Microwave-Assisted Palladium-Catalyzed Allylation of β-enaminones
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1. General Remarks

Unless special mention, all reactions were carried out under an argon atmosphere, glassware was flame-dried under an argon gas flow prior to use. Reactions were run in scellled tubes and with magnetic stirring. Reagents and solvents were purchased from commercial sources and used as received. Reactions with microwave assistance were performed using a Biotage Initiator TM 2.0 apparatus in a Biotage 2-5 mL microwave vial, at the indicated temperature (detected by IR-sensor), on very high absorption mode, for an indicated period of time.
TLC were performed on Merck 60 F254 silica gel and revealed with either a ultra-violet lamp (λ = 254 nm) or a specific color reagent (potassium permanganate, vanillin, etc.). A silica gel Merck Geduran® SI 60 (40-63 μm) was used for flash column chromatography (FC).
NMR spectra (1H, 13C) were recorded on a Bruker AM 300 MHz or a Bruker AVANCE 400 MHz spectrometer (BBFO probe). Chemical shifts are given in parts per million (ppm) using the CDCl3 residual chloroform signal as reference (δ1H = 7.26 ppm, δ13C = 77.0 ppm). The terms m, s, d, t and q represent multiplet, singlet, doublet, triplet and quadruplet respectively. Coupling constants (J) are given in Hertz (Hz). IR spectra were recorded with a Tensor 27 (ATR diamond) Bruker spectrometer. IR was reported as characteristic bands (cm⁻¹). High resolution mass spectra (HRMS) were recorded at the Institut Parisien de Chimie Moléculaire (FR 2769) (electrospray source).

2. Synthesis and Characterization of enamino-carbonyl derivatives 1a-k
General procedure for preparation of enaminones GP1
To a solution of 4-(trimethylsilyl)-3-buty-2-one (1.08 mL, 7.5 mmol, 1 equiv) in methanol (30 mL) at 0 °C was added an amine (15 mmol, 2 equiv). After stirring overnight at room temperature, the solvent was removed in vacuo. The crude product was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 40/60) to afford the corresponding enaminone.

4-(benzylamino)but-3-en-2-one (1a)
The general procedure GP1 was followed with benzylamine (1.63 mL, 15 mmol, 2 equiv) yielding 1.18 g of the desired enaminone 1a as a mixture of Z and E isomers.

Yield= 90%; yellow oil; ratio (Z/E) = 1.3/1; IR (film) 3254, 3030, 1637 cm⁻¹; ¹H NMR (CDCl₃, 300 MHz): 9.95 (brs, 1H, NH(Z)), 7.47 (dd, J = 13.1, 8.3 Hz, 1H, =CHNH(E)), 7.25-7.13 (m, 10H, HAr(E+Z)), 6.61 (dd, J = 12.7, 7.4 Hz, 1H, =CHNH(E)), 5.19 (d, J = 13.2 Hz, 1H, =CHCO(E)), 4.96 (d, J = 7.4 Hz, 1H, =CHCO(E)), 4.26 (d, J = 6.2 Hz, 2H, CH₂Ph(E)), 4.14 (d, J = 5.5 Hz, 2H, CH₂Ph(E)), 5.68 (brs, 1H, NH(E)), 2.57 (s, 3H, CH₃CO(E)), 1.98 (s, 3H, CH₃CO(E)); ¹³C NMR (CDCl₃, 75 MHz): 197.8 (C=O(Z)), 196.2 (C=O(E)), 152.4 (=CHNH(Z+E)), 138.0 (C(q)Ar(E+Z)), 128.9 (CHAr), 128.8 (CHAr), 127.8 (CHAr), 127.5 (CHAr), 94.5 (=CHCO(Z+E)), 52.4 (NHCH₂(Z+E)), 29.1 (CH₂CO(E)), 27.0 (CH₂CO(E)); HRMS m/z calcd. for C₁₁H₁₃NONa (M+Na)+: 198.0895; found: 198.0887.

4-(4-methoxybenzylamino)but-3-en-2-one (1b)
The general procedure GP1 was followed with 4-methoxybenzylamine (1.96 mL, 15 mmol, 2 equiv) yielding 1.5g of the desired enaminone 1b as a mixture of Z and E isomers.

Yield= 97 %; Beige solid; ratio (Z/E) = 9/1; IR (film) 3230, 3012, 1637 cm⁻¹; ¹H NMR (CDCl₃, 300 MHz): 10.02 (brs, 1H, NH(Z)), 7.57 (dd, J = 13.2, 7.4 Hz, 1H, =CHNH(E)), 7.19-7.16 (m, 4H, HAr(E+Z)), 6.90-6.87 (m, 4H, HAr(E+Z)), 6.71 (dd, J = 12.7, 7.4 Hz, 1H, =CHNH(E)), 5.60 (brs, 1H, NH(E)), 5.32 (d, J = 13.2 Hz, 1H, =CHCO(E)), 5.05 (d, J = 7.4 Hz, 1H, =CHCO(E)), 4.31 (d, J = 6.0 Hz, 2H, CH₂Ar(E)), 4.18 (d, J = 5.4 Hz, 2H, CH₂Ar(E)), 3.80 (s, 6H, CH₃OAr(Z/E)), 2.11 (s, 3H, CH₂CO(E)), 2.07 (s, 3H, CH₂CO(E)), 13C NMR (CDCl₃, 75 MHz): Only the Z isomer 197.6 (C=O), 159.2 (C(q)Ar), 152.1 (NHCH=), 129.9 (C(q)Ar), 128.5 (CHAr), 114.2 (CHAr), 94.3 (=CHCO), 55.3 (CH₂O), 51.9 (NHCH₂), 29.0 (CH₂CO). HRMS m/z calcd. for C₁₂H₁₅NO₂Na (M+Na)+: 228.100; found: 228.0987.

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(Z)-3-(benzylamino)-1-phenylprop-2-en-1-one (1c)

To a suspension of Pd(PPh3)2Cl2 (28 mg, 0.04 mmol, 2 mol%) and CuI (11 mg, 0.08 mmol, 4 mol%) in THF (0.2 M, 10 mL), were added, under argon atmosphere, Et3N (0.27 mL, 2 mmol, 1 equiv), benzoyl chloride (0.23 mL, 2 mmol, 1 equiv) and ethynyltrimethylsilane (0.28 mL, 2 mmol, 1 equiv). After stirring overnight at room temperature, the mixture was filtered on a plug of Celite, then the solvent was removed in vacuo.2 MeOH (0.3 M, 6 mL) then benzylamine (0.44 mL, 4 mmol, 2 equiv) were added to the crude. The mixture was stirred overnight at room temperature and concentrated. The resulting yellow oil was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 10/90) yielding 455 mg of the desired Z-enaminone 1c.

Yield= 96 %; Brown solid; IR (film) 3007, 1634, 1542 cm−1; 1H NMR (CDCl3, 400 MHz): 10.63 (brs, 1H, NH), 7.92-7.31 (m, 10H, HAr), 7.06 (dd, J = 12.7, 7.5 Hz, 1H, =CHNH), 5.80 (d, J = 7.5 Hz, 1H, =CHCO), 4.48 (d, J = 6.1 Hz, 2H, CH2Ph); 13C NMR (CDCl3, 101 MHz): 190.2 (C=O), 154.1 (NHCH=), 139.7 (C(q)Ar), 137.8 (C(q)Ar), 131.0 (CHAr), 128.9 (CHAr), 128.3 (CHAr), 127.8 (CHAr), 127.3 (CHAr), 127.1 (CHAr), 90.7 (=CHCO), 52.7 (NHCH2). HRMS m/z calcd. for C16H15NONa (M+Na)+: 260.1051; found: 260.1048.

(Z)-4-(allylamino)but-3-en-2-one (1d)

The general procedure GP1 was followed with allylamine (1.13 mL, 15 mmol, 2 equiv) yielding 535 mg of the Z-enaminone 1d.

Yield= 57%; Brown oil; IR (film) 2976, 1649, 1542 cm−1; 1H NMR (CDCl3, 300 MHz): 9.67 (brs, 1H, NH), 6.50 (dd, J = 12.7, 7.4 Hz, 1H, =CHNH), 5.99-5.67 (m, 1H, CH=CH2), 5.12-5.03 (m, 2H, CH2=CH), 4.67 (d, J = 7.4 Hz, 1H, =CHCO), 3.69-3.65 (m, 2H, NHCH2), 1.94 (s, 3H, CH3CO); 13C NMR (CDCl3, 75 MHz): 197.7 (C=O), 152.3 (NHCH=), 134.4 (CH=CH2), 116.9 (CH2=CH), 94.3 (=CHCO), 50.8 (NHCH2), 29.1 (CH3CO). HRMS m/z calcd. for C7H11NONa (M+Na)+: 148.0738; found: 148.0733.

(Z)-4-(butylamino)but-3-en-2-one (1e)

The general procedure GP1 was followed with butylamine (1.48 mL, 15 mmol, 2 equiv) yielding 655 mg of the Z-enaminone 1e.

Yield = 62%; yellow oil; IR (film) 3005, 1646, 1542 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\), 300 MHz): 9.85 (brs, 1H, \(\text{NH}\)), 6.67 (dd, \(J = 15.0, 9.0\) Hz, 1H, =CHNH), 4.50 (d, \(J = 9.0\) Hz, 1H, =CHCO), 3.21 (t, \(J = 6.0\) Hz, 2H, CH\(_2\)NH), 2.07 (s, 3H, CH\(_3\)CO), 1.57-1.29 (m, 4H, (CH\(_2\))\(_2\)CH\(_3\)), 0.96 (t, \(J = 7.5\) Hz, 3H, CH\(_3\)CH\(_2\)); \(^{13}\)C NMR (CDCl\(_3\), 101 MHz): 197.2 (C=O), 152.6 (NHCH=), 93.4 (=CHCO), 48.8 (CH\(_2\)CH\(_3\)), 28.9 (CH\(_3\)CO), 19.7 (CH\(_2\)CH\(_2\)), 13.7 (CH\(_3\)CH\(_2\)); HRMS m/z calcd for C\(_8\)H\(_{15}\)NONa (M+Na\(^+\)): 164.1051; found: 164.1043.

(Z)-4-(tert-butylamino)but-3-en-2-one (1f)

The general procedure GP1 was followed with tert-butylamine (1.57 mL, 15 mmol, 2 equiv) yielding 528 mg of the Z-enaminone 1f.

Yield = 50%; Beige solid; IR (film) 2986, 1654, 1542 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\), 300 MHz): 10.02 (brs, 1H, \(\text{NH}\)), 6.70 (dd, \(J = 15.0, 9.0\) Hz, 1H, =CHNH), 4.88 (d, \(J = 9.0\) Hz, 1H, =CHCO), 1.92 (s, 3H, CH\(_3\)CO), 1.17 (s, 9H, t-BuNH); \(^{13}\)C NMR (CDCl\(_3\), 75 MHz): 196.9 (C=O), 148.1 (NHCH=), 93.4 (=CHCO), 51.8 (C(q)tBu), 30.0 (CH\(_3\)tBu), 28.9 (CH\(_3\)CO). HRMS m/z calcd. for C\(_8\)H\(_{15}\)NONa (M+Na\(^+\)): 164.1051; found: 164.1055.

4-(cyclohexylamino)but-3-en-2-one (1g)

The general procedure GP1 was followed with cyclohexylamine (1.71 mL, 15 mmol, 2 equiv) yielding 851 mg of the desired enaminone 1g as a mixture of Z and E isomers.

Yield = 68%; yellow oil; ratio (Z/E) = 9/1; IR (film) 2929, 2355, 1646, 1541 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\), 400 MHz): 9.91 (brs, 1H, NH(Z)), 7.50-7.45 (m, 1H, =CHNH(E)), 6.74 (dd, \(J = 12.0, 8.0\) Hz, 1H, =CHNH(E)), 5.29 (d, \(J = 12.0\) Hz, 1H, =CHCO(E)), 4.98 (d, \(J = 8.0\) Hz, 1H, =CHCO(E)), 3.19-9.17 (m, 1H, HNCH(E)), 3.07-3.05 (m, 1H, HNCH(E)), 2.12 (s, 1H, CH\(_2\)CO(E)), 2.06 (s, 3H, CH\(_2\)CO(E)), 1.64-1.28 (m, 20H, CH\(_2\)cyl(Z+E)); \(^{13}\)C NMR (CDCl\(_3\), 101 MHz): Only the Z isomer 197.0 (C=O), 150.5 (NHCH=), 93.3 (=CHCO), 57.1 (NHCH), 34.1 (CH\(_2\)), 28.9 (CH\(_3\)CO), 25.2 (CH\(_2\)), 24.6 (CH\(_2\)); HRMS m/z calcd. for C\(_{10}\)H\(_{17}\)NOH (M+H\(^+\)): 168.1383; found: 168.1388.

(Z)-4-(tosylamino)but-3-en-2-one (1h)
This product was prepared following an already described procedure, and the data are in accordance with those reported in the literature.3

Yield= 51 %; yellow solid; IR (film) 2965, 2899, 1633, 1484, 1100 cm⁻¹; ¹H NMR (CDCl₃, 300 MHz): 11.40 (brs, 1H, NH), 7.76 (d, J = 8.4 Hz, 2H, CH₃), 7.35 (d, J = 8.1 Hz, 2H, CH₃), 6.98 (d, J = 8.1 Hz, 1H, =CHNH), 5.50 (d, J = 8.4 Hz, 1H, =CHCO), 2.46 (s, 3H, CH₃), 2.17 (s, 3H, CH₃CO).

(E)-4-(allyl(benzyl)amino)but-3-en-2-one (1i)

To a suspension of NaH (77 mg, 1.87 mmol, 1.1 equiv) in THF (0.2M, 9 mL) was added the enaminone 1a (300 mg, 1.7 mmol, 1 equiv). After 5 minutes stirring, allyl bromide (0.16 mL, 1.87 mmol, 1.1 equiv) was added and the reaction mixture was stirred overnight at room temperature. The solvent was removed in vacuo and the mixture was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 20/80) to afford 146 mg of the desired product 1i (only E isomer).

Yield= 40 %; yellow oil; IR (film) 2998, 2889, 1657, 1599, 1554 cm⁻¹; ¹H NMR (CDCl₃, 400 MHz, 325K): 7.64 (d, J = 16.0 Hz, 1H, =CHNH), 7.35-7.17 (m, 5H, HAr), 5.77-5.67 (m, 1H, CH₂=CH), 5.25-5.12 (m, 3H, COCH + CH₂=CH), 4.35 (s, 2H, CH₃N), 3.73 (d, J = 8.0 Hz, 2H, CH₂CH=), 2.08 (s, 3H, CH₃CO); ¹³C NMR (CDCl₃, 101 MHz, 325K): 195.4 (C=O), 151.6 (HC=), 135.9 (C=), 128.7 (CH₂), 127.8 (CH₃), 127.4 (CH₂), 118.2 (CH₂), 97.8 (CH); HRMS m/z calcd. for C₁₄H₁₇NONa (M+Na)+: 238.1208; found: 238.1205.

(Z)-4-(benzylamino)pent-3-en-2-one (1j)

To a suspension of acetylaceton e (0.51 mL, 5 mmol, 1 equiv) and L-proline (29 mg, 0.25 mmol, 5 mol%) was added benzylamine (0.545 mL, 5 mmol, 1 equiv). The mixture was stirred overnight at room temperature. The mixture was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 10/90) to afford 0.9 g of the enaminone 1j. The data are in accordance with those reported in the literature.4

Yield= 95 %; yellow oil; ¹H NMR (CDCl₃, 300 MHz): 11.19 (brs, 1H, NH), 7.38-7.26 (m, 5H, HAr), 5.07 (s, 1H, =CHCO), 4.47 (d, J = 6.4 Hz, 2H, CH₂Ph), 2.06 (s, 3H, CH₃), 1.93 (s, 3H, CH₃).

methyl-3-(benzylamino)acrylate (1k)

To a solution of methyl 3-(trimethylsilyl)propionate (0.9 mL, 10 mmol, 1 equiv) in THF (40 mL) at 0 °C was added benzylamine (1.1 mL, 10 mmol, 1 equiv). After stirring overnight at room temperature, the solvent was removed in vacuo. The crude product was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 10/90) to afford 1.7 g of the enamino-ester 1k as a mixture of Z and E isomers. 

Yield= 89 %; white solid; ratio (Z/E)= 2/1; IR (film) 2952, 1682, 1616 cm⁻¹; ¹H NMR (CDCl₃, 300 MHz): 8.04 (brs, 1H, NH(Z)), 7.26-7.16 (m, 11H, HAr(E+Z) + =CHNH(E)), 6.61 (dd, J = 12.0, 9.0 Hz, 1H, =CHNH(Z)), 4.74 (d, J = 15.0 Hz, 1H, =CHCO(E)), 4.48 (d, J = 9.0 Hz, 1H, =CHCO(Z)), 4.26 (d, J = 6.0 Hz, 2H, CH₂Ph(Z)), 4.12 (d, J = 6.0 Hz, 2H, CH₂Ph(E)), 3.58 (s, 3H, CH₃O(E)), 3.57 (s, 3H, CH₃O(Z)); ¹³C NMR (CDCl₃, 75 MHz): Only the Z isomer 171.1 (C=O), 152.2 (NHCH=), 138.6 (C(q)Ar), 128.8 (CH₃), 127.6 (CH₃), 127.1 (CH₃), 82.6 (=CHCO), 52.2 (NHCH₂), 50.2 (CH₂O). HRMS m/z calcd. for C₁₁H₁₃NO₂Na (M+Na)⁺: 214.0844; found: 214.0830.

4-(benzylimino)but-2-en-2-ol (1a’)

Yellow solid; IR (film) 3023, 2960, 1605, 1405 cm⁻¹; NMR (CDCl₃, 300 MHz): 7.25-7.21 (m, 4H, CH₃), 7.15-7.11 (m, 1H, CH₃), 6.76 (d, J = 6.0 Hz, 1H, =CH), 4.76 (d, J = 6.0 Hz, 1H, =CH), 4.50 (s, 2H, CH₂Ph), 1.74 (s, 3H, CH₃); ¹³C NMR (CDCl₃, 101 MHz): 176.3 (C₆), 157.0 (=CH), 141.2 (C₆), 128.2 (=CH₃), 127.3 (=CH₃), 126.5 (=CH₃), 93.6 (=CH), 58.1 (CH₂), 24.3 (CH₃). HRMS m/z calcd. for C₁₁H₁₄NO (M+H)⁺: 176.1075; found: 176.1065.
3. Synthesis and Characterization of allylated products 2a-n

**Pd catalyst source screening**

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**Ligand screening**

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**Solvent screening**

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General procedure for the allylation of enamino-carbonyles with allyl acetate (GP2)

To a suspension of Pd(OAc)$_2$ (13 mg, 0.057 mmol, 10 mol%), dpff (35 mg, 0.063 mmol, 11 mol%) and proton sponge (0.12 g, 0.57 mmol, 1 equiv) in THF (0.5 mL) in a sealed-tube equipped with a septum, under argon atmosphere, was added allyl acetate (0.12 mL, 1.14 mmol, 2 equiv). After 5 minutes stirring, a solution of enaminone (0.57 mmol, 1 equiv) in THF (0.5 mL) was added, the tube was sealed and the mixture was stirred during 1 hour under microwave irradiation at 100 °C. The crude was filtered on a plug of silica gel. The solvent was removed in vacuo and the mixture was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 20/80) to afford the allylated enaminone.

3-((benzylamino)methylene)hex-5-en-2-one (2a)

The general procedure GP2 was followed from 1a (0.1 g, 0.57 mmol, 1 equiv) yielding 86 mg of the desired allylated compound 2a as a mixture of Z and E isomers.

Yield= 60 %; yellow oil; ratio (Z/E)= 1.7/1 (analysis of the crude $^1$H NMR showed a Z/E ratio= 1/1); IR (film) 3272, 3030, 2920, 1638, 1558 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 300 MHz): 10.24 (brs, 1H, NH$_Z$), 7.42-7.25 (m, 11H, =CH$_NH$E+ CH$_Ar$(Z+E)), 6.66 (d, J = 12.4 Hz, 1H, =CHNH$_E$), 5.94-5.71 (m, 2H, HC=CH$_2$(Z+E)), 5.10-4.99 (m, 4H, HC=CH$_2$(Z+E)), 4.43 (d, J = 5.9 Hz, 2H, CH$_2$Ph$_E$), 4.39 (d, J = 6.1 Hz, 2H, CH$_2$Ph$_E$), 3.12 (dt, J = 6.0, 1.6 Hz, 2H, CH$_2$CH=CH$_2$(Z+E)), 2.94 (dt, J = 5.8, 1.6 Hz, 2H, CH$_2$CH=CH$_2$(Z+E)), 2.22 (s, 3H, CH$_3$CO$_E$), 2.13 (s, 3H, CH$_3$CO$_Z$); $^{13}$C NMR (CDCl$_3$,75 MHz): 198.2 (C=O$_Z$), 194.2 (C=O$_E$), 153.0 (C=CH$_N$E), 149.5 (C=CHN$_E$), 138.6 (C$_Ar$), 138.5 (C$_Ar$), 138.4 (HC=CH$_2$), 136.0 (HC=CH$_2$), 128.9 (CH$_Ar$), 128.8 (CH$_Ar$), 127.8 (CH$_Ar$), 127.6 (CH$_Ar$), 127.0 (CH$_Ar$), 126.9 (CH$_Ar$), 114.8 (HC=CH$_2$), 114.6 (HC=CH$_2$), 102.8 (C$_Ar$CO$_Z$E), 52.5 (NHCH$_2$), 52.2 (NHCH$_2$), 35.6 (CH$_2$CH=CH$_2$), 28.0 (CH$_2$CH=CH$_2$), 27.6 (CH$_3$CO$_E$), 24.4 (CH$_3$CO$_Z$). HRMS m/z calcd. for C$_{14}$H$_{17}$ONa (M+Na)$^+$: 238.1208; found: 238.1204.
3-((4-methoxybenzylamino)methylene)hex-5-en-2-one (2b)

The general procedure GP2 was followed from 1b (0.117 g, 0.57 mmol, 1 equiv) yielding 60 mg of the desired allylated compound 2b as a mixture of Z and E isomers.

Yield= 43%; yellow oil; ratio (Z/E)= 2.5/1 (analysis of the crude $^1$H NMR showed a Z/E ratio= 1.75/1; IR (film) 3009, 2930, 1645, 1558 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 300 MHz): 10.08 (brs, 1H, (CH)$=CH_2$), 5.97-4.90 (m, 4H, HC=CH$_2$(Z/E)), 4.25 (d, J = 5.8 Hz, 2H, CH$_2$Ph(Z)), 4.22 (d, J = 6.0 Hz, 2H, CH$_2$Ph(E)), 3.73 (s, 3H, CH$_2$O(Q)), 3.71 (s, 3H, CH$_2$O(Q)), 2.99 (dt, J =5.9, 1.6 Hz, 2H, CH$_2$CH=CH$_2$(Z)), 2.83 (dt, J =5.8, 1.6 Hz, 2H, CH$_2$CH=CH$_2$(E)), 2.11 (s, 3H, CH$_3$CO(Q)), 2.01 (s, 3H, CH$_3$CO(Q)); $^13$C NMR (CDCl$_3$, 75 MHz): 191.8 (C=O(Q)), 194.2 (C=O(E)), 159.2 (C(q)Ar), 159.0 (C(q)Ar), 152.9 (C(q)Ar), 149.4 (C(q)Ar), 138.6 (HC=CH$_2$(Z)), 135.9 (HC=CH$_2$(E)), 130.4 (C(q)Ar), 130.2 (C(q)Ar), 128.4 (CH$_3$), 128.3 (CH$_3$), 114.7 (HC=CH$_2$(Z)), 114.6 (HC=CH$_2$(E)), 114.2 (CH$_3$), 114.1 (CH$_3$), 102.6 (C(q)CO(2z-E)), 55.3 (CH$_2$O(2z-E)), 52.0 (CH$_2$Ph(Z) ou E)), 35.6 (CH$_2$CH=CH$_2$(Z)), 29.7 (CH$_3$CH=CH$_2$(Z)), 28.0 (CH$_3$CO(Q)), 27.5 (CH$_3$CO(Q)). HRMS m/z calcd. for C$_{13}$H$_{29}$NO$_3$Na (M+Na)$^+$: 268.1313; found: 268.1300.

2-((benzylamino)methylene)-1-phenylpent-4-en-1-one (2c)

The general procedure GP2 was followed from 1c (0.135 g, 0.57 mmol, 1 equiv) yielding 90 mg of the desired allylated compound 2c as a mixture of Z and E isomers.

Yield= 57%; yellow oil; ratio (Z/E)= 1/2.8 (analysis of the crude $^1$H NMR showed a Z/E ratio= 1/1; IR (film) 3292, 2941, 1634, 1541 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 400 MHz): 10.70 (brs, 1H, NH(Z)), 7.38-7.09 (m, 11H, NH(E)$+H_{Ar}(Z)$); 7.01 (d, J = 13.6 Hz, 1H, =CHNH(E)), 6.83 (d, J = 12.5 Hz, 1H, =CHNH(E)), 5.83-5.65 (m, 2H, HC=CH$_2$(Z/E)), 5.06-4.83 (m, 4H, HC=CH$_2$(Z/E)), 4.38 (d, J = 6.0 Hz, 2H, CH$_2$Ph(Z)), 4.20 (d, J = 5.9 Hz, 2H, CH$_2$Ph(E)), 3.17 (d, J =6.0 Hz, 2H, CH$_2$CH=CH$_2$(E)), 2.87 (d, J =5.9 Hz, 2H, CH$_2$CH=CH$_2$(Z)); $^13$C NMR (CDCl$_3$, 101 MHz): 195.7 (C=O(Q)), 194.4 (C=q), 156.1 (=CHNH(E)), 153.9 (=CHNH(E)), 142.1 (C(q)), 140.9 (C(q)), 139.2 (HC=CH$_2$(Z)), 138.1 (C(q)), 137.9 (C(q)), 136.1 (HC=CH$_2$(E)), 129.5 (C(q)), 129.1 (CH$_3$), 128.9 (CH$_3$), 128.4 (CH$_3$), 127.9 (CH$_3$), 127.2 (CH$_3$), 126.9 (CH$_3$), 126.7 (CH$_3$), 114.9 (HC=CH$_2$(Z/E)), 109.0 (C(q)CO), 101.9 (C(q)CO), 52.9 (NHCH$_2$(Z)), 52.3 (NHCH$_2$(E)), 35.1 (CH$_3$CH=CH$_2$(Z)), 28.5 (CH$_3$CH=CH$_2$(E)). HRMS m/z calcd. for C$_{13}$H$_{29}$NO$_3$Na (M+Na)$^+$: 300.1364; found: 300.1360.

3-((allylamino)methylene)hex-5-en-2-one (2d)

The general procedure GP2 was followed from 1d (70 mg, 0.57 mmol, 1 equiv) yielding 30 mg of the desired allylated compound 2d as a mixture of Z and E isomers.

Yield= 32 %; yellow oil; ratio (Z/E)= 2.5/1 (analysis of the crude $^1$H NMR showed a Z/E ratio= 1.2/1; IR (film) 3309, 2923, 1698, 1567 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 400 MHz): 9.86 (brs, 1H, NH(Z)), 7.20 (d, J = 12.0 Hz, 1H, =CHNH(E)), 7.10-6.77 (m, 8H, H$_{Ar}(Z)$), 6.55 (d, J = 12.4 Hz, 1H, =CHNH(E)), 5.83-5.59 (m, 2H, HC=CH$_2$(Z/E)). HRMS m/z calcd. for C$_{13}$H$_{29}$NO$_3$Na (M+Na)$^+$: 300.1364; found: 300.1360.
Yield= 47 %; yellow oil; ratio (desired allylated compound)
calcd. for C11H19NONa (M+Na)+: 204.1364; found: 204.1363.

The general procedure GP2 was followed from 1e (80 mg, 0.57 mmol, 1 equiv) yielding 48 mg of the
desired allylated compound 2e as a mixture of Z and E isomers.

Yield= 47 %; yellow oil; ratio (Z/E)= 3/1 (analysis of the crude 1H NMR showed a Z/E ratio= 1/1); IR
(film) 2956, 2857, 1636, 1558 cm⁻¹; 1H NMR (CDCl₃, 400 MHz): 9.92 (brs, 1H, \( =\text{CHNH}_{(Z)} \)), 7.22 (d, \( J = 13.6 \) Hz, 1H, \( =\text{CHNH}_{(E)} \)), 6.50 (d, \( J = 12.5 \) Hz, 1H, \( =\text{CHNH}_{(Z)} \)), 5.82-5.72 (m, 1H, \( \text{CH} = \text{CH}_{(Z)} \)), 5.69-5.62 (m, 1H, \( \text{CH} = \text{CH}_{(E)} \)), 4.97-4.91 (m, 4H, \( \text{CH} = \text{CH}_{(Z,E)} \)), 4.48 (brs, 1H, \( =\text{CHNH}_{(E)} \)), 3.15-3.07 (m, 4H, \( \text{CH} = \text{CH}_{(Z,E)} \)), 2.98 (d, \( J = 6.0 \) Hz, 2H, \( \text{CH} = \text{CH}_{(Z)} \)), 2.82 (d, \( J = 5.8 \) Hz, 2H, \( \text{CH} = \text{CH}_{(E)} \)), 2.12 (s, 3H, \( \text{COCH}_{3} \)), 2.00 (s, 3H, \( \text{COCH}_{3} \)), 1.49-1.42 (m, 4H, \( \text{CH} = \text{CH}_{(Z,E)} \)), 1.35-1.24 (m, 4H, \( \text{CH} = \text{CH}_{(Z,E)} \)), 0.89-0.83 (m, 6H, \( \text{CH}_{3} \)), 13C NMR (CDCl₃, 101 MHz): 197.5 (C = O(\( \text{O}_{(E)} \))), 193.8 (C = O(\( \text{O}_{(Z)} \))), 153.5 (\( =\text{CHNH}_{(E)} \)), 138.7 (\( =\text{CHNH}_{(Z)} \)), 136.3 (\( \text{CH} = \text{CH}_{(Z)} \)), 114.3 (\( \text{CH} = \text{CH}_{(E)} \)), 101.7 (\( \text{C}_{(E)} \)), 48.7 (\( \text{CH}_{2} = \text{NH}_{(Z,E)} \)), 48.4 (\( \text{CHNH}_{(Z,E)} \)), 35.5 (\( \text{CH}_{2} = \text{CH}_{(Z)} \)), 33.4 (\( \text{CH}_{2} = \text{E} \)), 33.7 (\( \text{CH}_{2(\text{Z,E})} \)), 28.0 (\( \text{CH}_{2} = \text{CH}_{(Z)} \)), 27.3 (\( \text{COCH}_{2} \)), 24.2 (\( \text{COCH}_{2} \)), 19.7 (\( \text{CH}_{2} \)), 13.6 (\( \text{CH}_{2(\text{Z,E})} \)). HRMS m/z calcd. for C₁₁H₁₅NONa (M+Na)⁺: 204.1364; found: 204.1355.

Yield= 34 %; yellow oil; ratio (Z/E)= 2.6/1 (analysis of the crude 1H NMR showed a Z/E ratio= 2/1); IR
(film) 3308, 2969, 1638, 1595 cm⁻¹; 1H NMR (CDCl₃, 400 MHz): 10.25 (brs, 1H, \( \text{NH}_{(Z)} \)), 7.42 (d, \( J = 14.0 \) Hz, 1H, \( =\text{CHNH}_{(E)} \)), 6.67 (d, \( J = 13.0 \) Hz, 1H, \( =\text{CHNH}_{(Z)} \)), 5.82-5.73 (m, 1H, \( \text{CH} = \text{CH}_{(Z)} \)), 5.69-5.59 (m, 1H, \( \text{CH} = \text{CH}_{(Z)} \)), 4.96-4.91 (m, 4H, \( \text{CH} = \text{CH}_{(Z,E)} \)), 2.98 (dt, \( J = 6.1 \), 1.8 Hz, 2H, \( \text{CH} = \text{CH}_{(Z)} \)), 2.84 (dt, \( J = 5.9 \), 1.6 Hz, 2H, \( \text{CH} = \text{CH}_{(Z)} \)), 2.13 (s, 3H, \( \text{COCH}_{3} \)), 2.00 (s, 3H, \( \text{COCH}_{3} \)), 1.21 (s, 9H, \( \text{CH}_{3(tbu)} \)). 13C NMR (CDCl₃, 101 MHz): 197.1 (C = O(\( \text{O}_{(E)} \))), 193.8 (C = O(\( \text{O}_{(Z)} \))), 149.8 (\( =\text{CHNH}_{(E)} \)), 144.9 (\( =\text{CHNH}_{(Z)} \)), 138.8 (\( \text{CH} = \text{CH}_{(Z)} \)), 136.2 (\( \text{CH} = \text{CH}_{(Z)} \)), 114.5 (\( \text{CH} = \text{CH}_{(E)} \)), 114.3 (\( \text{CH} = \text{CH}_{(E)} \)), 101.6 (\( \text{CO}_{(Z)} \)), 52.03 (\( \text{NH}_{(Z,E)} \)), 51.6 (\( \text{NH}_{(Z,E)} \)), 35.8 (\( \text{CH}_{2} = \text{CH}_{(Z)} \)), 28.0 (\( \text{CH}_{2} = \text{CH}_{(E)} \)), 27.4 (\( \text{COCH}_{2} \)), 24.2 (\( \text{COCH}_{2} \)). HRMS m/z calcd. for C₁₁H₁₅NONa (M+Na)⁺: 204.1364; found: 204.1355.
The general procedure **GP2** was followed from **1g** (95 mg, 0.57 mmol, 1 equiv) yielding 47 mg of the desired allylated compound **2g** as a mixture of **Z** and **E** isomers.

Yield = 40%; yellow oil; ratio (Z/E) = 2.6/1 (analysis of the crude \(^1\)H NMR did not allow the determination of the Z/E ratio); IR (film) 2929, 2854, 1645, 1558 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\), 300 MHz): 10.00 (brs, 1H, \(\text{NH}(Z)\)), 7.32 (d, \(J = 13.7\) Hz, 1H, \(=\text{CH}NH(E)\)), 6.58 (d, \(J = 12.7\) Hz, 1H, \(=\text{CH}NH(Z)\)), 5.83-5.58 (m, 2H, \(=\text{CH}2(Z+E)\)), 5.07-4.91 (m, 4H, \(=\text{CH}2(Z+E)\)), 4.56 (brs, 1H, \(\text{NH}(E)\)), 3.04-2.91 (m, 2H, \(=\text{CH}NH(Z+E)\)), 2.89 (dt, \(J = 6.1, 1.7\) Hz, 2H, \(=\text{CH}2\text{CH}=\text{CH}2(E)\)), 2.82 (dt, \(J = 5.8, 1.7\) Hz, 2H, \(=\text{CH}2\text{CH}=\text{CH}2(Z)\)), 2.11 (s, 3H, \(\text{COCH}3(E)\)), 2.00 (s, 3H, \(\text{COCH}3(Z)\)), 1.86-1.78 (m, 4H, \(=\text{CH}2(Z+E)\)), 1.70-1.63 (m, 4H, \(=\text{CH}2(Z+E)\)), 1.56-1.18 (m, 12H, \(=\text{CH}2(Z+E)\)); \(^{13}\)C NMR (CDCl\(_3\), 75 MHz): 197.2 (=CH\(_2\)O\(Z\)), 193.7 (=CH\(_2\)O\(E\)), 151.5 (=CH\(_2\)NH\(Z\)), 147.9 (=CH\(_2\)NH\(E\)), 138.7 (=CH=CH\(_2\)), 136.2 (=CH=CH\(_2\)), 114.5 (=CH=CH\(_2\)), 114.3 (=CH=CH\(_2\)), 101.5 (C\(_{q}\)CO), 57.1 (=CH\(_2\)NH\(Z\)), 56.6 (=CH\(_2\)NH\(E\)), 35.6 (=CH\(_2\)CH=CH\(_2\)), 34.4 (=CH\(_2\)), 34.2 (=CH\(_2\)), 29.7 (=CH\(_2\)), 29.6 (=CH\(_2\)), 29.3 (=CH\(_2\)), 28.0 (=CH\(_2\)CH=CH\(_2\)), 27.3 (=COCH\(_3\)), 25.3 (=CH\(_2\)), 25.2 (=CH\(_2\)), 24.5 (=CH\(_2\)), 24.5 (=COCH\(_3\)), 24.1 (=CH\(_2\)), 22.7 (=CH\(_2\)). HRMS m/z calcd. for C\(_{13}\)H\(_{21}\)NOH (M+H\(^+\))**: 208.1701; found: 208.1694.

The general procedure **GP2** was followed from **1h** (0.16 g, 0.57 mmol, 1 equiv) to give 20 mg of the \(N\)-allylated compound **3h** (only **E** isomer).

Yield = 13%; yellow oil; IR (film) 3061, 2919, 1619, 1583 cm\(^{-1}\); \(^1\)H NMR (CDCl\(_3\), 400 MHz): 7.97 (d, \(J = 14.0\) Hz, 1H, \(=\text{CH}NH\)), 7.64 (d, \(J = 8.0\) Hz, 2H, \(=\text{CH}ArTs\)), 7.63 (d, \(J = 8\) Hz, 2H, \(=\text{CH}ArTs\)), 5.54-5.41 (m, 1H, \(=\text{CH}2\)), 5.39 (d, \(J = 14.0\) Hz, 1H, \(=\text{CH}CO\)), 5.12-5.06 (m, 2H, \(=\text{CH}2\)), 4.01 (dt, \(J = 5.6\) Hz, 2H, \(=\text{CH}CO\)), 2.37 (s, 3H, \(=\text{CH}CO\)), 2.16 (s, 3H, \(=\text{CH}2\)); \(^{13}\)C NMR (CDCl\(_3\), 101 MHz): 196.6 (=CH\(_2\)O), 145.1 (C\(_{q}\)Ar), 141.2 (=CHN), 135.3 (C\(_{q}\)Ar), 130.2 (=CH), 129.9 (=CH), 129.7 (=CH), 127.3 (=CH), 126.5 (=CH), 118.9 (=CH=CH\(_2\)), 109.0 (=CHCO), 48.3 (=CHCH\(_2\)), 27.6 (=COCH\(_3\)), 21.6 (=CH\(_{17}\)). HRMS m/z calcd. for C\(_{14}\)H\(_{17}\)NNaO\(_3\)S (M+Na\(^+\))**: 302.0821; found: 302.0836.

The general procedure **GP2** was followed from **1j** (0.108 g, 0.57 mmol, 1 equiv) yielding 30 mg of the desired allylated compound **2j** as a mixture of \(Z\) and \(E\) isomers (analysis of the crude \(^1\)H NMR showed...
a Z/E ratio= 1/1) but after purification only the Z isomer was isolated. The data are in accordance with those reported in the literature.5

Yield= 23 %; yellow oil; IR (film) 2924, 1647, 1596 cm⁻¹; ¹H NMR (CDCl₃, 400 MHz): 12.39 (brs, 1H, NH), 7.29-7.16 (m, 5H, HAr), 5.86-5.73 (m, 1H, CH=CH₂), 4.96-5.89 (m, 2H, CH=CH₂), 4.41 (d, J =6.1 Hz, 2H, CH₂NH), 2.94 (dt, J = 5.0, 2.0 Hz, 2H, CH₂CH=CH₂), 2.06 (s, 3H, CH₃), 1.84 (s, 3H, CH₃).

**Methyl 2-((benzylamino)methylene)pent-4-enoate (2k)**

The general procedure GP2 was followed from 1k (0.11 g, 0.57 mmol, 1 equiv) to give 26 mg of the desired allylated compound 2k as a mixture of Z and E isomers.

Yield= 20 %; yellow oil; ratio (Z/E)= 2/1 (analysis of the crude ¹H NMR showed a Z/E ratio= 1.2/1); IR (film) 3337, 2918, 1671, 1636 cm⁻¹; ¹H NMR (CDCl₃, 300 MHz): 8.01 (brs, 1H, NH(Z)), 7.44 (d, J = 13.6 Hz, 1H, CH=CH₂NH(E)), 7.26-7.14 (m, 10H, HAr(Z+E)), 6.54 (d, J = 12.9 Hz, 1H, CH=CH₂NH(Z)), 5.84-5.65 (m, 2H, CH=CH₂(Z+E)), 5.01-4.85 (m, 4H, CH=CH₂(Z+E)), 4.27(d, J = 6.1 Hz, 4H, CH₂NH(Z+E)), 3.61 (s, 6H, CH₃OCO(Z+E)), 2.95 (d, J = 5.7 Hz, 2H, CH₂CH=CH₂), 2.78 (d, J = 6.2 Hz, 2H, CH₂CH=CH₂); ¹³C NMR (CDCl₃, 75 MHz): 170.6 (C=O(Z)), 169.4 (C=O(E)), 151.5 (C(CH₂NH(Z))), 147.8 (C(CH₂NH(E))), 139.0 (C(CH=CH₂(Z+E))), 138.6 (C(CH=CH₂(Z))), 128.8 (C(CH=CH₂(Z))), 128.7 (C(CH=CH₂(Z))), 127.7 (C(CH=CH₂(Z))), 127.5 (C(CH=CH₂(Z))), 127.0 (C(CH=CH₂(Z))), 126.9 (C(CH=CH₂(Z))), 114.6 (C(CH=CH₂(Z))), 114.2 (C(CH=CH₂(Z))), 95.9 (C(CH=CH₂(Z))), 92.8 (C(CH=CH₂(Z))), 52.2 (C(CH₂NH(Z+E))), 51.0(C(CH₂NH(Z))), 50.52(C(CH₂NH(Z))), 33.9 (C(CH₂CH=CH₂(Z))), 29.2 (C(CH₂CH=CH₂(Z))). HRMS m/z calcd. for C₁₄H₁₇NO₂Na (M+Na)+: 254.1157; found: 254.1158.

**General procedure for the allylation of enamnone 1a with other allylic partners (GP3)**

To a suspension of Pd(OAc)₂ (13 mg, 0.057 mmol, 10 mol%), dppf (35 mg, 0.063 mmol, 11 mol%) and proton sponge (0.12 g, 0.57 mmol, 1 equiv) in THF (0.5 mL) in a sealed-tube equipped with a septum, under argon atmosphere, was added the allylic partner (1.14 mmol, 2 equiv). After 5 minutes stirring, a solution of enamnone 1a (0.57 mmol, 1 equiv) in THF (0.5 mL) was added, the tube was sealed and the mixture was stirred during 1 hour under microwave irradiation at 100 °C. The crude was filtered on a plug of silica gel. The solvent was removed *in vacuo* and the mixture was purified by flash chromatography on silica gel (ethyl acetate/cyclohexane: 20/80) to afford the allylated enamnone.

**3-((benzylamino)methylene)-4-methylhex-5-en-2-one (2l)**

The general procedure GP3 was followed using but-3-en-2-yl acetate (0.13 g, 1.14 mmol, 2 equiv) to give 8 mg of the desired allylated compound 2l as a mixture of Z and E isomers.

---

Yield = 14%; yellow oil; ratio (Z/E) = 4.9/1 (analysis of the crude $^1$H NMR did not allow the determination of the Z/E ratio); IR (film) 3272, 3030, 2920, 1638 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 400 MHz): 10.32 (brs, 1H, NH(Z)), 7.32-7.14 (m, 11H, =CHNH(E)+HAr(Z+E)), 6.69 (d, $J = 12.0$ Hz, 1H, =CHNH(Z)), 6.03-5.96 (m, 1H, CH=CH$_2$(Z)), 5.85-5.77 (m, 1H, CH=CH$_2$(E)), 5.08-5.03 (m, 2H, CH=CH$_2$(E)), 4.95-4.91 (m, 2H, CH=CH$_2$(Z)), 4.27 (d, $J = 6.1$ Hz, 2H, CH$_2$NH(Z)), 4.26 (d, $J = 8.0$ Hz, 2H, CH$_2$NH(E)), 3.92-3.89 (m, 1H, CH$_2$CH$_3$(E)), 3.22-3.15 (m, 1H, CH$_2$CH$_3$(Z)), 2.12 (s, 3H, CH$_3$CO(E)), 2.09 (s, 3H, CH$_3$CO(Z)); $^{13}$C NMR (CDCl$_3$, 101 MHz): only the Z isomer 197.8 (C=O), 151.7 (=CHNH), 143.8 (CH=CH$_2$), 138.4 (C$_{Ar}$(q)), 127.5 (CH$_z$), 126.9 (CH$_z$), 112.5 (CH=CH$_2$), 108.7(C$_{Ar}$(q)CO), 52.7 (CH$_2$NH), 36.9 (CH$_3$), 27.2 (COCH$_3$), 20.5 (CH$_2$CH$_3$). HRMS m/z calcd. for $C_{15}H_{19}NO$Na (M+Na)$^+$: 252.1364; found: 252.1366.

![Diagram](attachment:image.png)

3-((benzylamino)methylene)-6-phenylhex-5-en-2-one (2n)

The general procedure GP3 was followed from the diethyl 3-phenylprop-2-enyl phosphate (0.30 g, 1.14 mmol, 2 equiv) to give 70 mg of the desired allylated compound 2n as a mixture of Z and E isomers.

Yield = 42%; yellow oil; ratio (Z/E) = 1/1.2 (analysis of the crude $^1$H NMR showed a Z/E ratio = 1/1); IR (film) 3024, 2923, 1706, 1597 cm$^{-1}$; $^1$H NMR (CDCl$_3$, 400 MHz): 10.17 (brs, 1H, NH(Z)), 7.34-7.10 (m, 21H, =CHNH(E)+HAr(Z+E)), 6.62 (d, $J = 12.4$ Hz, 1H, =CHNH(Z)), 6.32-6.27 (m, 2H, CH=CHPh(Z+E)), 6.19-6.12 (m, 1H, CH$_2$CH=CHPh(E)), 6.09-6.02 (m, 1H, CH=CHPh(E)), 4.32-4.30 (m, 4H, CH$_2$NH(Z+E)), 3.17 (dd, $J = 6.2$, 1.6 Hz, 2H, CH$_2$CH=CHPh(E)), 3.01 (dd, $J = 5.9$, 1.5 Hz, 2H, CH$_2$CH=CHPh(E)), 2.15 (s, 3H, CH$_3$CO(E)), 2.07 (s, 3H, CH$_3$CO(E)); $^{13}$C NMR (CDCl$_3$, 101 MHz): 198.2 (C=O(Z)), 194.2 (C=O(E)), 153.0 (=CHNH(Z)), 149.4 (=CHNH(E)), 138.4 (C$_{Ar}$(q)), 137.5 (C$_{Ar}$(q)), 130.0 (CH=CHPh(E)), 128.9 (CH$_z$), 128.8 (CH$_z$), 128.5 (CH$_z$), 128.5 (CH$_z$), 127.9 (CH=CHPh(E)), 127.4 (CH$_z$), 127.6 (CH$_z$), 127.1 (CH$_z$), 126.9 (CH$_z$), 126.1 (CH$_z$), 103.0 (C$_{Ar}$(q)CO(Z+E)), 52.5 (CH$_2$NH(Z)), 52.3 (CH$_2$NH(E)), 34.8 (CH$_2$CH=CHPh(E)), 27.7 (CH$_2$CO(E)), 27.1 (CH$_2$CH=CHPh(E)), 24.4 (CH$_2$CO(E)). HRMS m/z calcd. for $C_{20}H_{21}NO$Na (M+Na)$^+$: 314.1521; found: 314.1520.
4. $^1$H and $^{13}$C NMR Spectra

Enaminone 1a
Enaminone 1b

Parameter | Value
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1. Title | Enaminone 1b
2. Solvent | CDCl3
3. Spectrometer Frequency | 500.13 MHz
4. Nucleus | 1H

---

Parameter | Value
--- | ---
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2. Solvent | CDCl3
3. Number of Scans | 256
4. Spectrometer Frequency | 75.46 MHz
5. Nucleus | 13C
Enaminone 1c
Enaminone 1d
Enaminone 1e
Enaminone 1h
Enaminone 1i
Enaminone 1j
Enamino-ester 1k

Parameter | Value
--- | ---
Title | EPM142
Solvent | CDCl3
Spectrometer Frequency | 300.18 MHz
Nucleus | 1H

![Chemical Structure 1](image1)

![NMR Spectrum 1](image2)

Parameter | Value
--- | ---
Title | EPM142
Solvent | CDCl3
Spectrometer Frequency | 75.48 MHz
Nucleus | 13C

![Chemical Structure 2](image3)

![NMR Spectrum 2](image4)
Allylated Enaminone 2a
Allylated Enaminone 2b
Allylated Enaminone 2c
Allylated Enaminone 2d
Allylated Enaminone 2e

Parameters
Parameter Value
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4. Experiment  1D
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Allylated Enaminone 2f

Parameter | Value
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2. Solvent | CDCl₃
3. Number of Scans | 32
4. Spectrometer Frequency | 400.13 MHz
5. Nuclear | 1H

---

Parameter | Value
--- | ---
1. Title | 2(R)-3-(2-Oxopropyl)-2-propylpyrrolidin-5-ium chloride (2f)
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N-Allylated Enaminone 3h

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![N-Allylated Enaminone 3h](imageurl)

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![N-Allylated Enaminone 3h](imageurl)

![N-Allylated Enaminone 3h](imageurl)
Allylated Enaminone 2j

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Allylated Enaminone 2l
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