Synthesis of $N$-substituted quaternary carbon centers through KOt-Bu-catalyzed aza-Michael addition of pyrazoles to cyclic enones

Subin Yoon, Sungbin Lee, Seung Hyun Nam, Hyejeong Lee* and Yunmi Lee**

$^a$Department of Chemistry, Kwangwoon University, Seoul 01897, Republic of Korea
$^b$College of Pharmacy, Duksum Women's University, Seoul 01369, Republic of Korea.

Supplementary Information

Table of Contents

1. Copies of $^1$H and $^{13}$C NMR spectra for all products S2
2. 2D-NOESY proton NMR spectra of compound 3af, 3ah and $^1$H NOESY correlations S36
Copies of $^1$H and $^{13}$C NMR spectra for all products

Figure S1. $^1$H NMR spectrum of the compound 3aa in CDCl$_3$, 400 MHz

Figure S2. $^{13}$C NMR spectrum of the compound 3aa in CDCl$_3$, 100 MHz
Figure S3. $^1$H NMR spectrum of the compound 3ab in CDCl₃, 400 MHz

Figure S4. $^{13}$C NMR spectrum of the compound 3ab in CDCl₃, 100 MHz
**Figure S5.** $^1$H NMR spectrum of the compound 3ac in CDCl$_3$, 400 MHz

**Figure S6.** $^{13}$C NMR spectrum of the compound 3ac in CDCl$_3$, 100 MHz
Figure S7. $^1$H NMR spectrum of the compound 3ad in CDCl$_3$, 400 MHz

Figure S8. $^{13}$C NMR spectrum of the compound 3ad in CDCl$_3$, 100 MHz
Figure S9. $^1$H NMR spectrum of the compound 3ae in CDCl₃, 400 MHz

Figure S10. $^{13}$C NMR spectrum of the compound 3ae in CDCl₃, 100 MHz
Figure S11. $^1$H NMR spectrum of the compound 3af in CDCl$_3$, 400 MHz

Figure S12. $^{13}$C NMR spectrum of the compound 3af in CDCl$_3$, 100 MHz
Figure S13. $^1$H NMR spectrum of the compound 3ah in CDCl$_3$, 400 MHz

Figure S14. $^{13}$C NMR spectrum of the compound 3ah in CDCl$_3$, 100 MHz
Figure S15. $^1$H NMR spectrum of the compound 3ai in CDCl$_3$, 400 MHz

Figure S16. $^{13}$C NMR spectrum of the compound 3ai in CDCl$_3$, 100 MHz
Figure S17. $^1$H NMR spectrum of the compound 3aj in CDCl$_3$, 400 MHz

Figure S18. $^{13}$C NMR spectrum of the compound 3aj in CDCl$_3$, 100 MHz
Figure S19. $^1$H NMR spectrum of the compound 3ak in CDCl$_3$, 400 MHz

Figure S20. $^{13}$C NMR spectrum of the compound 3ak in CDCl$_3$, 100 MHz
Figure S21. $^1$H NMR spectrum of the compound 3al in CDCl$_3$, 400 MHz

Figure S22. $^{13}$C NMR spectrum of the compound 3al in CDCl$_3$, 100 MHz
Figure S23. $^1$H NMR spectrum of the compound 3am in CDCl$_3$, 400 MHz

Figure S24. $^{13}$C NMR spectrum of the compound 3am in CDCl$_3$, 100 MHz
Figure S25. $^1$H NMR spectrum of the compound 3an in CDCl$_3$, 400 MHz

Figure S26. $^{13}$C NMR spectrum of the compound 3an in CDCl$_3$, 100 MHz
Figure S27. $^1$H NMR spectrum of the compound 3ao in CDCl$_3$, 400 MHz

Figure S28. $^{13}$C NMR spectrum of the compound 3ao in CDCl$_3$, 100 MHz
Figure S29. $^1$H NMR spectrum of the compound $3\text{ap}$ in CDCl$_3$, 400 MHz

Figure S30. $^{13}$C NMR spectrum of the compound $3\text{ap}$ in CDCl$_3$, 100 MHz
Figure S31. $^1$H NMR spectrum of the compound 3bc in CDCl$_3$, 400 MHz

Figure S32. $^{13}$C NMR spectrum of the compound 3bc in CDCl$_3$, 100 MHz
Figure S33. $^1$H NMR spectrum of the compound 3cc in CDCl$_3$, 400 MHz

Figure S34. $^{13}$C NMR spectrum of the compound 3cc in CDCl$_3$, 100 MHz
Figure S35. $^1$H NMR spectrum of the compound 3dc in CDCl$_3$, 400 MHz

Figure S36. $^{13}$C NMR spectrum of the compound 3dc in CDCl$_3$, 100 MHz
**Figure S37.** $^1$H NMR spectrum of the compound 3ec in CDCl$_3$, 400 MHz

**Figure S38.** $^{13}$C NMR spectrum of the compound 3ec in CDCl$_3$, 100 MHz
Figure S39. $^1$H NMR spectrum of the compound 3fc in CDCl$_3$, 400 MHz

Figure S40. $^{13}$C NMR spectrum of the compound 3fc in CDCl$_3$, 100 MHz
Figure S41. $^1$H NMR spectrum of the compound 3gc in CDCl$_3$, 400 MHz

Figure S42. $^{13}$C NMR spectrum of the compound 3gc in CDCl$_3$, 100 MHz
Figure S43. $^1$H NMR spectrum of the compound 3hc in CDCl$_3$, 400 MHz

Figure S44. $^{13}$C NMR spectrum of the compound 3hc in CDCl$_3$, 100 MHz
Figure S45. $^1$H NMR spectrum of the compound 3ic in CDCl$_3$, 400 MHz

Figure S46. $^{13}$C NMR spectrum of the compound 3ic in CDCl$_3$, 100 MHz
**Figure S47.** $^1$H NMR spectrum of the compound 3jc in CDCl$_3$, 400 MHz

**Figure S48.** $^{13}$C NMR spectrum of the compound 3jc in CDCl$_3$, 100 MHz
Figure S49. $^1$H NMR spectrum of the compound 3kc in CDCl$_3$, 400 MHz

Figure S50. $^{13}$C NMR spectrum of the compound 3kc in CDCl$_3$, 100 MHz
Figure S51. $^1$H NMR spectrum of the compound 3kd in CDCl$_3$, 400 MHz

Figure S52. $^{13}$C NMR spectrum of the compound 3kd in CDCl$_3$, 100 MHz
Figure S53. $^1$H NMR spectrum of the compound 3ke in CDCl$_3$, 400 MHz

Figure S54. $^{13}$C NMR spectrum of the compound 3ke in CDCl$_3$, 100 MHz
Figure S55. $^1$H NMR spectrum of the compound 3lc in CDCl$_3$, 400 MHz

Figure S56. $^{13}$C NMR spectrum of the compound 3lc in CDCl$_3$, 100 MHz
Figure S57. $^1$H NMR spectrum of the compound 3mc in CDCl$_3$, 400 MHz

Figure S58. $^{13}$C NMR spectrum of the compound 3mc in CDCl$_3$, 100 MHz
Figure S59. $^1$H NMR spectrum of the compound 3nc in CDCl$_3$, 400 MHz

Figure S60. $^{13}$C NMR spectrum of the compound 3nc in CDCl$_3$, 100 MHz
Figure S61. $^1$H NMR spectrum of the compound 3oc in CDCl$_3$, 400 MHz

Figure S62. $^{13}$C NMR spectrum of the compound 3oc in CDCl$_3$, 100 MHz
Figure S63. $^1$H NMR spectrum of the compound 4a in CDCl$_3$, 400 MHz

Figure S64. $^{13}$C NMR spectrum of the compound 4a in CDCl$_3$, 100 MHz
Figure S65. $^1$H NMR spectrum of the compound 4b in CDCl$_3$, 400 MHz

Figure S66. $^{13}$C NMR spectrum of the compound 4b in CDCl$_3$, 100 MHz
Figure S67. $^1$H NMR spectrum of the compound $4c$ in CDCl$_3$, 400 MHz

Figure S68. $^{13}$C NMR spectrum of the compound $4c$ in CDCl$_3$, 100 MHz
2D-NOESY proton NMR spectra of compound 3af, 3ah and $^1$H NOESY correlations

Figure S. 2D-NOESY spectrum of the compound 3af in CDCl$_3$
Figure S. 2D-NOESY spectrum of the compound 3ah in CDCl₃