

## The sustainability of the Morita–Baylis–Hillman reaction

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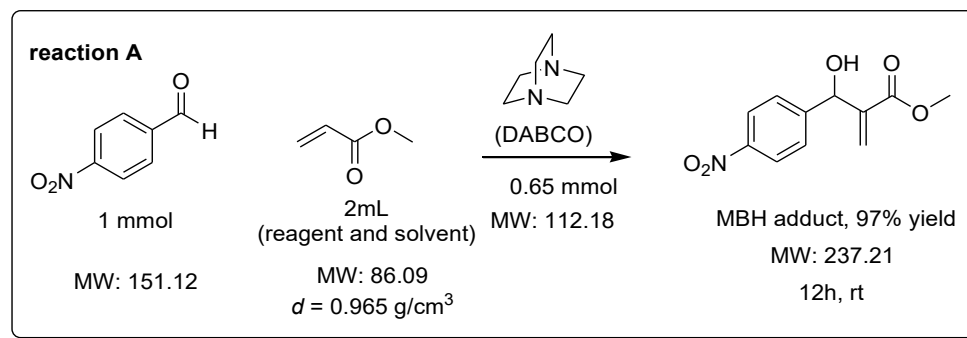
<sup>d</sup> *Supplementary Information available: experimental procedures and E-factor calculations. See DOI: 10.1039/x0xx00000x*

### Supplementary Material

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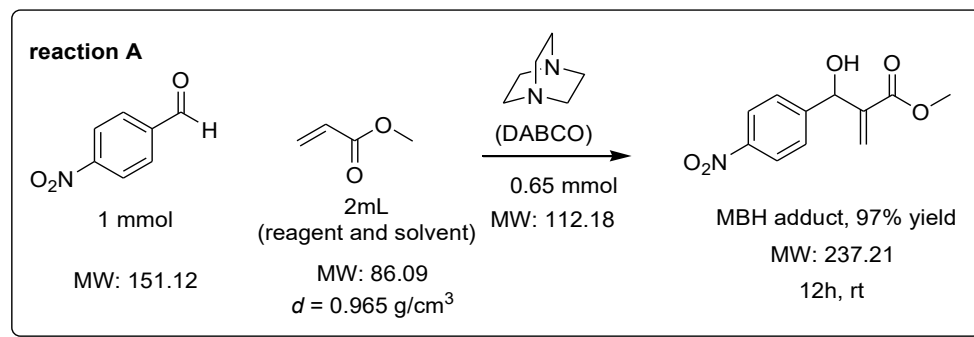
## 1. Reaction A: experimental procedure



A mixture of the aldehyde (1 mmol), methyl acrylate (2 mL) and DABCO (0.65 equiv.) was sonicated for 6h. Ultrasound bath temperature was constantly monitored and kept at 30–40°C during the reaction, through ice addition or by using a refrigerated recirculator. After the reaction time, the mixture was diluted with ethyl acetate (20 mL). The organic solution was washed with 10% aqueous HCl (3×10 mL), concentrated under reduced pressure and dried over Na<sub>2</sub>SO<sub>4</sub> (2g). After filtration and solvent removal, the residue was filtered through a pad with 5 g of silica gel (10-30% ethylacetate-hexane).

Details: 3 vials of 10mL of 10% ethylacetate-hexane (recovery of the aldehyde); 1 vial of 10 ml of 10% ethylacetate-hexane (any product); 5 vials of 10 mL of 30% ethylacetate-hexane (MBH adduct).

## 2. Reaction A: simple E factor calculation (sEF)



Aldehyde	Acrylate	DABCO	Product (97%)
0.151 g	0.965 g	0.73 g	0.23 g (0.237 g x 0.97)

$$sEF = \frac{(\sum m_{\text{raw materials}} + \sum m_{\text{reagents}}) - m_{\text{product}}}{m_{\text{product}}}$$

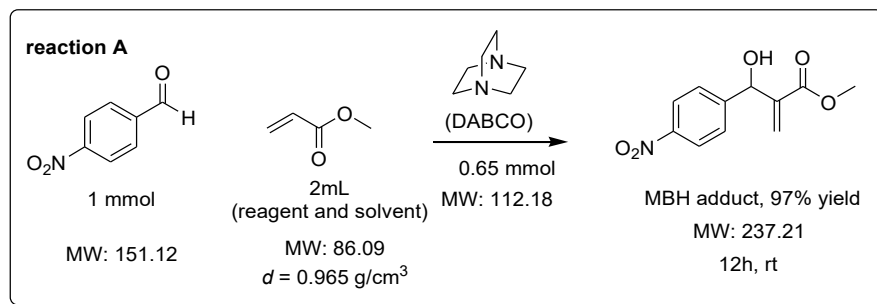
$$\rightarrow sEF = 4.3$$

Raw materials: aldehyde (0.151 g) + acrylate (0.965 g)

Reagents: DABCO (0.112 g)

**Product:** MBH adduct (0.230 g)

### 3. Reaction A: complete E factor calculation (cEF)



Aldehyde	Acrylate	DABCO	Product (97%)
0.151 g	0.965 g	0.073 g	0.23 g (0.237 g x 0.97)

$$cEF = \frac{(\sum m_{\text{raw materials}} + \sum m_{\text{reagents}} + \sum m_{\text{solvents}} + m_{\text{water}}) - m_{\text{product}}}{m_{\text{product}}} \rightarrow cEF = 541$$

Raw materials: aldehyde (0.151 g) + acrylate (0.965 g)  $\rightarrow$  1.116 g

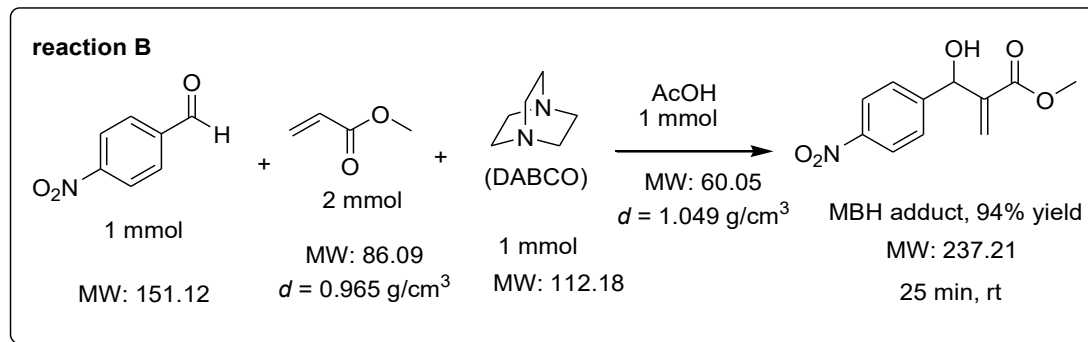
Reagents/waste: DABCO (0.073 g) + silica gel (5 g) + drying agent (2 g)  $\rightarrow$  7.112 g

Solvents: acrylate (0.965 g) + ethyl acetate (20 mL  $\sim$  18.04 g) + eluents  $\sim$ 67.5 g (hexane-ethyl acetate: 90 mL)  $\rightarrow$  86.51g

"Water": 27g and 3 g of HCl (30 mL of HCl 10%)  $\sim$ 30g

**Product:** MBH adduct (0.230 g)

#### 4. Reaction B: experimental procedure

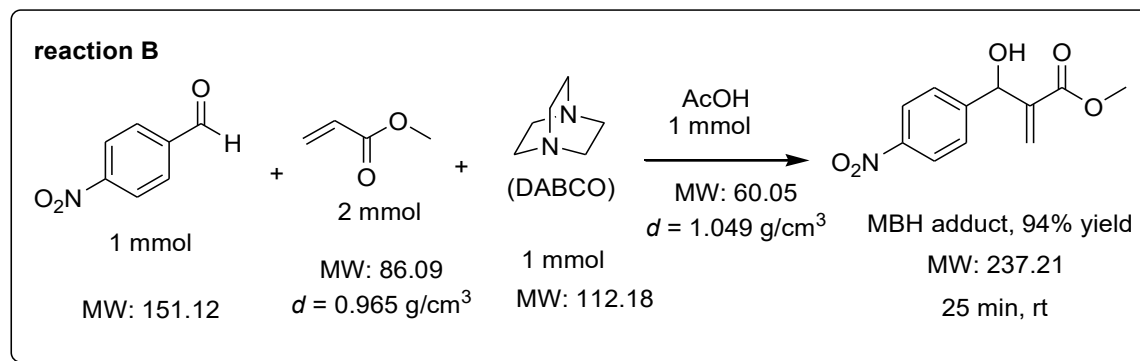


In a 10 mL round-bottom flask, a mixture of methyl acrylate (2 mmol), aldehyde (one mmol), DABCO (1 mmol), and acetic acid (57.25  $\mu\text{L}$ , 1 mmol) was stirred at room temperature until full conversion of limiting starting material or stagnation of reaction.

The excess of ethyl acrylate was removed under reduced pressure, and the resulting crude residue was purified by silica gel *flash* chromatography using a gradient mixture of hexane/ethyl acetate as eluent to furnish the corresponding MBH adduct, in 94% yield.

Purification: 3 vials of 10mL of 10% ethylacetate-hexane (recovery of the aldehyde); 1 vial of 10 ml of 10% ethylacetate-hexane (any product); 5 vials of 10 mL of 30% ethylacetate-hexane (MBH adduct).

## 5. Reaction B: simple E factor calculation (sEF)



Aldehyde	Acrylate	DABCO	Acetic acid	Product (94%)
0.151 g	1.76 g (0.86 x 2)	0.112 g	0.06 g	0.22 g (0.24 g x 0.94)

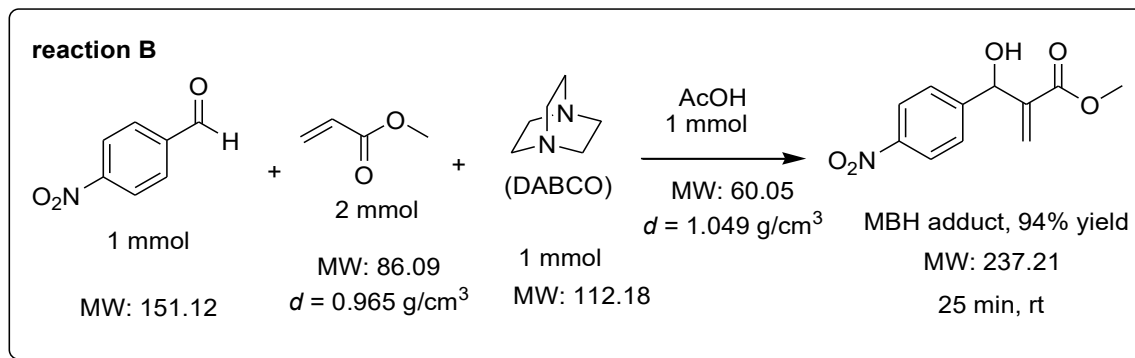
$$sEF = \frac{(\sum m_{\text{raw materials}} + \sum m_{\text{reagents}}) - m_{\text{product}}}{m_{\text{product}}} \rightarrow sEF = 4.8$$

Raw materials: aldehyde (0.151 g) + acrylate (0.965 g)

Reagents: DABCO (0.112 g), acetic acid (0.06 g)

**Product:** MBH adduct (0.237g x 0.94 = 0.22 g)

## 6. Reaction B: complete E factor calculation (cEF)



Aldehyde	Acrylate	DABCO	Acetic acid	Product (94%)
0.151 g	1.76 g (0.86 x 2)	0.112 g	0.06 g	0.22 g (0.24 g x 0.94)

$$cEF = \frac{\overbrace{(\sum m_{\text{raw materials}} + \sum m_{\text{reagents}} + \sum m_{\text{solvents}} + m_{\text{water}})}^{\text{input}} - m_{\text{product}}}{m_{\text{product}}}$$

$$\rightarrow cEF = 430$$

Raw materials: aldehyde (0.151 g) + acrylate (0.965 g)  $\rightarrow$  1.116 g

Reagents/waste: DABCO (0.112 g) + acetic acid (0.06) + silica gel (5 g) + drying agent (2 g)  $\rightarrow$  7.112 g

Solvents: acrylate (0.965 g) + eluents  $\sim$ 67.5 g (hexane-ethyl acetate: 90 mL)  $\rightarrow$  86.51g

**Product:** MBH adduct (0.237 x 0.94 = 0.220 g)

## Reference

Ref. R. A. Sheldon. *Green Chem.*, 2017, 19, 18. <https://doi.org/10.1039/C6GC02157C>