

Synthesis and Anti-tuberculosis Activity of Substituted 3,4-(di-coumarin-3-yl)-2,5-diphenyl Furans and Pyrroles [†]

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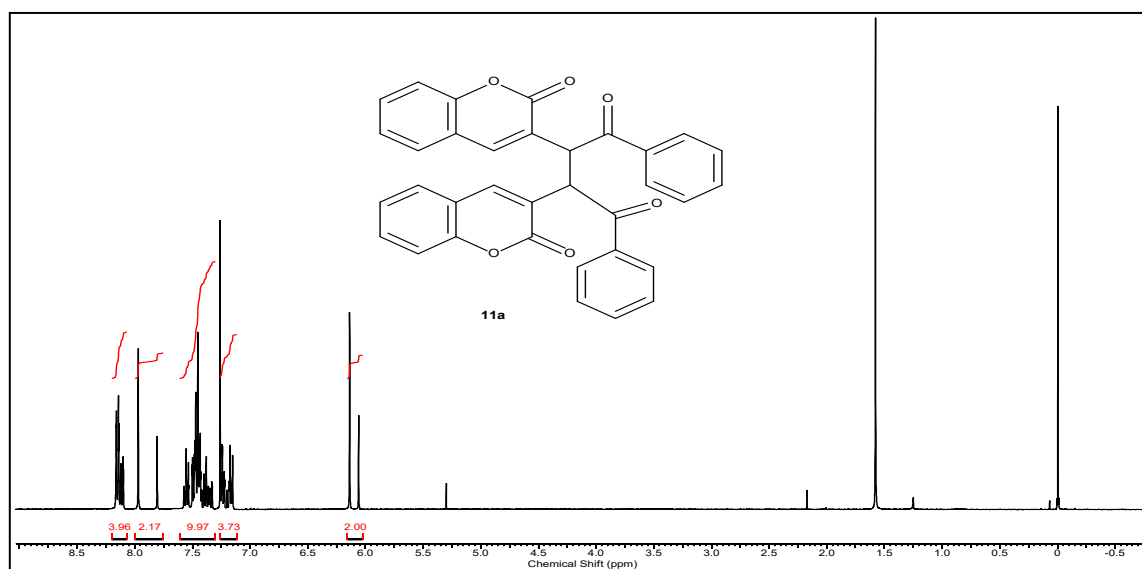
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Spectral Data

Synthesis of 2,3-bis(2-oxo-2H-chromen-3-yl)-1,4-diphenylbutane-1,4-dione (11a):

A mixture of 3-(2-oxo-2-phenylethyl)-2H-chromen-2-one **2a** (1.5 g, 5.68 mmol), 3-(1-bromo-2-oxo-2-phenylethyl)-2H-chromen-2-one **3a** (1.948 g, 5.68 mmol) and potassium carbonate (1.569 g, 11.35 mmol) in acetone (56.8 ml) was heated to 60 °C for 16hrs. The mixture was cooled to room temperature and then added 150ml water solid separated out, filtered and wash with 15 ml water and dried. Crude compound was purified by column chromatography to get pure compound in 81% yield (2.42g), white solid; M.P = 160–162 °C; ¹H NMR (400 MHz, CDCl₃): δ 6.14 (s, 2H), 7.24–7.15 (m, 4H), 7.58–7.33 (m, 10H), 7.97 (s, 2H), 8.16–8.14 (d, J = 8.0 Hz, 4H); FT IR (CM⁻¹): 3020 (Aromatic C-H Stretch), 1714 (Pyran C=O group), 1666 (Aryl ketone C=O Stretch), 1608 (Aromatic C=C stretching);



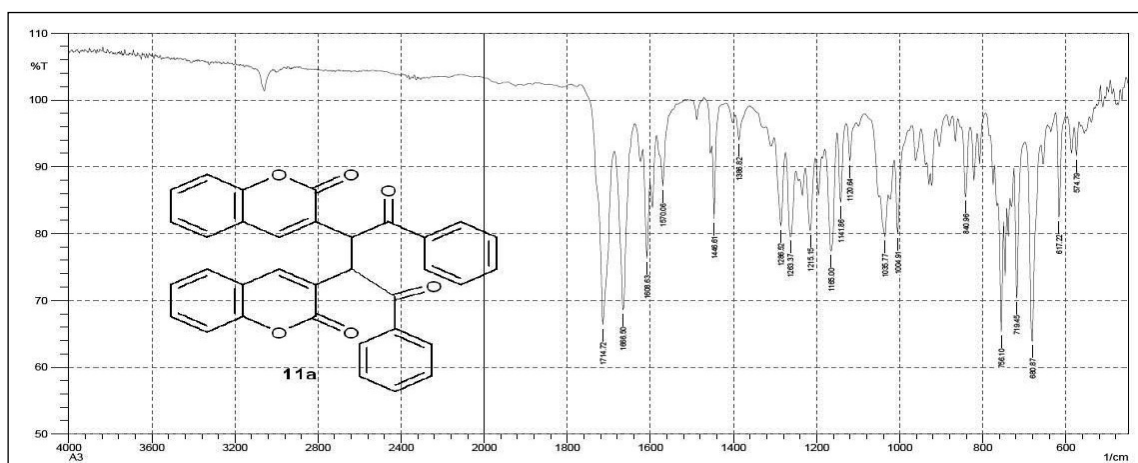
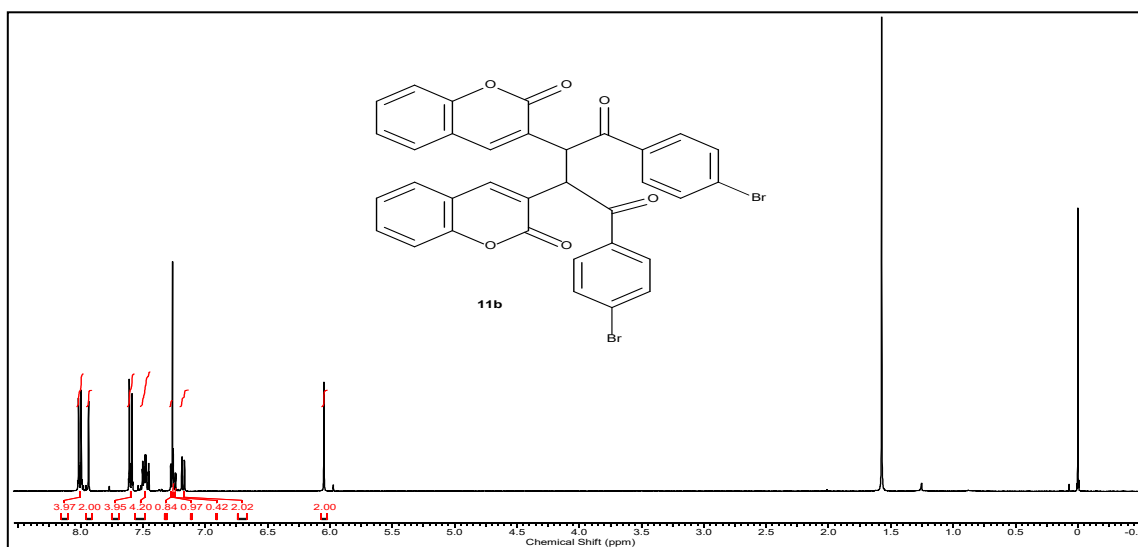


Figure S1. ^1H NMR and FT-IR spectra of (11a).

Synthesis of 1,4-bis(4-bromophenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione (11b):

A mixture of 3-(2-oxo-2-(4-bromophenyl)ethyl)-2H-chromen-2-one **2b** (1.94 g, 5.68 mmol), 3-(1-bromo-2-oxo-2-(4-bromophenyl)ethyl)-2H-chromen-2-one **3b** (2.38 g, 5.68 mmol) and potassium carbonate (1.569 g, 11.35 mmol) in acetone (56.8 ml) was heated to 60 °C for 16hrs. The mixture was cooled to room temperature and then added 150ml water solid separated out, filtered and wash with 15 ml water and dried. Crude compound was purified by column chromatography to get pure compound in 74% yield (2.21g) white solid; M.P = 156-58 °C; ^1H NMR (400 MHz, CDCl_3): δ 6.05 (s, 2H), 7.19-7.17 (d, 2H), 7.26 (d, 1H), 7.28 (d, 1H), 7.52-7.45 (m, 4H), 7.61-7.59 (d, J = 8.0 Hz, 4H), 7.94 (s, 2H), 8.02-7.99 (d, J = 8.0 Hz, 4H); FT IR (cm^{-1}):- 3015 (Aromatic C-H Stretch), 1716.6 (Pyrano C=O group), 1664.5 (Aryl ketone C=O Stretch), 1608.6 (Aromatic C=C stretching);



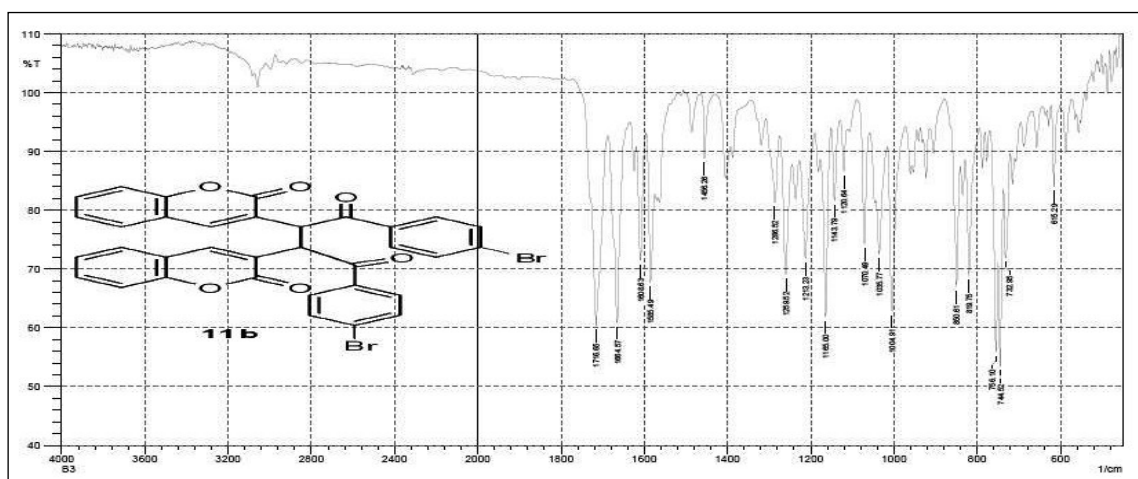
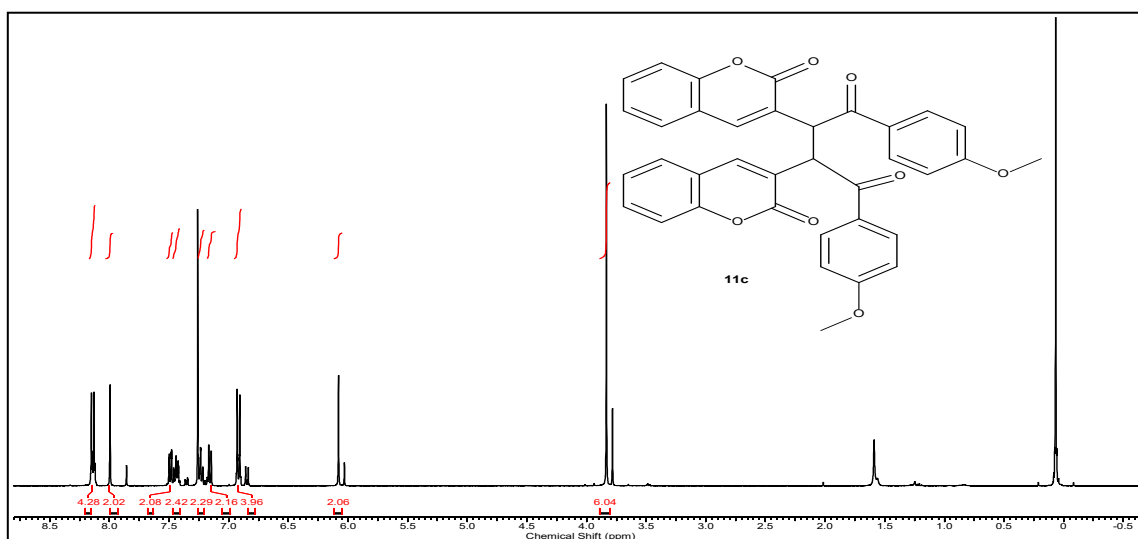


Figure S2. ^1H NMR and FT-IR spectra of (11b).

Synthesis of 1,4-bis(4-methoxyphenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione (11c):

A mixture of 3-(2-oxo-2-(4-methoxyphenyl)ethyl)-2H-chromen-2-one **2c** (1.67 g, 5.68 mmol), 3-(1-bromo-2-oxo-2-(4-methoxyphenyl)ethyl)-2H-chromen-2-one **3c** (2.11 g, 5.68 mmol) and potassium carbonate (1.569 g, 11.35 mmol) in acetone (56.8 ml) was heated to 60 °C for 16hrs. The mixture was cooled to room temperature and then added 150ml water solid separated out, filtered and wash with 15 ml water and dried. Crude compound was purified by column chromatography to get pure compound in 78% yield (2.33g), white solid; M.P = 145-49 °C; ^1H NMR (400 MHz, CDCl_3): δ 3.83 (s, 6H), 6.08 (s, 2 H), 6.93-6.91 (d, J = 8.0 Hz, 4 H), 7.17-7.15 (d, 2H), 7.24-7.22 (m, 2H), 7.46-7.42 (m, 2H), 7.50-7.48 (dd, 2H), 8.00 (s, 2H), 8.15-8.13 (d, J = 8.0 Hz, 4 H); FT IR (CM^{-1}):- 3025 (Aromatic C-H Stretch), 1714.7 (Pyrano C=O group), 1662.6 (Aryl ketone C=O Stretch), 1595.1 (Aromatic C=C stretching);



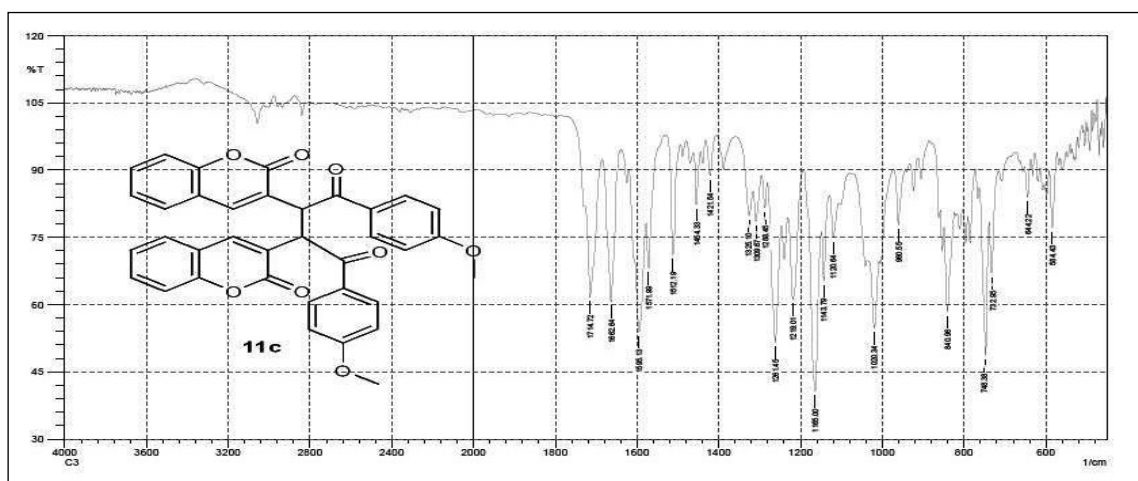
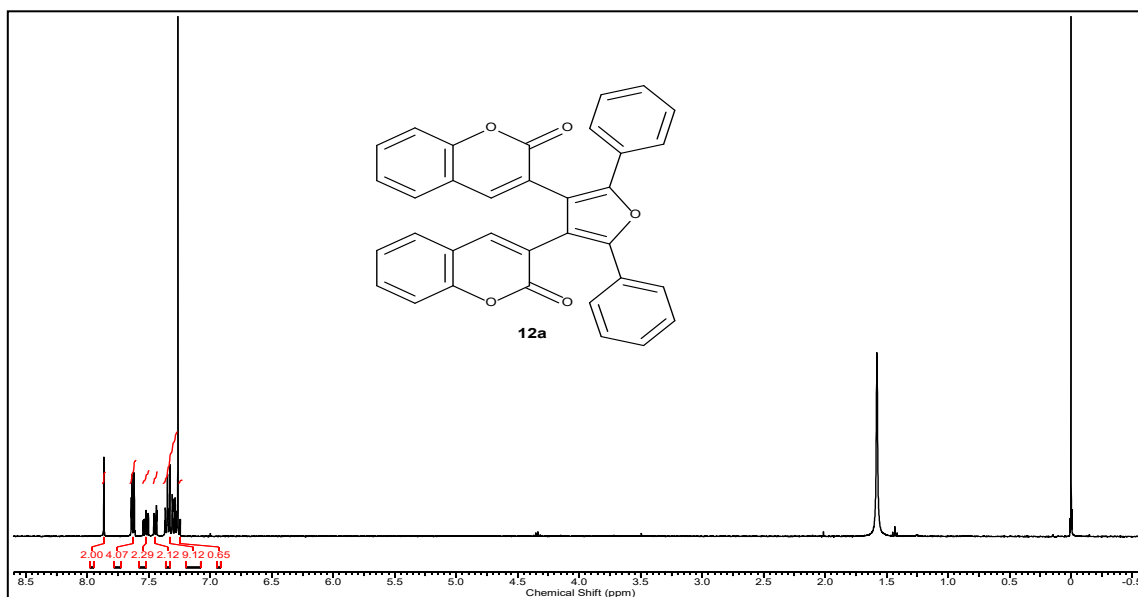


Figure S3. ^1H NMR and FT-IR spectra of (11c).

Synthesis of 3-[4-(2-oxochromen-3-yl)-2,5-diphenyl-3-furyl]chromen-2-one (12a):

2,3-bis(2-oxo-2H-chromen-3-yl)-1,4-diphenylbutane-1,4-dione (11a) (0.5 g, 0.950 mmol) was taken in ethanol (18.99 ml) and added 17 ml of conc. H_2SO_4 drop wise, where upon the solid dissolves completely. The reaction mixture was cooled to room temperature, diluted with 100 ml ice cold water. Solid precipitates out were filtered off and recrystallized from ethanol and dried. 79% yield (0.38 g) white solid; M.P = 149-51 $^\circ\text{C}$; ^1H NMR (400 MHz, CDCl_3): δ 7.37-7.24 (m, 10H), 7.46 -7.44 (dd, 2H), 7.55-7.50 (td, 2H), 7.64-7.62 (m, 4H), 7.87 (s, 2H); ^{13}C -NMR (400MHz, CDCl_3): δ 116.3,117.8,118.7,120.8,124.2,125.7,127.8,128.0,128.4,129.5, 131.5,144.2,149.8,153.5,160.2; FT IR (CM-1):- 3018 (Aromatic C-H Stretch), 1718.5 (Pyrano C=O group), 1595.1 (Aromatic C=C stretching);



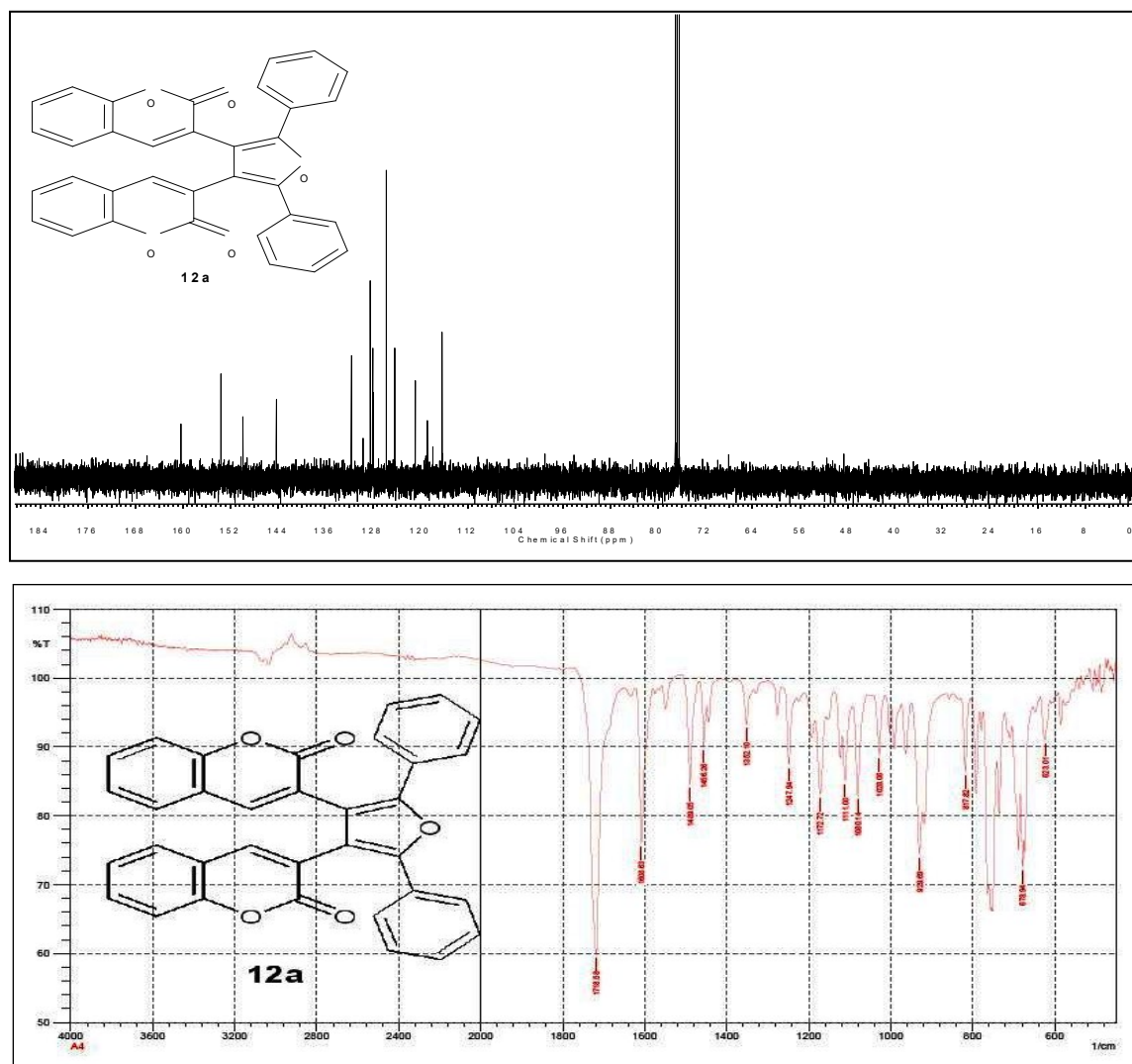


Figure S4. ¹H NMR, ¹³C NMR and FT-IR spectra of (**12a**).

*Synthesis of 3-[2,5-bis(4-bromophenyl)-4-(2-oxochromen-3-yl)-3-furyl]chromen-2-one (**12b**):*

1,4-bis(4-bromophenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione **11b** (0.65 g, 0.950 mmol) was taken in ethanol (18.99 ml) and added 17 ml of conc.H₂SO₄ drop wise, where upon the solid dissolves completely. The reaction mixture was cooled to room temperature, diluted with 100 ml ice cold water. Solid precipitates out were filtered off and recrystallized from ethanol and dried. 71% yield (0.447 gm) off white solid; M.P= 164-66 °C; ¹H NMR (400 MHz, CDCl₃): δ 7.34-7.28 (m, 4H), 7.48 -7.45 (m, 9H), 7.57-7.51 (m, 3H), 7.84 (s, 2H); FT IR (CM⁻¹): - 3018 (Aromatic C-H Stretch), 1718.5 (Pyrano C=O group), 1595.1 (Aromatic C=C stretching);



1,4-bis(4-methoxyphenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione **11c** (0.557 g, 0.950 mmol) was taken in ethanol (18.99 ml) and added 17 ml of conc.H₂SO₄ drop wise, where upon the solid dissolves completely. The reaction mixture was cooled to room temperature, diluted with 100 ml ice cold water. Solid precipitates out were filtered off and recrystallized from ethanol and dried. 80% yield (0.43 g) off white solid; M.P = 136-37 °C; ¹H NMR (400 MHz, CDCl₃): δ 3.80 (s, 6H), 6.88-6.86 (d, 4H), 7.27 -7.23 (t, 2H), 7.32-7.30 (d, 2H), 7.44-7.42 (d, 2H), 7.51 -7.49 (m, 2H), 7.55-7.53 (d, 4H), 7.84 (s, 2H) ; FT IR (CM⁻¹): - 3018 (Aromatic C-H Stretch), 1716.6 (Pyrano C=O group), 1606.7 (Aromatic C=C stretching); MS (ESI) (m/z): calcd for C₃₆H₂₄O₇, [M+1]⁺, 569.57; found, 569.1;

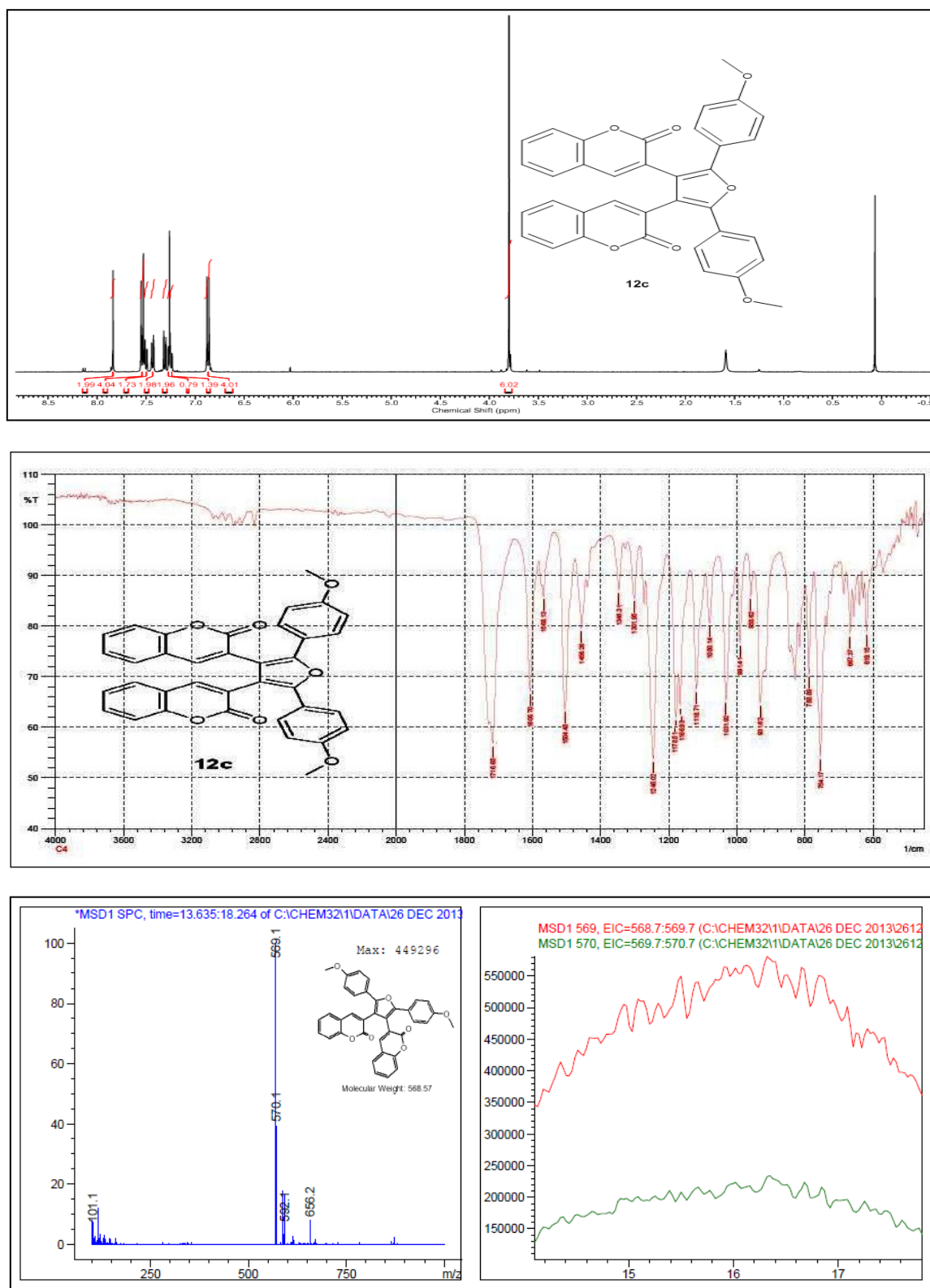
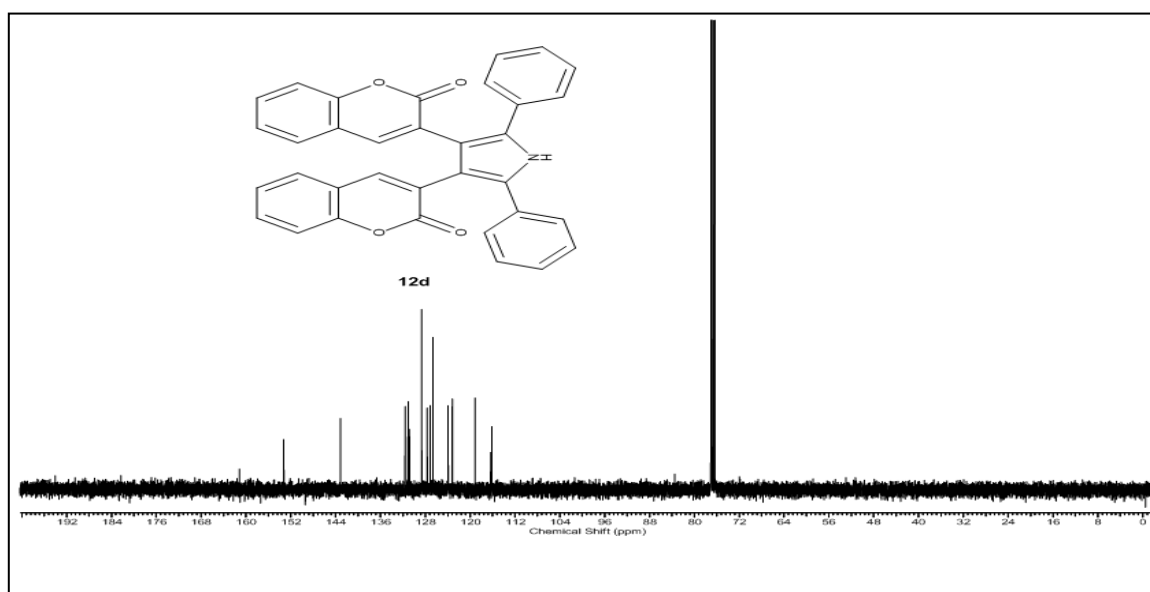
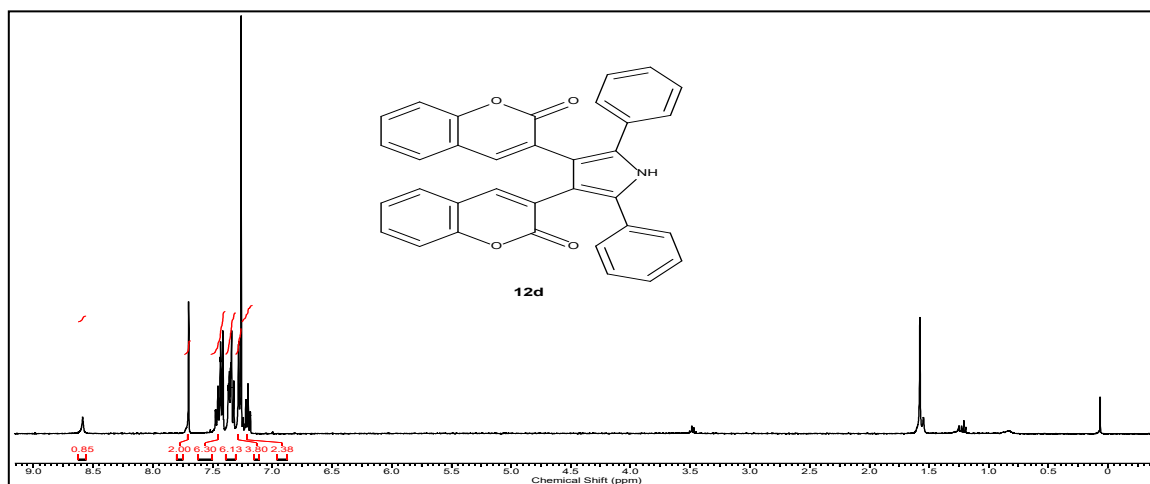


Figure S6. ¹H NMR, FT-IR and Mass spectra of (12c).

Synthesis of 3-[4-(2-oxochromen-3-yl)-2,5-diphenyl-1H-pyrrol-3-yl]chromen-2-one (12d):

A mixture of 2,3-bis(2-oxo-2H-chromen-3-yl)-1,4-diphenylbutane-1,4-dione (**11a**) (0.5 g, 0.950 mmol) and Ammonium acetate (0.732 g, 9.50 mmol) in ethanol (47.5 ml) were heated to reflux for 15 hrs. Ethanol was evaporated under reduced pressure. 100 ml of water was added to the reaction mixture. Solid precipitates out were filtered off and

recrystallized from ethanol and dried. 77% yield (0.37 g) yellow solid; M.P = 156-59 °C; ^1H NMR (400 MHz, CDCl_3): δ 7.24-7.18 (m, 2H), 7.28 -7.26 (m, 4H), 7.37-7.32 (m, 6H), 7.48-7.41 (m, 6 H), 7.70 (s, 2H), 8.59 (broad s, 1H); ^{13}C -NMR (400 MHz, CDCl_3): δ 116.1, 116.3, 119.1, 123.1, 123.9, 126.6, 127.1, 127.6, 128.6, 130.8, 131.0, 131.5, 143.1, 153.2, 161.1; FT IR (CM^{-1}):- 3015 (Aromatic C-H Stretch), 1712.6 (Pyrano C=O group), 1602.8 (Aromatic C=C stretching); MS (ESI) (m/z): calcd for $\text{C}_{34}\text{H}_{21}\text{NO}_4$, $[\text{M}^+]$, 508.53; found, 508;



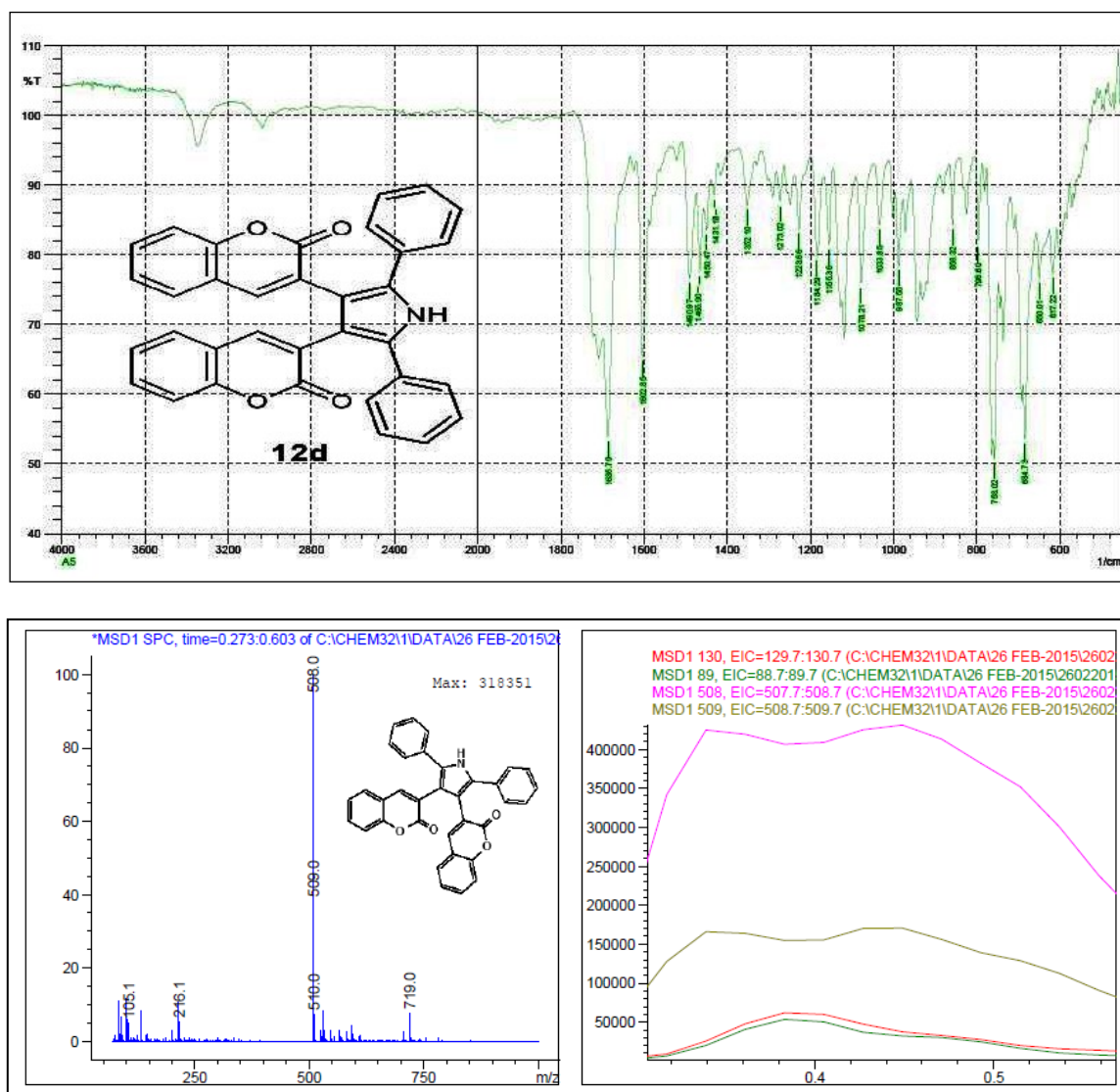


Figure S7. ¹H NMR, ¹³C NMR, FT-IR and Mass spectra of (12d).

Synthesis of 3-[2,5-bis(4-bromophenyl)-4-(2-oxochromen-3-yl)-1H-pyrrol-3-yl]chromen-2-one (12e):

A mixture of 1,4-bis(4-bromophenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione **11b** (0.65 g, 0.950 mmol) and Ammonium acetate (0.732 g, 9.50 mmol) in ethanol (47.5 ml) were heated to reflux for 15 hrs. Ethanol was evaporated under reduced pressure. 100 ml of water was added to the reaction mixture. Solid precipitates out were filtered off and recrystallized from ethanol and dried. 72% yield (0.35g) yellow solid; M.P = 142–44 °C; ¹H NMR (400 MHz, CDCl₃): δ 7.24–7.20 (m, 2H), 7.29–7.25 (m, 6H), 7.38–7.36 (dd, 2H), 7.50–7.43 (m, 6 H), 7.66 (s, 2H), 8.68 (broad s, 1H); FT IR (CM⁻¹): 1712.8 (Pyran C=O group), 1608.6 (Aromatic C=C stretching); MS (ESI) (m/z): calcd for C₃₄H₁₉Br₂NO₄, [M]⁺, 663.0; found, 663.6;

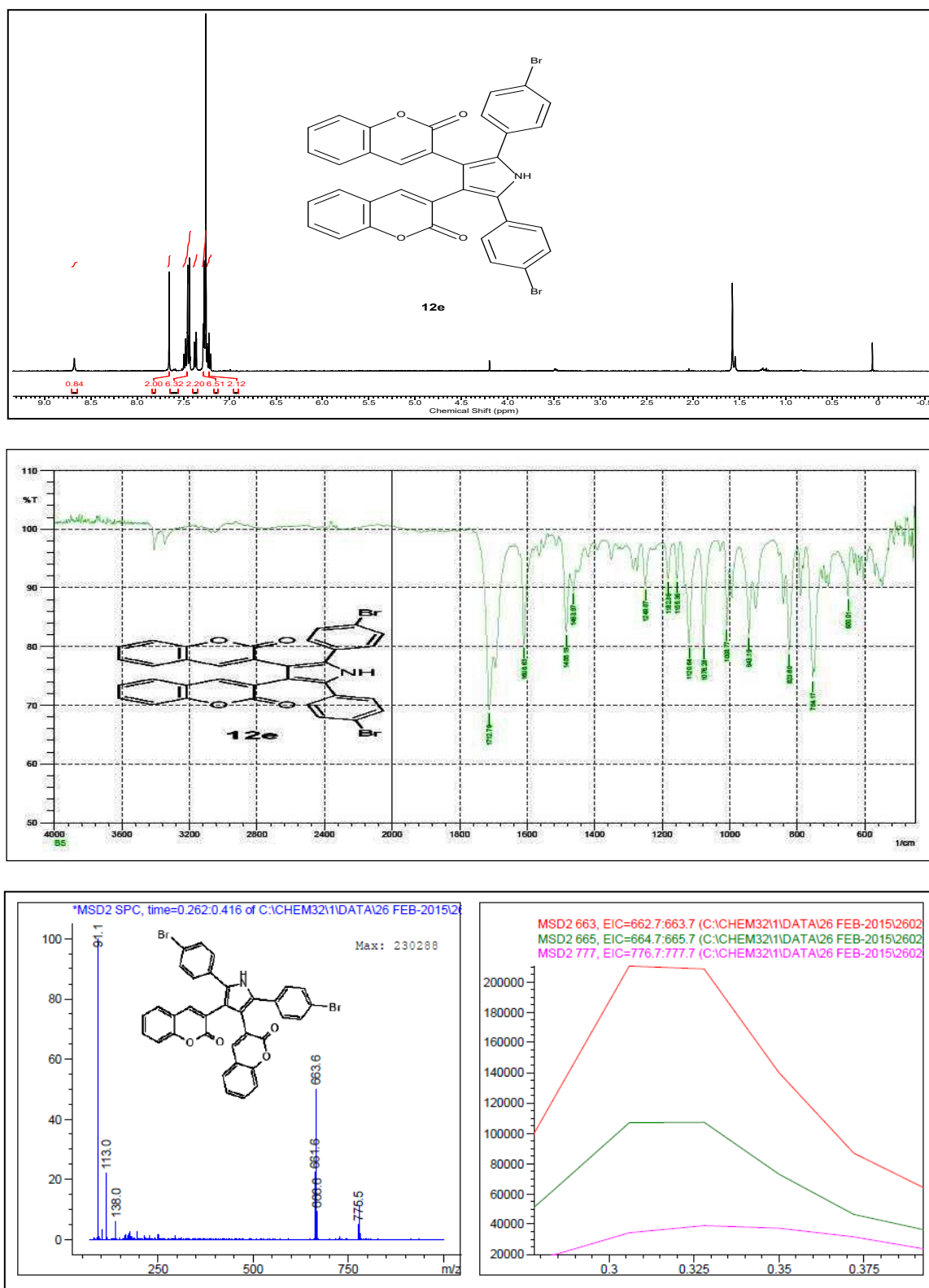
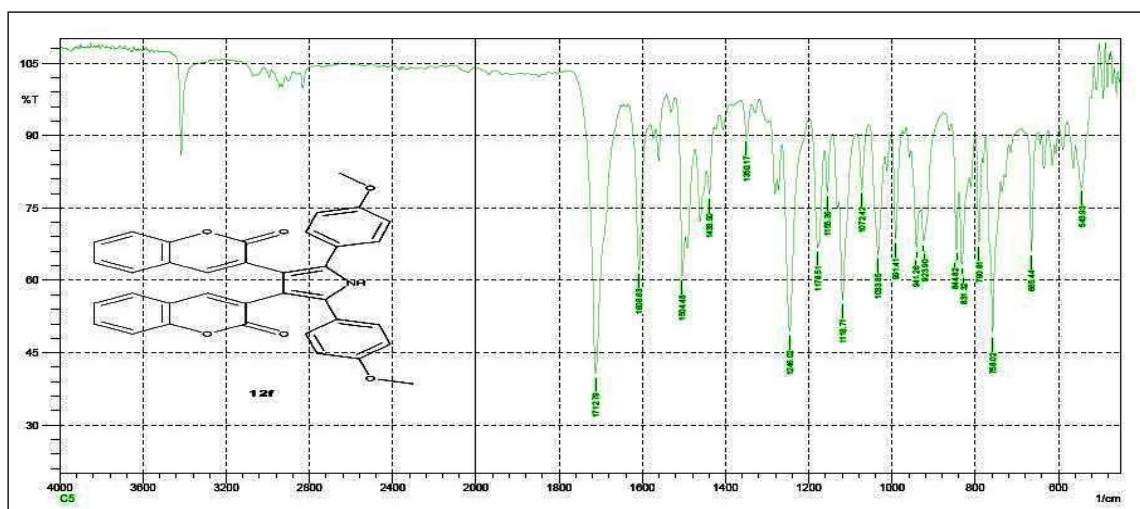
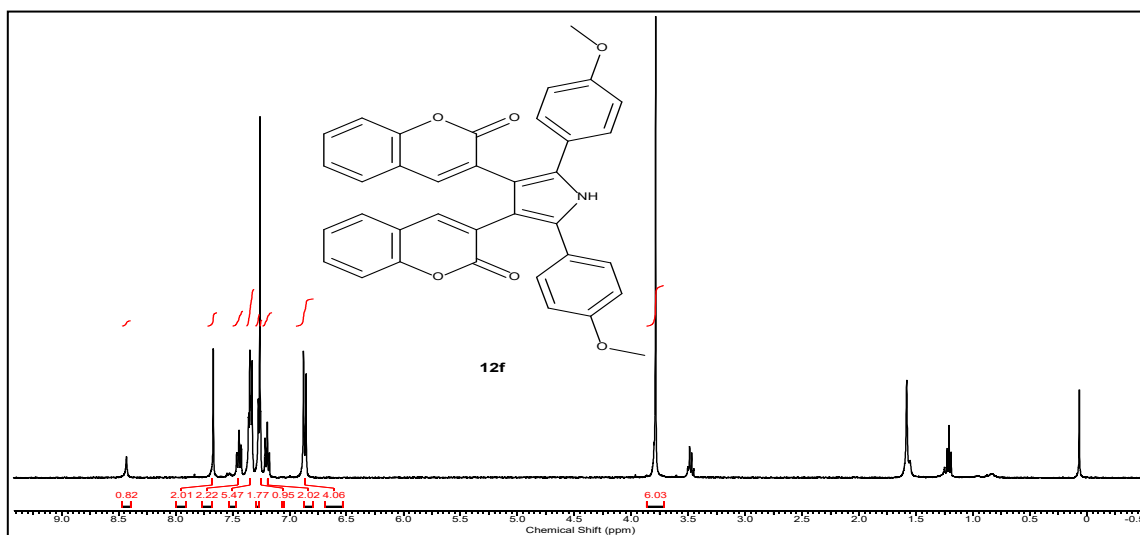


Figure S8. ¹H NMR, FT-IR and Mass spectra of (**12e**).

*Synthesis of 3-[2,5-bis(4-methoxyphenyl)-4-(2-oxochromen-3-yl)-1H-pyrrol-3-yl]chromen-2-one (**12f**):*

A mixture of 1,4-bis(4-methoxyphenyl)-2,3-bis(2-oxo-2H-chromen-3-yl)butane-1,4-dione **11c** (0.557 g, 0.950 mmol) and Ammonium acetate (0.732 g, 9.50 mmol) in ethanol (47.5 ml) were heated to reflux for 15 hrs. Ethanol was evaporated under reduced

pressure. 100 ml of water was added to the reaction mixture. Solid precipitates out were filtered off and recrystallized from ethanol and dried. 76% yield (0.34 g) yellow solid; M.P = 121–24 °C; ^1H NMR (400 MHz, CDCl_3): δ 3.79 (s, 6H), 6.88–6.85 (d, 4H), 7.21–7.18 (t, 2H), 7.27–7.24 (m, 3H), 7.36–7.33 (m, 5H), 7.46–7.42 (t, 2H), 7.67 (s, 2H), 8.43 (broad s, 1H); FT IR (CM^{-1}): 3015 (Aromatic C–H Stretch), 3425 (pyrrolo NH group), 3020 (Aromatic C–H Stretch), 1712.8 (Pyrano C=O group), 1602.8 (Aromatic C=C stretching); MS (ESI) (m/z): calcd for $\text{C}_{36}\text{H}_{25}\text{NO}_6$, $[\text{M}^{+1}]^+$, 568.2; found, 568.0;



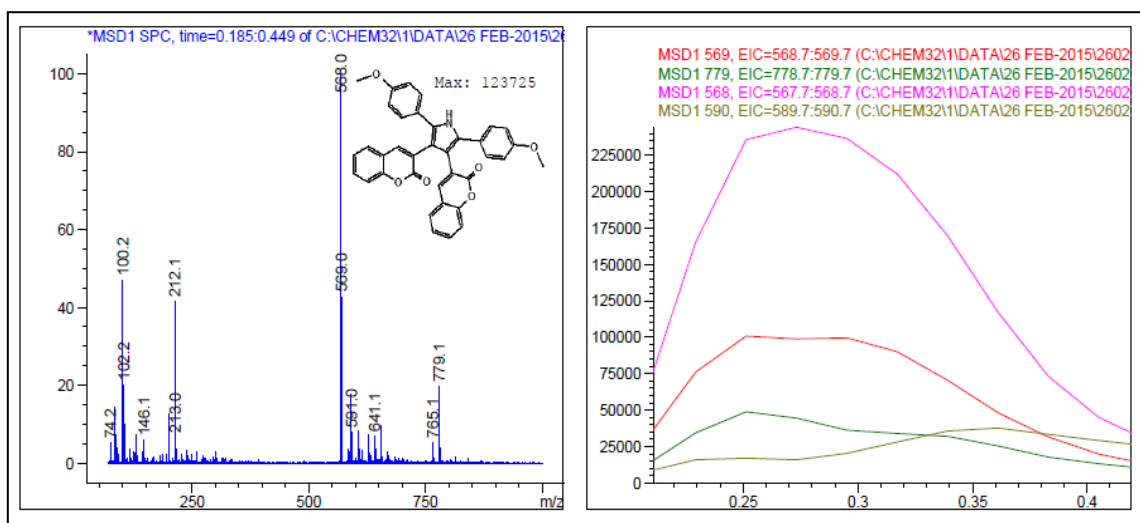


Figure S9. ¹H NMR, FT-IR and Mass spectra of (12e).

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