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SUPPLEMENTARY MATERIAL TO

Synthesis, antioxidant and antimicrobial activity of carbohydrazones

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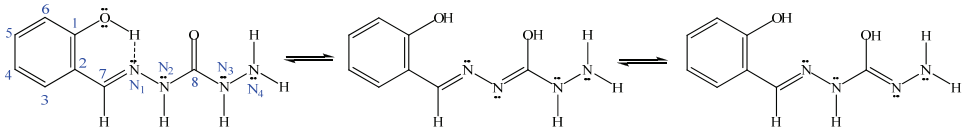
SPECTRAL DATA FOR COMPOUNDS **1**–**14**

[(2-Hydroxyphenyl)methylidene]carbonohydrazide ***(1)***[1]. White solid (solvent used for crystallization: ethanol). Yield: 66 %; m.p. 180-181°C (lit m.p. -). Anal. Calcd. for $C_8H_9N_4O_2$ (*Mw* = 245.24 g mol^{-1}): C, 49.74; H, 4.70; N, 29.00 %. Found: C, 49.68; H, 4.66; N, 28.93 %. IR (KBr, cm^{-1}): 3353 (OH), 3282 (NH_2), 3096 (NH), 1680 (C=O), 1640 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.16 (2H, *s*, H_2–N_4), 6.79-6.89 (2H, *m*, H–C_5, H–C_3), 7.18 (1H, *td*, H–C_4, $^3J_{4,5}$ = 7.7 Hz, $^4J_{4,6}$ = 1.4 Hz), 7.64 (1H, *s*, H–C_6), 7.92 (1H, *s*, H–N_3), 8.22 (1H, *s*, H–C_7), 10.08-10.73 (2H, *br.m.ovlp.*, OH, H–N_2). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 116.09 (C_3), 119.22 (C_5), 120.06 (C_2), 127.86 (C_6), 130.23 (C_4), 140.22 (C_7), 156.24 (C_1), 157.92 (C_8). lit. ^{1}H NMR (300 MHz, DMSO-d_6, δ / ppm): 4.12 (2H, H_2–N_4), 6.81 (1H, H–C_5), 6.84 (1H, H–C_3), 7.18 (1H, H–C_4), 7.66 (1H, H–C_6), 7.90 (1H, H–N_3), 8.20 (1H, H–C_7), 10.40 (2H, OH, H–N_2). ^{13}C NMR (90 MHz, DMSO-d_6, δ / ppm): 116.48 (C_3), 119.62 (C_5), 120.49 (C_2), 128.12 (C_6), 130.61 (C_4), 140.05 (C_7), 156.60 (C_1), 157.30 (C_8).



1-a **1**-b **1**-c

Fig. S-1. Equilibrium of tautomeric forms and geometrical isomers of **1** with numeration of the atom of interest.

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*(2-pyridinylmethylidene)carbonohydrazide (**2**)*.

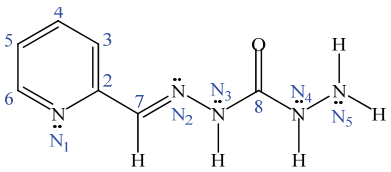

Fig. S-2. (*E*)-isomer of compound **2** with numeration of atom of interest.

White solid (acetonitrile). Yield: 67 %; m.p. 173-174 °C. Anal. Calcd. for $C_7H_9N_5O$ (*Mw* = 179.18 g mol^{-1}): C, 46.92; H, 5.06; N, 39.09 %. Found: C, 46.88; H, 5.01; N, 39.11 %. IR (KBr, cm^{-1}): 3313 (NH_2), 3208 (NH), 1678 (C=O), 1635 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.11 (2H, *s*, H_2–N_5), 7.31 (1H, *ddd*, H–C_5, $^3J_{5,4}$ = 7.5 Hz, $^3J_{5,6}$ = 4.9 Hz, $^4J_{5,3}$ = 1.1 Hz), 7.78 (1H, *td*, H–C_4, $^3J_{4,5}$ = 7.5 Hz, $^4J_{4,6}$ = 1.5 Hz), 7.89 (1H, *s*, H–C_7), 8.10-8.28 (2H, *br.m.ovlp*., H–C_3, H-N_4), 8.51 (1H, *ddd*, H–C_6, $^3J_{6,5}$ = 4.9 Hz, $^4J_{6,4}$ = 1,5 Hz, $^5J_{6,3}$ = 0,9 Hz,), 10.64 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 119.85 (C_3), 123.54 (C_5), 136.53 (C_4), 140.59 (C_7), 149.09 (C_6), 153.77 (C_2), 156.85 (C_8). ^{15}N NMR (derived from 2D HMBC, δ / ppm): 51.10 (N_5), 99.70 (N_4), 153.60 (N_3), 312.20 (N_1), 326.00 (N_2).

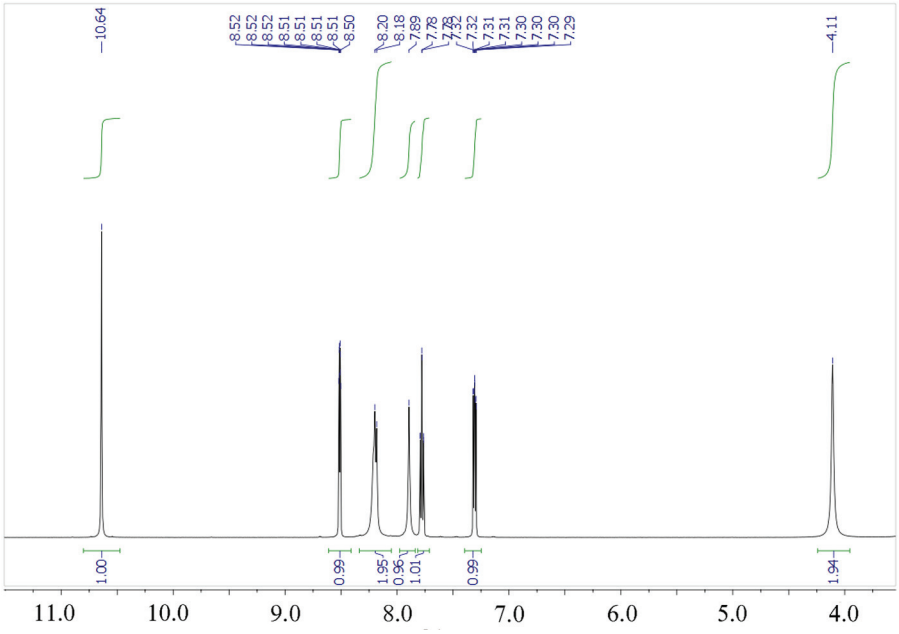

Fig. S-3. ^{1}H NMR spectrum of **2** in DMSO-d_6 recorded at 298 K

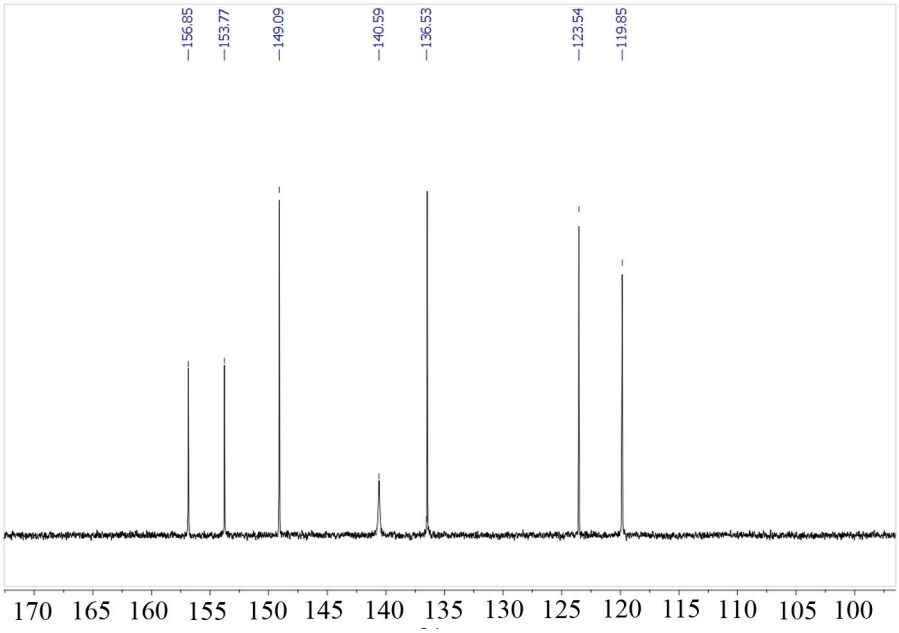

Fig. S-4.[13]C-NMR spectrum of **2** in DMSO-d_6 recorded at 298 K

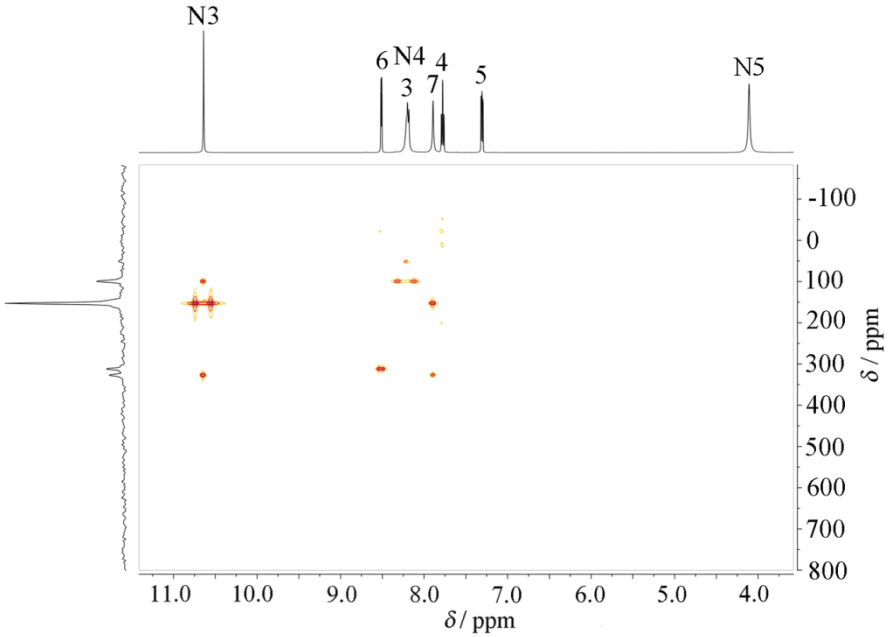

Fig. S-5. 2D [15]N-HMBC spectrum of **2** in DMSO-d_6 recorded at 298 K (x-axis, [1]H; y-axis, [15]N-NMR chemical shift).

*[1-(2-Pyridinyl)ethylidene]carbonohydrazide (**3**)*[2]. White solid (ethanol). Yield: 72,0 %; m.p. 203 °C (lit m.p. 202-203°C). Anal. Calcd. for $C_8H_{11}N_5O$ (*Mw* = 193.21 g mol^{-1}): C, 47.73; H, 5.74; N, 36.25 %. Found: C, 47.61; H, 5.82; N, 36.18 %. IR (KBr, cm^{-1}): 3308 (NH_2), 3197 (NH), 1674 (C=O), 1631 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 2.25 (3H, *s*, H_3-CH_3), 4.15 (2H, *s*, H_2–N_5), 7.36 (1H, *dd*, H-C_5, $^3J_{5,4}$ = 6.4 Hz, $^3J_{5,6}$ = 4.6 Hz), 7.78 (1H, *ddd*, H-C_4, $^3J_{4,3}$ = 8.1 Hz, $^3J_{4,5}$ = 6.4 Hz, $^4J_{4,6}$ = 1.5 Hz), 8.20 (1H, *s*, H-N_4), 8.41 (1H, *d*, H-C_3, $^3J_{3,4}$ = 8.1 Hz), 8.54 (1H, *d*, H-C_6, $^3J_{6,5}$ = 4.6 Hz), 9.78 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 11.60 (CH_3), 120.58 (C_3), 123.57 (C_5), 136.27 (C_4), 145.14 (C_7), 148.10 (C_6), 155.01 (C_2), 157.40 (C_8). lit. ^{1}H NMR (300 MHz, DMSO-d_6, δ / ppm): 2.26 (3H, *s*, CH), 4.14 (2H, *br*, NH). 7.34 (1H, *t*, py), 7.76 (1H, *t*, py), 8.18 (1H, *br*, NH), 8.38 (1H, *d*, py). 8.52 (1H, *d*, py), 9.76 (1H, *br*, NH).

*[Phenyl(2-pyridinyl)methylidene]carbonohydrazide (**4**).*

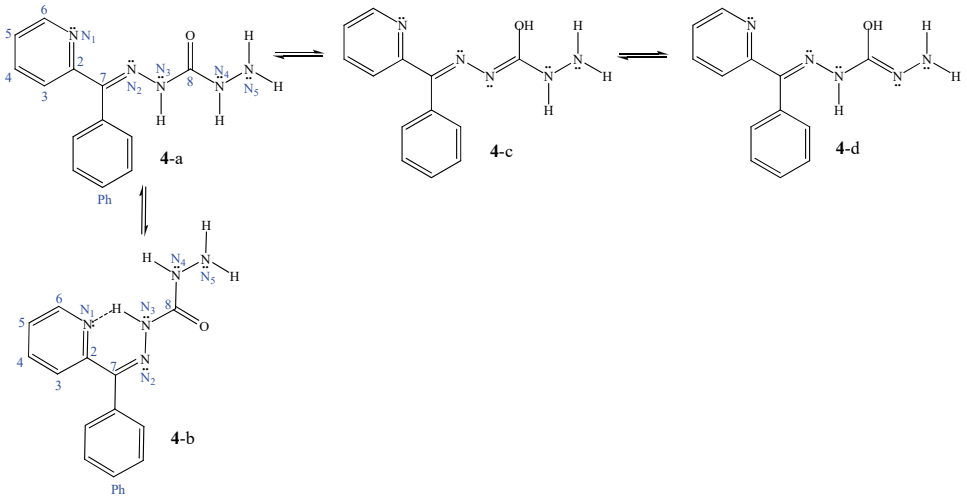

Fig. S-6. Equilibrium of tautomeric forms (**4**-a, **4**-c and **4**-d) and geometrical isomers (**4**-a and **4**-b) of compound **4** with numeration of the atom of interest.

White solid (ethanol). Yield: 84 %; m.p. 203-205 °C. Anal. Calcd. for $C_{13}H_{13}N_5O$ (*Mw* = 255.11 g mol^{-1}): C, 61.17; H, 5.13; N, 27.43 %. Found: C, 61.02; H, 4.98; N, 27.15 %. IR (KBr, cm^{-1}): 3304 (NH_2), 3215 (NH), 1674 (C=O), 1623 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.15 (2H, *s*, H_2–N_5), 7.36 (1H, *d*, H–C_3, $^3J_{3,4}$ = 7.8 Hz), 7.40-7.60 (5H, *m*, Ph), 7.68 (1H, *dd*, H–C_4, $^3J_{4,3}$ = 7.8 Hz, $^3J_{4,5}$ =7.5 Hz), 8.01 (1H, *dd*, H–C_5, $^3J_{5,4}$ = 7.5 Hz, $^3J_{5,6}$ = 4.5 Hz), 8.26 (1H, *s*, H-N_4), 8.85 (1H, *d*, H–C_6, $^3J_{6,5}$ = 4.5 Hz), 13.20 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 121.79 (C_3), 123.87 (C_5), 124.84 (Ph), 125.95 (Ph), 128.27 (Ph), 128.93 (Ph), 129.14 (Ph), 138.18 (C_4), 143.23 (C_7), 148.90 (C_6), 151.40 (C_2), 157.21 (C_8). ^{15}N NMR (derived from 2D HMBC, δ / ppm): 57.62 (N_5), 100.07 (N_4), 155.1 (N_3), 306.33 (N_1), 315.85 (N_2).

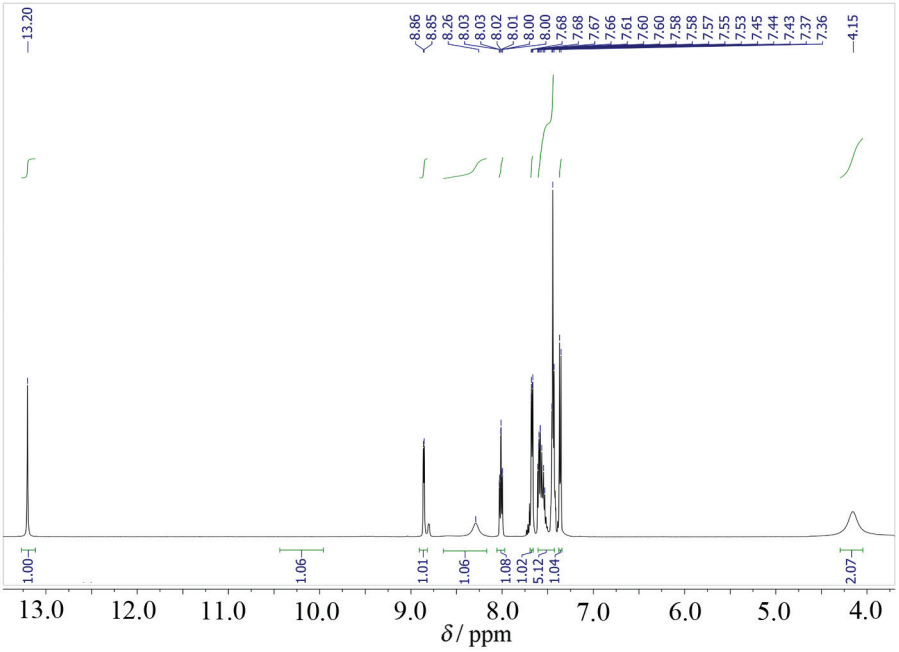

Fig. S-7. ^{1}H NMR spectrum of **4** in DMSO-d_6 recorded at 298 K

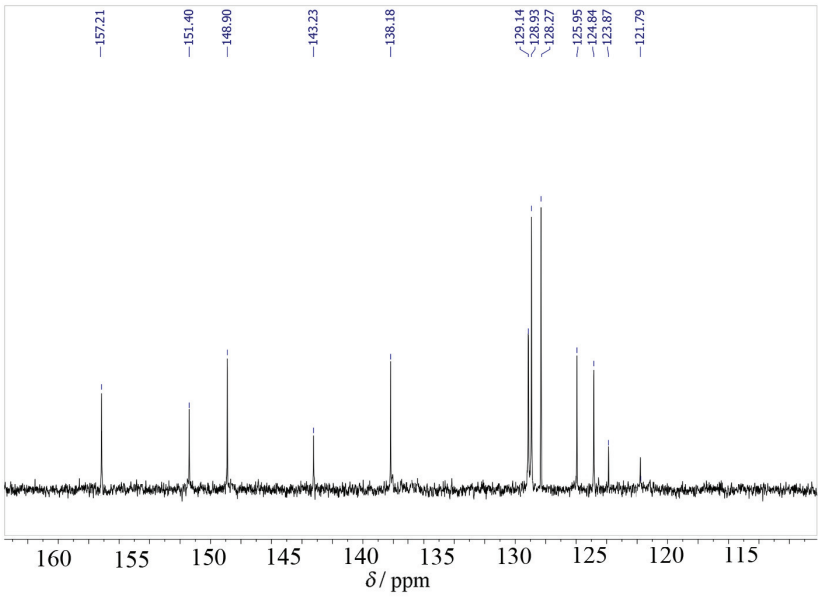

Fig. S-8. ^{13}C NMR spectrum of 4 in DMSO-d_6 recorded at 298 K.

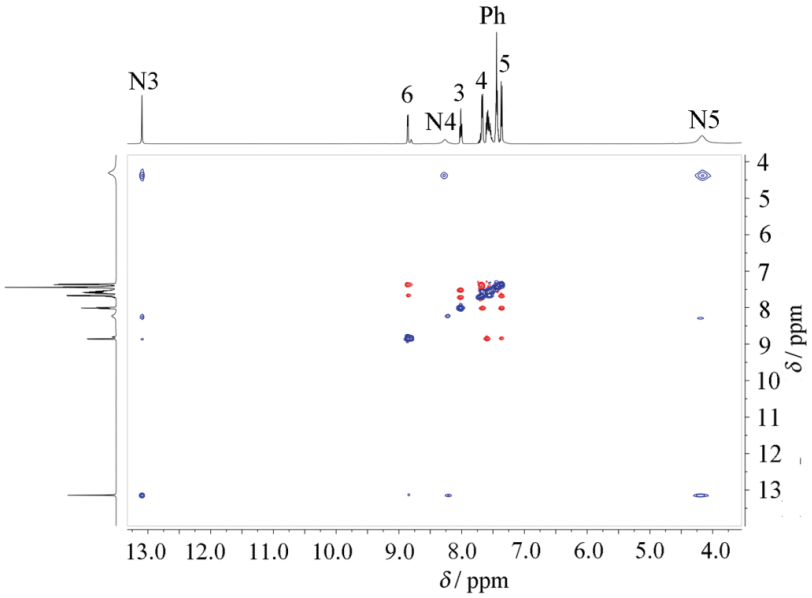

Fig. S-9. 2D NOESY of **4** in DMSO-d_6 recorded at 298 K (x- and y-axes, ^{1}H-NMR chemical shift).

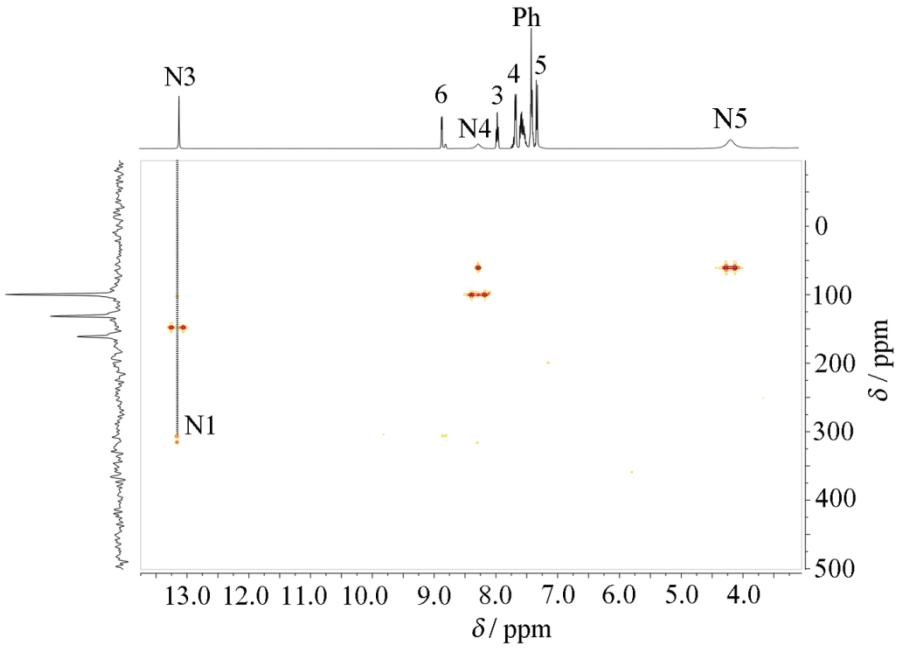

Fig. S-10. 2D ^{15}N-HMBC of **4** in DMSO-d6 at 298 K (x-axis, ^{1}H; y-axis, ^{15}N-NMR chemical shift).

*(2-Quinolinylmethylidene)carbonohydrazide (**5**)*[3]. White solid (methanol). Yield: 56 %; m.p. 183 °C (lit m.p. 183°C). Anal. Calcd. for $C_{11}H_{11}N_5O$ (*Mw* = 229.24 gmol^{-1}): C, 57.63; H, 4.84; N, 30.55 %. Found: C, 57.58; H, 4.62; N, 30.69 %. IR (KBr, cm^{-1}): 3297 (NH_2), 3188 (NH), 1679 (C=O), 1638 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.15 (2H, *s*, H–N_5), 7.58 (1H, *ddd*, H–C6, $^3J_{6,7}$ = 8.2 Hz, $^3J_{6,5}$ = 7.0 Hz, $^4J_{6,8}$ = 1.1 Hz), 7.74 (1H, *ddd*, H–C_7, $^3J_{7,6}$ = 8.2 Hz, $^3J_{7,8}$ = 6.9 Hz, $^4J_{7,5}$ = 1.4 Hz), 7.93-7.99 (2H, *br.m.ovlp*., H–C_5, H–C_8), 8.03 (1H, *s*, H–C_9), 8.27 (1H, *d*, H–C_4, $^3J_{4,3}$ = 8.4 Hz), 8.34-8.46 (2H, *br.m.ovlp*., H–C_3, H–N_4, $^3J_{3,4}$ = 8.4 Hz), 10.84 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 118.03 (C_3), 126.84 (C_6), 127.66 (C_{4a}), 127.92 (C_5), 128.69 (C_8), 129.82 (C_7), 136.19 (C_4), 140.64 (C_9), 147.26 (C_{8a}), 154.34 (C_2), 156.76 (C_{10}).

*[(8-Hydroxy-2-quinolinyl)methylidene]carbonohydrazide (**6**)*[3]. Yellow solid (methanol). Yield: 72 %; m.p. 214-215 °C (lit m.p. 214-215°C). Anal. Calcd. for $C_{11}H_{11}N_5O_2$ (*Mw* = 245.24 g mol^{-1}): C, 53.83; H, 4.525; N, 28.56 %. Found: C, 53.66; H, 4.68; N, 28.74 %. IR (KBr, cm^{-1}): 3371 (OH), 3335 (NH_2), 3198 (NH), 1696 (C=O), 1600 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.14 (2H, *s*, H–N_5), 7.08 (1H, *dd*, H–C_7, $^3J_{7,6}$ = 7.4 Hz, $^4J_{7,5}$ = 1.4 Hz), 7.36 (1H, *dd*, H–C_5, $^3J_{5,6}$ = 8.1 Hz, $^4J_{5,7}$ = 1.4 Hz), 7.41 (1H, *m*, H–C_6), 8.09 (1H, *s*, H–C_9), 8.24 (1H, *d*, H–C_4, $^3J_{4,3}$ = 8.6 Hz), 8.30-8.50 (2H, *br.m.ovlp*., H–C_3, H–N_4), 9.71 (1H, *s*, OH), 10.88 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 111.59 (C_7), 117.74 (C_5), 118.35 (C_3), 127.73 (C_6), 128.52 (C_{4a}), 136.06 (C_4), 137.93 (C_{8a}), 140.50 (C_9), 152.25 (C_2), 153.24 (C_8), 156.83 (C_{10}).

*(8-Quinolinylmethylidene)carbonohydrazide (**7**)*[3]. Yellow solid (methanol). Yield: 64 %; m.p. 185 °C (lit m.p. 185°C). Anal. Calcd. for $C_{11}H_{11}N_5O$ (*Mw* = 229.24 gmol^{-1}): C, 57.63; H, 4.84; N, 30.55 %. Found: C, 57.71; H, 4.78; N, 30.62 %. IR (KBr, cm^{-1}): 3316 (NH_2), 3200 (NH), 1681 (C=O), 1621 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 4.12 (2H, *s*, H–N_5), 7.57 (1H, *dd*, H–C_3, $^3J_{3,4}$ = 8.3 Hz, $^3J_{3,2}$ = 4.1 Hz), 7.63 (1H, *t*, H–C_6, $^3J_{6,5}$ = 7.7 Hz), 7.98 (1H, *dd*, H–C_5, $^3J_{5,6}$ =7.7 Hz, $^4J_{5,7}$ = 1 Hz), 8.16 (1H, *s*, H–N_4), 8.39 (1H, *dd*, H–C_4, $^3J_{4,3}$ = 8.3 Hz, $^4J_{4,2}$ =2.0 Hz), 8.58 (1H, *d*, H–C_7, $^3J_{7,6}$ = 7.4 Hz), 8.94 (1H, *dd*, H–C_2, $^3J_{2,3}$ = 4.1 Hz, $^3J_{2,4}$ = 2.0 Hz), 9.14 (1H, *s*, H–C_9), 10.65 (1H, *s*, H–N_3). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 121.67 (C_3), 125.61 (C_7), 126.45 (C_6), 127.94 (C_{4a}), 128.90 (C_5), 131.59 (C_8), 136.55 (C_4), 136.89 (C_9), 145.01 (C_{8a}), 150.08 (C_2), 157.21 (C_{10}).

*1,5-Bis[(2-hydroxyphenyl)methylidene]carbonohydrazide (**8**)*[4]. Yelow cristal (ethanol). Yield: 78 %; m.p. 219°C (lit m.p. 216°C); Anal. Calcd. for $C_{15}H_{14}N_4O_3$ (*Mw* = 298.11 g mol^{-1}): C, 60.35; H, 4.74; N, 18.79 %, Found: C, 60.22; H, 4.62; N, 18.93 %; IR (KBr, cm^{-1}): 3344 (OH), 3284 (NH), 1704 (C=O), 1622 (C=N). ^{1}H NMR (400 MHz, DMSO-d_6, δ / ppm): 6.86--6.90 (4H, *m*), 7.22-7.26 (2H, *m*), 7.68-7.71 (2H, *m*), 8.43 (2H, *s*), 10.84 (4H, *br*). ^{13}C NMR (400 MHz, DMSO-d_6, δ / ppm): 116.10, 119.10, 119.60, 128.10, 130.60, 142.60, 151.90, 156.60.

*1,5-Bis(2-pyridinylmethylidene)carbonohydrazide (**9**)*[5]. White solid (ethanol). Yield: 88 %; m.p. 185°C (lit m.p. 190-191°C). Anal. Calcd. for $C_{13}H_{12}N_6O$ (*Mw* = 268.11 g mol^{-1}): C, 58.20; H, 4.51; N, 31.33 %. Found: C, 58.12; H, 4.88; N, 30.98 %. IR (KBr, cm^{-1}): 3201 (NH), 1696 (C=O), 1604 (C=N). ^{1}H NMR (400 MHz, DMSO-d_6, δ / ppm): 11.08 (1H, *s*, N–H_{urea}), 8.59 (1H, *d*, *J* = 4.4 Hz, C–H_{ar}), 8.25 (1H, *s*, C–H_{imine}), 8.15 (1H, *s*, N–H_{urea}), 7.87 (1H, *t*, *J* = 7.6, C–H_{ar}), 7.39 (2H, *t*, *J* = 6.0, C–H_{ar}). ^{13}C NMR (400 MHz, DMSO-d_6, δ / ppm): 151.68, 148.56, 144.59, 143.83, 126.01, 123.88.

*1,5-Bis[1-(2-pyridinylethylidene]carbonohydrazide (**10**)*[2]. White solid (ethanol). Yield: 88,0 %; m.p.(decomp.) 187 °C (lit m.p.(decomp.) 186°C). Anal. Calcd. for $C_{15}H_{16}N_6O$ (*Mw* = 296.14 g mol^{-1}): C, 60.80; H, 5.44; N, 28.36 %. Found: C, 60.61; H, 5.31; N, 28.62 %. IR

(KBr, cm^{-1}): 3206 (NH), 1698 (C=O), 1611 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 2.31 (6H, *s*, H_3-CH_3), 7.42 (2H, *dd*, H-C_5 = H-C_{13}, $^3J_{5,4}$ =$^3J_{13,12}$= 8.1 Hz, $^3J_{5,6}$ =$^3J_{13,14}$ = 4.6 Hz), 7.88 (2H, *ddd*, H-C_4 = H-C_{12} , $^3J_{4,3}$ =$^3J_{12,11}$ = 7.9 Hz, $^3J_{4,5}$ =$^3J_{12,13}$ = 6.2 Hz, $^4J_{4,6}$ = $^4J_{12,14}$ = 1.7 Hz), 8.16 (2H, *d*, H-C_3= H-C_{11}, $^3J_{3,4}$ = $^3J_{11,12}$ =7.9 Hz), 8.58 (2H, *dd*, H-C_6 = H-C_{14}, $^3J_{6,5}$ = $^3J_{14,13}$ = 4.6 Hz, $^4J_{6,4}$ = $^4J_{14,12}$ =1.7 Hz), 10.31 (2H, *s*, H–N_3 = H–N_4). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 13.25 (CH_3), 123.58 (C_3=C_{11}), 133.70 (C_5=C_{13}), 145.81 (C_4= C_{12}), 147.14 (C_7 = C_9), 149.61 (C_6=C_{14}), 151.45 (C_2=C_{10}), 152.12 (C_8). lit. ^{1}H NMR (300.00 MHz, DMSO-d_6, δ / ppm): 2.38 (6 H, *s*, CH,), 7.38 (2 H, *t*, py), 7.85 (2 H, *t*, py), 8.09 (2 H, *d*, py). 8.59 (2 H, *d*, py), 10.30 (2 H, *br*, NH).

1,5-Bis[phenyl(2-pyridinyl)methylidene]carbonohydrazide ***(11)***[2,6]. White solid (ethanol). Yield: 91,0 %; m.p. 223 °C (lit M.p. 225-226°C). Anal. Calcd. for $C_{25}H_{20}N_6O$ (*Mw* = 420.17 g mol^{-1}): C, 71.41; H, 4.79; N, 19.99 %. Found: C, 71.16; H, 4.82; N, 20.04 %. IR (KBr, cm^{-1}): 3177 (NH), 1702 (C=O), 1612 (C=N). ^{1}H NMR (400 MHz, DMSO-d_6, δ / ppm): 7.20–8.79 (18H, *m*, C–H_{ar}), 9.90 (1H, *s*, N–H), 12.74 (1H, *s*, N–H). ^{13}C NMR (62.90 MHz, DMSO-d_6, δ / ppm): 123.70, 124.60, 127.20, 128.70, 129.00, 129.50, 131.00, 133.40, 136.80, 138.10, 148.80, 149.00, 162.40.

1,5-Bis(2-quinolinylethylidene)carbonohydrazide ***(12)***[3]. White solid (DMF/methanol mixture 1 : 9 v/v). Yield 78 %; m.p. 162-164 °C (lit m.p. 162-164°C). Anal. Calcd. for $C_{21}H_{16}N_6O$ (*Mw* = 368.14 g mol^{-1}): C, 68.47; H, 4.38; N, 22.81 %. Found: C, 68.81; H, 4.80; N, 22.56 %. IR (KBr, cm^{-1}): 3392 (NH), 1708 (C=O), 1630 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 7.63 (2H, *ddd*, H–C_6 = H–C_{16}, $^3J_{6,5}$ = $^3J_{16,15}$ = 8.2 Hz, $^3J_{6,7}$ = $^3J_{16,17}$ = 6.8 Hz, $^4J_{6,8}$ = $^4J_{16,18}$ = 1.2 Hz), 7.79 (2H, *ddd*, H–C_7 = H–C_{17}, $^3J_{7,8}$ = $^3J_{17,18}$ = 7.9 Hz, $^3J_{7,6}$ = $^3J_{17,16}$ = 6.8 Hz, $^4J_{7,5}$ = $^3J_{17,15}$ = 1.7 Hz), 7.99-8.13 (4H, *m*, H–C_5 = H–C_{15}, H–C_8 = H–C_{18}), 8.31 (2H, *s*, H–C_9 = H–C_{11}), 8.38-8.60 (4H, *br.m.ovlp*., H–C_3 = H–C_{13}, H–C_4 = H–C_{14}), 11.31 (2H, *s*, H–N_3= H–N_4). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 117.78 (C_3 = C_{13}), 127.11 (C_7 = C_{17}), 127.79 (C_6 = C_{16}), 127.99 (C_{4a} = C_{14a}), 128.84 (C_5 = C_{15}), 130.00 (C_8 = C_{18}), 136.47 (C_4 = C_14), 144.06 (C_9 = C_{11}), 147.35 (C_{8a} = C_{18a}), 151.67 (C_2 = C_{12}), 153.99 (C_{10}).

1,5-Bis(8-hydroxy-2-quinolinyl)methylidene]carbonohydrazide ***(13)***[3]. Yellow solid (DMF/ /methanol mixture 1 : 9 v/v). Yield: 66 %; m.p. 248-249 °C (lit m.p. 248-249°C). Anal. Calcd. for $C_{21}H_{16}N_6O_3$ (*Mw* = 400.39 gmol^{-1}): C, 62.99; H, 4.03; N, 20.99, %. Found: C, 62.84; H, 4.11; N, 21.22 %. IR (KBr, cm^{-1}): 3408 (OH), 3116 (NH), 1684 (C=O), 1601 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 7.12 (2H, *dd*, H–C_7 = H–C_{17}, $^3J_{7,6}$ = $^3J_{17,16}$ = 7.4 Hz, $^4J_{7,5}$ = $^4J_{17,15}$ = 1.5 Hz), 7.41 (2H, *dd*, H–C_5 = H–C_{15}, $^4J_{5,7}$ = $^4J_{15,17}$ = 1.5 Hz), 7.45 (2H, *t*, H–C_6 = H–C_{16}, $^3J_{6,7}$ = $^3J_{16,17}$ =7.4 Hz), 8.17-8.39 (4H, *br.m.ovlp*., H–C_3 = H–C_{13}, H–C_4 = H–C_{14}), 8.48 (2H, *s*, H–C_9 = H–C_{11}), 9.80 (2H, *s*, H–O_1 = H–O_2), 11.34 (2H, *s*, H–N_3 = H–N_4). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm): 112.13 (C_7 = C_{17}), 117.90 (C_5 = C_{15}), 118.12 (C_3 = C_{13}), 128.13 (C_6 = C_{16}), 128.75 (C_{4a} = C_{14a}), 136.40 (C_4 = C_{14}), 138.13 (C_{8a} = C_{18a}), 144.02 (C_9 = C_{11}), 151.92 (C_2 = C_{12}), 153.37 (C_8 = C_{18}), 162.45 (C_{10}).

1,5-Bis(8-quinolinylethylidene)carbonohydrazide ***(14)***[3]. Yellow solid (methanol). Yield: 54 %; m.p. 219-220 °C (lit m.p. 219-220°C). Anal. Calcd. for $C_{21}H_{16}N_6O$ (*Mw* = 368.14 g mol^{-1}): C, 68.47; H, 4.38; N, 22.81 %. Found: C, 68.32; H, 4.91; N, 22.73 %. IR (KBr, cm^{-1}): 3331 (NH), 1707 (C=O), 1614 (C=N). ^{1}H NMR (500 MHz, DMSO-d_6, δ / ppm): 7.61 (2H, *dd*, H–C_3 = H-C_{17}, $^3J_{3,2}$ = $^3J_{17,18}$ = 4.1 Hz, $^3J_{3,4}$ = $^3J_{17,16}$ = 8.3 Hz), 7.72 (2H, *t*, H-C_6 = H-C_{14}, $^3J_{6,5}$ = $^3J_{14,15}$ = 7.9 Hz); 8.04 (2H, *dd*, H–C_5 = H-C_{15}, $^3J_{5,6}$ = $^3J_{15,14}$ = 7.9 Hz), 8.43 (2H, *dd*, H–C_4 = H-C_{16}, $^3J_{4,3}$ = $^3J_{16,17}$ = 8.3 Hz, $^4J_{4,2}$ = $^4J_{16,18}$ = 1.75 Hz), 8.60 (2H, *d*, H–C_7 = H-C_{13}, $^3J_{7,6}$ = $^3J_{13,14}$ = 0.4 Hz), 8.99 (2H, *dd*, H–C_2 = H-C_{18}, $^3J_{2,3}$ =$^3J_{18,17}$ = 4.1 Hz, $^4J_{2,4}$ = $^4J_{18,16}$ = 1.75 Hz), 9.50 (2H, *s*, H–C_9 = H-C_{11}), 11.09 (2H, *s*, H–N_3, H-N_4). ^{13}C NMR (126 MHz, DMSO-d_6, δ / ppm):

121.77 (C_3 = C_{17}), 125.72 (C_7 = C_{13}), 126.49 (C_6 = C_{14}), 128.02 (C_{4a} = C_{15a}), 129.28 (C_5 = C_{15}), 131.65 (C_8 = C_{12}), 136.62 (C_4 = C_{16}), 139.89 (C_9 = C_{11}), 145.19 (C_{8a} = C_{12a}), 150.16 (C_2 = C_{18}), 152.28 (C_{10}).

TABLE S-I. *In vitro* antifungal activity of the compounds tested by the well-diffusion agar assay expressed as the diameter (mm) of the inhibition zone (includes diameter of the well of 8 mm)

Tested compound	*C. albicans*	*S. cerevisiae*	*A. brasiliensis*
1	–	–	–
2	–	–	–
3	–	–	–
4	–	–	–
5	10	14	12
6	12	14	12
7	12	16	16
8	–	–	–
9	–	–	–
10	–	–	–
11	–	–	–
12	–	–	–
13	12	10	10
14	14	10	10
Nystatin	34	56	32

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