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## DIFFERENT BEHAVIOUR OF DISUBSTITUTED AROMATIC HETEROCYCLES IN POLAR DIELS-ALDER REACTIONS

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**Abstract.** Dienophilic behaviour of disubstituted aromatic heterocycles towards normal electron demand Diels-Alder reactions is studied under thermal conditions. Formation of pyrrolyl-thiophenes are observed only in the reactions of nitrothiophenes with isoprene.

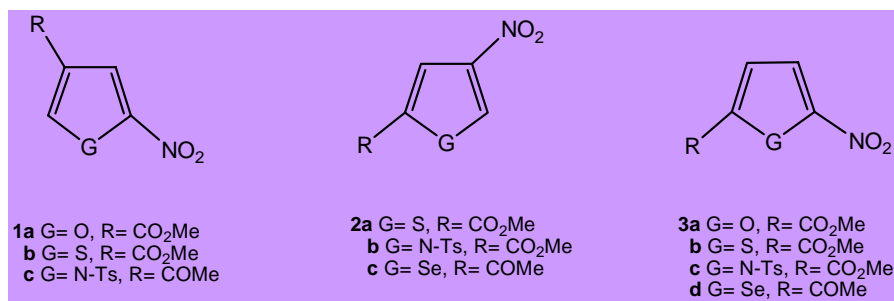
**Keywords:** heterocycles, Diels-Alder, dienophiles

### Introduction

It is known that furans, pyrroles and thiophenes can act as dienes in Diels-Alder (DA) reactions.<sup>1</sup> However, in previous work we have informed on the dienophilic character of these aromatic system in DA reactions with normal electron demand.<sup>2</sup> In this opportunity we would like to compare the behaviour of furans, pyrroles, thiophenes and selenophenes disubstituted with electron-withdrawing groups in thermal reactions with isoprene as diene.

### Results and discussion

We prepared and discussed the reactivity of the following dienophiles:

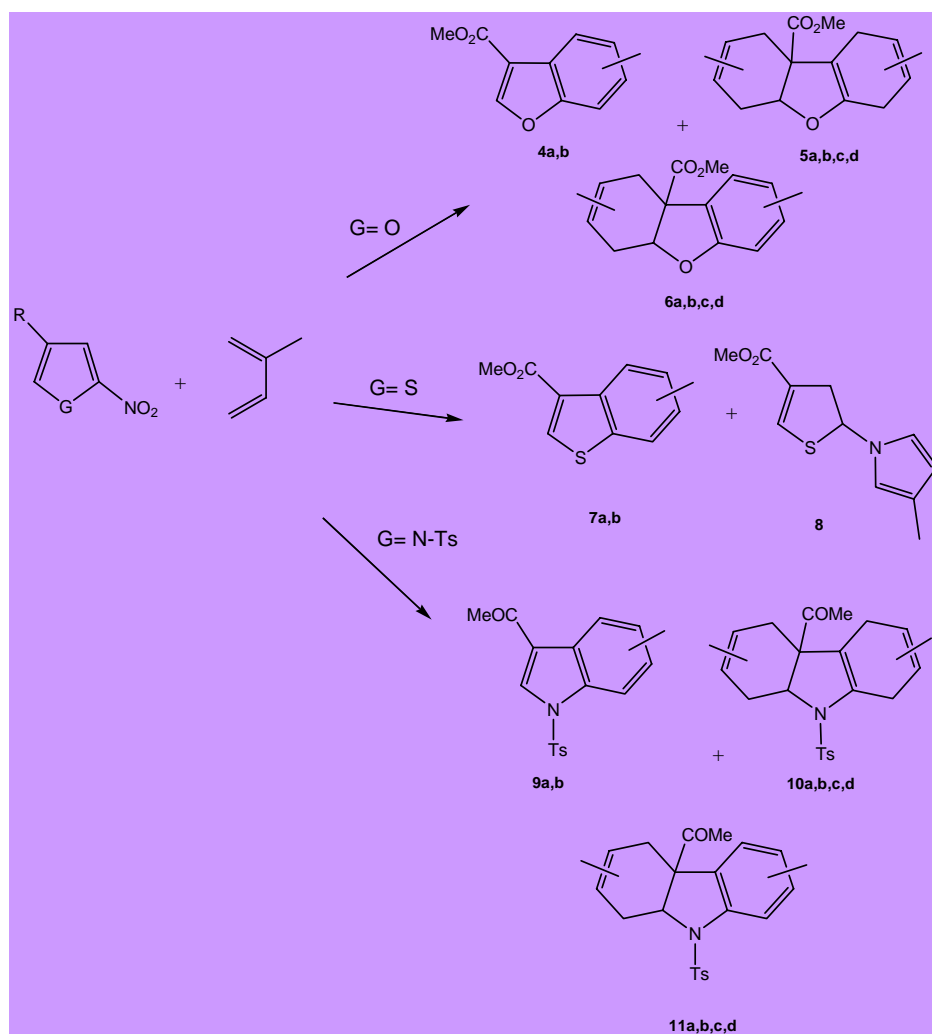


Scheme 1

Isoprene was chosen as the diene component due to its low reactivity in this type of reactions.

Exposure of **1a** to isoprene in different reaction conditions (12 equiv. of diene, 150°C, 72 h and 200°C, 72 h) yield the mixture of isomeric cycloadducts **4a,b** as principal products and the double addition adducts **5a-d** and **6a-d**. (Scheme 2). The behaviour of 2-nitrofurans with carbomethoxy group substituent at  $\beta'$  position is in agreement with the difference between  $\beta$ -acylfurans and their  $\alpha$ -acyl isomers.<sup>3</sup>

$\alpha$ -Nitrosubstituted thiophene **1b**, gave the expected benzothiophene **7a,b** and the unexpected pyrrolyl derivative **8** as principal product, when isoprene was used as diene (Scheme 2). It is assumed that this nitroaromatic compound would be reacting through the heterodienophilic fragment NO by a hetero Diels-Alder reaction (HAD).<sup>4</sup>

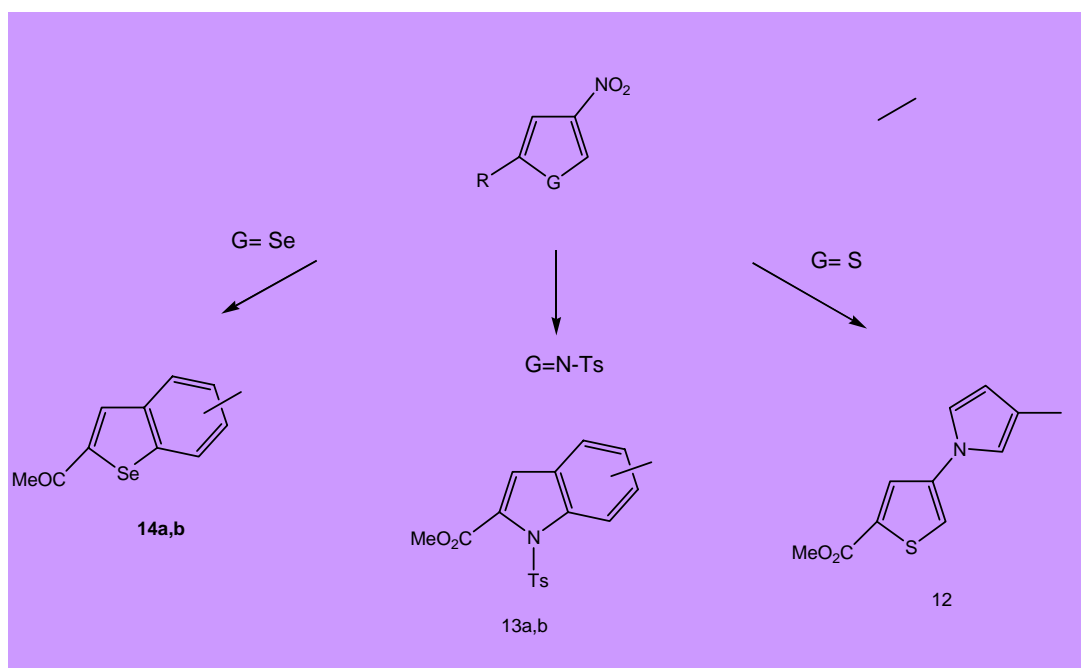


Scheme 2

On the other hand, the treatment of **1c** with the same diene afforded a mixture of isomeric indoles **9a,b** as the principal products and a mixture of double addition adducts **10a-d** and **11a-d**. (Scheme 2).

When the aromatic heterocycles holding an electron withdrawing group (such as nitro group at  $\beta$ -position) have shown to be excellent dienophiles in the interaction with isoprene. The reactions of **2b** and **2c** with isoprene underwent cycloaddition with the formation of 1:1 adducts, respectively.

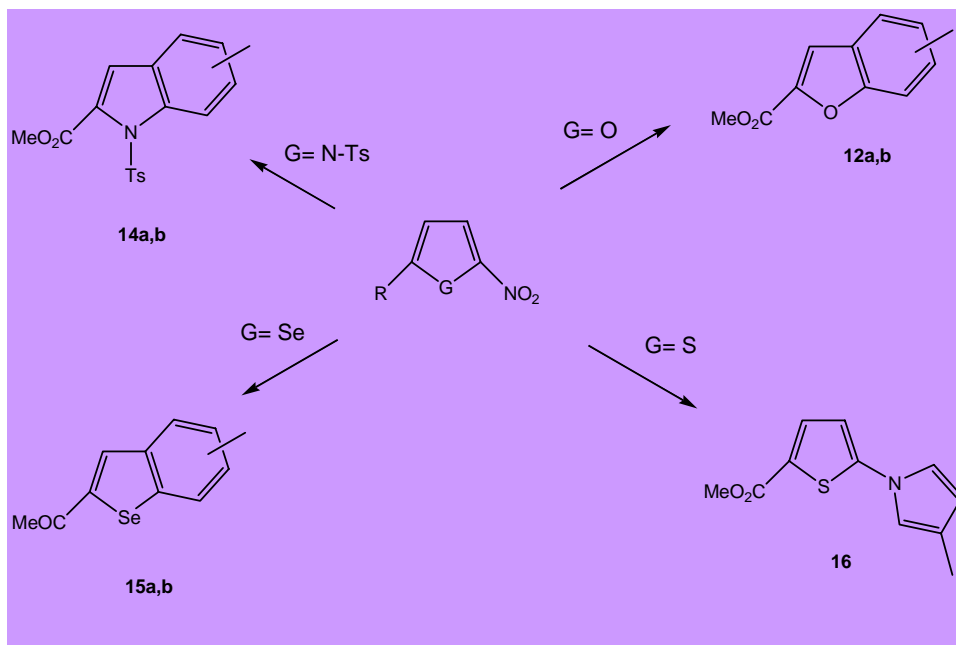
This reactions proceeded by the addition of the diene selectively to the nitro-substituted double bond of the heterocycles. No bis adduct from the double cycloaddition was detected. (Scheme 3).



**Scheme 3**

Compound **2a** gave with isoprene pyrrol derivative **13** with high yield.

The cycloaddition between **3a** and isoprene yielded only a mixture of isomeric benzofurans **12a,b**. This reactions proceed by the addition of the diene selectively to the nitro-substituted double bond of the furan.



**Scheme 4**

The reactions of **3c** and **3d** with isoprene afforded the cycloadducts **14a,b** and **15a,b**, respectively. Moreover, when nitrothiophene **3b** reacted with isoprene, it generated pyrrolyl derivative **16**.

## Conclusions

This study demonstrates that disubstituted furans, pyrroles and selenophenes can act as dienophiles in normal electron demand DA reactions. The nitro group is easily extruded under thermal conditions, giving cycloadducts of high interest as intermediaries in the synthesis of some alkaloids as morphine, serotonin and tryptamine.

Interestingly, when nitrothiophenes reacted with isoprene, they produced pyrrolyl derivatives.

In general, a very strong electron-acceptor group, such as nitro group induces in the heterocyclic ring similar reactivity at  $\alpha$ - and  $\beta$ -positions.

## Acknowledgement

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