

The Dimethoxyphenylbenzyl Protecting Group: An Alternative to the *p*-Methoxybenzyl Group for Protection of Carbohydrates

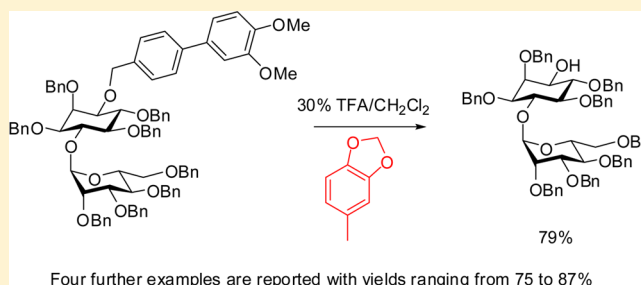
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S Supporting Information

ABSTRACT: A reliable reagent system for the cleavage of 4-(3,4-dimethoxyphenyl)benzyl (DMPBn) ethers under acidic conditions has been established. Treatment of DMPBn-protected mono- and pseudodisaccharides with TFA in anhydrous CH₂Cl₂ and 3,4-(methylenedioxy)toluene as a cation scavenger resulted in the selective cleavage of the DMPBn ether giving the corresponding deprotected products in moderate to high yields. Examples are reported which show that allyl, benzyl, and *p*-bromobenzyl ethers, esters, and glycosidic linkages are stable to these reaction conditions. The selective cleavage of allyl, *p*-bromobenzyl, and PMB ethers in protected carbohydrates containing DMPBn ethers are also demonstrated. This work establishes the 4-(3,4-dimethoxyphenyl)-benzyl ether as an effective and robust alternative to *p*-methoxybenzyl as a protecting group for alcohols.



Four further examples are reported with yields ranging from 75 to 87%

INTRODUCTION

Phosphatidylinositol mannosides (PIMs), compounds that are found in the cell wall of mycobacteria, have received much attention due to their immune regulatory properties. In a program of research aimed at utilizing synthetic PIMs for the treatment of diseases such as asthma and also for natural product structural elucidation, we have developed syntheses of the major PIM species found in the cell wall as well as simplified analogues that retain some aspects of their biological activities.^{1–8} More recently, we have reported the first total synthesis of a fully lipidated PIM, Ac₂PIM₂ **1**,⁹ that contains four fatty acid residues (Figure 1).

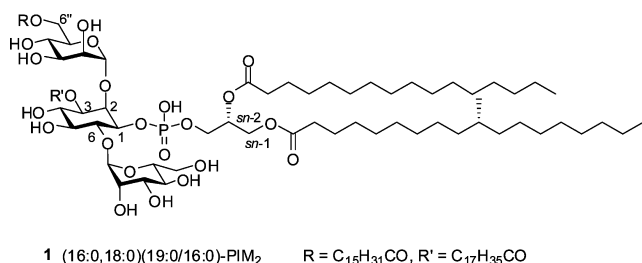


Figure 1. Ac₂PIM₂ **1**.

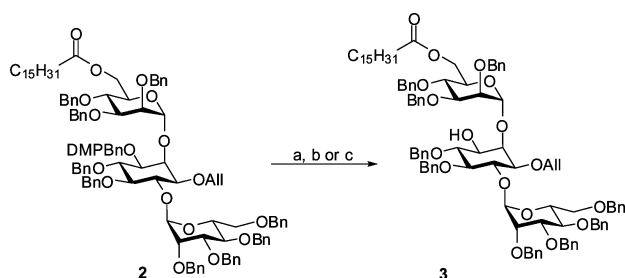
The synthesis of **1** required orthogonal protection of a *myo*-inositol intermediate that allowed sequential introduction of each of the mannose residues, the *O*-6'' fatty ester, the *O*-3 fatty ester, and finally the *O*-1 phosphatidyl group. The choice of protecting groups proved crucial. In the course of our work, we found that the lability of *p*-methoxybenzyl (PMB) ethers

was problematic; conditions required for glycosylation reactions resulted in the undesired removal of the PMB group. A similar hydrolysis has been observed by Seeberger et al., who used it to their advantage, in the synthesis of a fully lipidated GPI anchor of *T. gondii*.¹⁰ Our results prompted us to explore the use of the 4-(3,4-dimethoxyphenyl)benzyl (DMPBn) group, developed by the Seeberger group,¹¹ as a robust alternative to the PMB group for the protection of alcohols. They found that DMPBn ethers were as labile as PMB ethers when treated with DDQ but were more resistant to acid hydrolysis. Furthermore, oxidative removal of this group could be carried out selectively in the presence of ester, TBS, benzyl, and allyl protecting groups as exemplified using protected mono- and disaccharides.

Our strategy for the synthesis of Ac₂PIM₂ relied on the intermediacy of protected pseudotrisaccharide **2**.⁹ Unfortunately, removal of the DMPBn protecting group proved problematic. Using the reported reaction conditions of 3 equiv of DDQ in a 10:1 mixture of CH₂Cl₂ and water for 3 h, a complex mixture of products was formed (Scheme 1, TLC provided in Supporting Information). Mass spectral analyses of column fractions revealed that they contained **3** and compounds where the DMPBn group had been removed along with loss of some of the benzyl protecting groups. Seeberger et al. had noted that the DDQ-labile DMPBn group could not be removed selectively when operating on a hexasaccharide intermediate for the synthesis of a fully lipidated GPI anchor of *P. falciparum*.¹² Given our investment in preparing late-stage intermediate **2**, we investigated developing

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Scheme 1. Deprotection of Pseudotrisaccharide 2 Using DDQ^a

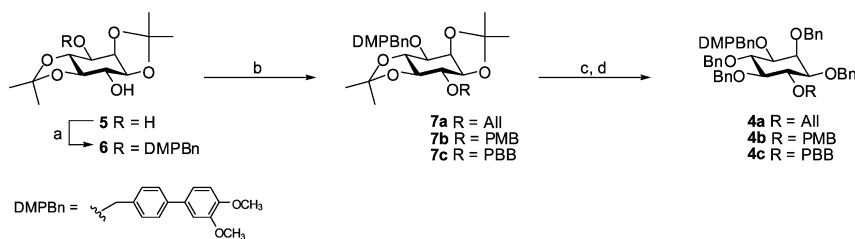
^aReagents and conditions: (a) DDQ (3 equiv), CH₂Cl₂/H₂O, 3 h; (b) DDQ (1.2 equiv), CH₂Cl₂/H₂O, 1 h; (c) DDQ (3 equiv), Mn(OAc)₃·H₂O (3 equiv), CH₂Cl₂/H₂O, 12 h.

reaction conditions for the selective deprotection of DMPBn ethers, thereby increasing the scope and utility of this protecting group.

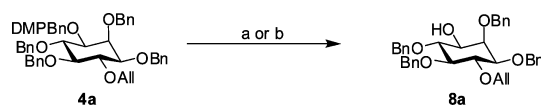
RESULTS AND DISCUSSION

We proposed to optimize the conditions required for the selective removal of the DMPBn protecting group using inositols 4a–c, prepared from bis-isopropylidene-*myo*-inositol 5^{13–15} (Scheme 2). DMPBn-protected inositol 6 was prepared by the selective alkylation of 5 with 4-(3,4-dimethoxyphenyl)-benzyl bromide in 85% yield. Allylation of DMPBn alcohol 6 furnished allyl ether 7a in 91% yield. Acidic cleavage of the isopropylidene groups and subsequent benzylation afforded model inositol 4a. PMB and PBB inositol ethers 4b and 4c were prepared using the same approach. Given literature precedence for the successful hydrolysis of DMPBn-protected monosaccharides,¹¹ 4a should undergo oxidative deprotection with minimal occurrence of side reactions.

Unexpectedly, reaction of 4a with 3 equiv of DDQ in a 10:1 mixture of CH₂Cl₂ and water for 3 h gave a complex mixture of products as determined by TLC and NMR analysis (Scheme 3a). Loss of benzyl groups was evident from the mass spectrum of the crude product. None of the starting material 4a remained, and the desired product 8a was isolated in 11% yield. Reducing the reaction time to 1 h showed an improvement, giving a 2.5:1 inseparable mixture of product to starting material along with decomposition products. Reducing the amount of DDQ to 1.2 equiv gave the best result with a 50% conversion of 4a into 8a with no evidence of decomposition products. Column chromatography of this reaction gave an 80% recovery of material containing a 1:1 inseparable mixture of 4a and 8a along with 4-(3,4-dimethoxyphenyl)benzaldehyde. Given the latter result, these reaction conditions were trialed

Scheme 2. Synthesis of Model Protected Inositols 4a–c^a

^aReagents and conditions: (a) DMPBnBr, NaH, THF, 85%; (b) for 7a, AllBr, NaH, DMF, 91%; for 7b, PMBCl, NaH, THF, 86%; for 7c, PBBBr, NaH, THF, 89%; (c) TFA, MeOH, CH₂Cl₂; (d) BnBr, NaH, DMF, for 7a, 45%; for 7b, 24%; for 7c, 74% (two steps).

Scheme 3. Deprotection of Model DMPBn-Protected Inositol 4a^a

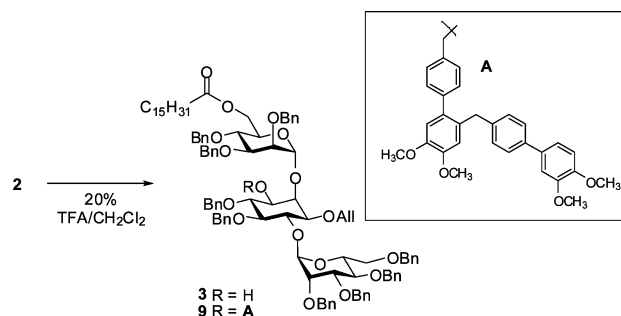
^aReagents and conditions: (a) DDQ, CH₂Cl₂/H₂O, 11%; (b) DDQ, Mn(OAc)₃·H₂O, CH₂Cl₂/H₂O.

with pseudotrisaccharide 2, but unexpectedly no reaction occurred.

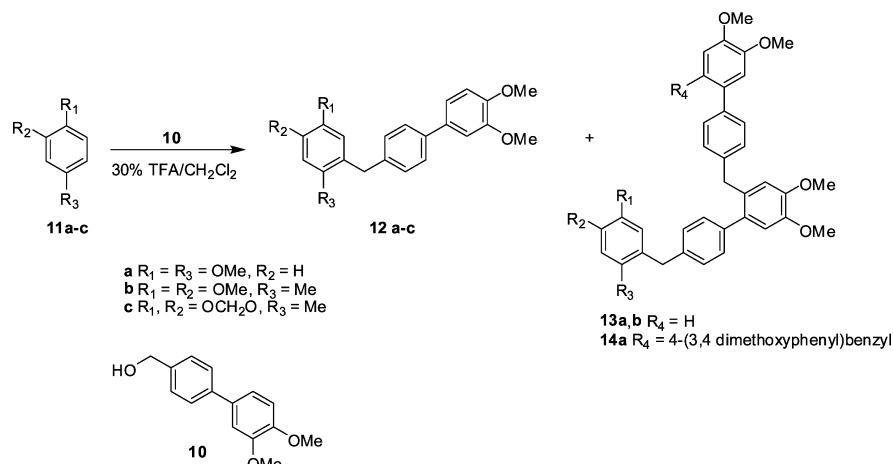
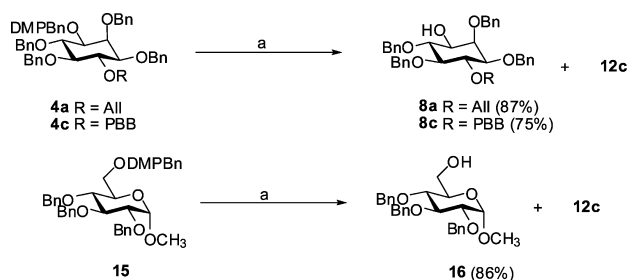
Sharma et al.¹⁶ have reported that Mn(OAc)₃ is a mild and efficient reagent for regenerating DDQ for the deprotection of PMB ethers. The use of this as a co-oxidant would minimize the amount of DDQH₂ present. Treatment of 4a with 0.1 equiv of DDQ and 3 equiv of Mn(OAc)₃ for 12 h resulted in a 30% conversion into 8a with no sign of byproduct formation (Scheme 3 reagents b). Increasing the amount of DDQ to 1 equiv cleanly gave an 80% conversion into 8a. Unfortunately, reaction of pseudotrisaccharide 2 under these conditions gave a complex mixture of products along with starting material.

Given the disappointing results using DDQ to deprotect DMPBn ethers, our attention turned to exploiting its acid lability. Treatment of 2 with 20% TFA in CH₂Cl₂ at room temperature for 1 h gave a mixture of products as shown by TLC (Scheme 4, TLC provided in Supporting Information)

Scheme 4. Deprotection of 2 Using 20% TFA for 1 h



and after column chromatography gave returned starting material 2 (18%) and the target pseudotrisaccharide 3 (58%), along with 10% of a higher molecular weight product 9 that resulted from the electrophilic addition of the released benzylic cation to the substituted dimethoxyphenyl moiety of 2 (Scheme 4). Mass spectra of the trace amounts of lower *R_f* products indicated that further substitution of the dimethoxyphenyl moiety had also occurred.

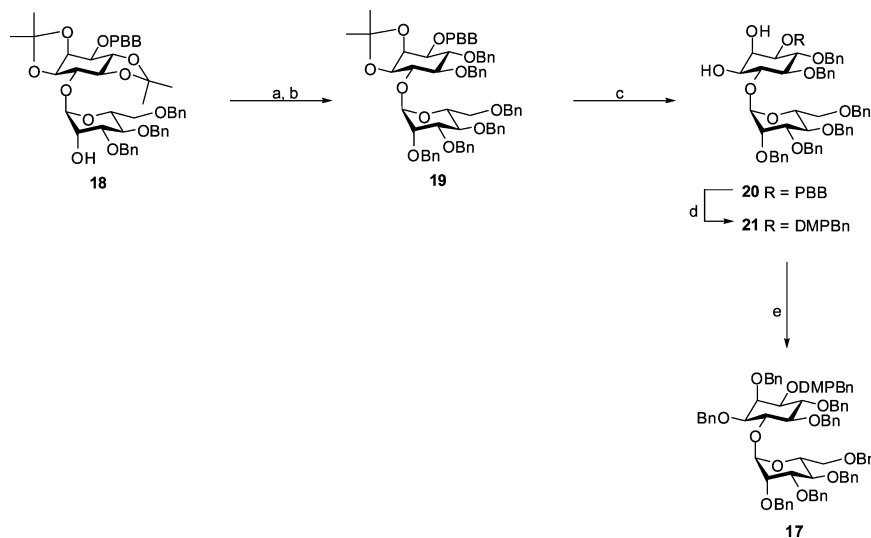
Scheme 5. Reactions of **10** with Cation Scavengers **11a–c** in 30% TFA in CH₂Cl₂Scheme 6. Deprotection of DMPBn Inositols **4a** and **4c** and Glucoside **15** Using 30% TFA for 1 h^a

^aReagents and conditions: (a) **11c** (5 equiv), 30% TFA/CH₂Cl₂.

The use of a cation scavenger such as anisole might circumvent this problem. However, we believed that the electron-rich benzyl-substituted dimethoxyphenyl moiety of the protecting group might still be a more effective cation trap. To test this, anisole was treated with 5 equiv of 4-(3,4-dimethoxyphenyl)benzyl alcohol (**10**)¹¹ in 30% TFA in

CH₂Cl₂. A complex mixture of products was produced where further substitution of the activated rings had occurred. Using the more electron-rich scavenger 1,4-dimethoxybenzene (**11a**) also gave a mixture of products from which **12a** (21%), **13a** (13%), and **14a** (3%) were isolated (Scheme 5). Given these results, scavengers with similar structural features to the activated ring of the DMPBn group were investigated. Under the same reaction conditions, 3,4-dimethoxytoluene (**11b**)¹⁷ gave mainly the monosubstituted adduct **12b** (85%) along with a small amount of the further substituted species **13b**. 3,4-Methylenedioxytoluene (**11c**)¹⁷ gave a single scavenged product **12c** in 93% yield.

The latter two results were pleasing, and the fact that only one product was formed when **11c** was used as the cation trap would facilitate isolation of deprotected DMPBn ethers. Reaction of **4a** with 30% TFA in CH₂Cl₂ and 5 equiv of **11c** cleanly afforded the deprotected material **8a** in 87% yield (Scheme 6). The scavenged product **12c** was isolated in near quantitative yield. In a similar fashion, PBB ether **4c** gave **8c** in 75% yield. Further examples were investigated and subjected to

Scheme 7. Synthesis of DMPBn Pseudodisaccharide **17**^a

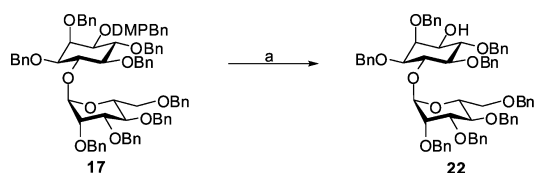
^aReagents and conditions: (a) TFA, H₂O, CH₂Cl₂, 0 °C, 2.5 h; (b) BnBr, NaH, DMF, 74%, two steps; (c) TFA, MeOH, CH₂Cl₂, 12 h, 85%; (d) K₃PO₄, Bu₄NBr, Pd(OAc)₂, 3,4-dimethoxyphenylboronic acid, EtOH, 69%; (e) BnBr, NaH, DMF, 80%.

these reaction conditions. DMPBn glucoside **15**¹¹ gave the desired deprotected derivative **16** (86%) and the scavenged product **12c** in quantitative yield.

DMPBn-protected pseudodisaccharide **17** was prepared in five steps using standard chemical transformations from **18**⁹ (Scheme 7). Selective hydrolysis of the trans-fused isopropylidene group and benzylation afforded **19**. Hydrolysis of the cis-fused isopropylidene group giving **20**, a Suzuki–Miyaura coupling of the PBB group with 3,4-dimethoxyphenylboronic acid to **21**, and benzylation of the remaining hydroxyl group gave the target compound **17**.

The reaction of pseudodisaccharide **17** with 30% TFA and scavenger **11c** in CH₂Cl₂ cleanly gave the selectively deprotected product **22** in 79% yield (Scheme 8).

Scheme 8. Deprotection of DMPBn Pseudodisaccharide **17** Using 30% TFA for 1 h^a



^aReagents and conditions: (a) **11c** (5 equiv), 30% TFA/CH₂Cl₂, **22** 79%, **12c** quant.

The compatibility of the DMPBn protecting group with allyl, PMB, and PBB ethers was examined (Scheme 9). The allyl protecting group of **4a** was selectively removed by treatment with hydrogen-activated iridium(I) catalyst **23** and subsequent treatment with methanolic HCl to give **24** in 63% yield. The PMB ether of **4b** was selectively hydrolyzed upon treatment with 1% TFA in CH₂Cl₂ and scavenger **11c**, providing inositol **24** in 77% yield and scavenged product **25** in quantitative yield. Deprotection of the PBB ether of **4c** was achieved using a palladium(0)-catalyzed amination with *N*-methylaniline followed by treatment with methanolic HCl which provided **24** in an unoptimized yield of 52%.

The ultimate test of this reagent system was for the removal of the DMPBn group on **2**. As reported in our previous paper,⁹ this reaction cleanly afforded the pseudotrisaccharide **3** in 74% yield.

CONCLUSION

We have developed an alternative method for the deprotection of DMPBn ethers, using anhydrous TFA in CH₂Cl₂ in the presence of either 3,4-dimethoxy- or 3,4-(methylenedioxy)-toluene as a cation scavenger. Allyl and benzyl ethers, esters, and glycosidic bonds were unaffected by this reagent system. Furthermore, we have demonstrated that allyl, PMB, and PBB

ethers can be selectively removed in the presence of the DMPBn group. This method, along with the use of either DDQ or a combination of DDQ and Mn(OAc)₃, increases the scope of the DMPBn protecting group in organic synthesis by providing an alternative to the acid-labile PMB protecting group.

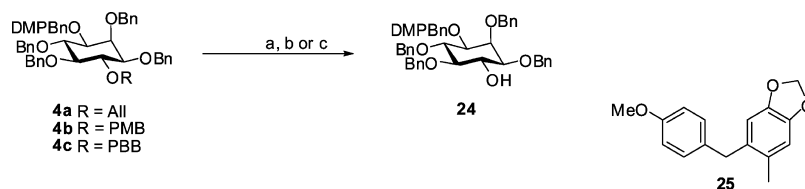
EXPERIMENTAL SECTION

¹H NMR spectra were obtained at 400 or 500 MHz and referenced to the residual solvent peak (¹H CHCl₃, δ 7.26 ppm). ¹³C NMR spectra were recorded at 125 MHz and referenced to the internal solvent (CDCl₃, δ 77.0 ppm). Electrospray ionization (ESI) mass spectra were recorded on a microTOF_Q mass spectrometer. Anhydrous solvents were sourced either commercially or from a solvent purification system and used without further treatment unless stated. Powdered molecular sieves were flame-dried under vacuum immediately prior to use. Flash column chromatography was carried out using 40–63 μm silica gel unless otherwise stated. All flash chromatography solvents were LR-grade. Petroleum ether with a bp range 60–80 °C was used. All compounds were isolated after silica gel column chromatography, and fractions collected were one spot by TLC. Thin layer chromatography (TLC) plates were visualized under an UV lamp and/or with a spray consisting of 5% w/v dodecamolybdophosphoric acid in ethanol with subsequent heating.

(±)-3-*O*-(4-(3,4-Dimethoxyphenyl)benzyl)-1,2,4,5-di-*O*-isopropylidene-*myo*-inositol (**6**). To a solution of diol **5**^{13–15} (3.05 g, 11.7 mmol) in dry THF (150 mL) were added NaH (60% dispersion in oil, 0.558 g, 23.26 mmol) and 4-(3,4-dimethoxyphenyl)benzyl bromide¹¹ (1.79 g, 5.81 mmol) and refluxed overnight under an atmosphere of nitrogen. The reaction mixture was quenched with H₂O (5 mL) and extracted into EtOAc (3 × 100 mL) and washed with H₂O (100 mL) and brine (100 mL). The organic extract was dried (MgSO₄) and filtered and the solvent removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 2:3 to 1:1) to give the title compound **6** as a white solid (2.41 g, 85%): mp 143–146 °C (EtOAc/PE); ν_{\max} (ATR-IR) 3519, 2985, 2934, 2888, 2832, 1603, 1590, 1525, 1464, 1465, 1399, 1371, 1242, 1215, 1168, 1140, 1120, 1073, 1046 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 1.36 (s, 3H), 1.47 (s, 3H), 1.50 (s, 3H), 1.55 (s, 3H), 2.55 (d, *J* = 2.6 Hz, 1H), 3.28 (dd, *J* = 9.4, 10.5 Hz, 1H), 3.83 (dd, *J* = 4.2, 10.1 Hz, 1H), 3.88–3.96 (m, 2H), 3.92 (s, 3H), 3.95 (s, 3H), 4.06 (t, *J* = 9.7 Hz, 1H), 4.35 (t, *J* = 4.5 Hz, 1H), 4.83 (d, *J* = 12.6 Hz, 1H), 4.93 (d, *J* = 12.5 Hz, 1H), 6.95 (d, *J* = 8.3 Hz, 1H), 7.10 (d, *J* = 2.1 Hz, 1H), 7.15 (dd, *J* = 2.1, 8.3 Hz, 1H), 7.47 (d, *J* = 8.2 Hz, 2H), 7.55 (d, *J* = 8.3 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 26.0, 27.02, 27.06, 28.3, 56.02, 56.06, 71.6, 74.4, 74.6, 76.7, 77.4, 78.4, 81.7, 110.3, 110.5, 111.6, 112.6, 119.4, 126.9, 128.9, 133.9, 136.4, 140.8, 148.8, 149.3; HRMS-ESI [*M* + Na]⁺ Calcd for C₂₇H₃₄NaO₈: 509.2146. Found: 509.2163. Anal. Calcd for C₂₇H₃₄O₈: C, 66.65; H, 7.04. Found: C, 66.41; H, 7.22.

(±)-6-*O*-Allyl-3-*O*-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-di-*O*-isopropylidene-*myo*-inositol (**7a**). To a solution of alcohol **6** (1.400 g, 2.87 mmol) in anhydrous DMF (20 mL) were added NaH (60% dispersion in oil, 0.138 g, 5.75 mmol) and allyl bromide (0.50 mL, 5.75 mmol) at 0 °C, and the reaction mixture was stirred overnight. The reaction was quenched with H₂O and extracted into

Scheme 9. Selective Deprotections of **4a–c** in the Presence of a DMPBn Ether^a



^aReagents and conditions: (a) for **4a**, (COD)(MePh₂P)₂Ir⁺PF₆⁻ (**23**), H₂, THF, and then AcCl, MeOH/CH₂Cl₂ (63%); (b) for **4b**, 1% TFA in CH₂Cl₂, **11c**, 1 h (77%); (c) for **4c**, MeNHC₃H₄N, (*o*-biphenyl)P(*t*-Bu)₂, Pd₂dba₃, NaOt-Bu, toluene (52%).

CH₂Cl₂ (3 × 50 mL). The combined organic layers were washed with H₂O (50 mL) and brine (50 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:2) to give the title compound **7a** (1.38 g, 91%) as a white solid: mp 123–126 °C (EtOAc/PE); ν_{\max} (ATR-IR) 2991, 2932, 2882, 2837, 1603, 1590, 1525, 1504, 1455, 1417, 1397, 1374, 1329, 1279, 1239, 1214, 1168, 1157, 1138, 1122, 1085, 1070, 1055 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 1.35 (s, 3H), 1.46 (s, 3H), 1.49 (s, 3H), 1.55 (s, 3H), 3.30 (dd, *J* = 9.4, 10.6 Hz, 1H), 3.66 (dd, *J* = 6.5, 10.7 Hz, 1H), 3.78 (dd, *J* = 4.2, 10.1 Hz, 1H), 3.93 (s, 3H), 3.95 (s, 3H), 4.01–4.08 (m, 2H), 4.27 (dt, *J* = 1.4, 5.7 Hz, 2H), 4.34 (t, *J* = 4.6 Hz, 1H), 4.83 (d, *J* = 12.6 Hz, 1H), 4.93 (d, *J* = 12.7 Hz, 1H), 5.18 (dq, *J* = 10.4, 1.4 Hz, 1H), 5.31 (dq, *J* = 17.1, 1.6 Hz, 1H), 5.94 (dddd, *J* = 5.7, 5.7, 10.4, 17.3 Hz, 1H), 6.95 (d, *J* = 8.3 Hz, 1H), 7.10 (d, *J* = 2.1 Hz, 1H), 7.15 (dd, *J* = 2.2, 8.2 Hz, 1H), 7.47 (d, *J* = 8.3 Hz, 2H), 7.55 (d, *J* = 8.3 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 26.0, 27.09, 27.13, 28.1, 56.02, 56.06, 71.3, 71.6, 74.4, 76.9, 77.2, 78.7, 80.1, 81.4, 110.0, 110.5, 111.6, 112.2, 117.4, 119.4, 126.9, 128.9, 133.9, 134.8, 136.5, 140.7, 148.8, 149.2; HRMS-ESI [M + Na]⁺ Calcd for C₃₀H₃₈NaO₈: 549.2459. Found: 549.2491.

(±)-6-O-Allyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-tetra-O-benzyl-myo-inositol (4a). To a solution of allyl ether **7a** (0.708 g, 1.34 mmol) in CH₂Cl₂ (10 mL) were added MeOH (0.136 mL, 3.36 mmol) and TFA (0.518 mL, 6.72 mmol), and the reaction mixture was stirred at rt overnight. The solvent was evaporated under reduced pressure to afford (±)-6-O-allyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-myo-inositol (0.60 g) as a white foam which was used without further purification. HRMS-ESI [M + Na]⁺ Calcd for C₂₄H₃₀O₈Na: 469.1833. Found: 469.1826. NaH (0.322 g, 60% dispersion in oil, 13.4 mmol) was added to a stirred solution of crude tetraol (0.60 g, 1.34 mmol) and BnBr (1.28 mL, 10.8 mmol) in dry DMF (10 mL) at 0 °C. The reaction was left to warm to rt and stirred overnight. Excess NaH was quenched with MeOH (2 mL), and the solvent was removed in vacuo. The residue was extracted into CH₂Cl₂ (3 × 50 mL), and the combined organic layers were washed with H₂O (3 × 25 mL) and brine (25 mL) and dried (MgSO₄). The solution was filtered and the solvent removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 1:2) to give the title compound **4a** (0.492 g, 45%) as a white solid: mp 132–136 °C (EtOAc/PE); ν_{\max} (ATR-IR) 3087, 3062, 3028, 2923, 2882, 1603, 1589, 1566, 1504, 1453, 1396, 1359, 1326, 1275, 1256, 1217, 1172, 1134, 1086, 1066, 1024 cm⁻¹; ¹H NMR (500 MHz, CDCl₃) δ 3.31 (dd, *J* = 2.2, 9.9 Hz, 1H), 3.37 (dd, *J* = 2.3, 9.8 Hz, 1H), 3.44 (t, *J* = 9.3 Hz, 1H), 3.93–3.98 (m, 1H), 3.94 (s, 3H), 3.96 (s, 3H), 4.04–4.08 (m, 2H), 4.33 (ddt, *J* = 1.1, 5.7, 12.3 Hz, 1H), 4.41 (ddt, *J* = 1.3, 5.9, 12.2 Hz, 1H), 4.60 (d, *J* = 11.8 Hz, 1H), 4.62–4.71 (m, 3H), 4.81–4.90 (m, 5H), 4.93 (d, *J* = 10.8 Hz, 1H), 5.15 (dq, *J* = 10.3, 1.4 Hz, 1H), 5.27 (dq, *J* = 17.2, 1.6 Hz, 1H), 5.98 (dddd, *J* = 5.8, 5.8, 10.4, 17.1 Hz, 1H), 6.95 (d, *J* = 8.3 Hz, 1H), 7.11 (d, *J* = 2.1 Hz, 1H), 7.16 (dd, *J* = 2.1, 8.3 Hz, 1H), 7.26–7.38 (m, 20H), 7.40–7.42 (m, 2H), 7.49–7.52 (m, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 56.04, 56.08, 72.5, 72.9, 74.2, 74.6, 74.7, 75.9, 76.0, 80.90, 80.94, 81.5, 81.7, 83.8, 110.5, 111.6, 116.7, 119.4, 126.9, 127.0, 127.4, 127.54, 127.55, 127.58, 127.62, 127.8, 128.0, 128.10, 128.12, 128.2, 128.37, 128.39, 128.4, 128.6, 134.0, 135.5, 137.1, 138.6, 138.9, 139.0, 139.1, 140.42, 148.7, 149.3; HRMS-ESI [M + Na]⁺ Calcd for C₅₂H₅₄NaO₈: 829.3711. Found: 829.3680.

(±)-6-O-p-Methoxybenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-di-O-isopropylidene-myo-inositol (7b). To a solution of alcohol **6** (134 mg, 0.275 mmol) and 4-methoxybenzyl chloride (110 μ L, 0.811 mmol) in anhydrous THF (5 mL) was added NaH (60% dispersion in oil, 33 mg, 0.826 mmol), and the mixture was refluxed for 1 h and then stirred at rt overnight. The reaction was quenched with water (30 mL), and the product was extracted into CH₂Cl₂ (3 × 30 mL). The combined organic layers were washed with brine (30 mL) and dried (MgSO₄), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound **7b** (144 mg, 86%) as a white solid: mp 122–124 (EtOAc/PE); ν_{\max}

(ATR-IR) 2982, 2931, 2904, 2836, 1611, 1588, 1566, 1504, 1455, 1399, 1372, 1327, 1302, 1242, 1216, 1170, 1142, 1082, 1055, 1023; ¹H NMR (500 MHz, CDCl₃) δ 1.34 (s, 3H), 1.41 (s, 3H), 1.47 (s, 3H), 1.51 (s, 3H), 3.34 (dd, *J* = 9.5, 10.4 Hz, 1H), 3.67 (dd, *J* = 6.5, 10.6 Hz, 1H), 3.79 (s, 3H), 3.77–3.81 (m, 1H), 3.92 (s, 3H), 3.95 (s, 3H), 4.03 (t, *J* = 9.8 Hz, 1H), 4.05 (dd, *J* = 5.1, 6.4 Hz, 1H), 4.33 (t, *J* = 4.6 Hz, 1H), 4.74 (app s, 2H), 4.85 (d, *J* = 12.6 Hz, 1H), 4.92 (d, *J* = 12.6 Hz, 1H), 6.86 (d, *J* = 8.7 Hz, 2H), 6.95 (d, *J* = 8.3 Hz, 1H), 7.10 (d, *J* = 2.0 Hz, 1H), 7.14 (dd, *J* = 8.3, 2.1 Hz, 1H), 7.32 (d, *J* = 8.6 Hz, 2H), 7.47 (d, *J* = 8.1 Hz, 2H), 7.54 (d, *J* = 8.2 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 25.9, 27.0, 27.1, 27.9, 55.2, 55.92, 55.96, 71.5, 71.6, 74.3, 76.7, 77.2, 78.8, 79.5, 81.12, 109.9, 110.4, 111.5, 112.1, 113.6, 119.3, 126.8, 128.8, 129.6, 130.3, 133.8, 138.5, 140.6, 148.7, 149.2, 159.1; HRMS-ESI [M + Na]⁺ Calcd for C₃₅H₄₂O₉Na: 629.2721. Found: 629.2730.

(±)-6-O-p-Methoxybenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-tetra-O-benzyl-myo-inositol (4b). Methanol (40 μ L, 0.988 mmol) and TFA (26 μ L, 0.337 mmol) were added to a solution of the *p*-methoxybenzyl ether **7b** (148 mg, 0.244 mmol) in CH₂Cl₂ (8 mL), and the mixture was stirred at rt for 7 days. The solvent was removed in vacuo, the residue was dissolved in CH₂Cl₂ (30 mL), washed with water (30 mL), NaHCO₃ (30 mL), and brine (30 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (MeOH/CHCl₃ = 1:9) to give (±)-6-O-*p*-methoxybenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-myo-inositol (53 mg) as a slightly impure white solid. HRMS-ESI [M + Na]⁺ Calcd for C₂₉H₃₄O₈Na: 549.2095. Found: 549.2114. Anhydrous DMF (5 mL) and BnBr (230 μ L, 1.95 mmol) were added and the mixture cooled to 0 °C under argon. NaH (98 mg, 2.44 mmol, 60% dispersion in oil) was added with stirring, and the reaction was warmed to rt overnight. Excess NaH was quenched by the addition of H₂O (30 mL) and the mixture extracted with CH₂Cl₂ (3 × 30 mL). The combined organic layers were washed with NaHCO₃ (30 mL) and brine (30 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound **4b** (51 mg, 24%) as a white solid: mp 129–133 °C (EtOAc/PE); ν_{\max} (ATR-IR) 3025, 2932, 1730, 1611, 1588, 1503, 1454, 1400, 1360, 1327, 1302, 1247, 1217, 1171, 1141, 1071, 1027; ¹H NMR (500 MHz, CDCl₃) δ 3.28–3.33 (m, 2H), 3.41 (t, *J* = 9.3 Hz, 1H), 3.71 (s, 3H), 3.87 (s, 3H), 3.89 (s, 3H), 3.99–4.05 (m, 3H), 4.54–4.63 (m, 4H), 4.70 (d, *J* = 10.3 Hz, 1H), 4.76–4.88 (m, 7H), 6.73 (d, *J* = 8.4 Hz, 2H), 6.89 (d, *J* = 8.3 Hz, 1H), 7.04 (d, *J* = 2.0 Hz, 1H), 7.08 (d, *J* = 2.1 Hz, 1H), 7.10 (d, *J* = 1.7 Hz, 1H), 7.13 (d, *J* = 8.5 Hz, 2H), 7.19–7.38 (m, 21H), 7.44 (d, *J* = 8.0 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 55.2, 55.95, 55.99, 72.4, 72.8, 74.1, 74.4, 75.5, 75.9, 80.9, 81.0, 81.7, 83.7, 110.4, 110.5, 113.7, 119.3, 126.8, 127.4, 127.5, 127.7, 127.8, 128.01, 128.07, 128.14, 128.29, 128.31, 128.35, 129.7, 131.0, 133.9, 137.0, 138.4, 138.85, 138.9, 140.0, 140.4, 148.7, 149.2, 150.1; HRMS-ESI [M + Na]⁺ Calcd for C₅₇H₅₈O₉Na: 909.3973. Found: 909.3943.

(±)-6-O-p-Bromobenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-di-O-isopropylidene-myo-inositol (7c). NaH (60% dispersion in oil, 49 mg, 1.23 mmol) was added to a stirred solution of inositol **6** (155 mg, 0.319 mmol) and 4-bromobenzyl bromide (159 mg, 0.637 mmol) in anhydrous THF (5 mL) under argon. The reaction mixture was allowed to warm to rt and then heated at reflux for 30 min. The reaction was quenched with water (30 mL), and the product extracted into CH₂Cl₂ (3 × 30 mL). The combined organic layers were washed with brine (30 mL) and dried (MgSO₄), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound **7c** (186 mg, 89%) as a white solid: mp 140–143 °C (EtOAc/PE); ν_{\max} (ATR-IR) 2987, 2933, 1590, 1566, 1527, 1503, 1488, 1454, 1399, 1372, 1327, 1302, 1421, 1216, 1169, 1141, 1083, 1056, 1025, 1011; ¹H NMR (500 MHz, CDCl₃) δ 1.34 (s, 3H), 1.42 (s, 3H), 1.47 (s, 3H), 1.49 (s, 3H), 3.34 (dd, *J* = 10.5, 9.5 Hz, 1H), 3.64 (dd, *J* = 10.6, 6.5 Hz, 1H), 3.79 (dd, *J* = 10.2, 4.2 Hz, 1H), 3.93 (s, 3H), 3.95 (s, 3H), 4.01–4.07 (m, 2H), 4.34 (dd, *J* = 4.8, 4.3 Hz, 1H), 4.76 (app s, 2H), 4.83 (d, *J* = 12.6 Hz,

1H), 4.92 (d, $J = 12.6$ Hz, 1H), 6.95 (d, $J = 8.3$ Hz, 1H), 7.10 (d, $J = 2.1$ Hz, 1H), 7.15 (dd, $J = 9.0, 2.9$ Hz, 1H), 7.26 (d, $J = 8.4$ Hz, 2H), 7.44 (d, $J = 8.4$ Hz, 2H), 7.47 (d, $J = 8.1$ Hz, 2H), 7.54 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ 25.9, 27.0, 27.1, 28.0, 55.95, 55.99, 71.2, 71.5, 74.2, 76.8, 77.2, 78.7, 80.2, 81.1, 110.0, 110.4, 111.5, 112.2, 119.4, 121.3, 126.8, 128.8, 129.5, 131.3, 133.8, 136.4, 137.3, 140.7, 148.7, 149.2; HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{34}\text{H}_{39}^{81}\text{BrO}_8\text{Na}$: 679.1670. Found: 679.1702.

(±)-6-O-*p*-Bromobenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-1,2,4,5-tetra-O-benzyl-myoinositol (4c). MeOH (24 μL , 0.60 mmol) and TFA (56 μL , 0.73 mmol) were added to a solution of inositol 7c (157 mg, 0.239 mmol) in CH_2Cl_2 (4 mL), and the reaction mixture was stirred at rt overnight. The solvent was removed in vacuo to give (±)-6-O-*p*-bromobenzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-myoinositol as a white solid which was used without further purification. HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{28}\text{H}_{31}^{79}\text{BrO}_8\text{Na}$: 597.1095. Found: 597.1093. Anhydrous DMF (5 mL) and BnBr (230 μL , 1.93 mmol) were added, and the solution was cooled to 0 °C under argon. NaH (60% dispersion in oil, 96 mg, 2.40 mmol) was added, and the reaction was left to warm to rt overnight with stirring. Excess NaH was quenched by the addition of water (50 mL). The reaction mixture was extracted into CH_2Cl_2 (3 \times 30 mL), the combined organic layers were washed with brine (50 mL) and dried (MgSO_4), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound 4c (166 mg, 74%) as a white solid: mp 154–157 °C (EtOAc/PE); ν_{max} (ATR-IR) 3029, 2918, 1590, 1529, 1505, 1453, 1395, 1359, 1328, 1275, 1256, 1217, 1172, 1134, 1088, 1067, 1036, 1024; ^1H NMR (500 MHz, CDCl_3) δ 3.38 (dd, $J = 9.9, 2.2$ Hz, 1H), 3.41 (dd, $J = 9.8, 2.2$ Hz, 1H), 3.49 (t, $J = 9.3$ Hz, 1H), 3.95 (s, 3H), 3.97 (s, 3H), 4.06–4.14 (m, 3H), 4.62 (app s, 2H), 4.67 (d, $J = 11.8$ Hz, 1H), 4.71 (d, $J = 11.8$ Hz, 1H), 4.77 (d, $J = 11.2$ Hz, 1H), 4.83–4.94 (m, 6H), 4.97 (d, $J = 10.7$ Hz, 1H), 6.98 (d, $J = 8.4$ Hz, 1H), 7.13–7.15 (m, 3H), 7.18 (dd, $J = 8.3, 2.1$ Hz, 1H), 7.27–7.45 (m, 24H), 7.53 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ 55.9, 56.0, 72.5, 72.7, 74.16, 74.22, 74.8, 75.83, 75.84, 80.85, 80.88, 81.5, 81.7, 83.6, 110.4, 111.5, 119.3, 121.3, 126.8, 127.4, 127.5, 127.6, 127.7, 128.0, 128.2, 128.29, 128.32, 128.36, 129.6, 131.3, 133.8, 136.9, 137.9, 138.2, 138.7, 138.78, 138.89, 140.9, 148.7, 149.2; HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{56}\text{H}_{55}^{81}\text{BrO}_8\text{Na}$: 959.2924. Found: 959.2957.

(±)-6-O-Allyl-1,2,4,5-tetra-O-benzyl-myoinositol (8a). Method 1. DDQ (0.042 g, 0.186 mmol) was added to a solution of 4a (0.05 g, 0.062 mmol) in $\text{CH}_2\text{Cl}_2/\text{H}_2\text{O}$ (10:1, 1.1 mL) at rt. After 3 h, the reaction mixture was diluted with CH_2Cl_2 (40 mL) and washed with a freshly prepared aqueous solution of sodium ascorbate (1 mol L^{-1} , 20 mL) to remove excess DDQ. The aqueous solution was re-extracted with CH_2Cl_2 (3 \times 10 mL), and the combined organic fractions were washed with NaHCO_3 (30 mL) and brine (30 mL) and dried (MgSO_4). The solution was filtered and the solvent removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:2 to 1:1) to give the title compound 8a (4 mg, 11%) as a colorless oil.

Method 2. To a solution of 4a (0.030 g, 0.037 mmol) and scavenger 11c (0.025 g, 0.186 mmol) in CH_2Cl_2 (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (40 mL) and extracted into CH_2Cl_2 (3 \times 20 mL). The combined organic layers were washed with NaHCO_3 (20 mL), H_2O (20 mL), and brine (20 mL), dried (MgSO_4), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4) to give 6-(4-(3,4-dimethoxyphenyl)benzyl)-3,4-(methylenedioxy)-toluene (12c) (0.016 g, quant, $R_f = 0.60$, EtOAc/petroleum ether 1:2) and the title compound 8a (0.019 g, 87%, $R_f = 0.55$, EtOAc/petroleum ether 1:2) both as colorless oils. Data for 8a: ^1H NMR (500 MHz, CDCl_3) δ 2.19 (brs, 1H), 3.38–3.46 (m, 2H), 3.48 (dd, $J = 2.1, 9.7$ Hz, 1H), 3.77 (t, $J = 9.4$ Hz, 1H), 3.92 (t, $J = 9.5$ Hz, 1H), 4.01 (t, $J = 2.4$ Hz, 1H), 4.34 (ddt, $J = 1.3, 5.7, 12.1$ Hz, 1H), 4.43 (ddt, $J = 1.3, 5.8, 12.2$ Hz, 1H), 4.66–4.78 (m, 4H), 4.82 (d, $J = 10.6$ Hz, 1H), 4.89 (d, $J = 11.2$ Hz, 1H), 4.92 (d, $J = 10.7$ Hz, 1H), 4.97 (d, $J = 11.5$ Hz,

1H), 5.16 (dq, $J = 10.5, 1.2$ Hz, 1H), 5.29 (dq, $J = 17.2, 1.6$ Hz, 1H), 5.99 (dddd, $J = 5.7, 5.7, 10.5, 16.2$ Hz, 1H), 7.28–7.38 (m, 20H); ^{13}C NMR (125 MHz, CDCl_3) δ 72.4, 73.1, 74.7, 74.8, 75.6, 75.9, 77.3, 81.0, 81.7, 82.2, 83.6, 116.7, 127.61, 127.63, 127.69, 127.7, 127.8, 128.07, 128.1, 128.4, 128.45, 128.47, 128.5, 135.4, 138.4, 138.68, 138.69, 138.8; HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{37}\text{H}_{40}\text{NaO}_6$: 603.2723. Found: 603.2724.

Data for 12c: ν_{max} (ATR-IR) 2997, 2920, 2850, 1601, 1588, 1530, 1500, 1485, 1467, 1399, 1353, 1312, 1274, 1252, 1217, 1195, 1170, 1148, 1122 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 2.21 (s, 3H), 3.92 (s, 5H), 3.94 (s, 3H), 5.90 (s, 2H), 6.64 (s, 1H), 6.68 (s, 1H), 6.94 (d, $J = 8.3$ Hz, 1H), 7.09 (d, $J = 2.0$ Hz, 1H), 7.12 (dd, $J = 2.1, 8.3$ Hz, 1H), 7.17 (d, $J = 8.2$ Hz, 2H), 7.47 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ 19.7, 38.8, 55.98, 56.03, 100.7, 110.3, 110.4, 110.5, 111.5, 119.3, 126.9, 129.0, 129.5, 131.8, 134.1, 138.8, 139.3, 145.7, 145.9, 148.5, 149.2; HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{23}\text{H}_{22}\text{NaO}_4$: 385.1416. Found: 385.1414.

(±)-6-O-*p*-Bromobenzyl-1,2,4,5-tetra-O-benzyl-myoinositol (8c). TFA (1.5 mL) was added to a solution of 4c (30 mg, 0.032 mmol) and 11c (43 mg, 0.316 mmol) in CH_2Cl_2 (3.5 mL), and the mixture was stirred at rt for 1 h. The solvent was removed in vacuo, the residue was redissolved in CH_2Cl_2 (30 mL), washed with water (30 mL), NaHCO_3 (30 mL), and brine (30 mL), and dried (MgSO_4), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 1:3) to give 12c (10 mg, 86%, $R_f = 0.60$, EtOAc/petroleum ether 1:2) and the title compound 8c (17 mg, 75%, $R_f = 0.55$ EtOAc/petroleum ether 1:2) both as colorless oils. Data for 8c: ν_{max} (ATR-IR) 3553, 2918, 2868, 1496, 1488, 1454, 1392, 1360, 1307, 1208, 1129, 1069, 1027, 1012; ^1H NMR (500 MHz, CDCl_3) δ 2.20 (d, $J = 6.3$ Hz, 1H), 3.43–3.51 (m, 3H), 3.80 (t, $J = 9.5$ Hz, 1H), 4.02 (t, $J = 9.6$ Hz, 1H), 4.04 (t, $J = 2.6$ Hz, 1H), 4.64 (d, $J = 11.7$ Hz, 1H), 4.68 (d, $J = 11.7$ Hz, 1H), 4.72 (d, $J = 11.5$ Hz, 1H), 4.76 (d, $J = 11.1$ Hz, 1H), 4.76 (d, $J = 11.1$ Hz, 1H), 4.85 (app s, 2H), 4.86 (d, $J = 11.4$ Hz, 1H), 4.88 (d, $J = 11.1$ Hz, 1H), 4.97 (d, $J = 11.5$ Hz, 1H), 7.13 (d, $J = 8.4$ Hz, 2H), 7.26–7.36 (m, 23H), 7.38 (d, $J = 8.4$ Hz, 2H); ^{13}C NMR (125 MHz, CDCl_3) δ 72.4, 72.9, 74.8, 74.9, 75.5, 75.7, 81.0, 81.7, 82.1, 83.5, 121.4, 121.57, 127.61, 127.64, 127.68, 127.76, 127.77, 127.81, 128.1, 128.35, 128.4, 128.45, 128.5, 129.6, 131.4, 137.7, 138.1, 138.51, 138.53, 138.6; HRMS-ESI $[\text{M} + \text{Na}]^+$ Calcd for $\text{C}_{41}\text{H}_{41}^{79}\text{BrO}_6\text{Na}$: 731.1979. Found: 731.1928.

1-O-Allyl-4,5-di-O-benzyl-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-2-O-(2,3,4-tri-O-benzyl-6-O-palmitoyl- α -D-mannopyranosyl)-D-myoinositol (3)⁹ and 1-O-Allyl-4,5-di-O-benzyl-3-O-(4-(3,4-dimethoxy-(6-(4-(3,4-dimethoxyphenyl)benzyl)phenyl)benzyl)-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-2-O-(2,3,4-tri-O-benzyl-6-O-palmitoyl- α -D-mannopyranosyl)-D-myoinositol (9). To a solution of 2⁹ (0.085 g, 0.047 mmol) in CH_2Cl_2 (2.4 mL) was added TFA (0.6 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (50 mL) and extracted into CH_2Cl_2 (3 \times 30 mL). The combined organic layers were washed with NaHCO_3 (20 mL), H_2O (20 mL), and brine (20 mL), dried (MgSO_4), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 1:2) to give the title compound 3⁹ (0.043 g, 58%, $R_f = 0.52$, EtOAc/petroleum ether 1:2) and the title compound 9 (0.009 g, 10%, $R_f = 0.37$, EtOAc/petroleum ether 1:2) both as colorless oils. Data for 9: $[\alpha]_{\text{D}}^{25} +25.4$ ($c = 0.95$, CHCl_3); ν_{max} (ATR-IR) 3063, 3029, 2922, 2852, 1732, 1604, 1587, 1524, 1453, 1358, 1248, 1210, 1071, 1090, 1026 cm^{-1} ; ^1H NMR (500 MHz, CDCl_3) δ 0.88 (t, $J = 6.9$ Hz, 3H), 1.17–1.27 (m, 24H), 1.51–1.59 (m, 2H), 2.22 (t, $J = 7.6$ Hz, 2H), 3.19 (dd, $J = 1.5, 9.7$ Hz, 1H), 3.24–3.29 (m, 2H), 3.33 (dd, $J = 2.3, 10.0$ Hz, 1H), 3.38 (dd, $J = 2.7, 11.1$ Hz, 1H), 3.78–4.05 (m, 13H), 3.84 (s, 3H), 3.88 (s, 3H), 3.898 (s, 3H), 3.905 (s, 3H), 4.15–4.23 (m, 3H), 4.33–4.34 (m, 1H), 4.45–4.93 (m, 20H), 5.09 (dd, $J = 10.4, 1.1$ Hz, 1H), 5.21 (dd, $J = 17.2, 1.4$ Hz, 1H), 5.21 (d, $J = 0.9$ Hz, 1H), 5.53 (d, $J = 1.3$ Hz, 1H), 5.72 (dddd, $J = 5.5, 5.5, 10.7, 17.1$ Hz, 1H), 6.73 (s, 1H), 6.84 (s, 1H), 6.90 (d, $J = 8.3$ Hz, 1H), 7.04–7.42 (m, 55H); ^{13}C NMR (125 MHz, CDCl_3) δ 14.2, 22.8, 24.9, 29.3, 29.35, 29.43, 29.6, 29.7, 29.73, 29.74,

29.8, 32.0, 34.2, 38.2, 55.98, 56.04, 56.07, 56.09, 62.9, 68.6, 70.2, 71.2, 71.3, 71.5, 71.97, 72.01, 72.3, 72.5, 73.3, 74.0, 74.5, 74.8, 75.0, 75.3, 75.7, 75.8, 75.9, 76.1, 78.76, 78.84, 80.3, 81.4, 81.5, 81.8, 98.75, 98.83, 110.4, 111.5, 113.3, 113.4, 117.9, 119.2, 126.8, 127.0, 127.30, 127.32, 127.4, 127.48, 127.5, 127.51, 127.56, 127.6, 127.63, 127.72, 127.76, 127.77, 127.9, 128.0, 128.09, 128.14, 128.17, 128.22, 128.25, 128.26, 128.31, 128.34, 128.37, 128.41, 128.6, 129.1, 129.6, 130.1, 133.9, 134.1, 134.4, 136.3, 138.0, 138.2, 138.3, 138.4, 138.5, 138.6, 138.76, 138.82, 139.1, 140.6, 141.0, 147.3, 148.4, 148.5, 149.2, 173.6; HRMS-ESI $[M + Na]^+$ Calcd for $C_{130}H_{148}NaO_{21}$: 2068.0405. Found: 2068.0367.

Reaction of 4-(3,4-dimethoxyphenyl)benzyl Alcohol (10) with 1,4-Dimethoxybenzene (11a). To a solution of alcohol **10**¹¹ (0.050 g, 0.205 mmol) and 1,4-dimethoxybenzene (**11a**) (0.141 g, 1.023 mmol) in CH_2Cl_2 (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (40 mL) and extracted into CH_2Cl_2 (3×20 mL). The combined organic layers were washed with $NaHCO_3$ (20 mL), H_2O (20 mL), and brine (20 mL), dried ($MgSO_4$), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4 to 1:2) to give 3-(4-(3,4-dimethoxyphenyl)benzyl)-1,4-dimethoxybenzene (**12a**) (0.015 g, 21%, $R_f = 0.76$, EtOAc/petroleum ether 1:1), 3-(4-(3,4-dimethoxy-6-(4-(3,4-dimethoxyphenyl)benzyl))phenyl)benzyl)-1,4-dimethoxybenzene (**13a**) (0.016 g, 13%, $R_f = 0.63$, EtOAc/petroleum ether 1:1) and 3-(4-(3,4-dimethoxy-6-(4-(3,4-dimethoxy-6-(4-(3,4-dimethoxyphenyl)benzyl))phenyl)benzyl))phenyl)benzyl)-1,4-dimethoxybenzene (**14a**) (0.005 g, 3%, $R_f = 0.34$, EtOAc/petroleum ether 1:1) all as colorless oils. Data for **12a**: 1H NMR (500 MHz, $CDCl_3$) δ 3.74 (s, 3H), 3.80 (s, 3H), 3.92 (s, 3H), 3.94 (s, 3H), 3.98 (s, 2H), 6.70 (d, $J = 3.0$ Hz, 1H), 6.73 (dd, $J = 3.1, 8.7$ Hz, 1H), 6.81 (d, $J = 8.7$ Hz, 1H), 6.93 (d, $J = 8.3$ Hz, 1H), 7.09 (d, $J = 2.1$ Hz, 1H), 7.12 (dd, $J = 2.1, 8.3$ Hz, 1H), 7.27 (d, $J = 8.4$ Hz, 2H), 7.46 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 35.7, 55.7, 55.97, 56.0, 56.1, 110.5, 111.3, 111.48, 111.52, 117.0, 119.3, 126.8, 129.4, 130.9, 134.3, 138.7, 139.5, 148.5, 149.1, 151.7, 153.6; HRMS-ESI $[M + H]^+$ Calcd for $C_{23}H_{25}O_4$: 365.1753. Found: 365.1756.

Data for **13a**: 1H NMR (500 MHz, $CDCl_3$) δ 3.73 (s, 3H), 3.79 (s, 3H), 3.84 (s, 3H), 3.87 (s, 3H), 3.92 (s, 3H), 3.94 (s, 3H), 3.95 (s, 2H), 3.98 (s, 2H), 6.70–6.74 (m, 3H), 6.79–6.83 (m, 2H), 6.93 (d, $J = 8.3$ Hz, 1H), 7.05 (d, $J = 8.0$ Hz, 2H), 7.08 (d, $J = 1.8$ Hz, 1H), 7.11 (dd, $J = 1.8, 8.2$ Hz, 1H), 7.18–7.23 (m, 4H), 7.41 (d, $J = 8.1$ Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 35.7, 38.2, 55.7, 55.99, 56.0, 56.05, 56.07, 56.13, 110.4, 111.2, 111.49, 111.54, 113.3, 113.4, 117.1, 119.2, 126.7, 128.7, 129.1, 129.4, 130.2, 131.0, 134.1, 134.7, 138.5, 139.1, 139.4, 140.7, 147.2, 148.2, 148.5, 149.2, 151.8, 153.6; HRMS-ESI $[M + Na]^+$ Calcd for $C_{38}H_{38}NaO_6$: 613.2566. Found: 613.2565.

Data for **14a**: 1H NMR (500 MHz, $CDCl_3$) δ 3.70 (s, 3H), 3.77 (s, 3H), 3.82 (s, 3H), 3.83 (s, 3H), 3.86 (s, 3H), 3.87 (s, 3H), 3.91–3.98 (m, 12H), 6.68–7.47 (m, 22H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 35.7, 38.2, 38.4, 55.7, 55.99, 56.01, 56.02, 56.06, 56.07, 56.1, 56.11, 110.36, 110.4, 111.1, 111.5, 111.6, 113.3, 113.33, 113.38, 113.4, 117.1, 119.2, 126.7, 126.8, 128.5, 128.6, 128.7, 129.0, 129.1, 129.2, 129.38, 129.43, 129.45, 130.1, 130.2, 131.0, 134.1, 134.6, 134.8, 138.5, 139.0, 139.1, 139.4, 140.6, 140.7, 147.2, 148.17, 148.24, 148.25, 148.5, 149.2, 151.7, 153.6; HRMS-ESI $[M + Na]^+$ Calcd for $C_{53}H_{52}NaO_8$: 839.3560. Found: 839.3563.

Reaction of 4-(3,4-Dimethoxyphenyl)benzyl Alcohol (10) with 3,4-Dimethoxytoluene (11b). To a solution of alcohol **10**¹¹ (0.020 g, 0.082 mmol) and 3,4-dimethoxytoluene (**11b**)¹⁷ (0.062 g, 0.409 mmol) in CH_2Cl_2 (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (40 mL) and extracted into CH_2Cl_2 (3×20 mL). The combined organic layers were washed with saturated $NaHCO_3$ (20 mL), H_2O (20 mL), and brine (20 mL), dried ($MgSO_4$), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4 to 1:2) to give 6-(4-(3,4-dimethoxyphenyl)benzyl)-3,4-dimethoxytoluene (**12b**) (0.026 g, 85%, $R_f = 0.59$, EtOAc/petroleum ether 1:1) and 6-(4-(3,4-dimethoxy-6-(4-(3,4-dimethoxyphenyl)benzyl))phenyl)benzyl)-3,4-

dimethoxytoluene (**13b**) (0.004 g, 8%, $R_f = 0.43$, EtOAc/petroleum ether 1:1) both as colorless oils. Data for **12b**: v_{max} (ATR-IR) 3017, 3000, 2920, 2851, 1605, 1588, 1562, 1517, 1503, 1451, 1397, 1332, 1319, 1301, 1270, 1250, 1219, 1198, 1170, 1144, 1095, 1070, 1050 cm^{-1} ; 1H NMR (500 MHz, $CDCl_3$) δ 2.22 (s, 3H), 3.83 (s, 3H), 3.88 (s, 3H), 3.92 (s, 3H), 3.94 (s, 3H), 3.96 (s, 2H), 6.70 (s, 1H), 6.72 (s, 1H), 6.93 (d, $J = 8.3$ Hz, 1H), 7.09 (d, $J = 2.0$ Hz, 1H), 7.13 (dd, $J = 2.1, 8.2$ Hz, 1H), 7.17 (d, $J = 8.1$ Hz, 2H), 7.47 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.3, 38.7, 55.97, 55.99, 56.03, 56.1, 110.4, 111.5, 113.8, 119.2, 126.9, 128.6, 128.9, 130.6, 134.1, 138.7, 139.5, 147.0, 147.4, 148.5, 149.2; HRMS-ESI $[M + Na]^+$ Calcd for $C_{24}H_{26}NaO_3$: 401.1729. Found: 401.1738.

Data for **13b**: 1H NMR (500 MHz, $CDCl_3$) δ 2.22 (s, 3H), 3.81 (s, 3H), 3.83 (s, 3H), 3.86 (s, 3H), 3.87 (s, 3H), 3.91 (s, 3H), 3.93 (s, 5H), 3.96 (s, 2H), 6.69 (s, 1H), 6.71 (s, 1H), 6.73 (s, 1H), 6.79 (s, 1H), 6.93 (d, $J = 8.3$ Hz, 1H), 7.04 (d, $J = 8.2$ Hz, 2H), 7.07 (d, $J = 2.0$ Hz, 1H), 7.09–7.12 (m, 3H), 7.20 (d, $J = 8.2$ Hz, 2H), 7.40 (d, $J = 8.2$ Hz, 2H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 19.3, 38.2, 38.8, 56.0, 56.01, 56.02, 56.06, 56.08, 56.14, 110.4, 111.6, 113.3, 113.34, 113.8, 113.9, 119.2, 126.7, 128.3, 128.7, 129.0, 129.5, 130.1, 130.7, 134.1, 134.6, 138.6, 139.2, 139.4, 140.7, 147.0, 147.2, 147.4, 148.3, 148.5, 149.2; HRMS-ESI $[M + Na]^+$ Calcd for $C_{39}H_{40}NaO_6$: 627.2723. Found: 627.2726.

6-(4-(3,4-Dimethoxyphenyl)benzyl)-3,4-(methylenedioxy)toluene (12c). To a solution of alcohol **10**¹¹ (0.020 g, 0.082 mmol) and 3,4-(methylenedioxy)toluene (**11c**)¹⁷ (0.056 g, 0.409 mmol) in CH_2Cl_2 (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (40 mL) and extracted into CH_2Cl_2 (3×20 mL). The combined organic layers were washed with $NaHCO_3$ (20 mL), H_2O (20 mL), and brine (20 mL), dried ($MgSO_4$), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4 to 1:2) to give the title compound **12c** (0.028 g, 93%) as a colorless oil.

2,3,4-Tri-O-benzyl-6- α -D-glucopyranoside (16).¹⁸ To a solution of methyl 2,3,4-tri-O-benzyl-6-O-(4-(3,4-dimethoxyphenyl)benzyl)- α -D-glucopyranoside (**15**)¹¹ (0.040 g, 0.058 mmol) and 3,4-(methylenedioxy)toluene (**11c**)¹⁷ (0.039 g, 0.290 mmol) in CH_2Cl_2 (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H_2O (50 mL) and extracted into CH_2Cl_2 (3×25 mL). The combined organic layers were washed with $NaHCO_3$ (20 mL) and brine (20 mL), dried ($MgSO_4$), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4 to 1:2) to give 6-(4-(3,4-dimethoxyphenyl)benzyl)-3,4-(methylenedioxy)toluene (**12c**) (0.021 g, quant, $R_f = 0.60$, EtOAc/petroleum ether 1:2) and the title compound **16** (0.023 g, 86%, $R_f = 0.32$, EtOAc/petroleum ether 1:2) both as colorless oils. Data for **16**: 1H NMR (500 MHz, $CDCl_3$) δ 1.57–1.63 (m, 1H), 3.37 (s, 3H), 3.48–3.45 (m, 2H), 3.63–3.72 (m, 2H), 3.74–3.79 (m, 1H), 4.01 (t, $J = 8.9$ Hz, 1H), 4.57 (d, $J = 3.5$ Hz, 1H), 4.62–4.68 (m, 2H), 4.80 (d, $J = 12.0$ Hz, 1H), 4.84 (d, $J = 10.9$ Hz, 1H), 4.88 (d, $J = 11.1$ Hz, 1H), 4.99 (d, $J = 10.9$ Hz, 1H), 7.27–7.38 (m, 15H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 55.3, 62.0, 70.7, 73.5, 75.1, 75.8, 77.5, 80.0, 82.0, 98.3, 127.7, 127.9, 128.00, 128.02, 128.1, 128.2, 128.46, 128.53, 128.54, 138.17, 138.19, 138.8; HRMS-ESI $[M + Na]^+$ Calcd for $C_{28}H_{32}NaO_6$: 487.2091. Found: 487.2117.

3-O-(4-Bromobenzyl)-4,5-di-O-benzyl-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-1,2-di-O-isopropylidene-L-myo-inositol (19). To a solution of **18**⁹ (2.06 g, 2.44 mmol) in CH_2Cl_2 (25 mL) were added H_2O (44 μ L, 2.44 mmol) and TFA (0.376 mL, 4.88 mmol) at 0 °C. The solution was stirred for 2.5 h, diluted with CH_2Cl_2 (100 mL), and washed with saturated $NaHCO_3$ (50 mL) and saturated $NaCl$ (50 mL). The organic phase was dried ($MgSO_4$) and filtered, and the solvent was evaporated under reduced pressure to give 3-O-(4-bromobenzyl)-6-O-(3,4,6-tri-O-benzyl- α -D-mannopyranosyl)-1,2-di-O-isopropylidene-L-myo-inositol (1.97 g) as a white foam. To a solution of crude triol (1.97 g, 2.40 mmol) in dry DMF (20 mL) were added NaH (60% dispersion in oil, 0.517 g, 21.6 mmol) and benzyl bromide (1.71 mL, 14.4 mmol) at 0 °C, and the reaction mixture was

stirred overnight. The reaction was quenched by careful addition of H₂O (5 mL) and then extracted into EtOAc (3 × 100 mL). The combined organic layers were washed with H₂O (100 mL) and saturated NaCl (100 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 1:2) to give the title compound **19** (1.88 g, 72%) as a colorless oil. $[\alpha]_D^{26} +24.2$ ($c = 1.20$, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 1.29 (s, 3H), 1.52 (s, 3H), 3.31 (t, $J = 8.6$ Hz, 1H), 3.61–3.64 (m, 2H), 3.67 (dd, $J = 1.9$, 10.8 Hz, 1H), 3.85–3.98 (m, 5H), 4.03 (dt, $J = 2.5$, 10.0 Hz, 1H), 4.17 (t, $J = 9.8$ Hz, 1H), 4.26 (t, $J = 4.5$ Hz, 1H), 4.29 (d, $J = 12.4$ Hz, 1H), 4.32 (d, $J = 12.4$ Hz, 1H), 4.48 (d, $J = 12.0$ Hz, 1H), 4.54 (d, $J = 10.8$ Hz, 1H), 4.57 (d, $J = 11.8$ Hz, 1H), 4.58 (d, $J = 11.8$ Hz, 1H), 4.64 (d, $J = 11.8$ Hz, 1H), 4.69–4.75 (m, 4H), 4.78 (d, $J = 10.8$ Hz, 1H), 4.85 (d, $J = 11.7$ Hz, 1H), 4.86 (d, $J = 10.7$ Hz, 1H), 5.31 (d, $J = 1.8$ Hz, 1H), 7.14–7.36 (m, 32H), 7.41–7.45 (m, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 25.8, 27.9, 68.9, 72.0, 72.1, 72.2, 72.4, 73.5, 74.1, 74.6, 74.9, 75.2, 75.3, 75.7, 77.2, 77.5, 78.9, 80.2, 81.0, 82.6, 98.7, 109.8, 121.8, 127.0, 127.1, 127.3, 127.4, 127.5, 127.57, 127.61, 127.82, 127.83, 128.07, 128.19, 128.26, 128.32, 128.44, 128.45, 129.6, 131.6, 137.2, 138.2, 138.4, 138.66, 138.68, 138.8, 138.9; HRMS-ESI [M + Na]⁺ Calcd for C₆₄H₆₇⁷⁹BrNaO₁₁: 1113.3759. Found: 1113.3718.

3-O-(4-Bromobenzyl)-4,5-di-O-benzyl-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-L-myo-inositol (20). To a solution of **19** (1.48 g, 1.36 mmol) in CH₂Cl₂ (50 mL) were added MeOH (0.084 mL, 2.03 mmol) and TFA (0.522 mL, 6.78 mmol), and the reaction mixture was stirred at rt overnight. The reaction mixture was diluted with CH₂Cl₂ (50 mL) and washed with saturated NaHCO₃ (50 mL) and saturated NaCl (50 mL). The organic phase was dried (MgSO₄) and filtered, and the solvent was evaporated under reduced pressure. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:2 to 1:1) to give the title compound **20** (1.21 g, 85%) as a white foam. $[\alpha]_D^{26} +13.3$ ($c = 1.10$, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 2.53 (brs, 1H), 3.31 (t, $J = 9.4$ Hz, 1H), 3.36–3.41 (m, 2H), 3.63 (dd, $J = 7.2$, 10.2 Hz, 1H), 3.73 (dd, $J = 1.9$, 10.3 Hz, 1H), 3.77 (t, $J = 2.3$ Hz, 1H), 3.82–3.91 (m, 3H), 4.00 (t, $J = 9.5$ Hz, 1H), 4.06–4.11 (m, 1H), 4.14–4.16 (m, 1H), 4.26 (d, $J = 3.7$ Hz, 1H), 4.43–4.51 (m, 5H), 4.53–4.60 (m, 3H), 4.63 (d, $J = 12.1$ Hz, 1H), 4.68 (d, $J = 12.2$ Hz, 1H), 4.77 (d, $J = 10.7$ Hz, 1H), 4.82 (d, $J = 11.3$ Hz, 1H), 4.84 (d, $J = 10.8$ Hz, 1H), 4.85 (d, $J = 10.9$ Hz, 1H), 5.10 (d, $J = 2.1$ Hz, 1H), 7.16–7.35 (m, 32H), 7.41–7.44 (m, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 69.4, 69.9, 71.1, 71.8, 72.0, 72.65, 72.71, 73.5, 75.04, 75.08, 75.70, 75.73, 75.9, 79.51, 79.54, 80.8, 82.3, 85.4, 100.5, 121.7, 127.0, 127.55, 127.56, 127.59, 127.65, 127.66, 127.69, 127.77, 127.84, 128.0, 128.02, 128.3, 128.38, 128.41, 128.42, 128.5, 129.5, 131.6, 137.1, 138.0, 138.2, 138.3, 138.6, 138.7; HRMS-ESI [M + Na]⁺ Calcd for C₆₁H₆₃⁷⁹BrNaO₁₁: 1073.3446. Found: 1073.3415.

4,5-Di-O-benzyl-3-O-(4-(3,4-dimethoxyphenyl)benzyl)-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-L-myo-inositol (21). To an oven-dried Schlenk flask were added diol **20** (1.04 g, 0.98 mmol), 3,4-dimethoxyphenylboronic acid (0.215 g, 1.18 mmol), tetrabutylammonium bromide (0.032 g, 0.10 mmol), potassium phosphate (K₃PO₄) (0.626 g, 2.95 mmol), and EtOH (25 mL). The resulting mixture was subjected to the freeze–pump–thaw cycle for three times to exclude air. Pd(OAc)₂ (11 mg, 0.05 mmol) was then added under a flow of argon, and the reaction mixture was stirred at rt for 3 h. Once the reaction was complete, the solution was filtered through a plug of Celite and washed with EtOAc (100 mL). The reaction mixture was washed with saturated aq. NaHCO₃ (100 mL) and the aqueous layer was back-extracted with EtOAc (3 × 50 mL). The combined organic layers were washed with H₂O (50 mL), saturated NaCl (50 mL), dried (MgSO₄), filtered and the solvent removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:2 to 2:3) to give the title compound **21** (0.753 g, 69%) as a white foam. $[\alpha]_D^{27} +19.8$ ($c = 1.00$, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 2.54 (brs, 1H), 3.33 (t, $J = 9.4$ Hz, 1H), 3.38–3.42 (m, 1H), 3.44 (dd, $J = 2.6$, 9.6 Hz, 1H), 3.63 (dd, $J = 7.1$, 10.3 Hz, 1H), 3.73 (dd, $J = 2.0$, 10.3 Hz, 1H), 3.76 (t, $J = 2.3$ Hz, 1H), 3.82–3.87 (m, 2H), 3.91 (t, $J = 9.3$ Hz, 1H), 3.93 (s,

3H), 3.95 (s, 3H), 4.01 (t, $J = 9.5$ Hz, 1H), 4.07–4.12 (m, 1H), 4.18–4.20 (m, 1H), 4.21 (d, $J = 3.9$ Hz, 1H), 4.23–4.51 (m, 5H), 4.52–4.61 (m, 3H), 4.73–4.79 (m, 3H), 4.83 (d, $J = 10.9$ Hz, 1H), 4.85 (d, $J = 10.6$ Hz, 1H), 4.92 (d, $J = 10.7$ Hz, 1H), 5.12 (d, $J = 2.0$ Hz, 1H), 6.95 (d, $J = 8.3$ Hz, 1H), 7.10 (d, $J = 2.1$ Hz, 1H), 7.14 (dd, $J = 2.1$, 8.3 Hz, 1H), 7.16–7.18 (m, 2H), 7.20–7.34 (m, 28H), 7.41 (d, $J = 8.2$ Hz, 2H), 7.51 (d, $J = 8.2$ Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 56.02, 56.06, 69.4, 70.0, 71.1, 72.0, 72.3, 72.6, 72.7, 73.5, 75.03, 75.07, 75.7, 76.0, 79.48, 79.54, 81.0, 82.4, 85.2, 100.5, 110.5, 111.6, 119.4, 126.95, 126.97, 127.54, 127.56, 127.63, 127.64, 127.65, 127.75, 127.83, 128.01, 128.13, 128.33, 128.37, 128.39, 128.40, 128.44, 128.46, 133.9, 136.6, 138.1, 138.2, 138.3, 138.69, 138.74, 140.7, 148.7; HRMS-ESI [M + Na]⁺ Calcd for C₆₉H₇₂NaO₁₃: 1131.4865. Found: 1131.4820.

3-O-(4-(3,4-Dimethoxyphenyl)benzyl)-1,2,4,5-tetra-O-benzyl-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-L-myo-inositol (17). To a solution of diol **21** (0.300 g, 0.270 mmol) in dry DMF (15 mL) was added NaH (60% dispersion in oil, 0.039 g, 1.62 mmol) and benzyl bromide (0.161 mL, 1.35 mmol) at 0 °C and the reaction mixture was stirred overnight. The reaction was quenched by careful addition of H₂O (2 mL) and then extracted into EtOAc (3 × 50 mL). The combined organic layers were washed with H₂O (50 mL) and saturated NaCl (50 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 1:2) to give the title compound **17** (0.279 g, 80%) as a colorless oil. $[\alpha]_D^{27} +4.0$ ($c = 1.70$, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 3.13 (dd, $J = 2.2$, 10.0 Hz, 1H), 3.36 (dd, $J = 2.4$, 9.8 Hz, 1H), 3.40 (t, $J = 9.3$ Hz, 1H), 3.44 (dd, $J = 1.9$, 11.1 Hz, 1H), 3.50 (dd, $J = 3.6$, 11.1 Hz, 1H), 3.70 (dd, $J = 1.9$, 3.1 Hz, 1H), 3.88 (dd, $J = 3.0$, 9.5 Hz, 1H), 3.93 (s, 3H), 3.95 (s, 3H), 4.03–4.13 (m, 3H), 4.17–4.27 (m, 3H), 4.34 (d, $J = 12.1$ Hz, 1H), 4.36 (t, $J = 9.6$ Hz, 1H), 4.45–4.52 (m, 3H), 4.54–4.72 (m, 7H), 4.80–4.92 (m, 4H), 5.02 (d, $J = 11.8$ Hz, 1H), 5.50 (d, $J = 1.8$ Hz, 1H), 6.96 (d, $J = 8.3$ Hz, 1H), 7.07–7.33 (m, 40H), 7.36–7.41 (m, 4H), 7.52 (d, $J = 8.2$ Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 56.02, 56.06, 68.9, 71.8, 71.9, 72.0, 72.4, 72.8, 73.2, 74.2, 74.3, 74.86, 74.91, 75.0, 75.85, 75.87, 75.91, 79.3, 80.2, 80.7, 81.9, 84.4, 98.5, 110.5, 111.6, 119.4, 126.4, 126.9, 127.0, 127.2, 127.3, 127.36, 127.39, 127.5, 127.6, 127.7, 127.77, 127.83, 128.0, 128.11, 128.14, 128.17, 128.21, 128.22, 128.26, 128.34, 128.4, 128.5, 133.9, 137.0, 137.6, 138.6, 138.74, 138.77, 138.8, 138.95, 139.05, 139.2, 140.5, 148.8, 149.3; HRMS-ESI [M + Na]⁺ Calcd for C₈₃H₈₄NaO₁₃: 1311.5804. Found: 1311.5805.

1,2,4,5-Tetra-O-benzyl-6-O-(2,3,4,6-tetra-O-benzyl- α -D-mannopyranosyl)-L-myo-inositol (22). To a solution of DMPBn pseudodisaccharide **17** (0.020 g, 0.016 mmol) and 3,4-(methylenedioxy)toluene (**11c**)¹⁷ (0.011 g, 0.081 mmol) in CH₂Cl₂ (3.5 mL) was added TFA (1.5 mL), and the reaction was stirred at rt for 1 h. The reaction was diluted with H₂O (50 mL) and extracted into CH₂Cl₂ (3 × 25 mL). The combined organic layers were washed with NaHCO₃ (20 mL) and brine (20 mL), dried (MgSO₄), and filtered, and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:4 to 1:2) to give 6-(4-(3,4-dimethoxyphenyl)benzyl)-3,4-(methylenedioxy)toluene (**12c**) (0.006 g, quant, $R_f = 0.60$, EtOAc/petroleum ether 1:2) and the title compound **22** (0.013 g, 79%, $R_f = 0.30$, EtOAc/petroleum ether 1:2) both as colorless oils. $[\alpha]_D^{28} +2.6$ ($c = 0.65$, CHCl₃); ¹H NMR (500 MHz, CDCl₃) δ 2.18 (d, $J = 7.5$ Hz, 1H), 3.30 (dd, $J = 2.2$, 10.0 Hz, 1H), 3.39 (t, $J = 9.3$ Hz, 1H), 3.45 (dd, $J = 1.9$, 11.1 Hz, 1H), 3.46–3.53 (m, 2H), 3.71 (dd, $J = 1.9$, 3.0 Hz, 1H), 3.78 (t, $J = 9.4$ Hz, 1H), 3.89 (dd, $J = 3.0$, 9.5 Hz, 1H), 4.03 (t, $J = 2.7$ Hz, 1H), 4.05 (t, $J = 9.8$ Hz, 1H), 4.18–4.25 (m, 3H), 4.32 (d, $J = 12.5$ Hz, 1H), 4.34 (d, $J = 9.6$ Hz, 1H), 4.47 (d, $J = 11.1$ Hz, 1H), 4.53–4.76 (m, 9H), 4.85 (d, $J = 11.1$ Hz, 1H), 4.93–4.99 (m, 2H), 5.52 (d, $J = 1.8$ Hz, 1H), 7.07–7.34 (m, 40H); ¹³C NMR (125 MHz, CDCl₃) δ 69.0, 71.8, 72.0, 72.5, 73.2, 73.3, 74.8, 74.87, 74.9, 75.0, 75.5, 75.6, 75.8, 79.6, 80.2, 82.7, 84.2, 98.5, 126.5, 127.0, 127.24, 127.26, 127.27, 127.4, 127.5, 127.6, 127.76, 127.81, 127.85, 127.9, 128.0, 128.14, 128.19, 128.2, 128.3, 128.46, 128.49, 128.6, 137.4, 138.4, 138.6, 138.65, 138.7, 138.8, 138.9, 139.2; HRMS-ESI [M + Na]⁺ Calcd for C₆₈H₇₀NaO₁₁: 1085.4810. Found: 1085.4774.

(±)-3-O-(4-(3,4-Dimethoxyphenyl)benzyl)-1,2,4,5-tetra-O-benzyl-myoinositol (**24**). *Method 1: Deallylation of 4a.* The argon atmosphere of a solution of (1,5-cyclooctadiene)bis(methyldiphenylphosphine)iridium(I) hexafluorophosphate (**23**) (7 mg, 8.4 μmol) and **4a** (45 mg, 0.056 mmol) in anhydrous THF (10 mL) was replaced with hydrogen for ca. 1 min, and then the reaction flask was flushed with argon. The reaction mixture was stirred for 2.5 h, and the volatiles were removed in vacuo. The residue was redissolved in MeOH/CH₂Cl₂ (1:2, 15 mL). Acetyl chloride (120 μL, 1.67 mmol) was added, and the reaction was stirred overnight. The reaction mixture was quenched with sat. aq NaHCO₃ and extracted with CH₂Cl₂. The combined organic fractions were dried (MgSO₄), and the solvent was removed under reduced pressure. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound **24** (27 mg, 63%) as a colorless oil. ν_{\max} (ATR-IR) 3465, 3029, 2922, 1604, 1589, 1526, 1502, 1453, 1399, 1359, 1327, 1307, 1249, 1216, 1171, 1141, 1052, 1025; ¹H NMR (500 MHz, CDCl₃) δ 3.16 (dd, *J* = 9.9, 9.2 Hz, 1H), 3.34 (t, *J* = 9.0 Hz, 1H), 3.36 (dd, *J* = 9.7, 2.5 Hz, 1H), 3.88 (s, 3H), 3.90 (s, 3H), 4.01–4.04 (m, 2H), 4.13 (dd, *J* = 9.7, 9.3 Hz, 1H), 4.50 (d, *J* = 11.8 Hz, 1H), 4.55 (d, *J* = 11.8 Hz, 1H), 4.61 (d, *J* = 11.8 Hz, 1H), 4.65 (d, *J* = 11.8 Hz, 1H), 4.75–4.86 (m, 5H), 4.89 (d, *J* = 10.7 Hz, 1H), 6.90 (d, *J* = 8.3 Hz, 1H), 7.06 (d, *J* = 2.1 Hz, 1H), 7.10 (dd, *J* = 8.2, 2.1 Hz, 1H), 7.20–7.36 (m, 22H), 7.46 (d, *J* = 8.2 Hz, 2H); ¹³C NMR (125 MHz, CDCl₃) δ 55.95, 55.99, 72.3, 72.5, 72.9, 73.7, 74.1, 75.4, 75.8, 80.1, 81.1, 81.4, 83.5, 110.4, 111.5, 119.3, 126.8, 127.4, 127.5, 127.6, 127.68, 127.73, 127.8, 128.03, 128.05, 128.2, 128.3, 128.4, 128.5, 133.8, 136.9, 137.9, 138.8, 140.4, 148.7, 149.2; HRMS-ESI [*M* + Na]⁺ Calcd for C₄₉H₅₀O₈Na: 789.3398. Found: 789.3412.

Method 2: Selective Hydrolysis of the PMB Group of 4b. Trifluoroacetic acid (50 μL, 0.65 mmol) was added to a solution of the PMB ether **4b** (18 mg, 0.020 mmol) and **11c** (30 mg, 0.220 mmol) in CH₂Cl₂ (4.95 mL), and the reaction mixture was stirred at rt for 1 h. The reaction was quenched by the addition of aq NaHCO₃ (30 mL), and the aqueous layer was extracted with CH₂Cl₂ (3 × 30 mL). The combined organic layers were dried (MgSO₄), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 2:3) to give the title compound **24** (12 mg, 77%, *R*_f = 0.3 EtOAc/petroleum ether 1:3) and 6-(4-methoxybenzyl)-3,4-(methylenedioxy)toluene (**25**) (7 mg, quant, *R*_f = 0.75 EtOAc/petroleum ether 1:3). Data for **25**: ν_{\max} (ATR-IR) 2925, 1611, 1583, 1509, 1485, 1464, 1442, 1360, 1301, 1245, 1175, 1163, 1105, 1038; ¹H NMR (400 MHz, CDCl₃) δ 2.17 (s, 3H), 3.78 (s, 3H), 3.82 (s, 2H), 5.89 (s, 2H), 6.58 (s, 1H), 6.65 (s, 1H), 6.81 (d, *J* = 8.4 Hz, 2H), 7.03 (d, *J* = 8.75 Hz, 2H); ¹³C NMR (100 MHz, CDCl₃) δ 19.5, 38.2, 55.3, 100.3, 110.1, 110.4, 113.8, 129.4, 129.5, 132.3, 132.6, 145.6, 145.7, 157.9; HRMS-ESI [*M* + Na]⁺ Calcd for C₁₆H₁₆O₃Na: 279.0991. Found: 279.1031.

Method 3: Selective Removal of the PBB Group of 4c. Freshly distilled *N*-methylaniline (8 μL, 0.069 mmol) was added to a solution of the PBB ether **4c** (54 mg, 0.058 mmol) in anhydrous toluene (1 mL) under argon. In another flask, (*o*-biphenyl)P(*t*-Bu)₂ (1 mg, 3.37 μmol), tris(dibenzylideneacetone)dipalladium(0) (1.2 mg, 1.3 μmol), and NaOt-Bu (6 mg, 0.063 mmol) were dissolved in anhydrous toluene (1 mL) under argon. The solution of **4c** was then added to this mixture via cannular under argon. The reaction mixture was heated to 80 °C and stirred for 2 h. The reaction mixture was cooled to rt, diluted with Et₂O, and filtered through a pad of Celite, and the solvent was removed in vacuo. Acetyl chloride (10 μL, 0.14 mmol) was added to a solution of the residue in CH₂Cl₂/MeOH (8:2, 10 mL) and the reaction stirred for 30 min. The reaction was quenched by the addition of aq NaHCO₃ (30 mL), extracted with CH₂Cl₂ (2 × 30 mL), and dried (MgSO₄), and the solvent was removed in vacuo. The residue was purified by column chromatography on silica gel (EtOAc/petroleum ether = 1:9 to 3:7) to give the title compound **24** (23 mg, 52%) as a colorless oil.

■ ASSOCIATED CONTENT

📄 Supporting Information

Copies of ¹H and ¹³C NMR spectra for all novel compounds. This material is available free of charge via the Internet at <http://pubs.acs.org>.

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Notes

The authors declare no competing financial interest.

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