

Paths of analysis*

Y7

Synthia

October 10, 2022

1 Analysis parameters

Analysis type: Automatic Retrosynthesis

Rules: none selected

Filters: Exclude Diastereoselective reactions, Tunnels, FGI, FGI with protections

Max. paths returned: 50

Max. iterations: 2000

Commercial:

1. Max. molecular weight - 1000 g/mol
2. Max. price - 1500 \$/g

Published:

1. Max. molecular weight - 1000 g/mol
2. Popularity - 5

My Stockroom:

1. Max. molecular weight - 1000 g/mol

Reaction scoring formula: $\text{TUNNEL_COEF} * \text{FGI_COEF} * \text{STEP} * 20 + 1000 * (\text{CONFLICT} + \text{NON_SELECTIVITY} + \text{FILTERS} + \text{PROTECT})$

Chemical scoring formula: $\text{SMALLER}^3, \text{SMALLER}^{1.5}$

Min. search width: 400

Max. reactions per product: 60

*The results stated herein were generated using the proprietary platform owned and maintained by Grzybowski Scientific Inventions, Inc., a subsidiary of Merck KGaA, Darmstadt Germany. The results are provided on an as is basis, and shall be used solely in connection with the rights afforded in the license agreement and for no other purpose.

Strategies: none selected

FGI Coeff: 0

Tunnels Coeff: 0

JSON Parameters: {}

2 Paths

5 paths found. *Paths are sorted by score. Reactions are sorted in appearance order for each path.*

2.1 Path 1

Score: 2250084.06

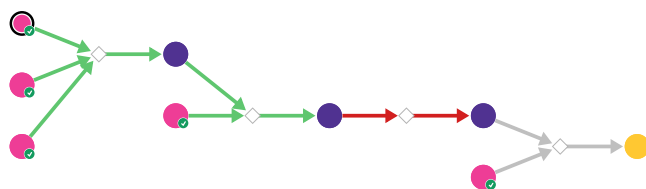
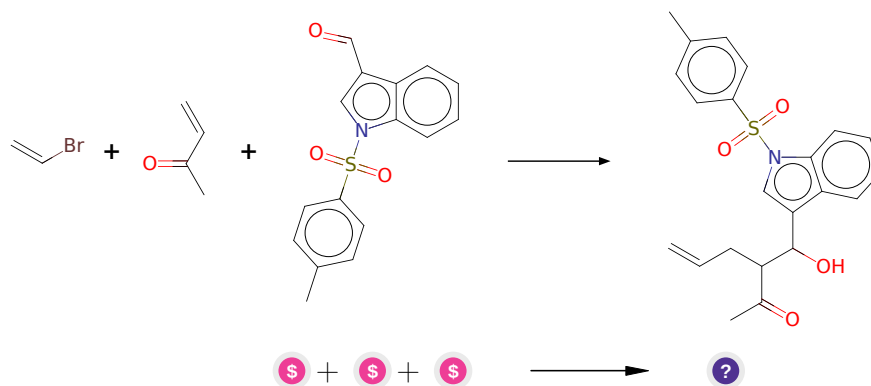


Figure 1: Outline of path 1

2.1.1 Alkenylation-Aldol reaction of enones and enoate esters



Substrates:

1. 3-Buten-2-one - *available at Sigma-Aldrich*
2. Bromoethylene - *available at Sigma-Aldrich*

3. 1-Tosyl-1H-indole-3-carbaldehyde - *available at Sigma-Aldrich*

Products:

1. C=CCC(C(C)=O)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

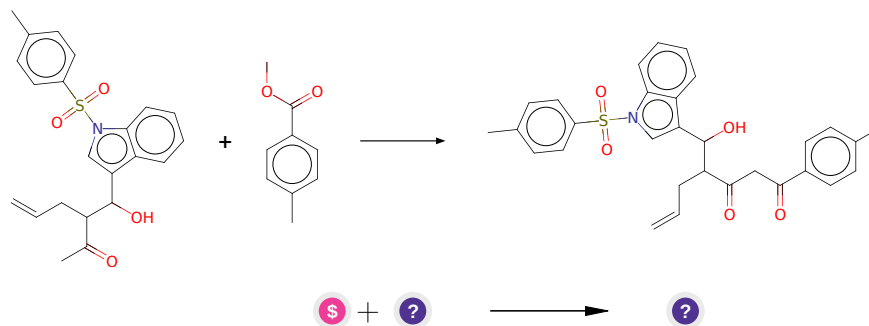
Typical conditions: 1.RCuLi.2.RCHO

Protections: none

Reference: [10.1016/S0040-4039\(01\)80891-1](#) AND [10.1016/S0040-4020\(01\)82115-3](#) AND [10.1021/jo2010186](#) AND [10.1021/jo101439h](#) AND [10.1021/ja906241w](#)

Retrosynthesis ID: 20547

2.1.2 Condensation of methyl ketones with esters



Substrates:

1. Methyl p-toluate - *available at Sigma-Aldrich*
2. C=CCC(C(C)=O)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

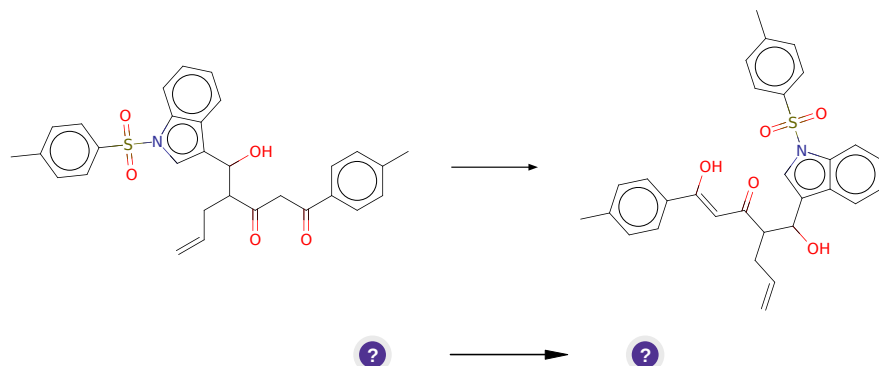
Typical conditions: NaOMe.MeOH

Protections: none

Reference: [10.1016/j.tetlet.2007.10.010](#) and [10.1016/j.tetlet.2013.09.025](#) and [10.1016/j.ejmech.2013.10.072](#) and [10.1002/ange.19921040631](#)

Retrosynthesis ID: 4792

2.1.3 Keto-enol Tautomerism



Substrates:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

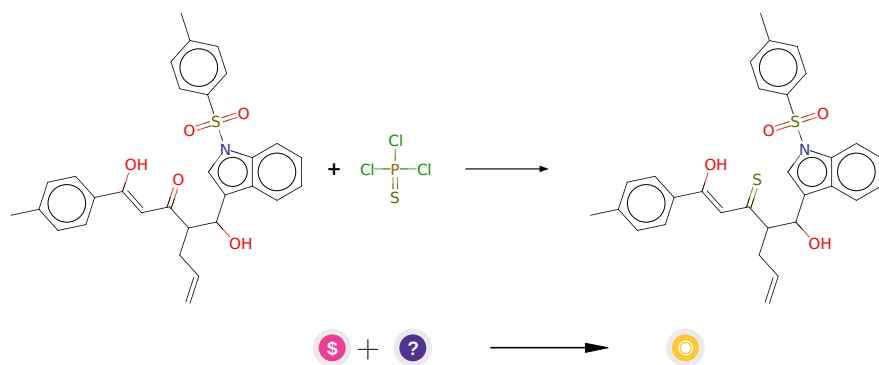
Typical conditions: solvent

Protections: none

Reference: [10.1021/ja01065a003](#) AND [10.1021/jo8012385](#)

Retrosynthesis ID: 7781

2.1.4 Thionation of Carbonyl Compounds using PSCl3



Substrates:

1. Phosphorus thiochloride - *available at Sigma-Aldrich*
2. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=S))/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: NEt3.H2O.microwave.70-100C

Protections: none

Reference: DOI: [10.1021/jo7022069](https://doi.org/10.1021/jo7022069)

Retrosynthesis ID: 11555

2.2 Path 2

Score: 2250084.06

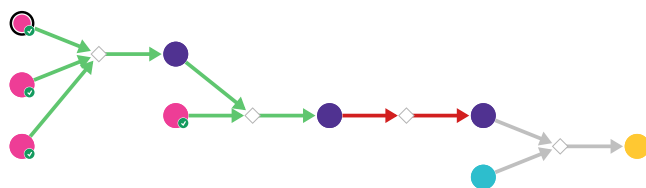
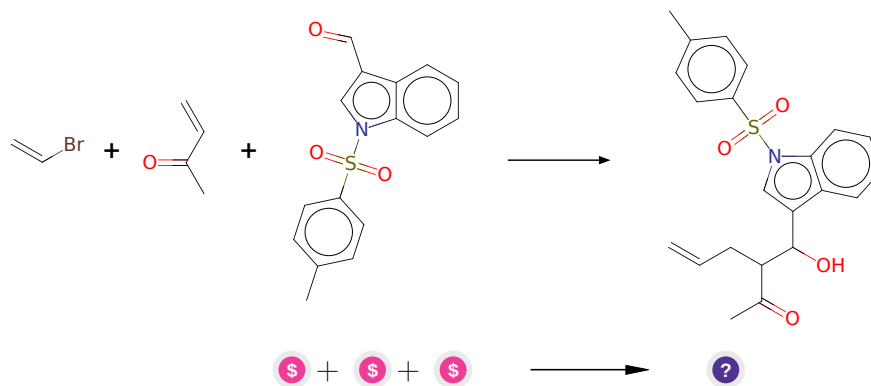


Figure 2: Outline of path 2

2.2.1 Alkenylation-Aldol reaction of enones and enoate esters



Substrates:

1. 3-Buten-2-one - *available at Sigma-Aldrich*
2. Bromoethylene - *available at Sigma-Aldrich*

3. 1-Tosyl-1H-indole-3-carbaldehyde - *available at Sigma-Aldrich*

Products:

1. C=CCC(C(C)=O)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

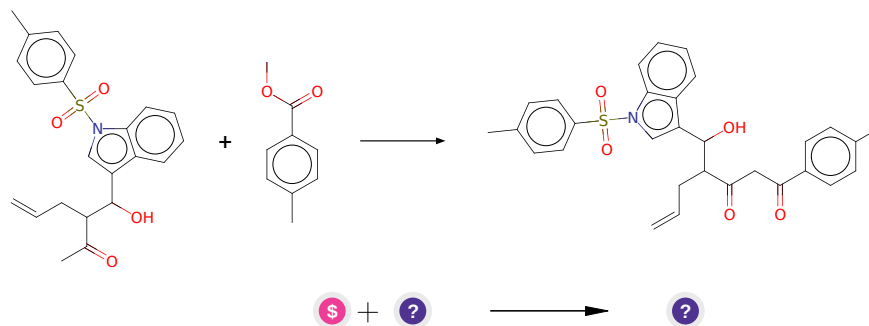
Typical conditions: 1.RCuLi.2.RCHO

Protections: none

Reference: [10.1016/S0040-4039\(01\)80891-1](#) AND [10.1016/S0040-4020\(01\)82115-3](#) AND [10.1021/jo2010186](#) AND [10.1021/jo101439h](#) AND [10.1021/ja906241w](#)

Retrosynthesis ID: 20547

2.2.2 Condensation of methyl ketones with esters



Substrates:

1. Methyl p-toluate - *available at Sigma-Aldrich*
2. C=CCC(C(C)=O)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

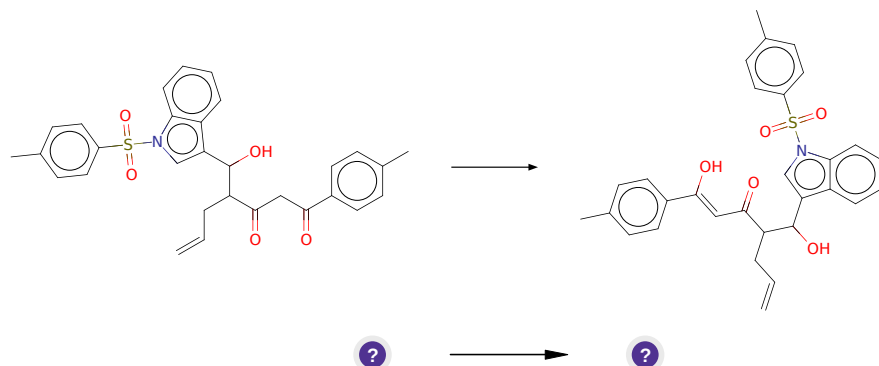
Typical conditions: NaOMe.MeOH

Protections: none

Reference: [10.1016/j.tetlet.2007.10.010](#) and [10.1016/j.tetlet.2013.09.025](#) and [10.1016/j.ejmech.2013.10.072](#) and [10.1002/ange.19921040631](#)

Retrosynthesis ID: 4792

2.2.3 Keto-enol Tautomerism



Substrates:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

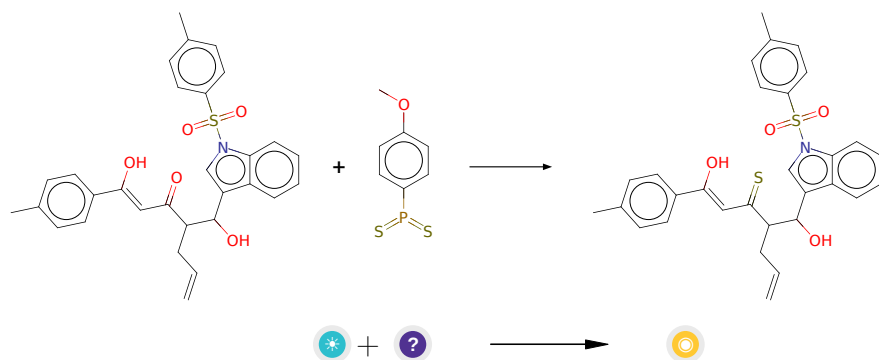
Typical conditions: solvent

Protections: none

Reference: [10.1021/ja01065a003](#) AND [10.1021/jo8012385](#)

Retrosynthesis ID: 7781

2.2.4 Synthesis of Thioketones using Lawesson's Reagent



Substrates:

1. 4-methoxyphenyl-dithiophosphoric anhydride
2. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=S)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: Lawesson's Reagent.neat.microwave

Protections: none

Reference: DOI: [10.1021/ol990629a](https://doi.org/10.1021/ol990629a)

Retrosynthesis ID: 10798

2.3 Path 3

Score: 2250115.31

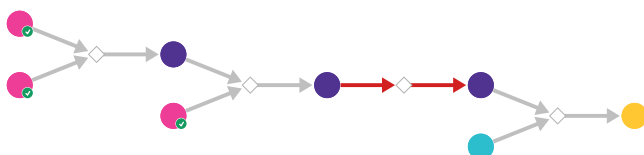
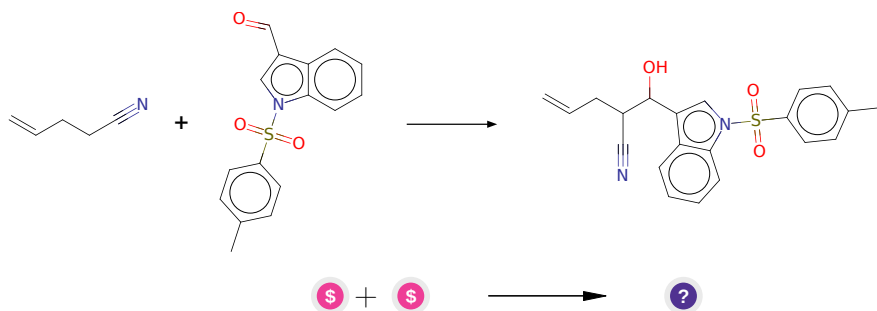


Figure 3: Outline of path 3

2.3.1 Aldol-like condensation with nitriles



Substrates:

1. 4-Pentenitrile - *available at Sigma-Aldrich*
2. 1-Tosyl-1H-indole-3-carbaldehyde - *available at Sigma-Aldrich*

Products:

1. C=CCC(C#N)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

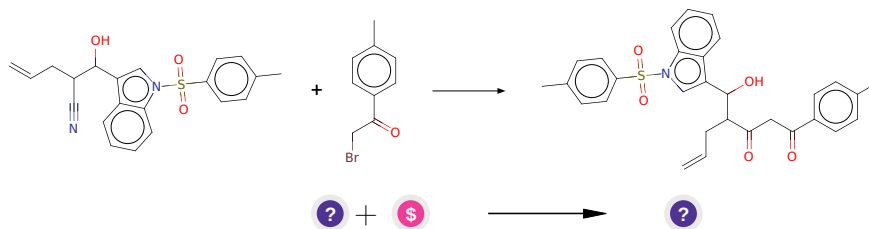
Typical conditions: LDA.THF.cooling

Protections: none

Reference: [10.1039/B800634B](#) and [10.1002/anie.201302613](#) and [10.1021/jm701319c](#) and [10.1016/S0040-4020\(98\)00122-7](#) and [10.1021/jo025872t](#)

Retrosynthesis ID: 23727

2.3.2 Blaise Reaction



Substrates:

1. C=CCC(C#N)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12
2. 2-Bromo-4'-methylacetophenone - [available at Sigma-Aldrich](#)

Products:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

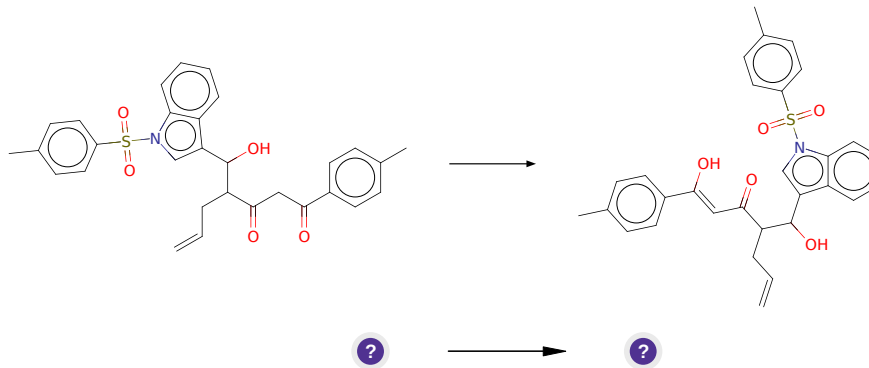
Typical conditions: Zn.TMSCl.THF then HCl

Protections: none

Reference: [10.1002/ejoc.201403402](#)

Retrosynthesis ID: 10000153

2.3.3 Keto-enol Tautomerism



Substrates:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

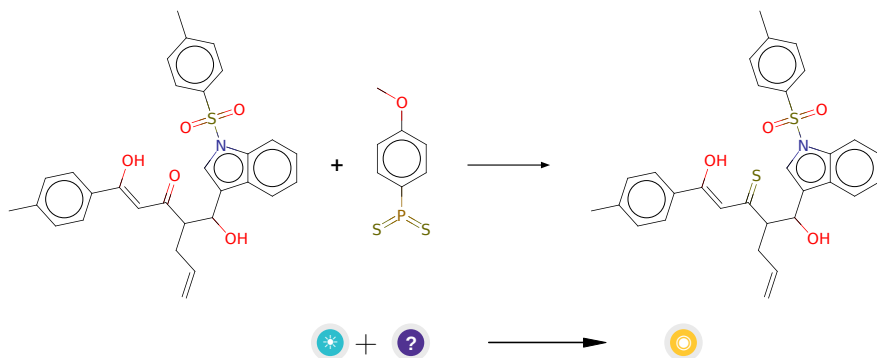
Typical conditions: solvent

Protections: none

Reference: [10.1021/ja01065a003](#) AND [10.1021/jo8012385](#)

Retrosynthesis ID: 7781

2.3.4 Synthesis of Thioketones using Lawesson's Reagent



Substrates:

1. 4-methoxyphenyl-dithiophosphoric anhydride
2. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=S)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: Lawesson's Reagent.neat.microwave

Protections: none

Reference: DOI: [10.1021/ol990629a](#)

Retrosynthesis ID: 10798

2.4 Path 4

Score: 2250115.31

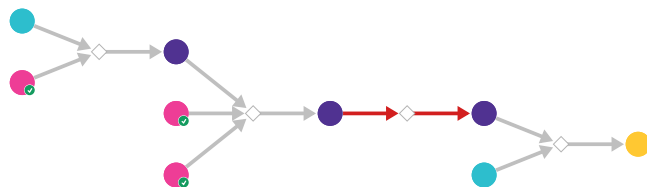
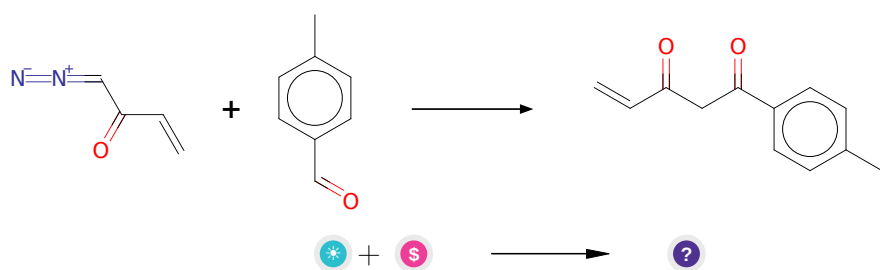


Figure 4: Outline of path 4

2.4.1 Homologation of aldehydes to ketones with diazoalkanes



Substrates:

1. 1-diazo-but-3-en-2-one
2. p-Tolualdehyde - *available at Sigma-Aldrich*

Products:

1. C=CC(=O)CC(=O)c1ccc(C)cc1

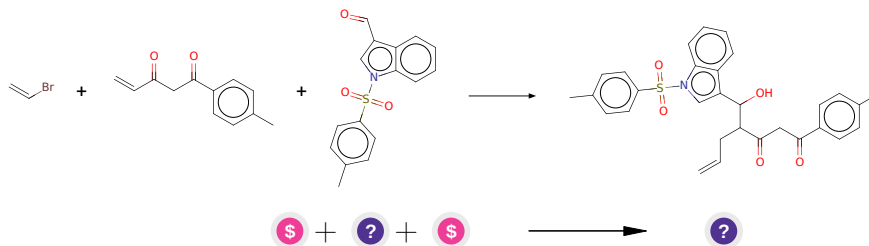
Typical conditions: Lewis.acid

Protections: none

Reference: [10.1021/jo00275a006](https://doi.org/10.1021/jo00275a006) AND [10.1016/j.tet.2014.05.107](https://doi.org/10.1016/j.tet.2014.05.107) AND [10.1016/j.tet.2014.11.059](https://doi.org/10.1016/j.tet.2014.11.059) AND [10.1021/ol9010932](https://doi.org/10.1021/ol9010932)

Retrosynthesis ID: 15017

2.4.2 Alkenylation-Aldol reaction of enones and enoate esters



Substrates:

1. Bromoethylene - *available at Sigma-Aldrich*
2. C=CC(=O)CC(=O)c1ccc(C)cc1
3. 1-Tosyl-1H-indole-3-carbaldehyde - *available at Sigma-Aldrich*

Products:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

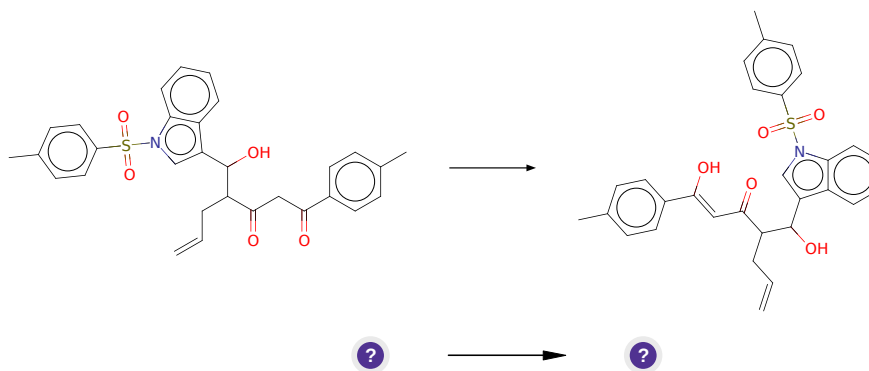
Typical conditions: 1.RCuLi.2.RCHO

Protections: none

Reference: [10.1021/jo2010186](#) AND [10.1021/jo101439h](#) AND [10.1021/ja906241w](#)
AND [10.1016/S0040-4039\(01\)80891-1](#) AND [10.1016/S0040-4020\(01\)82115-3](#)

Retrosynthesis ID: 13048

2.4.3 Keto-enol Tautomerism



Substrates:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

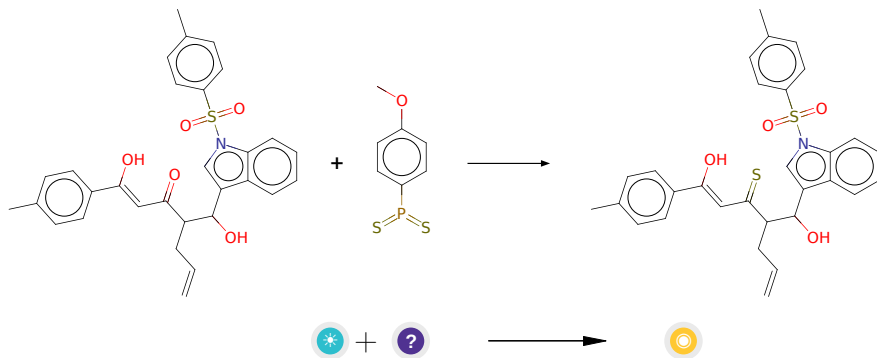
Typical conditions: solvent

Protections: none

Reference: [10.1021/ja01065a003](https://doi.org/10.1021/ja01065a003) AND [10.1021/jo8012385](https://doi.org/10.1021/jo8012385)

Retrosynthesis ID: 7781

2.4.4 Synthesis of Thioketones using Lawesson's Reagent



Substrates:

1. 4-methoxyphenyl-dithiophosphonane
2. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=S)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: Lawesson's Reagent.neat.microwave

Protections: none

Reference: DOI: [10.1021/ol990629a](https://doi.org/10.1021/ol990629a)

Retrosynthesis ID: 10798

2.5 Path 5

Score: 2250115.31

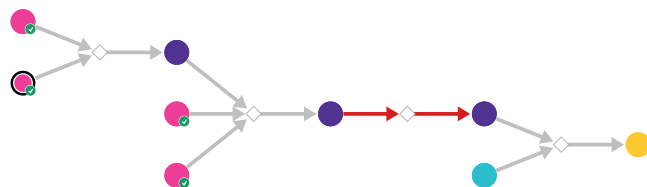
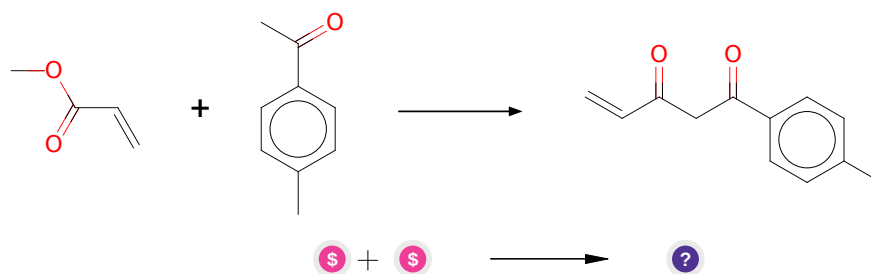


Figure 5: Outline of path 5

2.5.1 Condensation of methyl ketones with esters



Substrates:

1. Methyl p-tolyl ketone - *available at Sigma-Aldrich*
2. Methyl acrylate - *available at Sigma-Aldrich*

Products:

1. C=CC(=O)CC(=O)c1ccc(C)cc1

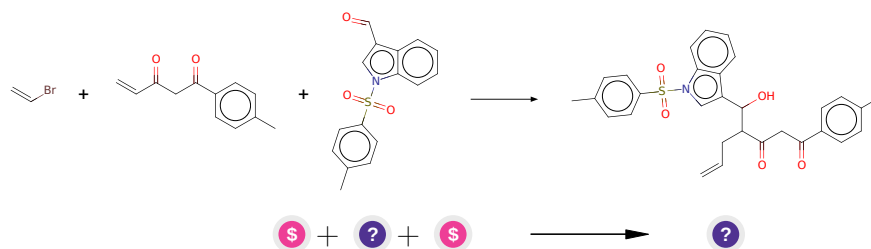
Typical conditions: NaOMe.MeOH

Protections: none

Reference: [10.1016/j.tetlet.2007.10.010](#) and [10.1016/j.tetlet.2013.09.025](#) and [10.1016/j.ejmech.2013.10.072](#) and [10.1002/ange.19921040631](#)

Retrosynthesis ID: 4792

2.5.2 Alkenylation-Aldol reaction of enones and enoate esters



Substrates:

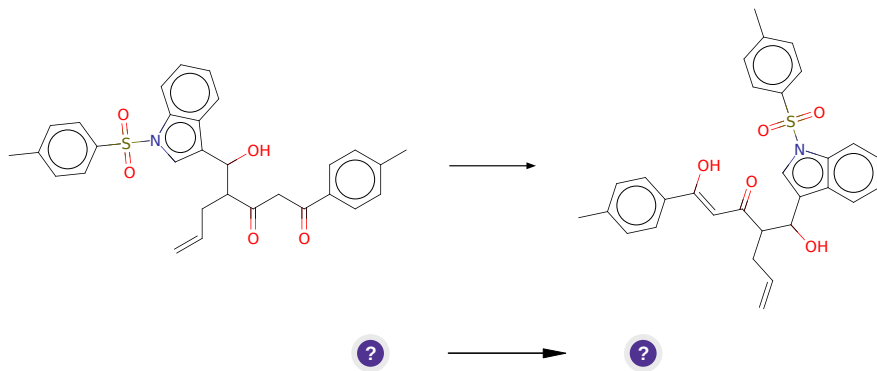
1. Bromoethylene - *available at Sigma-Aldrich*
2. C=CC(=O)CC(=O)c1ccc(C)cc1
3. 1-Tosyl-1H-indole-3-carbaldehyde - *available at Sigma-Aldrich*

Products:

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: 1.RCuLi.2.RCHO**Protections:** none

Reference: [10.1021/jo2010186](#) AND [10.1021/jo101439h](#) AND [10.1021/ja906241w](#)
 AND [10.1016/S0040-4039\(01\)80891-1](#) AND [10.1016/S0040-4020\(01\)82115-3](#)

Retrosynthesis ID: 13048**2.5.3 Keto-enol Tautomerism****Substrates:**

1. C=CCC(C(=O)CC(=O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

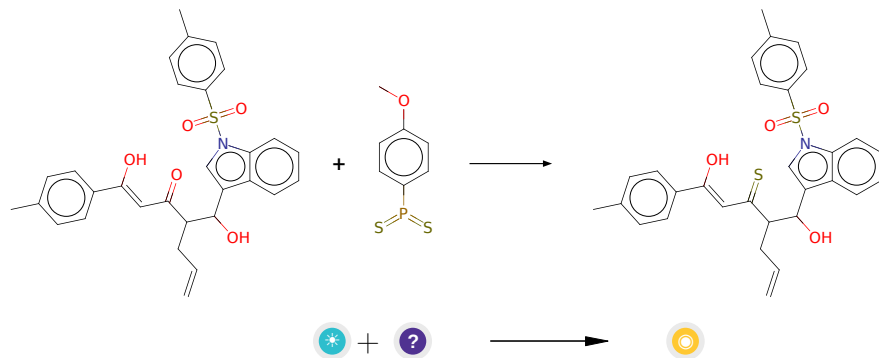
1. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: solvent**Protections:** none

Reference: [10.1021/ja01065a003](#) AND [10.1021/jo8012385](#)

Retrosynthesis ID: 7781

2.5.4 Synthesis of Thioketones using Lawesson's Reagent



Substrates:

1. 4-methoxyphenyl-dithiophosphoric anhydride
2. C=CCC(C(=O)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Products:

1. C=CCC(C(=S)/C=C(\O)c1ccc(C)cc1)C(O)c1cn(S(=O)(=O)c2ccc(C)cc2)c2ccccc12

Typical conditions: Lawesson's Reagent.neat.microwave

Protections: none

Reference: DOI: [10.1021/ol990629a](https://doi.org/10.1021/ol990629a)

Retrosynthesis ID: 10798