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LETTERS

Practical synthesis of bis-homoallylic alcohols from dialdehydes or their acetals

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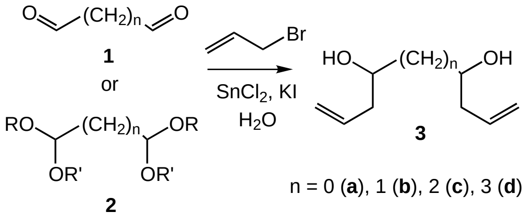
Abstract—Bis-homoallylic alcohols were prepared in good yields by allylation of dialdehydes or their acetals with allyl bromide, tin(II) chloride and potassium iodide in water or water/THF. © 2002 Elsevier Science Ltd. All rights reserved.

Homoallylic alcohols are ubiquitous in organic synthesis.[1–8] In particular, bis-homoallylic alcohols have been used as starting compounds or building blocks for syntheses of crown compounds,[3] polycyclic ethers,[4] and cyclic and linear diketones.[7] Bis-homoallylic alcohols have been synthesized by allylboration of dialdehydes,[3,8–10] by Grignard allylation of 1,2-cyclohexanedione,[11] by palladium-catalyzed allylation of 1,2-dicarbonyl compounds with allyl alcohol and $SnCl_2$,[12] by allylation of enolizable 1,2-diketones with allyltrifluorosilanes in the presence of Et_3N,[13] by allylation of malondialdehyde with allyl chloride, NaI and $SnCl_2$ in DMF,[14] and also by vinylation[15] of bis-epoxides, and by their reaction with dimethylsulfonium methylide.[4] Unfortunately, the reactions of dialdehydes in anhydrous conditions are often difficult to carry out, since many dialdehydes are unstable (e.g. malondialdehyde[16]), and are commercially available only in water solutions or as acetals.

During the last two decades, much effort has been put into the development of allylation of aldehydes and ketones in water or water containing media (e.g. see Refs. 1,2,5,7,17–26). Among other homoallylic alcohols, a few bis-homoallylic alcohols have been prepared by Barbier-type reaction of dicarbonyl compounds with allyl halide and indium,[2,7] tin,[2,18] or zinc metal,[18–20] and by allylation with tetraallyltin,[21,22] dibutylallyltin chloride,[23] or diallyltin dibromide.[24]

Considering bis-homoallylic alcohols **3** as potential precursors in a synthesis of *C*-disaccharides via bis-tetrahydropyranyl derivatives,[27] we tried to prepare them using commercially available water solutions of dialdehydes **1**. Unsatisfactory results (low yields, a number of byproducts) were obtained in reaction with allyl bromide and zinc powder in saturated NH_4Cl solution.[18–20,25] We achieved much better results by a modification of a procedure using allyl halide, tin(II) chloride and potassium iodide in water solution[26] (Table 1).



Very similar reaction conditions were suitable for preparation of **3** from commercially available dialdehyde bis-acetals **2** and acetal **4** (Table 1). Apparently, a hydrolysis of acetals in a weakly acidic medium preceded the allylation. The more stable cyclic acetals required a much longer reaction time. This approach allows a synthesis of bis-homoallylic alcohols based on dialdehydes available neither in pure form nor in solution.[28–30]

The diastereomeric ratio 3:1 (NMR) was observed for **3a**. Approximately equal amounts of diastereomers were formed in other reactions.

A typical procedure for the bis-allylation is as follows.

1,7-Octadiene-4,5-diol (3a). A solution of glyoxal (20 mmol) in water (50 mL) was added during 20 min at

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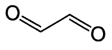
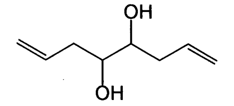
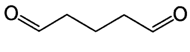
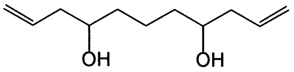
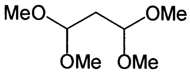
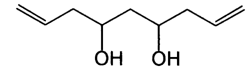
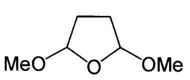
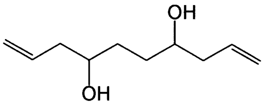
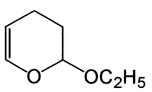
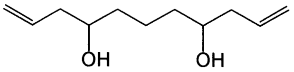
Table 1. Synthesis of bis-homoallylic alcohols **3**

Starting compound	Bis-homoallylic alcohols **3** [a]	Yield %
 **1a**	 **3a**	85
 **1d**	 **3d**	67
 **2b**	 **3b**	77
 **2c**	 **3c**	66
 **4**	 **3d**	80

[a] All the products were characterized by ^{1}H and ^{13}C NMR, mass-spectrometry, and comparison with lit. values: **3a**[4,18] **3b**,[15] **3c**,[4] **3d**.[18]

35°C to a stirred mixture of $SnCl_2$ dihydrate (13.56 g, 60 mmol), allyl bromide (5.2 mL, 60 mmol) and KI (19.9 g, 120 mmol) in water (150 mL). The stirring was continued for 30 min at 30°C. The resulting mixture was extracted with CH_2Cl_2 (3×150 mL). The extract was washed with 5% aq. $Na_2S_2O_3$, dried and evaporated to yield 2.7 g of a yellowish oil, which was purified by a flash chromatography (silica gel; ethyl acetate or ether–hexane): 2.4 g (85%).

Dialdehyde bis-acetals **2** or acetal **4** were dissolved in 15 mL THF for addition to the reaction mixture. Their reaction required a few hours (up to 48 h in the case of **2c**); the conversion was monitored by TLC.

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