

The relative stability of allyl ether, allyloxycarbonyl ester and prop-2 enylidene acetal, protective groups toward Iridium, Rhodium and Palladium catalysts.

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Summary : The deprotection of allyloxycarbonyl derivatives of sugars was realized in the presence of allylether or prop-2-enylidene acetal with Pd(PPh₃)₄ or RhCl (PPh₃)₃ as catalyst while [Ir (COD) (PMePh₂)₂]PF₆ isomerized selectively the allyl ethers.

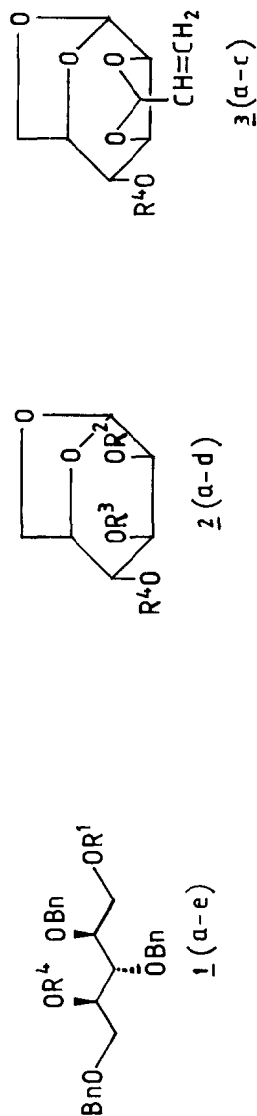
The discriminative protection between hydroxyl groups of carbohydrate compounds is of current interest. Recently we reported a selective introduction of the allyloxycarbonyl (AOC) protecting group on the less sterically hindered hydroxyl of two alcohol functions.¹⁻³

Taking in account the possible transformation of allyl carbonates into allyl ethers,⁴ the removal of one of these protecting groups in the presence of the other would increase the usefulness of the AOC protection.

The usual procedure for de-allylation is a two-step process which consists of isomerization of the allyl ether function by (a) strong base (KtBuO),⁵ (b) RhCl(PPh₃)₃ (Wilkinson catalyst)⁶ or (c) [Ir (COD) (PMePh₂)₂] PF₆ (iridium catalyst),⁷ followed by removal of the resulting prop-1-enyl ether with mercuric salts,⁸ iodine⁹ or mild acid,¹⁰ Direct removal of the allyl group is generally accomplished with PdCl₂¹¹ or Pd/C/H⁺¹² while the AOC protecting group was recently removed using Pd(0) complexes.¹³

We have investigated the influence of the metal complexes PdCl₂, Pd(PPh₃)₄, RhCl(PPh₃)₃ and [Ir (COD) (PMePh₂)₂] PF₆ on the relative stability of the allyl and AOC protecting groups. As the prop-2-enylidene acetal function can be ring-opened¹⁴ to afford an allyl function we also included dioxolane **3** (a-b) in this investigation.

The results are depicted in the table. When compound **1b** was treated with PdCl₂ in acidic buffer (CH₃CO₂H/NaOAc/H₂O, pH 4.5)¹¹ a non selective removal of both the allyl ether and allyloxycarbonyl ester was observed.



Bn = benzyl

Catalysts	$\text{Pd}(\text{PPh}_3)_4$ -THF-H ₂ O	$\text{RhCl}(\text{PPh}_3)_3$ i	$[\text{r}(\text{COD})\{\text{PMePh}_2\}_2]\text{PF}_6$
Starting compounds	$\text{PdCl}_2\text{-NaOAc}$ $\text{CH}_3\text{CO}_2\text{H-H}_2\text{O}$ 2 eq., 20°C, 24h.	1.4 10 ⁻² eq., 70°C	Cat., 20°C, 2h.
<u>1a</u> R ¹ =AOC, R ⁴ =H	<u>1c</u> R ¹ =R ⁴ =H	<u>1c</u> R ¹ =R ⁴ =H	<u>1a</u> R ¹ =AOC l, R ⁴ =H
<u>1b</u> R ¹ =AOC, R ⁴ =All	<u>1c</u> R ¹ =R ⁴ =H	<u>1d</u> R ¹ =H, R ⁴ =All	<u>1e</u> R ¹ =AOC l, R ⁴ =prop-1-enyl
<u>2a</u> R ² =AOC, R ³ =All, R ⁴ =Bn	<u>2b</u> R ² =R ³ =H, R ⁴ =Bn	<u>2c</u> R ² =H, R ³ =All, R ⁴ =Bn	<u>2d</u> R ² =AOC l, R ³ =prop-1-enyl, R ⁴ =Bn
<u>3a</u> R ⁴ =AOC	<u>3c</u> R ⁴ =H j	<u>3c</u> R ⁴ =H	Mixture l,m
<u>3b</u> R ⁴ =All	1, 6-anhydro- β -D-mannopyranose. k	<u>3b</u> R ⁴ =All	Mixture l,m

- i) The reaction time could be lowered from 4h to 1h by addition of DBO (0.8 eq.) but a better control of the selectivity of cleavage in the case of 1b and 2a was obtained with Wilkinson catalyst only.
- j) Complete removal of AOC ester within 3h with 15% removal of acetal function.
- k) PdCl_2 [4eq] used.
- l) 10-20% of AOC ester is transformed into the prop-1-enyloxycarbonyl ester.¹⁵
- m) The double bond in the acetal function seems to be partly isomerized and reduced.

Treatment with the Wilkinson catalyst showed removal of the allyloxycarbonyl protecting group in **1a** and selective removal of the AOC ester in the presence of the allyl ether in compound **1b**. An increase of the reaction rates was observed by addition of diazabicyclo [2.2.2] octane (DBO).^{6b}

Further, selective de-allyloxycarbonylation was also observed by boiling compound **1b** under reflux for 20 min in wet oxolane with Pd(PPh₃)₄.

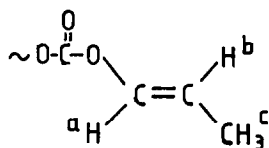
However, upon treatment of **1b** with the iridium catalyst, complete isomerization of the allyl into the trans prop-1-enyl ether occurred, with only partial (10-20%) migration of the double bond in the allyloxycarbonyl ester.¹⁵ In order to remove the prop-1-enyl group, this mixture of compounds was treated with HgCl₂/H₂O, after which compound **1a** was obtained in reasonable yield after column chromatography.¹⁶ Thus it has been shown that the allyl ether can be removed using successively the iridium catalyst and mercuric salts in the presence of the allyloxycarbonyl ester, albeit not completely selective.

Finally, we found that the prop-2-enylidene acetal was stable to treatment with Pd(PPh₃)₄ and Wilkinson catalyst, so that the AOC ester in **3a** and the allyl ether in **3b** can be respectively removed completely or partly isomerized¹⁷ in its presence applying these conditions.

Footnotes and references

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3. Further investigation showed this discriminative carbonatation to be a general reaction. For example, treatment of 1,2-O-isopropylidene- α -D-glucofuranose or 1,2-propanediol with allyloxycarbonyl chloride and pyridine in oxolane afforded the corresponding primary allylcarbonates.
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15. As evidenced from NMR spectroscopy, the *trans* prop-1-enyl carbonate 4 is formed:



^1H NMR (CDCl_3 , TMS int. standard): δ 1.60 (dd, $-\text{CH}=\text{CH}-\underline{\text{CH}}_3$, $J_{a,c}$ 1.63 Hz, $J_{c,b}$ 6.96 Hz); δ 5.38 (m, $-\text{CH}=\underline{\text{C}}\text{H}-\text{CH}_3$); δ 6.84 (dd, $-\underline{\text{C}}\text{H}=\text{CH}-\text{CH}_3$, $J_{a,b}$ 13 Hz).

16. This compound was in every aspect (TLC, ^1H NMR and ^{13}C NMR spectra) identical with the authentic sample 1a.
17. Only partial isomerization (50%) was observed after 12h. However, when the separated unreacted material was treated again with the Wilkinson catalyst the same 50 % isomerization was observed.

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