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First Total Synthesis of Cryptopyranmoscatone A3 and Cryptopyranmoscatone B4

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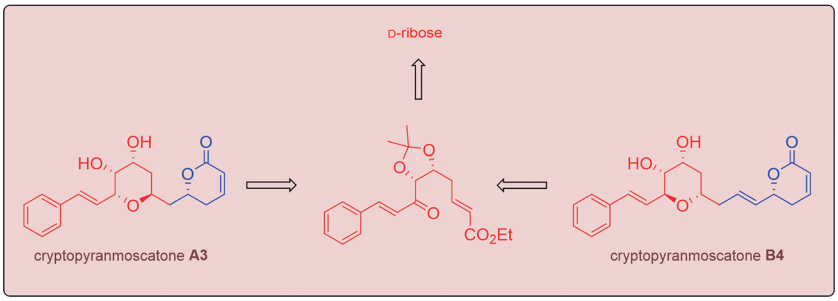

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Abstract The first total synthesis of cryptopyranmoscatones A3 and B4 has been accomplished from D-ribose or but-3-ynol. The key steps involved in the synthesis are oxa-Michael addition, highly diastereoselective Brown allylation, and ring closing metathesis (RCM) and cross metathesis (CM) reactions.

Key words oxa-Michael addition, Brown asymmetric allylation, ring-closing metathesis, cross metathesis

Natural products possessing α,β-unsaturated δ-lactone moieties have attracted considerable attention because of their promising pharmacological properties, which include anticancer,[1,2] antimicrobial,[3] antifungal,[4] and insecticidal activity.[5] Cryptopyranmoscatones A1, A2, A3, B1, B2, and B4 (**1**–**6**; Figure 1) were isolated by Cavalheiro and Yoshida[6] from the branch and stem bark of *Cryptocarya moschata*, *Lauraceae* in 2000, together with other representative structures. This tree grows up to 30–40 m high, mainly in the Southeastern Region of Brazil. The structures of these compounds were established by spectroscopic methods. Based on circular dichroism measurements, the authors were able to set the absolute configuration at C6 as *R*. Structurally, these styryl lactones incorporate a dihydro-α-pyrone moiety as well as a tetra-substituted tetrahydropyran ring. In preliminary biological studies, the cryptomoscatone family of compounds showed G2 checkpoint inhibitory properties[7] and cytotoxicity against human cervical carcinoma cell lines.[8] Cryptocaryalactones belonging to this group are natural germination inhibitors, although they have no effect on corn.[9] Extracts of *Cryptocarya* species have shown cyclooxygenase-1 and -2 inhibition.[10] At least some of these pharmacological effects may be related to the presence of the conjugated double bond, which acts as a Michael acceptor. The biological activity of the cryptopyranmoscatones has not been studied, presumably because of the limited supply from natural sources. The fascinating structural architecture and scarcity of these natural products have attracted our attention with the aim to develop a general synthetic strategy to prepare them.

As part of our continued efforts towards the synthesis of biologically active natural lactones,[11] we have already reported the first total synthesis of cryptopyranmoscatones A1,[12] A2,[13] and B1.[14] In the present communication, we herein report the first stereoselective total synthesis of cryptopyranmoscatones A3 and B4 either from but-3-ynol or from D-ribose in a synthetic pathway via an intermediate from which both cryptopyranmoscatone A3 and B4 could be obtained.

Our retrosynthetic strategy for cryptopyranmoscatone A3 and B4 is depicted in Scheme 1. We envisaged that both cryptopyranmoscatone A3 and B4 could be obtained from a common intermediate **7** by adopting a stereoselective reduction, oxa-Michael addition reaction protocol. The analysis reveals that target compound **3** could be synthesized from bis-olefin **8** by utilizing a ring closing metathesis reaction, while the bis-olefin itself could be obtained from **9** by successive reactions involving oxidation and allylation followed by acrylation. The 2,6-*trans*-tetrasubstituted tetrahydropyran ring in compound **9** could be constructed from a common intermediate **7**. In turn, intermediate **7** could be obtained via lactone **15** through a phenylacetylene addition reaction of the aldehyde, produced from the corresponding primary alcohol **13**, which could be derived from D-ribose. Cryptopyranmoscatone B4 (**6**) could be prepared from compound **10** by performing a cross-metathesis reaction as the key step; whereas, the precursor, 2,6-*trans*-tetrahydropyran **11** could be obtained from intermediate **7**.

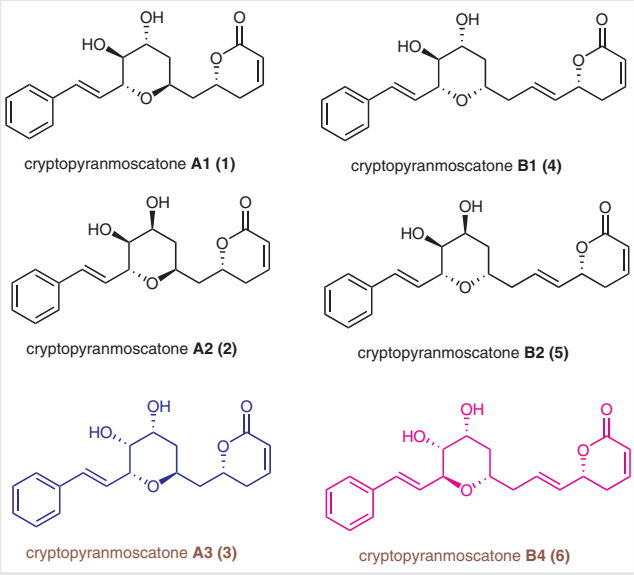
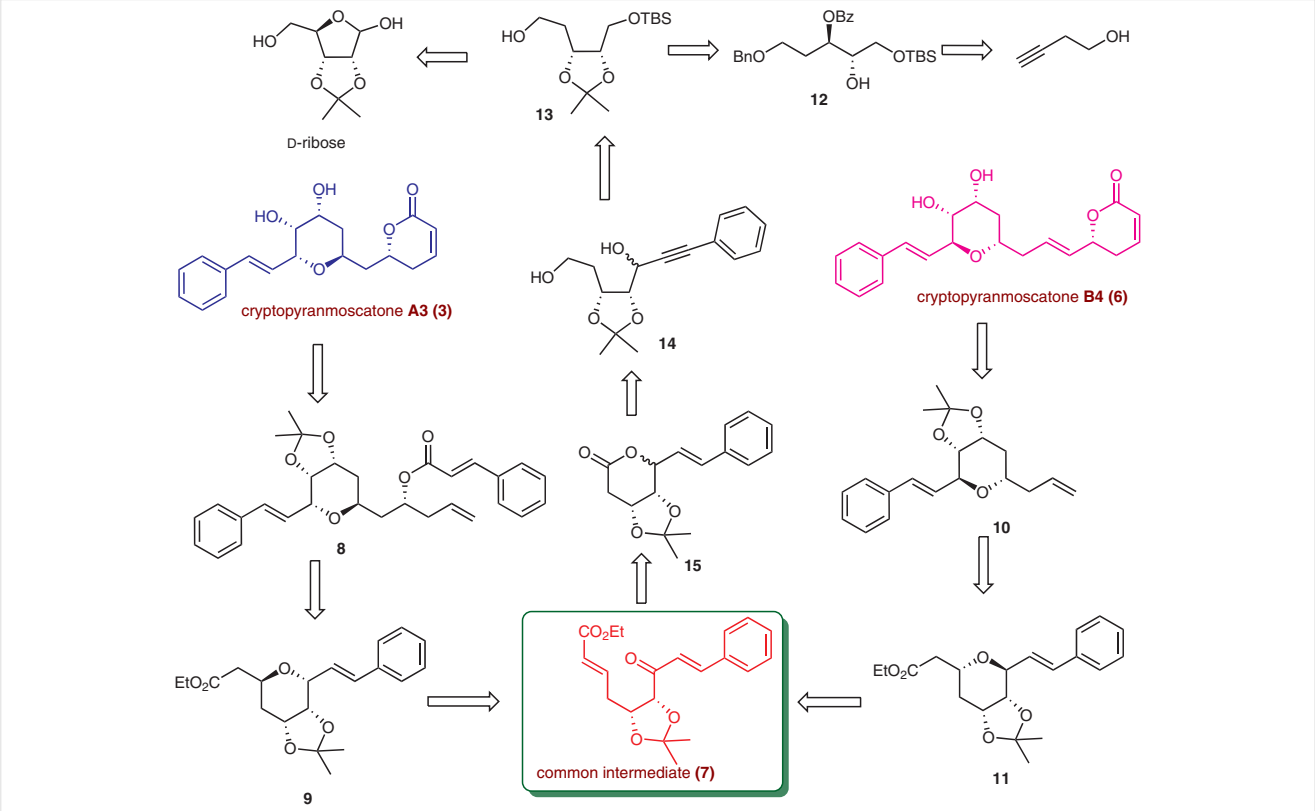
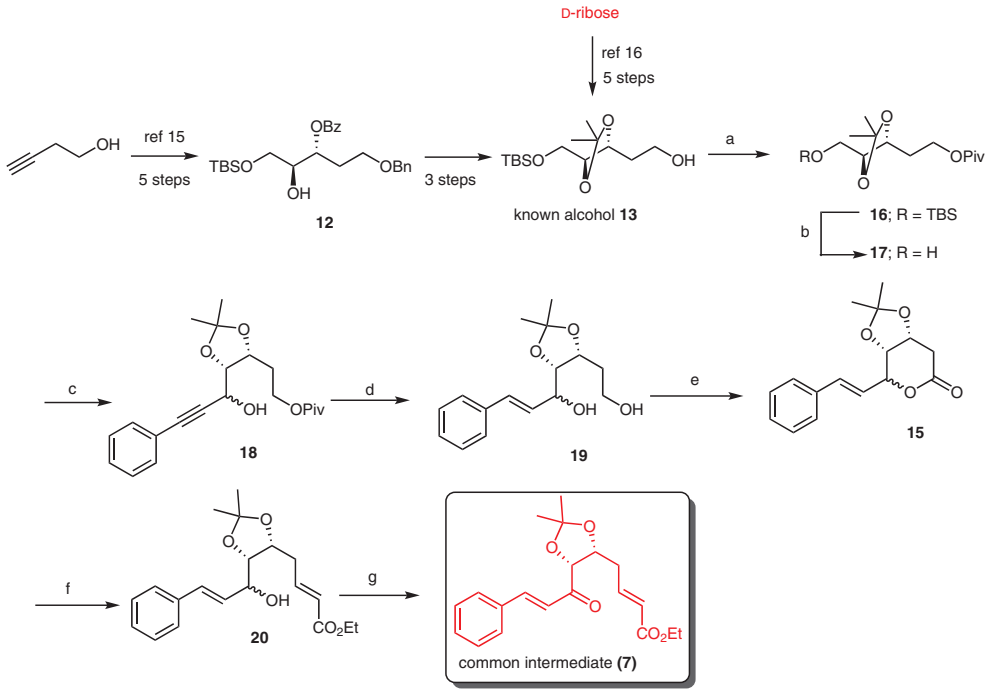


Figure 1 Structures of natural cryptopyranmoscatones

The synthesis of the key intermediate **7** started with the known alcohol **13** (Scheme 2). Initially, we planned to prepare **13** from benzoate diol **12**[15] in a three-step sequence by protecting group manipulations involving TBS protection followed by removal of the benzoyl and benzyl groups. The known benzoate diol **12** could be prepared in five steps by following reported procedures. However, bearing in mind the number of steps involved and overall yield in obtaining alcohol **13**, it was alternatively prepared from D-ribose in five steps in an overall yield of 70%.[16] After protecting the free hydroxy group in **13** as its pivaloyl ether **16**, the TBS group was removed with tetrabutylammonium fluoride (TBAF) to yield the corresponding alcohol **17**. Oxidation of alcohol **17** with 2-iodoxybenzoic acid (IBX) gave an aldehyde that was subjected to Grignard addition with phenyl acetylene to give propargyl alcohol **18** as a mixture of diastereomers in 88:12 ratio (determined by chiral HPLC).[17] This inseparable mixture was carried on to the preparation of ketone intermediate keto **7**. Thus, partial reduction of the triple bond in **18** with Red-Al furnished diol **19**. Oxidative cyclization of 1,5-diol **19** with 2,2,6,6-tetramethyl-1-piperidinyloxy (TEMPO) and [bis(acetoxy)iodo]benzene (BAIB)[18] produced the desired δ-lactone **15** in 86% yield. Lactone **15** was reduced to the lactol using diisobutylaluminum hydride (DIBAL-H) and subjected to Wittig olefination using the two carbon stabilized ylide to furnish α.β-unsaturated ester **20** in 78% overall yield (Scheme 2). IBX oxidation of **20** furnished the key intermediate **7**, from which both target molecules cryptopyranmoscatone A3 and B4 could be synthesized by adopting a chemoselective reduction of the keto group.

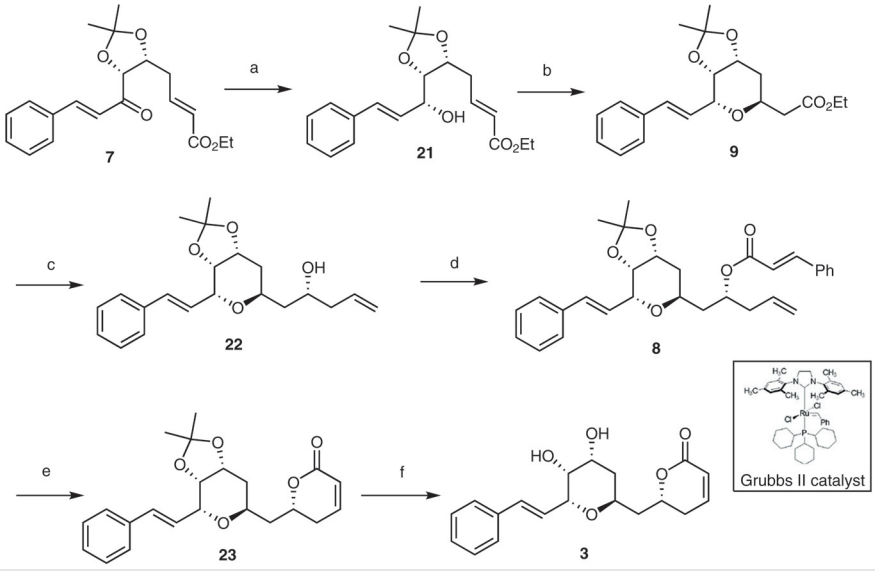


Scheme 1 Retrosynthetic analysis for cryptopyranmoscatone A3 and B4



Scheme 2 Synthesis of key intermediate **7**. *Reagents and conditions*: (a) PivCl, Et_3N, CH_2Cl_2, 0 °C, 4 h, 90%; (b) TBAF, THF, 0 °C, 0.5 h, 90%; (c) (i) IBX, CH_3CN, Δ, 1 h; (ii) EtMgBr, phenylacetylene, THF, r.t., 1 h, 80%; (d) Red-Al, THF/r.t., 90%; (e) BAIB, TEMPO, CH_2Cl_2, r.t., 2 h, 86%; (f) (i) DIBAL-H, CH_2Cl_2, –78 °C; (ii) $Ph_3P{=}CHCO_2Et$, C_6H_6, reflux, 1 h, 85%; (g) IBX, CH_3CN, Δ, 1 h, 90%.

Accordingly, the synthesis of A3 (**3**) commenced with stereoselective reduction of the keto group in **7** using $NaBH_4$ in the presence of $CeCl_3{\cdot}7H_2O$ at –78 °C in MeOH to furnish the *syn* alcohol **21**, the properties of which correlated with those reported.[19] The hydroxyester **21**, on exposure to *t*-BuOK[20] in THF at –78 °C, readily underwent intramolecular oxa-Michael reaction to afford 2,6-*trans* tetrahydropyran **9** as a single diastereomer (>20:1) in 95% yield (Scheme 3).



Scheme 3 Synthesis of cryptopyranmoscatone A3 (**3**). *Reagents and conditions*: (a) $NaBH_4$,$CeCl_3{\cdot}7H_2O$, MeOH, 1 h, 85%; (b) *t*-BuOK, THF, –78 °C, 0.5 h, 95%; (c) (i) DIBAL-H, CH_2Cl_2, –78 °C; (ii) (+)-IPC_2B(allyl), ether, –100 °C, 1 h, 80%; (d) cinnamic acid, Et_3N, *N*,*N*-dicyclohexylcarbodiimide (DCC), 4-(*N*,*N*-dimethylamino)pyridine (DMAP), CH_2Cl_2, 0 °C, 12 h, 85%; (e) Grubbs II catalyst, CH_2Cl_2, reflux, 6 h, 90%; (f) $TiCl_4$, CH_2Cl_2, 0 °C, 15 min, 80%.

The *trans*-stereochemistry of the newly generated ring junction of tetrahydropyran **9** was assigned based on ^{1}H NMR (600 MHz, $CDCl_3$) data and assignments were made with the aid of TOCSY and NOESY experiments (see SI, Figure 2). The medium NOE enhancement between C2H/C6H suggested that both protons are *anti* to each other (*trans* related). This was further supported by the NOE correlations between C2H/Me-a, C4H/C6H, C2H/C5H, and C3H/C4H.

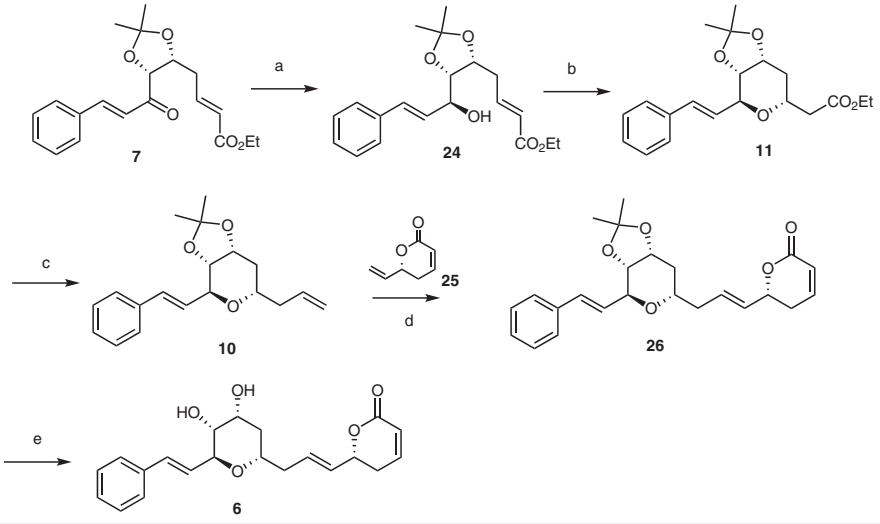
After confirming the structure, the ester group in **9** was reduced with DIBAL-H and the resulting aldehyde was subjected to Brown's asymmetric allylation[21] using (+)-Ipc$_2$B-allyl to furnish the homoallylic alcohol **22** in 80% overall yield over the two-step sequence. Subsequent coupling of alcohol **22** with cinnamic acid using DCC-DMAP provided diene **8** in 85% yield. Ring closing metathesis (RCM)[22] of diene **8** using the second-generation Grubbs' catalyst in CH_2Cl_2 under refluxing conditions yielded lactone **23** exclusively. Finally, removal of the acetonide group using trifluoroacetic acid (TFA) in CH_2Cl_2 at 0 °C to room temperature for 0.5 h furnished cryptopyranmoscatone A3 (**3**) in 80% yield. The spectroscopic and physical data of synthetic **3** are in agreement with those of the natural compound; thereby confirming its structure and absolute stereochemistry.

We then focused on the synthesis of cryptopyranmoscatone B4 (**6**) from common intermediate **7**, which, on DIBAL-H reduction,[23] produced *anti*-alcohol **24** following a reported precedent (Scheme 4). The hydroxy ester **24**, on exposure to *t*-BuOK in THF at –78 °C, readily underwent intramolecular oxa-Michael reaction[20] to afford 2,6-*trans* tetrahydropyran **11** as mainly a single diastereomer (>20:1) in 90% yield. The *trans*-stereochemistry of the newly generated ring-junction of tetrahydropyran **11** was assigned based on ^{1}H NMR (600 MHz, $CDCl_3$) analysis, with the aid of TOCSY and NOESY experiments. The moderate NOE between C2H/C6H suggested that both protons are *anti* to each other (*trans* related). This was further supported by the NOE correlations between C2H/Me-a, C4H/C6H, C2H/C5H, and C3H/C4H, confirming the structure.

After establishing the structure, the ester group in **11** was converted into a terminal alkene by reduction using DIBAL-H in CH_2Cl_2 followed by Wittig reaction to afford **10**. Cross-metathesis[24] reaction of terminal alkene with the known vinyl lactone **25**[25] was carried out using Grubbs' second generation catalyst in CH_2Cl_2 under refluxing conditions for 4 h to afford the desired lactone **26**. Finally, removal of the acetonide was achieved by treatment with TFA in CH_2Cl_2 at 0 °C to room temperature for 0.5 h to give the cryptopyranmoscatone B4 (**6**) in 80% yield. The spectroscopic and physical data of synthetic **6** are in agreement with those of the natural compound, thereby confirming its structure and absolute stereochemistry.

In conclusion, we have achieved the first total synthesis of cryptopyranmoscatones A3 and B4. The key steps involved in the synthesis are oxa-Michael addition, asymmetric allylation, and metathesis reactions.

All reactions were performed under inert atmosphere. All glassware used for performing the reactions was oven- or flame-dried. Anhydrous solvents were distilled prior to use: THF from Na and benzophenone; CH_2Cl_2 from CaH_2; MeOH from Mg. Commercial reagents were used without purification. Column chromatography was carried out using silica gel (60–120 mesh) unless otherwise mentioned. Analytical thin-layer chromatography (TLC) was run on silica gel 60 F_{254} pre-coated plates (250 µm thickness). Specific rotations $[\alpha]_D$ were measured with a polarimeter and given in 10^{-1} deg cm^2 g^{-1}. Infrared spectra were recorded in $CHCl_3$ or as KBr discs (as mentioned) and reported in wavenumber (cm^{-1}). High-resolution mass spectra (HRMS)



Scheme 4 Synthesis of cryptopyranmoscatone B4 (**6**). *Reagents and conditions*: (a) DIBAL-H, CH_2Cl_2, –78 °C, 85%; (b) *t*-BuOK, THF, –78 °C, 0.5 h, 90%; (c) (i) DIBAL-H, CH_2Cl_2, –78 °C, 2 h; (ii) $Ph_3P{=}CH_2$, *n*-BuLi, THF, –78 °C, 60%; (d) Grubbs-II catalyst, CH_2Cl_2, reflux, 4 h, 90%; (e) $TiCl_4$, CH_2Cl_2, 0 °C, 15 min, 80%.

[ESI+] were obtained by using either a TOF or a double focusing spectrometer. ^{1}H NMR spectra were recorded at 300, 400, 500 MHz and ^{13}C NMR spectra were obtained at 75, 100, 125 MHz in $CDCl_3$ solution unless otherwise mentioned. Chemical shifts are reported in ppm downfield from tetramethylsilane and coupling constants (*J*) are reported in Hertz (Hz). The following abbreviations are used to designate signal multiplicity: s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet, br = broad.

Ethyl (*E*)-4-((4*R*,5*R*)-5-Cinnamoyl-2,2-dimethyl-1,3-dioxolan-4-yl)but-2-enoate (7)

To an ice-cooled solution of 2-(iodooxy)benzoic acid (1.8 g, 6.5 mmol) in anhydrous CH_3CN (20 mL) was added a solution of alcohol **20** (1.5 g, 4.3 mmol). The mixture was heated to reflux for 1 h, and then allowed to cool to r.t. The solvent was removed under reduced pressure and the compound was purified by silica gel column chromatography (hexane/EtOAc, 8:2) to give **7**.

Yield: 1.3 g (90%); liquid; $[\alpha]_D^{25}$ +9.5 (*c* = 0.26, $CHCl_3$).

IR (neat): 3449, 2928, 2847, 1720, 1476, 1374, 1216, 1147, 1070, 771 cm^{-1}.

^{1}H NMR ($CDCl_3$, 500 MHz): δ = 7.7 (d, *J* = 16.0 Hz, 1 H), 7.62–7.58 (m, 2 H), 7.44–7.39 (m, 3 H), 7.25 (d, *J* = 7.8 Hz, 1 H), 6.92 (dt, *J* = 13.9, 6.9 Hz, 1 H), 5.86 (dt, *J* = 15.7, 1.4 Hz, 1 H), 4.71 (d, *J* = 7.5 Hz, 1 H), 4.58–4.53 (m, 1 H), 4.13 (q, *J* = 6.9 Hz, 2 H), 2.47–2.40 (m, 1 H), 2.30–2.21 (m, 1 H), 1.68 (s, 3 H), 1.43 (s, 3 H), 1.24 (t, *J* = 7.0, 3 H).

^{13}C NMR ($CDCl_3$, 75 MHz): δ = 197.7, 166.1, 144.4, 143.9, 134.3, 131.6, 128.9, 128.7, 123.9, 121.1, 110.3, 81.9, 76.6, 60.2, 33.6, 27.2, 24.9, 14.1.

MS (ESI): *m*/*z* = 367 [M + Na]$^+$.

Ethyl (*E*)-4-((4*R*,5*S*)-5-[(*R*,*E*)-1-Hydroxy-3-phenylallyl]-2,2-dimethyl-1,3-dioxolan-4-yl)but-2-enoate (21)

To a solution of **7** (0.6 g, 1.7 mmol) in MeOH (15 mL), $CeCl_3{\cdot}7H_2O$ (0.85 g, 2.2 mmol) was added, and the mixture was cooled to 0 °C and stirred for 10 min at that temperature. The resultant suspension was then cooled to –78 °C and stirred for 10 min, $NaBH_4$ (0.2 g, 5.2 mmol) was added portionwise to the suspension and the mixture was stirred at the same temperature for 0.5 h. After completion of the reaction (TLC) it was cautiously quenched by the addition of water (3 mL). Excess MeOH was evaporated off and the resulting residue was diluted with water (15 mL) and extracted with EtOAc (3 × 10 mL). The combined organic layers were washed with brine (10 mL), dried over anhydrous Na_2SO_4, filtered, concentrated under reduced pressure and purified by silica gel column chromatography (hexane/EtOAc, 7:3) to afford α,β-unsaturated ester **21**.

Yield: 0.5 g (85%); pale-yellow liquid; $[\alpha]_D^{25}$ +39.5 (*c* = 0.23, $CHCl_3$).

IR (neat): 3447, 2948, 2857, 1735, 1238, 1170, 1039, 770 cm^{-1}.

^{1}H NMR ($CDCl_3$, 500 MHz): δ = 7.39 (d, *J* = 7.2 Hz, 2 H), 7.32 (t, *J* = 6.9 Hz, 2 H), 7.26 (t, *J* = 3.3 Hz, 1 H), 6.97 (dt, *J* = 15.7, 6.9 Hz, 1 H), 6.70 (d, *J* = 15.8 Hz, 1 H), 6.19 (dd, *J* = 15.9, 6.9 Hz, 1 H), 5.92 (dt, *J* = 15.7, 1.5 Hz, 1 H), 4.34–4.27 (m, 2 H), 4.21–4.13 (m, 3 H), 2.72–2.62 (m, 1 H), 2.58–2.47 (m, 2 H), 1.54 (s, 3 H), 1.39 (s, 3 H), 1.28 (t, *J* = 7.3 Hz, 3 H).

^{13}C NMR ($CDCl_3$, 75 MHz): δ = 166.2, 144.6, 136.2, 128.5, 128.0, 127.6, 126.6, 123.5, 108.5, 79.9, 75.6, 70.6, 60.2, 33.0, 27.6, 25.1, 14.2.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd. for $C_{20}H_{26}O_5Na$: 369.1677; found: 369.1678.

(*R*)-6-{[(2*S*,4*R*,5*R*,6*R*)-4,5-Dihydroxy-6-[(*E*)-styryl]tetrahydro-2*H*-pyran-2-yl]methyl}-5,6-dihydro-2*H*-pyran-2-one (3)

To a stirred solution of **23** (30 mg, 0.08 mmol) in anhydrous CH_2Cl_2 (5 mL), $TiCl_4$ (0.01 mL, 0.08 mmol) was added at 0 °C and the reaction mixture was stirred at this temperature for 1 h. The reaction was quenched with solid $NaHCO_3$, and the mixture was filtered. The solvent was removed under reduced pressure and the residue was purified by silica gel column chromatography (EtOAc/hexane, 50%) to afford **3**.

Yield: 21 mg (80%); colorless oil; $[\alpha]_D^{25}$ +5.2 (*c* = 0.1, $CHCl_3$).

IR (neat): 3468, 2987, 2983, 1714, 1648, 1452, 1254, 1168, 769 cm^{-1}.

^{1}H NMR ($CDCl_3$, 500 MHz): δ = 7.437.23 (m, 5 H), 6.95–6.84 (m, 1 H), 6.68 (d, *J* = 16.0 Hz, 1 H), 6.23 (dd, *J* = 16.0, 6.9 Hz, 1 H), 6.09–5.99 (m, 1 H), 4.83–4.90 (m, 1 H), 4.0–4.15 (m, 1 H), 3.88–3.67 (m, 2 H), 3.66–3.52 (m, 1 H), 2.45–2.40 (m, 1 H), 2.34–2.28 (m, 1 H), 2.02–1.91 (m, 2 H), 1.87–1.79 (m, 1 H), 1.65–1.50 (m, 1 H).

^{13}C NMR ($CDCl_3$, 75 MHz): δ = 164.4, 145.2, 136.6, 132.3, 128.6, 127.9, 126.5, 125.8, 121.4, 78.4, 76.4, 74.3, 71.0, 69.4, 41.3, 35.2, 29.9.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd. for $C_{19}H_{22}O_5Na$: 353.1365; found: 353.1366.

Ethyl (*E*)-4-{(4*R*,5*S*)-5-[(*S*,*E*)-1-Hydroxy-3-phenylallyl]-2,2-dimethyl-1,3-dioxolan-4-yl}but-2-enoate (24)

A stirred solution of **7** (0.6 g, 1.7 mmol) in CH_2Cl_2 (10 mL) was cooled to –78 °C, then DIBAL-H (1.6 M in toluene, 2.2 mL) was added slowly. After 1 h, the reaction was quenched with MeOH (10 mL) and sodium potassium tartrate (15 mL), and stirred at r.t. for 0.5 h. The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 20 mL). The combined organic layers were washed with brine (2 × 10 mL), dried over anhydrous Na_2SO_4, filtered, and concentrated in vacuo to afford the pure α,β-unsaturated ester **24**.

Yield: 1.6 g (85%); pale-yellow oil; $[\alpha]_D^{25}$ +27.3 (*c* = 0.2, $CHCl_3$).

IR (neat): 3446, 2984, 2977, 1643, 1449, 1372, 1264, 1168, 1058, 977 cm^{-1}.

^{1}H NMR ($CDCl_3$, 500 MHz): δ = 7.43–7.39 (m, 2 H), 7.33 (t, *J* = 7.1 Hz, 2 H), 7.28–7.25 (m, 1 H), 7.04 (dt, *J* = 15.6, 6.9 Hz, 1 H), 6.69 (dd, *J* = 16.0, 1.0 Hz, 1 H), 6.37 (dd, *J* = 16.0, 6.1 Hz, 1 H), 5.94 (dt, *J* = 15.6, 1.5 Hz, 1 H), 4.22–4.37 (m, 1 H), 4.36–4.31 (m, 1 H), 4.19 (q, *J* = 7.1 Hz, 2 H), 4.08 (dd, *J* = 7.7, 5.7 Hz, 1 H), 2.76–2.69 (m, 1 H), 2.63–2.54 (m, 1 H), 1.47 (s, 3 H), 1.35 (s, 3 H).

^{13}C NMR ($CDCl_3$, 75 MHz): δ = 166.4, 145.6, 136.3, 132.0, 129.1, 128.5, 127.9, 126.6, 123.3, 108.6, 79.8, 76.3, 70.9, 60.2, 33.0, 27.9, 25.5, 14.2.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd. for $C_{20}H_{26}O_5Na$: 369.1677; found: 369.1676.

(*R*)-6-[(*E*)-3-{(2*S*,4*R*,5*R*,6*S*)-4,5-Dihydroxy-6-[(*E*)-styryl]tetrahydro-2*H*-pyran-2-yl}prop-1-en-1-yl]-5,6-dihydro-2*H*-pyran-2-one (6)

To a stirred solution of **26** (20 mg, 0.25 mmol) in anhydrous CH_2Cl_2 (5 mL), $TiCl_4$ (0.03 mL, 0.25 mmol) was added at 0 °C. The mixture was stirred at this temperature for 0.5 h, then the reaction was quenched with solid $NaHCO_3$ and the mixture was filtered. The solvent was removed under reduced pressure and the residue was purified by silica gel column chromatography (EtOAc/hexane, 1:1) to afford **6**.

Yield: 14 mg (80%); pale-yellow oil; $[\alpha]_D^{25}$ +5.2 (*c* = 0.1, $CHCl_3$).

IR (neat): 3448, 2983, 2854, 1712, 1648, 1542, 1484, 1263, 1090, 755 cm^{-1}.

^{1}H NMR ($CDCl_3$, 500 MHz): δ = 7.43–7.37 (m, 2 H), 7.30 (t, *J* = 7.7 Hz, 2 H), 7.25–7.19 (m, 1 H), 6.87 (dt, *J* = 16.1, 5.4 Hz, 1 H), 6.68 (dd, *J* = 16.0, 1.1 Hz, 1 H), 6.27 (dd, *J* = 16.1, 5.4 Hz, 1 H), 6.04 (dt, *J* = 9.6, 1.7 Hz, 1 H), 5.96–5.87 (m, 1 H), 5.70 (dd, *J* = 15.5, 6.4 Hz, 1 H), 4.94–4.87 (m, 1 H), 4.53–4.47 (m, 1 H), 4.05 (dd, *J* = 9.1, 4.6 Hz, 1 H), 4.01–3.92 (m, 1 H), 3.82 (dd, *J* = 9.2, 4.7 Hz, 1 H), 2.47–2.36 (m, 3 H), 2.34–2.24 (m, 1 H), 1.92 (dt, *J* = 14.9, 2.9 Hz, 1 H), 1.80–1.71 (m, 1 H).

^{13}C NMR ($CDCl_3$, 75 MHz): δ = 164.0, 144.7, 136.1, 133.6, 131.0, 129.6, 128.7, 128.3, 126.5, 124.9, 121.5, 77.2, 76.1, 69.7, 68.3, 65.2, 37.2, 33.6, 28.8.

HRMS (ESI): *m*/*z* [M + Na]$^+$ calcd. for $C_{21}H_{24}O_5Na$: 379.1521; found: 379.1520.

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Supporting Information

Experimental procedures, spectroscopic data, copies of ^{1}H NMR ^{13}C NMR and NOESY spectra are available. Supporting information for this article is available online at https://doi.org/10.1055/s-0036-1591931.

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