13.2$, Hz, $J = 9.2$ Hz, 1H), 3.32 (bd, $J = 13.2$ Hz, 1H), 4.09 (dd, $J = 9.7$ Hz, $J = 4.7$ Hz, 1H), 4.12 (AB, $J = 13.2$ Hz, 1H), 4.20 (AB, $J = 13.2$ Hz, 1H), 7.20 – 7.45 (m, 10H). ee 98% $[\alpha]_{\text{D}}^{24} +41.1$ (c 1, AcOH) [lit., 1 (R)-isomer $[\alpha]_{\text{D}}^{23} -40$ (c 1, AcOH)].

(S)-N-Benzyl alanine (2b): ^1H NMR ($\text{dmso-d}_6/2\%\text{H}_2\text{SO}_4$) δ 1.48 (d, $J = 7.3$ Hz, 3H), 3.98 (q, $J = 7.3$ Hz, 1H), 4.12 (AB, $J = 13.1$ Hz, 1H), 4.17 (AB, $J = 13.1$ Hz, 1H), 7.41 – 7.43 (m, 5H). ee 78% $[\alpha]_{\text{D}}^{25} +3.2$ (c 1, 2N HCl) [lit., 2 $[\alpha]_{\text{D}}^{24} 3.9$ (c 1, 6N HCl)].

(R)-N-Benzyl phenylglycine (2c): ^1H NMR ($\text{D}_2\text{O}/5\%\text{H}_2\text{SO}_4$) δ 3.94 (AB, $J = 13.1$ Hz, 1H), 4.00 (AB, $J = 13.1$ Hz, 1H), 4.91 (s, 1H), 7.18 – 7.34 (m, 10H). ee 19% $[\alpha]_{\text{D}}^{25} -17$ (c 1, AcOH) [lit., 1 (S)-isomer $[\alpha]_{\text{D}}^{23} +90$ (c 1, AcOH)].

(S)-N-Benzyl glutamic acid (2d): ^1H NMR ($\text{dmso-d}_6/2\%\text{H}_2\text{SO}_4$) δ 2.04 (dt, $J = 8.2$ Hz, $J = 14.5$ Hz, 1H), 2.15 (dt, $J = 7.1$ Hz, $J = 13.6$ Hz, 1H), 2.34 (dt, $J = 17.0$ Hz, $J = 7.8$ Hz, 1H), 2.46 (dt, $J = 6.3$, Hz, $J = 8.6$ Hz, 1H), 3.94 (dd, $J = 7.9$ Hz, $J = 5.1$ Hz, 1H), 4.12 (AB, $J = 13.1$ Hz, 1H), 4.17 (AB, $J = 13.1$ Hz, 1H), 7.42 – 7.44 (m, 5H). ee 60% $[\alpha]_{\text{D}}^{24} +10.3$ (c 1, 6N HCl) [lit., 3 $[\alpha]_{\text{D}}^{22} +18.5$ (c 1, 6N HCl)].

N-Benzyl benzylalanine (2f): ^1H NMR ($\text{dmso-d}_6/1\%\text{H}_2\text{SO}_4$) δ 2.08 – 2.17 (m, 2H), 2.55 – 2.59 (m, 1H), 2.69 – 2.75 (m, 1H), 3.85 (dd, $J = 7.2$ Hz, $J = 4.9$ Hz, 1H), 4.12 (AB, $J = 13.2$ Hz, 1H), 4.16 (AB, $J = 13.2$ Hz, 1H), 7.15 – 7.28 (m, 10H). ee 81% $[\alpha]_{\text{D}}^{27} +32.2$ (c 1, AcOH).

(S)-N-Benzyl leucine (2g): ^1H NMR ($\text{dmso-d}_6/1\%\text{H}_2\text{SO}_4$) δ 0.86 (d, $J = 4.4$ Hz, 3H), 0.87 (d, $J = 4.7$ Hz, 3H), 1.70 (m, 2H), 3.81 (t, $J = 6.5$ Hz, 1H), 4.12 (AB, $J = 13.1$ Hz, 1H), 4.20 (AB, $J = 13.1$ Hz, 1H), 7.41 – 7.49 (m, 5H). ee 90% $[\alpha]_{\text{D}}^{26} +34.2$ (c 1, AcOH) [lit., 1 (R)-isomer $[\alpha]_{\text{D}}^{23} -38$ (c 1, AcOH)].

(S)-N-Benzyl tert-butylalanine (2h): ^1H NMR ($\text{dmso-d}_6/1\%\text{H}_2\text{SO}_4$) δ 0.89 (s, 9H), 1.77 (m, 2H), 3.75 (d, $J = 6.7$ Hz, 1H), 4.07 (AB, $J = 13.1$ Hz, 1H), 4.17 (AB, $J = 13.1$ Hz, 1H), 7.43 – 7.45 (m, 5H). ee 86% $[\alpha]_{\text{D}}^{26} +11.2$ (c 1, AcOH).

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