Supporting Information

Synthesis and Biological Activity of Novel Succinate Dehydrogenase Inhibitor Derivatives as Potent Fungicide Candidates

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Table of Contents

General synthesis procedure for intermediate 4 ................................................................. S3

$^1$H NMR spectra of intermediates .................................................................................. S5

$^1$H NMR spectra of target compounds ......................................................................... S11

HRMS spectra of target compounds ............................................................................... S22
General synthesis procedure for intermediate 4

Scheme S1 The synthesis route of compounds 4

General synthesis procedure for intermediate II.

In a 250 mL two-neck round bottom flask, 28.3 mmol of pyrazole acid compound I was added and suspended in tert-butanol solution under N₂. Then 36.91 mmol of diphenylphosphoryl azide (DPPA) and 56.78 mmol of diisopropylethylamine (DIPEA) were added at room temperature, and the reaction solution was stirred at room temperature for 0.5 h, followed by heating at 80-90° C for 4 h. After the reaction was completed, the reaction system was cooled to room temperature, and the excess solvent was removed by concentration under reduced pressure. The residue is purified by silica gel column chromatography to afford compound II.

Data for tert-butyl (1-methyl-3-(trifluoromethyl)-1H-pyrazol-4-yl)carbamate (II-1). Yield 76%; white solid; mp 111-112 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.91 (s, 1H), 6.45 (s, 1H), 3.88 (s, 3H), 1.50 (s, 9H).

Data for tert-butyl (3-(difluoromethyl)-1-methyl-1H-pyrazol-4-yl)carbamate (II-2). Yield 91%; white solid; mp 91-92 °C. ¹H NMR (400 MHz, CDCl₃) δ 7.87 (s, 1H), 6.70 (t, J = 54.8 Hz, 1H), 6.61 (s, 1H), 3.84 (s, 3H), 1.51 (s, 9H).

General synthesis procedure for intermediate 4.

The mixture of 4 mmol of compound II (4 mmol), dry CH₂Cl₂ (8 mL) and trifluoroacetic acid (4 mL) were stirred at room temperature for 2 h. The reaction was monitored by TLC. After the reaction was completed, the mixture was concentrated under reduced pressure to remove excess solvent and trifluoroacetic acid. Then 40 mL of water was added to the mixture and the mixture was neutralize with a saturated aqueous solution of sodium carbonate, and then, it was extracted with ethyl acetate, followed by combining the organic layer and washing with saturated sodium hydrogen
carbonate and saturated sodium chloride. After dried over anhydrous sodium sulfate and filtration, the solvent was removed under reduced pressure, and the residue was purified by silica gel column chromatography to afford compound 4.

Data for 1-methyl-3-(trifluoromethyl)-1H-pyrazol-4-amine (4a). Yield 93%; pink oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.96 (s, 1H), 3.79 (s, 3H), 3.17 (s, 2H).

Data for 3-(difluoromethyl)-1-methyl-1H-pyrazol-4-amine (4b). Yield 89%; pink oil. $^1$H NMR (400 MHz, CDCl$_3$) $\delta$ 6.91 (s, 1H), 6.64 (t, $J = 54.7$ Hz, 1H), 3.73 (t, $J = 1.5$ Hz, 3H), 3.11 (s, 2H).
$^1$H NMR spectras of intermediates

Figure S1. The $^1$H NMR (400 MHz, CDCl$_3$) of II-1

Figure S2. The $^1$H NMR (400 MHz, CDCl$_3$) of II-2
Figure S3. The $^1$H NMR (400 MHz, CDCl$_3$) of 4a

Figure S4. The $^1$H NMR (400 MHz, CDCl$_3$) of 4b
Figure S5. The $^1$H NMR (400 MHz, CDCl$_3$) of 2a

Figure S6. The $^1$H NMR (400 MHz, CDCl$_3$) of 2b
Figure S7. The $^1$H NMR (400 MHz, CDCl$_3$) of 2c

Figure S8. The $^1$H NMR (400 MHz, CDCl$_3$) of 2d
Figure S9. The $^1$H NMR (400 MHz, CDCl$_3$) of 2e

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.11 (dd, $J$ = 8.8, 5.7 Hz, 1H), 7.20 (ddd, $J$ = 8.8, 7.7, 2.6 Hz, 1H), 6.99 – 6.90 (m, 2H).

Figure S10. The $^1$H NMR (400 MHz, CDCl$_3$) of 2f

$^1$H NMR (400 MHz, CDCl$_3$) δ 8.15 (dd, $J$ = 8.5, 4.8 Hz, 1H), 7.45 (d, $J$ = 7.7 Hz, 1H), 7.04 (m, 2H), 7.02 (d, $J$ = 8.0 Hz, 1H), 7.01 (d, $J$ = 8.2, 7.8 Hz, 1H), 6.89 (d, $J$ = 8.2 Hz, 2H).
Figure S11. The $^1$H NMR (400 MHz, CDCl$_3$) of 2g

Figure S12. The $^1$H NMR (400 MHz, CDCl$_3$) of 2h
$^1$H NMR spectras of target compounds

Figure S13. The $^1$H NMR (400 MHz, CDCl$_3$) of 5a

Figure S14. The $^1$H NMR (400 MHz, CDCl$_3$) of 5b
Figure S15. The $^1$H NMR (400 MHz, CDCl$_3$) of 5c

Figure S16. The $^1$H NMR (400 MHz, CDCl$_3$) of 5d
Figure S17. The $^1$H NMR (400 MHz, CDCl$_3$) of 5e

Figure S18. The $^1$H NMR (400 MHz, CDCl$_3$) of 5f
Figure S19. The $^1$H NMR (400 MHz, CDCl$_3$) of 5g

Figure S20. The $^1$H NMR (400 MHz, CDCl$_3$) of 5h
Figure S21. The $^1$H NMR (400 MHz, CDCl$_3$) of 5i

Figure S22. The $^1$H NMR (400 MHz, CDCl$_3$) of 5j
Figure S23. The $^1$H NMR (400 MHz, CDCl$_3$) of 5k

Figure S24. The $^1$H NMR (400 MHz, CDCl$_3$) of 5l
Figure S25. The $^1$H NMR (400 MHz, CDCl$_3$) of 5m

Figure S26. The $^1$H NMR (400 MHz, CDCl$_3$) of 5n
Figure S27. The $^1$H NMR (400 MHz, CDCl$_3$) of 5o

Figure S28. The $^1$H NMR (400 MHz, CDCl$_3$) of 5p
Figure S29. The $^1$H NMR (400 MHz, CDCl$_3$) of 5q

Figure S30. The $^1$H NMR (400 MHz, CDCl$_3$) of 5r
Figure S31. The $^1$H NMR (400 MHz, CDCl$_3$) of 5s

Figure S32. The $^1$H NMR (400 MHz, CDCl$_3$) of 5t
Figure S33. The $^1$H NMR (400 MHz, CDCl$_3$) of 5u
HRMS spectra of target compounds

Figure S34. The HRMS spectra of 5a

Figure S35. The HRMS spectra of 5b
Figure S36. The HRMS spectra of 5c

Figure S37. The HRMS spectra of 5d
Figure S38. The HRMS spectras of 5e

Figure S39. The HRMS spectras of 5f
Figure S40. The HRMS spectras of 5g

Figure S41. The HRMS spectras of 5h
Figure S42. The HRMS spectras of $5i$

Figure S43. The HRMS spectras of $5j$
Figure S44. The HRMS spectras of 5k

Figure S45. The HRMS spectras of 5l
Figure S46. The HRMS spectra of 5m

Figure S47. The HRMS spectra of 5n
Figure S48. The HRMS spectras of 5o

Figure S49. The HRMS spectras of 5p
Figure S50. The HRMS spectras of $5q$

Figure S51. The HRMS spectras of $5r$
Figure S52. The HRMS spectras of $5_s$

Figure S53. The HRMS spectras of $5_t$
Figure S54. The HRMS spectra of $5u$