

# Europium activated Bismuth catalysed multi component cascade reactions for the competent methodologies for various simple molecules

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## Abstract:

For the regiospecific and stereo selective synthesis, a Europium activated Bismuth catalysed three-component cascade reaction was used. Novel substituted (Z)-2-butene 1,4-diamine analogues and substituted 4-aryloxy analogues were synthesised. Analogues of but-2-enyl amine. The related alkynes were initially synthesised into allenes using the Crabbé reaction was followed by reactions with a variety of commercially available aryl iodides and amines. to assemble a tiny molecule library The reaction can be carried out with aryl iodides that contain both of these elements. Electron-donating and electron-withdrawing groups are two types of groups. Amines of various sizes can also be used using this method. There was no discernible difference in yield, regiospecificity, or stereoselectivity.

**Key words:** Bismuth catalyst, Multicomponent Alkynes, Crabbé reaction, 2-Butene-1,4-diamine

## Introduction:

One-pot multicomponent reactions (MCRs) are an efficient way to make complex molecular scaffolds in a single step [1–3]. Better yields, easier synthetic access to analogues, and a single purification step are all advantages of using MCRs over a linear reaction sequence to obtain the same molecule (Fig. 1 and Fig. 2).

Allenes are a little-used functionality in organic synthesis, but they have a lot of potential because they can react with so many different functional groups [4]. When an aryl Bismuth(III) intermediate reacts with an allene, a highly reactive p-allyl bismuth species is formed, which can subsequently go through a variety of transformations. Nucleophilic attack [5, electrophilic attack [6, and transmetallation assault [7] have all been documented. We present the synthesis of a small library of novel substituted (Z)-2-butene 1,4-diamine analogues and substituted 4-aryloxy but-2-enyl amine analogues by nucleophilic assault on the p-allyl bismuth species by an amine, as part of our ongoing research in bismuth catalysed cascade chemistry. To examine the impacts of component, a varied spectrum of amines and aryl iodides were used, on reaction stereoselectivity and regioselectivity, sterics and electronic characteristics are important.

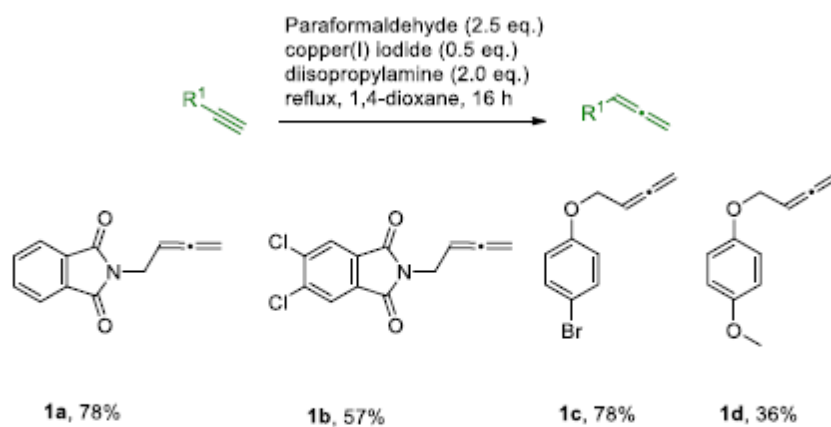
We began our research by synthesising a variety of allenes for use in a three-component cascade process catalysed by bismuth. The Crabbé reaction was used to make four allenes in good yields from N-propargyl phthalimides and O-propargyl phenols (Scheme 1).

The allenes were then combined with a variety of commercially available amines and aryl iodides with various steric and electronic characteristics in a bismuth -catalyzed cascade reaction (Scheme 2)

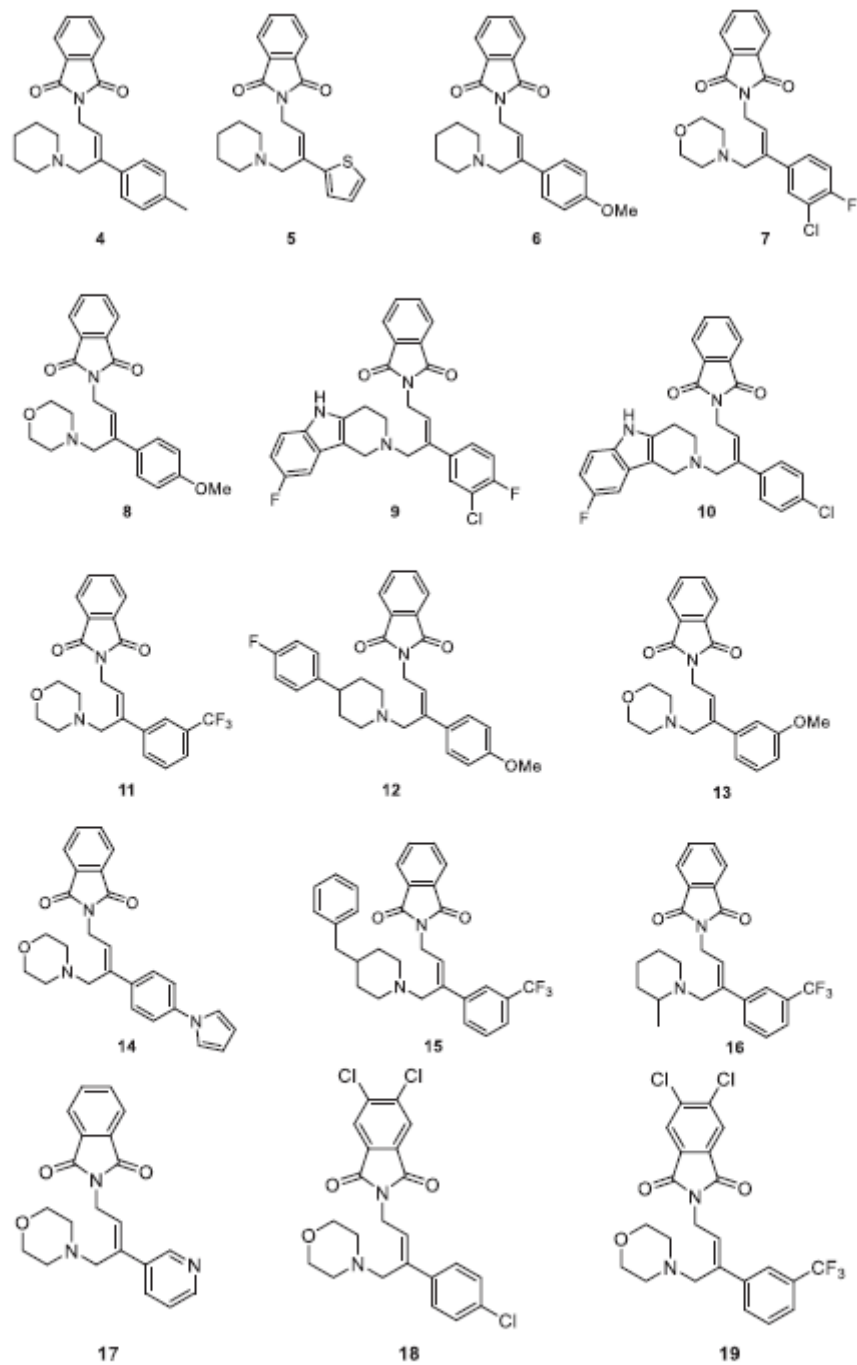
First, the reactions of phthalimide-based allenes (1a and 1b) with a variety of aryl iodides and amines were examined. Yields for the Z-isomer ranged from 31 to 90 percent, with strong stereoselectivity (Table 1). The yield, stereoselectivity, and regiospecificity of aryl iodides containing both electron-donating and electron-withdrawing groups were tolerated with little influence. The final products were a combination of inseparable E and Z isomers. By analogy with comparable molecules [8–9], the preference for Z geometry was demonstrated. The E/Z ratio was calculated by comparing the alkenyl protons' integrals.

After that, the reactivity of phenol-based allenes (1c and 1d) with a variety of aryl iodides was investigated. Yields for the Z-isomer ranged from 31 to 67 percent, with moderate selectivity (Table 2). The yields obtained from phenol-based allenes were equivalent to those obtained from phthalimide-based allenes, although the process was less stereoselective.

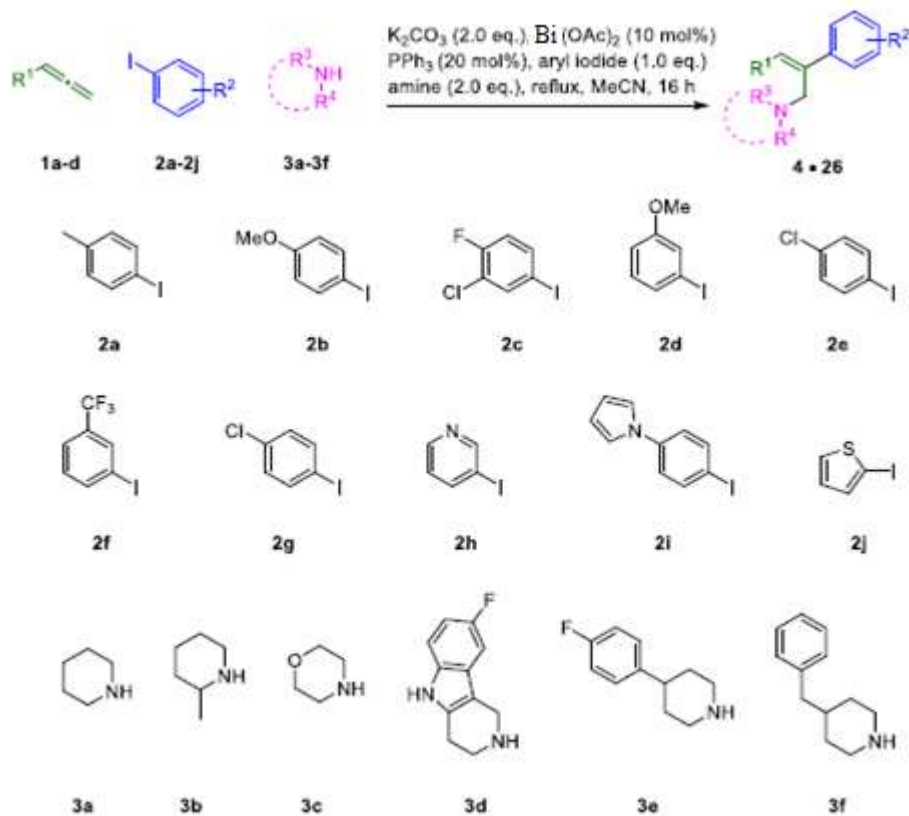
Figure 3 depicts the proposed reaction process. PPh<sub>3</sub> is used to decrease Bi(III) to Bi(0). The aryl iodide is then oxidatively inserted with Bi (0). Allene insertion then displaces one of the PPh<sub>3</sub> ligands from Bi(0), followed by aryl group migratory insertion. The amine can then attack the complex nucleophilically to free the product. Reductive elimination by a base can be used to recover the catalyst[9]



**Scheme 1.** Synthesis of a range of allenes via the Crabbé reaction for use in the palladium catalysed cascade.



**Fig. 1.** Major isomers (*Z*) of the products formed from phthalimide based allenes in the palladium catalysed cascade reaction.



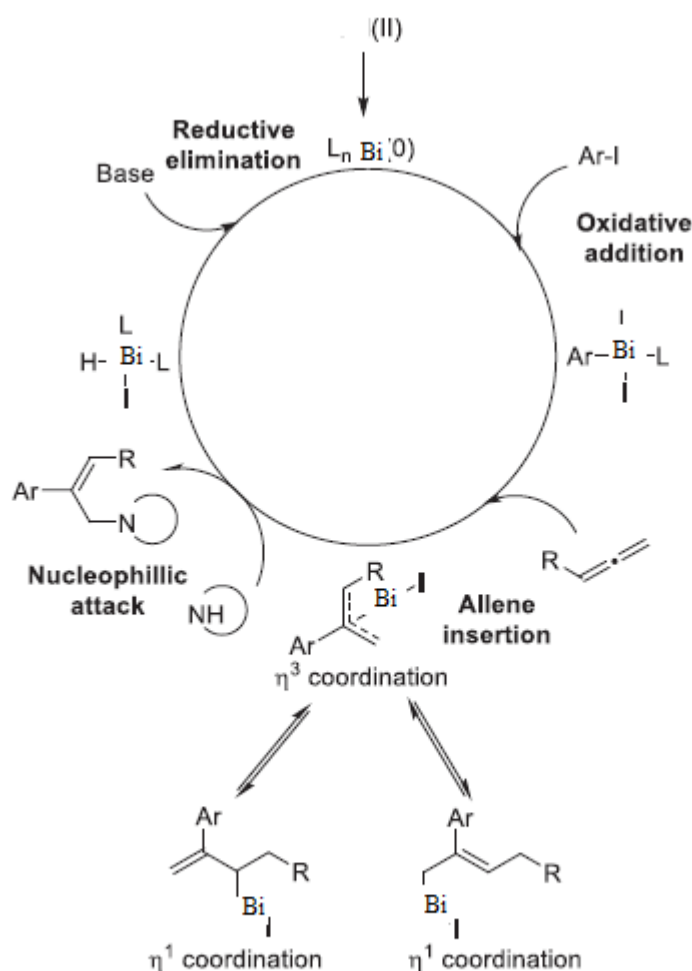
**Scheme 2.** The range of amines and aryl iodides used in the cascade reaction and the general reaction scheme.

**Table 1**

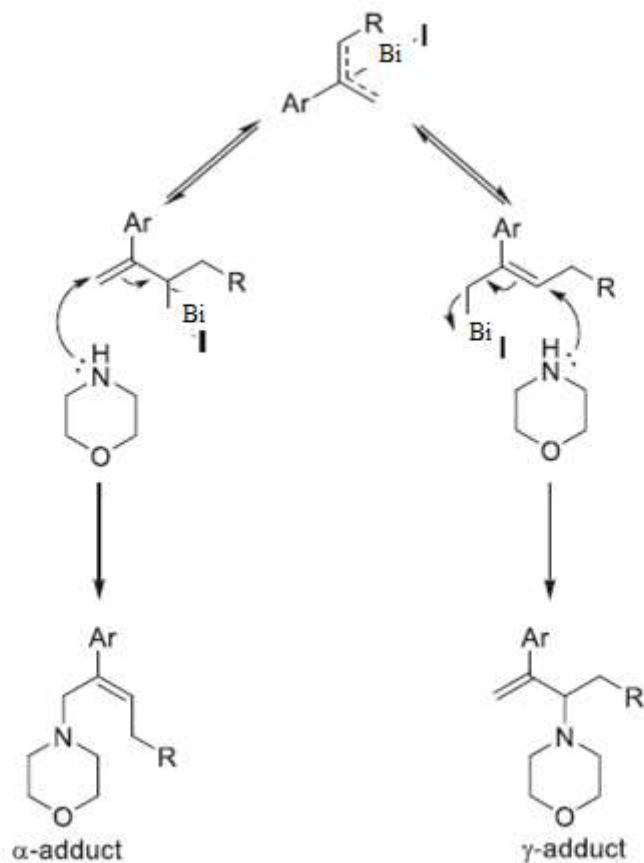
Combination of the aryl iodide, amine and allene used, along with the product obtained, yield and stereoselectivity.

Allene	Aryl iodide	Amine	Product	Yield (%)	E/Z
1a	2a	3a	4	53	6:94
1a	2j	3a	5	78	0:100
1a	2b	3a	6	55	0:100
1a	2c	3c	7	76	17:83
1a	2b	3c	8	65	29:71
1a	2c	3d	9	73	22:78
1a	2e	3d	10	75	12:88
1a	2f	3c	11	74	21:79
1a	2b	3e	12	63	20:80
1a	2d	3c	13	90	16:84
1a	2i	3c	14	36	4:96
1a	2f	3f	15	31	10:90
1a	2f	3b	16	40	2:98
1a	2h	3c	17	36	0:100
1b	2g	3c	18	53	17:83
1b	2f	3c	19	61	12:88

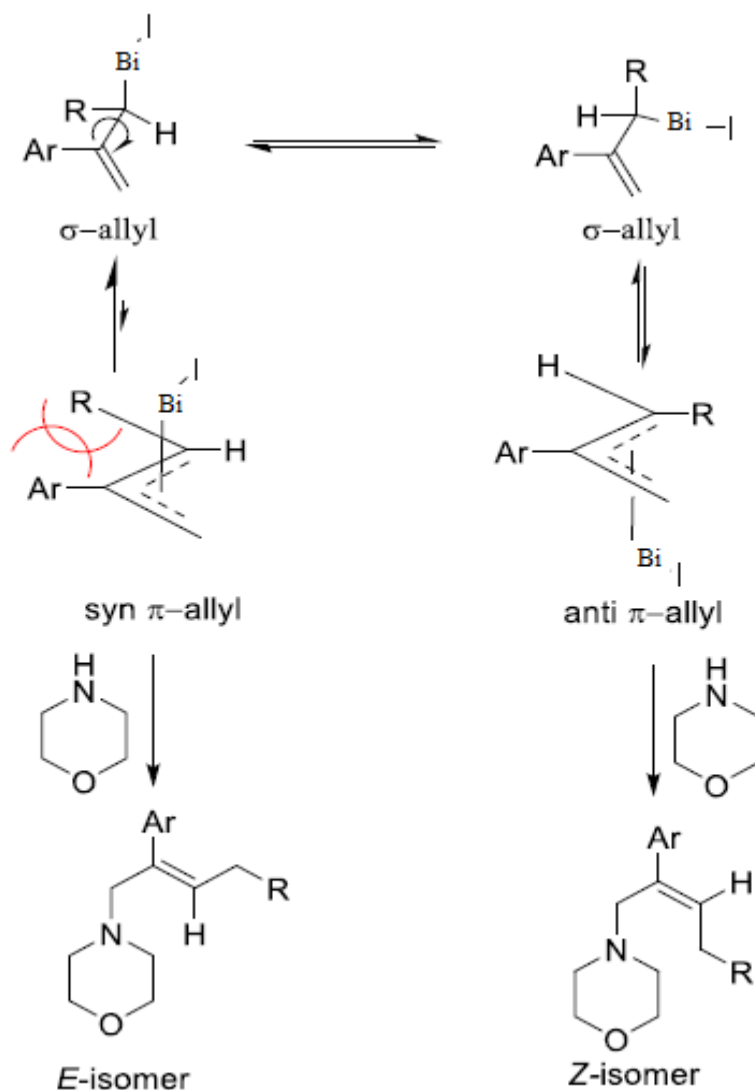
Allene	Aryl iodide	Amine	Product	Yield (%)	E/Z
1c	2f	3c	20	43	26:74
1c	2b	3c	21	53	29:71
1c	2g	3c	22	36	25:75
1d	2b	3c	23	67	25:75
1d	2g	3c	24	64	25:75
1d	2f	3c	25	61	30:70



**Fig. 3.** Proposed reaction mechanism for the palladium catalyzed, three-component cascade reaction.



**Scheme 3.** Regiochemical outcome of nucleophilic attack on both  $\eta^1$  palladium complexes. Nucleophilic attack on the least hindered position is favoured ( $\alpha$ adduct).



**Scheme 4.** Unfavourable interactions in the syn  $\pi$ -allyl complex leads to preferential formation of the anti  $\pi$ -allyl complex and the Z-isomer.

Through rearrangement of the two r-allyl palladium species, the two p-allyl Bismuth species can interconvert (Scheme 4). Amphetamine is a kind of amine. Each p-allyl Bismuth complex is attacked by the least hindered carbon. to produce a blend of E and Z isomers The greater the desire for With phthalimide-based allenes, the Z-isomer can be Because of its increased steric mass, it has a greater impact. In the syn pallyl, the allene R group and the aryl ring collide. Complex this encourages the production of anti-p-allyl compound, as well as the Z-isomer that results [9].

#### Conclusions:

In summary, we have successfully produced a wide range of substituted (Z)-2-butene 1,4-diamine analogues and substituted 4-aryloxy but-2-enyl amine analogues with good yields, regioselectivity, and stereoselectivity for the Z-isomer utilising a Bismuth catalysed three-component cascade reaction. A variety of aryl iodides, including those with electron-withdrawing and electron-donating groups, were utilised in the experiment. There was no discernible difference in yield, regioselectivity, or stereoselectivity when amines of various steric bulk were employed.

#### References:

- [1] R. Lei, Y. Wu, S. Dong, K. Jia, S. Liu, W. Hu, *J. Org. Chem.* 82 (2017) 2862–2869.
- [2] K. Li, L. Chen, Y.X. Fan, Y. Wei, S.J. Yan, *J. Org. Chem.* 84 (2019) 11971–11982.
- [3] Q.X. Zi, C.L. Yang, K. Li, Q. Luo, J. Lin, S.J. Yan, *J. Org. Chem.* 85 (2020) 327–338.
- [4] R. Zimmer, C.U. Dinesh, E. Nandan, F.A. Khan, *Chem. Rev.* 100 (2000) 3067–3125.
- [5] R. Grigg, I. Köppen, M. Rasparini, V. Sridharan, *Chem. Commun.* (2001) 964–965.
- [6] X. Gai, R. Grigg, S. Collard, J.E. Muir, *Chem. Commun.* (2000) 1765–1766.
- [7] U. Anwar, R. Grigg, M. Rasparini, V. Savic, V. Sridharan, *Chem. Commun.* (2000)

645–646.

[8] R. Grigg, E.E. Elboray, S. Akkarasamiyo, N. Chuanopparat, H.A. Dondas, H.H. Abbas-Temirek, C.W.G. Fishwick, M.F. Aly, B. Kongkathip, N. Kongkathip, *Chem. Commun.* 52 (2016) 164–166.

[9] K. Ross, R. Grigg, *J. Assoc. Lab Autom.* 9 (2004) 103–108.