Electronic Supplementary Information for

**Diastereoselective route to 2,5-diaryl-3,4-disubstituted tetrahydrofuran lignans: Protection free synthesis of (+)-galbelgin and (+)-galbacin**

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General Information

All the reactions were carried out using oven dried glassware under an atmosphere of Argon (Ar). All reagents were used as purchased from commercial supplier without further purification. Solvents were dried and distilled following usual protocols. Flash column chromatography was performed in all cases using the indicated solvent system on Rankem silica gel (230-400 mesh) purchased from Rankem India. Analytical thin layer chromatography was performed using Merk 60 F254 precoated silica gel plate (0.2 mm thickness) and compounds were visualized by irradiation of UV light. The $^1$H NMR and $^{13}$C NMR spectra were measured with 200 MHz in CDCl$_3$. $^1$H NMR chemical shifts are expressed in parts per million ($\delta$) downfield to CHCl$_3$ ($\delta = 7.26$); $^{13}$C NMR chemical shifts are expressed in parts per million ($\delta$) relative to the central CDCl$_3$ resonance ($\delta = 77.0$). Coupling constants in $^1$H NMR are expressed in Hz. Melting points (mp) of solid compounds are reported without correction. HRMS (ESI) spectra were recorded on a Q-Tof analyzer.

Experimental section:

(R)-methyl 4-(4-isopropyl-2-oxooxazolidin-3-yl)-4-oxobutanoate (8)

Title compound was prepared according to the literature procedure$^{7a}$ from D-valine derived oxazolidinone in 80% yield as colourless gummy liquid. $[\alpha]_D^{28} = -65.2$ (c 2.0, CHCl$_3$). $^1$H NMR (200 MHz, CDCl$_3$) $\delta$: 0.86 (d, $J = 4.6$ Hz, 3H), 0.90 (d, $J = 4.6$ Hz, 3H), 2.25–2.50 (m, 1H), 2.65 (t, $J = 5.8$ Hz, 2H), 3.23 (t, $J = 5.8$ Hz, 2H), 3.68 (s, 3H), 4.20 (dd, $J = 7.9$, 3.4 Hz, 1H), 4.28 (t, $J = 7.9$ Hz, 1H), 4.35–4.50 (m, 1H) $^{13}$C NMR (50 MHz, CDCl$_3$) $\delta$: 14.4, 17.6, 27.9, 28.2, 30.5, 51.5, 58.2, 63.4, 153.9, 171.6, 172.6.
3-[(2-(3,4-Dimethoxy-phenyl)-5-oxo-tetrahydro-furan-3-carbonyl]-4-isopropyl-oxazolidin-2-one (7a); **Dibutylboron triflate mediated syn-aldol reaction and lactonization:**

To a well-stirred solution of N-succinyl oxazolidinone 8 (0.972 g, 4.0 mmol) in dry DCM (30 mL) was dropwise added 4.4 mL of Bu$_2$BOTf [(1.0 M) solution in DCM, 4.4 mmol] at –78 °C under argon atmosphere and the solution allowed to stir for 30 min. To this solution was added i-Pr$_2$NEt (0.84 mL, 4.8 mmol) and allowed to stir for 45 min. at –78 °C. A solution of veratraldehyde (0.93 g, 1.4 equiv., 5.6 mmol) in 5 mL of DCM was drop wise added to the reaction mixture at –78 °C. After stirring the reaction at this temperature for 2 h, and then was gradually raised to -10 °C. The reaction was monitored by TLC and on completion; quenched with aqueous NH$_4$Cl, extracted with DCM (2 x 50 mL), washed with brine, dried over Na$_2$SO$_4$ and concentrated. The resultant residue was purified immediately by flash chromatography to obtain 1.39 g of lactone 7a (92%) as a white solid. Mp 123-125 °C; MF: C$_{19}$H$_{23}$NO$_7$. MW: 377.38. $[^{1}]$H NMR (200 MHz, CDCl$_3$) δ: 0.88 (d, $J$ = 7.0 Hz, 3H), 0.93 (d, $J$ = 7.0 Hz, 3H), 2.30-2.43 (m, 1H), 2.72 (dd, $J$ = 17.2, 9.4 Hz, 1H), 3.24 (dd, $J$ = 17.2, 8.9 Hz, 1H), 3.87 (s, 3H), 3.89 (s, 3H), 4.24–4.32 (m, 2H), 4.39-4.51 (m, 2H), 5.83 (d, $J$ = 7.6 Hz, 1H), 6.81- 6.95 (m, 3H). 13C NMR (50 MHz, CDCl$_3$) δ: 14.9, 18.1, 28.5, 33.7, 48.5, 56.2, 56.2, 58.8, 64.0, 81.8, 109.3, 111.3, 118.9, 129.9, 149.6, 149.8, 153.6, 170.3, 173.8.

(R)-3-[(2R,3R)-2-(benzo[d][1,3]dioxol-5-yl)-5-oxotetrahydrofuran-3-carbonyl]-4-isopropyloxazolidin-2-one (7b): 1.27 g of lactone 7b (88%) obtained as a gummy liquid from 0.972 g of compound 8 using the procedure as of lactone 7a. MF: C$_{18}$H$_{19}$NO$_7$. MW: 361.35. $[^{2}]$H NMR (CDCl$_3$, 200 MHz) δ: 0.84 (d, $J$ = 6.8 Hz, 3H), 0.90 (d, $J$ = 7.0 Hz, 3H), 2.25-2.41 (m, 1H), 2.66 (dd, $J$ = 9.4, 17.2 Hz, 1H) 3.20 (dd, $J$ =
9.0, 17.4 Hz, 1H), 4.16-4.29 (m, 2H), 4.34-4.45 (m, 1H), 5.77 (d, J = 7.4 Hz, 1H), 5.92 (s, 2H), 6.75 (s, 1H), 6.79 (s, 1H), 6.82 (d, J = 1.4 Hz, 1H). $^{13}$C NMR (CDCl$_3$, 50 MHz) δ: 14.8, 17.9, 28.4, 33.5, 48.4, 58.6, 64.0, 81.5, 101.5, 106.5, 108.4, 112.0, 131.3, 148.2 (2C), 153.5, 170.1, 173.7. HRMS (ESI) calcd for C$_{18}$H$_{19}$NaO$_7$ [M + Na]$^+$ 361.1162; found 361.1165.

(4S,5R)-5-(3,4-dimethoxyphenyl)-4-(hydroxymethyl)dihydrofuran-2(3H)-one (5a)

To a well stirred solution of lactone 7a (1.0 g, 2.65 mmol) in THF-MeOH (9:1, 11 mL; 4 mL/mmol) at 0 °C was added NaBH$_4$ (0.1 g, 1.0 equiv., 2.65 mmol) portion wise. After stirring the reaction at 0 °C for 3 h, reaction was quenched with aq. NH$_4$Cl solution, solvent was evaporated at room temperature and residue was diluted with EtOAc. Organic layer was separated; aqueous layer was extracted with EtOAc (3 times), washed with brine, dried (Na$_2$SO$_4$) and concentrated. The residue was purified by flash chromatography and gave 0.625 g of lactone alcohol 5a as a gummy liquid (93%). MF: C$_{13}$H$_{16}$O$_5$, MW: 252.26. $[^{20}]$D –8.04 (c 1.0, CHCl$_3$). $^1$H NMR (CDCl$_3$, 200 MHz) δ: 2.47-2.76 (m, 3H), 3.73 (d, $J$ = 5.2 Hz, 2H), 3.86 (s, 6H), 5.30 (d, $J$ = 6.0 Hz, 1H), 6.85 (s, 3H). $^{13}$C NMR (CDCl$_3$, 50 MHz) δ: 31.7, 46.2, 56.1 (2C), 61.3, 83.3, 109.0, 111.2, 118.6, 131.0, 149.4 (2C), 176.9. HRMS (ESI) calcd for C$_{13}$H$_{16}$NaO$_5$ [M + Na]$^+$ 275.0895; found 275.0895.

(4S,5R)-5-(benzo[d][1,3]dioxol-5-yl)-4-(hydroxymethyl)dihydrofuran-2(3H)-one (5b)

Lactone alcohol 5b (0.59 g) was synthesized from lactone 7b (1.0 g) according to the procedure compound 5a in 90 % yield as gummy liquid. MF: C$_{12}$H$_{12}$O$_5$, MW: 236.22. $[^{20}]$D –4.41 (c 0.78, CHCl$_3$). $^1$H NMR (CDCl$_3$, 200 MHz) δ: 2.04 (bs, 1H), 2.55-2.77 (m, 3H), 3.75 (d, $J$ = 4.2 Hz, 2H), 5.29 (d, $J$ = 6.0 Hz, 1H), 5.98 (s, 2H), 6.80 (s, 2H), 6.82 (s, 1H). $^{13}$C NMR (CDCl$_3$, 50 MHz) δ: 31.6, 46.2, 61.2, 83.3, 101.5, 106.4, 108.4, 119.8, 132.4, 148.0, 148.3, 177.1. HRMS (ESI) calcd for C$_{12}$H$_{13}$O$_5$ [M + H]$^+$ 237.0763; found 237.0767.
(3R,4S,5R)-5-(3,4-dimethoxyphenyl)-4-(hydroxymethyl)-3-methylidihydrofuran-2(3H)-one (12a)

To a cold (–30 °C) solution of LDA (4.2 mmol, 2.1 equiv.) [LDA was prepared by reaction of n-BuLi (1.8 mL, 2.5 M in hexane) and diisopropylamine (0.6 mL, 4.2 mmol) in THF (12 mL) at 0 °C for 30 min, then temperature was decreased to –30 °C] in THF (12 mL) under argon atmosphere, lactone alcohol 5a (0.504 g, 2.0 mmol, 1.0 equiv.) in THF (4 mL) was added drop wise. After stirring at that temperature for 1 h, a solution MeI (0.13 mL, 2.0 mmol, 1.0 equiv.) in THF (4 mL) was added drop wise. The reaction mixture was stirred at this temperature for 2 h, then quenched with saturated aqueous NH₄Cl and extracted with EtOAc, washed with brine, dried over Na₂SO₄, and concentrated. The crude product was purified by flash chromatography and afforded 0.335 g of C-methyl lactone 12a (63%) along with 0.15 g recovery of 5a (30%). MF of compound 12a: C₁₄H₁₈O₅. MW: 266.19. [α]³₀.⁷_D +8.3 (c 1.0, CHCl₃). ¹H NMR (CDCl₃, 200 MHz) δ: 1.25 (d, 3H, J = 7.0 Hz), 2.04-2.21 (m, 1H), 2.42 (bs, 1H), 2.78-2.95 (m, 1H), 3.68-3.82 (m, 2H), 3.86 (s, 6H), 5.22 (d, 1H, J = 9.6 Hz), 6.77-6.96 (m, 3H). ¹³C NMR (CDCl₃, 50 MHz) δ: 13.7, 37.4, 54.3, 55.9, 56.0, 58.7, 81.0, 109.2, 111.1, 119.1, 130.3, 149.3, 149.5, 179.1. HRMS (ESI) calcd for C₁₄H₁₈NaO₅ [M + Na]⁺ 289.1052; found 289.1054.

(3R,4S,5R)-5-(benzo[d][1,3]dioxol-5-yl)-4-(hydroxymethyl)-3-methylidihydrofuran-2(3H)-one (12b)

Lactone 12b (0.305 g) was synthesized from 5b (0.472 g) according to the procedure of compound 12a in 61% yield along with 30% recovery of 5b. MF: C₁₃H₁₄O₅. MW: 250.25. [α]³⁷_D +12.3 (c 0.88, CHCl₃). ¹H NMR (CDCl₃, 200 MHz) δ: 1.32 (d, J = 7.0 Hz, 1H), 1.86 (bs) 2.12-2.26 (m, 1H), 2.79-2.95 (m, 1H), 3.44-3.60 (m, 2H), 5.14 (d, J = 9.4 Hz, 1H), 5.99 (s, 2H), 6.81-6.84 (3 Ar-H). ¹³C NMR (CDCl₃, 50 MHz) δ: 13.9, 37.5, 54.6, 59.0, 81.1,
101.5, 106.8, 108.5, 120.5, 132.0, 148.3, 148.4, 178.9. HRMS (ESI) calcd for C_{13}H_{15}O_{5} [M + H]^+ 251.0920; found 251.0921.

\((3R,4R,5R)-4-(bromomethyl)-5-(3,4-dimethoxyphenyl)-3-methyldihydrofuran-2(3H)-one\) (13a)

To a stirred solution of lactone alcohol 12a (0.532 g, 2.0 mmol, 1.0 equiv.) in CH₂Cl₂ (10 mL) was added PPh₃ (0.577 g, 2.2 mmol, 1.2 equiv.) and NBS (0.196 g, 2.1 mmol, 1.1 equiv.) under argon at room temperature. After completion of reaction, solvent was evaporated and residue was purified by flash chromatography and gave bromomethyl lactone 13a (0.605 g, 92%) as a gummy liquid. MF: C_{14}H_{17}BrO_{4}. MW: 329.03. \([\alpha]^{29}_{D} -40.2 (c 0.53, \text{CHCl}_3)\). \(^1\)H NMR (CDCl₃, 200 MHz) \(\delta\): 1.29 (d, \(J = 7.0\) Hz, 3H), 2.12-2.26 (m, 1H), 2.80-2.89 (m, 1H), 3.41-3.57 (m, 2H), 3.85 (s, 6H), 5.14 (d, \(J = 9.4\) Hz, 1H), 6.83-6.84 (3 Ar-H).

\(^{13}\)C NMR (CDCl₃, 50 MHz) \(\delta\): 13.2, 30.9, 39.1, 53.0, 56.0, 56.1, 81.9, 108.8, 111.1, 119.0, 129.0, 149.5, 149.7, 177.5. HRMS (ESI) calcd for C_{14}H_{17}BrNaO_{5} [M + Na]^+ 351.0208; found 351.0211

\((3R,4R,5R)-5-(benzo[d][1,3]dioxol-5-yl)-4-(bromomethyl)-3-methyldihydrofuran-2(3H)-one\) (13b)

Bromomethyl lactone 13b (0.578 g) was synthesized from 12b (0.50 g) using same procedure as of compound 13a in 92% yield as a gummy liquid. MF: C_{13}H_{13}BrO_{4}, MW: 314.0. \([\alpha]^{30.7}_{D} -32.4 (c 0.7, \text{CHCl}_3)\). \(^1\)H NMR (CDCl₃, 200 MHz) \(\delta\): 1.32 (dd, \(J = 7.0, 5.0\) Hz, 3H), 2.12-2.26 (m, 1H), 2.77-2.94 (m, 1H), 3.44-3.59 (m, 2H), 5.13 (d, \(J = 9.4\) Hz, 1H), 5.98 (s, 2H), 6.81 (s, 3H). \(^{13}\)C NMR (CDCl₃, 50 MHz) \(\delta\): 13.3, 30.8, 39.1, 53.1, 81.8, 101.4, 106.3, 108.4, 120.3, 130.5, 148.3 (2C), 177.3. HRMS (ESI) calcd for C_{13}H_{14}BrO_{4} [M + H]^+ 313.0075; found 313.0079.
NaCNBH₃ (0.38 g, 6.0 mmol, 4.0 equiv.) was added to a solution of substrate 13a (0.493 g, 1.5 mmol, 1.0 equiv.) in HMPA (7.0 mL) under argon and stirred at 70 °C for 12 h. On completion of reaction, the reaction mixture diluted with water, extracted with ether, washed with brine, dried (Na₂SO₄) and concentrated. The crude product was purified by flash chromatography to give 3,4-dimethyl lactone 6a (0.337 g) in 90% of yield as a gummy liquid.

MF: C₁₄H₁₈O₄. MW: 250.29. [α]₀.₆ -15.5 (c 0.76, CHCl₃). ¹H NMR (CDCl₃, 200 MHz) δ: 1.13 (d, J = 6.6 Hz, 3H), 1.31 (d, J = 7.0 Hz, 3H), 1.90-2.10 (m, 1H), 2.28-2.44 (m, 1H), 3.89 (s, 3H), 3.90 (s, 3H), 4.77 (d, J = 10.0 Hz, 1H), 6.86-6.87 (3 Ar-H). ¹³C NMR (CDCl₃, 50 MHz) δ: 12.9, 14.2, 43.3, 47.6, 55.9, 55.9, 86.3, 109.2, 110.9, 119.2, 129.7, 149.2, 149.4, 178.6. HRMS (ESI) calcd for C₁₄H₁₉O₄ [M + H]⁺ 251.1283; found 251.1281.

3.4-Dimetyl lactone 6b (0.316 g) was synthesized from 13b (0.471 g) according to the procedure of compound 6a in 90% yield as a gummy liquid. MF: C₁₃H₁₄O₄. MW: 234.25. [α]₀.₆ -16.5 (c 0.53, CHCl₃). ¹H NMR (CDCl₃, 200 MHz) δ: 1.06 (d, J = 6.4 Hz, 3H), 1.23 (d, J = 7.0 Hz, 3H), 1.81-2.01 (m, 1H), 2.21-2.37 (m, 1H), 4.67 (d, J = 9.8 Hz, 1H), 5.91 (s, 2H), 6.74 (s, 2H), 6.78 (d, J = 1.2 Hz, 1H). ¹³C NMR (CDCl₃, 50 MHz) δ: 13.1, 14.4, 43.5, 47.9, 86.4, 101.5, 106.7, 108.3, 120.6, 131.3, 148.2, 148.3, 178.5. HRMS (ESI) calcd for C₁₃H₁₅O₄ [M + H]⁺ 235.0970; found 235.0975.

To a solution of lactone 6a (0.125 g, 0.5 mmol, 1.0 equiv.) in CH₂Cl₂ (10 mL) was added dropwise DIBAL-H (1.0 mL, 1.0 M solution in toluene, 2.0 equiv.) at −78 °C. After being stirred for 1 h, the reaction mixture was quenched with MeOH and allowed to warm to room
temperature. To this mixture, MeOH (4 mL), trimethyl orthoacetate (0.6 mL, 8.0 mmol, 8.0 equiv.), and PTSA (0.043 g, 0.25 mmol, 0.5 equiv.) were added. The resulting mixture was stirred for 12 h at rt, quenched with aqueous NaHCO₃, diluted with EtOAc. It was extracted with EtOAc (3 times), washed with brine, dried over anhydrous Na₂SO₄ and concentrated. The crude product was purified by flash chromatography and yielded methyl acetal 14a (0.125 g, 95%) as a gummy liquid in 1:1 mixture of diastereomers. MF: C₁₅H₂₂O₄, MW: 266.33. ¹H NMR (CDCl₃, 200 MHz): δ 0.94 (d, J = 6.6 Hz, 6H), 1.02 (d, J = 6.2 Hz, 3H), 1.15 (d, J = 7.0 Hz, 3H), 1.50-1.64 (m, 2H), 1.76-1.89 (m, 2H), 3.42 (s, 3H), 3.47 (s, 3H), 3.85 (s, 6H), 3.88 (s, 6H), 4.38 (d, J = 8.8 Hz, 1H), 4.46 (d, J = 9.8 Hz, 1H), 4.77 (d, J = 4.0 Hz, 1H), 4.83 (d, J = 3.6 Hz, 1H), 6.83 (m, 4H), 6.89 (s, 1H), 6.95 (s, 1H). ¹³C NMR (CDCl₃, 50 MHz): δ 11.2, 14.1, 14.3, 16.2, 46.5, 46.7, 48.9, 50.1, 55.2, 55.9, 56.1 (2C), 86.7, 89.7, 106.7, 109.8, 110.1, 110.8, 111.2, 111.6, 119.5, 133.0, 135.2, 148.7, 149.0, 149.3 (2C). HRMS (ESI) calcd for C₁₅H₂₂NaO₄ [M + Na]⁺ 289.1416; found 289.1419.

5-((2R,3R,4R)-5-methoxy-3,4-dimethyltetrahydrofuran-2-yl)benzo[d][1,3]dioxole (14b)

Methyl acetal 14b (0.119 g) was prepared from dimethyl lactone 6b (0.117 g) in 95% yield as a gummy liquid in 1:1 mixture of diastereomers according to the above procedure of compound 14a. MF: C₁₄H₁₈O₄. MW: 250.29. ¹H NMR (CDCl₃, 200 MHz) δ: 0.94 (d, J = 6.4 Hz, 6H), 1.02 (d, J = 6.2 Hz, 3H), 1.14 (d, J = 6.8 Hz, 3H), 1.52-1.64 (m, 1H), 1.75-1.89 (m, 3H), 3.42 (s, 3H), 3.46 (s, 3H), 4.35 (d, J = 9.0 Hz, 1H), 4.44 (d, J = 9.6 Hz, 1H), 4.76 (d, J = 4.2 Hz, 1H), 4.82 (d, J = 4.2 Hz, 1H), 5.92 (s, 4H), 6.76 (m, 4H), 6.88 (s, 2H). ¹³C NMR (CDCl₃, 50 MHz) δ: 11.2, 14.1 (2C), 16.1, 46.4, 46.8, 48.8, 50.2, 55.3, 56.0, 86.7, 89.6, 101.1, 101.1, 106.6, 107.0, 107.4, 107.9, 108.1, 111.5, 120.5, 120.6, 134.5, 136.5, 147.2, 147.4, 148.0 (2C). HRMS (ESI) calcd for C₁₄H₁₈NaO₄ [M + Na]⁺ 273.1103; found 273.1108.
(2R,3R,4R,5R)-2,5-bis(3,4-dimethoxyphenyl)-3,4-dimethyltetrahydrofuran, (+)-galbelgin (1)

To a stirred solution of methyl acetal 14a (0.04 g, 0.15 mmol, 1.0 equiv.) and 1,2-dimethoxybenzene (0.105 g, 0.75 mmol, 5.0 equiv.) in CH₂Cl₂ (3.0 mL) was added dropwise BF₃·OEt₂ (0.9 mL, 1.0 M in CH₂Cl₂, 6 equiv.) at −78 °C and stirred for 2 h. Then temperature was raised to −20 °C and stirred for 10 h. The reaction mixture was quenched with aqueous NaHCO₃, extracted with EtOAc, washed with brine, dried over anhydrous Na₂SO₄, and concentrated. The residue was purified by flash chromatography and afforded the desired (+)-galbelgin 1 (0.051 g) in 92% yield. MF: C₂₂H₂₈O₅. MW: 372.45. {[α]D²⁸ = +80 (c 0.5, CHCl₃), lit.² [α]D²⁸ = +80.7 (c 0.55, CHCl₃), lit.³ [α]D²⁸ = +83.4 (c 0.47, CHCl₃)}. ¹H NMR (CDCl₃, 200 MHz) δ: 1.05 (d, J = 5.4 Hz, 6H), 1.77-1.82 (m, 2H), 3.88 (s, 6H), 3.91 (s, 6H), 4.66 (d, J = 9.2 Hz, 2H), 6.82-6.96 (6 Ar-H). ¹³C NMR (CDCl₃, 50 MHz) δ: 14.1 (2C), 51.2 (2C), 56.1 (4C), 88.5 (2C), 109.4 (2C), 111.1 (2C), 118.8 (2C), 135.2 (2C), 148.7 (2C), 149.3 (2C).

5,5'-(2R,3R,4R,5R)-3,4-dimethyltetrahydrofuran-2,5-diyl) dibenzo[d][1,3]dioxole, (+)-galbacin (2)

(+)-Galbacin 2 (0.052 g) was synthesized from methyl acetal 14b (0.04 g) and methylenedioxybenzene according to the above procedure in 95% yield. MF: C₂₀H₂₀O₅. MW: 340.37. {[α]D²⁸ = +110 (c 1.0, CHCl₃), lit.⁴ [α]D²⁸ = +117 (CHCl₃)}. ¹H NMR (CDCl₃, 200 MHz) δ: 1.03 (d, J = 6.0 Hz, 6H), 1.71-1.81 (m, 2H), 4.61 (d, J = 9.2 Hz, 2H), 5.95 (s, 4H), 6.77 (d, AB type, J = 7.8 Hz, 2H), 6.84 (dd, J = 8, 1.5 Hz, 2H), 6.93 (d, J = 1.5 Hz, 2H). ¹³C NMR (CDCl₃, 50 MHz) δ: 14.0 (2C), 51.2 (2C), 88.5 (2C), 101.1 (2C), 106.8 (2C), 108.1 (2C), 119.9 (2C), 136.5 (2C), 147.1 (2C), 148.0 (2C).
Reference


$^1$H NMR of 7a (200 MHz)
\(^{13}\)C NMR of 7a (50 MHz)

DEPT-135 NMR of 7a (50 MHz)
DEPT-135 NMR of 7b (50 MHz)

^1 H NMR of 5a (200 MHz)
$^{13}$C NMR of 5a (50 MHz)

DEPT-135 NMR of 5a (50 MHz)
$^{1}$H NMR of 5b (200 MHz)

$^{13}$C NMR of 5b (50 MHz)
DEPT-135 NMR of 5b (50 MHz)

\[ \text{DEPT-135 NMR of } 5b \text{ (50 MHz)} \]

\[ \text{H NMR of } 12a \text{ (200 MHz)} \]

Electronic Supplementary Material (ESI) for RSC Advances
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$^{13}$C NMR of $12a$ (50 MHz)

$^1$H NMR of $12b$ (200 MHz)
$^{13}$C NMR of 12b (50 MHz)

$^1$H NMR of 13a (200 MHz)

18
$^{13}$C NMR of 13a (50 MHz)

DEPT-135 NMR of 13a (50 MHz)
$^1$H NMR of 13b (200 MHz)

$^{13}$C NMR of 13b (50 MHz)
DEPT-135 NMR of 13b (50 MHz)

'H NMR of 6a (200 MHz)
$^{13}$C NMR of 6a (50 MHz)

DEPT-135 NMR of 6a (50 MHz)
$^1$H NMR of 6b (200 MHz)

$^{13}$C NMR of 6b (50 MHz)
DEPT-135 NMR of 6b (50 MHz)

$^1$H NMR of 14a (200 MHz)
$^{13}$C NMR of 14a (50 MHz)

DEPT-135 NMR of 14a (50 MHz)
$^{1}H$ NMR of 14b (200 MHz)

$^{13}C$ NMR of 14b (50 MHz)
DEPT-135 NMR of 14b (50 MHz)

H NMR of galbelgin 1 (200 MHz)
$^{13}$C NMR of galbelgin 1 (50 MHz)

$^1$H NMR of galbacin 2 (200 MHz)
$^{13}$C NMR of galbacin 2 (50 MHz)

DEPT-135 NMR of galbacin 2 (50 MHz)