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Preliminary communication

Deacetylation of α-acetoxy-furanurono-6,3-lactones by lipases and lyophilised yeast

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Many methods for chemical deacylation have been proposed[1]. Although there are many reports on *stereospecific* enzyme-mediated deacylations of non-carbohydrates, the reactions of acylated monosaccharides have been limited only to *regiospecific* transformations[2–8]. There has been no report on comparative deacetylations of monosaccharide derivatives using different enzymes. Carbohydrate secondary acetates have been deacetylated enzymically only by chance[2,7], and no stereochemical dependencies were established. Recent publications[2–8] on enzymic transformations of carbohydrates prompted the present report.

Deacetylation of α-acetoxylactones is difficult. Attempted chemical deacetylation of 5-*O*-acetyl-1,2-*O*-isopropylidene-α-D-glucofuranurono-6,3-lactone (**1**) under various conditions resulted in appreciable destruction and only relatively poor yields of 1,2-*O*-isopropylidene-α-D-glucofuranurono-6,3-lactone (**2**) were obtained. The lipase from *Aspergillus sp.*, AP6, however, effected 94% deacetylation within 3 h, whereas that from *Pseudomonas sp.* (P) (Amano) effected 30% deacetylation after 3 h and 84% after 30 h. The lipase from *Candida cylindracea* (CC), porcine pancreatic lipase (PPL), pig-liver esterase (PLE), α-chymotrypsin (CT), and lyophilised yeast (*Saccharomyces cerevisiae* Hansen) (LY)[9] had no effect on **1**.

In order to determine their stereochemical requirements, 5-*O*-acetyl-1,2-*O*-isopropylidene-β-L-idofuranurono-6,3-lactone (**3**), the C-5 epimer of **1**, was treated with these enzymes under the same conditions; **3** can be obtained easily by partial epimerisation of **1** with pyridine–water[10], acetylation of 1,2-*O*-isopropylidene-β-L-idofuranurono-6,3-lactone (**4**), or nucleophilic displacements starting from suitable *gluco* precursors[11]. CC, PPL, PLE, P, LY, and CT effected 80–85% conversion of **3** into **4**, but AP6 was inactive. When a mixture of **1** and **3** was treated with AP6, 81% of **2** was obtained and 97% of **3** was recovered. The stereochemical require-

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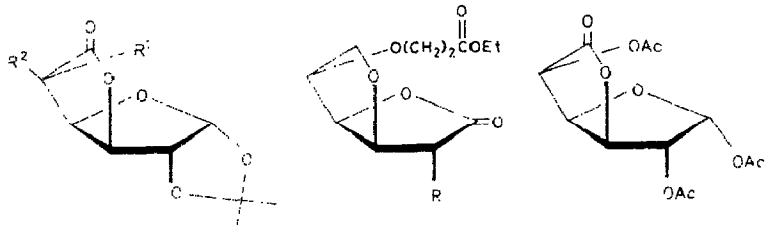
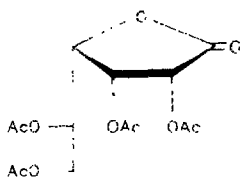


1 R^1 = OAc R^2 = H
2 R^1 = OH R^2 = H
3 R^1 = H R^2 = OAc
4 R^1 = H R^2 = OH

5 R = OAc
6 R = OH

7



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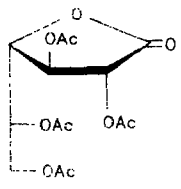

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ments for P are low since both **1** and **3** are deacetylated. On the other hand, treatment of a mixture of **1** and **3** with CC, PLE, PPL, LY, or CT selectively saponified the latter and gave 74–78% of **2**. Therefore, **3** can be obtained conveniently by treating the equilibrium mixture, formed by the epimerisation of **1**, with AP6 followed by extraction and recrystallisation, thereby avoiding tedious chromatography.

Whereas the chemical deacetylation of 2-*O*-acetyl-3,6-anhydro-5-*O*-ethoxycarbonyl-D-glucono-1,4-lactone (**5**) gave moderate yields, treatment with enzymes (CC, PLE, P, AP6) effected complete saponification within 4 h to give 3,6-anhydro-5-*O*-ethoxycarbonyl-D-glucono-1,4-lactone (**6**). Deacetylation with LY required 15 h, CT required 10 h, and PLE was inactive.

Typically, a suspension of starting compound (1 g) in 0.1M phosphate buffer (pH 7, 50 mL) was treated with the enzyme (0.5 g; 1.5 g of LY); CC, PLE, PPL, and CT are available from Sigma (F.R.G.), and P and AP6 from AMANO Pharmaceutical (Japan). The mixture was stirred vigorously and the pH was kept at 7.0 by the addition of M NaOH. After completion of the reaction (t.l.c.), the mixture was extracted several times with ethyl acetate, the extracts were combined, dried (Na_2SO_4), and concentrated, and the residue was recrystallised or subjected to column chromatography.

1,2,5-Tri-*O*-acetyl-α-D-glucofuranurono-6,3-lactone (**7**) was partially saponified by AP6 after 6 h, and completely after 24 h. LY effected little deacetylation, and CC, PPL, PLE, P, and CT were inactive. 2,3,5,6-Tetra-*O*-acetyl-D-galactono-1,4-lactone (**8**) was non-selectively deacetylated with CC, PPL, PLE, P, CT, or LY during 7 h but was a non-substrate for AP6. 2,3,5,6-Tetra-*O*-acetyl-L-mannono-1,4-lactone (**9**) was non-selectively and completely deacetylated within 6

h by CC, P, and AP6. The reactions with PPL, PLE, and CT were slower but were also non-selective. The deacetylated lactones were obtained in moderate yields and the purification required chromatography.

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