

## Supplementary Material

### The carbamate esters as organocatalysts in asymmetric Michael addition reactions in aqueous media: when pyrrolidine backbone surpasses 1,2-diaminocyclohexane

Anirban Mondal and Kartick C. Bhowmick\*

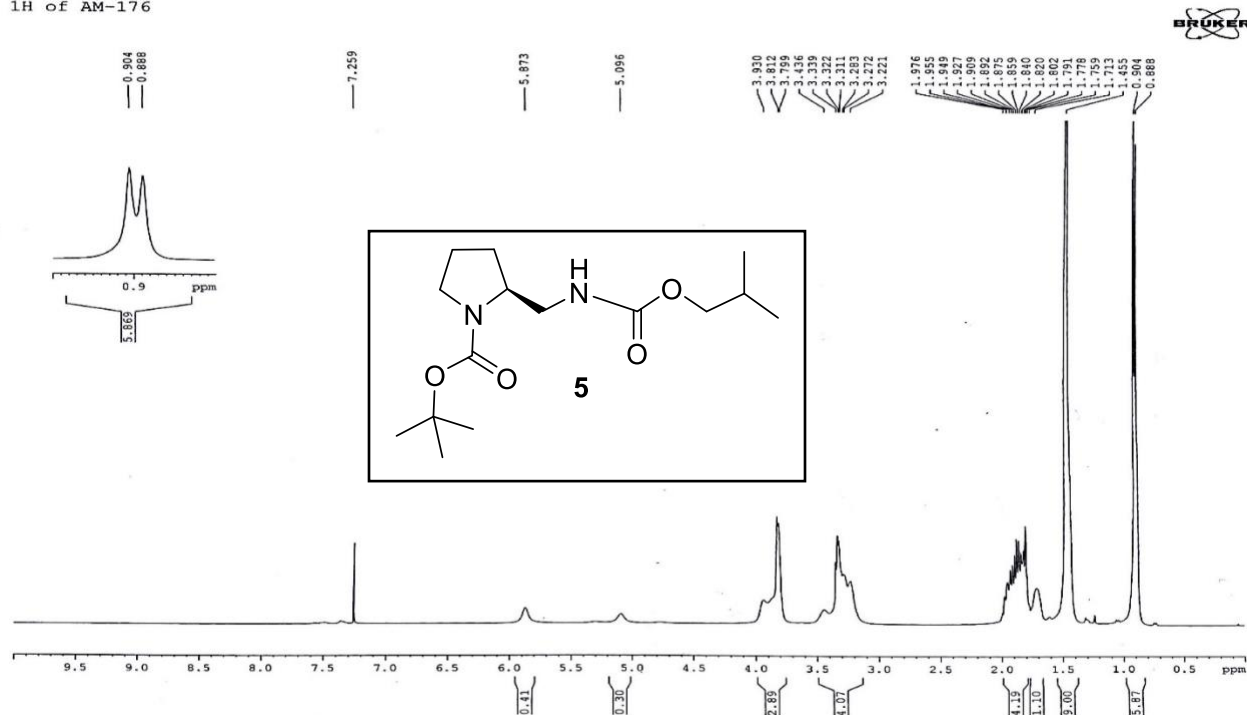
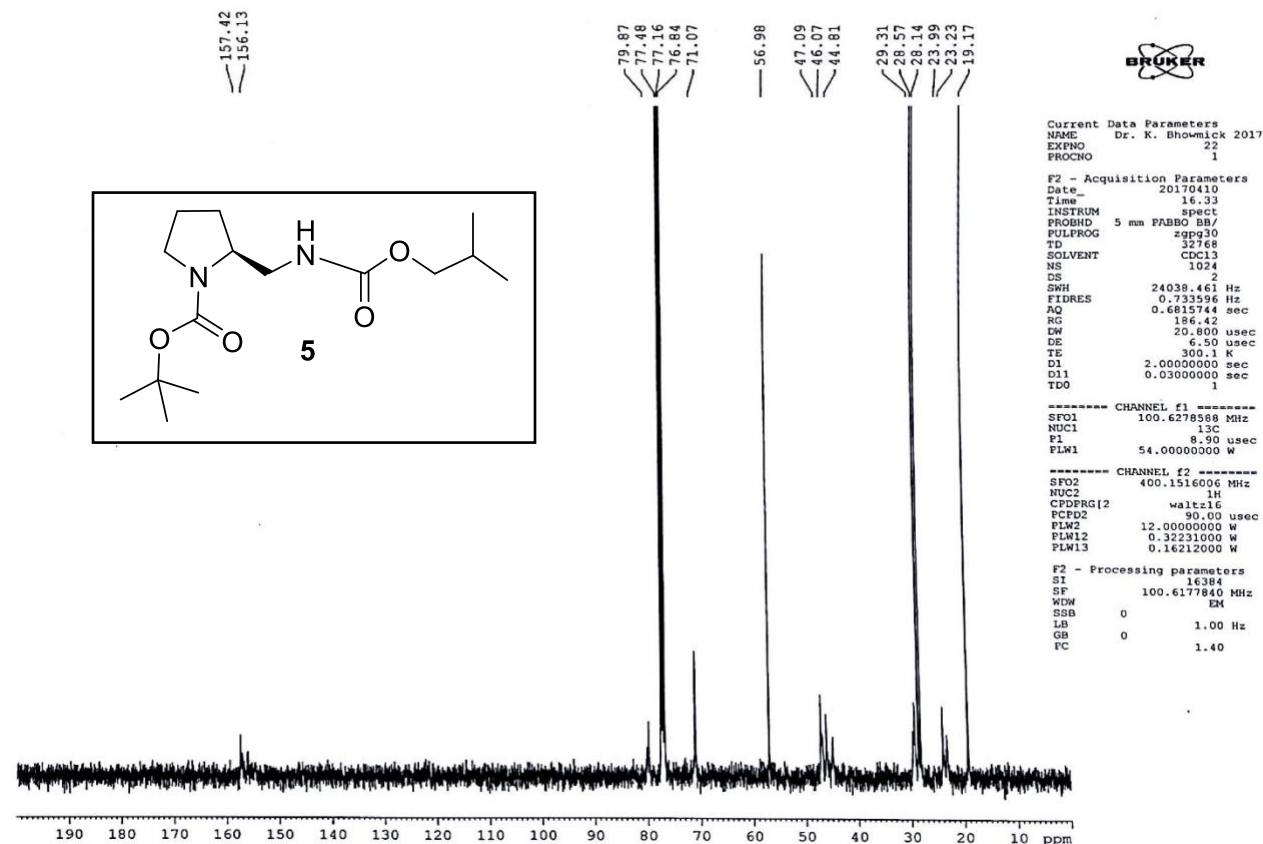
*Division of Organic Synthesis, Department of Chemistry, Visva-Bharati (A Central University); Bolpur, West Bengal-731 235, India.*

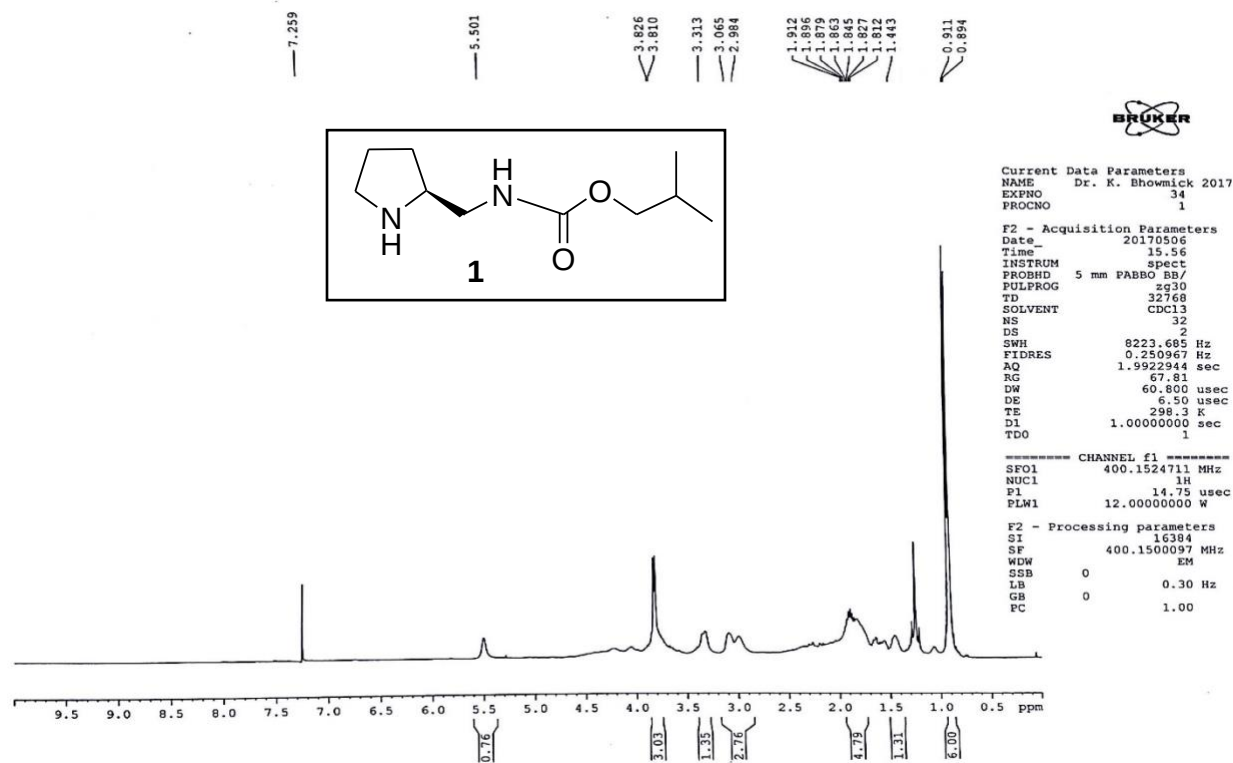
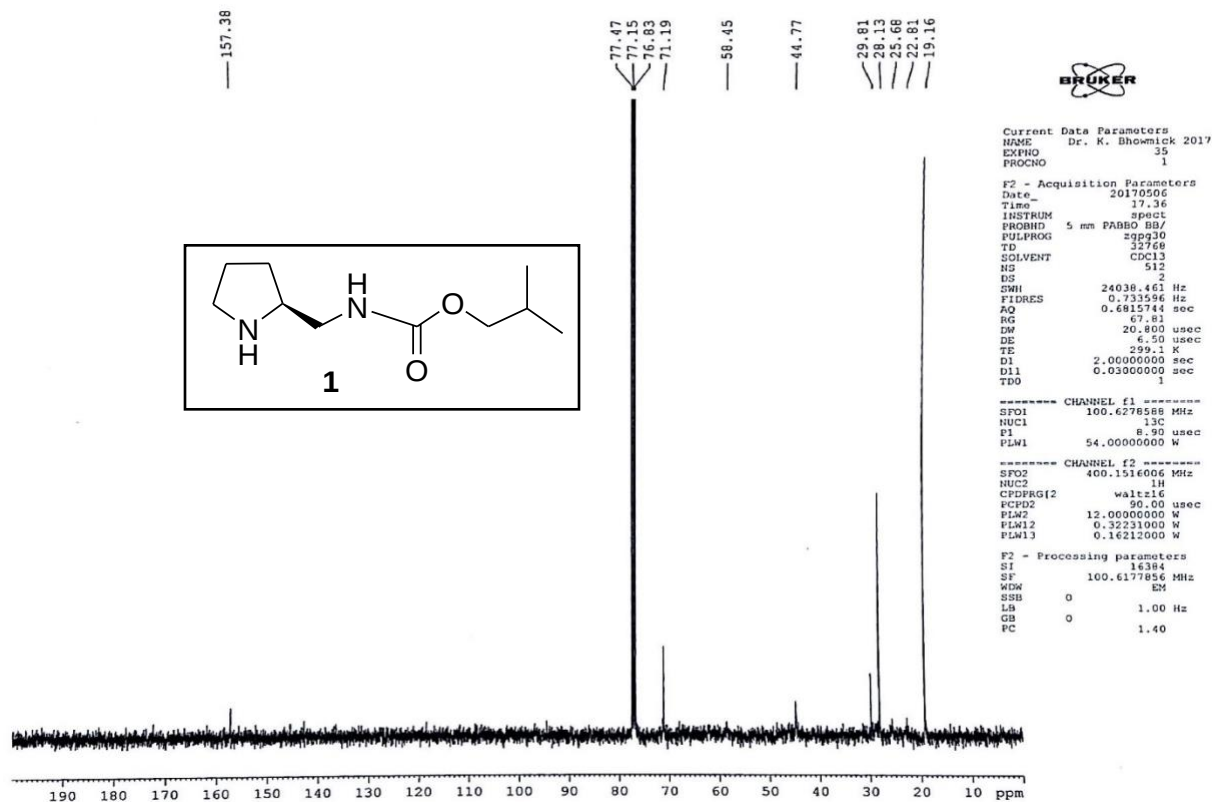
*E-mail: [kartickc.bhowmick@visva-bharati.ac.in](mailto:kartickc.bhowmick@visva-bharati.ac.in)*

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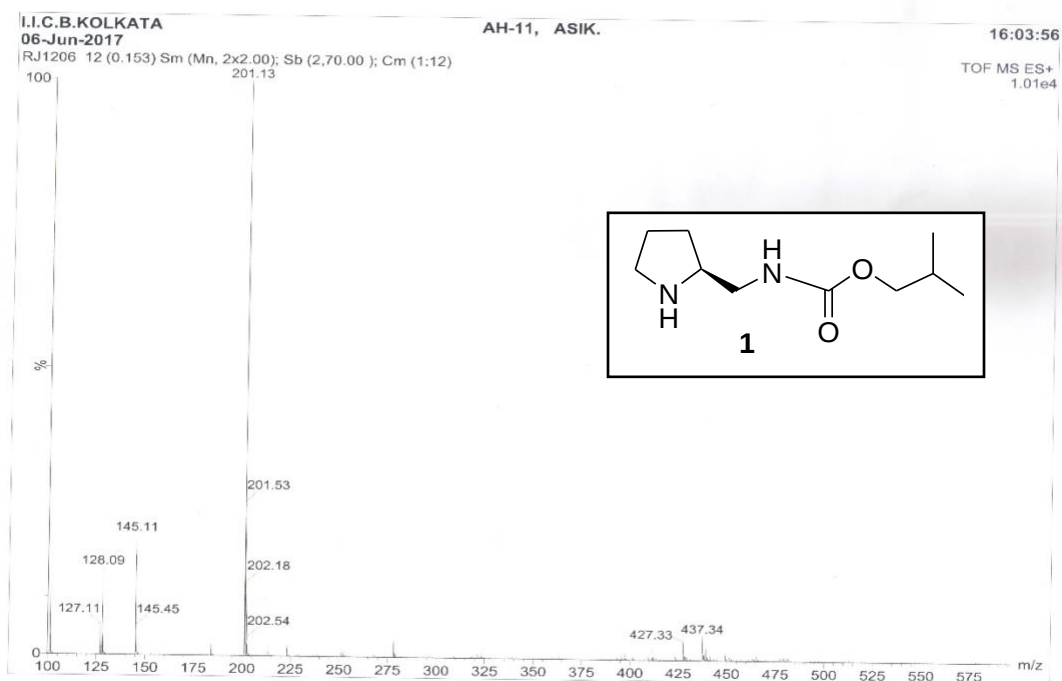
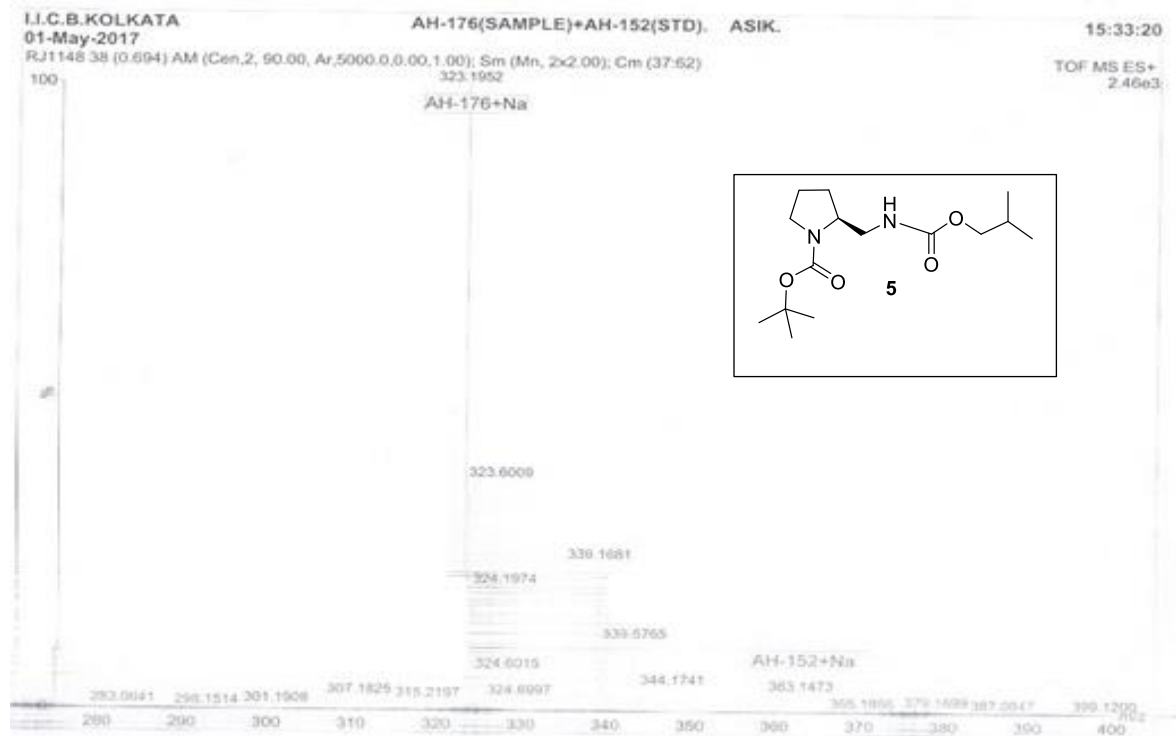
|                                                   |    |
|---------------------------------------------------|----|
| 1. NMR spectra of compounds <b>1</b> & <b>5</b>   | S2 |
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## 1. NMR spectra of the compound 5

 $^1\text{H}$  NMR $^1\text{H}$  of AM-176 $^{13}\text{C}$  NMR $^{13}\text{C}$  of AM-176

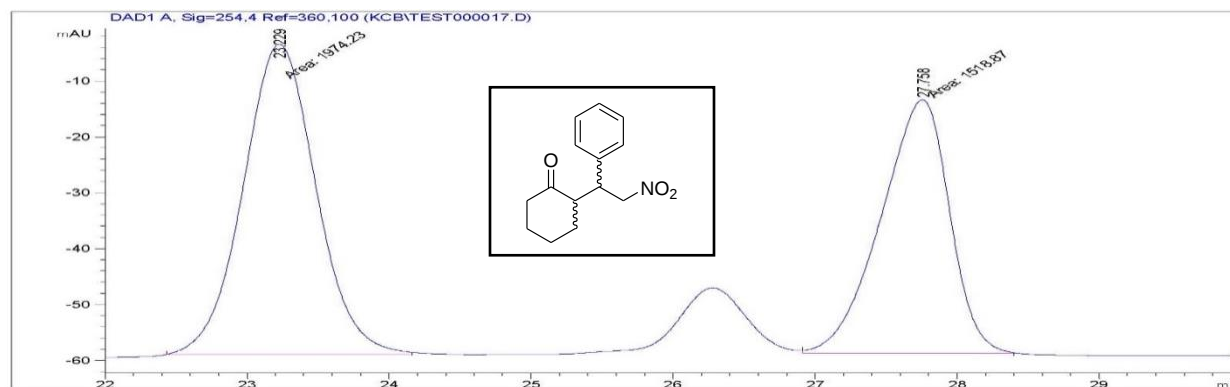
<sup>1</sup>H NMR of organocatalyst 1<sup>1</sup>H of AM-181<sup>13</sup>C NMR of organocatalyst 1<sup>13</sup>C of AM-181

## 2. Mass spectra of the compound 1 and 5



### 3. HPLC Data of Michael addition Products

#### Racemic



#### Area Percent Report

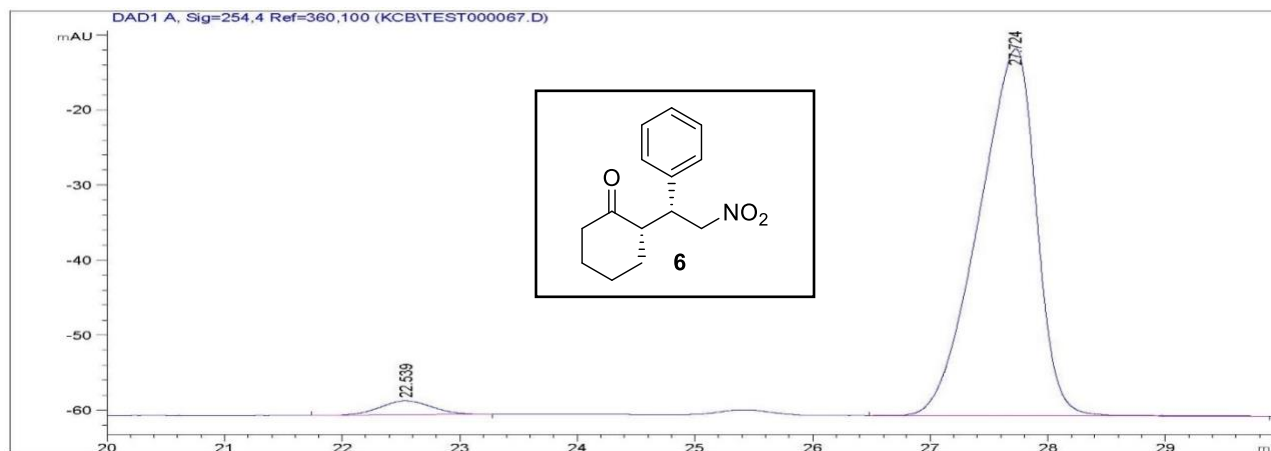
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 23.229        | MM   | 0.5926      | 1974.23474   | 55.52208     | 56.5180 |
| 2      | 27.758        | MM   | 0.5581      | 1518.87329   | 45.36180     | 43.4820 |

Totals : 3493.10803 100.00388

#### Chiral



#### Area Percent Report

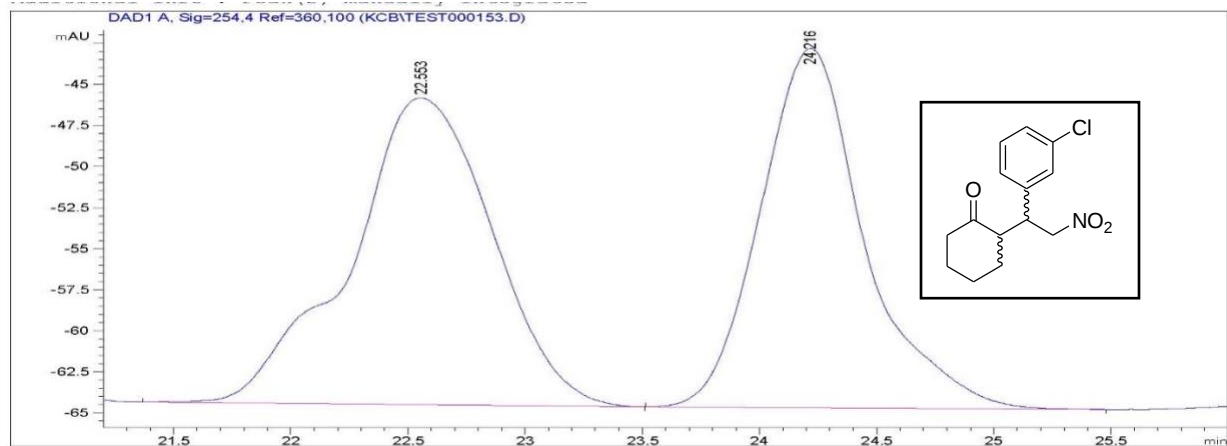
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.539        | BB   | 0.4762      | 56.43361     | 1.84831      | 3.2943  |
| 2      | 27.724        | BBA  | 0.5197      | 1656.62549   | 48.83812     | 96.7057 |

Totals : 1713.05910 50.68643

## Racemic



### Area Percent Report

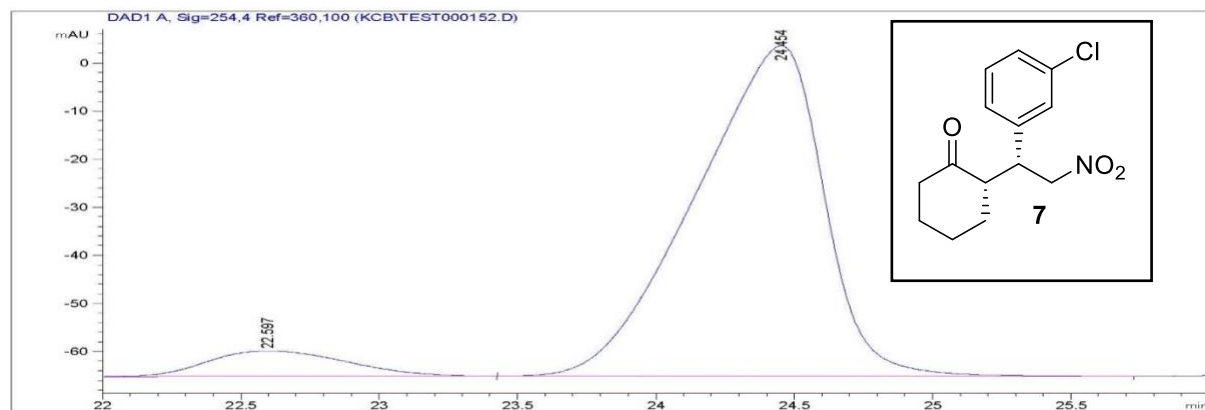
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Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.553        | BB   | 0.6466      | 786.47101    | 18.70302     | 53.8725 |
| 2      | 24.216        | BB   | 0.4668      | 673.40454    | 21.89748     | 46.1275 |

Totals : 1459.87555 40.60051

## Chiral



### Area Percent Report

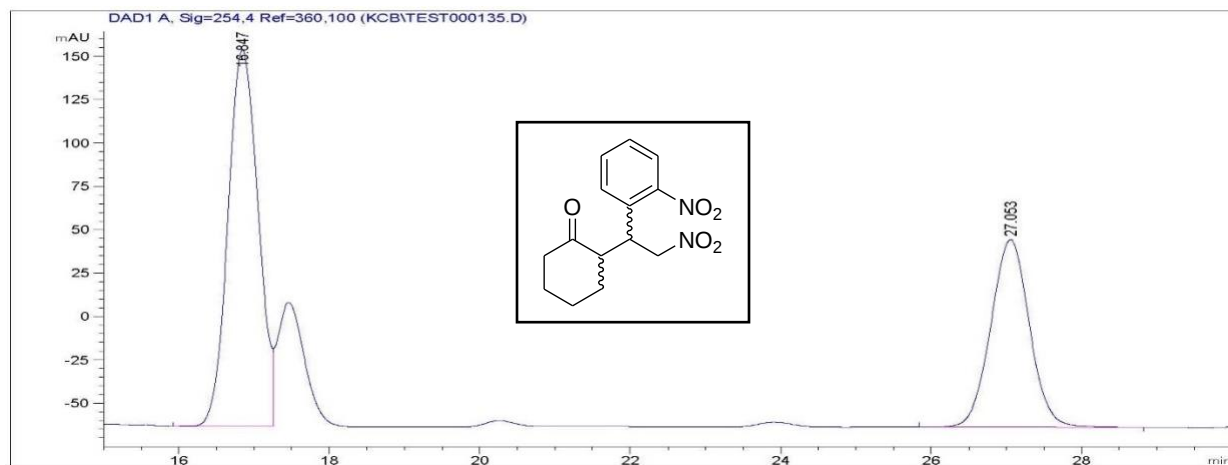
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.597        | BB   | 0.5517      | 187.23883    | 5.33140      | 7.7684  |
| 2      | 24.454        | BB   | 0.4796      | 2223.01758   | 68.69134     | 92.2316 |

Totals : 2410.25641 74.02274

## Racemic



### Area Percent Report

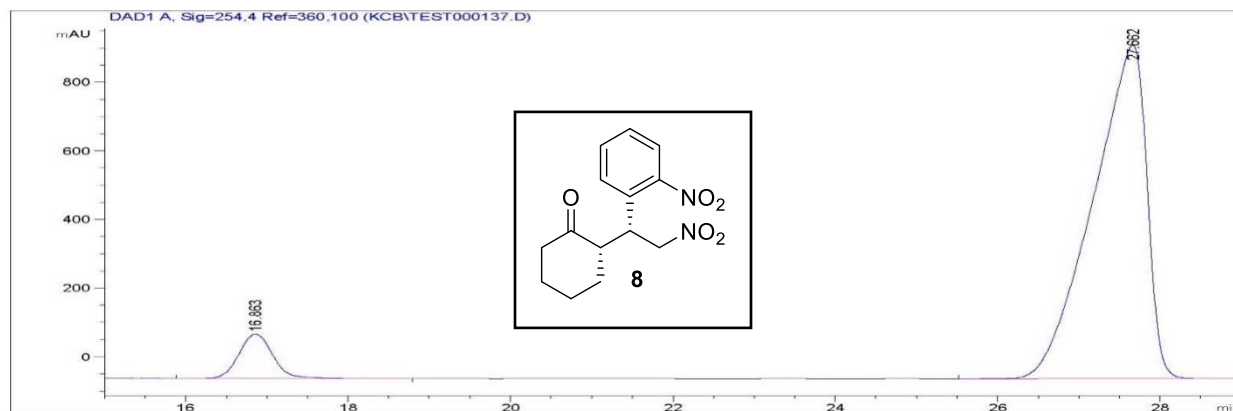
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 16.847        | BV   | 0.4415      | 6046.09961   | 216.71820    | 61.0787 |
| 2      | 27.053        | BB   | 0.5522      | 3852.76709   | 107.99067    | 38.9213 |

Totals : 9898.86670 324.70887

## Chiral



### Area Percent Report

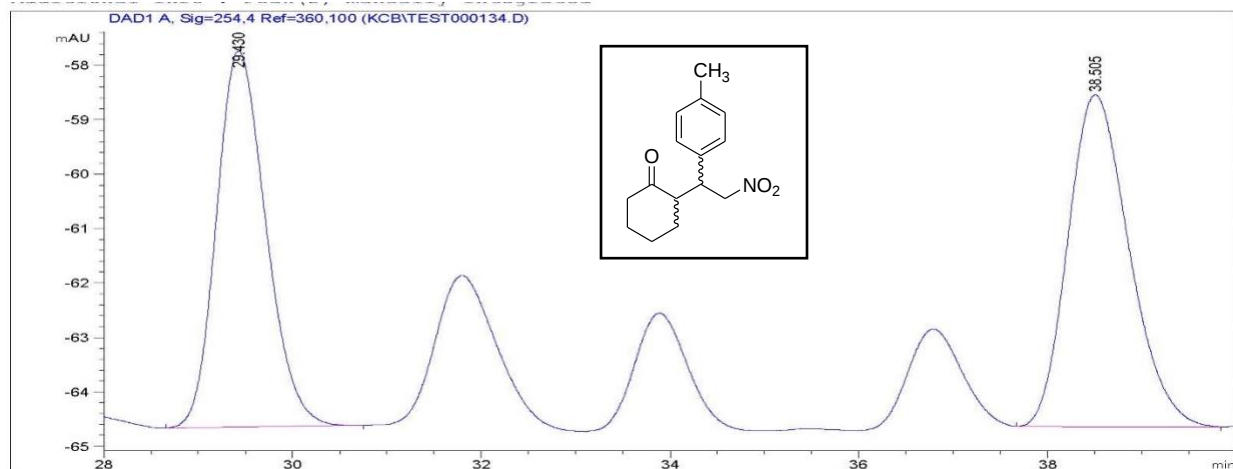
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 16.863        | BB   | 0.4538      | 3748.36035   | 129.44632    | 7.7380  |
| 2      | 27.662        | BBA  | 0.6809      | 4.46925e4    | 971.21509    | 92.2620 |

Totals : 4.84408e4 1100.66141

## Racemic



### Area Percent Report

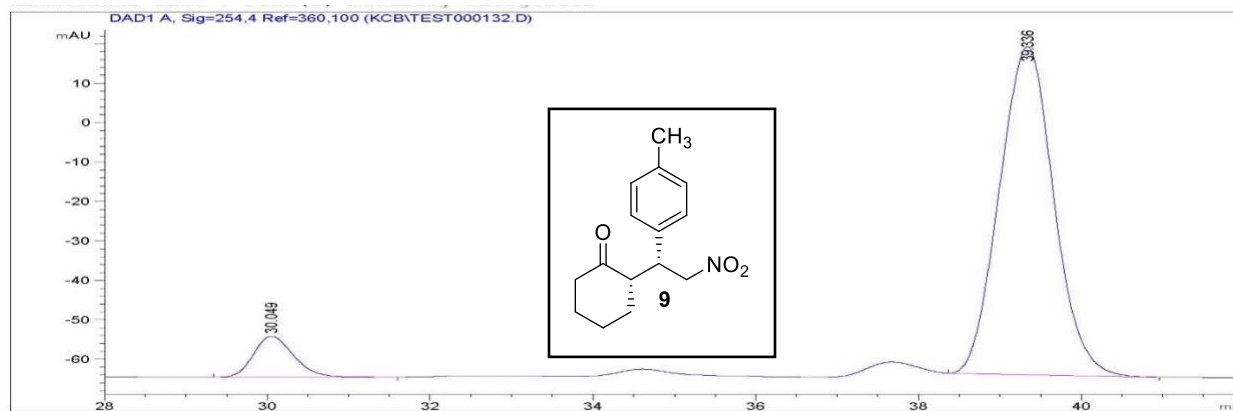
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 Dilution: : 1.0000  
 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 29.430        | BB   | 0.5432      | 250.64798    | 6.90930      | 47.7257 |
| 2      | 38.505        | BB   | 0.6693      | 274.53613    | 6.09692      | 52.2743 |

Totals : 525.18411 13.00622

## Chiral



### Area Percent Report

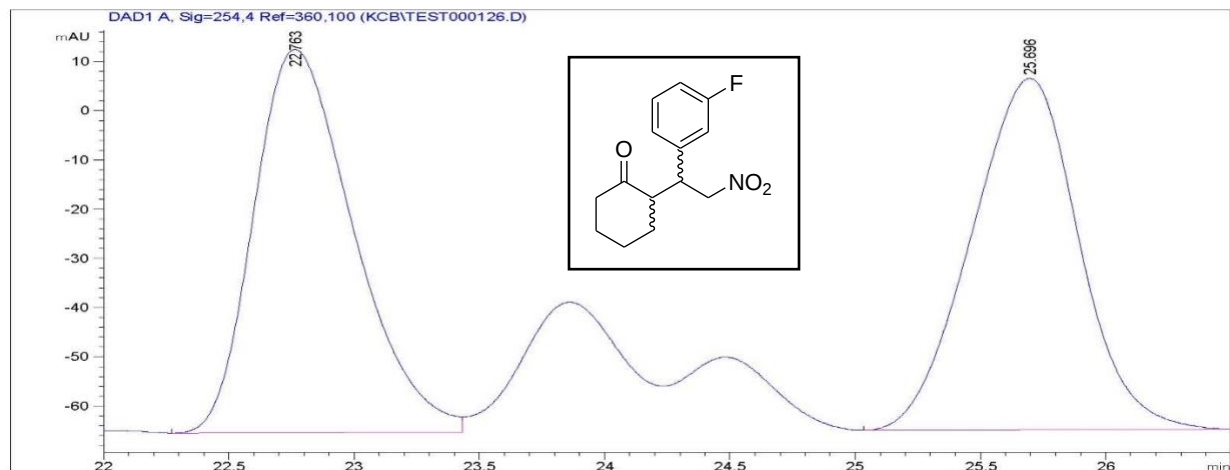
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 Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 30.049        | BB   | 0.5246      | 358.16095    | 10.43052     | 8.4898  |
| 2      | 39.336        | BB   | 0.7250      | 3860.58301   | 83.25861     | 91.5102 |

Totals : 4218.74396 93.68913

## Racemic



## Area Percent Report

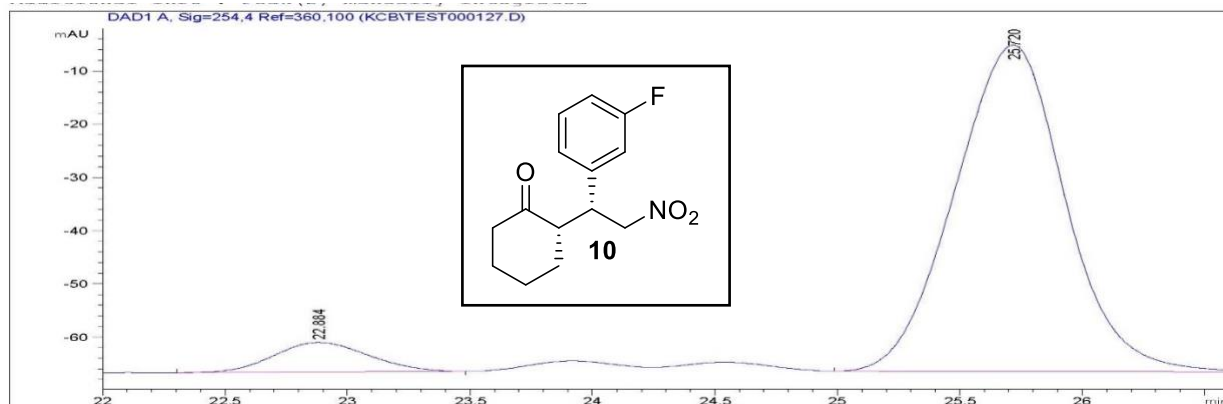
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.763        | BV   | 0.4239      | 2147.28906   | 77.82543     | 50.3129 |
| 2      | 25.696        | BB   | 0.4624      | 2120.58228   | 71.43094     | 49.6871 |

Totals : 4267.87134 149.25637

## Chiral



## Area Percent Report

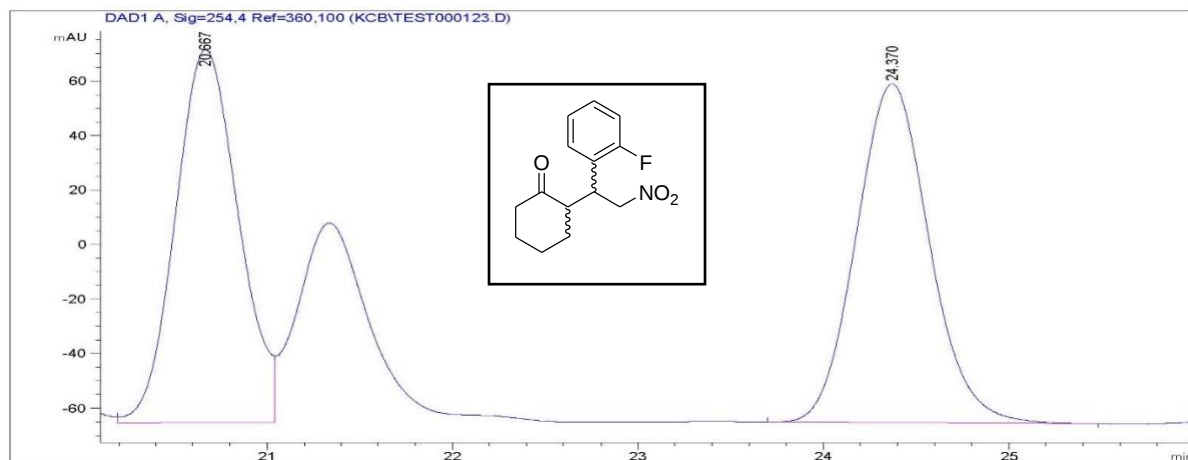
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Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.884        | BB   | 0.4135      | 149.17635    | 5.55099      | 7.1885  |
| 2      | 25.720        | BBA  | 0.4863      | 1926.02612   | 61.34002     | 92.8115 |

Totals : 2075.20247 66.89101

## Racemic



### Area Percent Report

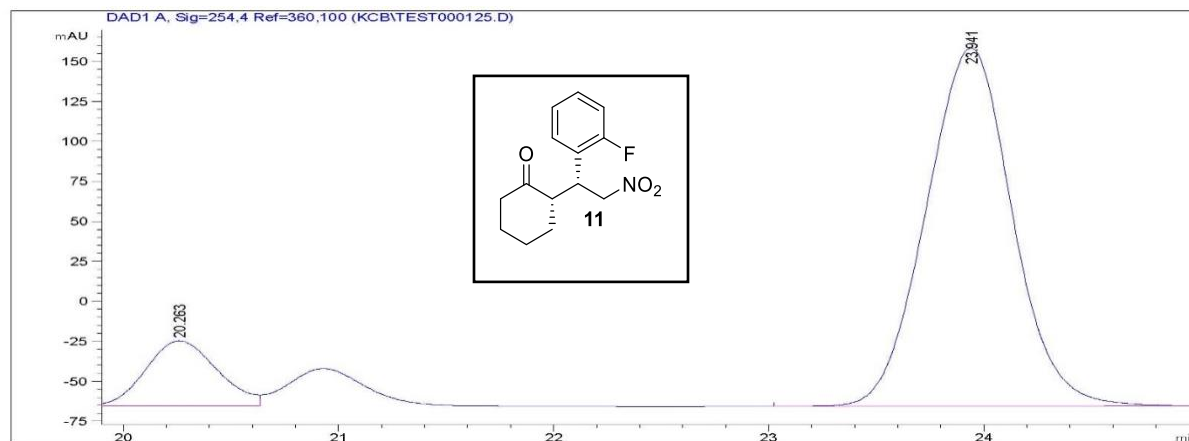
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 20.667        | VV   | 0.3660      | 3233.63184   | 136.69766    | 48.7702 |
| 2      | 24.370        | BB   | 0.4232      | 3396.71021   | 124.16700    | 51.2298 |

Totals : 6630.34204 260.86466

## Chiral



### Area Percent Report

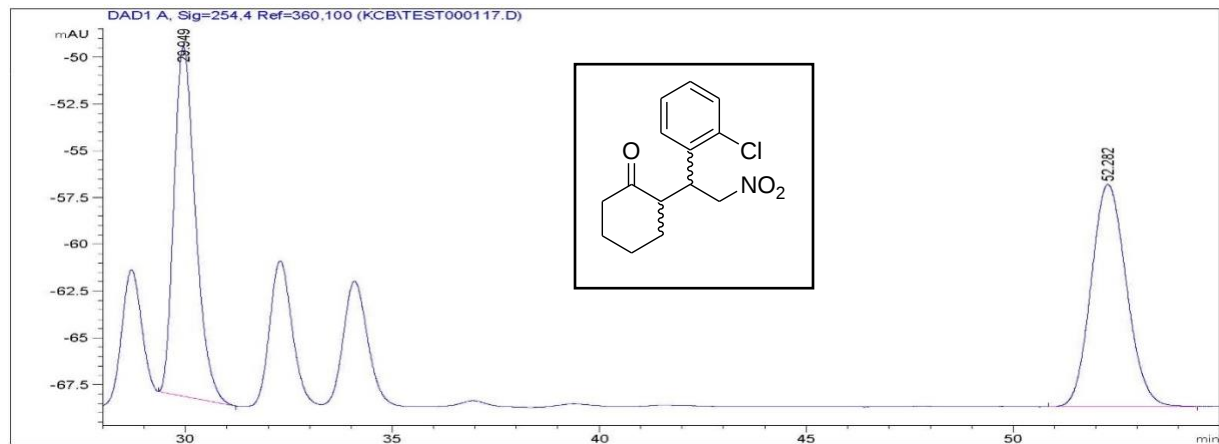
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 20.263        | VV   | 0.3574      | 928.23480    | 40.50366     | 12.9971 |
| 2      | 23.941        | BB   | 0.4318      | 6213.62061   | 223.85617    | 87.0029 |

Totals : 7141.85541 264.35983

## Racemic



### Area Percent Report

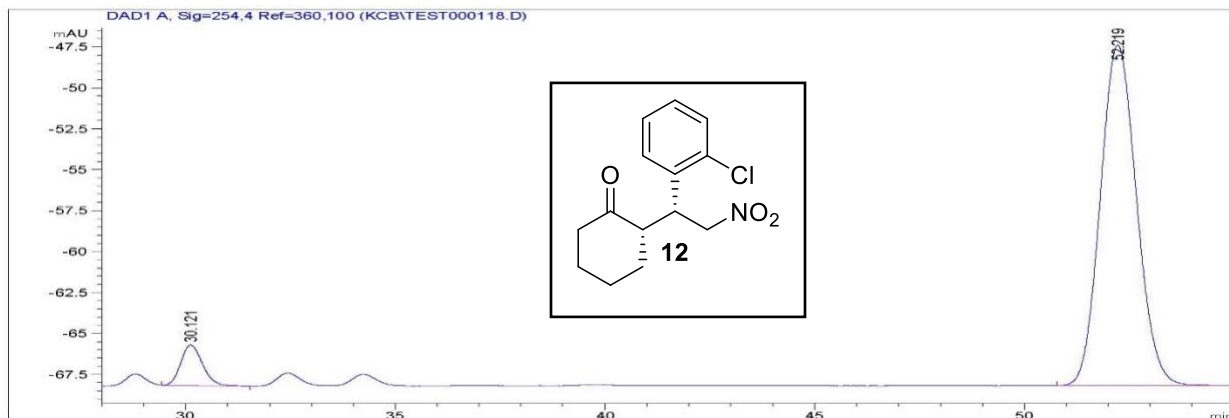
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 29.949        | BB   | 0.5528      | 673.95917    | 18.68406     | 48.8994 |
| 2      | 52.282        | BB   | 0.8822      | 704.29700    | 11.86974     | 51.1006 |

Totals : 1378.25616 30.55381

## Chiral



### Area Percent Report

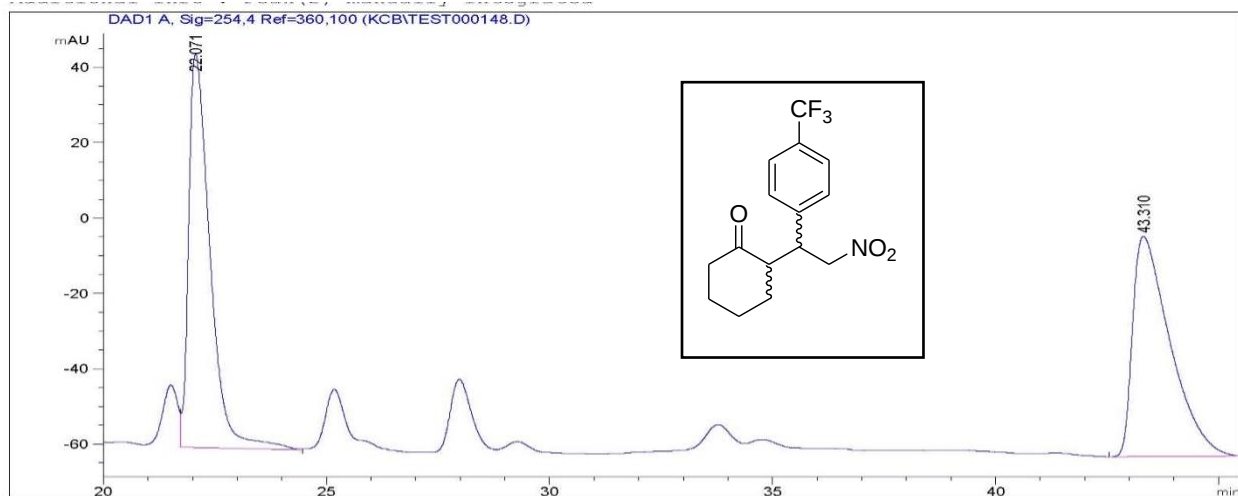
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 30.121        | BB   | 0.5222      | 88.57727     | 2.47092      | 6.6317  |
| 2      | 52.219        | BBA  | 0.9076      | 1247.08484   | 20.79625     | 93.3683 |

Totals : 1335.66211 23.26717

## Racemic



### Area Percent Report

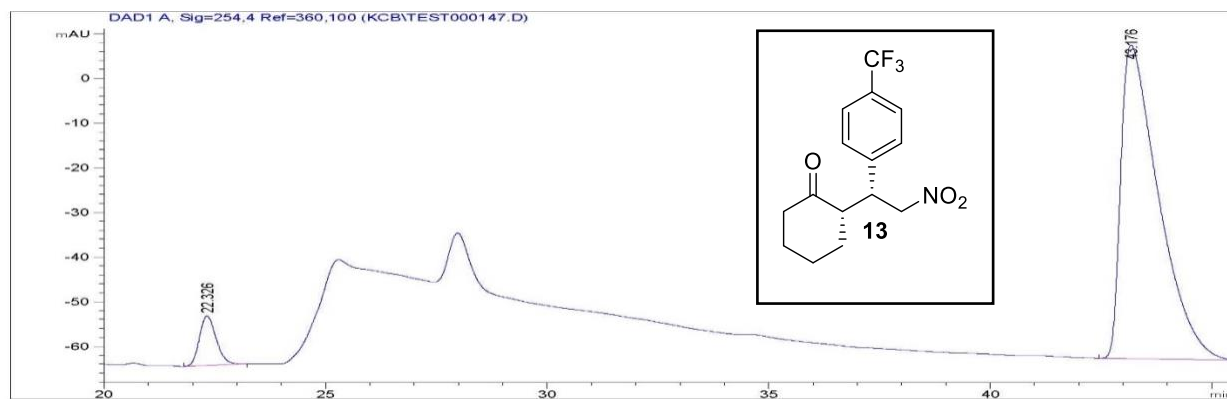
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.071        | VV   | 0.5066      | 3459.63647   | 104.41255    | 50.3926 |
| 2      | 43.310        | BB   | 0.8721      | 3405.72583   | 58.42039     | 49.6074 |

Totals : 6865.36230 162.83294

## Chiral



### Area Percent Report

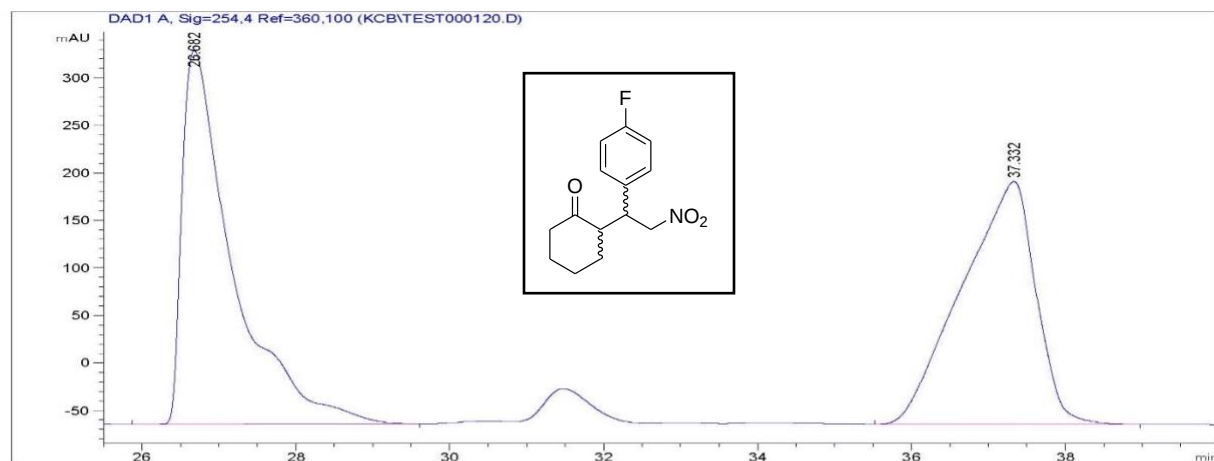
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 22.326        | BB   | 0.4036      | 291.16653    | 11.11613     | 6.5592  |
| 2      | 43.176        | BBA  | 0.8534      | 4147.91113   | 70.19157     | 93.4408 |

Totals : 4439.07767 81.30771

## Racemic



## Area Percent Report

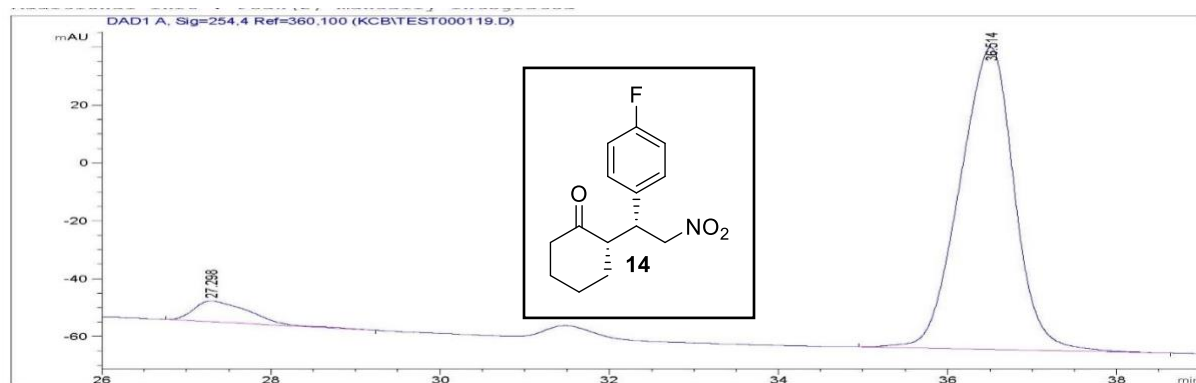
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 26.682        | BB   | 0.6540      | 1.79314e4    | 393.20734    | 51.2681 |
| 2      | 37.332        | BB   | 0.8994      | 1.70444e4    | 255.79810    | 48.7319 |

Totals : 3.49758e4 649.00543

## Chiral



## Area Percent Report

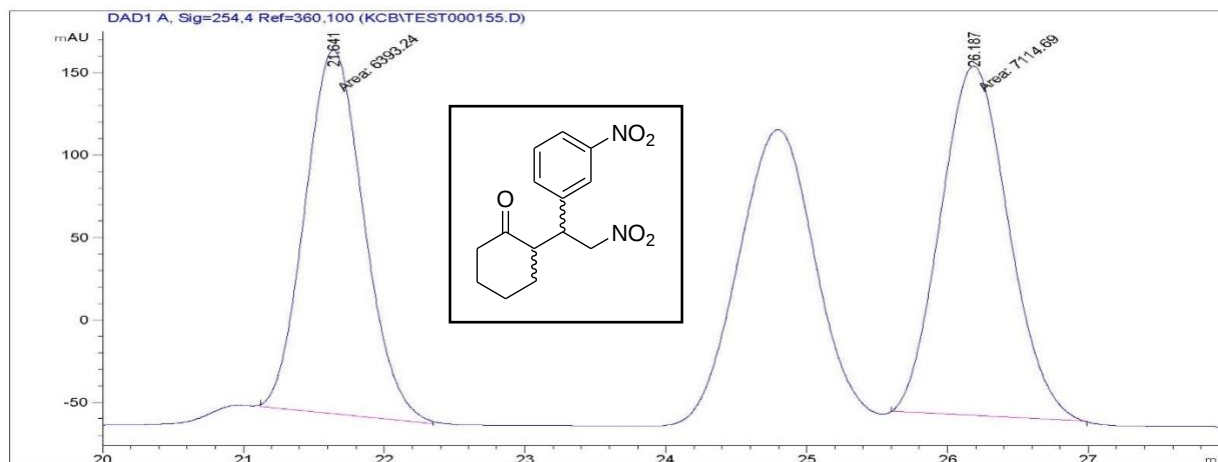
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Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 27.298        | BB   | 0.6345      | 329.17538    | 7.15839      | 6.5901  |
| 2      | 36.514        | BB   | 0.6934      | 4665.82764   | 104.39725    | 93.4099 |

Totals : 4995.00302 111.55564

## Racemic



### Area Percent Report

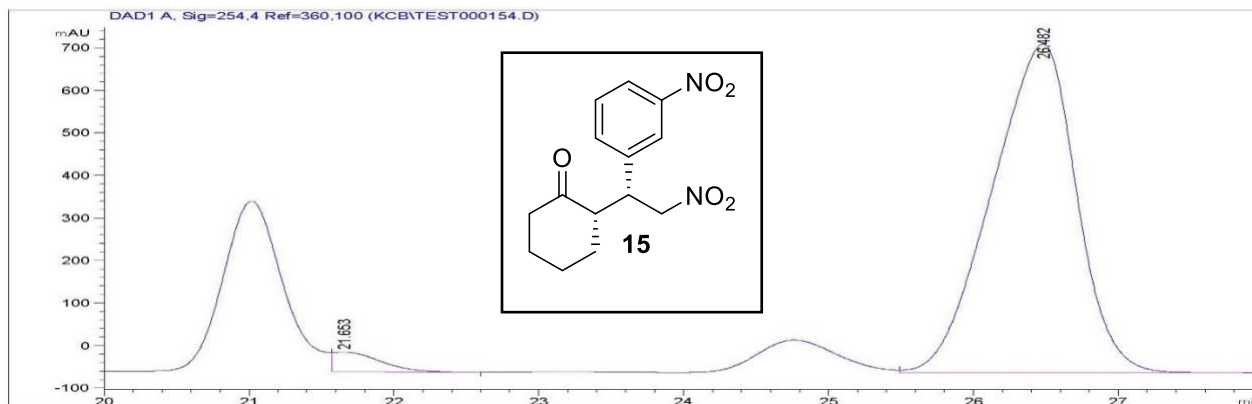
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Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 21.641        | MM   | 0.4833      | 6393.24023   | 220.47656    | 47.3295 |
| 2      | 26.187        | MM   | 0.5595      | 7114.69189   | 211.95001    | 52.6705 |

Totals : 1.35079e4 432.42657

## Chiral



### Area Percent Report

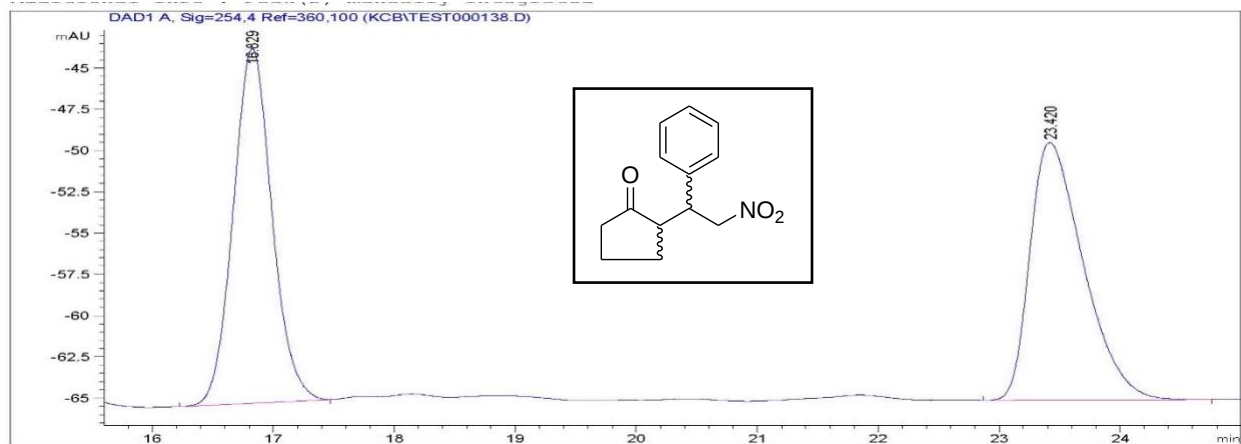
Sorted By : Signal  
Multiplier: : 1.0000  
Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 21.653        | VB   | 0.3428      | 1050.89331   | 46.30445     | 3.2475  |
| 2      | 26.482        | VB   | 0.6386      | 31309.1e4    | 772.96631    | 96.7525 |

Totals : 3.23600e4 819.27076

## Racemic



## Area Percent Report

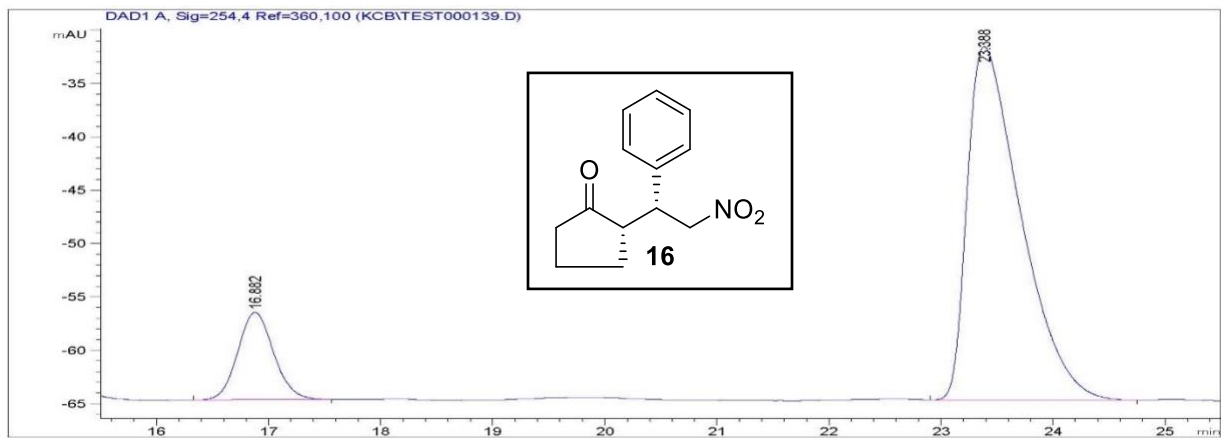
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Multiplier: : 1.0000  
Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 16.829        | BB   | 0.3414      | 478.75424    | 21.52957     | 50.0531 |
| 2      | 23.420        | BB   | 0.4690      | 477.73895    | 15.61443     | 49.9469 |

Totals : 956.49319 37.14400

## Chiral



## Area Percent Report

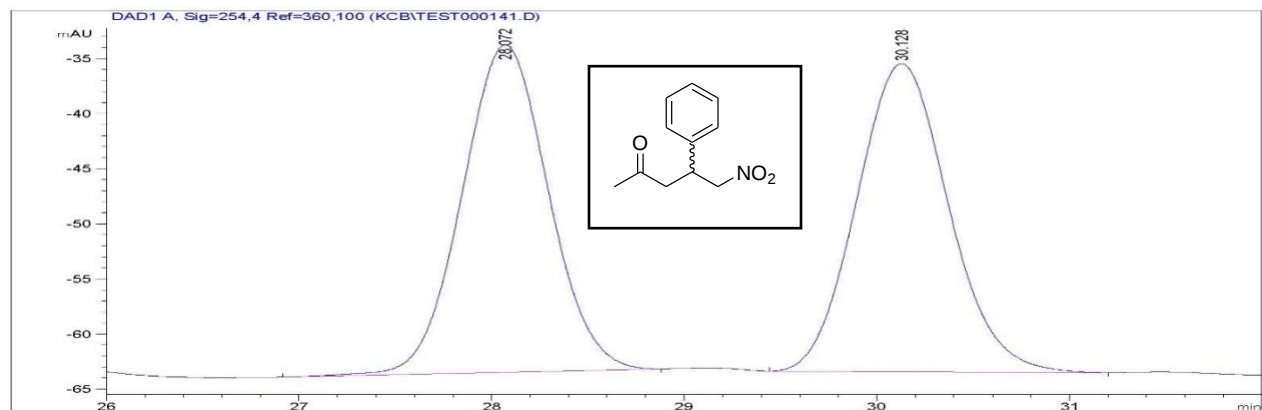
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 16.882        | BB   | 0.3426      | 181.25787    | 8.17723      | 14.1850 |
| 2      | 23.388        | BB   | 0.4965      | 1096.55823   | 33.09870     | 85.8150 |

Totals : 1277.81610 41.27593

## Racemic



## Area Percent Report

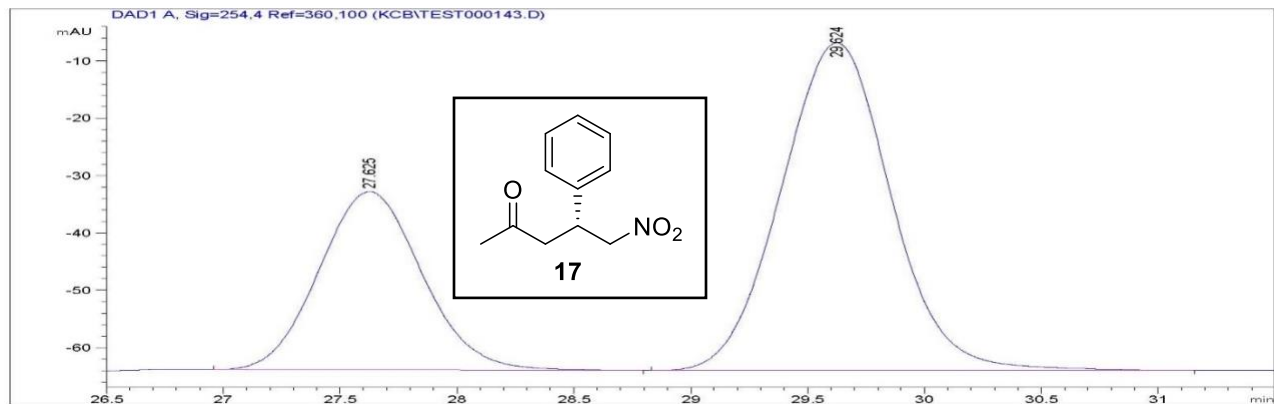
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Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 28.072        | BB   | 0.4845      | 922.46887    | 29.68477     | 50.0144 |
| 2      | 30.128        | BB   | 0.5131      | 921.93939    | 27.92962     | 49.9856 |

Totals : 1944.40826 57.61439

## Chiral



## Area Percent Report

Sorted By : Signal  
Multiplier: : 1.0000  
Dilution: : 1.0000  
Use Multiplier & Dilution Factor with ISTDs

Signal 1: DAD1 A, Sig=254,4 Ref=360,100

| Peak # | RetTime [min] | Type | Width [min] | Area [mAU*s] | Height [mAU] | Area %  |
|--------|---------------|------|-------------|--------------|--------------|---------|
| 1      | 27.625        | BB   | 0.4751      | 950.46588    | 31.05261     | 33.7824 |
| 2      | 29.624        | BB   | 0.5024      | 1863.02625   | 57.14528     | 66.2176 |

Totals : 2813.49213 88.19789