Fluoroalcohols: Efficient Solvents for the Iodine(III)-Promoted Oxidative Rearrangement of 1,2-Dihydronaphthalenes

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INTRODUCTION

Hypervalent iodine reagents have a key role in chemical synthesis.[1] Since the first report,[2] CF_3CH_2OH (TFE) and $(CF_3)_2CHOH$ (HFIP) have been used as solvent in reactions with hypervalent iodine compounds. However, TFE and HFIP have not been used in the rearrangement of alkenes.[1] We reported the ring contraction of 1,2-dihydronaphthalenes in MeOH or in MeCN mediated by PhI(OH)OTs (HTIB).[3] Herein we describe fluoroalcohols as a great alternative for the oxidative rearrangement of alkenes mediated by HTIB. Some of the results in this work were already presented,[4] and they are shown here for comparison.

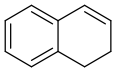
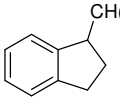
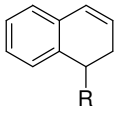
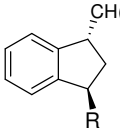
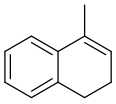
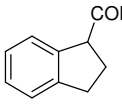
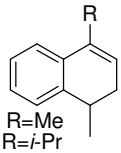
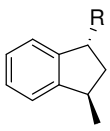
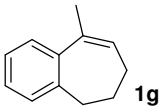
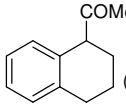
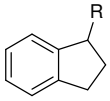
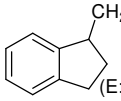
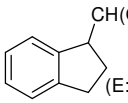
RESULTS AND DISCUSSION

The reactions of the 1,2-dihydronaphthalenes **1a**, **1b** and **1c** with HTIB in TFE led to the desired products in higher yields than in MeOH[3] (entries 1 and 2, table 1). The oxidation of trisubstituted alkenes **1d** to **1g** with HTIB in TFE gave the corresponding indanes also in very good yields (entries 3, 4 and 5). Although TFE gives higher yields, the diastereoselectivity is lower.[3] Thus, several conditions were tested to optimize the diastereoselectivity. Eventually, this goal was achieved using a 4:1 mixture of DCM:TFE as the solvent (entries 1 and 2). This media is also appropriate for trisubstituted alkenes (entry 4). Considering the very good results with TFE, we tested the even more polar solvent, HFIP. The oxidation of **1a** in HFIP was very fast and led to **3**, but in lower yield than in TFE (entries 1 and 6). To avoid decomposition, **3** was reduced *in situ*, giving **4** after addition of $NaBH_4$, but in only 34% yield (entry 6). The alcohol **4** was isolated in better yield using DCM:HFIP (4:1), however together with **5** (entry 7). The treatment of **1a** with HTIB and H_2O in DCM:HFIP (4:1), followed by $NaBH_4$, led only to **4** in 74% yield (entry 8).

CONCLUSION

Fluoroalcohols appeared to be an excellent medium for the iodine(III)-mediated ring contraction of 1,2-dihydronaphthalenes. This protocol represents a green alternative to the analogous reaction using toxic thallium(III) salts and will be useful in medicinal and synthetic organic chemistry to access functionalized indanes in an expeditious manner.

TABLE 1. Reaction of alkenes with HTIB in Fluoroalcohols[a].

Entry	Substrate	Product (Isolated Yield)
1	 **1a**	 **2a** (A: 73%) (B: 67%)
2	 **1b**: R=Me **1c**: R=*p*-F-C_6H_4	 **2b**: R=Me (A: 70%, *trans:cis* = 6:1) **2c**: R=*p*-F-C_6H_4 (A: 65%, *trans:cis* = 10:1) (B: 69%, *trans:cis* = 17:1)
3	 **1d**	 **2d** (A: 72%)
4	 **1e**: R=Me **1f**: R=*i*-Pr	 **2e**: R=COMe (A: 53%, *trans:cis* = 2:1) (B: 76%, *trans:cis* = 7:1) **2f**: R=$COCH(CH_3)_2$ (B: 62%, *trans:cis* = 9:1)
5	 **1g**	 **2g** (A: 62%)
6	**1a**	 **3**: R=CHO (C: 58%) **4**: R=CH_2OH (D: 34%)
7	**1a**	 **4** (E: 48%)  **5** (E: 17%)
8	**1a**	**4** (F: 74%)

[a] **A**: TFE; **B**: DCM:TFE (4:1); **C**: HFIP; **D**: i) HFIP, ii) $NaBH_4$. **E**: i) DCM: HFIP (4:1), ii) $NaBH_4$; **F**: i) DCM:HFIP (4:1), 22 equiv H_2O, ii) $NaBH_4$.

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