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Kinetic Resolution of 2-Acylated-1,2-Diols by Lipase-Catalyzed Enantiomer Selective Acylation

Gabriella Egri[a], Eszter Baitz-Gács[b], László Poppe[b]*

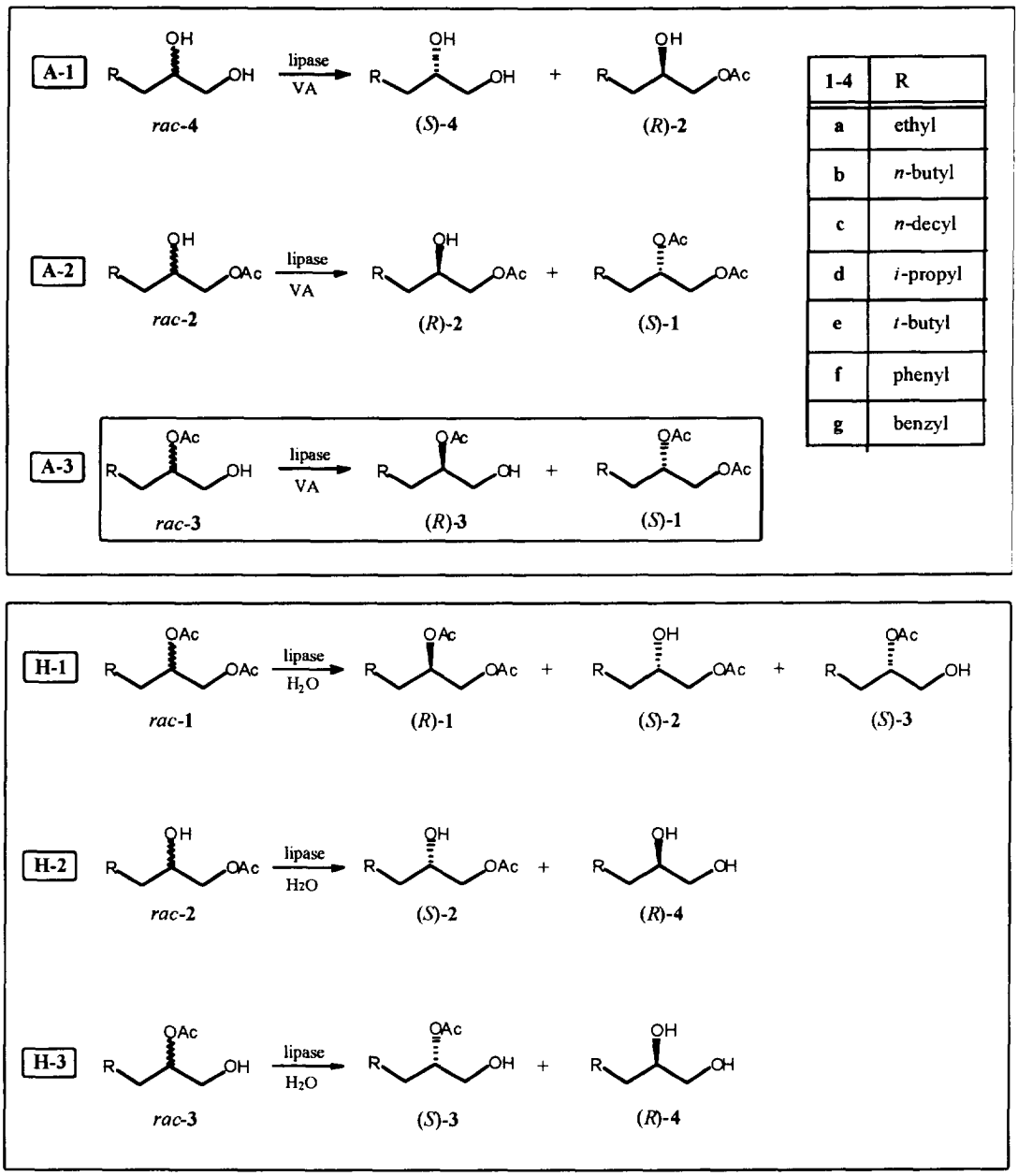
[a] Department for Organic Chemical Technology, Technical University Budapest, H-1521 Budapest, P.O. Box 91, HUNGARY
[b] Central Research Institute for Chemistry, Hungarian Academy of Sciences, H-1525 Budapest, P.O. Box 17, HUNGARY

Abstract: Enantiomer selectivity of lipase catalyzed acylation of 2-acylated 1,2-diols was studied. First, acylation of 2-acetoxyheptan-1-ol rac-3b with vinyl acetate was investigated by varying the enzyme and the solvent, showing the highest enantiomer selectivity by using lipase from Pseudomonas fluorescens (PfL) in hexane-vinyl acetate (VA). We have found varying or even reversed enantiomer selectivity for different secondary acyl moieties in 2-acyloxyheptan-1-ols rac-3bA-F. Next, all six possible types of enantiomer selective biotransformations (hydrolysis of diacetate and the two kinds of monoacetetes; acylation of diol and the two kinds of monoacetates) were compared on two model diols rac-4b,d. Among the transformations investigated, acetylation of secondary monoacetates rac-3b,d showed the highest enantiomer selectivity. Finally, PfL catalyzed acetylations of several 2-acetylated 1,2-diols rac-3a-g were investigated under our optimum conditions.

Optically active 1,2-diols are widely used as synthetic building blocks for numerous natural products, pharamaceuticals and fine chemicals. Manufacture of these diols in enantiomerically highly enriched form has primary importance, since the two enantiomers of these compounds may possess markedly different biological activities, e.g. while the active enantiomer of pheromone brevicomin contains 1,2-dioxy-butane subunit with the *R* configuration, the other enantiomer shows inhibitory properties[1]. Consequently, enantiomer selective biotransformations of 1,2-diol derivatives have been the subject of many recent interests.

The usefulness of hydrolases, especially lipases, for enantiomer and regioselective transformation of diols and related compounds is well known[2,3]. Enzymatic biotransformations of 1,2-diol derivatives have been extensively studied: lipase-catalyzed acylation (transesterification) of racemic 1,2-diols[4-13] or primary acetates of 1,2-diols[3,13] were chosen as a tool for kinetic resolution in most studies. Hydrolysis[14,15] or alcoholysis[16] of 1,2-diol diacetates, however, have also been investigated. Generally, very high regioselectivity preferring the primary hydroxyl group along with a variable but a usually low degree of enantiomer selectivity has been observed by the lipase-catalyzed acylations of 1,2-diols[3]. The further enzymatic acetylation of the primary acetate products proved to be a slower but a more enantiomer selective process[3,13]. In contrast, hydrolysis of 1,2-diol diacetates proceeded with moderate regioselectivity but the enantiomer selectivity was significantly higher than for acylation of the corresponding 1,2-diol with the same enzyme[15]. This observation, that acylation of the 1,2-diols proved to be less enantiomer selective than the hydrolysis of the corresponding diacetate, suggested us that the size and/or characteristics of the substituent at C_2 plays a crucial role in enantiomer selectivity. Based on this hypothesis, we expected a higher enantiomer selectivity in biotransformations of 2-acetates than those of the corresponding enzymatic reactions of derivatives with free 2-hydroxy group.

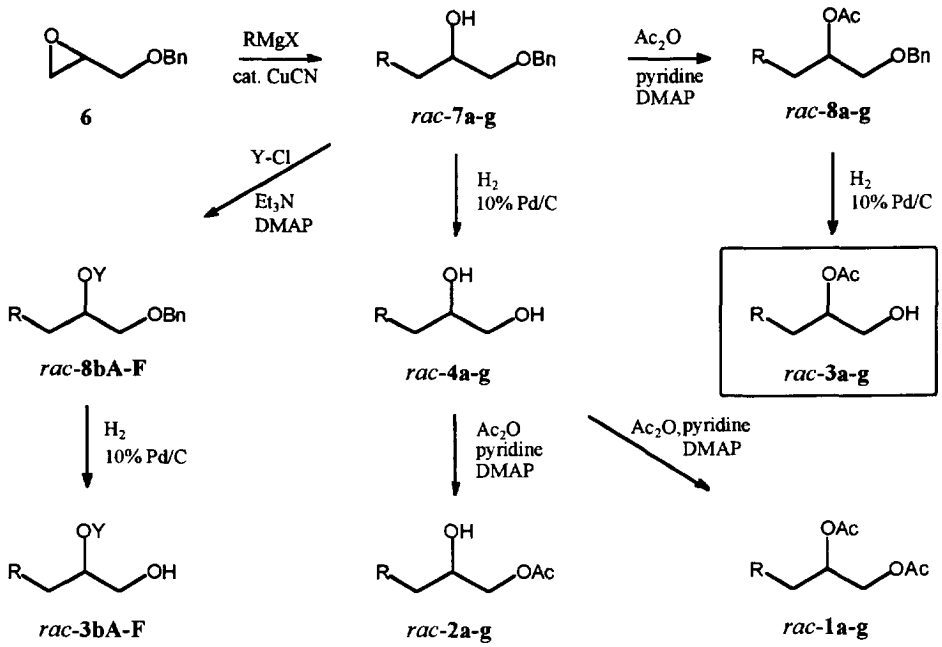
These remarkable differences in selectivities between different enzymatic reactions of 1,2-diols and their acetate derivatives prompted us to test our above hypothesis and compare the enantiomer selectivities of all the possible lipase-catalyzed kinetic resolutions (acetylations **A1-3** and hydrolyses **H1-3**) of these diol derivatives (Scheme 1).



1-4	R
a	ethyl
b	*n*-butyl
c	*n*-decyl
d	*i*-propyl
e	*t*-butyl
f	phenyl
g	benzyl

Scheme 1. Lipase-catalyzed enantiomer selective biotransformations of 1,2-diol derivatives (*rac*-**1-4**)

Preparation of the *rac*-1,2-diols *rac*-**4a-g**and their acetate derivatives (Scheme 2) were based on the corresponding 1-benzyloxy-2-alkanols *rac*-**7a-g** which were prepared from racemic benzyl glycidyl ether **6** and the corresponding Grignard reagents[17]. The secondary monoacetates *rac*-**3a-g** were obtained *via* acetylation of the secondary alcohols *rac*-**7a-g** followed by hydrogenolysis. 2-Acylated heptane-1,2-diols *rac*-**3bA-F** were also synthesized in an analogous manner.



Scheme 2. Preparation of the *rac*-1,2-diol derivatives utilized in the present study

First, the selectivity of several lipases in acetylation of 2-acetyloxy-heptan-1-ol *rac*-**3b** with vinyl acetate was investigated (Method **A-3** in Scheme 1, Table 1).

Table 1. Acetylation of racemic 2-acetoxy-heptan-1-ol *rac*-**3b** with different enzymes

Enzyme[a] (mg)	Time[b] (h)	c (%)	(*R*)-**3b** Y(%)	Diol from (*R*)-**3b** $[\alpha]_D$	ee(%)	(*S*)-**1b** Y(%)	Diol from (*S*)-**1b** $[\alpha]_D$	ee(%)	E_{SP}[c]
PfL (5)	1.1	46	52	+8.8	43	40	-8.8	43	3.8
PPL (30)	4.6	55	33	+5.7	28	40	-5.4	26	2.2
MjL (30)	120	19	78	+1.4	7	18	-6.1	30	2.0
CcL (30)	5.3	54	39	+3.3	16	46	-4.4	22	1.8
PLE (50)	20	48	31	+2.9	14	29	-3.0	15	1.5
AnL (30)	20	46	49	-0.2	1[d]	41	+0.3	2[d]	1.0
RaL (30)	[e]	-	-	-	-	-	-	-	-

[a] PPL: lipase from porcine pancreas, CcL: lipase from *Candida rugosa (cylindracea)*, PfL: lipase from *Pseudomonas fluorescens*, PLE: esterase from pig liver (acetone powder), AnL: lipase from *Aspergilus niger*, MjL: lipase from *Mucor javonicus*, RaL: lipase from *Rhisopus arrhisus*, [b] *rac*-**3b** (200 mg) and the given amount of enzyme were stirred in vinyl acetate (2 ml) at RT. [c] E values (E_{SP}) were calculated from an equation[18] containing the enantiomeric excesses of substrate (S) and product (P). Determination of enantiomeric excess values: *i.*) transformation of S and P into the corresponding 1,2-diols, *ii.*) ^{1}H-NMR investigation of di-MTPA-esters prepared from the 1,2-diols and (*R*)-MTPA-Cl in pyridine/CCl_4. [d] Configuration is opposite to the products obtained with other enzymes. [e] The reaction proved to be extremely slow in comparison with other enzymes

Lipase from *Pseudomonas fluorescens* (PfL) was choosen for the further study, since this enzyme showed both the highest enantiomer selectivity and efficacy among the lipases tested.

Next, the solvent effect on enantiomer selectivity of acetylation of racemic 2-acetoxy-heptan-1-ol *rac*-**3b** with PfL was investigated. Interestingly, no correlation between the solvent polarity (logP) and enantiomer selectivity was found. In this solvent effect study, the inhibitory behaviour of chloroform was also

quite surprising. The best selectivities were obtained in neat vinyl acetate or with hexane as solvent, therefore, this hexane-vinyl acetate 1:1 system was applied in further acylations.

Table 2. Effect of solvent on acetylation of racemic 2-acetoxy-heptan-1-ol *rac*-**3b** with PfL

Solvent	Time[a] (h)	c (%)	(*R*)-**3b** Y(%)	Diol from (*R*)-**3b** $[\alpha]_D$	ee(%)	(*S*)-**1b** Y(%)	Diol from (*S*)-**1b** $[\alpha]_D$	ee(%)	E_{SP}[b]
chloroform	[c]	-	-	-	-	-	-	-	-
tert-butanol	6.75	71	27	+3.2	16	68	-2.3	11	1.4
carbon tetrachloride	4.75	66	34	+3.4	17	67	-2.6	13	1.5
diethylether	4.75	64	32	+4.7	23	58	-5.0	25	2.0
2-methyltetrahydrofuran	4	46	44	+5.2	26	38	-6.3	31	2.4
ethyl acetate	120	34	60	+4.7	23	38	-7.7	38	2.7
tetrahydrofuran	8.25	40	46	+3.0	15	31	-8.4	41	2.8
hexane[d]	3.55	42	52	+5.1	25	37	-8.1	40	2.9
hexane	6.75	54	41	+5.4	26	49	-8.3	41	3.0
hexane-vinyl acetate 1:1	1.3	55	38	+9.9	49	48	-8.1	40	3.7
vinyl acetate	1.1	46	47	+8.8	43	40	-8.8	43	3.8

[a] *rac*-**3b** (200 mg), vinyl acetate (5 mmol) and PfL (5 mg) were stirred at RT in the solvent given in Table. [b] E value calculated from he enantiomeric excesses of substrate (S) and product (P)[18] (see also Table 1). [c] The reaction proved to be extremely slow in omparison with other solvents. [d] Saturated with water

We thought it also worthwhile to investigate the influence of structural features of the 2-acyl moiety on the enantiomer selectivity of the PfL-catalyzed acylation process. Our study with a series of racemic 2-acyloxy-heptan-1-ols *rac*-**3bA-F**; synthesis: (Scheme 2) showed a strong correlation between the size of the acyl moiety in the 2-position and the degree of enantiomer selectivity: a decrease in selectivity (E_{SP}) along with the increasing bulkiness was observed. In the case of acylation of the very bulky pivaloyl derivative *rac*-**3bF**, even a reversal in enantiomer preference was found, deduced from the observed (*R*) configuration of the diol **3b** obtained after hydrolysing the product **5*F**.

Table 3. Effect of 2-acyl moiety (Y) on acetylation of racemic 2-acyloxy-heptan-1-ols *rac*-**3bA-F** by PfL

	Y	Time[a] (h)	c (%)	**3b*** **A-F** Y(%)	Diol **3b*** $[\alpha]_D$	from **A-F** ee(%)	**5*A-F** Y(%)	config.	Diol **5*** $[\alpha]_D$	from **A-F** ee(%)	E_{SP}[b]
A	acetyl	1.3	55	39	+9.9	49	48	***S***	-8.1	40	3.6
B	propionyl	4	31	55	+4.0	20	25	***S***	-8.7	43	3.0
C	trifluoroacetyl	120	32	57	+3.8	19	26	***S***	-8.4	41	2.9
D	phenylacetyl	2.1	34	61	+1.3	6	31	***S***	-2.5	6	1.4
E	benzoyl	3.5	49	45	0	0	43		0	0	1.0
F	pivaloyl	4	45	53	-1.2	6	42	***R***	+0.7	4	1.1

[a] *rac*-**3bA-F** (1 mmol) and PfL (5 mg) were stirred in a solution of vinyl acetate (1 ml) and hexane (1 ml) at RT, [b] E value calculated rom the enantiomeric excesses of substrate (S) and product (P) [18] (see also Table 1).

For testing our starting hypothesis on the crucial role of the 2-acetyl moiety in enantiomer selectivity, derivatives of two different diols - the straight-chain heptan-1,2-diol *rac*-**4b** and the branched-chain 4-methylpentan-1,2-diol *rac*-**4d** - were chosen as models. All six possible types of biotransformations - the three possible kinds of enzymatic transesterifications, such as acetylation of diols *rac*-**4b,d**; method **A-1**, acetylation of primary monoacetates *rac*-**2b,d**; method **A-2**, and acetylation of secondary monoacetates *rac*-**3b,d**; method **A-3** , and the three possible kinds of enzymatic hydrolyses, namely hydrolysis of diacetates *rac*-**1b,d**; method **H-1**, hydrolysis of primary monoacetates *rac*-**2b,d**; method **H-2**, hydrolysis of secondary

monoacetates *rac*-**3b,d**; method **H-3** - were compared in this study (Scheme 1, Table 4). Acetylations were carried out under our standard conditions using vinyl acetate (VA) as an "irreversible" transesterifying reagent and lipase from *Pseudomonas fluorescens* (PfL) and hydrolyses were performed in water at a constant pH of 7.2.

Table 4. Lipase catalyzed enantiomer selective hydrolyses (Methods **H-1,2,3**) and acetylations (Methods **A-1,2,3**) of 1,2-diol derivatives (*rac*-**1-4a,b**)

Substrate	Method [a]	Time (h)	c (%)	S [b] Y(%)	diol from $[\alpha]_D$	S ee(%)	P [c] Y(%)	diol $[\alpha]_D$	from P ee(%)	E_{SP} [d]
rac-**1b**	**H-1**	0.66	51	40	+3.1	15	36	-2.7	13	1.5
rac-**2b**	**H-2**	3.15	53	45	-2.7	13	46	+2.8	14	1.5
rac-**3b**	**H-3**	5.3	63	15	-4.5	22	49	+1.1	5	1.3
rac-**4b**	**A-1**	0.75	24	67	-0.5	3	21	+1.9	9	1.2
rac-**2b**	**A-2**	432	44	52	+5.7	28	41	-7.0	34	2.6
rac-**3b**	**A-3**	1.33	55	39	+9.9	49	48	-8.1	40	3.6
rac-**1d**	**H-1**	3.3	39	45	+9.1	30	42	-9.7	32	2.5
rac-**2d**	**H-2**	13	20	64	-0.1	0	14	+1.1	4	1.1
rac-**3d**	**H-3**	25	24	60	-0.3	1	21	+1.4	5	1.1
rac-**4d**	**A-1**	3	51	44	-9.9	32	46	+9.5	31	2.6
rac-**2d**	**A-2**	192	29	59	+6.6	22	24	-14.1	46	3.3
rac-**3d**	**A-3**	1.75	41	53	+17.3	57	37	-30.2	99	>100

[a] **Methods H-1,2,3** (cf. Scheme 1): Racemic substrate (1 mmol) and PfL (5 mg) were stirred in water at RT and the pH was kept at 7.2 by addition of 0.05 M NaOH solution from an autoburette. **Methods A-1,2,3** (cf. Scheme 1): Racemic substrate (1 mmol) and PfL (5 mg) were stirred in a solution of vinyl acetate (1 ml) and hexane (1 ml) at RT. Products of the reactions were isolated by separation on silica gel with a hexane-acetone eluent. [b] S: remaining fraction of racemic substrate, [c] P: product(s) of enzymatic transformation, [d] E values (E_{SP}) were calculated from an equation[18] containing the enantiomeric excesses of substrate (S) and product (P) (c.f. Table 1).

Results of the test reactions (Table 4) indicate that, according to our expectations, the highest enantiomer selectivity can be obtained in enzymatic acetylation of the secondary monoacetates *rac*-**3b,d** (Method **A-3**). Interestingly, this process proved to be not only the most selective but one of the fastest as well. In accordance with the previous observations, acetylation of the diols *rac*-**4b,d** (Method **A-1**) proved to be a fast, highly regioselective but less enantiomer selective reaction. Considering this high regioselectivity toward the primary hydroxylic group in lipase-catalyzed acetylation, sluggishness of the acetylation of primary monoacetates *rac*-**2b,d** (Method **A-2**) is not surprising. Among the hydrolytic processes, hydrolysis of the diacetates *rac*-**1b,d** (Method **H-1**) proved to be the fastest and most selective. In accordance with our previous findings in hydrolysis of 1,2-diol diacetates[15], no acyl migration was found either in hydrolyses or acylations[19].

Interestingly, not only the measure but the sense of the enantiomer selectivity of these lipase-catalyzed biotransformations were substrate-dependent. Reversal in enantiomer preference was observed in both series; within hydrolyses the moderate *S*-enantiomer preference of diacetate hydrolysis (Method **H-1**) turned to a slight *R*-preference in hydrolyses of monoacetates (Methods **H-2,3**), while in transesterifications the moderate *R*-enantiomer preference of diol acetylation (Method **A-1**) changed to a higher degree of *S*-enantiomer selectivity in acetylations of monoacetates (Methods **A-2,3**). It is noteworthy, that similar process-dependent change in stereoselectivity, was observed in *Pseudomonas cepacia* lipase-catalyzed hydrolyses and acetylations of 1-O- and 3-O-β-D-glucosyl- and galactosyl-*sn*-glycerols[20].

Finally, dependence of the enantiomer selectivity of PfL-catalyzed acylations of secondary monoacetates *rac*-**3a-g** on the structural features of the 1,2-diol skeleton was investigated. For this study, typical representives of secondary monoacetates having straight-chain alkyl *rac*-**3a-c**, branched-chain alkyl *rac*-**3d,e**, and arylalkyl *rac*-**3f,g** side-chains were prepared. The racemic substrates were then subjected to

PfL-catalyzed reaction under our standard conditions. Results of these reactions (Table 5) indicate that for high enantiomer selectivity a bulky side chain (entries **d-f**) is required. The non-branched substrates (entries **a-c,g**) gave only moderate selectivities indicating that branching in β-position to the acetoxy moiety is essential for good enantiomer differentiation. This finding, that bulkiness of the side chain of 1,2-diols plays a crucial role in enantiomer selectivity, is in agreement with the previous results on acetylation of 1,2-diols or primary monoacetates[3,12,13].

Table 5. Effect of side-chain (R) on acetylation of racemic 2-acetylated 1,2-diols (*rac*-**3a-g**) with PfL

	R	$[\alpha]_{D\ diol}$ (100%ee)[a]	Time[b] (h)	c (%)	(*R*)-**3** Y(%)	diol from $[\alpha]_D$	(*R*)-**3** ee(%)	(*S*)-**1** Y(%)	diol from $[\alpha]_D$	(*S*)-**1** ee(%)	E_{SP}[c]
a	ethyl	21.7	2.25	42	32	+10.5	48	23	-13.2	60	7.0
b	*n*-butyl	20.4	1.3	55	39	+9.9	49	48	-8.1	40	4.4
c	*n*-decyl	13.4	8	40	41	+5.6	42	27	-7.2	54	4.5
d	*i*-propyl	30.6	1.75	41	53	+17.3	57	37	-30.2	>98	>100
e	*t*-butyl	27.9	3.3	43	52	+22.7	81	39	-27.9	>98	>100
f	phenyl	29.6	3	38	57	+18.9	67	34	-29.0	>98	>100
g	benzyl	30.8	9	51	43	+12.9	42	46	-13.6	44	3.8

[a] Extrapolated values calculated from specific rotation of diols and from the corresponding enantiomeric excess values obtained from ^{1}H-NMR spectra of di-MTPA-esters of the 1,2-diols. Absolute configuration of the 1,2-diols (**4a-d,f,,g**) was determined by comparison with literature rotation values {$[\alpha]_D$ (c, solvent)} of compounds having known absolute configuration: (*S*)-**4a**: -23.2 (1, ethanol)[21], -19.2 (2, ethanol)[22], (*R*)-**4a**: +17.4 (2, ethanol)[2]; (*S*)-**4b**: -20.6 (1, ethanol)[21], (*S*)-**4c**: -10.1 (1.2, methanol)[23], (*R*)-**4c**: +10.1 (1.18, methanol)[23]; (*S*)-**4d**: -31.5 (1, ethanol)[21], (*R*)-**4d**: +13.82 (neat)[24]; (*S*)-**4f**: -36 (1, ethanol)[25], (*R*)-**4f**: +23 (1.03, $CHCl_3$)[26]; (*S*)-**4g**: -34.1 (1, ethanol)[21]. (*S*)-configuration for (-)-**4e** is assumed by analogy with the other members of 1,2-diol series. [b] *rac*-**3** (1 mmol) and PfL (5 mg) were stirred in a solution of vinyl acetate (1 ml) and hexane (1 ml) at RT. [c] E values (E_{SP}) were calculated from an equation[18] containing the enantiomeric excesses of substrate (S) and product (P) (c.f. Table 1).

In summary, it can be concluded that acetylation of the easily accessible 2-acetates of 1,2-diols proved to be the best alternative among the six possible types of lipase-catalyzed kinetic resolutions of racemic 1,2-diol derivatives both with respect to enantiomer selectivity and productivity. Lipase-catalyzed acetylation seems to be an ideal choice for obtaining homochiral products from racemic 2-acylated 1,2-diol derivatives having bulkiness in β-position to the acetoxy moiety.

EXPERIMENTAL.

The ^{1}H-NMR spectra were taken on JEOL FX-100 (100 MHz) or Brucker AW-80 (80 MHz) spectrometers in $CDCl_3$ solution containing TMS as internal standard. Enantiomeric purity determinations (cf. Table 1, note c) using di-(*S*)-MTPA esters of the corresponding diols were carried out in $CDCl_3$ solution on a Varian VXR-400 (400 MHz) NMR-equipment. IR spectra were recorded on a Specord 2000 spectrometer. Optical rotations were determined on a Perkin Elmer 241 polarimeter. Thin-layer chromatography (TLC) was made using Merck Kieselgel 60 F_{254} alumina sheets. Spots were visualized by treatment with 3% ethanolic phosphomolybdic acid solution and heating of the dried plates. Preparative vacuum-chromatography[27] was performed using Merck Kieselgel 60 F_{254}. The 1-benzyloxy-alkan-2-ols *rac*-**7a-g** were prepared by a published procedure[17]. Porcine pancreatic lipase (PPL, Type II) was obtained from Sigma. Lipases from *Candida rugosa (cylindracea)* (CcL), *Pseudomonas fluorescens* (PfL), *Aspergilus niger* (AnL), *Mucor javonicus* (MjL), *Rhisopus arrhisus* (RaL), esterase from pig liver (PLE, acetone powder), acetic anhydride, and vinyl acetate were products of FLUKA. All solvents used were freshly distilled.

PREPARATION OF 2-ACYLATED 1-BENZYLATED 1,2-DIOLS *rac*-**8a-g** AND *rac*-**8bB-F**

General procedure: 1-Benzylated-1,2-diol *rac*-**7a-g**, 10 mmol, pyridine (30 mmol, 2.4 ml), and catalytic amount of dimethylaminopyridine were dissolved in hexane and dichloromethane (10 ml, each) followed by a dropwise addition of the corresponding acyl chloride or anhydride (15 mmol) at room temperature. The mixture was kept at 45°C until TLC investigation showed no remaining starting material (20-90 minutes). The

resulting mixture was then diluted with diethyl ether (10 ml) and washed with 5% hydrochloric acid (2x10 ml), saturated $NaHCO_3$ solution (10 ml), and brine (10 ml). The organic phase was dried over Na_2SO_4 and solvents were evaporated off *in vacuo*.

*rac-2-Acetoxy-1-benzyloxypentan rac-***8a**

(Ac_2O) *Yield*: 91%, *^1H NMR* ($CDCl_3$, δ ppm): 0.90 (m, 3H, CH_3), 1.51 (mc, 4H, $2CH_2$), 2.03 (s, 3H, CO-CH_3), 3.48 (mc, 2H, OCH_2), 4.53 (s, 2H, O-CH_2-Ph), 4.9-5.2 (m, 1H, OCH), 7.20-7.34 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3030 (w), 2960, 2872, 1738, 1496 (w), 1454, 1372, 1241, 1106, 1055, 1026, 944, 908, 736; Calcd. for $C_{14}H_{20}O_3$: C 71.16, H 8.53; found: C 70.80, H 8.56.

*rac-2-Acetoxy-1-benzyloxyheptan rac-***8b**

(Ac_2O) *Yield*: 98%, *^1H NMR* ($CDCl_3$, δ ppm): 0.93 (m, 3H, CH_3), 1.24 (mc, 4H, $2CH_2$), 2.02 (s, 3H, CO-CH_3), 3.44 (mc, 2H, OCH_2), 4.57 (s, 2H, O-CH_2-Ph), 4.9-5.2 (m, 1H, OCH), 7.20-7.37 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3030 (w), 2956, 2931, 2860, 1738, 1496, 1454, 1372, 1242, 1112, 1027, 943, 906, 735; Calcd. for $C_{16}H_{24}O_3$: C 72.69, H 9.15; found: C 72.98, H 9.08.

*rac-2-Acetoxy-1-benzyloxytridecan rac-***8c**

(Ac_2O) *Yield*: 95%, *^1H NMR* ($CDCl_3$, δ ppm): 0.87 (m, 3H, CH_3), 1.23 (mc, 20H, $10CH_2$), 2.03 (s, 3H, CO-CH_3), 3.44 (d, 2H, OCH_2), 4.48 (s, 2H, O-CH_2-Ph), 4.9-5.2 (m, 1H, OCH), 7.21-7.34 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3030 (w), 2925, 2860, 1740, 1496 (w), 1454, 1371, 1240, 1118, 1096, 1027, 902; Calcd. for $C_{22}H_{36}O_3$: C 75.82, H 10.41; found: C 76.35, H 10.50.

*rac-2-Acetoxy-1-benzyloxy-4-methylpentane rac-***8d**

(Ac_2O) *Yield*: 94%, *^1H NMR* ($CDCl_3$, δ ppm): 0.92-0.98 (d, 6H, $2CH_3$), 1.50 (mc, 3H, CH_2, CH), 2.04 (s, 3H, CO-CH_3), 3.45 (d, 2H, OCH_2), 4.52 (s, 2H, O-CH_2-Ph), 5.0-5.3 (m, 1H, OCH), 7.19-7.35 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3060 (w), 3030 (w), 2957, 2869, 1737, 1496, 1469, 1454, 1371, 1240, 1115, 1026, 947, 908, 736; Calcd. for $C_{15}H_{22}O_3$: C 71.97, H 8.86; found: C 71.61, H 8.92.

*rac-2-Acetoxy-1-benzyloxy-4,4-dimethylpentane rac-***8e**

(Ac_2O) *Yield*: 96%, *^1H NMR* ($CDCl_3$, δ ppm): 0.87 (m, 9H, $3CH_3$), 1.49 (mc, 2H, CH_2), 2.00 (s, 3H, CO-CH_3), 3.41 (d, 2H, OCH_2), 4.44 (s, 2H, O-CH_2-Ph), 5.05-5.38 (m, 1H, OCH), 7.21-7.35 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3030 (w), 2955, 2906, 2867, 1737, 1496 (w), 1476, 1453, 1371, 1240, 1204 (w), 1125, 1095, 1052, 1024, 944, 736; Calcd. for $C_{16}H_{24}O_3$: C 72.69, H 9.15; found: C 72.11, H 9.10.

*rac-2-Acetoxy-1-benzyloxy-4-phenylpropane rac-***8f**

(Ac_2O) *Yield*: 81%, *^1H NMR* ($CDCl_3$, δ ppm): 2.04 (s, 3H, CO-CH_3), 2.89 (m, 2H, Ar-CH_2) , 3.44 (d, 2H, OCH_2) ,4.53 (s, 2H, O-CH_2-Ph), 5.02-5.20 (m, 1H, OCH), 7.0-7.5 (m, 10H, $2C_6H_5$); *IR* (film, ν cm^{-1}): 3063 (w), 3029, 2933, 2863, 1826, 1737, 1604, 1496, 1454, 1372, 1239, 1124, 1097, 1050, 1029, 958, 896, 747; Calcd. for $C_{18}H_{20}O_3$: C 76.03, H 7.09; found: C 75.88, H 7.14.

*rac-2-Acetoxy-1-benzyloxy-4-phenylbutane rac-***8g**

(Ac_2O) *Yield*: 96%, *^1H NMR* ($CDCl_3$, δ ppm): 2.01 (s, 3H, CO-CH_3), 2.44-2.78 (m, 4H, 2CH2), 3.51 (d, 2H, OCH_2), 4.46 (s, 2H, O-CH_2-Ph), 4.9-5.2 (m, 1H, OCH), 7.0-7. 2 (m, 10H, $2C_6H_5$); *IR* (film, ν cm^{-1}): 3062 (w), 3027, 2933, 2862, 1737, 1603 (w), 1496, 1454, 1372, 1240, 1126, 1099, 1044, 1028, 907 (w), 737; Calcd. for $C_{19}H_{22}O_3$: C 76.48, H 7.43; found: C 76.10, H 7.42.

*rac-1-Benzyloxy-2-propionyloxyheptane rac-***8bB**

(C_2H_5COCl) *Yield*: 85%, *^1H NMR* ($CDCl_3$, δ ppm): 0.86 (m, 3H, CH_3), 0.96-1.48 (m, 11H, $4CH_2$, CH_3), 2.33 (q, 2H, OOC-CH_2), 3.42 (d, 2H, O-CH_2), 4.55 (s, 2H, O-CH_2-Ph), 4.87-5.20 (m, 1H, OCH), 7.18-7.32 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 2956, 2932, 2860, 1737, 1496, 1454, 1367, 1274, 1189, 1112, 1082, 905, 734; Calcd. for $C_{17}H_{26}O_3$: C 73.35, H 9.41; found: C 73.94, H 9.34.

*rac-1-Benzyloxy-2-(trifluoroacetyl)oxyheptane rac-***8bC**

[$(CF_3CO)_2O$] *Yield*: 85%, *^1H NMR* ($CDCl_3$, δ ppm): 0.89 (m, 3H, CH_3), 1.06-1.62 (m, 8H, $4H_2$), 3.58 (d, 2H, O-CH_2), 4.49 (s, 2H, O-CH_2-Ph), 5.0-5.2 (m, 1H, O-CH), 7.18-7.38 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 2959,

2933, 2863, 1785, 1455, 1386, 1342, 1222, 1167, 1110, 1028 (w), 867, 732; Calcd. for $C_{16}H_{21}F_3O_3$: C 60.37, H 6.65, F 17.90; found: C 60.61, H 6.70, F 17.88.

*rac-1-Benzyloxy-2-(phenylacetyl)oxyheptane rac-***8bD**

($C_6H_5CH_2COCl$) *Yield*: 84%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.82 (m, 3H, CH_3), 1.01-1.61 (m, 8H, $4CH_2$), 3.6 (m, 4H, O-CH_2, O(O)C-CH_2-Ph), 4.21 (s, 2H, O-CH_2-Ph), 4.85-5.20 (m, 1H, O-CH), 7.1-7.4 (m, 10H, $2C_6H_5$); *IR* (film, ν cm^{-1}): 2955, 2930, 2859, 1734, 1496, 1454, 1364, 1257, 1159, 1111, 1029, 908; Calcd. for $C_{22}H_{28}O_3$: C 77.61, H 8.29; found: C 77.92, H 8.35.

*rac-2-Benzoyloxy-1-benzyloxyheptane rac-***8bE**

(C_6H_5COCl) *Yield*: 95%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.86 (m, 3H, CH_3), 1.08-1.67 (m, 8H, $4CH_2$), 3.62 (d, 2H, O-CH_2), 4.52 (s, 2H, O-CH_2-Ph), 5.17-5.41 (m, 1H, O-CH), 7.12-7.54 (m, 10H, $2C_6H_5$); *IR* (film, ν cm^{-1}): 2955, 2930, 2859, 1790, 1716, 1601, 1495, 1452, 1364, 1314, 1274, 1212, 1175, 1106, 1070, 1026, 997, 936; Calcd. for $C_{21}H_{26}O_3$: C 77.27, H 8.03; found: C 77.81, H 7.99.

*rac-1-Benzyloxy-2-pivaloyloxyheptane rac-***8bF**

[$(CH_3C)_3CCOCl$] *Yield*: 82%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.86 (m, 3H, CH_3), 1.17 (s, 9H, $3CH_3$), 1.27-1.41 (m, 8H, $4H_2$), 3.48 (d, 2H, O-CH_2), 4.52 (s, 2H, O-CH_2-Ph), 4.85-5.17 (m, 1H, O-CH), 7.20-7.38 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 2957, 2932, 2861, 1810, 1728, 1496 (w), 1480, 1455, 1366, 1283, 1164, 1111, 1042, 1006, 940, 735; Calcd. for $C_{19}H_{30}O_3$: C 74.47, H 9.87; found: C 74.77, H 9.80.

PREPARATION OF 2-ACYLATED 1,2-DIOLS *rac-***3a-g** AND *rac-***3bB-F**

General procedure: To a suspension of 10 % Pd-C catalyst (100 mg) in isopropyl alcohol (20-30 ml), 7-10 mmol of the corresponding 1-benzylated-2-acylated-1,2-diol (*rac-***8a-g** or *rac-***8bB-F**) was added and the suspension was vigorously stirred under hydrogen atmosphere at 40°C for 1-3.5 hours. The catalyst was then filtered off and the solvent was evaporated *in vacuo*. The oily residue was purified by column chromatography with hexane:acetone.

*rac-2-Acetoxypentan-1-ol rac-***3a**

Yield: 72%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.95 (m, 3H, CH_3), 1.42 (mc, 4H, $2CH_2$), 2.06 (s, 3H, CO-CH_3), 3.63 (mc, 2H, OCH_2), 4.8-5.1 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3446 (bc), 2960, 2930, 2875, 1738, 1713, 1470, 1435, 1375, 1242, 1126, 1050, 1029, 955; Calcd. for $C_7H_{14}O_3$: C 57.51, H 9.65; found: C 57.22, H 9.59.

*rac-2-Acetoxyheptan-1-ol rac-***3b**

Yield: 75%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.92 (m, 3H, CH_3), 1.38 (mc, 4H, $2CH_2$), 2.06 (s, 3H, CO-CH_3), 3.72 (mc, 2H, OCH_2), 4.8-5.1 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3442 (bc), 2955, 2932, 2861, 1739, 1461, 1375, 1242, 1047, 956; Calcd. for $C_9H_{18}O_3$: C 62.04, H 10.41; found: C 62.47, H 10.34.

*rac-2-Acetoxytridecan-1-ol rac-***3c**

Yield: 70%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.83 (m, 3H, CH_3), 1.20 (mc, 20H, $10CH_2$), 2.04 (s, 3H, CO-CH_3), 3.63 (mc, 2H, OCH_2), 4.78-5.0 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3452 (bc), 2924, 2854, 1965, 1740, 1719, 1466, 1374, 1241, 1055, 941, 891; Calcd. for $C_{15}H_{28}O_3$: C 69.72, H 11.70; found: C 70.14, H 11.72.

*rac-2-Acetoxy-4-methylpentan-1-ol rac-***3d**

Yield: 74%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.92-0.98 (d, 6H, $2CH_3$), 1.50 (mc, 3H, CH_2, CH), 2.07 (s, 3H, CO-CH_3), 3.62 (mc, 2H, OCH_2), 4.8-5.1 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3446 (bc), 2958, 2872, 1739, 1713, 1470, 1432, 1372, 1241, 1171, 1145, 1067, 1025, 952, 879, 820; Calcd. for $C_8H_{16}O_3$: C 59.98, H 10.07; found: C 59.80, H 9.99.

*rac-2-Acetoxy-4,4-dimethylpentan-1-ol rac-***3e**

Yield: 81%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.87 (m, 9H, $3CH_3$), 1.41 (mc, 2H, CH_2), 2.01 (s, 3H, CO-CH_3), 3.55 (mc, 2H, OCH_2), 4.84-5.16 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3446 (bc), 2955, 2896, 2871, 1736, 1476, 1430 (w), 1368, 1242, 1198, 1083, 1046, 1023, 944, 910; Calcd. for $C_9H_{18}O_3$: C 62.04, H 10.41; found: C 61.92, H 10.43.

*rac-2-Acetoxy-3-phenylpropan-1-ol rac-***3f**

Yield: 65%, ^1H *NMR* ($CDCl_3$, δ ppm): 2.00 (s, 3H, CO-CH_3), 3.61 (mc, 2H, OCH_2), 4.04 (m, 2H, Ph-CH_2), 4.92-5.20 (m, 1H, OCH), 7.05-7.32 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3445 (bc), 3062, 3028, 2937, 1736, 1604, 1496, 1454, 1431, 1374, 1241, 1086, 1033, 943, 749; Calcd. for $C_{11}H_{14}O_3$: C 68.02, H 7.27; found: C 68.22, H 7.23.

*rac-2-Acetoxy-4-phenylbutan-1-ol rac-***3g**

Yield: 79%, ^1H *NMR* ($CDCl_3$, δ ppm): 2.00 (s, 3H, CO-CH_3), 2.47-2.82 (m, 2H, CH2), 3.71 (mc, 2H, OCH_2), 4.02 (m, 2H, Ph-CH_2), 4.86-5.02 (m, 1H, OCH), 7.00-7.32 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3443 (bc), 3026, 2948, 1737, 1608 (w), 1496, 1454, 1371, 1244, 1096, 1043, 950, 915; Calcd. for $C_{12}H_{16}O_3$: C 69.21, H 7.74; found: C 68.93, H 7.71.

*rac-2-Propionyloxyheptan-1-ol rac-***3bB**

Yield: 79%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.87 (m, 3H, CH_3), 1.06-1.57 (m, 11H, $4CH_2$, CH_3), 2.3 (q, 2H, O(O)C-CH_2), 3.81 (d, 2H, O-CH_2), 4.90-5.06 (m, 1H, OCH); *IR* (film, ν cm^{-1}): 3446 (bc), 2956, 2932, 2860, 1737 1463, 1423, 1378, 1342, 1276, 1190, 1125 (w), 1083, 1021, 920, 889, 806; Calcd. for $C_{10}H_{20}O_3$: C 63.80, H 10.71; found: C 64.25, H 10.75.

*rac-2-(Trifluoroacetyl)oxyheptan-1-ol rac-***3bC**

Yield: 81%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.84 (m, 3H, CH_3), 1.02-1.51 (m, 8H, $4H_2$), 3.64 (d, 2H, O-CH_2), 5.1 (mc, 1H, O-CH); *IR* (film, ν cm^{-1}): 3355 (bc), 2960, 2935, 2863, 1788, 1460, 1382, 1345, 1260, 1223, 1170, 1074, 867, 812, 776, 730; Calcd. for $C_9H_{15}F_3O_3$: C 47.37, H 6.62, F 24.97; found: C 46.95, H 6.59, F 25.19.

*rac-2-(Phenylacetyl)oxyheptan-1-ol rac-***3bD**

Yield: 88%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.91 (m, 3H, CH_3), 1.04-1.47 (m, 8H, $4CH_2$), 3.58 (s, 2H, Ph-CH_2), 3.67 (d, 2H, O-CH_2), 4.71-4.98 (m, 1H, O-CH), 7.03-7.40 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3442 (bc), 2955, 2930, 2860, 1733, 1496, 1454, 1259, 1161, 1075, 964, 910; Calcd. for $C_{15}H_{22}O_3$: C 71.97, H 8.86; found: C 71.68, H 8.85.

*rac-2-Benzoyloxyheptan-1-ol rac-***3bE**

Yield: 83%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.92 (m, 3H, CH_3), 1.05-1.74 (m, 8H, $4CH_2$), 3.79 (d, 2H, O-CH_2), 4.96-5.22 (m, 1H, O-CH), 7.05-7.44 (m, 5H, C_6H_5); *IR* (film, ν cm^{-1}): 3462 (bc), 2955, 2931, 2860, 1717, 1602, 1451, 1359, 1276, 1177, 1115, 1096, 1070, 1026, 936; Calcd. for $C_{14}H_{20}O_3$: C 71.16, H 8.53; found: C 71.44, H 8.54.

*rac-2-Pivaloyloxyheptan-1-ol rac-***3bF**

Yield: 74%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.88 (m, 3H, CH_3), 1.18 (s, 9H, $3CH_3$), 1.22-1.43 (m, 8H, $4H_2$), 3.62 (d, 2H, O-CH_2), 4.77-4.98 (m, 1H, O-CH); *IR* (film, ν cm^{-1}): 3447 (bc), 2958, 2933, 2872, 2072 (b), 1729, 1708, 1538 (w), 1481, 1461, 1398, 1367, 1285, 1164, 1093, 1061, 1034, 938, 893, 770; Calcd. for $C_{12}H_{24}O_3$: C 66.63, H 11.18; found: C 66.36, H 11.15.

PREPARATION OF 1,2-DIOLS *rac-***4b,d**

General procedure: To a suspension of 10 % Pd-C catalyst (100 mg) in isopropyl alcohol (20-30 ml), 7-10 mmol of the corresponding 1-benzylated -1,2-diol (*rac-***7b,d**) was added and the suspension was vigorously stirred under hydrogen atmosphere at 40°C for 2-3 hours. The catalyst was then filtered off and the solvent was evaporated *in vacuo*. The oily residue was purified by column chromatography on silica gel with hexane:acetone=1:1.

*rac-Heptan-1,2-diol rac-***4b**

Yield: 89%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.94 (m, 3H, CH_3), 1.41 (mc, 4H, $2CH_2$), 3.4-3.8 (m, 3H, O-CH, O-CH_2); *IR* (film, ν cm^{-1}): 3356 (bc), 2955, 2931, 2860, 1466, 1378, 1133, 1072, 1032, 938, 871; Calcd. for $C_7H_{16}O_2$: C 63.60, H 12.20; found: C 64.11, H 12.22.

*rac-4-Methylpentan-1,2-diol rac-***4d**

Yield: 85%, ^1H *NMR* ($CDCl_3$, δ ppm): 0.87 (d, 6H, $2CH_3$), 1.21 (q, 2H, CH_2), 1.77 (mc, 1H, O-CH), 3.4-3.9 (m, 3H, O-CH, O-CH_2); *IR* (film, ν cm^{-1}): 3355 (bc), 2956, 2930, 2871, 1469, 1386, 1368, 1220, 1171, 1145, 1071, 1028, 948, 920, 882, 842, 734; Calcd. for $C_6H_{14}O_2$: C 60.98, H 11.94; found: C 60.61, H 11.86.

PREPARATION OF 1-ACETYLATED 1,2-DIOLS *rac*-**2b,d**

General procedure: The corresponding 1,2-diol *rac*-**4b,d**, (10 mmol), pyridine (25 mmol, 2.4 ml), and catalytic amount of dimethylaminopyridine were dissolved in hexane (10 ml) followed by a dropwise addition of acetic anhydride (10 mmol, 0.95 ml) at room temperature. The mixture was then stirred at room temperature until TLC investigation showed no remaining starting material (20-90 minutes). The resulting mixture was then diluted with diethyl ether (10 ml) and washed with 5% hydrochloric acid (2x10 ml), saturated $NaHCO_3$ solution (10 ml), and brine (10 ml). The organic phase was dried over Na_2SO_4 and solvents were evaporated off *in vacuo*. The residue was purified by column chromatography on silica gel with hexane-acetone.

rac-1-Acetoxyheptan-2-ol rac-**2b**

Yield: 69%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.92 (t, 3H, CH_3), 1.2-1.6 (m, 8H, $4H_2$), 2.08 (s, 3H, CO-CH_3), 3.8-4.1 (m, 3H, O-CH_2, O-CH); *IR* (film, ν cm^{-1}): 3447 (bc), 2956, 2933, 2860, 1742, 1458, 1371, 1241, 1137, 1041, 944, 916; Calcd. for $C_9H_{18}O_3$: C 62.04, H 10.41; found: C 62.35, H 10.47.

rac-1-Acetoxy-4-methylpentan-2-ol rac-**2d**

Yield: 77%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.97 (d, 6H, $2CH_3$), 1.19-1.41 (m, 3H, CH_2-CH), 2.06 (s; 3H, CO-CH_3), 3.97 (mc, 3H, O-CH, O-CH_2); *IR* (film, ν cm^{-1}): 3454 (bc), 2957, 2871 (w), 1741, 1469, 1369, 1241, 1171, 1149, 1038, 981, 950, 921; Calcd. for $C_8H_{16}O_3$: C 59.98, H 10.07; found: C 60.22, H 10.08.

PREPARATION OF 1,2-DIOL DIACETATES *rac*-**1b,d**

General procedure: The corresponding 1,2-diol *rac*-**4b,d**, (10 mmol), pyridine (50 mmol, 4.0 ml), and catalytic amount of dimethylaminopyridine were dissolved in hexane (10 ml) followed by a dopwise addition of acetic anhydride (25 mmol, 2.4 ml) at room temperature. The mixture was kept at 40°C for 20 minutes and the resulting mixture was then diluted with diethyl ether (10 ml) and washed with 5% hydrochloric acid (2x10 ml), saturated $NaHCO_3$ solution (10 ml), and brine (10 ml). The organic phase was dried over Na_2SO_4 and solvents were evaporated off *in vacuo*. The remaining oil was purified by column chromatography on silica gel with hexane-acetone.

rac-1,2-Diacetoxyheptane rac-**1b**

Yield: 72%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.84 (t, 3H, CH_3), 1.16-1.38 (m, 8H, $4H_2$), 2.01 (s, 3H, CO-CH_3), 4.1 (mc, 2H, O-CH_2), 4.85-5.10 (m, 1H, O-CH); *IR* (film, ν cm^{-1}): 2957, 2933, 2862, 1744, 1461, 1371, 1243, 1227, 1126 (w), 1096, 1048, 958, 873; Calcd. for $C_{11}H_{20}O_3$: C 61.09, H 9.32; found: C 60.60, H 9.30.

rac-1,2-Diacetoxy-4-methylpentane rac-**1d**

Yield: 75%, *^{1}H NMR* ($CDCl_3$, δ ppm): 0.96 (d, 6H, $2CH_3$), 1.2-1.6 (m, 3H, CH_2-CH), 2.02 (s; 6H, 2CO-CH_3), 3.8-4.3 (m, 2H, O-CH_2), 4.95-5.15 (m, 1H, O-CH); *IR* (film, ν cm^{-1}): 2959, 2873 (w), 1745, 1558 (w), 1506 (w), 1471, 1431, 1372, 1227, 1097, 1045, 1026, 952, 890; Calcd. for $C_{10}H_{18}O_3$: C 59.39, H 8.97; found: C 58.97, H 9.00.

ACETYLATION OF RACEMIC 2-ACETOXY-HEPTAN-1-OL *rac*-**3b** WITH DIFFERENT ENZYMES

General procedure: Racemic 2-acetoxyheptan-1-ol *rac*-**3b** (200 mg) and enzyme were stirred in vinyl acetate (2 ml) at room temperature. After reaching a reasonable conversion (for conversions and reaction times see Table 1) enzyme was filtered off and solvent was evaporated. The residue was subjected to column chromatography on silica gel with hexane-acetone resulting pure diacetate (**1b**) and monoacetate (**3b**) fractions. Spectral data for optically active compounds have not differed significantly from that obtained for the corresponding racemic compounds. Data for type of enzyme (amount of enzyme), **1b**: % yield, **3b**: % yield, are given below. (For determination of absolute configuration and enantiomeric purity *via* the corresponding 1,2-diol, see Table 1 and Experimental, Section on enantiomeric purity determination.)

PfL (5), (*R*)-**3b**: 52, (*S*)-**1b**: 40; PPL (30), (*R*)-**3b**: 55, (*S*)-**1b**: 40; MjL (30), (*R*)-**3b**: 78, (*S*)-**1b**: 18; CcL (30), (*R*)-**3b**: 54, (*S*)-**1b**: 46; PLE (50), (*R*)-**3b**: 48, (*S*)-**1b**: 29; AnL (30), **3b**: 46, **1b**: 41.

ACETYLATION OF RACEMIC 2-ACETOXY-HEPTAN-1-OL *rac*-**3b** IN DIFFERENT SOLVENTS

General procedure: Racemic 2-acetoxyheptan-1-ol *rac*-**3b** (200 mg), vinyl acetate (5 mmol) and PfL (5 mg) were stirred in the given solvent (2 ml) at room temperature. After reaching a reasonable conversion (for conversions and reaction times, see Table 2) PfL enzyme was filtered off and solvent was evaporated. The

further work up and analysis of products were carried out as described in the previous section. Data for solvent, (*R*)-**3b**: % yield, (*S*)-**1b**: % yield, are given below.

Chloroform, no reasonable conversion; *tert*-butanol, (*R*)-**3b**: 27, (*S*)-**1b**: 68; carbon tetrachloride, (*R*)-**3b**: 34, (*S*)-**1b**: 67; diethyl ether, (*R*)-**3b**: 32, (*S*)-**1b**: 58; 2-methyltetrahydrofuran, (*R*)-**3b**: 46, (*S*)-**1b**: 38; ethyl acetate, (*R*)-**3b**: 60, (*S*)-**1b**: 38; tetrahydrofuran, (*R*)-**3b**: 46, (*S*)-**1b**: 31; hexane (satd. with water), (*R*)-**3b**: 52, (*S*)-**1b**: 37; hexane, (*R*)-**3b**: 41, (*S*)-**1b**: 49; hexane-vinyl acetate 1:1, (*R*)-**3b**: 38, (*S*)-**1b**: 48.

ACETYLATION OF RACEMIC 2-ACYLOXY-HEPTAN-1-OLS *rac*-**3bA-F** BY PfL

General procedure: Racemic 2-acyloxyheptan-1-ol *rac*-**3bA-F** (1 mmol) and PfL (5 mg) were stirred in hexane-vinyl acetate 1:1 (2 ml) at room temperature. After reaching a reasonable conversion (for conversions and reaction times see Table 3) PfL was removed by filtration and solvents were evaporated. The further work up and analysis of products were carried out as described in the previous sections. Data for remaining fraction of substrate **3bA-F**: % yield, and the acetylated products **5*A-F**: % yield, are given below.

(*R*)-**3bA**≡ (*R*)-**3b**, (*S*)-**5*A**≡ (*S*)-**1b**; (*R*)-**3bB**: 55, (*S*)-**5*B**: 25; (*R*)-**3bC**: 57, (*S*)-**5*C**: 26; (*R*)-**3bD**: 61, (*S*)-**5*D**: 31; **3bE**: 45, **5*E**: 43; (*S*)-**3bF**: 53, (*R*)-**5*F**: 42.

HYDROLYSIS OF RACEMIC 1,2-DIOL DIACETATES *rac*-**1b,d** (Method **H-1**), PRIMARY *rac*-**2b,d** (Method **H-2**), OR SECONDARY MONOACETATES (*rac*-**3b,d**; Method **H-3**) BY PfL

General procedure: Racemic 1,2-diol diacetate *rac*-**1b,d**, primary *rac*-**2b,d**, or secondary *rac*-**3b,d** monoacetate (3 mmol) and PfL (15 mg) were stirred in water (25 ml) at RT and pH value was kept at 7.2 by addition of 0.05M NaOH solution from an autoburette. When reasonable conversion (preferably around 0.5) was achieved, the mixture was extracted with ethyl acetate (3x30 ml). The combined organic phase was dried over Na_2SO_4, and the solvent was evaporated off *in vacuo*. The oily residue was purified by column chromatography on silica gel with hexane:acetone. Yields for remaining fraction of substrates and products are listed below. For configuration and enantiomeric purity analysis of pruducts, see Table 4.

Method **H-1**: (*R*)-**1b**: 40, (*S*)-**2b**+(*S*)-**3b**: 36; (*R*)-**1d**: 45, (*S*)-**2d**+(*S*)-**3d**: 42; Method **H-2**: (*S*)-**2b**: 45, (*R*)-**4b**: 46; (*S*)-**2d**: 64, (*R*)-**4d**: 14; Method **H-3**: (*S*)-**3b**: 15, (*R*)-**4b**: 49; (*S*)-**3d**: 24, (*R*)-**4d**: 21.

ACETYLATIONS OF RACEMIC 1,2-DIOLS *rac*-**1b,d** (Method **A-1**), PRIMARY *rac*-**2b,d** (Method **A-2**), OR SECONDARY MONOACETATES (*rac*-**3a-g** (Method **A-3**) BY PfL

General procedure: Racemic diol *rac*-**4b,d**, (1.5 mmol; Method **A-1**)), or primary *rac*-**2b,d** (Method **A-2**), or secondary monoacetates *rac*-**3a-g** (Method **A-3**), vinyl acetate (5 mmol) and PfL (5 mg) were stirred in the hexane-vinyl acetate 1:1 (2 ml) at room temperature. After reaching a reasonable conversion (for conversions and reaction times, see Tables 4 and 5) PfL enzyme was filtered off and solvent was evaporated. The further work up and analysis of products were carried out as described at the previous acylations. Yields for remaining fraction of substrates and products are listed below.

Method **A-1**: (*S*)-**4b**: 24, (*R*)-**2b**: 21; (*S*)-**4d**: 51, (*R*)-**2d**: 46; Method **A-2**: (*R*)-**2b**: 44, (*S*)-**1b**: 41; (*R*)-**2d**: 59, (*S*)-**1d**: 24; Method **A-3**: (*R*)-**3a**: 32, (*S*)-**1a**: 23; (*R*)-**3b**: 39, (*S*)-**1b**: 48; (*R*)-**3c**: 40, (*S*)-**1c**: 27; (*R*)-**3d**: 41, (*S*)-**1d**: 37; (*R*)-**3e**: 43, (*S*)-**1e**: 39; (*R*)-**3f**: 38, (*S*)-**1f**: 34; (*R*)-**3g**: 51, (*S*)-**1g**: 46.

DETERMINATION OF THE ENANTIOMERIC COMPOSITION 1,2-DIOL DERIVATIVES

General procedure: ***Step I:*** *Hydrolysis of the acylated derivative* **1-3a-g**, **3bA-F**, **5*A-F** *to the corresponding 1,2-diols* (*R*)- or (*S*)-**4a-g**: A 10%(v/v) methanolic solution of the appropriate acylated derivative, containing catalytic amount of sodium methylate, was stirred at room temperature overnight. After evaporating off the methanol from the mixture, residue was purifiad by chromatography on a small silica gel column with hexane-acetone yielding (yield was usually over 90 %) pure 1,2-diol [(*R*)- or (*S*)-**4a-g**. For optical rotation values of the optically active 1,2-diols (*R*)- or (*S*)-**4a-g**, see Tables 1-5.

Step II: *Preparation of bis-(S)-MTPA esters of 1,2-diols* **4a-g**: (*R*)-MTPA-Cl (125 μmol), pyridine (150 μmol), and the corresponding 1,2-diol (*R*)- or (*S*)-**4a-g**, (50 μmol) were mixed in CCl_4 (1ml) in an ampoule. The ampoule was sealed and kept at 45°C for 1 hours. After cooling to RT, the mixture was diluted with diethyl ether (5 ml) and washed with 5% hydrochloric acid (1 ml), saturated $NaHCO_3$ solution (1 ml), and brine (1 ml). After drying (Na_2SO_4) and removing the solvents, the remaining oil was analyzed by ^{1}H-NMR. The characteristic signals of the O-CH_2- moieties of the bis-MTPA esters (given below) were used for

determination of diastereomeric-composition (reflecting to the enantiomeric composition of the parent diol). For absolute configuration determination of 1,2-diols **4a-g**, see note [a] in Table 5.

Characteristic ^{1}H-NMR signals ($CDCl_3$, δ, ppm): (*R*)-**4a**, bis-MTPA ester: 4.54 (dd, 1H), 4.57 (dd, 1H); (*S*)-**4a**, bis-MTPA ester: 4.61 (dd, 1H), 4.64 (dd, 1H); (*R*)-**4b**, bis-MTPA ester: 4.54 (dd, 1H), 4.57 (dd, 1H); (*S*)-**4b**, bis-MTPA ester: 4.61 (dd, 1H), 4.64 (dd, 1H); (*R*)-**4c**, bis-MTPA ester: 4.54 (dd, 1H), 4.57 (dd, 1H); (*S*)-**4c**, bis-MTPA ester: 4.61 (dd, 1H), 4.64 (dd, 1H); (*R*)-**4d**, bis-MTPA ester: 4.54 (dd, 1H), 4.57 (dd, 1H); (*S*)-**4d**, bis-MTPA ester: 4.61 (dd, 1H), 4.64 (dd, 1H); (*R*)-**4e**, bis-MTPA ester: 4.51 (dd, 1H), 4.54 (dd, 1H); (*S*)-**4e**, bis-MTPA ester: 4.55 (dd, 1H), 4.58 (dd, 1H); (*R*)-**4f**, bis-MTPA ester: 4.55 (dd, 1H), 4.58 (dd, 1H); (*S*)-**4f**, bis-MTPA ester: 4.63 (dd, 1H), 4.66 (dd, 1H); (*R*)-**4g**, bis-MTPA ester: 4.56 (dd, 1H), 4.59 (dd, 1H); (*S*)-**4g**, bis-MTPA ester: 4.63 (dd, 1H), 4.66 (dd, 1H).

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