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Asymmetric Hydrolyses of 1,2-Diacetoxycyclohexanes by the Cultured Suspension Cells of *Marchantia polymorpha*

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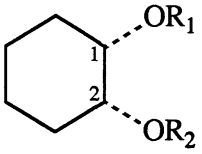
The enantioselectivity in the hydrolyses of *cis*- and *trans*-1,2-diacetoxycyclohexanes by the cultured suspension cells of *Marchantia polymorpha* was very high. The acetoxyl groups at the stereogenic center of (*R*)-configuration were preferentially hydrolyzed.

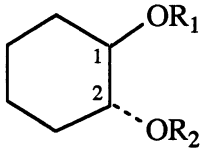
Chiral secondary alcohols are useful as synthons for organic synthesis. Hence, the enantioselective hydrolyses of acetates with biocatalysts have been extensively investigated.[1-4] However, few studies on the enantioselective hydrolyses of acetates by plant cultured cells have been reported.[5,6] We have now investigated the enantioselectivity in the hydrolyses of symmetric diacetates, such as *cis*- and *trans*-1,2-diacetoxycyclohexane (**1a** and **2a**), by the cultured cells of *Marchantia polymorpha*.[7]

The cultured cells of *M. polymorpha* were inoculated in MSK-II medium[8] and cultured for 14 days. Twenty mg of the acetate (**1a** or **2a**) was administered to a flask containing 20 g of cultured cells in 80 ml of MSK-II starvation medium (glucose 0.2%). The mixture was incubated at 25 °C under illumination (1000 lux). After indicated period of incubation the mixture was extracted with ethyl acetate. Identification of products and their yields were determined by using GLC and GC-MS. The absolute configurations and enantiomeric purities of the products were determined by analyses of the ^{1}H NMR spectra of the corresponding MTPA derivatives[9,10] and/or GLC with a CP cyclodextrin β 236M-19 column.

meso-Diacetate, **1a**, was converted stereoselectively into (1*S*,2*R*)-1-monoacetate (**1b**)[11] in a 63% yield after a 12-h incubation, while further hydrolysis of the monoacetate to *meso*-diol (**1c**) hardly occurred, as shown in Table 1. On the other hand, (±)-*trans*-1,2-diacetoxycyclohexane (**2a**) was hydrolyzed to the *trans*-diol (**2c**) in a 12-h incubation, but the corresponding monoacetate (**2b**) did not accumulate in appreciable amounts (data not shown). Since **2b** was able to isolate after 3-h incubation, the absolute configurations and



1a: R_1=R_2=Ac
1b: R_1=Ac, R_2=H
1c: R_1=R_2=H



2a: R_1=R_2=Ac
2b: R_1=Ac, R_2=H
2c: R_1=R_2=H

Table 1. Asymmetric hydrolyses of the acetates (**1a**, **1b**, **2a**, and **2b**) by the cultured cells of *M. polymorpha*

Substrate	Time / h	Products	Transform.[a] / %	Config.	e.e.[b] / %
1a	12	**1b**	63	1*S*,2*R*	91[c]
(±)-**1b**	12	**1c**	2	*meso*	—
(±)-**2a**	3	**2b**	19	1*R*,2*R*	90
		2c	11	1*R*,2*R*	>99
(±)-**2b**	3	**2c**	28	1*R*,2*R*	92

a) Relative percentage in the reaction mixture.
b) Determined by GLC analyses with a CP Cyclodextrin β 236M-19 column.
c) Determined by HPLC analysis of the corresponding MTPA ester.

enantiomeric purities of the hydrolysis products, **2b**[11] and **2c**, in a 3-h incubation were determined (Table 1). The results indicated that the (1*R*,2*R*)-enantiomer was preferentially hydrolyzed to the corresponding alcohols.

Thus, it has been clarified that the cultured cells of *M. polymorpha* hydrolyzed enantioselectively the acetoxyl group at the stereogenetic center of (*R*)-configuration of the symmetric 1,2-diacetoxycyclohexanes.

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9) Δδ values [Δδ (ppm)=δ{(*R*)-MTPA ester of (*R*)-alcohol} - δ{(*R*)-MTPA ester of (*S*)-alcohol}][10] were +0.056 for the acetoxyl proton of *cis*-1-acetoxy-2-hydroxycyclohexane and +0.128 for the acetoxyl proton of *trans*-1-acetoxy-2-hydroxycyclohexane.
10) J. A. Dale, D. L.Dull, and H. S. Mosher, *J. Org. Chem.*, **34**, 2543 (1969).
11) **1b**: IR ν_{max} 3433 and 1730 cm^{-1}; ^1H NMR δ 2.10 (3H, s, OAc), 3.88 (1H, td, *J*=3.0 and 6.9 Hz, 2-H), and 4.92 (1H, td, *J*=3.0 and 8.9 Hz, 1-H). **2b**: IR ν_{max} 3463 and 1732 cm^{-1}; ^1H NMR δ 2.09 (3H, s, OAc), 3.55 (1H, td, *J*=9.5 and 4.4 Hz, 2-H), and 4.58 (1H, td, *J*=9.5 and 4.9 Hz, 1-H).

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