

# Ring expansions promoted by iodine(III): Synthesis of heterocycles

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## Abstract

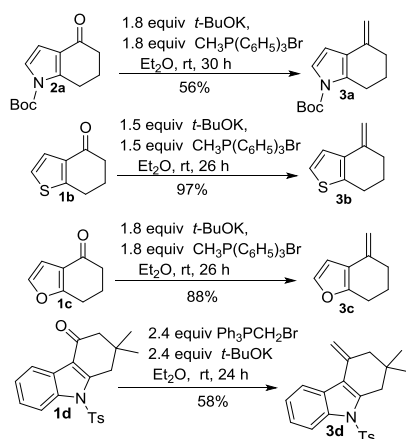
A metal-free approach for the synthesis of heterocycles bearing seven membered rings is described by using hypervalent iodine(III) reagent.

## Introduction

The ring expansion of methylene derivatives mediated by  $\text{PhI}(\text{OH})\text{OTs}$  (HTIB or Koser's Reagent) has been investigated by Justik and Koser for the synthesis six-, seven-, and eight-membered ring carbocyclic compounds.<sup>1,2</sup> The eight substrates used in this previous work bear a non-substituted benzene ring as migrating group.<sup>2</sup> This protocol was subsequently applied in the total synthesis of both isomers of *ar*-himachalene.<sup>3</sup> Herein, we describe the ring expansion of heterocyclic benzo-methylenes mediated by the hypervalent iodine<sup>4</sup> reagent HTIB ( $\text{PhI}(\text{OH})\text{OTs}$ ).<sup>5,6</sup>

## Results and Discussion

Different methylenes derivatives were prepared for ring expansions reaction from corresponding ketones (Scheme 1).



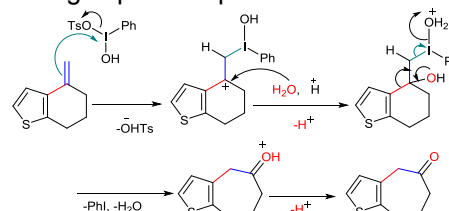
Scheme 1. Preparation of substrates 3a-d.

To study the oxidative rearrangement reaction with HTIB we apply the same protocol mentioned in literature.<sup>5</sup> The reaction of pyrrole 3a led to 4a in 36% yield (Table1, entry 1). Seven-membered ring of thiophene 4b was obtained in yield of 95% (entry 2). Similarly furan 4c gave 4d in 55% yield with an additional ring opening product 5c in 42% yield (entry 3). The reaction of indole 3d affording the desired ring expansion 4d in 59% yield (entry 4).

Table 1. Ring expansions using HTIB.

| Entry | Substrate | Conditions                           | Product |
|-------|-----------|--------------------------------------|---------|
| 1     |           | 3 equiv HTIB, MeOH 95%, rt, 3 h      |         |
| 2     |           | 1.2 equiv HTIB, MeOH 95%, rt, 30 min |         |
| 3     |           | 1.2 equiv HTIB, MeOH 95%, rt, 30 min |         |
| 4     |           | 1.2 equiv HTIB, MeOH 95%, rt, 15 min |         |

Mechanism for the ring expansion induced by HTIB is presented in Scheme 2.<sup>2</sup> The electrophilic attack of iodine(III) on the double bond forms carbocation which is attacked by water. The migration of aryl bond and elimination of  $\text{H}_2\text{O}$  and  $\text{PhI}$  molecules gives the ring expansion product.



Scheme 2. Mechanism of the ring expansion.

## Conclusion

A metal-free approach for the synthesis of seven-membered rings through an iodine(III)-mediated ring expansion reaction is described. The substrates can be easily obtained from readily available starting materials.

## Acknowledgements

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